CHEMICAL REACTIONS AND EQUATIONS

1. Chemical Reactions: The transformation of chemical substance into a new chemical substance by making and breaking of bonds between different atoms is known as chemical reaction.

1.1. Signs of a Chemical Reaction: These factors denote that a chemical reaction has taken place- change of state of substance, change of color of substance, evolution of heat, absorption of heat, evolution of gas and evolution of light.

2. Chemical Equation: The representation of chemical reaction by means of symbols of substances in the form of formulae is called chemical equation. Ex- $H2 + O2 \rightarrow H2O$ (Hydrogen and oxygen are reactants whereas water is product)

2.1. Forward Arrow ($\rightarrow$) when reaction proceeds in forward direction

2.2. Double Arrow ($\rightleftarrows$) when reaction is reversible

2.3. Equilibrium Arrow ($\rightleftharpoons$) when a reversible reaction is at equilibrium.

3. Balanced Chemical Equation: A balanced chemical equation has number atoms of each element equal on both left and right sides of the reaction. According to law of conservation of mass, mass can neither be created nor destroyed in a chemical reaction. To obey this law, the total mass of elements present in reactants must be equal to the total mass of elements present in products.

4. Types of Chemical Reactions:

Name and Definition	Example
In a combination reaction, two or more reactants combine to give single product.	$CaO(s)+H2O(l) \longrightarrow Ca(OH)2(aq)$
In a decomposition reaction, a single reactant breaks down into two or more simpler products.	$AB \longrightarrow A + B$ $NaCl(s) \xrightarrow{\text{aqueous}} Na^+ (aq)\ Cl^- (aq)$
When decomposition reaction is carried out by heating, it is called thermal decomposition reaction.	$CaCO_3 (s) \longrightarrow CaO(s)+CO_2 (g)$
When decomposition reaction is carried out in the presence of sunlight, the process is called photochemical decomposition.	$2AgBr(s) \longrightarrow 2Ag(s) + Br_2(g)$
Electrolysis: When decomposition reaction is carried out with the help of electric current, the process is called electrolysis.	$2H_2O(l) \longrightarrow 2H_2 (g)+O_2 (g)$
In a displacement reaction, a more reactive element displaces a less reactive element from a less compound.	$Fe(s)+CuSO_4 (aq) \longrightarrow BaSO_4 (aq)+Cu(s)$
Those reactions in which the different atoms or groups of atoms are displaced by other atoms or groups of atom, i.e., two compounds exchange their ions and one of the products formed is insoluble, are said to be double displacement reactions.	$Na_2SO_4 (aq)+BaCl_2 (aq) \longrightarrow BaSO_4 (s)+ 2NaCl(aq)$
The reactions in which acid or acidic oxide reacts with the base or basic oxides to form salt and water are called neutralization reactions.	$2NaOH+H_2SO_4 \longrightarrow Na_2SO_4 + H_2O(l)$
Precipitation the insoluble compound called precipitate forms in this reaction.	$AgNO_3 (aq)+ KCl (aq) \longrightarrow AgCl(s)+KNO_3 (aq)$
Exothermic reactions which produce energy are called exothermic reaction. Most of the	$H_2 (g)+Cl_2 (g) \longrightarrow 2HCl(g)\ (\Delta H > 0)$

decomposition reactions are exothermic.	
Endothermic reactions which absorb energy are called endothermic reaction. Most of the combination reactions are endothermic.	$C(s)+H_2O(l)\longrightarrow CO(g)+H_2(g)$ ($\Delta H > 0$)
Oxidation is gain of oxygen or removal of hydrogen or metallic element from a compound is known as oxidation.	$MnO_2(s) + 4HCl(aq)\longrightarrow MnCl_2(aq)+Cl_2(g)+ 2H_2O(l)$
Reduction is addition of hydrogen or removal of oxygen from a compound is called reduction.	
Redox is chemical reactions where oxidation and reduction both take place simultaneously are also known as Redox reaction.	$2\ NaOH(aq)+HCl(aq)\longrightarrow NaCl(s)+H_2O(l)$

5. Rusting: When iron reacts with oxygen and moisture forms a red substance called rust.
Reaction: $4Fe + 3O_2 + 2H_2O \longrightarrow 2Fe_2O_3.H_2O$ (rust)
6. Rancidity: Oils and fats when get oxidized on exposure to air show a change in taste and smell. Due to this reason packets of chips are flushed with gas such as nitrogen that acts as antioxidant and prevents spoilage of the fried chips.

Sample Questions for Practice:

Q1. What happens chemically when quick lime is added to water?
Q2. How will you test for the gas which is liberated when HCL reacts with an active metal?
Q3. What is an oxidation reaction? Is it exothermic or endothermic? Give one example of oxidation Reaction.
Q4. Give an example of photochemical reaction.
Q5. Give an example of a decomposition reaction. Describe any activity to illustrate such a reaction by heating.
Q6. Why is respiration considered as exothermic process?
Q7. Balance the following chemical equation.

$Fe(s) + H_2O(g) = Fe_3O_4 + H_2(g)$
$MnO_2 + HCL = MnCl_2 + Cl_2 + H_2O$
$HNO_3 + Ca(OH)_2 = Ca(NO_3)_2 + H_2O$

Q8. On what basis is a chemical equation balanced?
Q9. State any two observations in an activity suggesting the occurrence of a chemical reaction.
Q10. Name a reducing agent which may be used to obtain manganese from manganese dioxide.
Q11. What change in colour is observed when silver chloride is left exposed to sunlight? Also mention the type of chemical reaction.
Q12. Define a combination reaction. Give one example of an exothermic combination reaction.
Q13. What is observed when a solution of potassium iodide is added to lead nitrate solution? What type of reaction is this? Write a balanced chemical equation for this reaction.
Q14. Distinguish between an exothermic and an endothermic reaction.
Q15. Distinguish between a displacement and a double displacement reaction.
Q16. Identify the type of reaction in the following:

$Fe + CuSO_4(aq) = FeSO_4(aq) + Cu(s)$
$2H_2 + O_2 = 2H_2O$

Important Questions for Practice:

1. What is a redox reaction?
2. What is corrosion? Explain its advantage and disadvantage.
3. What is rancidity? How can we reduce the problem of rancidity?
4. How is corrosion different from rusting?
5. What is meant by endothermic and exothermic reactions? Give suitable example for each.
6. Define different types of chemical reaction and give examples for each.
7. Why is photosynthesis considered as an endothermic reaction?
8. In electrolysis of water, why is the volume of gas collected over one electrode double that of the other electrode?
9. What happens when water is added to solid calcium oxide taken in a container? Write a chemical formula for the same.
10. Give one use of quick lime.
11. Give three types of decomposition reaction.
12. Name the compound used for testing CO^2 gas.

ACIDS, BASES AND SALTS

1. Acids: Those substances which turn blue litmus solution red are called acids. Acids are sour in taste. They give H^+ ions in aqueous solution. Some acid are organic while others inorganically created. A concentrated acid is one which contains the minimum amount of water in it. A dilute acid is obtained by mixing the concentrated acid with water. Example: HCl, H_2SO_4, HNO_3, CH_3COOH

1.1. Types:

(a) Weak Acid: weak acids → release a smaller number of H^+ ions → acetic acid

(b) Strong Acid: strong acids → release more H^+ ions → HCl

1.2. Reactions:

(a) Neutralization: Acid + Base → Salt + Water ⇒ $HCl(aq)+NaOH(aq) \longrightarrow H2O(l) +$ Salt

(b) With Water: Acids produce H^+ ions when dissolved in water. H^+ ions cannot exist alone. They combine with water molecule (H_2O) to form H_3O^+ (Hydronium ions). It conducts electricity. Decrease in H_30^+ ions concentration per unit volume results in formation of dilute acids. It is a highly exothermic reaction. Acids when dissolved in water release large amount of heat. If water is added to concentrated acid, then the heat generated may cause the mixture to splash out and cause burns. Hence to avoid burns acid must be added drop wise into water with constant stirring.

(c) With Metals: Acid + Metal → Salt + Hydrogen Gas ⇒ $2HCl + Zn \rightarrow ZnCl_2 + H_2$

(d) With Metal Oxides: Acid + Metal Oxide → Salt + Water ⇒ $2HCl + CuO \rightarrow CuCl_2 + H_2O$

(e) With Metal Carbonate: Acid + Metal Carbonate → Salt + $CO_2 + H_2O$ ⇒ $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

2. Bases: They are bitter in taste and soapy to touch. Sea water and detergents are some examples of substances that are basic. Many bases are oxide or hydroxide compounds of metals. Strong bases can also burn ones skin. Ex- Caustic soda, NaOH; Caustic potash, KOH; Milk of magnesia, $Mg(OH)_2$; Liquor ammonia, NH_3; Washing powder, Tooth paste.

2.1. Types:

(a) Weak Base: weak base → gives less OH^- ions → NH_4OH

(b) Strong Base: strong base → give more OH^- ions → NaOH

2.2. Reactions:

(a) With Water: Bases produce OH^- ions when dissolved in water. Bases soluble in water are called alkalis. It conducts electricity. Decrease in OH^- ions single concentration per unit volume results in formation of dilute bases. It is an exothermic reaction. To make basic solution, base must be added drop wise into water with constant stirring, so that the heat generated spreads over in water.

(b) With Metals: Base + Metal → Salt + H_2 Gas ⇒ $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

(c) With Non-Metal Oxides: Base + Non-metallic oxide → Salt + H_2O

3. Salts: Salts are obtained by treating an acid with a base. Salts consist of both positive ions or 'cations', and negative ions or 'anions'.

The cations are called basic radicals and are mostly obtained from metallic ions (ammonium ion being one exception), while the anions are called acidic radicals and are obtained from acids. Salts can be classified into the following types:

3.1. Normal Salts: A salt that is formed by the complete replacement of the replaceable hydrogen ions of an acid by a metal ion or ammonium ion is called a normal salt. Examples: NaCl, Na_2SO_4, Na_3PO_4, NH_4Cl, K_2CO_3

3.2. Neutral Salts: A neutral salt arises due to the neutralization reaction. Here, salts of strong acid and strong base combine to form such salts that show a neutral pH of 7.

Acid	Uses
Organic acids	
Citric acid ($C_6H_8O_7$)	1. As a preservative for food 2. As a flavoring agent
Ascorbic acid ($C_6H_8O_6$) (also called vitamin C)	1. In the treatment of bone marrow and scurvy diseases
Acetic acid (CH_3COOH)	1. Added to pickles to make them sour
Tartaric acid ($C_4H_6O_6$)	1. A component of baking powder (baking powder is a mixture of sodium hydrogen carbonate and tartaric acid)
Inorganic acids	
Hydrochloric acid (HCl)	1. 1Its presence in the gastric juice helps digestion of food which we eat. 2. As a bathroom cleaner 3. Manufacturing of PVC
Nitric acid (HNO_3)	1. Nitric acid present in rainwater forms nitrates in the soil which are then used by plants to obtain nitrogen. 2. In manufacturing fertilizers like ammonium nitrate. 3. Making explosives like TNT and dynamite
Sulphuric acid (H_2SO_4)	1. In storage batteries 2. In manufacturing fertilizers, paints, fibers, HCl and alum
Phosphoric acid (H_3PO_4)	1. In fertilizer and detergent industries
Boric acid (H_3BO_3)	1. In the manufacture of glass, glazes and enamels, leather, paper, adhesives and explosives 2. In detergents 3. As grain preservative
Bases	Uses
Sodium hydroxide (NaOH)	1. In the manufacture of soaps, textile, paper, medicines 2. In the refining of petroleum
Ammonium hydroxide [$Al(OH)_3$]	1. As a reagent in the laboratory 2. In making fertilizers, rayon, plastics and dyes
Calcium hydroxide [$Ca(OH)_2$]	1. In making cement and mortar 2. In making bleaching powder 3. In whitewashing 4. In removing acidity of soils
Salts	Uses
Sodium chloride (NaCl)	1. An essential requirement of our food 2. In the preservation of food 3. In curing fish and meat 4. In making a freezing mixture which is used by ice-cream vendors 5. In the manufacture of soaps

Sodium carbonate (Na_2CO_3)	1. As washing soda for cleaning clothes 2. Used in the manufacture of glass, paper, textiles, caustic soda, etc. 3. In the refining of petroleum 4. In fire extinguishers
Sodium bicarbonate ($NaHCO_3$)	1. Used as baking soda 2. In fire extinguishers 3. As an antacid in medicine
Potassium nitrate (KNO_3)	1. To make gun powder, fireworks and glass 2. As a fertilizer in agriculture
Copper sulphate ($CuSO_4$)	1. Called 'blue vitriol', used as a fungicide to kill certain germs 2. In electroplating 3. In dyeing
Potash alum [$KAl(SO_4)_2 .12H_2O$]	1. Used to purify water; makes suspended particles in water settle down 2. As an antiseptic and in Dying

4. Baking Soda: The chemical name of baking soda is sodium hydrogen carbonate ($NaHCO_3$). Chlorine produced on passing electricity through brine solution undergoes reaction with ammonia produces baking soda.

$NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$

4.1 On Heating: $NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

4.2 Uses: As a component of baking powder. In fire extinguishers, In medicines as a mild antiseptic for skin diseases and to neutralize the acidity of stomach, As a reagent in laboratory.

5. Plaster of Paris: Chemical name is Calcium sulphate sodium carbonate hydrated. Formula: $CaSO_4 . \frac{1}{2}H_2O$

5.1 On Reaction with Water: $CaSO_4 . \frac{1}{2}H_2O + \frac{3}{2}H_2O \longrightarrow CaSO_4.2H_2O$

5.2 Uses: It is in manufacturing chalks, toys, making walls of homes, medical use etc.

6. Bleaching Powder: Chlorine produced on passing electricity through brine solution undergoes reaction with dry slaked to produce bleaching powder. Formula: $CaOCl_2$

6.1 Reaction: $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

6.2 Uses: For bleaching cotton and linen in the textile industry, to bleach wood pulp in paper manufacturing industry. To bleach washed clothes in laundry, to disinfect drinking water and make it germfree.

7. Washing Soda: Chemical name is sodium carbonate hydrated. The heating of baking soda produces sodium carbonate. This sodium carbonate undergoes recrystalization to give off washing soda. Formula: $Na_2CO_3.10H_2O$

7.1 On recrystalization: $Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$

7.2 Uses: In glass, soap and paper manufacturing industries. It is also used in the manufacture of sodium compounds like borax. It is also used as a cleaning agent and in removing permanent hardness of water.

8. pH Indicator: The acidity or basicity (alkalinity) of a solution is usually expressed in terms of a function of the H+ ion concentration.

This function is called the pH of a solution.

8.1. Types of indicators:

(a) Olfactory indicators: Those substances whose odor changes in acidic or basic media e.g., clove, vanilla, onion.

(b) Natural indicators: Turmeric, litmus (obtained from lichen).

(c) Synthetic indicators: Methyl orange, phenolphthalein

8.2. pH scale Value: The scale lies between 0 to 14

(a) The pH of a neutral solution is 7.

(b) The pH of an acidic solution is less than 7.

(c) The pH of an alkaline solution is more than 7.

(d) The pH of an aqueous solution is the negative logarithm of its H+ ion concentration. That is, pH = –log $[H^+]$.

(e) pOH = –log $[OH^-]$.

8.3. Rules for pH scale (at 298 K)

(a) Acidic solutions have pH less than 7.

(b) The lower the pH, the more acidic is the solution.

(c) Neutral solutions or pure water has pH equal to 7.

(d) Basic solutions have pH greater than 7.

(e) The higher the pH, the more basic is the solution.

Sample Questions for Practice:

1. How will you test for a gas which is liberated when HCL reacts with an active metal? **(CBSE 2008)**
2. What is baking powder? How does it make the cake soft and spongy? **(CBSE 2008)**
3. When fresh milk is changed into curd will its pH value increase or decrease? Why?
4. Give Arrhenius definition of an acid and a base. **(CBSE 2009)**
5. What happens chemically when quick lime is added to water? **(CBSE 2008)**
6. Name the gas evolved when dilute HCL reacts with Sodium hydrogen carbonate. How is it recognized? **(CBSE 2008)**
7. How does the flow of acid rain water into a river make the survival of aquatic life in the river difficult? **(CBSE 2008)**
8. How is the pH of a solution of an acid influenced when it is diluted? **(CBSE 2008 F)**
9. How does the pH of the solution change when a solution of base is diluted? **(CBSE 2008 F)**
10. Arrange these in increasing order of their pH values- NaOH, blood, lemon juice. **(CBSE 2008 F)**
11. Two solutions of A and B have pH values of 5 and 8. Which solution will be basic in nature? **(CBSE 2008 C)**
12. Why does tooth decay start when pH of mouth is lower than 5.5? **(CBSE 2009)**
13. What would be the colour of litmus in a solution of sodium carbonate? **(CBSE 2009)**
14. Name the products obtained when sodium hydrogen carbonate is heated. Write the chemical equation for the same. **(AI CBSE 2009)**
15. Write the chemical formula of washing soda and baking soda. Which one of these two is an ingredient of antacids? How does it provide relief in stomachache? **(CBSE 2008 F)**
16. What do you mean by "water of crystallization" of a substance? Describe an activity to show that blue copper sulphate crystals contain water of crystallization. **(CBSE 2009 F)**
17. How can washing soda be obtained from baking soda? Name an industrial use of washing soda other than washing clothes. **(AI CBSE 2008)**
18. Why does 1 M HCL solutions have a higher concentration of H^+ ions than 1M CH_3COOH solution? **(AII CBSE 2009)**

Important Questions for Practice:

1. Why is Plaster of Paris stored in a moisture proof container?
2. What do you mean by neutralization reaction? Give two examples.
3. Mention two uses of baking soda and washing soda.
4. Why does a milkman add a small amount of baking soda to fresh milk to shift the pH of fresh milk from 6 to slightly alkaline?

5. Why do acids not show acidic behavior in the absence of water?
6. Rain water conducts electricity but distilled water does not. Why?
7. Why don't we keep sour substances in brass and copper vessels?
8. What is the common name of CaOCl2?
9. Name the compound used for softening hard water.
10. What happens when baking soda is heated?
11. Give the properties and uses of bleaching powder.
12. Give a few uses of acids, bases and salts respectively.

METALS AND NON-METALS

1. Chemical Properties of Metals:

1.1. Metals react with air or oxygen to form metal oxide. Ex: Copper reacts with oxygen to form copper oxide.

$$\text{Metal} + O_2 \rightarrow \text{Metal oxide}$$

1.2. Oxides of metals can react with both acids and bases to produce salt and water. Such oxides are known as amphoteric Oxides.

$$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + H_2O$$

1.3. Metals also react with water to form metal oxide. Metal oxide in turn can react with water to form metal hydroxide.

$$2Na + 2H_2O \rightarrow 2NaOH + 1H_2$$

1.4. Metals also react with dilute acids to form salt and hydrogen. Metal + Acid → Metal Salt + Hydrogen

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

2. Chemical Properties of Non-metals:

2.1. Non-metals react with oxygen to form non-metal oxide. Non-metal + Oxygen → Non-metal oxide

$$C + O_2 \rightarrow CO_2$$

2.2. Non-metals do not react with water and acids to evolve hydrogen gas.

2.3. Non-metals can react with salt solution; more reactive element will displace the less reactive non-metal.

$$2NaBr\ (aq) + Cl_2(aq) \rightarrow 2NaCl\ (aq) + Br_2\ (aq)$$

2.4. Non-metals can also react with hydrogen to form hydrides.

$$H_2(g) + S(l) \rightarrow H_2S(g)$$

3. Reactivity Series:

3.1. The series in which metals are arranged in the decreasing order of reactivity.

3.2. K (most reactive) > Na > Ca > Mg > Al > C > Zn > Fe > Sn > Pb > H > Cu > Ag > Au > Pt (least reactive)

4. Ionic Compounds: Compounds formed due to the transfer of electrons from a metal to a non-metal. They are generally solid, with a high melting and boiling point. They are soluble in water but insoluble in inorganic solvents like ether. They conduct electricity in molten and solution state.

5. Occurrence of Metals: Elements or compounds which occur naturally in earth crust are known as minerals. Minerals from which pure metals can be extracted are known as mineral ores.

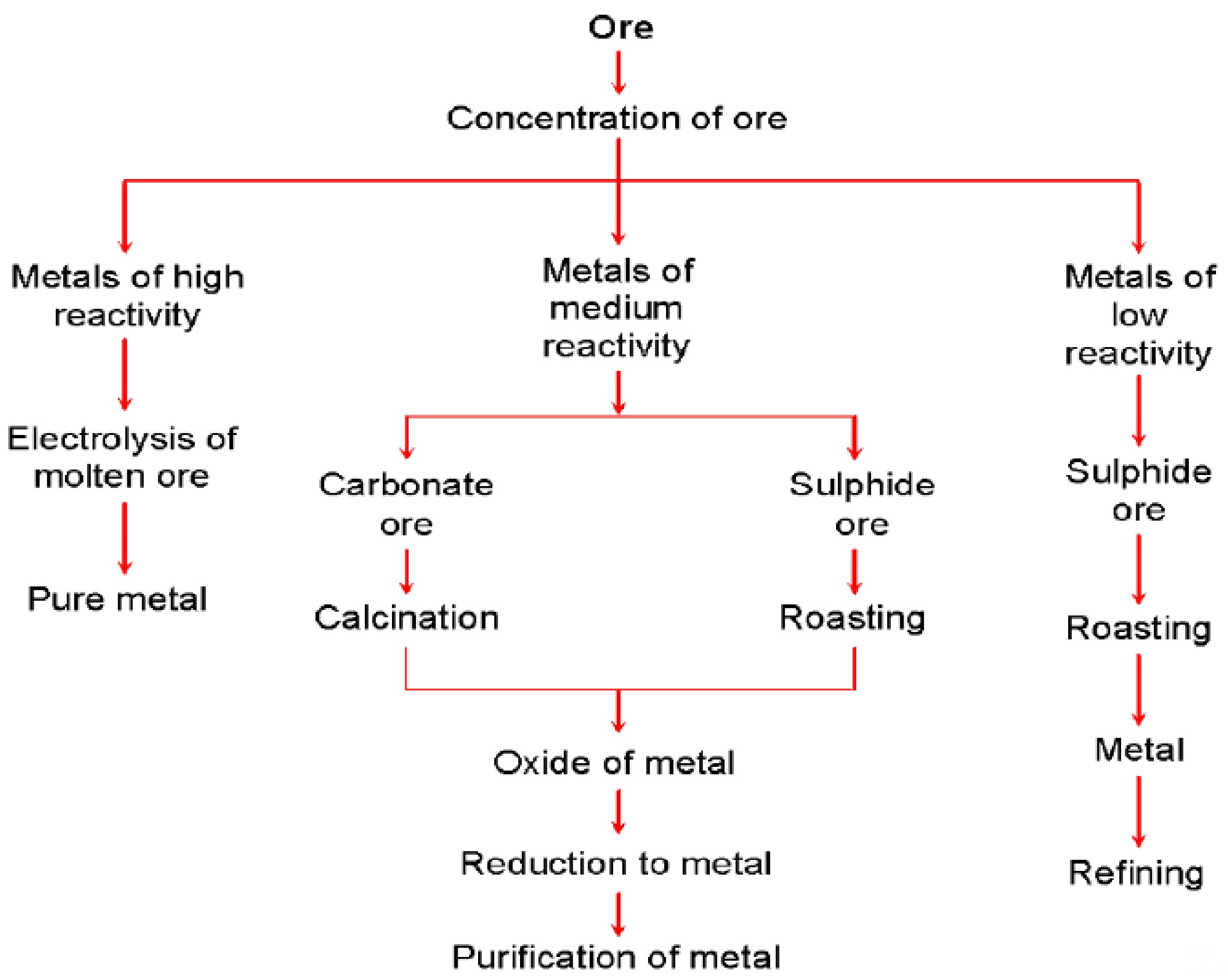
6. Extraction: Extraction of pure metals from its ores start with enrichment of the ore, extraction of metals, refining of metal.

6.1. The metals at the top of the activity series (K, Na, Ca, Mg and Al) are so reactive that they are never found in nature as free elements.

6.2. The metals in the middle of the activity series (Zn, Fe, Pb, etc.) are moderately reactive. They are found in the earth's crust mainly as oxides, sulphides or carbonates.

6.3. Below copper lies gold and silver that are found in Free State. These metals have low reactivity.

7. Gangue: Ores contain different impurities in it such as sand, soil etc. Gangue + Flux = Slag
8. Refining of Metals: Refining of impure metal is done using electrolytic refining. Impure copper is used as anode and strip of pure copper is used as cathode. Acidified copper sulphate is used as electrolyte. When electric current is passed through this, impure metal from the anode gets deposited in the electrolyte solution, whereas pure metal from the electrolyte is deposited at cathode.
9. Extracting Metals which are Low in Activity Series: Metals which are low in activity series are unreactive. The oxides of such metals can be reduced to metals by heating alone. For example, Cinnabar (HgS)
10. Extracting Metals in the Middle of the Activity Series: These metals are moderately reactive. They exists as sulphides or carbonates in nature. Before reduction, metal sulphides and carbonates must be converted into metal oxides. Sulphide ores are converted into oxides by heating strongly in presence of excess air, this is known as roasting. Carbonate ores are converted into oxides by heating in limited air. This is known as Calcination.



$$2HgS(s) + 3O_2(g) \xrightarrow{\text{Heat}} 2HgO(s) + 2SO_2(g)$$

$$2HgO(s) \xrightarrow{\text{Heat}} 2Hg(l) + O_2(g)$$

Roasting:

$$2ZnS(s) + 3O_2(g) \xrightarrow{\text{Heat}} 2ZnO(s) + 2SO_2(g)$$

Calcination:

$$ZnCO_3\,(s) \xrightarrow{\text{Heat}} ZnO\,(s) + CO_2\,(g)$$

Reduction-metal oxides can be reduced to metals using reducing agent such as such as carbon.

11. Extracting Metals towards the Top of the Activity Series: The metals are highly reactive. They cannot be obtained by heating.

Ex- Sodium, magnesium and calcium are obtained by the electrolysis of their molten chlorides.

At cathode $Na^+ + e^- \rightarrow Na$

At anode $2Cl^- \rightarrow Cl_2 + 2e^-$

12. Corrosion: Metals when exposed to moist air for a long period of time, they become corroded. Ex: Silver reacts with moist air and becomes black in colour due to silver sulphide coating.

Iron + oxygen → Iron (III) oxide = $Fe + O_2 \rightarrow Fe_2O_3$

12.1. Prevention of Corrosion:

(a) Rusting of iron can be prevented by oiling, galvanizing, painting, greasing etc.

(b) To protect steel and iron from rusting, a thin layer of zinc is coated on them, this is known as galvanization.

(c) Sacrificial Protection: 'Rusting' can be prevented by connecting iron to a more reactive metal

(d) Electroplating: Coating the surface with metals like tin, chromium, nickel etc.

(e) Alloying: Iron or steel along with other metals can also be protected by 'alloying' or mixing with other metals (e.g., chromium) to make non-rusting alloys.

Sample Questions for Practice:

1. Name a reducing agent that may be used to obtain manganese from manganese dioxide. (CBSE 2009)

2. From amongst the metals sodium, calcium, aluminium, copper and mangnesium, name the metal (I) which reacts with metal only on boiling and

(II) another which does not react even with steam. (CBSE 2008)

3. (a) Show the formation of NaCl from sodium and chlorine atoms by the transfer of electrons.

(b) Why sodium chloride has a high melting point?

(c) Name the anode and cathode used in electrolytic refining of impure copper metal. (CBSE 2008)

Why are ionic compounds usually hard? How is it that ionic compounds in the solid state do not conduct electricity but they do so when in molten state? (CBSE 2008)

On adding dilute HCL acid to copper oxide powder the solution formed is blue-green. Predict the new compound formed which imparts a blue-green colour to the solution. (CBSE 2008)

4. (a) Show on a diagram the transfer of electron between the atoms in the formation of MgO.

(b) Name the solvent in which ionic compounds are generally soluble.

(c) Why are aqueous solutions of ionic compounds able to conduct electricity? (CBSE 2008)

5. What are amphoteric oxides? Choose the amphoteric oxides from- Na_2O, ZnO, Al_2O_3, CO_2, H_2O

6. Why is it that non-metals do not displace hydrogen from dilute acids? (AI CBSE 2008)

7. Show the electronic transfers in the formation of $MgCl_2$ from its elements. (CBSE 2008 F)

8. Which of the following metals will melt at body temperature: gallium, magnesium, caesium, aluminium? (CBSE 2008 C)

9. Name the two metals which react violently with cold water. Write any three observations you would make when such a metal is dropped into water. How would you identify the gas evolved, if any? (AI CBSE 2008)

10. Give reasons for the following: (i) Gold and silver are used for jewellery making.

(ii) carbonate and sulphide ores are usually converted into oxides prior to reduction during the process of extraction. (CBSE 2008 C)

11. Give reasons for the following: (i) Aluminium oxide is considered as an amphoteric oxide.

(ii) Ionic compounds conduct electricity in molten state. (CBSE 2008 C)

12. Give reasons for the following:

(i) Metals can be given different shapes according to our needs.

(ii) Hydrogen is not evolved when a metal reacts with nitric acid.

Important Questions for Practice:

1. A metal 'X' loses two electrons and a non-metal 'Y' gains one electron. Show the electron dot structure of compound formed between them. Is ionic or covalent? Does it have high melting point or low? Will it conduct electricity in solid state or in aqueous solution and why? Will it be soluble in water?

2. A student was given Mn, Zn, Fe and Cu metals. Identify which of them

(a) will not displace H_2 from dil. HCl.

(b) will react only with steam to give H2(g).

(c) Will give H_2 with 5% HNO_3.

Write the chemical reactions involved.

3. Compound X and aluminium are used to join railway tracks.

(a) Identify the compound X.

(b) Name the reaction.

(c) Write down its reaction.

4. Samples of five metals 'A', 'B', 'C', 'D' and 'E' were taken and added to the following solution one by one. The results obtained have been tabulated as follows.

Metal- $FeSO_4$,$CuSO_4$,$ZnSO_4$,$AgNO_3$,$Al_2(SO_4)_3$,$MgSO_4$

A. No reaction, Displacement, No reaction, Displacement, No reaction, No reaction

B. Displacement, Displacement, No reaction, Displacement, No reaction, No reaction

C. No reaction, No reaction, No reaction, Displacement, No reaction, No reaction

D. No reaction, No reaction, No reaction, No reaction, No reaction, No reaction

E. Displacement, Displacement, Displacement, Displacement, No reaction, No reaction

Use the above table to answer the following questions about the given metals.

(a) Which of them is most reactive and why?

(b) What would you observe if 'B' is added to $CuSO_4$?

(c) Arrange 'A', 'B', 'C', 'D' and 'E' in the increasing order of reactivity.

(d) Container of which metal can store zinc sulphate and silver nitrate solution?

(e) Which of the above solution(s) can be stored in a container made of any of these metals and why?

5. A metal A, which is used in Thermite process, when heated with oxygen gives an oxide B, which is a amphoteric in nature? Identify A and B. Write down the reactions of oxide B with HC1 and NaOH.

6. A non-metal A is an important constituent of our food and forms two oxides B and C. Oxide B is toxic whereas C causes global warming.

(a) Identify A, B and C.

(b) To which group of periodic table does A belong?

7. An element A reacts with water to form a compound B which is used in white washing. The compound B on heating forms an oxide which on treatment with water gives back B. Identify A, B and C and give the reactions involved.

8. A non-metal A which is the largest constituent of air, when heated with H2 in 1 : 3 ratio in the presence of catalyst (Fe) gives a gas B. On heating with O2, it gives an oxide C. If this oxide is passed into water in the presence of air, it gives and acid D which act as a strong oxidizing agent.

(a) Identify A, B, C and D.

(b) To which group of periodic table does this non-metal belong?

9. An element A burns with golden flame in air. It reacts with another element B, atomic number 17 to give a product C. An aqueous solution of product C on electrolysis gives a compound D and Liberates hydrogen. Identify A, B, C and D. Also write down the equations for the reactions involved.

CARBON & ITS COMPOUND

INTRODUCTION:

The compound obtained from ‘Carbon’ is widely used as clothes, medicines, books fertilizer, fuel etc. al living structures are carbon based.

The amount of carbon present in the earth’s crust and in the atmosphere is quite merge. The earths crust has only 0.02% carbon in the form of mineral (like carbonates, hydrogen-carbonates, coal and petroleum) and the importance has 0.03% of carbon dioxide. In spite of this small amount of carbon available in nature, the importance of carbon seems to be immense.

Carbon forms a large number of compounds with hydrogen which are known as hydrocarbons. In addition to hydrogen, Carbon compound may also contain some other element such as oxygen, halogen, nitrogen, phosphorus, sulphur etc.

The number of compounds of carbon is more than three million which is much larger than the compounds formed by all other element put together.

BONDING IN CARBON COMPOUNDS:

Carbon forms **covalent bonds** in its compounds with other atoms. In each compound the valency of carbon is four. That is, carbon has **tetravalent c**haracter. But what is covalent bond and what is meaning of tetravalent?

Why does a carbon atom form only covalent bond?

- The atomic number of carbon is 6 and first shell contains just two electrons and second shell (Outermost shell) contains four electrons.
- Carbon atom can attain the noble gas configuration by sharing its valence electrons with other atoms of carbon or with atoms of other elements and form covalent bond.

COVALENT BOND:

A chemical bond formed between two atoms of the same element or two atoms of different elements by sharing of electron is called a **covalent bond.**

Necessary conditions of the formation of covalent bond:

- The combining atoms should have **nonmetallic** character.
- The combining atoms should contain **4 to 7 electrons** in their respective valence shell.
- In **hydrogen** there is only **1 valence electron,** but it also forms **covalent bond.**
- The combining atoms need **1, 2,3, or 4 electrons** to complete their **octet (hydrogen completes its duplet)**
- The combining atoms should contribute equal number of electrons to form pair of electrons to be **shared.**
- After sharing the pair of electrons each combining atoms should attain stable electronic configuration like its nearest noble gas.

CLASSIFICATION OF COVALENT BOND:

On the basis of the number of electrons shared by two combining atoms, the covalent bond are of three types.

- **Single Covalent Bond :** A single covalent bond is formed by the sharing of one pair of electrons between the two atoms. It is represented by one short line (—) between the two atoms.
  Example: H—H, Cl—Cl, H—Cl, CH_3— CH_3.
- **Double Covalent Bond:** A double covalent bond is formed by the sharing of two pairs of electron between the two combining atoms. It is represented by putting (=) two short lines between the two bonded atoms.
  Examples: O = O (O_2), CO_2 (O = C = O), $H_2C = CH_2$
- **Triple covalent bond:** A triple bond is formed by the sharing of three pair of electrons between the two combining atoms. It is represented by putting three short line () between two bonded atom.
  Example: N_2($N\equiv N$), $CH\equiv CH$.

FORMATION OF SINGLE COVALENT COMPOUNDS:

- **Formation of hydrogen molecule (H_2) :**

A molecule of hydrogen is composed to two H-atoms. The electronic configuration of H-atom is.

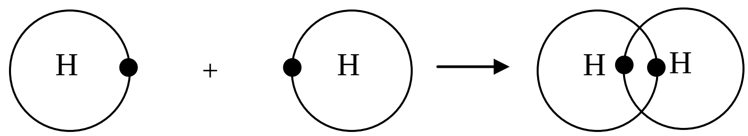
$$\left.\begin{array}{l}\text{Shell - K}\\ \\ \text{Electron-1}\end{array}\right\}\ \text{incomplete duplet (unstable)}$$

Electronic configuration of He atom

Shell - K
Electrons-2 } complete duplet (stable)

$H^{\cdot} + {}^{\cdot}H \longrightarrow$ H:H $\longrightarrow$ H- H $\longrightarrow$ H_2
K(1) K(1) Shared electron Covalent Hydrogen
Atom Pair Bond molecule

H – H Bond in terms of energy shells (orbits)



H Atom H Atom H_2 molecule

- **Formation of chlorine molecule** (Cl_2): The atomic number of chlorine is 17, thus there 17 electrons in an atom of chlorine.

Electronic configuration of Cl atom –

Shells	K	L	M'	
Electrons	2	8	7	Incomplete octet

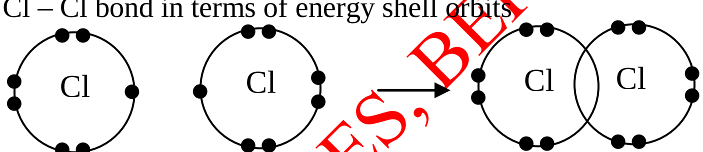
Electronic configuration of Ar atom –

Shells	K	L	M	
Electrons	2	8	8	Complete octet

Chlorine atom needs one electron more to complete its octet –

:Cl• + •Cl: $\longrightarrow$:Cl:Cl: $\longrightarrow$ Cl – Cl $\longrightarrow$ Cl_2
Atom Atom Shared electrons Covalent Bond Chlorine molecule

Cl – Cl bond in terms of energy shell orbits



Cl Atom Cl Atom Cl_2 Molecule

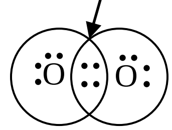
Formation of hydrochloric acid (HCl) :

- H atom has one valence electron. It needs 1 electron more to complete its duplet and chlorine has 7 valence electrons. It need 1 electron more to complete its octet and acquire stable electronic configuration (2,8,8) like noble gas argon.

H + .Cl: $\longrightarrow$  $\longrightarrow$ H — Cl $\longrightarrow$ HCl

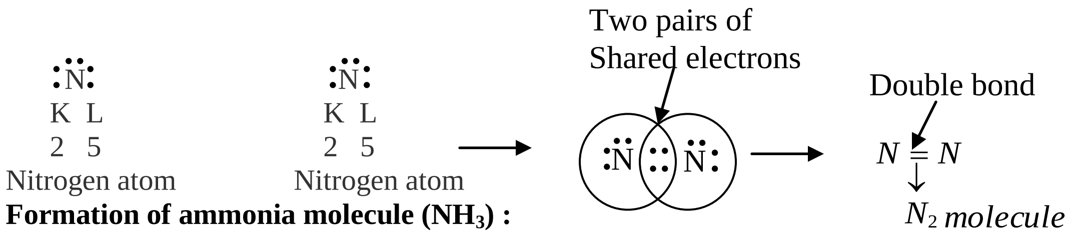
Shared pair of electrons Covalent bond Hydrogen chloride molecule

- **Formation of oxygen(O_2) :**
The atomic number of O atom is 8. There are 6 electron in the valence shell of oxygen atom it needs 2 more electrons to attain the nearest stable inert gas Neon (2,8) configuration :

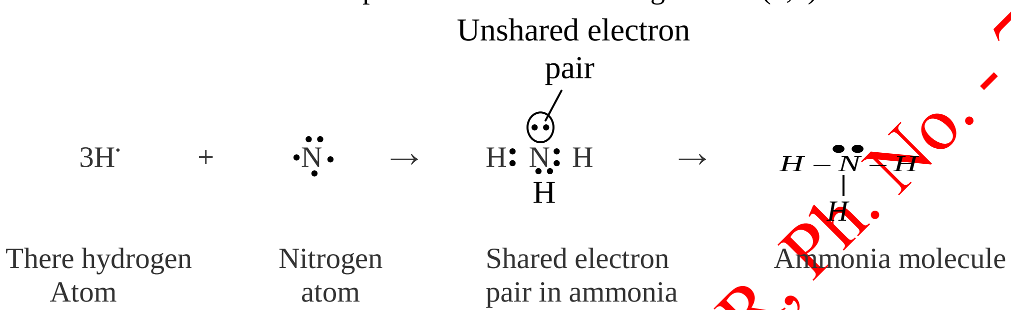
:Ö:		:Ö:		Two pairs of Shared electrons		Double bond
K L	+	K L	$\longrightarrow$		$\longrightarrow$	$O = O$
2 6		2 6				O_2 *molecule*
Oxygen atom		Oxygen atom				

2 , 8

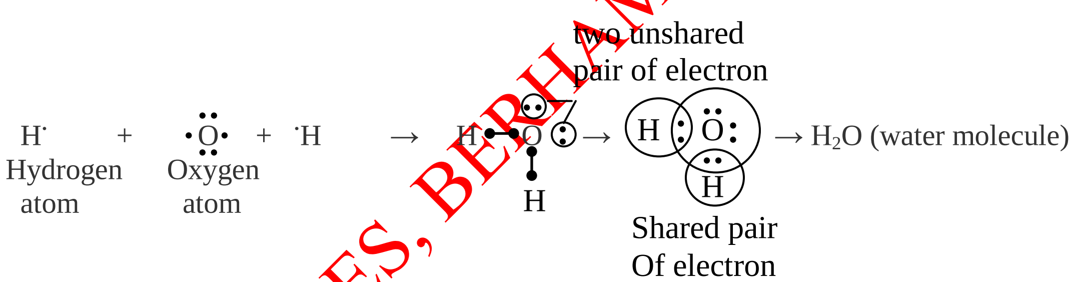
- **Formation of nitrogen molecule (N_2) :**
The atomic number of nitrogen is 7 and its electronic configuration is K(2). L(5). It needs 3 electrons more to complete its octet like noble gas neon (2,8).



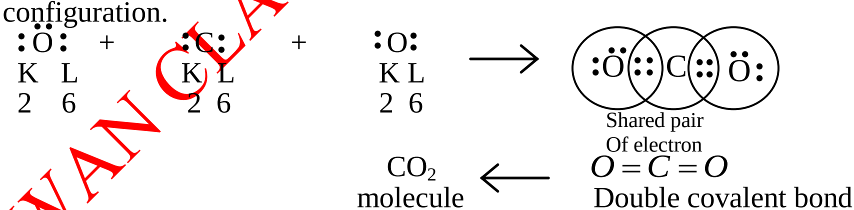
- **Formation of ammonia molecule (NH_3) :**
The atomic number of N is 7. It's electronic configuration is 2,5 there are 5 electrons in its valence shell. It needs 3 electrons more to complete its octet like noble gas neon (2,8).



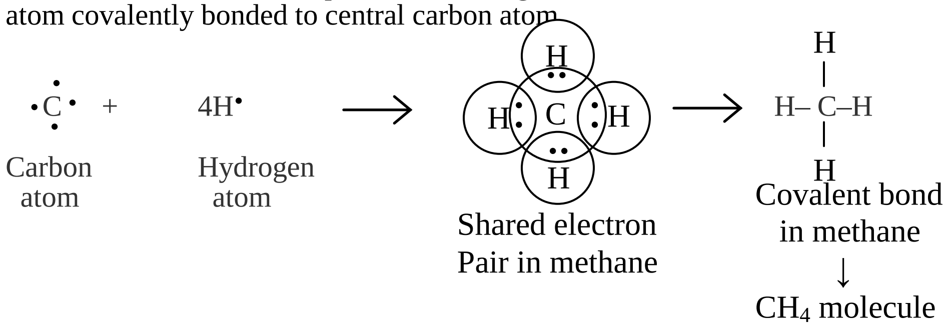
- **Formation of H_2O molecule :**
The electronic configuration of hydrogen is K (1) and that of oxygen is K(2) L(6) thus each hydrogen require one and oxygen required two electrons to achieve the stable electronic configuration.



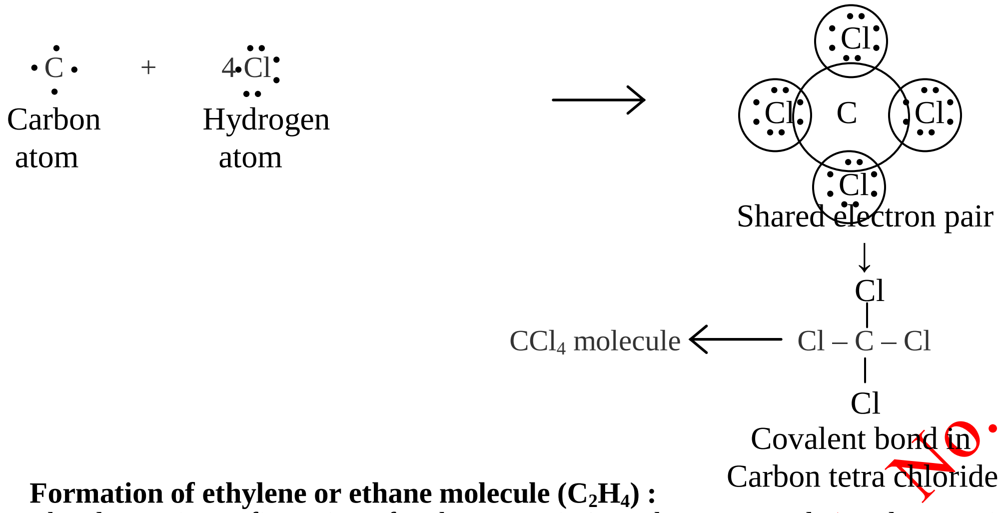
Formation of CO_2 molecule :
The atomic number of C is 6 and the electronic configuration of C is K(2). L(4) and that of oxygen is K(2), L(6) thus each carbon require 4 and oxygen require two electrons to achieve the stable electronic configuration.



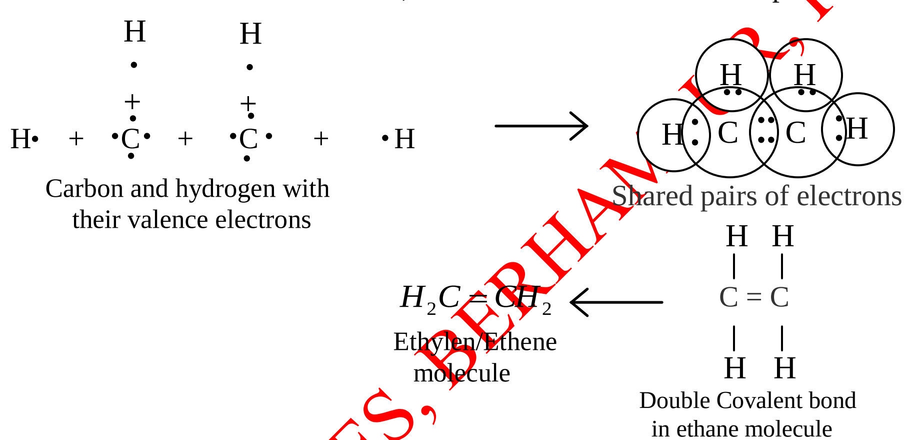
- **Formation of CH_4 molecule :**
Methane is a covalent compound containing 4 covalent bond. It contains one carbon atom and four hydrogen atom covalently bonded to central carbon atom.



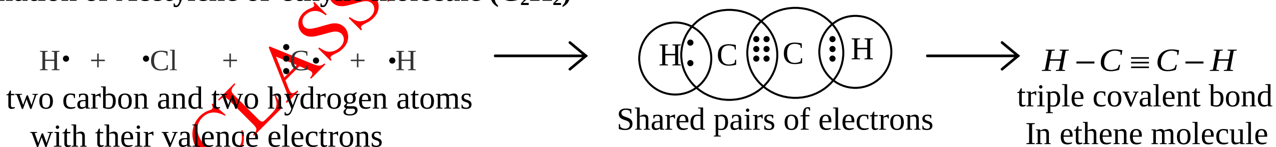
- **Formation of carbon tetrachloride molecule (CCl_4) :**
  The electronic configuration of carbon and chlorine atoms are (2,4) and (2,8,7) respectively. Carbon atom needs four electrons and chlorine atom needs one electron to attain the stable electronic configuration.



- **Formation of ethylene or ethane molecule (C_2H_4) :**
  The electronic configuration of carbon atom is 2,4. There are 4 valence electrons in one C atom. Each H atom contains 1 valence electron. Thus, there are 12 valence electrons present in ethane molecule.



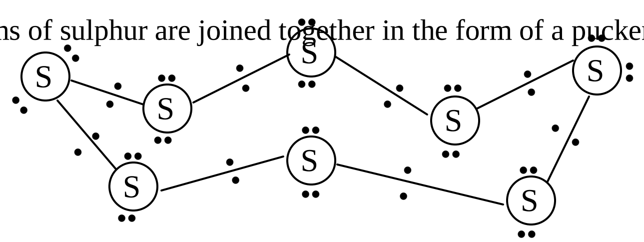
Formation of Acetylene or ethyne molecule (C_2H_2)



Q 1. What would be the electron dot structure of carbon dioxide which has formula CO_2? **[NCERT]**

Q 2. What would be the electron dot structure of a molecule of sulphur which is made up of eight atoms of sulphur ?

Ans. The eight atoms of sulphur are joined together in the form of a puckered ring. **[NCERT]**



Q. Explain the nature of the covalent bond using the bond formation in CH_3Cl. **[NCERT]**

Q. Draw the electron dot structure for **[NCERT]**

(a) Ethanoic acid (b) H_2S (c) Propanone (d) F_2

NON POLAR AND POLAR COVALENT COMPOUNDS :

Non polar covalent bond :

A covalent bond formed between **two atoms** of the same element or same **Electronegativity** is called a **non-polar covalent bond.** Example : H_2,N_2,O_2.Cl_2 etc.

$$H : H \qquad :\ddot{O}::\ddot{O}:$$

the shared pair electron lies exactly midway between the two atoms

Polar covalent bond :

The covalent bond between the atoms of **two elements** having **different electro negativities** is called a **polar covalent bond.** Molecule in which the atom are bonded by a polar covalent bond are called **polar molecules.**

Note : In a polar covalent bond, the shared pair of electrons lies more toward the atom which is more electronegative.

Example : HCl, H_2O & NH_3

$$H\cdot \quad + \cdot\ddot{\underset{\cdot\cdot}{Cl}}: \longrightarrow H\ :\ddot{\underset{\cdot\cdot}{Cl}}: \longrightarrow \overset{\delta\oplus}{H}\ :\overset{\delta\ominus}{\underset{\cdot\cdot}{Cl}}:$$

Shared pair of electrons lie nearer to Cl because Cl is more electronegative

Note : δ means partial

CHARACTERISTICS OF COVALENT BOND AND COVALENT COMPOUNDS :

Characteristics of covalent bond :

- Covalent bond are formed by mutual **sharing** of electrons
  Note : Shared pair of electrons is also called **bonding pair of electrons.**

- Covalent bond is directional in nature because shared pair of electrons remain localized in a definite space between the two atoms.

Characteristics of covalent compounds :

Physical Store : The covalent compounds are generally **gases or liquids.** but compounds with high molecular masses are **solids.**

Example : **Solid :** Urea, Glucose, Naphthalene.

Liquids : Water, ethanol, benzene.

Gases : Methane, chlorine, hydrogen, oxygen

- **Melting and boiling points :** Covalent compounds have **low melting** and **low boiling points** because **intermolecular forces** (cohesive forces) in covalent compounds **are weaker** than those in ionic compounds.

Note : Some exception like diamond and graphite which are covalent solids have very high M.P. & B.P.

- **Solubility :**

Covalent compounds generally dissolve readily in organic solvents but they are **less soluble in water.**

For example : Naphthalene which is an organic compound dissolves readily in organic solvents like ether but is insoluble in water. However some covalent compounds like urea, glucose, sugar etc. are soluble in water. Some polar covalent compounds like ammonia and hydrochloric acid are soluble in water.

- **Conductivity :**

Covalent compounds **do not conduct electricity** because they contain neither the ions nor free electrons necessary for conduction. So they do not conduct electricity

For example : Covalent compounds like glucose, alcohol. Carbon tetrachloride do not conduct electricity.

Differences between ionic and covalent compounds :

S.N.	Electrovalent (Ionic) Compounds	Covalent Compounds
1	Formed by transfer of electrons, (only single bond network exist)	Formed by sharing of electrons, (single, double & triple are formed).
2	Usually crystalline solid	Usually gasses or liquid only a few of them are solid
3	Generally have high melting and boiling points	Generally have low M.P. and B.P.
4	Soluble in water but insoluble in organic solvents	Soluble in organic solvent but insoluble or soluble in water
5	Conduct electricity in solution or molten state	Usually non conductor of electricity
6	Highly polar and ionize in water eg. $NaCl \rightarrow Na^+ + Cl^-$	Usually Non-polar and do not ionize in water but few compounds are polar in nature and ionize in water eg. $HCl \rightarrow H^+ + Cl^-$

ORGANIC COMPOUNDS :

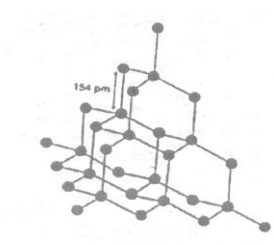
The chemical compounds which are present in living organisms (plant and animal) are called **organic compounds.** The belief that formation of organic compounds was possible only in plants and animals led the scientists of early days to propose that **Vital Force** was necessary for the formation of such compounds. But the experimental work of **Friedrich Wohler** (German chemist) denied the idea of vital force when he prepared urea in his laboratory. (urea is an organic compound and waste product of urine).

Q. Name the organic compound which was prepared by Wohler in his laboratory. **[NCERT]**

Allotropy/allotrops of carbon :

The phenomenon of existence of allotropic forms of an element is called allotropy. Allotropes are the different forms of the same element having different physical properties but almost similar chemical properties. There are three allotropes of carbon these are diamond, graphite and fullerene.
DIAMOND : Diamond is a **crystalline allotrope** of carbon. Its atomic symbol & empirical formula is 'C'.
Structure : In diamond, each carbon atom is covalently bonded to four other carbon atoms in a tetrahedral arrangement. This tetrahedral arrangement of carbon atoms gives a rigid, three dimensional structure to diamond It is due to this rigid structure that diamond.

- is very hard crystalline structure.
- Has high melting point.
- Is non conductor of heat and electricity.



Structure of Diamond

Properties : Pure diamond is a transparent and colorless solid.

- Polished diamond sparkles brightly because it reflects most of the light (refractive index of diamond is 245)
- Diamond are not attacked by acids. alkalis and solvents like water, ether, benzene or carbon tetrachloride but diamond is attacked by fluorine at 750^0C.

C (Diamond) + $2F_2 \xrightarrow{750^0 C} CF_4$

Carbon Fluorine Carbon Tetra fluoride

- The density of diamond is 3.51 g per cm^3 at 20^0C.

Uses :

- A saw fitted with diamond is used for sawing marbles.
- A chip diamond is used for glass cutting.
- Black diamonds are used in making drill.
- Diamonds are used for making dice for drawing very thin wires of harder metals.
- Diamonds are also used for making high precision tools for use in surgery such as, for the removal of cataract.
- Diamond are used for making precision thermometers and protective windows for space crafts.

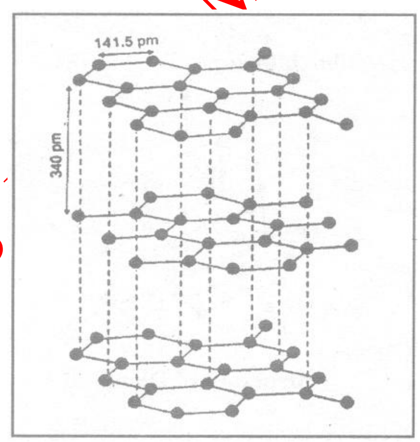
GRAPHITE:

Graphite is also known as **black lead** it marks paper work black. The name graphite has been taken from the Greek word "**graphein**" (which means to write) in reference to its uses as 'lead' in lead pencils.

Structure :

Graphite is an opaque and dark grey solid. In a crystal of graphite the carbon atoms are arranged in hexagonal patterns in parallel planes. In a layer of graphite each carbon atom is strongly bonded to three carbon atoms by covalent bonds. Thus, one valence electron of each carbon atoms is free in every layer of graphite crystal. Thus free electron makes graphite a good conductor of electricity.

Each layer is bonded to the adjacent layers by weak forces. As a result, each layer can easily slide over the other.



Properties :

- Graphite is grayish-black, opaque material having metallic (shiny) **luster.**
- It is soft and has a **soapy** (slippery) touch.
- Graphite is lighter than diamond. The **density of graphite** is 2.26 g per cm^3 at 20^0C.
- Graphite is a **good conductor** of heat and electricity.
- Graphite has a very **high melting point.**
- Graphite is **insoluble** in all common solvent.

Uses:

- For making electrodes in dry cells and electric arc furnaces.
- Graphite is a **good dry lubricant** for those parts of machines where grease and oil cannot be used.
- For making crucibles for melting metals.
- For manufacturing lead pencils.
- Graphite is used as neutron moderator in nuclear reactors.

- For the manufacture of gramophone records and in electrotyping.
- For the manufacture of artificial diamond.

Fullerene :

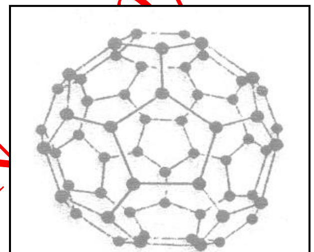
- Fullerene was discovered in 1985 by Robert F. Curl Jr, Harold Kroto and Richard E.Smally.
- This molecule containing sixty atoms of carbon has been named Buckminster fullerene. Fullerenes have been named after American architect and engineer **R. Buckminster-fuller** whose geodesic domes follow similar building principles.

Type of fullerene :

C_{60},C_{70},C_{74} and C_{78} are the members of the fullerene family. But C_{60} is the most stable and most studied from of fullerenes.

Structure of fullerene :

- Buckminster fullerene molecule (C_{60}) is nearly spherical.
- It consists of 12 pentagonal faces and 20 hexagonal faces giving it 60 corners. Thus, Buckminster fullerene has a hollow, cage-like structure.
- In figure, ball like molecules containing C atoms.


Structure of fullerene

Preparation :

- By electrically heating a graphite rod in atmosphere of helium.
- By vaporizing graphite by using laser.

Properties :

- Fullerene is soluble in benzene and forms deep violet colour solution.
- Crystalline fullerene has semiconductor properties.
- Compounds of fullerene with alkali metals are called fullerides and they are superconductors.

Uses :

- As a superconductor.
- As a semiconductor.
- As a lubricants and catalyst.
- As fibres to reinforce plastics.

VERSATILE NATURE OF CARBON :

About three million (or thirty lakh) compounds of carbon are known. The existence of such a large number of organic compounds is due to the following characteristic features of carbon.

(1) CATENATION : Tendency to form Carbon-Carbon bond:

"The property of forming bonds with atoms of the same element is called **catenation".**

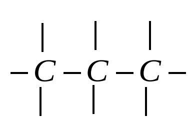
Carbon has the maximum tendency for catenation in the periodic table. This is because of strong carbon bonds as compared to other atoms.

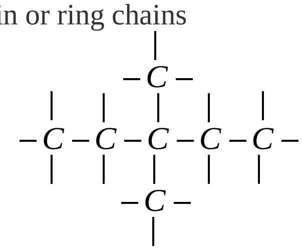
- When two or more carbon atoms combine with one another, they form different types of chain such as

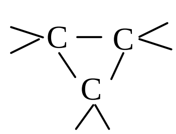
(i) Straight chains

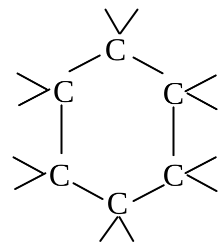
(ii) Branched chains

(iii) Closed chain or ring chains


Straight chain


Branched chain


(Minimum 3C required in closed chain structure)


Closed chain

(2) Tetravalency of Carbon :

- The atomic number of carbon is **6.**
- The electronic configuration of carbon atom is **$1s^2, 2s^2, 2p^2$.**
- It has four electrons in the outermost shell, therefore its valency is four. Thus carbon forms four covalent bonds in its compounds.

$\cdot\dot{\underset{\cdot}{C}}\cdot$	+	$4H^{\cdot}$	$\longrightarrow$	$H:\overset{H}{\underset{H}{\ddot{\underset{\cdot\cdot}{C}}}}:H$
Forms4 covalent bond		Forms1 covalent bond		Methane molecule

(3) Tendency to form multiple bonds :

Due to small size, carbon can easily form double or triple bonds**(called multiple bonds)** with itself and with the atoms of other elements as nitrogen, oxygen, sulphur etc.

$$H-\overset{H}{\underset{H}{\overset{|}{\underset{|}{C}}}}-H$$

Single bond

$$\begin{matrix} H & & & & H \\ & \diagdown & & \diagup & \\ & & C=C & & \\ & \diagup & & \diagdown & \\ H & & & & H \end{matrix}$$

Double bond

$>C = O$, $H-C\equiv C-H, -C\equiv N$

Triple Bond

(4) Isomerism :

Compounds having same molecular formula but different structural formulae are known as Isomers and the phenomenon of existence of isomers is termed as **isomerism.**

Example :

C_2H_6O(Same Molecular Formulae)

Two Isomers

C_2H_5OH	CH_3-O-CH_3
Ethyl alcohol	Dimethyl ether

C_5H_{12}(Pentane)

Three Isomers

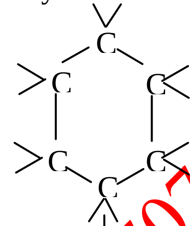
$CH_3-CH_2-CH_2-CH_2-CH_3$	$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3$	$H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$
n-pentane	Iso-pentane	Neo-pentane

HYDROCARBON :

Compounds formed from combination of carbon and hydrogen are known as hydrocarbon. Hydrocarbon the basis of chain are mainly classified into two parts.

Hydrocarbon

- Acyclic or open chain hydrocarbon -C-C-C-C-
  - Saturated Alkane Single Bond
  - Unsaturated
    - Alkene (double bond)
    - Alkyne (triple bond)
- Cyclic Hydrocarbon



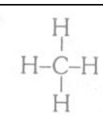
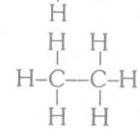
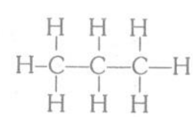
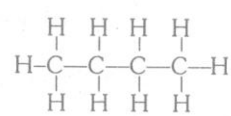
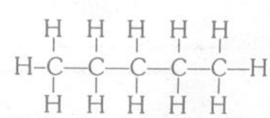
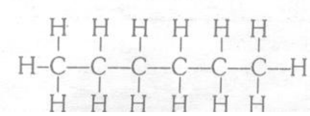
  - Heterocyclic
  - Homocyclic
    - Aromatic (Benzene)
    - Acyclic (Cycloalkane)

Saturated and unsaturated hydrocarbon :

(1) Saturated Hydrocarbon :

- The hydrocarbons which contain only single carbon-carbon covalent bonds are called **saturated hydrocarbons.**
- They are also called **alkanes.**
- General formula for alkanes is C_nH_{2n+2} where 'n' is the number of carbon atoms.

General formula of saturated hydrocarbon (C_nH_{2n+2})

No. of 'C' atoms	Name	Formula	Structure
1	Methane	CH_4	
2	Ethane	C_2H_6	
3	Propane	C_3H_8	
4	Butane	C_4H_{10}	
5	Pentane	C_5H_{12}	
6	Hexane	C_6H_{14}	

(2) Unsaturated hydrocarbons :

The hydrocarbon in which two carbon atoms are bonded to each other by a double (=) ior a triple (≡) bond is called an unsaturated hydrocarbon.

- Unsaturated hydrocarbons are of two types viz. alkenes and alkynes.

$$(-\overset{|}{C}=\overset{|}{C}-)$$

(1) Alkenes :

- The hydrocarbon in which the two carbon atoms are bonded by a double bond are called **alkenes.**
- Their general formula is C_nH_{2n} where "n" is the number of carbon atoms.

General formula of alkenes : C_nH_{2n}

No. of C atoms	Name	Formula	Structure
2.	Ethene or Ethylene	C_2H_4 $CH_2=CH_2$	$\begin{matrix}H\\H\end{matrix}\!>C-C<\!\begin{matrix}H\\H\end{matrix}$
3.	Propene or Propylene	C_3H_6 $CH_3-CH=CH_2$	$\begin{array}{ccccccccc} & & H & & H & & H & & \\ & & \vert & & \vert & & \vert & & \\ H & - & C & - & C & - & C & - & H \\ & & \vert & & & & & & \\ & & H & & & & & & \end{array}$
4.	Butene or Butylene	C_4H_8 $CH_3-CH=CH-CH_3$ or $CH_2=CH-CH_2-CH_3$	$\begin{array}{ccccccccccc} & & H & & H & & H & & H & & \\ & & \vert & & \vert & & \vert & & \vert & & \\ H & - & C & - & C & = & C & - & C & - & H \\ & & \vert & & \vert & & \vert & & \vert & & \\ & & H & & H & & H & & H & & \end{array}$ or $\begin{array}{ccccccccccc} & & H & & H & & H & & H & & \\ & & \vert & & \vert & & \vert & & \vert & & \\ H & - & C & = & C & - & C & - & C & - & H \\ & & & & & & \vert & & \vert & & \\ & & & & & & H & & H & & \end{array}$

(II) Alkyne $(-C\equiv C-)$

- The hydrocarbon in which two carbon atoms are bonded by a triple bond are called **alkyne.**
- Their general formula is C_nH_{2n-2} where 'n' is the number of carbon atoms.

General formula of alkynes : C_nH_{2n-2}

No. of 'C' atoms	Name	Formula	Structure
2	Ethyne or Acetylene	$C_2H_2 or$ $HC\equiv CH$	$H-C\equiv C-H$
3	Propyne or Methyl acetylene	$C_3H_4 or$ $H_3C-C\equiv C-H$	$\begin{array}{ccccccc} & & H & & & & \\ & & \vert & & & & \\ H & - & C & - & C\equiv C & - & H \\ & & \vert & & & & \\ & & H & & & & \end{array}$
4	Butylene or Dimethyl acetylene	$C_4H_6 or$ $H_3C-C\equiv C-CH_3$	$\begin{array}{ccccccccc} & & H & & & & H & & \\ & & \vert & & & & \vert & & \\ H & - & C & - & C\equiv C & - & C & - & H \\ & & \vert & & & & \vert & & \\ & & H & & & & H & & \end{array}$

Q. Give a test that can be used to differentiate chemically between butter and cooking oil. **[NCERT]**

CHAINS, BRANCHES AND RINGS :

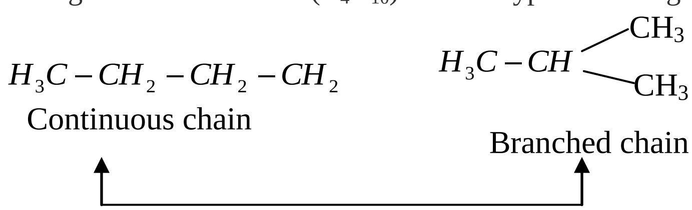
The hydrocarbon may also have branched, closed chains or ring or cyclic structures.

Branched structure :

The alkanes containing three or less carbon atoms do not form branches.

CH_4	CH_3-CH_3	$CH_3-CH_2-CH_3$
Methane	Ethane	Propane

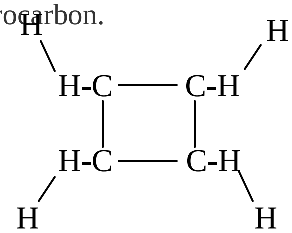
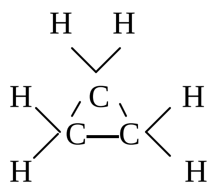
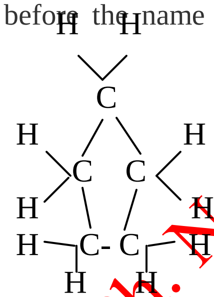
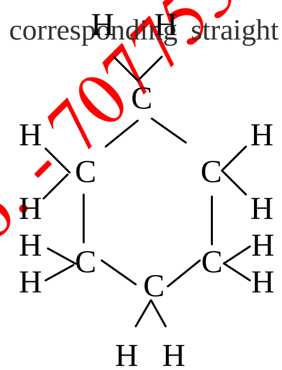
- The Alkane containing four carbon atoms (C_4H_{10}) has two types of arrangement of carbon atoms.



- **Closed chains or cyclic hydrocarbon :** Isomers
  These hydrocarbons contains closed chain or rings of atoms in their molecules. These are of two types :

(A) Salicylic hydrocarbon :

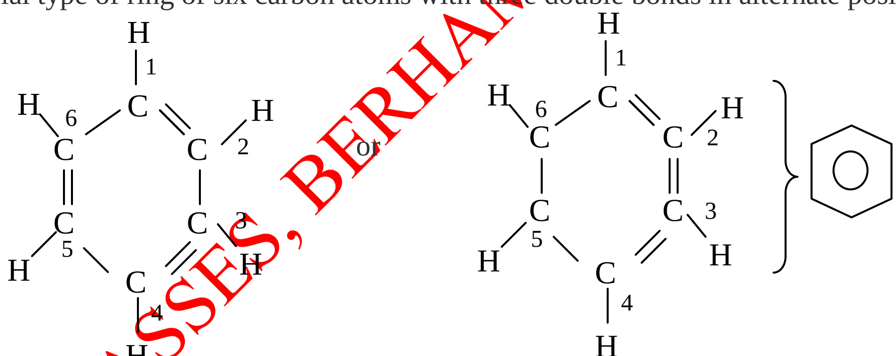
- These hydrocarbon contain a ring chain of three or more carbon atoms.
- These cyclic compounds are named by prefixing cyclo before the name of corresponding straight chain hydrocarbon.

Cyclobutane (C_4H_8) Cyclopropane (C_3H_6) Cyclopentane (C_5H_{10}) Cyclohexane (C_6H_{12})

(B) Aromatic hydrocarbon :

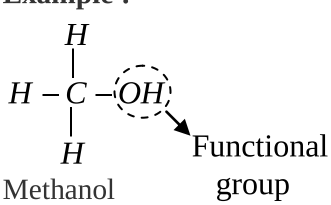
- These have at least one benzene ring in their molecules.
- It is a special type of ring of six carbon atoms with three double bonds in alternate positions.



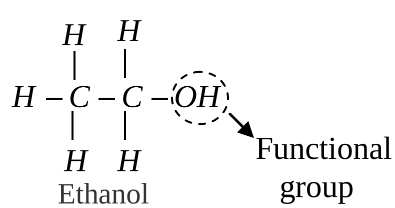
Will you be may friend ? (functional group) :

- Carbon forms many compounds with hydrogen. But carbon also forms bonds with other atoms such as halogen, oxygen, nitrogen and sulphur. Therefore, carbon is said to be very friendly element.
  These compounds are obtained by replacing one or more hydrogen atoms by other atoms such that the valency of carbon remains satisfied. The atom replacing the hydrogen atom is called **heteroatom** or **Funtional** group.
- Different organic compounds having same functional group have almost same properties these are called **families.**

Example :



Methanol



Ethanol

- Properties of CH_3-OH and CH_3-CH_2OH are similar and it is due to the presence of –OH (hydroxyl) group .
- This group is known as **alcoholic group.**
- Family of compounds having –OH group is called **alcohols.**

SOME FUNCTIONAL GROUPS IN CARBON COMPOUNDS

Hetero atom	Functional Group	Formula of Functional Group
Halogen atom (F, Cl, Br, I)	Halo (Fluoro, Chloro, Bromo, Iodo)	-X (-F,-Cl,-Br,-I)
Oxygen	1. Alcohol	-OH
	2. Aldehydes	$-\overset{H}{\overset{\vert}{C}}=O$ or $-CHO$
	3. Ketones	$>C=O$ or $-\overset{\vert}{C}O$
	4.Carboxylic acid	$-\overset{O}{\overset{\Vert}{C}}-OH$ or $-COOH$
Nitrogen	1. Nitro	$-NO_2$
	2. Amines	$-NH_2$

HOMOLOGOUS SERIES :

"A series of organic compounds having similar structures and similar chemical properties in which the successive members differ in their molecular formula by $-CH_2$ group".

The different members of the series are called **homologous.**

Characteristics of Homologous Series :

- All the member of a homologous series can be described by a common general formula.
  Example : All Alkane can be described by the general formula $\mathbf{C_nH_{2n+2}}$.
- Each member of a homologous series differ from its higher and lower neighboring members by a common difference of $-CH_2$ group.
- Molecular masses of the two adjacent homologues differ by 14 mass units, because molecular mass of $-CH_2$ group is 12 + 2 = 14.
- All the members of a homologous series show similar chemical properties.
- All the members of the series can be prepared by similar methods known as the general method of preparation.

Table : Some members of Alkane, Alkene and alkyne homologous series.

Alkane C_nH_{2n+2} Homologous series		**Alkene** C_nH_{2n} Homologous series		**Alkyne** C_nH_{2n+2} Homologous series	
Name	**Formula**	**Name**	**Formula**	**Name**	**Formula**
Methane	CH_4	-	-	-	-

Ethane	C_2H_6	Ethene	C_2H_4	Ethyne	C_2H_2
Propane	C_3H_8	Propene	C_3H_6	Propyne	C_3H_4
Butane	C_4H_{10}	Butene	C_4H_8	Butyne	C_4H_6
Pentane	C_5H_{12}	Pentene	C_5H_{10}	Pentyne	C_5H_8
Hexane	C_6H_{14}	Hexene	C_6H_{12}	Hexyne	C_6H_{10}

Activity : Calculate the difference in the formulae and molecular masses for (a) CH_3OH and C_2H_5OH (b) C_2H_5OH and C_3H_7OH and (c) C_3H_7OH and C_4H_9OH

Q. It there any similarity in these three ? **[NCERT]**

Q. Arrange these alcohols in the order of increasing carbon atoms to get a family. Can we call this family a homologous series ? **[NCERT]**

Q. What is homologous series ? Explain with an example. **[NCERT]**

Solution :

Formula	**Molecular Mass (Calculated)**	**Difference In**	
		Formula	**Molecular mass**
(a) CH_3OH	12 + 3 + 16 + 1 = 32	$-CH_2$	14
C_2H_5OH	24 + 5 + 16 + 1 = 46		
(b) C_2H_5OH	24 + 5 + 16 + 1 = 46	$-CH_2$	14
C_3H_7OH	36 + 7 + 16 + 1 = 60		
(c) C_3H_7OH	36 + 7 + 16 + 1 = 60	$-CH_2$	14
C_4H_9OH	49 + 9 + 16 + 1 = 74		

Conclusion :

(i) Yes, all these compounds are the members of a homologous series for alcohols.

(ii) CH_3OH, C_2H_5OH, C_3H_7OH and C_4H_9OH –increasing carbon atoms. These four compounds from a homologous series.

HOMOLOGOUS SERIES CONTAINING FUNCTIONAL GROUPS.

- **Aldehydes** :
  HCHO, CH_3CHO, CH_3CH_2CHO, $CH_3CH_2CH_2CHO$
- **Carboxylic acids :** HCOOH, CH_3COOH, CH_3CH_2COOH, $CH_3CH_2CH_2COOH$
- **Amines :** CH_3NH_2, $CH_3CH_2NH_2$,$CH_3CH_2CH_2NH_2$.
- **Ketones :** CH_3COCH_3,$CH_3COCH_2CH_3$,$CH_3COCH_2CH_2CH_3$
- **Holoalkanes :** CH_3X,CH_3CH_2X,$CH_3CH_2CH_2X$,$CH_3CH_2CH_2$-CH_2X

How do physical properties change in a homologous series of hydrocarbons.

The physical properties of the various members of a homologous series change regularly with an increases in the molecular mass.

(i) **Melting and boiling points :** Melting point and boiling of hydrocarbon in a homologous series increases with an increase in molecular mass.

(ii) **Physical State :**

- Hydrocarbons containing lesser number of carbon atoms are **gases.**
- Hydrocarbons containing large number of carbon are **solids.**
- Hydrocarbon containing intermediate number of carbon atoms are **liquid.**

Example : Hydrocarbon containing 1-4 carbon atoms are gases, these containing 5-13 carbon atoms are liquid and those containing more than 14 carbon atoms are solids,

Nomenclature of carbon compounds :

Carbon compounds can be called by their common names, but, then remembering millions of compounds by their individual names may be very difficult. Due to this reason, **the International Union of Pure and Applied chemistry (IUPAC)** has devised a very systematic method of naming these compounds.

Naming a carbon compound can be done by the following methods.

- The number of carbon atoms in the molecule of a hydrocarbon is indicated by the following stems.

No. of carbon atom :	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Stem	Meth	Eth	Prop	But	Pent	Hex	Hept	Oct	Non	Dec.

Example; Saturated hydrocarbon.

Alkane → Meth +ane = Methane

Unsaturated hydrocarbon

Alkene → Eth + ene = Ethene

Alkyne → Eth + yne = Ethyne

- In case of functional group is present, it is indicated in the name of compound with either a prefix or a suffix.
- Identify the longest continuous chain of carbon atoms. This gives the name of parent hydrocarbon.
- In the case of any substituent appropriate prefix is added before the name of parent hydrocarbon.
- In the case of a functional group. the ending 'e' in the name of the parent hydrocarbon is replaced by the appropriate suffix.

Functional Group :

"Functional group may be defined as an atom or a group of atoms which is responsible for most of the characteristic chemical properties of an organic compound".

The prefixes and suffixes of some substituent/functional group

Substituent/ Functional group	**Prefix**	**Suffix**	**Example**	
			Structure	**Name**

1. Halogen : Chlorine Bromine Iodine	Chloro Bromo Iodo	- - -	$CH_3CH_2-CH_2-Cl$ $CH_3-CH_2-CH_2-Br$ $CH_3-CH_2-CH_2-I$	Chloropropane Bromopropane Iodo propane
2. Alcohol	-	ol	$CH_3-CH_2-CH_2-OH$	propanol
3. Aldehydes	-	al	$\begin{array}{c}H\\ \vert\\ CH_3-CH_2-C=O\end{array}$	propanal
4. Ketone	-	one	$\begin{array}{c}H_3C-C-CH_3\\ \Vert\\ O\end{array}$	Propanone
5. Carboxylic acid	-	oic acid	$\begin{array}{c}O\\ \Vert\\ H_3C-CH_2-C-OH\end{array}$	Propanoic acid
6. Single bond (Alkane**)** **7.** Double bond (Alkene**)** **8.** Triple bond (Alkyne**)**	- - -	ane ene yne	$CH_3-CH_2-CH_3$ $CH_3-CH=CH_2$ $CH_3-CH\equiv CH$	Propane Propene Propyne

Q. How many structure isomers can you draw for pentane?

Q. What will be the formula and electron dot structure of cyclopentane?

Q. Draw the structure for the following compounds :

(i) Ethanoic acid (ii) Bromopentane (iii) Butanone (iv) Hexanal

Q. Draw the possible structural isomers for bromopentane.

Q. How would you name the following compounds ?

(i) CH_3-CH_2-Br (ii) $\begin{array}{c}H\\ \vert\\ H-C=O\end{array}$

(ii) $\begin{array}{ccccccccccccccc} & & H & & H & & H & & H & & & & & & \\ & & \vert & & \vert & & \vert & & \vert & & & & & & \\ H & - & C & - & C & - & C & - & C & - & C & \equiv & C & - & H \\ & & \vert & & \vert & & \vert & & \vert & & & & & & \\ & & H & & H & & H & & H & & & & & & \end{array}$

CHEMICAL PROPERTIES OF CARBON COMPOUND:

All carbon compounds show more common characteristic properties. As most of the fuels we use are either carbon or its compounds. Some such properties are described here :

COMBUSTION :

Combustion is a chemical process in which heat and light (in the form of flame) are given out
The process of combustion. is a rapid oxidation reaction of any substance in which heat and light are produced.

Combustion of some common substance :

- **Combustion of Carbon :** Carbon (or charcoal) burn in air or oxygen to give CO_2 productin heat and light.

$$\underset{\text{Carbon}}{C(s)} + \underset{\text{Oxygen}}{O_2(g)} \xrightarrow{Combustion} \underset{\text{Carbon dioxide}}{CO_2(g)} + Heat + light$$

Q. Why carbon and its compounds are used as fuels for most application ?

- **Combustion of Hydro Carbon :** Hydrocarbons burn to produce carbon dioxide (CO_2), water (H_2O) and heat and light.

$$\underset{\text{Methane}}{CH_4(g)} + O_2(g) \xrightarrow{Combustion} CO_2(g) + H_2O(g) + Heat + Light$$

Note: Natural gas and biogas contain methane. So, burning of natural gas and biogas are also combustion reactions.

Burning of LPG (Butane) produces CO2,H2O heat and light.

$$\underset{\text{Butane/LPG}}{C_4H_{10}(g)} + \frac{13}{2}O_2(g) \xrightarrow{Combustion} 4CO_2(g) + 5H_2O(g) + Heat + Light$$

- **COMBUSTION OF CELLULOSE:**

Combustion of cellulose (like wood, cotton, cloth and paper) gives CO_2, H_2O heat and light. Cellulose is a carbohydrate and can be described by the formula $(C_6H_{10}O_5)_n$.

$$\underset{\text{Cellulose}}{(C_6H_{10}O_5)_n(s)} + 6nO_2(g) \xrightarrow{burn} 6nCO_2(g) + 5nH_2O(g) + Heat + light$$

- Combustion of alcohol :

$$\underset{\text{Ethanol}}{C_2H_5OH(l)} + \underset{\text{oxygen (in air)}}{3O_2(g)} \xrightarrow{burn} 2CO_2(g) + 3H_2O(g) + Heat + light$$

Activity : To observe the combustion of given organic compounds.
Materials : Benzene, naphthalene, Camphor, alcohol (ethanol). Spirit, acetone.
Procedure:
1. Take each compound on iron spatula and burn them in Bunsen burner.
2. Record the type of flame produced.
3. Put a metal plate above the flame and observe whether or not there in black carbon deposition.

Observation :

Compound used	Flame Produced	Deposit
Benzene	Smoky flame	Carbon deposited
Naphthalene	Smoky flame	Carbon deposited
Camphor	Smoky flame	Carbon deposited
Alcohol	Non-Luminous flame	No Carbon deposited
Spirit	Non-Luminous flame	No Carbon deposited
Acetone	Non-Luminous flame	No Carbon deposited

Conclusion :

Benzene, naphthalene, camphor burn with smoky flame and carbon particles get deposited they undergo incomplete combustion due to excess of carbon content.

- Alcohol, spirit and acetone burn with non-Luminous flame and no carbon gets deposited. They under go complete combustion, therefore produce more heat.

Activity : To study the different types of flames/presence of smoke.

Material required : Bunsen burner.

Procedure:
1. Light the Bunsen burner.
2. Close the air hole and observe the colour of the flame.
3. Put a metal plate over it and observe the nature of deposit.
4. Open the air regulator to allow flow of air.
5. Observe the colour of flame.
6. Put a metal plate and observe the nature of deposit.

Observation:

Air Regulator	Colour of flame	Nature of deposit	Nature of flame	Temperature
Closed	Yellow sooty flame	Black carbon deposited	Reducing flame	low
Open	Bluish flame	No black carbon deposited	Oxidizing flame	High

Conclusion : Keep the air regulator open to get oxidizing, non-sooty flame which has high temperature and does not lead to black deposits.

COMBUSTION AND THE NATURE FO FLAME :

(i) Saturated hydrocarbon such as, methane, ethane, propane, butane and natural gas and LPG burn with a blue flame in the presence of sufficient/excess of air/oxygen.

(ii) In the presence of limited amount/of air/oxygen, saturated hydrocarbon, such as, methane, butane, etc give smoky flame.

(iii) Unsaturated hydrocarbon such as ethane, ethyne etc. burn with a luminous/yellow smoky flame.

(iv) The gas/kerosene stove used at home has inlets for air so that a sufficiently oxygen rich mixture is burnt to give a clean blue flame. If you carefully observe the bottoms of vessels getting blackened, it is clear indication that the air holes are blocked and the fuel is getting wasted.

(v) Fuels, such as coal and petroleum, have some amount of nitrogen and sulphur in them. Combustion of coal and petroleum results in formation of oxides of sulphur and nitrogen (such as sulphur dioxide, nitric oxide. Nitrogen peroxide) which are major pollutants in the environment.

FORMATION OF COAL AND PETROLEUM :

Coal and petroleum have been formed from biomass which has been subjected to various biological can geological processes.

Coal is a naturally occurring black mineral and is a mixture of free carbon and compounds of carbon containing hydrogen, oxygen, nitrogen and sulphur. It is not only a good fuel but is also a source of many organic compounds.

It is found in coal mines deep under the surface of earth.

Coal is believed to be formed from fossils which got buried inside the earth during earthquakes and volcanoes which occurred about 300 million years ago. Due to huge pressure and temperature inside the earth and in the absence fo air the fossils fuels (vegetable matter or wood, etc.) were converted into coal. The slow chemical processes of the conversion of wood into coal is called **carbonization.** Since coal is formed by slow carbonization. of plants and fossils, it produces many important carbonization products like peat, lignite, bituminous and anthracite etc. and is itself known as **fossil fuel.** Coal is also a **non-renewable source** of energy.

Petroleum is complex mixture containing various hydrocarbons (compounds of carbon and hydrogen) in addition to small amounts of other organic compounds containing oxygen, nitrogen, and sulphur. It is a dark colored. viscous and foul smelling crude oil. The name petroleum is derived from latin words: **“petra”** meaning rock and **“Oleum”** meaning oil. Since petroleum is found trapped between various rocks, it is also known as **rock oil.**

OXYDATION:

Carbon and its compounds can be easily oxidized on combustion (or burning). During combustion/burning, the compounds gets oxidized completely to different products, depending upon the nature of the oxidizing agents.

- Carbon gives carbon monoxide or carbon dioxide depending upon the oxygen available.

$$2C(s) \ + \ O_2(g) \ \rightarrow \ 2CO(g)$$

Carbon Oxygen(limited) Carbon monoxide

- $C(s) \ + \ O_2(g) \ \rightarrow \ CO_2(g)$

(excess) Carbon dioxide

- Hydrocarbon when oxidized give different product as follows :

$$CH_4(g) \ + \ 2O_2(g) \xrightarrow{\text{Complete oxidation}} CO_2(g) \ + \ 2H_2O(g)$$

Methane Oxygen(excess)

- $2CH_4(g) \ + \ 3O_2(g) \xrightarrow{\text{Incomplete oxidation}} 2CO\ (g) \ + \ 4H_2O(g)$

Methane Oxygen (Limited)

- Alcohols also give different products on oxidation depending upon the reaction conditions.

Example:

Alcohols on oxidation with certain oxidizing agents such as chromic anhydride in acetic acid, yield corresponding aldehydes, where as on oxidation with alkaline potassium permanganate (or acidified potassium dichromate) corresponding carboxylic acid is formed, as given below:

$$CH_3CH_2OH(l) \ + [O] \xrightarrow[CH_3COOH]{CrO_3 in} CH_3CHO \ + \ H_2O$$

Ethanol Nascent oxygen Ethanal (an aldehyde)

$$CH_3CH_2OH(l) \ + \ 2[O] \xrightarrow[KMnO_4, Heat]{Alkaline} CH_3COOH + \ H_2O$$

Ethanoic acid

Activity: To study the reaction of ethanol with alkaline potassium permanganate:

Material required : Ethanol, alkaline $KMnO_4$, test tube.

Procedure:

- Take about 3 ml of ethanol in a test tube.
- Add 5% solution of alkaline $KMnO_4$ drop by drop into this solution.
- Observe the colour of alkaline $KMnO_4$ after adding initially as well as finally.

Observation : The colour of $KMnO_4$ gets discharged in the beginning. When excess of $KMnO_4$ is added, the colour of $KMnO_4$ does not disappear because whole of ethanol gets oxidized to Ethanoic acid.

$$CH_3CH_2OH \xrightarrow[\text{or } K_2Cr_2O_7/H_2SO_4,\text{Heat})]{\text{Alkaline},KMnO_4,\text{Heat}} CH_3COOH + H_2O$$

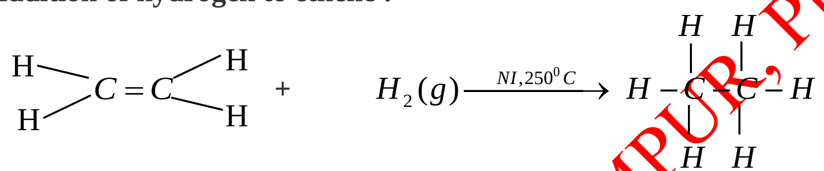
ADDITION REACTION :

All unsaturated hydrocarbons (unsaturated carbon compounds) react with a molecule like H2. X2. H2O etc. to form another saturated compounds are called **addition reactions.**

Unsaturated hydrocarbons add hydrogen, in the presence of catalysts, such as nickel or palladium to give saturated hydrocarbons.

Note: Catalysts are substance that cause a reaction to occur or proceed at a different rate without the reaction it say being affected.

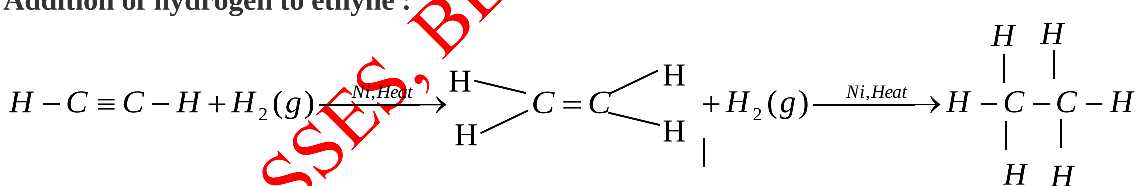
- **Addition of hydrogen to ethene :**



Ethene (Double bond containing unsaturated carbon compound) — Ethane (Saturated hydrocarbon)

Q. Which of the following hydrocarbons undergo addition reactions : C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4. **[NCERT]**

- **Addition of hydrogen to ethyne :**



Ethyne (acetylene) — Ethene (ethylene) — Ethane

- Addition of hydrogen to a unsaturated carbon compound is called **hydrogenation reaction.**
Certain vegetable oils such as ground nut oil, cotton seed oil and mustard oil, contain double bonds (C = C) are liquids at room temperature. Because of the unsaturation, the vegetable oils undergo hydrogenation. like alkenes, to from saturated products called vanaspati ghee. Which is semi-solid at room temperature.
Vegetable oils (Unsaturated oil)+Hydrogen $\xrightarrow{Ni,Heat}$ Vanaspati Ghee (Saturated ghee)

Q. What is hydrogenation? What is its industrial application? **[NCERT]**

Q. If a molecule Y contain two –C = C- double bonds, then how many moles of H_2 are required for completed hydrogenation of one mole of Y? **[NCERT]**

Q. Write the industrial application of hydrogenation. **[NCERT]**

SUBTITUTION REACTION:

The reactions in which one or more hydrogen atoms of a hydrocarbon are replaced by some other atoms or groups are called **substitution reaction.**

Example :
Methane reacts with chlorine (or bromine) in the presence of sunlight and undergo substitution reaction. It is called **photochemical reaction** because it takes place in presence of sunlight.

$$CH_4(g) + Cl_2(g) \xrightarrow{Sunlight} CH_3Cl(g) + HCl(g)$$
Chloromethane

$$CH_3Cl(g) + Cl_2(g) \xrightarrow{Sunlight} CH_2Cl_2(g) + HCl(g)$$
Dichloromethane

$$CH_2Cl_2(g) + Cl_2(g) \xrightarrow{Sunlight} CHCl_3(g) + HCl(g)$$
Trichloromethane(chloroform)

$$CHCl_3(g) + Cl_2(g) \xrightarrow{Sunlight} CCl_4(l) + HCl(g)$$
Tetra chloromethane
(carbon tetra chloride)

Q. Why is the conversion of ethanol to Ethanoic acid an oxidation reaction? **[NCERT]**
Q. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used ? **[NCERT]**

SOME IMPORTANT CARBON COMPOUNDS :

ETHANOL (ETHYL ALCOHOL. C_2H_5OH) :
Ethanol is the second member of the homologous series of alcohols.

Preparation : By the fermentation of carbohydrates (sugar or starch).

Ethanol is prepared on commercial scale by fermentation of sugar Fermentation is allowed to take place at 298-303 K in the absence of air. This is ethanol (ethyl alcohol) gets oxidized to ethanoic acid (acetic acid) in the presence of air.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{Invertase} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose Glucose Fructose

$$C_6H_{12}O_6 \xrightarrow{Zymase} 2C_2H_5OH + 2CO_2(g)$$

Glucose/Fructose Ethanol (ethyl alcohol) Carbon dioxide

PHYSICAL PROPERTIES :
- Physical state /colour and odour : Pure ethanol is a colorless liquid having a pleasant smell and a burning taste.
- **Boiling and Freezing points :** It is a volatile liquid with a boiling point of 78.1^{0}C, and freezing point is -118^{0}C.
- **Density :** Ethanol is lighter than water as its density is 0.79 g ml^{-1} at 293 K.
- **Solubility :** Ethanol is miscible with water in all proportion, due to the formation of hydrogen bonds with water molecules.
- **Conductivity :**Ethanol is a covalent compound and does not ionize easily in water. Hence it is a neutral compound.
- **Action on Litmus :** Ethanol is a neutral compound So, it has no effect on the colour of litmus.

CHEMICAL PROPERTIES OF ETHANOL :

- **Combustion (or burning) :** Ethanol is highly inflammable liquid and readily burn in air with blue flame to form water vapor, carbon dioxide and evolving heat. Thus, combustion of ethanol is an exothermic reaction.

$$C_6H_5OH(l) + 3O_2(g) \xrightarrow{Combustion} 2CO_2(g) + 3H_2O(g) + Heat$$

Q.	Carbon and its compounds are used as fuels. Give its main reason.	**[NCERT]**

- **Reaction with sodium metal :** Ethanol reacts with sodium metal to produce sodium ethoxide and hydrogen gas is evolved.

$$2C_2H_5OH(l) + 2Na(s) \rightarrow 2C_2H_5ONa + H_2(g)$$

Ethanol Sodium metal Sodium ethoxide Hydrogen

Activity : To study the reaction of ethanol with sodium metal.
Materials : Ethanol, dry piece of sodium metal test tube.

Procedure :

- Take ethanol in a test tube.
- Add a dry piece of sodium metal.
- Bring a burning matchstick near the gas evolved to test it and record observation.

Observation : The gas burns in air with a pop sound which is the characteristics of hydrogen gas.
Conclusion : Alcohol react with sodium metal to liberate hydrogen gas.

- **Reaction with Ethanoic acid (Etherification reaction) :**
  The reaction in which an alcohol reacts with acetic acid in the presence of conc. H2SO4 to form an ester is called
etherification.

$$CH_3COOH(l) + C_2H_5OH(l) \xrightleftharpoons{\text{Conc. } H_2SO_4\text{, Heat}} CH_3COOC_2H_5(l) + H_2O(l)$$

ethanoic acid (acetic acid) — ethanol — ethyl ethanoate (ethyl acetate) Sweet smelling compound

Note : Ester are sweet-smelling compounds and are used for making perfumes.

- **Reaction with conc. sulphuric acid (Dehydration) :**
  Ethanol when heated with excess of concentrated sulphuric acid at 443 K, gets dehydrated to give ethene.

$$C_2H_5OH(l) + H_2SO_4(Conc.) \xrightarrow{443K} H_2C=CH_2(g) + H_2O(l)$$

ethanol — excess — ethene

Note : The concentrated sulphuric acid can be regarded as a dehydrating agent which remove water from ethanol.

Use of ethanol :

- Ethanol is present in alcoholic beverages such as beer, wine, whisky.
- As a solvent for paints, varnishes-dyes, cosmetics, perfumes, soaps and synthetic rubber etc.
- Ethanol is used in cough syrups, digestive syrups and tonics.
- A mixture of 80% rectified spirit and 20% petrol is called **power alcohol.** It is used as fuel in cars and airplanes.
- A mixture of ethanol and water has lower freezing point than water this mixture is known as **antifreezing** and is used in radiators of vehicles in cold countries and at hill stations.
- As an antiseptic to sterilize wounds and syringes in hospitals.
- For the manufacture of terylene and polythene.
- As a preservative for biological specimens.
- Ethyl alcohol is used as hypnotic (induces-sleep).

Harmful effects of Alcohols:

- Consumption of small quantities of dilute ethanol causes drunkenness. Even though this practice is condemned, it is a socially widespread practice. However, intake of even a small quantity of pure ethanol (called **absolute alcohol**) can be lethal. Also long-term consumption of alcohol leads to many health problems.
- When large quantities of ethanol are consumed, it tends to slow metabolic processes and to depress the central nervous system. This results in lack of coordination, mental confusion, drowsiness, lowering of normal inhibitions and finally stupor(unconscious state of wild)
- Drinking of alcohol over a long period of time damages liver.

Denatured Alcohol :

Ethanol to which certain poisonous and nauseating substances like methyl alcohol, pyridine etc. have been added is termed **denatured alcohol.**

Note: To prevent the misuse of ethanol (Alcohol), industrial alcohol is colored blue to that it can be recognized easily.

Harmful effects of denatured alcohol:

- Methanol is highly poisonous compounds for human beings. Methanol when taken, even in small amount, can cause death.
- Methanol gets oxidized to methanol in the liver, which causes coagulation of protoplasm.
- Methanol also effects the optic nerve and cause blindness.

ETHANOIC ACID (ACETIC ACID) CH_3COOH:

- Ethanoic acid is commonly called acetic acid and belongs to the homologous series of carboxylic acid and is represented as CH_3COOH.
- 5-8% solution of acetic acid in water is called **vinegar** and is used for preservation foods like sausage, pickles. **Physical properties :**
- At ordinary temperature, Ethanoic acid is a colorless liquid with a strong pungent smell and sour taste.
- Its boiling point is 391 K and its density at 273 K is 1.08 (heavier than water).
- It is miscible with water due to the formation of hydrogen bonds with water molecules.
- On cooling at 289.6K, it turns in ice-like crystals, hence named as glacial acetic acid.
- It dissolves sulphur, iodine and many other organic compounds.
- It immerse when dissolved in benzene.
- $2CH_3COOH \rightleftharpoons (CH_3COOH)_2$

Ethanoic acid Dimer

Activity : To determine pH of acetic acid and hydrochloric acid.
Material : Acetic acid (1M).HCl (1M), blue litmus paper, universal indicator.
Procedure : Take two strips of blue litmus paper.

- Put a few drops of HCl on one of them and few drops of acetic acid on the other.
- Observe the change in colour.
- Take 1 ml of acetic acid in a test tube and add a few drops of universal indicator.
- Take 1ml of HCl in a test tube and add few drops of universal indicator.

Observation : Both acetic acid and HCl turn blue litmus red showing that they are acidic in nature. pH of acetic acid and HCl are not equal.

Conclusion : HCl is strong acid than CH_3COOH, therefore, pH of HCl will be lower than that of acetic acid.

CHEMICAL PROPERTIES :

- **Reaction with alcohols (Etherification reaction):**

Ethanoic acid reacts with ethanol in the presence of cons. H_2SO_4 to form ethyl ethanoate which is an ester.

$$CH_3COOH(l) \quad + \quad C_2H_5OH(l) \xrightarrow{Conc, H_2SO_4, heat} CH_3COOC_2H_5 \quad + \quad H_2O$$

Ethanoic acid Ethanol Ethyl ethanoate (ester)

The reaction of carboxylic acid with an alcohol to form an ester is called **"estrification".**

Note : Ester can be hydrolyzed in the presence of an acid or a base to give back the parent carboxylic acid and the alcohol.

Example :

(i) Ethyl ethanoate on acid hydrolysis gives Ethanoic acid and ethanol.

$$CH_3COOC_2H_5(l) \quad + \quad H_2O(l) \quad \rightarrow \quad CH_3COOH(aq.) \ + \ C_2H_5OH$$

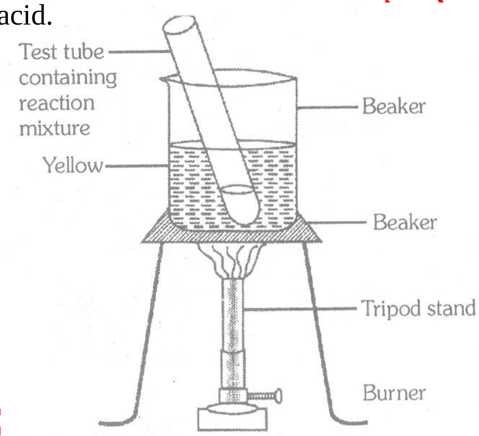
(ii) Hydrolysis of ester in the presence of base (alkali) is called **"Saponification reactions".**

$$CH_3COOC_2H_5(l) \quad + \quad NaOH(aq) \rightarrow CH_3COONa \quad + \ C_2H_5OH$$

Ethyl ethanoate — Sodium Hydroxide — Sodium ethanoate — Ethanol

Note: Alkaline hydrolysis of higher esters is used in the manufacture of soaps.

Activity : To study the etherification process using ethanol and acetic acid.



Materials : Beaker, water, test tube, ethanol, acetic acid.
Conc. H_2SO_4 etc.

Procedure : Take 2ml of ethanol in a test tube.

- Add 2ml of Ethanoic acid (acetic acid) in to it.
- Add few drops of conc. H_2SO_4.
- Warm it in a beaker containing water.

Observation : Pleasant fruity smelling compound (called ester) is formed.
Conclusion : Acetic acid reacts with alcohol in presence of conc. H2SO4 which act as a dehydrating agent to form ester.

Reaction with sodium carbonate and sodium hydrogen carbonate :

Ethanoic acid decomposes sodium hydrogen carbonate and sodium carbonate with a rapid evolution of carbon dioxide gas.

$$NaHCO_3(aq) + CH_3COOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l) + CO_2(g)$$

Sodium Hydrogen carbonate — Ethanoic acid — Sodium ethanoate

$$Na_2CO_3(aq) + \ 2CH_3COOH(aq) \rightarrow 2CH_3COONa(aq) + H_2O + CO_2(g)$$

Sodium carbonate — Ethanoic acid — Sodium ethanoate

Note : Reactions of Ethanoic acid with NaOH, NaHCO3, Na2CO3 and active metals show that the hydrogen present in the carboxy(-COOH) group is acidic in nature.
Activity : To study the reaction of carboxylic acid with sodium carbonate and sodium hydrogen carbonate.
Material : Ethanoic acid, Sodium carbonate, Sodium hydrogen carbonate.

Procedure :
- Take 1g of Na2CO3 and 2ml of Ethanoic acid into it.
- Pass the gas formed through lime water and note down the observation.
- Repeat the same procedure with sodium hydrogen carbonate and record observation.

Observation: Brisk effervescence due to carbon dioxide formed which turns lime water milky.
Conclusion: Acetic acid react with Na_2CO_3 and $NaHCO_3$ to liberate CO_2 gas.

USES OF ETHANOIC ACID :
- Ethanoic acid is used in the manufacture of various dyes, perfumes and rayon.
- It is used for making vinegar.
- It is used for making white lead [$2PbCO_3$. $Pb(OH)_2$]which is used in white paints.
- Its 5% solution is bactericidal (destroys bacteria).
- It is used in preparation of cellulose acetate which is used for making photographic film.

- It is used for coagulation of the latex.
- It is used for preparation of 2,4-dichloro phenoxy Ethanoic acid which is used as **herbicide.**
- Aluminium acetate and chromium acetate are used as mordents in dyeing and water proofing of fabrics.

Q. How would you distinguish experimentally between an alcohol and a carboxylic acid? **[NCERT]**

Q. What are oxidizing agents? **[NCERT]**

Q. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties? **[NCERT]**

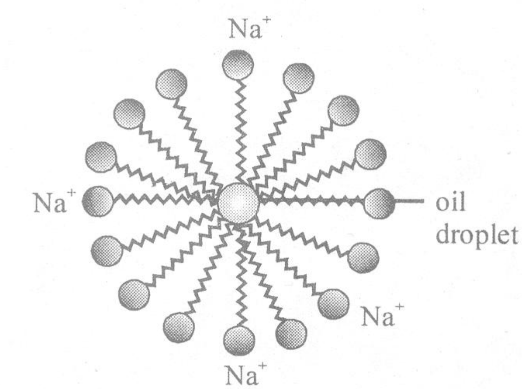
SOAP AND DETERGENTS :

Soap and detergents are substances which are used for cleaning. There are two types of detergents:

1. Soap 2. Synthetic detergents

Soap : A soap is the sodium or potassium salt of a long-chain fatty acids (carboxylic acid or glycerol).

Activity :



Formation of micelles

Take about 10mL of water each in two test fubes.

Add a drop of oil (cooking oil) to both the test tubes and label them as A and B.

To test tube B, add a few drops of soap solution. Now shake both the test tubes vigorously for the same period of time.

Can you see the oil and water layers separately in both the test tubes immediately after you stop shaking them.

Leave the test tubes undisturbed for some time add observe. Does the oil layer separate out ? In which test tube does this happen first ?

This activity demonstrate effect of soap in cleansing as we know that most of the dirt is oily in nature and oil does it dissolve in water.

But know the question arise what are soap? What is the detergent which one is more effect. How the work.

Soap is sodium or potassium salt a long change fatty acid (Carboxylic acid or Glycerol)

A soap has large non ionic hydrocarbon group and an ionic group. COONa.

Ex. of soap are :

(1) Sodium stearate ($C_{17}H_{35}COONa$)

(2) Sodium plamitate($C_{15}H_{31}COONa$)

Soap are basic in nature so soap solution turn red litmus to blue.

Preparation of Soap :

The soap is prepared by heating animal fats or vegetable oils (olive oils, castor oil or palm oil) with sodium hydroxide or potassium hydroxide.
The process of formation of soap by the hydrolysis of fat or oil with alkali is called saponification.
Oil or Fat + Sodium hydroxide → Soap + glycerol

Structure :

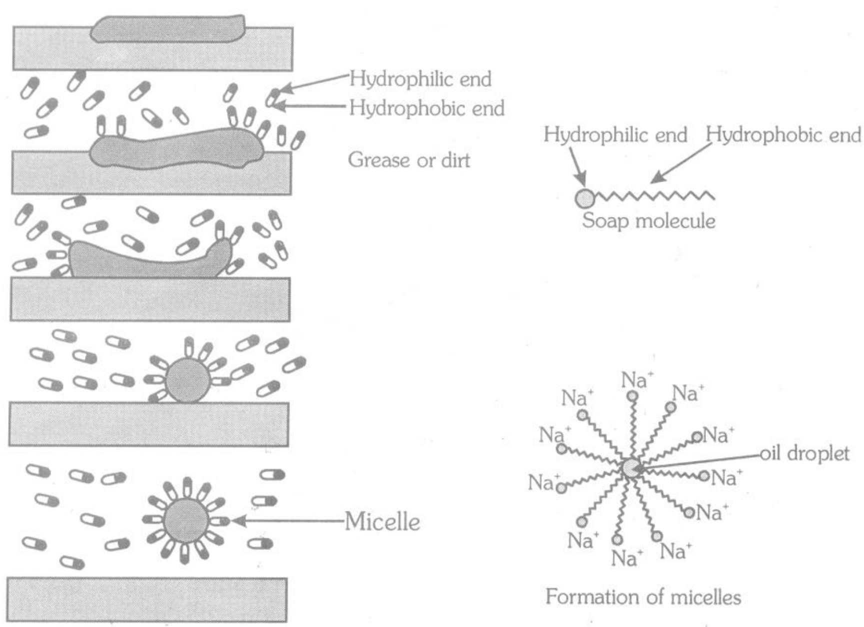
- A soap molecule contains two parts that interact differently with water. One part is a long hydrocarbon (non-polar) chain, and other belongs to the-COONa group (Hydrophilic).

A soap molecule may be represented as :

$$R-\underset{\displaystyle \overset{\|}{O}}{C}-O^{-}\ Na^{+}$$

Cleansing action of soap :

The molecules of soap are sodium or potassium salts of long chain carboxylic acids. The ionic end of soap dissolves in water while the carbon chain dissolves in oil. The soap molecules. thus form structures called micelles where one end of the molecules is towards the oil droplet while the ionic end faces outside. This form and emulsion in water. The soap micelle thus helps in dissolving the dirt in water and we can wash out clothes clean.



Effect of soap in cleaning

Q.	Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?	**[NCERT]**
Q.	Explain the mechanism of the cleaning action of soaps.	**[NCERT]**

Activity : Take two clean test tubes and label them as ‘A’ and ‘B’. Now put 10ml hard water in each of the two test tubes. Add five drops of soap solution in test tube ‘A’ and five drops of detergent solution in test tube ‘B’ Shake the two test tubes for the same period and observe if both observe if both the test tubes have the same amount of foam. Find out in which of the two test tubes a curdy white mass is formed.

In which test due do you get more form ?

We get more foams in test tube……………. .

A white curdy precipitate is formed in test tube……………….

Result (Conclusion): Soaps are not effective in acidic medium.

When soaps is used for washing clothes with hard water, a large amount of soap is wasted in reacting with the calcium and magnesium ions of hard water to form an insoluble precipitate called scum, before it can be used for the real purpose of washing soap. A large amount of soap is needed for washing clothes. When the water is hard.

Activity :

Take two test tubes with a about 10 mL of hard water in each.

Add five drops of soap solution to one and five drops of detergent solution to the other.

Shake both test tubes for the same period

Do both test tubes have the same amount of foam?

In which test tube is a curdy solid formed?

Observation :

Test tube in which …………………………..is present contain more amount of foam.

Curdy solids is form in the test tube containing……………

Conclusion : Detergents have better cleansing action than soap. Detergents are generally ammonium or sulphonate salts of long chain carboxylic acids. The charged ends of these compounds do not form insoluble precipitates with the calcium and magnesium ions in hard water. Thus, they remain effective in hard water. Detergents are usually used to make shampoos and products for cleaning clothes.

Q. What change will you observe if you test soap with litmus paper (red and blue)? **[NCERT]**

Q. Would you be able to check if water is hard by using a detergents?

Q. People use a variety to methods to wash clothes. Usually after adding the soap, they 'beat 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes ?

DIFFERENCES BETWEEN SOAPS AND SYNTHETIC DETERGENTS:

Soaps	Synthetic detergents
1. Soaps are sodium salts of long chain fatty acid (carboxylic acids)	**1.** Synthetic detergents are the sodium salts or long-chain benzene sulphonic acids or the sodium salt of a long. chain alkyl hydrogen sulphate
2. The ionic part of soap is $-COO^{-}Na^{+}$	**2.** The ionic part in a synthetic detergents is $-SO_3H-Na^{+}$
3. They are prepared from animal fats or plant based oils.	**3.** The are prepared from hydrocarbons extracted from coal or petroleum.
4. Their efficiency decreases in hard water	**4.** Their efficiency is unaffected in hard water.
5. Soaps take more time to dissolve in water.	**5.** Synthetic detergents dissolve faster than soaps in water
6. They are biodegradable	**6.** Some synthetic detergents are not biodegradable.
7. Examples : Sodium state, sodium palmitate	**7. Example :** Sodium lauryl sulphate, sodium dodecyl benzene sulphonate.

SOAP :

$$\begin{array}{l} C_{17}H_{35}COO-CH_2 \\ \qquad\qquad\quad | \\ C_{17}H_{35}COO-CH \quad + \quad 3NaOH \quad \rightarrow \quad 3C_{17}H_{35}COONa \\ \qquad\qquad\quad | \qquad\quad \text{Sodium hydroxide} \qquad \text{Sodium stearate(soap)} \\ C_{17}H_{35}COO-CH_2 \end{array}$$

Glycerol stearate
(fatty acid)

Structure:

- The hydrocarbon chain is non-polar and water-hating (hydrophobic), while the other part is polar or water loving (hydrophilic).

- Hydrophilic part makes the soap soluble in water and hydrophobic part makes the soap insoluble.

$$\underbrace{CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2}_{\text{Hydrophobic "Tail" (Non-polar part)}}\underbrace{-\overset{\overset{\displaystyle O}{\|}}{C}-O-Na^{+}}_{\text{Hydrophilic "head" (Polar part)}}$$

- When soap is added to water, the soap molecules assume a configuration which increases the interaction of the water loving heads with the water molecules, and decreases the interaction between the water hating tails with the water molecules.

- The hydrophobic part of the soap molecules traps the dirt and the hydrophilic part makes the entire molecules soluble in water. Thus, the dirt gets washed away with the soap.
- The water-hating, non polar tails clump together in a radial fashion with the water-loving. polar heads remaining at the periphery of the clump, these clumps or droplets of soap molecules are called micelles.

Disadvantage of soap :

- **Soaps are not effective in hard water :** Hard water contains calcium ions (Ca^{2+}) and magnesium ions (Mg^{2+}) These ions react with the carboxylate ions (RCCO-) of the soap forming an insoluble precipitate called scum, For example, soap like sodium stearate (C17H35COONa) reacts with calcium and magnesium ions as per the following chemical equation.

`

$$2C_{17}H_{35}COONa + Ca^{2+}(aq) \rightarrow (C_{17}H_{35}COO)_2Ca \downarrow + 2Na^{+}(aq)$$

Sodium stearate (In hard water) Calcium stearate Sodium ion

$$2C_{17}H_{35}COONa + Mg^{2+}(aq) \rightarrow (C_{17}H_{35}COO)_2Mg \downarrow + 2Na^{+}(aq)$$

Sodium stearate (In hard water) Magnesium stearate(scum) Sodium ion

The scum gets attached to the clothes, utensils and even skin and thus, interferes with the cleansing ability of the additional soap and makes the cleansing of clothes difficult. Moreover, large amount of soap is wasted in reacting with calcium and magnesium ions present in hard water.

Q.	Explain the formation of scum when hard water is treated with soap.	**[NCERT]**

- **Soaps are not effective in acidic medium :** In presence of hydrogen ions (H ions), i.e. in acidic medium, the carboxylate ions of soap ($RCOO^-$ion)interact with hydrogen ions (H^+) to form dissociated (free) fatty acid as represented below:

$$C_{17}H_{35}COO^-(aq) + H^+ \rightleftharpoons C_{17}H_{35}COOH$$

carboxylate ion Carboxylic acid (Unionized)

As the fatty are weak acids, so they do not get ionized and hence, micelle formation is hindered, thus, adversely affecting the cleansing property of soaps.

You will observe that the amount of foam in the two test tubes in different. The foam is formed to a greater extent in test tube 'B' (containing detergent solution), while formation of a curdy white mass will be observed in test tube 'A'. This activity clearly indicates that detergents can be used for cleansing purpose, even with hard water.

SYNTHETIC DETERGENTS :

- Synthetic detergents are called soap less soap because they are not prepared from **fatty acid** and **alkali.**

- Synthetic detergents are sodium salts of sulphonic acids, i.e. detergents contain a sulphonic acid group (-SO_3H). instead of a carboxylic acid group (-COOH), on one end of the hydrocarbon chain.

$$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2C_6H_4 \quad -\overset{\overset{\displaystyle O}{|}}{\underset{\underset{\displaystyle O}{|}}{S}}-O^- - Na^+$$

Hydrophobic "Tail"
(Non-polar part)

Hydrophilic "head"
(Polar part)

Properties of synthetic detergents :

- Synthetic detergents do not react with the ions present in hard water. Hence synthetic detergents have no problem in forming lather with hard water, i.e. their efficiency is not affected by hard water.

- Synthetic detergents can be used even in acidic solution and sea water, whereas soap cannot be used in the acidic solution (due to precipitation of free acids)

- Synthetic detergents do not form insoluble salts of calcium or magnesium with hard water. Hence, lesser amounts of synthetic detergents are required for washing.

Washing powder :

- Washing powders used for washing clothes contain only about 15 to 30 percent detergents by mass. The remaining part is made of the following.

(1) Sodium sulphate and sodium silicate which keep the power dry,

(ii) Sodium tripolyphosphate or sodium carbonate which maintains alkalinity for removing dirt.

(iii) Carboxymethylcelulose (CM-Cellulose) which keep the dirt particle suspended in water.

(iv) Sodium perborate (a mild bleaching agent) which impart whiteness to the materials (clothes, etc.) being washed.

PREVIOUS YEARS' BOARD QUESTIONS :

1. An organic compound 'A' has molecular formula $C_2H_4O_2$ and is acidic in nature. On heating with alcohol and conc. sulphuric acid, vapours with pleasant or fruity smell are given out, What is this chemical compound 'A' and what is the chemical equation involved in the reaction ? **(CBSE ALL India 1999)**

Ans. The compound 'A' with molecular formula $C_2H_4O_2$ is Ethanoic acid (acetic acid). Upon heating with ethanol (ethyl alcohol) and concentrated sulphuric acid, ethyl ethanoate (ethyl acetate) is formed as the product. It is an ester with pleasant or fruity smell. The reaction is known as etherification reaction.

$$CH_3COOH \quad + \quad C_2H_5OH \xrightarrow{H_2SO_4(conc.)} CH_3COOC_2H_5 + H_2O$$

Ethanoic acid (A)   Ethanol   Ethyl ethanoate (Ester)

2. An organic compound 'A' is a constituent of antifreeze and has the molecular formula C_2H_5O. Upon reaction with alkaline $KMnO_4$, the compound 'A' is oxidized to another compound 'B' with formula C_2H_6O, Identify the compounds 'A' and 'B'. Write the chemical equation for the reaction which leads to the formation of 'B'.
(CBSE ALL India 2000 Comptt.)

Ans. The compound 'A' is ethanol and with alkaline KMnO4, it is oxidized to ethanoic acid 'B'. The chemical equation for the reaction is :

$$C_2H_5OH \xrightarrow[KMnO_4]{Alkaline} CH_3COOH$$

Ethanol (A)   Ethanoic acid (B)

3. Name the functional groups present in the following compounds :

(i) $CH_3-CH_2-CH_2-OH$ (ii) $CH_2-CH_2-CH_2-COOH$

(iii) CH_3-CH_2-CHO (iv) $CH_3-CO-CH_2-CH_3$

Ans. (i) $-OH\,(ol)$ (ii) $-COON\,(oic\,acid)$ (iii) $-CHO\,(al)$ (iv) $-CO-(one)$

4. Write the formulae of the compounds and name the functional groups present in each of them

(i) Ethanoic acid   (ii) Propanone   (iii) Nitro methane   **(C.B.S.E. Delhi 2005)**

Ans. (i) Ethanoic acid : CH_3COOH (oic acid)

(ii) Propanone : CH_3COCH_3 (one)

(iii) Nitro methane : CH_3NO_2 (nitro)

5. Name the enzyme which converts :

(i) milk into curd (yogurt)

(ii) cane sugar into glucose and fructose

(iii) glucose into ethanol.

Ans. (i) Lactase converts milk into curd

(ii) Invertase converts cane sugar (sucrose) into glucose and fructose

(iii) Zymase converts glucose into ethanol. **(C.B.S.E. Foreign 2005)**

6. (i) Name the gas evolved during fermentation process. **(C.B.S.E. Delhi 2006)**

(ii) List the two products formed when enzyme invertase acts on sugar present in molasses.

Ans. (i) CO_2 gas is evolved accompanied by brisk effervescence.

(ii) Glucose and fructose are the products when enzyme invertase acts on sucrose ($C_{12}H_{22}O_{11}$) present in molasses.

7. Complete the following equations and write the names of the products formed. **(C.B.S.E. Delhi 2007)**

(i) $CH_3COOH + NaOH \xrightarrow{Heat}$ (ii) $C_2H_5OH + O_2 \xrightarrow[KMnO_4]{Alkaline}$

(iii) $CH_3COOH + C_2H_5OH \xrightarrow{conc.H_2SO_4}$

Ans. (i) $CH_3COOH + NaOH \xrightarrow{Heat} CH_3COOH + H_2O$

Ethanoic acid Sod. ethanoate

(ii) $C_2H_5OH + O_2 \xrightarrow[KMnO_4]{Alkaline} CH_3COOH + H_2O$

Ethanol Ethanoic acid

(iii) $CH_3COOH + C_2H_5OH \xrightarrow{conc.H_2SO_4} CH_3COOC_2H_5 + H_2O$

Ethanoic acid Ethanol Ethyl ethanoate

8. Name the organic compound present in vinegar. Write a chemical equation which represents the commercial method for the preparation of this compound from methanol. **(C.B.S.E. All India 2007)**

Ans. The organic compound present in vinegar is Ethanoic acid also called acetic acid. For its commercial preparation .

9. (a) Why does carbon form compounds by covalent bonding?

(b) An organic acid 'X' is a liquid which often freezes during winter time in cold countries. It has the molecular formula $C_2H_4O_2$. On warming with ethanol in the presence of a few drops of sulphuric acid, a compound 'Y' with sweet smell is formed.

(i) Identify X and 'Y'. (ii) Write chemical equation for the reaction involved. **(C.B.S.E. Delhi 2008)**

Ans. (a) Carbon forms a large number of organic compounds due to the self linking property known as catenation.

(b) The available information suggests that the organic acid X with molecular formula C2H4O2 is Ethanoic acid (CH_3COOH) . It reacts with ethanol in the presence of a few drops of sulphuric acid on warming to give ethyl ethanoate ester with a plesant smell.

$$CH_3COOH + C_2H_5OH \xrightarrow[Warm]{H_2SO_4(Conc)} CH_3COOC_2H_5 + H_2O$$

($C_2H_4O_2$) Warm Ethyl ethanoate (Y)

Ethanoic acid (X)

10. Why do covalent compounds have low melting and boiling points ? **(C.B.S.E. All India 2008)**

Ans. In covalent compounds, the atoms are linked by covalent bonds formed by electron sharing. Since no ions are present in these, the attractive forces are quite weak. As a result, the covalent compounds have low melting and boiling points.

11. (i) How ae carboxylic acids different from mineral acids from ionization point of view ?

(ii) Describe an activity to find how Ethanoic acid reacts with sodium carbonate. Name the gas evolved. How can it be tested ? **(C.B.S.E All India 2008)**

Ans. (i) Carboxylic acids (organic acids) are less ionized in solution as compared to mineral acids (HCl,HNO3,H2SO4 etc.) Due to this reason, these are weaker acids than the mineral acids.

(ii) Take a small volume of Ethanoic acid in a tube. Add a few drops of sodium carbonate (Na2CO3) solution prepared in water to the tube. A colorless gas with brisk effervescence will evolve. When the gas is passed through lime water, it will become milky.

$$Na_2CO_3(aq) + CH_3COOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l) + CO_2(g)$$

$$Ca(OH)_2(aq) + CO_2(g)) \rightarrow CaCO_3(s) + H_2O(l)$$

Lime water (Milky)

12. (a) What is a functional group in a carbon compound ? Identify the functional group present in CH_3COOH and C_2H_5OH.

(b) State the principle on which the cleansing action of soap is based. **(C.B.S.E. Foreign 2008)**

Ans. (a) Functional group may be defined as an atom or group of atoms upon which the properties of a particular organic compound are based. Different families differ in the functional groups.

Functional group in $CH_3COOH : (-COOH)$

Functional group in $C_2H_5OH : (-OH)$

(b) The cleansing action of soap is based on its tendency to act as a bridge between water and oil drops containing dirt particles. As a result. oil and water get mixed. They form a stable emulsion also called micelle. This helps in removing oil drops containing dirt particles from clothes. The clothes become clean.

13. (a) Draw the structure of the following compounds

(i) Ethanoic acid (ii) Butanone.

(b) Why is conversion of ethanol to Ethanoic acid considered an oxidation reaction? **(C.B.S.C. Foreign 2008)**

Ans. (a)
$$\begin{array}{ccccccccc} & & H & & O & & & & \\ & & | & & \| & & & & \\ H & - & C & - & C & - & O & - & H \\ & & | & & & & & & \\ & & H & & & & & & \end{array} \qquad \begin{array}{ccccccccccccc} & & H & & H & & O & & H & & & & \\ & & | & & | & & \| & & | & & & & \\ H & - & C & - & C & - & C & - & C & - & O & - & H \\ & & | & & | & & & & | & & & & \\ & & H & & H & & & & H & & & & \end{array}$$

Ethanoic acid Butanone

(b) When ethanol (C2H5OH) changes with Ethanoic acid (CH3COOH)

- There is a decrease in the number of hydrogen atoms by two.
- There is an increase in the number of oxygen atoms by one. Therefore, the conversion represents an oxidation reaction.

14. (a) What are esters ? How are they formed ? (b) Write two uses of ester ? **(CBSE Foreign 2008)**

Ans. (a) Esters are the group of organic compounds which contain the function group ($-COOR$) called ester group. The value of R may change as $-CH_3$, $-C_2H_5$, $-C_3H_7$ etc. A few example of esters are :

$$\begin{array}{ccccc} & & O & & \\ & & \| & & \\ H & - & C & - & OCH_3 \end{array} \qquad \begin{array}{ccccc} & & O & & \\ & & \| & & \\ CH_3 & - & C & - & OCH_3 \end{array}$$

Methyl methanoate Methyl ethanoate

Esters are formed as a result of chemical reaction called Etherification.

Uses of esters

(i) Esters have pleasant smell. These are used as flavoring agents and also in perfumes.

(ii) Esters of glycerol known as triglycerides are used in the manufacture of soaps. This reaction is called Saponification reaction.

15. Distinguish between Etherification and saponification reactions of organic compounds.

(C.B.S.E. All India 2008)

Ans. (a) In the Etherification reaction an acid reacts with alcohol in the pressure of conc. H2SO4 to form an ester with a pleasant or fruity smell. For example,

$$CH_3COOH + C_2H_5OH \xrightarrow{H_2SO_4(Con.)} CH_3COOC_2H_5 + H_2O$$

Ethanoic acid Ethanol Ethyl ethanoate (ester)

Saponification is quite different from Etherification because in this case an ester reacts with an alkali (NaOH or KOH) to form salt of acid and alcohol. For example,

$$CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$$

Ethyl ethanoate Sod. ethanoate Ethanol

16. (a) In organic compounds, which part largely determines the physical and chemical properties.

(CBSE All India, 2008)

(b) Write chemical equation to represent the reaction of ethanol with acidified solution of potassium dichromate.

Ans. (a) In organic compounds, it is the functional group which largely determines the physical and chemical properties of compounds. Actually, and organic compound is made up of two parts. These are alkyl group and the functional group. Whereas the alkyl group remains the same (size may change) but the functional groups change. These are responsible for the characteristics of the compounds. For example, the properties of alkanols ($-OH$ is the functional group) are different from those of alkanoic acid ($-COONa$ is the functional group). For more details, consult text part.

(b) Acidified solution of potassium dichromate ($K_2O_2O_7$) forms chromic acid (H_2CrO_4). It releases oxygen to bring about the oxidation of ethanol first to ethanal and then to Ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3-CH_2-OH} \xrightarrow[-H_2O]{(O)} \underset{\text{Ethanal}}{CH_3-\overset{\overset{H}{|}}{C}=O} \xrightarrow{(O)} \underset{\text{Ethanoic acid}}{CH_2-\overset{\overset{OH}{|}}{C}=O}$$

17. Give reason for the following:

(a) Air holes of the gas burners have to be adjusted when heated vessels get blackened by the flame.

(b) Use of synthetic detergents causes pollution problems. **(C.B.S.E. Delhi, 2009)**

Ans. (a) In case the vessel where cooking is done get blackened from outside, this means that combustion is incomplete. As a result, the carbon particles in the form of soot get deposited and the vessel becomes black from outside. In order to check this, oxygen or air supply must be increased. This can be done only by adjusting the air holes of the gas burner.

(b) The pollution problems caused by the synthetic detergents is due to their non-biodegradable nature. These are actually long chain organic compounds which do not break or decompose in water. Naturally, this will result in pollution problems. Some of the detergents are even of toxic nature and will make water unfit for drinking.

ROUND UP

- Carbon is versatile element that forms the basis of all living things.
- Carbon can from a vast variety of compounds because of its Tetravalency and the property of catenation.
- Covalent bonds are formed between two similar or different atoms by sharing electron in their valence shell, such that both of them can achieve the structure of nearest noble gas.
- Carbon forms covalent bonds with itself as well as atoms of hydrogen, oxygen, nitrogen, sulphur and halogens.
- Carbon can form compounds having a straight chain between carbon atoms with a single bond, or double bond or triple bond. It can also form compounds with branched chains and closed chains.
- Homologous series of carbon compounds is a group of carbon compounds having the same functional group with the same general formula.

- The functional groups such as alcohols, aldehydes, Ketones, carboxylic acids and halogens impart characteristic properties to the carbon compounds.
- Carbon and its compounds are the major sources of fuels.
- Ethanol and Ethanoic acid are most important compounds of carbon in our daily life.
- The soaps and detergents have cleansing action, because of the presence of hydrophobic and hydrophilic groups in their molecules, which help in emulsifying oil, and hence, in the removal of dirt.

EXERCISE #1 CARBON &ITS COMPOUNDS

1. Ethane, with the molecular formula C_2H_6 has (NCERT)
(a) 6 covalent bonds (b) 7 covalent bonds (c) 8 covalent bonds (d) 9 covalent bonds

2. Butanone is a four-carbon compound with the functional group (NCERT)
(a) Carboxylic acid (b) aldehyde (c) ketone (d) alcohol

3. While cooking. If the bottom of the vessel is getting blackened on the outside, it means that (NCERT)
(a) the food is not cooked completely (b) the fuel is not burning completely
(c) the fuel is wet (d) the fuel is burning completely

4. A covalent bond is formed by
(A) complete transfer of electrons (B) one sided sharing of electron
(C) mutual sharing of electron (D) all of the three above.

5. Which of the following compounds does not contain a multiple bond?
(A) Ethane (B) Ethene (C) Ethyne (D) Benzene

6. Which of the following is not a saturated hydrocarbon?
(A) Cyclohexane (B) Benzene (C) Butane (D) Isobutane

7. Benzene with molecular formula, C_6H_6, has
(A) 6 single bonds and 6 double bonds (B) 12 single bonds and 3 double bonds
(C) 18 single bonds only (D) 12 double bonds only

8. The functional group in methanol and methanol and methanal respectively are :
(A) $-OH, -CHO$ (B) $-CHO, -OH$ (C) $-OH, -COOH$ (D) $-CHO, -COOH$

9. Which of the following is not an allotropic form of carbon?
(A) Coal (B) Fullerene (C) Diamond (D)Graphite

10. Graphite is a soft lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite
(A) has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interpolate bonds.
(B) is a non-crystalline substance
(C) is an allotropic form of carbon

(D) has only single bonds between carbon atoms

11. Which of the following represent the correct order of unsaturation?
(A) Alkanes, alkenes, alkynes (B) Alkanes, alkynes, alkenes
(C) Alkenes, alkynes, alkenes (D) Alkynes, alkanes, alkenes

12. The general formula of alcohol is
(A) $C_nH_{2n+2}OH$ (B) $C_nH_{2n+1}OH$ (C) C_nH_{2n-1} OH) (D) $C_nH_{2n+4}OH$

13. Wine contains
(A) CH_3OH (B) C_6H_5OH (C) C_2H_5OH (D) CH_3COOH

14. The acid present in vinegar is
(A) CH_3COOH (B) $HCOOH$
(C) CH_3CH_2COOH (D) $CH_3CH_2CH_2COOH$

15. The reaction $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$ suggests that ethanol is
(A) Acidic in nature (B) Basic in nature (C) Amphoteric (D) Neutral

16. Which of the following substance is added to denature ethanol?
(A) Methanol (B) Benzene (C) Copper nitrate (D) Poison

17. Which of the following substances cannot be used to distinguish ethanol from Ethanoic acid ?
(A) Na metal (B) $NaHCO_3$
(C) hot alkaline $KMnO_4$ (D) hot acidified $K_2Cr_2O_7$ solution

18. An example of soap is
(A) CH_3COONa (B) CH3ONa (C) $C_{17}H_{35}COONa$ (D) $C_{17}H_{35}COOC_2H_5$

19. Detergents are sodium or potassium salts of long chain
(A) aldehydes (B) Ketones (C) carboxylic acids (D) sulphonic acids

20. Which of the following salts when dissolved in water produce hard water?
(A) Calcium sulphate (B) Magnesium bicarbonate
(C) Calcium chloride (D) Any of the above

21. Which of the following represents Lewis structure of N_2 molecule?

(A) ${}^{\times}_{\times}N \equiv N^{\times}_{\times}$ (B) ${}^{\times}_{\times}\overset{\times\times}{N} \equiv \overset{\times\times}{N}{}^{\times}_{\times}$ (C) ${}^{\times}_{\times}\overset{\times\times}{N} - \overset{\times\times}{N}{}^{\times}_{\times}$ (D) ${}^{\times}_{\times}\overset{\times\times}{N} = \overset{\times\times}{N}{}^{\times}_{\times}$

22. Which of the following has the shortest carbon-carbon bond length?
(A) C_2H_2 (B) C_2H_4
(C) C_2H_6 (D) All have the same bond length

23. Which of the following has the weakest carbon-carbon bond strength?
(A) C_2H_2 (B) C_2H_4
(C) C_2H_6 (D) All have the same bond length

24. The hydrocarbon with the general formula C_nH_{2n+n} is an-

(A) Alkane (B) Alkene
(C) Alkyne (D) unsaturated compounds

25. Which of the following is an alkyne?
(A) C_6H_6 (B) C_6H_{12} (C) C_6H_{10} (D) C_6H_{14}

EXERCISE #2 CARBON &ITS COMPOUNDS

1. Which of the following will not decolorize bromine water?
(A) C_4H_8 (B) C_3H_4 (C) C_3H_8 (D) C_4H_6

2. Compounds made up of carbon and hydrogen only are called
(A) Alkanes (B) Alkenes (C) Alkynes (D) Hydrocarbons

3. Open-chain saturated hydrocarbons are called
(A) Paraffin (B) Alkenes (C) Alkynes (D) Alkyl groups

4. The characteristic reaction of alkanes is
(A) Addition (B) Substitution (C) Polymerization (D) Isomerization

5. The major constituent of biogas is
(A) Propane (B) Acetylene (C) Methane (D) Benzene

6. n-butane and isobutane are
(A) Alkenes (B) Alkynes (C) Isomers (D) None of these

7. Methane is a major constituent of
(A) Coal gas (B) Water gas (C) Petroleum (D) Biogas

8. The major constituent of of natural gas is
(A) Butane (B) Methane (C) Propane (D) Ethane

9. Ethanol on oxidation gives
(A) Ethane (B) Formalin (C) Ethanoic acid (D) Methane

10. The functional group present in carboxylic acids is
(A) –OH (B) –CHO (C) –COOH (D) –CO

11. A dilute solution of Ethanoic acid in water is called
(A) Tincture of iodine (B) Fehling's solution (C) Vinegar (D) Tollen's reagent

12. Which of the following will undergo addition reactions?
(A) C_2H_4 (B) C_2H_6 (C) CH_4 (D) C_3H_8

13. Which of the following formula represent alkenes?

(A) C_nH_{2n} (B) C_nH_{2n+2} (C) C_nH_{2n-2} (D) C_nH_{2n+1}

14. The general formula of cyclic alkanes is

(A) C_nH_{2n+2} (B) C_nH_{2n-2} (C) C_nH_{2n-1} (D) C_nH_{2n}

15. A carboxylic group is present in

(A) Ethylene (B) Methanoic acid (C) Formaldehyde (D) Ethanol

16. The functional group in an alcohol is

(A) $-\overset{\overset{O}{\|}}{C}-O-$ (B) $-\overset{\overset{O}{\|}}{C}-OH$ (C) $-OH$ (D) $-\overset{\overset{H}{|}}{C}=O$

17. Which of the following will react with sodium metal?

(A) Ethanol (B) Ethanal (C) Ethene (D) Ethane

18. Which of the following will give a pleasant smell of ester when heated with ethanol and a small quantity of sulphuric acid?

(A) CH_3COOH (B) CH_2CH_2OH (C) CH_3OH (D) CH_3CHO

19. The functional group in aldehydes is

(A) $-CHO$ (B) $-\overset{|}{C}=O$ (C) $-COOH$ (D) $-COOR$

20. Ethanol on complete oxidation gives

(A) CO_2 and water (B) Acetaldehyde (C) Acetic acid (D) Acetone

21. Which class of organic compounds give effervescence with $NaHCO_3$ solution?

(A) Esters (B) Alcohols (C) Carboxylic acids (D) Aldehydes

22. Carboxylic acids are obtained from alcohols by -

(A) Oxidation (B) Reduction (C) Hydrolysis (D) Pyrolysis

23. Soaps are prepared by alkaline hydrolysis of-

(A) Carboxylic acids (B) Lower esters (C) Higher esters (D) None of these

FILL IN THE BLANKS TYPE QUESTION :

1. The ability of carbon atom to link with other carbon atom is known as ………………
2. The hydrocarbons containing only single bonds are known as ……………
3. Aliphatic hydrocarbons have been classified as alkanes, ……… and alkynes.
4. ……….. hydrocarbons undergo addition reaction.
5. Isomers have some molecular formula but different ……….. formula.
6. Hydrocarbons are insoluble in …………..
7. The next homologue of ethene is ………..
8. During the formation of hydrogen molecule from its atoms, energy is ………..
9. Bond between hydrogen and chlorine in HCl is ……………
10. $CH_2 = CH_2 + H_2 \rightarrow CH_3 - CH_3$
11. The general formula of the homologous series of alcohols is ………..
12. The functional group present in ethanol is ………..
13. When ethanol is warmed with alkaline potassium permanganate, the product formed is …………..
14. When a piece of sodium metal is added to ethanol, the gas formed with effervescence is …………..
15. Ethene and ethylene are examples of ………… hydrocarbons.
16. The ……….. group in a soap molecule is hydrophilic.

TRUE & FALSE :

1. Methane belongs to the homologous series of alkanes.
2. The compound having the molecular formula C_4H_{10} does not show isomerism.
3. The methane molecule has a pyramidal shape.
4. Methane undergoes substitution reaction.
5. The consumption of ethanol increases the activity of the body.
6. Ethanoic acid is used in the manufacture of textiles.
7. Alkenes as well as alkynes decolorize bromine water.
8. Vanaspati ghee is obtained by the hydrogenation of vegetable oil.
9. Alkanes undergo substitution reactions.
10. Alkenes and alkynes are unsaturated compounds.
11. Ethanol is oxidized by alkaline $KMnO_4$ to oxalic acid.
12. Detergents give scum with hard water.
13. The polar end in soap is called hydrophilic end.
14. Methanol is safe to be used for drinking purpose.
15. The reaction of ethanol with conc. H_2SO_4 gives ethane.
16. Carboxylic acids react with alcohols to form esters.

VERY SHORT ANSWER TYPE QUESTIONS :

1. Name an allotrope of carbon which has 60 carbon atoms.

2. What is combustion?

3. What is the nature of substances that produce a flame?

4. The molecular formula of a compound is C_2H_6O. Name its homologous series.

5. What type of reactions are given by alkanes?

6. What is the composition of natural gas used for cooking?

7. Which of the following open chain compounds can have a double bond?

8. Name an allotrope of carbon which contains both single and double bonds between carbon atoms.

9. Write the name and molecular formula of alcohol derived from butane.

10. What is rectified spirit?

11. Give the name and structural formula of one homologue of HCOOH.

12. Why does hard water not produce foam with soap easily?

13. Name the hydrophobic and hydrophilic ends of soap.

14. What is a detergent?

15. An organic compound burns with a sooty flame. Is it saturated or unsaturated compound?

SHORT ANSWER TYPE QUESTION :

1. Name any four substance obtained from organic compounds which are used in our daily life.

2. Hydrogen and chlorine react to form hydrochloric acid. Will they form and ionic or covalent bond?

3. How many electrons a carbon atom shared with other carbon atom in the formation of acetylene molecule?

4. Give examples of covalent compounds which contain :

(a) one unshared pair of electron(b) two unshared pairs of electrons.

5. What is meant by the term functional group?

6. What is meant by homologous series? Give its three important characteristics.

7. Name the functional group present in : (i) CH_3CH_2OH, and (ii) HCOOH.

8. The molecular formula of a hydrocarbon is C_5H_{10}. Name its homologous series.

9. Write structural formulae of the following compounds.

(i) Ethyl alcohol (ii) Acetaldehyde (iii) Propionic acid (iv) Butanone

10. What is the IUPAC name of fourth member of alcohol series? Draw its two structural isomers.

11. Write the general formulae of the following homologous series.

(i) Aldehydes (ii) Ketones (iii) Alkyne

12. How do alcohols differ structurally from alkanes?

13. Give the common and IUPAC names of the following alcohols:

(i) CH_3OH (ii) CH_3CH_2OH (iii) $CH_3CHOHCH_3$

14. Identify the functional group in CH_3CH_2OH . Give IUPAC name of the compound.

15. Ethanol can be oxidized to Ethanoic acid. Write the equation involved in the reaction.

16. Name the oxidizing agent which can oxidize:

(i) Ethanol to ethanal (ii) Ethanol to Ethanoic acid.

17. How would you distinguish experimentally between an alcohol and a carboxylic acid?

18. A neutral organic compound 'A' having molecular formula C_2H_6O,undergoes oxidation with acidified potassium permanganate to give an acidic compound 'B' . The organic compound 'A' reacts with compound 'B' on warming and in the presence of concentrated sulphuric acid to form a sweet-smelling substance 'C'. Identify A, B and C.

19. An organic compound 'A' having molecular formula $C_2H_6O_2$ turns blue litmus red and gives brisk effervescence with sodium hydrogen carbonate. Give the name and formula of 'A'.

20. What happens when (Give equations of the chemical reaction)

(i) Sodium ethanoate is heated with soda lime.

(ii) Ethanoic acid is warmed with methanol in presence of concentrated sulphuric acid.

(iii) A pinch of sodium hydrogen carbonate is added to ethanoic acid.

(iv) Ethanol is oxidized with acidified potassium dichromate.

LONG ANSWER TYPE QUESTION :

1. What is covalent bond ? Draw electron dot structure for the following :

(i) Methane (ii) Carbon dioxide (iii) Ammonia (iv) Water

2. Explain the following reaction with one example each :

(i) Substitution reactions (ii) Addition reactions

(iii) Combustion reactions (iv) Oxidation reactions

3. (i) What are alcohols? What is functional group ?
(ii) Write names and formulae of first four members of alcohols family.
(iii) How does the second member of alcohol family react with
(i) Sodium metal (ii) Ethanoic acid

4. What are soaps and synthetic detergents ? How do they differ ? Discuss their cleaning actions.

5. Which properties of carbon make it a versatile element . Discuss its bonding in saturated and unsaturated hydrocarbon.

6. What are harmful effect of drinking alcohol ?

7. Write short not on :

(i) Catenation (ii) Glacial acetic acid (iii) Power alcohol (iv) Saponification

8. Give chemical test to detect the presence of (i) ethanol. (ii) Ethanoic acid and (iii) and ester.

9. Discuss briefly two physical and three chemical properties of ethanol.

10. Discuss briefly the physical and chemical properties of Ethanoic acid.

EXERCISE # 1

- ***Objective type questions***

Qus.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	B	C	B	C	A	B	B	A	A	A
Qus.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	A	B	C	A	A	A	A	C	D	D
Qus.	**21**	**22**	**23**	**24**	**25**					
Ans	A	A	C	A	C					

EXERCISE # 2

Qus.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	C	D	A	B	C	C	D	B	C	C
Qus.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	C	A	A	D	B	C	A	A	A	A
Qus.	**21**	**22**	**23**							
Ans	C	A	C							

EXERCISE # 3

- ***Fill in the blanks***

1. Catenation **2.** Alkanes/saturated hydrocarbon **3.** Alkenes
4. Unsaturated **5.** Structural **6.** Water **7.** Propene
8. Released **9.** Covalent **10.** Ni catalyst **11.** $C_nH_{2n+1}OH$.
12. Hydroxy **13.** Ethanoic acid **14.** Hydrogen **15.** Unsaturated
16. Polar/$COONa^+$

- ***True or False***

1. T **2.** F **3.** F **4.** T
5. F **6.** T **7.** T **8.** T
9. T **10.** T **11.** F **12.** F
13. T **14.** F **15.** F **16.** T

NCERT SOLVED QUESTIONS

1. Write the chemical formula of simplest ketone.

Ans.

$$\begin{array}{ccccccc} & & H & & O & & H \\ & & | & & \| & & | \\ H & - & C & - & C & - & C - H \\ & & | & & & & | \\ & & H & & & & H \end{array}$$

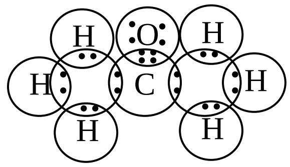
2. What will be formula and electron dot structure of cylopentane?

Ans. Formula for cylopentane is C5H10. Its electron dot structure can be represented as C_5H_{10}

$$\begin{array}{ccc} & CH_2 & \\ CH_2 & & CH_2 \\ | & & | \\ CH_2 & - & CH_2 \end{array}$$

3. Propanone.

Ans. Propanone $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$



4. What will happen if a piece of diamond is dropped in fire ? Write chemical equation for the reaction.

Ans. Diamond will burn in fire because it is an allotrope of carbon. On combustion, it will produce carbon dioxide.

C	+	O_2	$\longrightarrow$ CO_2
Diamond		Oxygen	Carbon dioxide

5. Write two main difference between the nature of diamond and graphite.

Ans. Two main difference between diamond and graphite are

(i) Diamond is very hard whereas graphite is a soft substance.

(ii) Diamond is a poor conductor of electricity whereas graphite is a good conductor of electricity.

6. Write the formulae for the given compounds and name the functional groups present in each of them.

(i) Ethanoic acid (ii) Propanone

Ans. (i) Compound : Ethanoic acid

Formula : $CH_3 - COOH$

Functional group : $-\overset{\overset{\displaystyle O}{||}}{C}-OH$

(Carboxylic acid group)

(ii) Compound : Propanone

Formula : $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$

Functional group : $-\overset{\overset{\displaystyle O}{||}}{C}-$

(Ketone group)

7. Mention any two test which can be used of defect carboxylic acid group in an organic compound.

Ans. **(i) Litmus test :-** Carboxylic acids turn blue litmus paper red.

(ii) Sodium bicarbonate test : Carboxylic acids give brisk effervescence due to the formation of carbon dioxide, when treated with sodium bicarbonate solution.

$$CH_3COOH + NaHCO_3 \rightarrow H_2O + CO_2 + CH_3COONa$$

8. What is hydrogenation ? What is its industrial application ?

Ans. Unsaturated hydrocarbons add hydrogen in the presence of palladium or nickel. This reaction is called hydrogenation.

$$C=C \quad + H_2 \xrightarrow{Pd\ or\ Ni} R-\underset{\underset{\displaystyle R}{|}}{\overset{\overset{\displaystyle H}{|}}{C}}-\underset{\underset{\displaystyle R}{|}}{\overset{\overset{\displaystyle H}{|}}{C}}-R$$

This reaction is industrially used in the conservation of vegetable oils into vegetable ghee.

9. Define the following giving one example of each :

(i) Etherification

(ii) Addition reaction

Ans. (i) The reaction of carboxylic acid with an alcohol in presence of sulphuric acid yields esters and the reaction is known as Etherification.

$$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - OH + CH_3 - CH_2 - OH$$

$$\Big\downarrow {\scriptstyle H_2SO_4 \;\; heat}$$

(ii) Reactions in which two or more atoms are added across a double or triple bond, are called addition reactions.

$$CH_3 = CH_2 + H_2 \xrightarrow{Pd.Pt\,or\,Ni} CH_3 - CH_3$$

10. An organic compound 'X' is a constituent of wine. This compound on heating with acidified potassium dichromate forms another compound 'Y'. Name the compound 'X' and 'Y' and write the chemical equation of the reaction involved.

Ans. Compound 'Y' is ethanol.

Compound 'Y' is Ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[heat]{K_2Cr_2O_7} \underset{\text{Ethanoic acid}}{CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - OH}$$

11. (a) Identify the compounds A and B in the following reaction :

(i) $C_2H_5OH + CH_3COOH \xrightarrow{H_2SO_4}$ (ii) $CH_3COOC_2H_5 + NaOH \rightarrow B + C_2H_5OH$

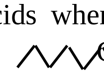
(b) Name the type of reaction taking place in the above cases.

Ans. (a) (i) $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - O - CH_2 - CH_3$ (ii) $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - ONa$

Ethyl ethanoate Sodium ethanoate

(b) (i) Etherification

12. Differentiate between a soap and a detergent on the basis fo their chemical constituents. For cleansing action why is a detergent preferred to a soap ?

Ans. Soaps are sodium salts of long chain fatty acids whereas detergents are sodium salts of alkyl benzene sulphonic acids. Basically, the structure soap is COONa whereas that of detergents is SO_3Na. If water is hard i.e., it contains calcium or magnesium chlorides then detergent is preferred to a soap.

13. Why does micelle formation take place when soap is added to water ? Will a micelle be formed in other solvents like ethanol also?

Ans. A molecule of soap has two dissimilar ends. At one end is the hydrocarbon chain which is water repellent. At the other end carboxylate anion is present which is water soluble end. 'When soap is dissolved in water, many molecules come together and form a group called micelle, these micelles are formed because their hydrocarbon chains come together and the polar ends are projected outward. Micelle formation in ethanol will not occur because the hydrocarbon chain end of the soap will also dissolve in ethanol.

14. Explain the formation of scum when hard water is treated with soap.

Ans. Hard water contains calcium and magnesium ions. When soap comes is contact with hard water these ions form calcium and magnesium salts of fatty acids which are insoluble in water. These calcium or magnesium salts precipitate out in the form of scum.

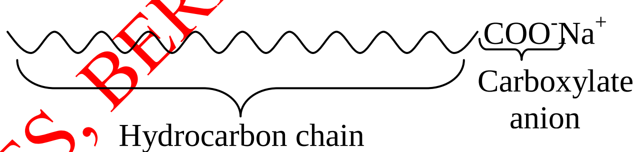
15. How can ethanol and Ethanoic acid be differentiated on the basis of their physical and chemical properties?

Ans.

	Property	**Ethanol**	**Ethanoic acid**
(i)	Melting point	156 K	290 K
(ii)	Action on litmus	No action	Turns blue litmus into red
(iii)	Reaction with $NaHCO_3$ solution	No reaction	Effervescence due to the formation of CO_2

16. Explain the mechanism of the cleansing action of soaps.

Ans. A molecule of soap has two dissimilar ends. At one end is the hydrocarbon, chain which is water repellent and the other and is carboxylate anion which is polar end.



When soap is dissolved in water, many molecules come together and from a group called micelle. These micelles are formed because their hydrocarbon chains come together and the polar ends are projected outward.

When a cloth with a spot of oil soaked into a soap solution. Soap dissolves tiny oil droplets by the hydrophobic end in the middle of the micelle. Due to the outer polar ends, these micelles dissolve in water and are washed away- In this way cloth gets cleaned.

17. What is soap ? How would you make soap in the laboratory ? State one advantage and one disadvantage of soap over synthetic detergents.

Ans. Soaps are sodium or potassium salts of long chain fatty acids Soap can be prepared in laboratory by heating the naturally occurring. Oil or fat with sodium hydroxide. On heating, sodium salt of the fatty acid soap is formed along with glycerol. This process is known as saponification.

$$Oil\ or\ fat + NaOH \rightarrow Soap + Glycerol$$

The soap is precipitated by adding common salt to the above solution. Soap being lighter, floats on water and is filtered. It is cooled and then cut into pieces.

Soaps have the advantage over detergents that they are biodegradable and do not cause water pollution.
The disadvantage of soaps over detergents is that, they cannot be used in hard water.

18. What happens when a small piece of sodium metal is dropped into ethanol.

Ans. Hydrogen gas is evolved when a piece of sodium metal is dropped into ethanol.

$$C_2H_5OH + Na \rightarrow C_2H_5ONa + \frac{1}{2}H_2$$

19. Give reasons for the following observations :

Ans. (a) The element forms a very number of compounds.

(b) Air holes of a gas burner have to be adjusted when heated vessels get blackened by the flame.

(c) Use of synthetic detergents causes pollution of water.

Ans. (a]) The two main properties of carbon responsible for a large number of compounds are catenation and Tetravalency of carbon.

(b) When the heated vessel is blackened by the flame, it shows that complete combustion of the gas is not occurring due to the less supply of oxygen or air. So air holes adjusted to increase the supply of air.

(c) Use of synthetic detergents causes pollution of water because most of them are non-biodegradable.

Important notes

INTRODUCTION :

Before the beginning of the **eighteenth century** when there are only 30 elements were known, it was easier to study and remember their properties. In later years when number of elements discovered were increased then it become difficult to study them. So scientist fell the need of simple method to facilitate the study of the properties of various elements and their compounds. After numerous attempts they got success & elements were arranged in such manner that similar elements were grouped together and different elements were separated. This arrangement of elements is known as classification of elements which led to the formation of periodic table.

Periodic table may be defined as the arrangement of all the known elements according to their properties in such way that the elements of similar properties are grouped together in a tabular form.

Earlier attempts of classification of elements (development of periodic table) :

Earlier attempts to classify the elements resulted in grouping as metals and non-metals. Later on they were classified on the basis of their atomic masses.

DOBEREINER TRIADS RULE :

In 1817, **Johann Wolfgang Döbereiner.** A German chemist, arranged the elements is group of three elements and in a manner that the atomic mass of middle element was roughly the average of the atomic masses of the other two elements of the triad.

Example : Element :	Lithium,	Sodium	and	Potassium.
Atomic mass	7	23		39

Average of the atomic masses of Lithium and Potassium is $\frac{7+39}{2} = 23$ only three triads could be arranged in this manner at that time. They were :

Triads	Elements	Atomic masses	Average of the atomic masses of first and third element
1	Li Na K	7 23 39	$\frac{7+39}{2} = 23$
2.	Ca Sr Ba	40 87.5 137	$\frac{40+137}{2} = 88.5$
3.	Cl Br I	35.5 80 127	$\frac{35.5+127}{2} = 81.2$

SHORT COMING OF DOBEREINER'S TRIADS RULE :

This classification was not found satisfactory as it could be applied to the limited number of elements. Now a days some more triads have been made they are

(i)	Potassium K	Rubidium Rb	Cesium Cs

(ii)	Phosphorous P	Arsenic As	Antimony Sb
(iii)	Sulphur S	Selenium Se	Tellurium Te
(iv)	Hydrogen H	Fluorine F	Chlorine Cl
(v)	Scandium Sc	Itrium Y	Lanthanum La

For a **Döbereiner's triad** all the three elements should belong to the same group and the difference in atomic number should be 8 or 18.

New lands law of octave : In 1866. J.A.R. Newlands correlated the chemical properties of the elements with the increasing order of atomic masses. i.e. to arrange the element having lowest atomic mass (H) firstely and ended to at secondly the element having highest atomic mass. **(Thorium** which was 56^{th} known element at that time).

Definition : When the elements are arranged in order of their increasing atomic masses, every eighth element has the properties similar to those of the first elements like the eighth note of an octav in music. Thus according to this law, the physical & chemical properties are repeated after an interval of eight elements and this is similar to eight notes of an octave on a musical scale shown below :

Sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	-	-

The properties of Lithium are similar to that of 8^{th} element i.e. Na, Be is similar to Mg and so on.

Limitations :

1. Law of octaves was applicable only up to calcium. It worked well with lighter elements only.

2. At that time only 56 elements were existed in nature, but later several elements were discovered which can not be kept in periodic table as per this law. Their properties were not in accordance with the law of octaves.

Law of octaves :

3. (i) In order to fit element in to his table New lands adjusted two elements in the same column. For example cobalt and nickel were placed in the same position and in the same column as fluorine and bromine.
(ii) Iron which resembles cobalt and nickel in properties were placed far away from these elements.

4. After the discovery of inert gases & included in the periodic table it becomes the eighth elements from alkali so this law has to be dropped out.

Ques. Did Döbereiner's triads also exist in the columns of Newland's Octaves ? Compare and find out.
Ques. What were the limitation of Döbereiner's Classification ?
Ques. What were the limitations of Newlands' Law of Octaves ?

Mendeleev's Periodic table :

In the year 1861, **D Mitri Ivanovich Mendeleev** arranged all the known elements (63 elements) in the form of a table in which elements were arranged in the increasing order of their atomic mass and also on the similarities of chemical properties.

❒ The arrangement of element was based on the physical and chemical properties of the elements and also the formulae of the compounds they formed with oxygen and hydrogen. He selected hydrogen and oxygen as they are very reactive and formed compound with most elements.

The table which classifies the elements in such a way that elements having similar properties are placed in same vertical column or group in known as periodic table. The term periodic means repetition of elements having similar properties after a certain regular interval. The periodic table consists of vertical columns which are called as groups and horizontal rows called as periods. **Mendeleev's** periodic table had six periods and eight groups as shown in the table, he arranged all the elements horizontally fin the order of their increasing atomic masses and vertically according to their similarities in properties. Each group was further sub divided into two sub groups A & B.

Group	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Oxide Hydride	R_2O RH	RO RH_2	R_2O_3 RH_2	RO_2 RH_3	R_2O_5 RH_3	RO_3 RH_2	R_2O_7 RH	RO_4
Period	A B	• A B	A B	A B	A B	A B	A B	Transition Series
1.	H 1.008							
2.	Li 6.939	Be 9.012	B 10.81	C 12.011	N 14.007	O 15.999	F 18.998	
3.	Na 22.99	Mg 24.31	Al 29.98	Si 28.09	P 30974	S 32.06	Cl 35.453	
4. First series second series	K 39.102 Cu 63.54	Ca 40.08 Cu 65.37	Sc 44.96 Ga 69.72	Ti 47.90 Ge 72.59	V 50.94 As 74.92	Cr 50.20 Se 78.96	Mn 54.94 Br 79.909	Fe Co Ni 55.85 58.93 58.71
5. First series second series	Rb 85.47 Ag 107.87	Sr 87.62 Cd 112.40	Y 88.91 In 114.69	Zr 91.22 Sn 118.69	Nb 92.91 Sb 121.75	Mo 95.94 Te 127.60	Tc 99 I 126.90	Rh 102.91 Ru Pd 101.07 106.4
6. First series second series	Cs 132.9. As 196.97	Ba 137.34 Hg 200.59	La 138.91 Hg 200.59	Hf 178.49 Pb 207.19	Ta 183.85 Bi 208.98	W 183.85		Ir Os 192.2 190.2 Pt 195.09

Achievements of the Mendeleev's periodic table :

1. **Systematic study of the elements :** All the elements in general were arranged systematically in increasing order of their atomic masses. This arrangement helped to study the properties of various elements. If the nature of the element present in a group is known, it become easier to predict or guess the expected properties of other elements.
2. **Prediction of new elements :** Mendeleev predicted the properties of some unknown elements and left gaps for these elements to be filled as and when discovered For eg. Scandium, Gallium and Germanium were not known at that time but Mendeleev already named these elements as **eka-boron, eks-aluminium** and **eka-silicon.** When these elements were later on discovered, they were found to have more or less similar properties as predicted by Mendeleev.
3. **Position of Noble gasses :** When noble gases were discovered they were placed in a new group without disturbing the existing order.
4. **Correction of atomic masses :** Atomic masses of several elements were corrected on the basis of periodic table. eg. Atomic mass of Beryllium was corrected from 135 to 9. Mendeleev predicted that atomic mass of gold is incorrect. Later on it was found to be so. Similarly atomic masses of Indium, Uranium and Platinum were also corrected.

Drawbacks of Mendeleev's periodic table :

Position of Hydrogen is uncertain becomes it resemble with IA group alkali metals elements and VII A (halogens) group elements.

(i) Isotopes : Isotopes of an element have similar chemical properties but different atomic masses.

(ii) Position of isotopes : Since basis of periodic table was increasing atomic mass. So isotope should be placed separately but no separate place ws given to isotopes.

(iii) Anomalous pairs of certain elements : Certain elements were not arranged according to their increasing atomic mass eg.

(a) Argon (Atomic mass 39.9) was placed before potassium (atomic mass 39.0)
(b) Cobalt (58.95) before Nickel (58.70)
(c) Tellurium (127.6) before Nickel (126.9)
(d) Thorium (232) before **Protactimum** (231)
(iv) Similar elements were placed in different groups. eg.
(a) Silver and thallium
(b) Barium and lead
(c) Copper and mercury
(d) Platinum and gold.

(v) Dissimilar elements were placed in same group eg. silver and gold were placed in a same group while there is little similarity in physical and chemical properties.

(vi) Cause of periodicity : Mendeleev did not explain the cause of periodicity in the physical and chemical properties of the elements.

(vii) Metals have not been separated from non-metals.

(viii) Position for elements of group (VIII) : There is no proper position for the elements of group (VIII) consisting of elements in three triads. These elements are placed out side the main structure of the periodic table.

The modern periodic table :

In 1913 **Henry Moseley** showed that properties of the elements are determined by atomic numbers instead of the atomic mass. It formed the basis of modern periodic law. The law is –
"The physical and chemical properties of the elements are periodic function of their atomic numbers". Since atomic mass is a nuclear property where as atomic number implies for the no of electrons in neutral atom or no. of protons in nucleus. Nucleus is deep seated in the atoms and does not take part in chemical reactions. Therefore the physical and chemical properties depends upon the no. of electrons and their electronic configuration which in turn depends upon atomic number (Z) . So when elements are arranged in the increasing order of atomic numbers. After an regular interval elements have similar no of valence electrons therefore chemical properties are repeated i.e. periodicity in the chemical properties of the elements of the elements occurs.

Ques. Use Mendeleev's periodic table to predict the formulae for the oxides of the following elements : K, C, Al, Si, Ba
Ques. Besides gallium, which other elements have since been discovered that were left by Mendeleev in his periodic table ? (any two)
Ques. What were the criteria used by Mendeleev in creating his periodic table ?
Ques. Why do you think the noble gases are placed in a separate group ?

Modern periodic table or long form of the periodic table :

- It is also called as **Bohr, Bury** & **Rang.** Werner periodic table

(1) It is based on the **Bohr-Bury** electronic configuration concept and atomic number.

(2) This model is proposed by Rang and Werner.

This table is based on modern periodic law, the elements are arranged in the increasing order of atomic numbers in such a way that elements having the same number of valence electrons are placed in the same

vertical column. It consists of 18 vertical columns and seven horizontal rows. Vertical columns of periodic table are known as groups while horizontal rows are known as periods.
The co-relation between the groups in long form of periodic table and in modern form of periodic table are given below :-

IA 1	IIA 2	IIB 3	IVB 4	VB 5	VIB 6	VIIB 7	VIII 8,9,10	IB 11	IIB 12
IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	O 18				

Elements belonging to same group having same number of electrons in the outer most shell so their properties are similar.
Description of periods :-
Description of periods ;

Period	**n**	**Sub shell**	**No. of elements**	**Element**	**Name of Period**
1.	1	1s	2	$_1H, _2He$	Shortest
2.	2	2s, 2p	8	$_3Li$ - $_{10}Ne$	Short
3.	3	3s,3p	8	$_{11}Na$ - $_{18}Ar$	Short
4.	4	4s,3d,4p	18	$_{19}K$ - $_{36}Kr$	Long
5.	5	5s,4d,5p	18	$_{37}Rb$ - $_{58}Xe$	Long
6.	6	6s,4f,5d,6p	32	$_{55}Cs$ - $_{86}Rn$	Longest
7.	7	7s,5f,6d,	26	$_{87}Fr$ - $_{112}Uub$	Incomplete

Description of Groups :

1st /IA/Alkali metals

H = $1s^1$
Li = $1s^2, 2s^1$
Na = $1s^2, 2s^2\ 2p^6, 3s^1$
K = $1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6, 4s^1$
General electronic configuration = ns1 (n= Number of shell)
Number of valence shell e^- = 1

2nd /IIA/Alkali earth metals :

Be = $1s^2, 2s^2$
Mg = $1s^2, 2s^2, 2p^6, 3s^2$
Ca = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
General electronic configuration = $\mathbf{ns^2}$
Number of valence shell e^- = 2

13th /IIIA/Boron Family ;

B = $1s^2, 2s^2, 2p^1$
Al = $1s^2, 2s^2. 2p^6, 3s^2, 3p^1$
Ga = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^1$
General electronic configuration = $\mathbf{ns^2\ np^1}$

14th /IVA/Carbon Family :

C = $1s^2, 2s^2, 2s^2$
Si = $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
Ge = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^2$

General electronic configuration = **ns^2 np^2**

Number of valence e^-s= 4

15^{th} /VA/Nitrogen family/Pnicogen : (Used in fertilizer as urea)

N = $1s^2$, $2s^2$, $2p^3$

P = $1s^2$. $2s^2$. $2p^6$, $3s^2$, $3p^3$

As = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^3$

General electronic configuration = **ns^2 np^3**

Number of valence shell e^- = 5

16^{th} /VIA/ Oxygen family/ Chalcogen : (Ore forming)

O = $1s^2$, $2s^2$, $2p^4$

S = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^4$

Se = $1s^2$, $2s^2$,$2p^6$,$3s^2$,$3p^6$,$3d^{10}$,$4s^2$,$4p^4$

General electronic configuration **: ns^2 np^4**

Number of valence e^-s=6

17^{th} /VIIA/ Fluorine family/ Halogens : (Salt forming)

F = $1s^2$, $2s^2$, $2p^5$

Cl = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^5$

Br = $1s^2$, $2s^2$,$2p^6$,$3s^2$,$3p^6$,$4s^2$,$3d^{10}$,$4p^5$

General electronic configuration = ns^2 np^5

Number of valence e^-s=7

18^{th} /Zero group/ Inert gases / Noble gases :

Ne = $1s^2$, $2s^2$, $2p^6$

Ar = 1s+, $2s^2$, $2p^6$, $3s^2$, $3p^6$

Kr = $1s^2$, $2s^2$,$3p^6$,$3s^2$,$3p^6$,$3d^{10}$,$4s^2$,$4p^6$

General electronic configuration **= ns^2 np^6** (except. He)

Number of valence shell e^-= 8

Elements of group 16 are known as Chalcogen Elements of group 17 are known as halogens.

Classification on the basis of sub shell in which last electron (e^-) enters

Periodicity in properties :

The electronic configurations of atoms display a periodic variation with increase in atomic number. Since the properties of elements depends upon the electronic configurations. So the elements exhibits periodic variation of physical & chemical properties. Some properties of elements are :-

(A) **Valency :-** It is defined as the combining capacity of the element. Valency is determined by the number of electrons present in outer most shell. These electron are known as valence electrons.

<u>Variation of valency across a period :-</u> The number of valency electron increases from 1 to 8 on moving across a period. The valency of an element with respect to hydrogen and halogen increases from 1 to 4 and then decreases from 4 to zero with respect to oxygen valency increases from 1 to 7.

<u>Variation of valency along a group :-</u> On moving down a group. The no. of valence electrons remains same so the valence of all the elements of a group is same.

Group (1) elements have valency – 1

Group (2) elements have valence – 2

Atomic size :- Atomic size means atomic radius of an atom which is defined as the distance between the centre of the nucleus of an atom and valence shell containing electrons in an isolated atom since it is very difficult to measure the atomic radius because –

(i) The isolation of single atom is very difficult.

(ii) There is no well defined boundary for the atom.

So the more accurate definition of atomic radius is –

(Half the inter nuclear distance between the two atoms in a homo atomic molecule is known as atomic radius)

This inter nuclear distance is also known as bond length. It depends upon the type of bond by which two atoms combine. Based on chemical bonds, atomic radius is divided in to four categories.

(a) Covalent radius (Single bonded covalent radius) For homo atoms

It is half of the inter nuclear distance between two singly bonded homo atoms.

(b) Covalent radius for hetero atoms.

(i) In case of hetero atomic molecule (A-B), if the Electronegativity difference is less. Then covalent radius of oxygen, nitrogen and carbon is taken from the compound H_2O_2, N_2H_4 and C_2H_6 respectively.

This radii is subtracted from the bond length of A-B molecules.

eg. C-I (Electronegativity is almost some 205)

Inter nuclear distance C-I is 2.13 Å, covalent radius of carbon in compound C_2H_6 is 0.77 Å covalent radius of I^- will be.

$d_{C-I}=r_C+r_I$ (covalent radius of iodine)

i.e.2.13 = 0.77 +r_1

r_1 = 2.13 – 0.77 = 1.36 Å

(ii) When Electronegativity difference is more. Then bond length is determined by the schole maker and Stevenson law-

$d_{A-B} = R_A+R_B - 0.09(X_A-X_B)$

where d_{A-B} = Bond length of d_{A-B} molecule

X_A= Electronegativity of A

X_B = Electronegativity of B

Example - Bond length of F_2 = 1.44 Å

i.e. d_{F-F} = 1.44 Å $r_F = \frac{1.44}{2} = 0.72\text{Å}$

d_{H-H} = 0.74 Å $r_H = \frac{0.74}{2} = 37\text{Å}$

Electronegativity of Fluorine is 4.0 and Electronegativity of Hydrogen is 2.1

$$d_{H-F} = r_F + r_H + 0.09(X_F - X_{H)}$$

= 0.72 +0.37 – 0. 09(4-2.1)

= 1.09 – (0.09×1.9)

= 1.09 – 0.171 = 0.919 Å

(B) Ionic Radius -

(i) Cationic radius (ii) Anionic radius

(i) Cationic Radius –

$$Size of\ cation \alpha \frac{1}{magnitude of\ the charge or\ z_{eff}}$$

e.g. $Fe>Fe^{+2}>Fe^{+3}$

(ii) Anionic radius -

Anionic radius is always greater than atomic radius because in an anion electrons are more than the protons so effective nuclear charge reduces and inter electronic repulsion increases so size anion also increases.

MODERN PERIODIC TABLE

BIT

Metals | Non metals | Metalloids

GROUP NUMBER

Period ↓	(1)	(2)	साइन्स (3)	टीचर (4)	विनिता (5)	कृपलानी (6)	मन (7)	फै (8)	को (9)	नि (10)	क्यू (11)	जान जलाती है (12)	(13)	(14)	(15)	(16)	(17)	(18)
1	1 H																	2 He 4.0 Helium
2	3 Li 6.9 Lithium	4 Be 9.0 Beryllium											5 B 10.8 Boron	6 C 12.0 Carbon	7 N 14.0 Nitrogen	8 O 16.0 Oxygen	9 F 19.0 Fluonne	10 Ne 20.2 Neon
3	11 Na 23.0 Sodium	12 Mg 24.3 Magnesium											13 Al 27.0 Aluminium	14 Si 28.1 Silicon	15 P 31.0 Phosporus	16 S 32.1 Sulphur	17 Cl 35.5 Chlorine	18 Ar 39.9 Argon
4	19 K 39.1 Potassium	20 Ca 40.1 Calcium	21 Sc 45.0 Scandium	22 Ti 48.8 Titanium	23 V 50.9 Vanadium	24 Cr 52.0 Chrominum	25 Mn 54.9 Manganese	26 Fe 55.9 Iron	27 Co 58.9 Cobolt	28 Ni 58.7 Nickel	29 Cu 63.5 Copper	30 Zn 65.4 Zinc	31 Ga 27.0 Gallium	32 Ge 72.6 Germanium	33 As 74.9 Arsenic	34 Se 79.0 Selenium	35 Br 79.9 Bromine	36 Kr 83.8 Krypton
5	37 Rb 85.5 Rubidium	38 Sr 87.6 Strontium	39 Y 88.9 Yttrium	40 Zr 91.2 Zirconium	41 Nb 92.9 Niobium	42 Mo 95.9 Molybdenum	43 Tc 99 Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.3 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
6	55 Cs 132.9 Cesium	56 Ba 137.3 Barium	57 La* 138.9 Lanthanum	72 Hf 178.5 Hafnium	73 Ta 181.0 Tantalum	74 W 183.9 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po 210 Polonium	85 At 210 Astatine	86 Rn 222 Radon
7	87 Fr 223 Francium	88 Ra 226 Radium	89 Ac** 227 Actinium	104 Rf 261	105 Db 262	106 Sg 263	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	–	114 Uuq	–	Uuh	–	–

	स	प	न	प	स	ई	घ	ट	द	ह	ई	ट	या	लु
*Lanthanide Series	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm 145 Promethium	62 Sm 150.4 Samarium	63 Eu 152.00 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dyspro-	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.5 Lutetium
**Actinide Series	90 Th 232.0 Thorium	91 Pa 231 Protactinium	92 U 238.1 Uranium	93 Np 237 Neptunium	94 Pu 242 Plutonium	95 Am 243 Americium	96 Cm 247 Curium	97 Bk 245 Berkelium	98 Cf 251 Californium	99 Es 254 Einsteinium	100 Fm 253 Fermium	101 Md 256 Mendelevium	102 No 254 Nobelium	103 Lr 257 Lawrencium
	ट	प	यू	न	प	ई	स	ब	क	इ	फ	म	ना	लू

3317

Important Question :

1. 1 period contains …………. And II period contains …………………… elements.
2. Group 17 elements are called ………..
3. Group 18 elements are …………….. Valent.
4. Which one has the bigger size
   Na (11) or Cl (17) : Cl (17) or F (9) ?
5. Name two elements whose valences are equal to their group numbers.
6. How many elements are there in the 4^{th} period.
7. Give two examples of elements of Groups 1,2, 16 and 17.
8. Group 2 elements are known as ……………

(C) Metallic Radius -

Half of the inter nuclear distance between two adjacent metallic atoms.

$$Metallic\,radius\,\alpha \frac{1}{Metallic\,bond\,strength}$$

(D) Vander Waal's radius -

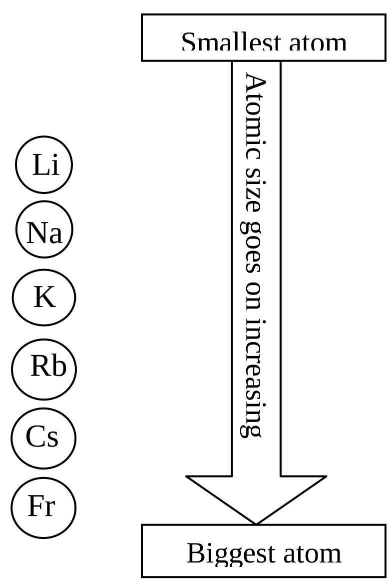
Those atoms which are not bonded with each other experiences a weak attractive to come nearer. Half of the distance between the nuclei of adjacently placed atoms in solid state of a noble gas is vanderwaal's radius.

Vander wall radius = 2 × Covalent Radius

Variation of Atomic size in a group :

On moving down a group of periodic table, the size of the atom increases.

Group-I Elements	**Atomic Radii (pm)**
Lithium (Li)	152
Sodium (Na)	186
Potassium (R)	231
Rubidium (Rb)	244
Cesium (Cs)	262
Francium (Fr)	-

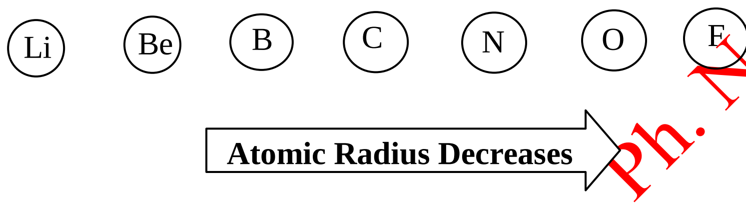


When we move from top to bottom in a group a new shell of electron is added in each period. This addition increases the size.

Variation of atomic size in period :

In general atomic radii decreases across a period from left to right eg. In IInd period. L atom is largest and Fluorine is the smallest atom because nuclear charge increases with increase in atomic number. Electrons are also increasing but these are added to the same shell.

Element	**Li**	**Be**	**B**	**C**	**N**	**O**	**F**
Atomic Number	3	4	5	6	7	8	9
Nuclear charge	+3	+4	+5	+6	+7	+8	+9
Electronic configuration	2 , 1	2 , 1	2 , 3	2 , 4	2 , 5	2 , 6	2 , 7
Radius (pm)	152	111	88	77	74	66	64



Atomic Size :- Decreases along the period. Increases down the group.

Metallic and Non-metallic character :

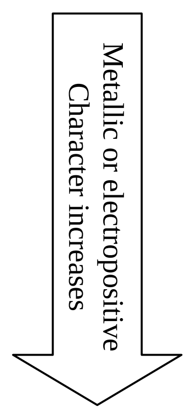
Metallic character is the tendency of atoms of the elements to lose electrons and form positive ions. It can be expressed as:

$$M \rightarrow M^{+} + e^{-}$$

Therefore metals are also called as electropositive elements.

The metallic character increases from top to bottom in a group the metallic character of the element goes on increasing eg. Li is least metallic element while cesium is most metallic element.

Elements	**Metallic character**
Lithium (Li)	Least Metallic
Sodium (Na)	
Potassium (K)	
Rubidium (Rb)	
Cesium (Cs)	Most Metallic



If we use the term electropositive in place of metallic character, we can say that electropositive character goes on increasing as we move from top to bottom in the periodic table. If we consider the electronegative character, it goes on decreasing as we move down in a group of the periodic table.

Ionization Enthalpy :

The minimum amount of energy required to remove the most loosely bounded electron from an isolated gaseous neutral atom to form gaseous electropositive ion called Ionization enthalpy. Its unit is kilo Joules per mole (kJ/mol)

$$M_{(g)} + Energy \rightarrow M^{+}{}_{(g)} + e^{-}$$

It is a measure of tendency to lose electrons by atoms. The tendency to lose electron from top to bottom in a group and it decreases on moving left to right in a period.

Electron gain enthalpy :

It is defined as the amount of energy released when as isolated atom in the ground state accepts an electron to form gaseous negative ion i.e. and anion. It is a measure of tendency of an atom to accept an extra electron to form an anion. Its unit is kilo joule mole (kJ/mole). Electron gain enthalpy of elements goes on increasing as we move from left to right in a period. In group it decreases from to bottom.

PREVIOUS YEARS' BOARD QUESTIONS :

1 Which physical and chemical properties of the elements were used by Mendeleev in creating his periodic table? List two observation which posed a challenge of Mendeleev's periodic law. **(C.B.S.E 2009)**

Ans. The creation of Mendeleev's periodic table was based upon certain physical and chemical properties.
Physical properties : The atomic masses of the elements was taken into account and the elements were arranged in order of increasing atomic masses. The influences of their physical properties such as melting points, boiling points, density etc.
Chemical properties : The distribution of the elements into different groups was linked with formation of hydrides by combining with hydrogen and formation of oxides by combining with oxygen. This is linked with the valency of the elements.
The two main observations which posed challenge to Mendeleev's periodic table are as follows.
(i) Position of isotopes : Since the isotopes of an element differ in their atomic masses, they must be assigned separate slots or positions in the periodic table.
(ii) Anomalous positions of some elements : In the Mendeleev's periodic table, certain elements with higher atomic masses precede or placed before the elements with lower atomic masses. For example, the element Ar (Atomic mass = 39.9) is placed before the element K (Atomic mass = 39.1)

2. Using the part of the periodic table given below, answer the questions that follow.

Group Period	I	II	III	IV	V	VI	VII	Zero
1	H							He
2	Li	Be	B	C	N	O	F	Ne
3	Na	Mg	Al	Si	P	S	Cl	Ar
4	K	Ca						

(i) Na has physical properties similar to which elements and why?
(ii) Write the electronic configuration of N and P
(iii) State one property common to fluorine and chlorine. **(C.B.S.E. All India 2008)**

Ans. (i) Na has physical properties similar to Li and K. All the three elements have one electron each in the valence of their atoms. These are known as alkali metals.

(ii) Electronic configuration of N(z = 7) = 2 ,5

Electronic configuration of P (z = 15) = 2,8,5

(iii) Both the elements have seven electrons in the valence shells as their atoms

Fluorine (z = 19) = 2, 7

Chlorine (z = 17) = 2,8,7

3. Table given below shows a part of the periodic table

H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar

Using this table explain why

(a) Li and Na are considered as active metals.

(b) Atomic size of Mg is less than that of Na.

(c) Fluorine is more reactive than chlorine. **(C.B.S.E. Foreign 2008)**

Ans. (a) Both Li and Na are active elements since their atoms have only one, electron in their valence shells. They readily lose this electron to have the configuration of the nearest noble gas element.

(b) Mg is placed after Na in the same period (third.) As the atomic size decreases along a period, the size of Mg is less than that of Na.

(c) Both F and Cl belong to group 17 (halogen family). Since fluorine is more electronegative than chlorine, it is therefore more reactive also.

4. (a) Why do all the elements of the same group have similar properties ?

(b) How will the tendency to gain electrons change as we go from left to right across a period ? Why ? **(C.B.S.E. All India, 2009)**

Ans. (a) The properties of the elements are linked with the valence shell electronic configuration of their atoms The elements with the sam configuration are expected to have similar properties. In a group, the element are separated by definite gaps of atomic numbers and have same number of electrons in the valence shells of their atoms. For example, the alkali metals in group I have one electron each. They have similar properties. For further details, consult text part.

(b) In moving from left towards the right across a period, the tendency of the elements to gain electrons increases

Explanation. In general, the atoms of all the elements have a desire or urge to have stable electronic configuration of the nearest noble gas elements or to have eight electrons in their outermost or valence shell. Now, across a period the valence electrons are added one by one from left to the right. This is supported by the electronic configuration of the elements present in period 3 or third period.

Element	**Na**	**Mg**	**Al**	**St**	**P**	**S**	**Cl**	**Ar**
No. of valence electrons	1	2	3	4	5	6	7	8
No. of electrons needed in Valence shells	7	6	5	4	5	2	1	0

This clearly shows that the element chlorine needs one electron while oxygen requires two to have to stable electronic configuration. Thus, tendency to gain electrons increases from left to right across a period.

ROUND UP

- Element are classified on the basis of similarities in their physical and chemical properties.
- **Döbereiner** grouped elements into **triads.**
- **Newland** grouped elements on the basis of law of **octaves.**
- **Mendeleev** grouped elements in the increasing order of their atomic masses and similarity in chemical properties.
- **Mendeleev** was able to predict the existence of some elements on the basis of gaps in the periodic table.
- Moseley discovered that fundamental property of an element is its atomic number. rather than atomic mass.
  He revised **Mendeleev Periodic Table** on the basis of **atomic numbers** of elements and removed some of its anomalies.
- Elements in the long form of Modern Periodic Table are arranged in **18 vertical columns** called groups and **7 horizontal** rows called periods.
- The elements arranged in the **long form of periodic table** show (i) periodicity of properties (ii) atomic size (iii) valency (iv) metallic and non-metallic character.

EXERCISE

OBJECTIVE TYPE QUESTIONS :-

1. According to IUPAC recommendations, the number of groups in the long form of the periodic table is :-

(A) 7 (B) 8 (C) 16 (D) 18

2. The law of modern periodic table was proposed by :-

(A) D. I. Mendeleev (B) Döbereiner (C) H.G.I Moseley (D) Newlands

3. the least metallic element of group 1 is :-

(A) Lithium (B) Sodium (C) Potassium (D) Caesium

4. Which of the following properties generally increases on moving from top to bottom ?

(A) Ionization energy (B) Non-metallic character

(C) Atomic size (D) Valency

5. Which of the following statement is not correct about the trends when going from left to right across the periodic table ?

(A) The elements become less metallic in nature (B) The number of valence electrons increases

(C) The atoms lose their electrons more easily (D) The oxides becomes more acidic

6. The law of octaves was proposed by :-

(A) New lands (B) Luther Meyer (C) Döbereiner (D) Mendeleev

7. The number of periods in the long form of the periodic table is :-

(A) 6 (B) 7 (C) 10 (D) 18

8. Which of the following has the maximum non-metallic character ?

(A) F (B) Cl (C) Br (D) I

9. Which of the following sets of elements do not belong to the same group ?

(A) F, Cl, Br (B) Na, K, Rb (C) P, S, Cl (D) C, Si, Ge

10. Which of the following has lowest number of electrons in the valency shell ?

(A) O (B) C (C) N (D) B

11. Which of the following pairs of elements does not belong to same group ?

(A) Cl, Br (B) N, p (C) Mg, Ca (D) Al, Si

12. Which of the following has largest atomic size ?

(A) Be (B) C (C) O (D) F

13. Which of the following belongs to group 18 ?

(A) Sr (B) I (C) Ar (D) Rb

14. What is the basis of long form of the periodic table ?

(A) Atomic mass (B) Atomic number

(C) Atomic size (D) Metallic and Non-metallic character

15. Which one is more metallic element ?

(A) Na (B) Mg (C) Al (D) Si

16. Element X forms a chloride with the formula XCl_2. Which is a solid with a high melting point, X would most likely be in the same group of the periodic table as :-

(A) Na (B) Mg (C) Al (D) Si

FILL IN THE BLANKS :-

1. The horizontal rows in the periodic table are known as …………………

2. The vertical columns of in the periodic table are known as …………..

3. A very short period contains ……….. elements.

4. The element having electronic configuration (2, 8 ,3) belongs to ……….group.

5. In a group atomic radii …………. from top to bottom and in a period atomic radii …………. from left to right.

6. Size of Na^+ is ………….. than sodium atom.

7. Size of Cl^- is …………. than Cl atom.

8. An element 'B' belongs to the second period and group 13,formula of its oxide is …………..

9. Elements in the same group have similar ……………..

10. Elements in the same group have similar …………….. in their outer most shell.

11. The alkaline earth metal with the smallest atomic number is …………..

12. A,B & C are the elements of the Döbereiner's triads. If the atomic mass of A is 7 and that of B is 23, then the atomic mass of 'C' will be ……………….

13. When Mendeleev made the periodic table the number of elements discovered till then were ......

14. Among alkali metal …………. has the smallest atomic radius.

15. Among halogens…………….. has the smallest atomic radius.

16. The amount of energy released when a neutral gaseous atom gains one electron is called………

17. The energy required to remove an electron from an isolated gaseous atom is called…………….

18. Non-metallic character …………. from left to right in a period.

19. Metallic character ………………. down a group.

20. Ionization energy …………….. down a group and ……………. along a period.

21. Atomic size ……………. form left to right in a period.

GIVE THE ANSWER FOLLOWING QUESTIONS :-

1. Why did Mendeleev leave some gaps in the periodic table of element ? Give you answer with examples.

2. Explain why the properties of the 8th element are repeated in case of elements arranged in 2nd and 3rd period of the long from of the periodic table.

3. Where in period 3 of the modern periodic table do we fine :

   (a) non-metals (b) elements forming negative ions

   (c) elements with high melting points (d) elements forming positive ions

   (e) metals

   (f) elements with low boiling points ?

   Mention their atomic number only.

4. If you look at the long of periodic table, you will find that the elements Li, B, C, N, O, F and Ne are present in the second period. Write down their electronic configurations.

5. Examine elements of the third period and classify them as metals and non-metals.

6. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to Group 15 of periodic table. Write the electronic configuration of these elements. Which of these will be more electronegative ? Why ?

7. How could the modern Periodic Table remove various anomalies of Mendeleev's Periodic Table ?

8. Name two element you would expect to show chemical reactions similar to magnesium. What is the basis for your choice ?

9. Name

(a) Three elements that have a single electron in their outermost shells.

(b) Two elements that have two electrons in their outermost shells.

(c) Three elements with filled outermost shells.

10. (a) Lithium, sodium, potassium are all metal that react with water to liberate hydrogen gas is thre any similarity in the atoms of these atoms.

11. In the Modern Periodic Table , which are the metals among the first ten elements ?

12. By considering their position in the periodic table, which one of the following elements would you expect to have maximum metallic characteristic.

Ga Ge As Se Be

13. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic table.

(a) The elements become less metallic in nature.

(b) The number of valence electrons increase

(c) The atoms lose their electrons more easily

(d) The oxides become more acidic

14. Element X forms a chloride with the formula XCl_2, which is a solid with a high melting point X would most likely be in the same group of the periodic table

15. (a) What property do all elements in the same column of the periodic table as boron have in common ?

(b) What property do all elements in the same column of the periodic table as fluorine have in common ?

16. An atom has electronic configuration 2,8,7

(a) What is the atomic number of this element ?

(b) To which of the following elements would it be chemically similar ? (Atomic number are given in parenthesis)

N(7) F(9) P(15) Ar(18)

17. The position of three elements A, B and C in the periodic table are shown below :

Group 16	**Group 17**
-	-
-	A
-	-
B	C

(a) Nitrogen whether A is a metal or non-metal

(b) State whether C is more reactive or less reactive than A.

(c) Will C be larger or smaller in size than B ?

(d) Which type of ion, Cation or anion, will be formed by element A

18. How does the electronic configuration of an atom relate to its positions in the Modern Periodic Table ?

19. In the Modern Periodic Table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19 21 and 38. Which of these have physical and chemical properties resembling calcium ?

20. Compare and contrast the arrangement of element in Mendeleev periodic table and the Modern Periodic Table.

PERIODIC CLASSIFICATION OF ELEMENTS | **ANSWER KEY** | **EXERCISE**

- ***Objective type questions***

1. D2. A 3. A 4. D 5. C 6. A 7. B 8. A 9. C 10. D

11. B 12. A 13. C 14. B 15. A 16. B

- ***Fill in the blanks***

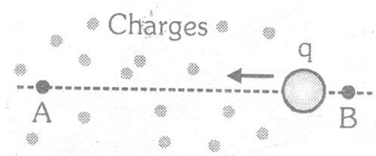
1. Periods	**2.Groups**	**3. 2**	**4. 13**	**5. Increases, decreases**
6. Smaller	**7. Larger**	**8. B2O3**	**9. Properties**	**10. electrons**
11. 4	**12. 15**	**13. 63 elements**		**14. Li**
15. F	**16. Electron affinity**	**17. Ionization energy**		**18. Increases**
19. Increases	**20. Decreases, Increases**		**21. Decreases**	

ELECTRICITY

ELECTRICITY

The source of all electricity is charge. As charge is the basis of all electrical phenomena, we need to know the amount of charge on a body. It is measured in coulombs. The coulomb is the SI unit of charge and its symbol is C. Matter is generally made of protons, electrons and neutrons. Each proton carries a charge of 1.6×10^{-19} coulomb, and each negative charge. Neutrons do not carry any net charge. Normally, a body has equal number of protons and electrons, and is therefore, electrically neutral. In certain situations, the balance of charge in a body is disturbed. For example, when a glass rod is rubbed with a silk cloth, some electrons get transferred from the glass rod to the silk. The silk cloth which gains electrons, becomes negatively charged. And the glass rod, which is left with more protons than electrons, becomes positively charged. Charged particles or object can exert forces on each other. While like (similar) charges repel each other, unlike charge attract. Another important thing about charged particles is that they can flow, i.e., they can move in a particular direction, this flow of charged particles is called an electric current. Charged particles such as electrons are present in all substances. But they do not flow on their own. For flow of charges, there has to be a potential difference.

POTENTIAL DIFFERENCE AND THE FLOW OF CHARGE



The potential difference between two points A and B is the work done per unit charge in taking a charge from B to a. We express this mathematically as

$$\boxed{V = V_A - V_B = \frac{W}{q}}$$

Here, V is the potential difference between the poets A and B, and V_A and V_B are the potentials at these points.

The potential at infinity is chosen as zero.

If B be the reference point, the potential at B is V_B = O. From Equation, the potential at A is $V_A = W/q$. So, the potential at a point is the work done per unit charge in taking a charge to that point from a chosen reference point. Equation may also be written as

$$W = qV.$$

The work done on the charge q is stored as the electric potential energy (U) of the group of charges. So,

$$U = qV$$

UNIT OF POTENTIAL DIFFERENCE

The unit of potential difference (and potential) is the volt, whose symbol is V. One volt is the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

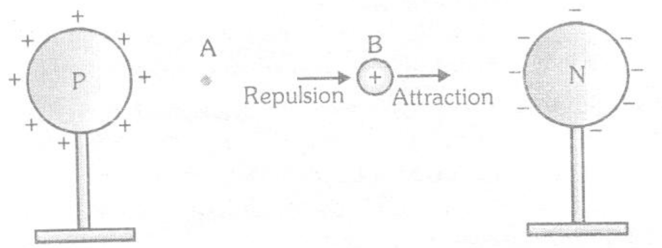
$$\boxed{\frac{1\text{ Joule}}{1\text{ Coulomb}} = 1\text{ volt or } 1V = 1JC^{-1}}$$

The potential difference between two points is sometimes also called the voltage.

FLOW OF CHARGE

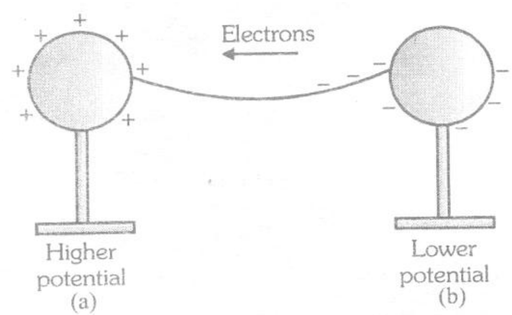
Consider two identical metallic spheres P and N, carrying equal amounts of positive and negative charges respectively. A positive charge is to be taken from B to A. It is attracted by the negatively charged sphere N and repelled by the positively charged sparer P. So, to move the charge towards A , one has to apply a force on it towards the left. Thus, he work done is positive. Hence, the potential difference $V_A - V_B$ is positive. This means $V_A > V_{B'}$.

As one moves towards P, the work done increases; so, the potential increases; And on moving towards N, the potential decreases. So, the potential of P is higher than of N. In general, the potential of a positively charged body is taken as higher than of a negatively charged body.



What happens when a free-to-move charge is placed between the spheres ? A positive charge will move towards the negatively charged sphere. And a negative charge will move towered the positively charged sphere. That is, a free positive charge moves towards lower potential. And a free negative charge moves towards higher potential

If the two spheres are connected by a metal wire, electrons from the negatively charged sphere (at a lower potential) will flow to the positively charged sphere (at a higher potential). Eventually, the flow of electrons causes the charges on the spheres to become balanced. When that happens, the spheres no longer carry a net charge, and therefore, have equal potential. So, the flow of electrons stops. So we can say that **a potential difference causes charges to flow.**



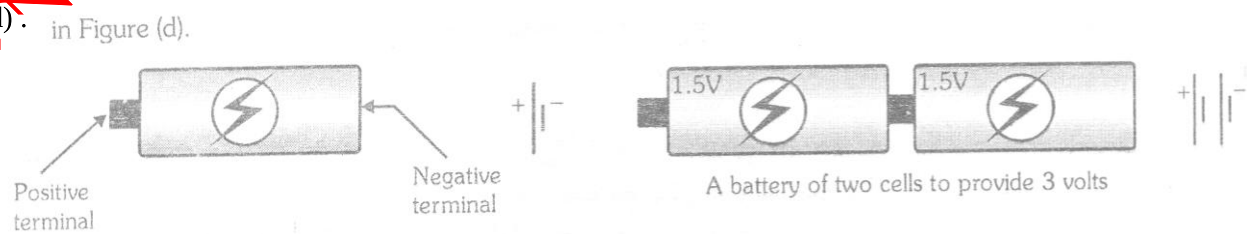
A CELL PROVIDES A CONSTANT POTENTIAL DIFFERENCE

The potential difference provided by things like charged spheres reduces to zero quickly once charges start to flow. So, we have to use cells to provide constant potential difference for a long time. Cells have chemicals inside. Reactions in the cell cause positive and negative charge to gather separately. This creates a potential difference between the terminals of the cell. The terminal at a higher potential is called the positive terminal and the one at a lower potential is called the negative terminal.

The cells that we commonly use are called dry cells (Figure). In a common dry cell, the small metallic cap at one end is the positive terminal, while the flat metallic plate at the other end is the negative terminal. It provides a potential difference of 1.5 V. A cell is represented by the symbol shown in fig (b) . The larger line represents the positive terminal, while the shorter line represents the negative terminal.

A COMBINATION OF CELLS IS CALLED A BATTERY

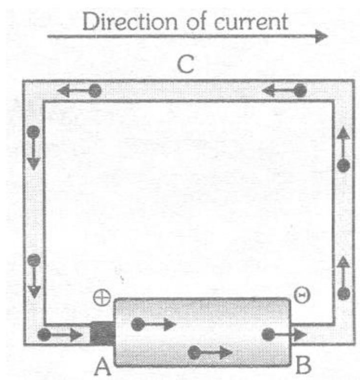
Quite often, multiple cells are combined to get a potential difference that is higher than that of a single cell. For example, we connect two 1.5V cells to get a potential difference of 3V (Figure (c)) This is shown using symbols in Figure (d) .



(a) (b) (c) (d)

ELECTRIC CURRENT

Consider a metallic wire ACB connoted across a cell of potential difference V. Since the end A is connected to the positive terminal, it is at a higher potential than the end B. In metals, some electrons are loosely bound to the atoms, and can move within it. These are called free electros. In the metallic wire, these electrons (negative charges) move from the low-potential side B to the high-potential side A. After reaching A, they enter the cell. The chemical reactions in the cell drive these electrons to the negative terminal. From there, they re-enter the wire at the end B. Thus, there is a continuous flow of electrons in the wire from B to C to A. We say that there is an electric current in the wire. In a metal, the flow of negative charges constitutes the current .



Current in a wire connected to a to a cell

An electric current can also be a flow of positive charges. So, a flow of charge is called an electric current. By convention, the direction of current is taken as the direction of flow of positive charges. Thus, the direction of current is opposite to the direction of flow of negative charges. So, **when a wire is connected to a cell, the current in the wire is from the positive-terminal end to the negative-terminal end.**

MEASUREMENT OF CURRENT

The charge passing per unit time through a given place (area) is the magnitude of the electric current at that place. Thus,

$$\boxed{i = \frac{Q}{t}}$$

Here Q is the charge that passes through a place in time t.

Unit of current From Equation, we find that current is charge divided by time. The SI unit of charge is the coulomb and that of time is the second. The SI unit of current, therefore, is coulomb/second. This unit is called the ampere, whose symbol is A. Thus, if one coulomb of charge passes through a place in one second, the current there is 1 ampere.

CONDUCTOR AND INSULATORS

Materials that conduct electricity easily are called good conductors or simply, conductors, And, materials that do not conduct electricity easily are called insulators.

All metals conduct electricity because they have some loosely bound free electrons, which flow when a potential difference is applied. However, some metals conduct electricity better than others, Silver is the best conductor.

But because of the high cost of silver, electric wires are made of copper, or in some cases aluminum.

Most nonmetallic solids do not conduct electricity. Although diamond and graphite are both forms of carbon (a nonmetal,) graphite is a conductor while diamond is an insulator. Insulators do conduct electricity because their electrons are tightly bound to the atoms. Rubber, plastics, wood glass and porcelain are some examples of insulators. Insulators have many uses. For example, they are used as protective covers on electric wires and electrician's tools.

Certain liquids also conduct electricity. While distilled water is an insulator, addition of certain slats, acids or bases allows it to conduct electricity. Under normal circumstances, gases do not conduct electricity.

ELECTRIC CIRCUITS AND MEASURING INSTRUMENTS

A closed path in which a current can flow is called an electric circuit. An electric circuit may have one or more electric elements such as bulbs (or lamps), cells, switches (or plug keys), metal wires, etc. Each element of a circuit has a specific function to play. For example, wires can be used to connect one element to the next. And a plug key or a switch can be used to either complete or break the closed path, thereby starting or stopping the current in the circuit.

Some common circuit elements and their symbols are shown in Figure.

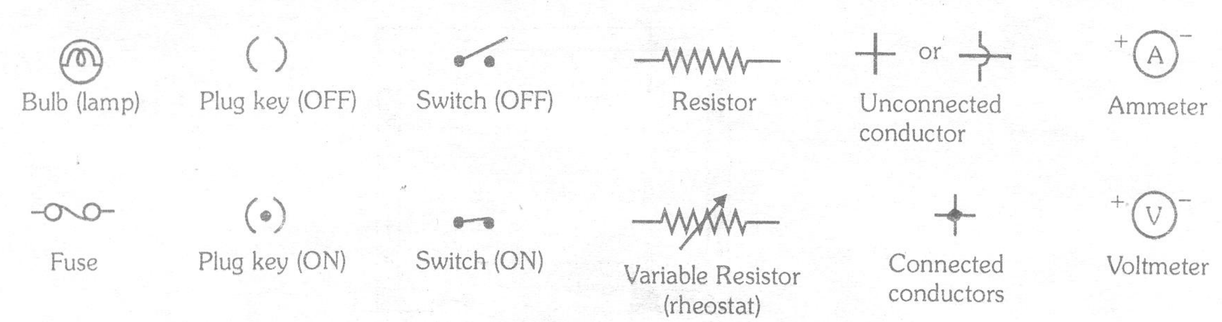


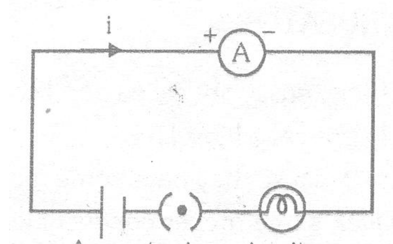
Fig. Some symbols used in circuit diagrams

COMMON MEASURING INSTRUMENTS

The electric current in a circuit is measured by an instrument called the ammeter, and the potential difference between two points in it is measured by a voltmeter (in voltage stabilizers). In these meters, a needle moving over a graduated scale gives the value of the measured quantity. Each meter has two terminals. The terminal marked '+' is connected by a wire to the higher-potential side of a circuit, while the terminal marked '-'is connected to the lower-potential side.

USING AN AMMETER TO MEASURE CURRENT

To measure the current through an element of a circuit, an ammeter is connected in such a way that the current flowing through it also flows through the element. Such a connection is called a series connection. In Figure, the current I flowing through the lamp also flows through the ammeter. The reading of the ammeter gives the current through the lamp. Note that if the ammeter is removed, there will be a gap, and the current through the circuit will stop .

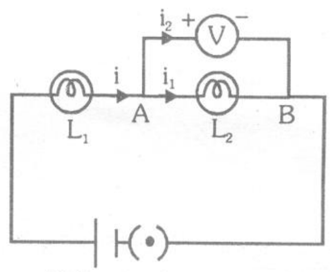


Ammeter in a circuit

Two or more electric elements are said to be connected in series if the current flowing through one also flows through the rest.
An ammeter is always connected in series in a circuit.

USING A VOLTMETER TO MEASURE POTENTIAL DIFFERENCE

Figure shows a circuit that two lamps connected to a cell. We want to measure the potential difference across the lamp L_2, i.e., between the points A and B. As A is on the side of the positive terminal of the cell, its potential is higher than to B. So, the '+' terminal of the voltmeter is connected to A, and the '-'terminal, to B. The reading of the voltmeter gives the potential difference across L_2. The current flowing through the voltmeter is different from those flowing through the other elements of the circuit. Also, even if the voltmeter is removed, the current continues to flow in the circuit. Note that the potential difference across L_2 and the voltmeter is the same. Such a connection is called a parallel connection.



Voltmeter in a circuit

Two or more electric elements are said to be connected in parallel if the same potential difference exists across them.

OHM'S LAW

The electric current through a metallic element or wire is directly proportional to the potential difference applied between its ends, provided the temperature remains constant.

If a potential difference V is applied to an element and a current i pass through it,

$$i \propto V$$

$$\text{or} \quad i = \left(\frac{1}{R}\right)V$$

Thus **Ohm's Law** **V = iR**

here R is a constant for the given element (metallic wire) at a given temperature and is called its resistance. It is the property of a conductor to resist the flow of charges through it.

RESISTANCE

From equation, $i = \frac{V}{R}$

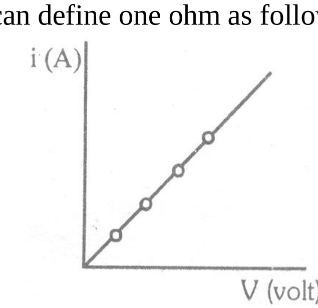
So, for a given potential difference $i \propto \frac{1}{R}$

Thus, for a given potential difference, the current is inversely proportional to the resistance. The higher is the resistance, the lower is the current. If the resistance is doubled, the current is halved. Good conductors have low resistance, while insulators have very high resistance.

UNIT OF RESISTANCE

Potential difference is measured in volts, and current is measured in amperes. From Equation, R = V/i. So, the unit of resistance is volt/ampere. This unit is called the ohm, and its symbol is Ω. We can define one ohm as follows.

If a potential difference of 1 volt is applied across an element, and a current of 1 ampere passes through it, the resistance of element is called 1 ohm,



$$1ohm = \frac{1volt}{1ampere}$$

ON WHAT DOES RESISTANCE DEPEND?

The resistance of the conductor depends (i) on its length, (ii) on its area of cross-section, and (iii) on the nature of its material. Resistance of a uniform metallic conductor is directly proportional to its length (ℓ) and inversely proportional to the area of cross-section (A).

$$R \propto \ell \quad \text{and} \quad R \propto \frac{1}{A}$$

Combining equations, we get $$R \propto \frac{\ell}{A}$$

or $$R = \rho \frac{\ell}{A}$$

where, ρ (rho) is a constant of proportionality and is called electrical of the material of the conductor. The SI unit of resistively is Ω m.

SERIES AND PARALLEL CONNECTIONS OF RESISTORS

A conducting material (e.g., a wire) of a particular resistance meant for use in a circuit is called a resistor. A resistor is sometimes simply referred to as a resistance. It is represented by the symbol . Two or more resistors can be connected in series, in parallel or in a manner that is a combination of these two.

SERIES CONNECTION OF RESISTORS

Two or more resistors are said to be connoted in series if current flowing through one also flows through the rest. The total potential difference across the combination of resistors connected in series is equal to the sum of the potential differences across the individual resistors.

$$V = V_1 + V_2 + V_3$$

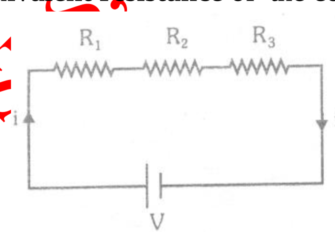
EQUIVALENT RESISTANCE IN SERIES CONCESSION

Figure (a) shows three resistors of resistances R_1, R_2 and R_3 connected in series. The cell connected across the combination maintains a potential difference V across the combination. The current through the cell is i. The same current i flows through each resistor.

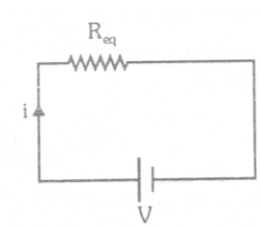
Let us replace the combination of resistors by a single resistor R_{eq} such that current does not change, i.e., it remains i. This resistance is called the **equivalent resistance** of the combination, and its value is given by

Ohm's law as $R_{eq} = V / i$

Thus $V = iR_{eq}$.



(a)



(b)

The potential differences V_1, V_2 and V_3 across the resistors R_1, R_2 and R_3 respectively are given by

Ohm's law as : $V_1 = iR_1$, $V_2 = iR_2$, $V_3 = iR_3$

Since the resistors are in series, $V = V_1 + V_2 + V_3$

Substituting the values of the potential differences in the above equation,

$$iR_{eq} = iR_1 + iR_2 + iR_3$$

or $$iR_{eq} = i(R_1 + R_3)$$

or $$\boxed{R_{eq} = R_1 + R_2 + R_3}$$

Similarly, for n resistors connected in series,

Equivalent resistance of resistors in series : $\boxed{\mathbf{Req = R_1 + R_2 + R_3 + \ldots\ldots\ldots + R_n}}$

PARALLEL CONNECTION OF RESISTORS

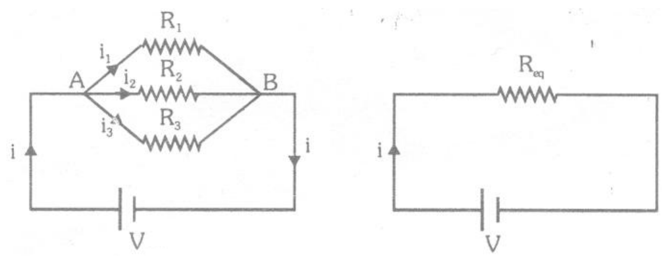
The total current flowing into the combination is equal to the sum of the currents passing through the individual resistors.

$$i = i_1 + i_2 + i_3$$

If resistors are connected in such a way that the same potential difference gets applied to each of them, they are said to be connected in parallel.

EQUIVALENT RESISTANCE IN PARALLEL CONNECTION

Figure (a) shows three resistors of resistances R_1, R_2 and R_3 connected in parallel across the points A and B . The cell connected across these two points maintains a potential difference V across each resistor. The current through the cell is i. It gets divided at A in to three parts i_1, i_2 and i_3. which flow through R_1, R_2 and R_3 respectively.



(a) (b)

Let us replaced the combination of resistors by an equivalent resistor R_{eq} such that the current i in the circuit does not change (Fig). The equivalent resistance is given by Ohm's law as $R_{eq} = V/I$.
Thus,

$$i = \frac{V}{R_{eq}} \text{i}$$

The currents i_1, i_2 and i_3 through the resistor R_1, R_2 and R_3 respectively are given by Ohm's law as

$$i_1 = \frac{V}{R_1}, \qquad i_2 = \frac{V}{R_2}, \qquad i_3 = \frac{V}{R_3}$$

Since the resistors are in parallel ,

$$i = i_1 + i_2 + i_3$$

Substituting the values of the currents in above equation,

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\text{or} \qquad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Similarly, if there are n resistors connected in parallel , their equivalent resistance R_{eq} is given by

Equivalent Resistance of resistors in parallel : $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots\dots\dots\dots + \frac{1}{R_n}$

For two resistances R_1 and R_2 connected in parallel.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R_1 R_2} \qquad \text{or} \qquad R = \frac{R_1 R_2}{R_1 + R_2}$$

The equivalent resistance in parallel connection is less than each of the resistances.
When a resistance is joined parallel to a comparatively smaller resistance, the equivalent resistance is very close to the value of the smaller resistance.

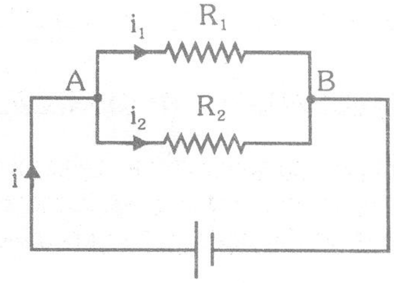
NOTE : If a resistor connected in series with others is removed or fails, the current through each resistor becomes zero. On the other hand, if a resistor connected in parallel with others fails or is removed, the current continues to flow through the other resistors.

DISTRIBUTION OF CURRENT IN TWO RESISTORS IN PARALLEL

Consider the circuit in fig. The resistors R_1 and R_2 are connected in parallel. The current i gets distributed in the two resistors.

$$i = i_1 + i_2 \qquad \dots(i)$$

Applying Ohm's law to the resistor R_1



$$V_A - V_B = R_1 i_1 \qquad \ldots(ii)$$

And applying Ohm's law to the resistor R2

$$V_A - V_B = R_2 i_2 \qquad \ldots(iii)$$

From (ii) and (iii), $R_1 i_1 = R_2 i_2$ or

$$i_2 = \frac{R_1}{R_2} i_1$$

Substituting for i_2 in (i), we have

$$i = i_1 + \frac{R_1}{R_2} i_1 = i_1\left(1 + \frac{R_1}{R_2}\right) = i_1 \frac{R_1 + R_2}{R_2}$$

or $$i_1 = \frac{R_2}{R_1 + R_2} i$$

Similarly, $$i_2 = \frac{R_1}{R_1 + R_2} i$$

Thus, $$\frac{i_1}{i_2} = \frac{R_2}{R_1}$$

The current through each branch in parallel combination of resistors is inversely proportional to its resistance

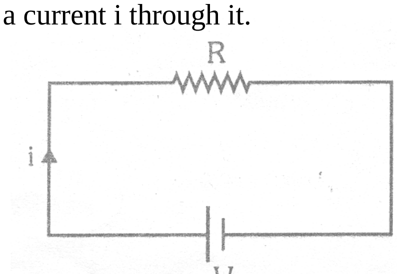
DEVICES IN SERIES AND PARALLEL

You must have seen tiny bulbs strung together for decorating buildings during festivals like Diwali, and occasions like marriages, etc. These bulbs are connected in series , and the mains voltage is applied to the combination. The potential difference (V) of the mains gets divided across the bulbs ($V = V_1 + V_2 + V_3 + \ldots$). So, a small potential difference exists across each bulb, close to that required to make the bulb work. However, the same current flows all the bulbs. So, if one bulb goes bad. The current through it strops. and this stops the current through the rest of the bulbs as well. To make the chain of lights work, we have to find and replace the defective bulb. This problem does not occur with the lights in our house. That is because **in houses, lights, fans, etc., are connected in parallel.** In parallel connection, the same mains voltage gets applied to each device, but the current through each is different. If one of them goes bad, the current in the other branches of the parallel connection does not stop. Another advantage of parallel connection is that, unlike series connection, each device can draw a different current, as per its requirement.

HEATING EFFECT OF ELECTRIC CURRENT

When an electric current passes through a bulb , the filament gets so hot that it glows and emits light. When a current passes through the filament of an electric iron, the iron becomes very not. This increase in temperature is due to what is called 'the heat produced due to current'. Suppose a resistor R is connected to a cell. The cell maintains a potential difference V across the resistor, driving a current i through it.

So, $V = iR \qquad \ldots(i)$



The current through the resistor is actually a flow of negative charges (electrons). Inside the cell, the negative charges flow from the positive to the negative terminal. The cell does work = QV to take a charge through the potential difference V between its terminals. This increases the energy of the charge by QV. This increased energy gets converted to heat in the resistor. So, the energy appearing as heat is given by

$$U = QV \qquad \ldots(ii)$$

The charge that passes through the wire in time is

$Q = it$ …(iii)

Using (i), (ii) and (iii), we find that the heat produced in the wire in time t is

$U = QV = (it)(iR) = i^2 Rt$.

From Equation the heat produced is proportional to the square of the current, if R and t remain constant. So, if the current passing for a given time through a given resistance is doubled, the heat produced becomes four times. Similarly, for a given i and t, the heat produced is proportional to R. If the same current i passes through two resistances in a given time, more heat will be produced in the larger resistance. The heat produced can also be written as.

$$U = i^2 Rt = \left(\frac{V}{R}\right)^2$$

or
$$U = \frac{V^2}{R} t$$

For a given V and t, the heat produced is inversely proportional to R. So, if the same potential difference is applied across two resistances, more heat will be produced in the smaller resistance.

We have seen above that the increased energy of a charge gets converted to heat in the resistor. The increases in energy come from the work done by the cell. This uses up the chemical energy of the cell. So, the energy appearing as heat in the resistor ultimately comes at the expense of the chemical energy of the cell.

Not always is the work done by a cell converted to hart immediately after a motor is connected to a cell, the speed of the shaft of the motor increases. A part of the work done by the cell goes into producing the increase in kinetic energy. And a part is used to overcome friction, etc. When the motor achieves a constant speed, its kinetic energy does not change. So the work done by the cell is only used to overcome friction. etc. This appears as heat. That is why the cover over a motor becomes warm on use.

ELECTRIC POWER

Power is the rate of doing work , or the rate at which energy is produced or consumed . The electrical energy produced or consumed per unit time is called electric power. In an electric circuit, the power is

$$P = \frac{U}{t} = \frac{i^2 Rt}{t} = i^2 R$$

Using $iR = Vi$

$P = Vi$

$$P = \frac{V^2}{R}$$

The energy consumed and power are related as

$U = Pt$.

UNIT OF POWER

The SI unit of energy is the joule, and that of times is the second. The SI unit of power is therefore joule/ second. This unit is called the watt, whose symbol is W.

APPLICATIONS OF THE HEATING EFFECT OF CURRENT

The heating effect of electric current has many uses. Electric bulbs, room heaters, electric irons, immersion heaters, toasters, electric fuses and a number of other appliances work in this principle. In all of these, a wire of suitable resistance, commonly called the heating element, is connected to the power supply. The current passing through the element produces heat in it, which is used for same specific purpose.

ELECTRIC BULB

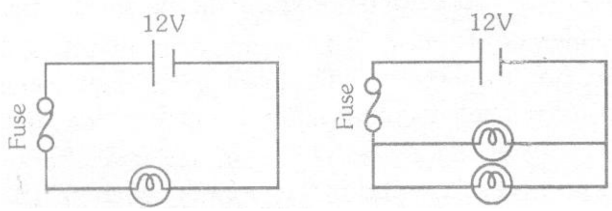
An electric bulb has a simple structure. It consists of a sealed glass bulb that has a tungsten filament connected to two electrical contacts. The bulb is filled with an uncreative gas like argon or nitrogen. To produce white light, the filament has to be heated to about 3000^0 C by passing a currant though it. Obviously, the material of the filament should such that it does not melt at this temperature. Tungsten is used for the filament because its melting point is about 3400^0 C. The sealed glass bulb serves two purposes. First, it protects the filament from oxidation and the effects of humidity. Secondly, the small enclosed volume makes it easier to maintain the required temperature, as without it the loss of heat would be more.

FUSE

A fuse is a safety device that does not allow excessive current to flow through an electric circuit. It consists of a metallic wire of low melting, fixed between the two terminals of a fuse plug. The fuse plug fits into a fuse socket connoted in the circuit. Fuses are available in various shapes. The fuse plug is used in household wiring. it is made f porcelain.

A fuse is connected in series with an appliance (such as a TV) or a group of appliances (such as the lights and fans in room). So, the current through the fuse is the same as the current through the appliance or the group of appliance. If this current exceeds a safe value, the heat produced in the fuse wire causes it to melt immediately. This brakes the circuit, preventing any damage. Figure shows examples of how a fuse is connected in circuits.

Good-quality fuse wires are made of tin, as it has low melting point. Some fuse wires are made of an alloy of tin and copper. The thickness of the fuse wire depends on the circuit in which it is to be used. If a section of the circuit is meant to carry a maximum of 5A current, the fuse wire should also be able to carry currents up to 5A. Similarly, for wiring meant for 15A, the fuse wire should be thicker, and should be able to carry current up to 15 A.



(a) (b)

DISADVANTAGES OF THE HEATING EFFECT OF CURRENT

A current always produces some neat, whether we use the heat or not. If the neat produced cannot be utilized, it represents a wastage of energy. A considerable amount of energy is thus wasted in the transmission of electricity from the generating station to out homes. Sometimes, the heat reduced in a device is so much that it can damage the device, unless power proper cooling arrangements are made. To dissipate the heat produced in TV sets, monitors, etc., their cabinets have grills for air to pass. Certain components of computer get so not that they have fans to cool them.

RATING OF ELECTRIC APPLIANCES

Take an electric bulb and see what is written on it. Apart from the name and the symbol of the company, we will find value of power and potential difference. For example, it could be 60W, 220V. It means that 220V should be applied across this bulb, and when 220V is applied, the power consumed will be 60W. We will find similar markings on all electric appliances. For an electric appliance, the values of power and voltage taken together form what is called the rating of the appliance?

From the rating of an appliance, you can easily calculate its resistance by using the equation $P = \frac{V^2}{R}$. Note that higher the power rating, smaller the resistance. So, a 1000W heater has less resistance than a 100W bulb. We can also calculate the current drawn by an appliance by using relation $i = \frac{P}{V}$.

KILOWATT HOUR

Power is the rate of energy consume or produced. If 1 joule of energy is used per second, the energy is used at the rate of 1 watt. In other words, if energy is used at the rate of 1 watt, the total energy used in 1 second is 1 joule . How much energy is used in 1 hour if it is used at the rate of 1000 watt ?

It is (1000 watt) × (3600 second) = 3, 600,00 joule.

This amount of energy is called 1 kilowatt hour, written in short as kWh. Thus, **1kWh = 3, 600,00j=3.6×10^{6}J**. The electrical energy used in hosed, factories , etc., is measured in kilowatt hours. The cost of electricity is fixed per kilowatt hour. **One kilowatt hour of electrical energy is called one unit.**

NCERT EXERCISE

1. A piece of wire of resistance R is cut into equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio R/R' is :

(A) 1/ 25 (B) 1/5 (C) 5 (D) 25

Ans. Resistance of each one of the five parts $= \frac{R}{5}$

Resistance of five parts connected in parallel is given by

$$\frac{1}{R'} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} \quad \text{or} \quad \frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} = \frac{25}{R}$$

or $\frac{R}{R'} = 25$

Thus, (D) is the correct answer.

2. Which of the following terms does not represent electrical power in a circuit :

(A) I^2R (B) IR^2 (C) VI (D) V^2/R

Ans. Electrical power , $P = VI = (IR)R = t^2R = V\left(\frac{V}{R}\right) = \frac{V^2}{R}$

Obviously , IR^2 does not represent electrical power in a circuit.

Thus, (B) is the current an answer .

3. An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be :

(A) 100W (B) 75 W (C) 50W (D) 25W

Ans. Resistance of the electric bulbs, $R = \frac{V^2}{P}$ $(P = V^2/R)$

or $R = \frac{(220)^2}{100} = 484\Omega$

power consumed by the bulb when it is operated at 110 V is given by

$$P' = \frac{V'^2}{R} = \frac{(110)^2}{484} = \frac{110 \times 110}{484} = 25W \qquad (V' = 100 \text{ V})$$

Thus, (D) is the correct answer .

4. Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then in parallel in electric circuit . The ratio of the heat produced in series and parallel combinations would be :

(A) 1 : 2 (B) 2 : 1 (C) 1 : 4 (D) 4 : 1

Ans. Since both the wires are made of the material and have equal lengths and equal diameters, these have the same resistance. Let it be R.

When connected in series, their equivalent resistance is given by

$R_s = R + R = 2R$

When connected in parallel, their equivalent resistance is given by

$$\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R} \text{ or } R_p = \frac{R}{2}$$

Further, electrical power is given by $P = \frac{V^2}{R}$

Power (or heat produced) in series, $P^s = \frac{V^2}{R_s}$

Power (or heat produced) in parallel, $P_p = \frac{V^2}{R_p}$

Thus, $\frac{p_s}{P_p} = \frac{V^2/R_s}{V^2/R_p} = \frac{R_p}{R_s} = \frac{R/2}{2R} = \frac{1}{4}$

or $P_s : Pp : : 1 : 4$

thus, (C) is the correct answer

5. How is voltmeter connected in the circuit to measure potential difference between two points ?

Ans. A voltmeter is always connected in parallel across the points between which the P.D. is to be determined.

6. A copper wire has a diameter of 0.5 mm and a resistively of 1.6×10^{-6} ohm cm. How much of this wire would be enquired to make a 10 ohm coil ? How much does the resistance change if the diameter is doubled ?

Ans. We are given that, Diameter of the wire, $D = 0.5 \text{ mm} = 0.5 \times 10^{-3}$ m

resistivity of copper, $\rho = 1.6 \times 10^{-3}$ ohm cm $= 1.6 \times 10^{-8}$ ohm m

required resistance, R = 10 ohm

As $R=\frac{\rho\ell}{A}, \ell=\frac{RA}{\rho}=\frac{R(\pi D^2/4)}{\rho}=\frac{\pi R D^2}{4\rho}[A=\pi r^2=\pi(D/2)^2=\pi D^2/4]$

or $\ell=\frac{3.14\times10\times(0.5\times10^{-3})^2}{4\times1.6\times10^{-8}}m=112.7\ m$

Since, $R=\frac{\rho\ell}{\pi D^2/4}=\frac{r\rho\ell}{\pi D^2}.R\propto 1/D^2$. When D is doubled, R becomes $\frac{1}{4}$ times.

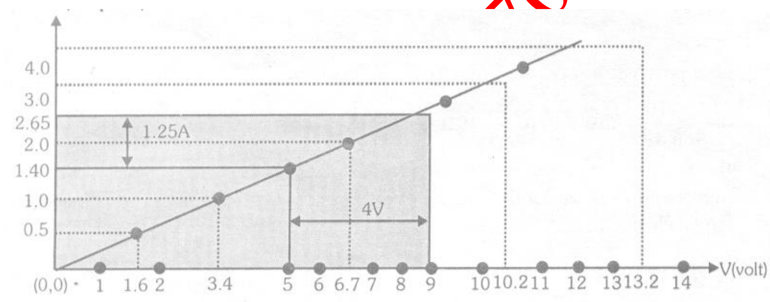
7. The value of current, I, flowing in a given resistor for the corresponding value of potential difference, V, across the resistor are given below :

I (ampere) :	0.5	1.0	2.0	3.0	4.0
V (volt)	1.6	3.4	6.7	10.2	13.2

Plot a graph between V and I and calculate the resistance of resistor.

Ans. The V-I graph is as shown in fig.

I (ampere)



For V = 4V (i.e., 9V – 5V), I = 1.25 A (i.e., 2.65 A – 1.40 A). Therefore, $R=\frac{V}{I}=\frac{4V}{1.25A}=3.2\ \Omega$

The value of R obtained from the graph depends upon the accuracy with which the graph is plotted.

8. When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

Ans. Here, V = 12V, I = 2.5 mA = 2.5 × 10^{-3} A

Resistance of the resistor $R=\frac{V}{I}=\frac{12V}{2.5\times10^{-3}A}=4800\ \Omega=4.8\ k\Omega$

9. A battery of 9 V is connected in series with resistors of 0.2Ω, 0.3Ω, 0.4Ω, 0.5Ω and 12Ω. How much current would flow through the 12Ω resistor ?

Ans. Since all the resistors are in series, equivalent resistance.

$R_s = 0.2\Omega + 0.3\Omega + 0.4\Omega + 0.5\Omega + 12\Omega = 13.4\Omega$

Current through the circuit, $I=\frac{V}{R_s}=\frac{9V}{13.4\Omega}=0.67A$

In series, same current (I) flows through all the resistors. Thus, current flowing through 12Ω resistor = 0.67 A

10. How many 176Ω resistors (in parallel) are required to carry 5 A in 220 V line ?

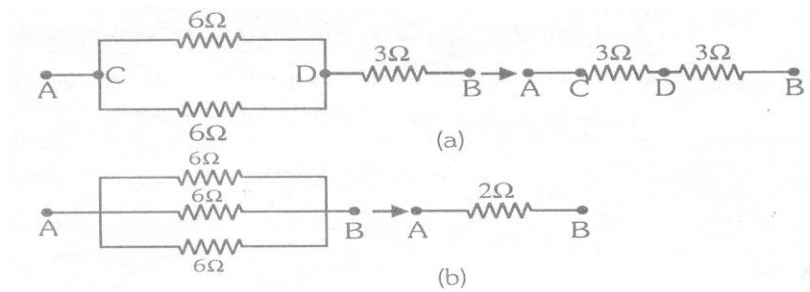
Ans. Here, I = 5A, V = 220 V.

Resistance required in the circuit , $R=\frac{V}{I}=\frac{220V}{5A}=44\Omega$, resistance of each resistor, r = 176 Ω If n resistors, each of resistance r, are connected in parallel to get the required resistance R, then $R=\frac{r}{n}$ or $44=\frac{176}{n}$ or $n=\frac{176}{44}=4$

11. Show how you would three resistors , each of resistance 6Ω, so that the combination has a resistance of (i) 9Ω (ii) 2Ω.

Ans. (i) In order to get a resistance of 9Ω from three resistors , each of resistance 6Ω, we connect two resistors in Parallel combination (or resistance 3Ω) in series with the third resistor as shown in fig.

(ii) In order to get a resistance of 2Ω from three resistors, each of resistance 6Ω, we connect all the three resistors in parallel as shown in fig (b) as equivalent resistance in parallel combination, i.e., R_p is given by $R_p = \dfrac{6\Omega}{3} = 2\Omega$



12. Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A ?

Ans. Resistance of each bulb,

$$r = \frac{V^2}{P} = \frac{(220)^2}{10} = 4840\Omega$$

Total resistance in the circuit, $R = \dfrac{220V}{5A} = 44\Omega$

Let n be he number of bulb (each of resistance r) to be connected in parallel to obtain a resistance R.

Clearly , $R = \dfrac{r}{n}$ or $n = \dfrac{r}{R} = \dfrac{48480\Omega}{44\Omega} = 110$

13. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Ans. Here, potential difference, V = 220 V

Resistance of each coil, r = 24 Ω

(i) When each of the coils A or B is connected separately, current through each foil, i.e.,

$$I = \frac{V}{r} = \frac{220V}{24\Omega} = 9.2A$$

(ii) When coils A and B are connected in series, equivalent resistance in the circuit,

R_s = r + r + r = 48 Ω

Current through are series combination , i.e, $I_s = \dfrac{V}{R_s} = \dfrac{220V}{48\Omega} = 4.6A$

(iii) When the coils A and B are connected in parallel, equivalent resistance in the circuit,

$$R_p = \frac{r}{2} = \frac{24\Omega}{2} = 12\Omega$$

Current through the parallel combination, i.e, $I_p = \dfrac{V}{R_p} = \dfrac{220V}{12\Omega} = 18.3A$

14. Compare the power used in the 2 Ω resistor in each of the following circuits:

(i) a 6V battery in series 1 Ω and 2 Ω resistors, and (ii) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

Ans. (i) Since 6V battery is in series with 1 Ω and 2 Ω resistors, current in the circuit.

$$I = \frac{6V}{1\Omega + 2\Omega} = \frac{6V}{3\Omega} = 2A$$

Power used in 2 Ω resistor, $P_1 = i^2 R = (2A)^2 \times 2\ \Omega$ = 8W

(ii) Since 4 V battery is in parallel with 12 Ω and 2 Ω resistors, pd across 2 Ω resistor, V = 4V. Power used in 2 Ω resistor, $P_2 = \dfrac{V^2}{R} = \dfrac{(4V)^2}{(2\Omega)} = 8W$

Clearly, $\dfrac{P_1}{P_2} = \dfrac{8W}{8W} = 1$

15. Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to the electric mains supply. What current is drawn from the line if the supply voltage is 220 V ?

Ans. Resistance of first lamp , $r_1 = \dfrac{V^2}{P} = \dfrac{(220)^2}{100} = 484\Omega$

Residence of the second lamp, $r_2 = \dfrac{V^2}{P} = \dfrac{(220)^2}{60} = 806.7\Omega$

Since the two lamps are connected in parallel , the equivalent resistance is given by

$$\frac{1}{R_p} = \frac{1}{r_1} + \frac{1}{r_2} = \frac{r_2 + r_1}{r_1 r_2}$$

or $$R_p = \frac{r_2 r_1}{r_1 + r_2} = \frac{484 \times 806.7}{484 + 806.7} = \frac{3904428}{1290.7} = 302.6\Omega$$

Current drawn from the line, i.e., $I = \frac{V}{R_p} = \frac{220V}{302.6\Omega} = 0.73A$

16. Which uses more energy, a 250 W TV set in 1 h, or 1200 W toaster in 10 minutes ?

Ans. Energy used by 250 W TV set in 1 h = 250 W × 1h = 250 Wh
Energy used by 1200 W toaster in 10 min. (i.e., 1/6 h) = 1200 W ×(1/6) h = 200 Wh
Thus, a 250 W TV set uses more power in 1h than a 1200 W toaster in 10 minutes.

17. An electric heater of resistance 8Ω draws 15 A from the service mains for 2 hour. Calculate the rate at which heat is developed in the heater

Ans. Here, I = 15A, R = 8Ω, t = 2h
Rate at which heat is developed , i.e, electric power , P = I^2 R = $(15)^2$ × 8 = 1800 W J/s.

18. Explain the following :

(a) Why is tungsten used almost exclusively for filament of incandescent lamps ?
(b) Why are the conductors of electric heating devices, such as toasters and electric irons, made of an alloy rather than a pure metal ?
(c) Why is the series arrangement not used for domestic circuits ?
(d) How does the resistance of a wire vary with its cross-sectional area ?
(e) Why are copper and aluminum wires usually employed for electricity transmission.

Ans. (a) Tungsten has a high milting point (3380^0C) and becomes incandescent (i.e., emits light at a high temperature) at 2400 K.
(b) The resistivity of an alloy is generally higher than that of pure metals of which it is made of .
(c) In series arrangement, if any one of the appliances fails or is swathed off, all the other appliances stop working because the same current is passing through all the appliances.
(d) The resistance of wire (R) varies inversely as its cross-sectional area (A) as R$\propto$ 1/A.
(e) Copper and Aluminium wires possess low resistivity and as such are generally used for electricity transmission.

EXERCISE – 1 (FOR SCHOOL / BOARD EXAMS)

OBJECTIVE TYPE QUESTIONS

CHOOE THE CORRECT ONE

1. The space around a charge in which its effect can be felt is called its
(A) potential (B) field (C) field intensity (D) potential difference

2. The force acting on a unit positive test charge at a point inside an electric field is called
(A) potential (B) field
(C) field intensity (D) potential difference.

3. Work done in moving a unit positive test charge from infinity to a point inside an electric field , is called
(A) electric potential (B) field
(C) field intensity (D) potential difference.

4. Work done is moving a unit positive test charge from point to other insider an electric field , is called
(A) potential (B) field
(C) field intensity (D) potential difference.

5. Electricity constituted by electric charge at rest on the surface of a conductor, is called
(A) positive electricity (B) negative electricity (C) current electricity (D) static electricity.

6. Electricity constituted by moving electric charges, is called
(A) positive electricity (B) negative electricity (C) current electricity (D) static electricity.

7. Time rate of flow of electric charge measures electric

(A) circuit (B) current (C) potential difference (D) cell.

8. The condition for an electric charge to flow one point to other is that the two points must have electric

(A) circuit (B) current (C) potential difference (D) cell.

9. The device that maintains electric potential difference between two points is called electric

(A) circuit (B) current (C) potential difference (D) cell.

10. The path connecting two points at different potentials, to make the electric charges flow, is called electric

(A) circuit (B) current (C) potential difference (D) cell.

11. The device which measures electric potential difference between two points is called

(A) ammeter (B) voltmeter (C) manometer (D) water meter

12. The device which measures electric current through a conductor is called

(A) ammeter (B) voltmeter (C) manometer (D) water meter

13. Electric current is produced by flow of

(A) electrons (B) protons (C) negative ions (D) positive ions

14. Direction of flow of conventional current is taken from

(A) negative to positive (B) positive to negative

(C) any of the above two (D) none of the above two

15. The law which gives a relation between electric potential difference and electric current is called

(A) Faraday's law (B) Oersted's law (C) Ohm's law (D) Newton's law

16. With increase in temperature, resistance of a conductor

(A) decreases

(B) increases

(C) may decreases or increase according to the situation

(D) no particular observation

17. In series combination, total resistance

(A) decreases (B) increases

(C) may decrease or increases according to the situation (D) no particular observation

18. In parallel combination, total resistance

(A) decreases (B) increases

(C) may decrease or increase according to the situation (D) no particular observation.

19. In series combination, resistance increases due to increase in

(A) temperature (B) humidity

(C) length (D) area of cross-section

20. In parallel combination, persistence decreases due to increase in

(A) temperature (B) humidity (C) length (D) area of cross-section

21. Central part of an atom is called

(A) molecule (B) proton (C) ion (D) nucleus.

22. In an atom, particle having no charge, is called

(A) neutron (B) proton (C) electron (D) ion

23. In an atom, particle having a positive charge is called

(A) neutron (B) proton (C) electron (D) ion

24. In an atom, particle having a negative charge, is called

(A) neutron (B) proton (C) electron (D) ion

25. Substances whose atoms have more free electrons, are called

(A) electrolytes (B) conductors (C) insulators (D) semiconductors

26. Substances whose atoms have no free electrons, are called

(A) electrolytes (B) conductors (C) insulators (D) semiconductors

27. Substances whose atoms have only few free electrons, are called

(A) electrolytes (B) conductors (C) insulators (D) semiconductors

28. A neutral body has
(A) both types of positive and negative charges (B) only positive charge
(C) only negative chare (D) no charge at all

29. A body gets positively charged by losing
(A) neutron (B) protons (C) electrons (D) $\alpha -$ particles

30. A body gets negatively charged by gaining
(A) neutron (B) protons (C) electrons (D) $\alpha -$ particles

31. Time rate of work done or electrical energy developed or consumed by a generator or appliance, is called electrical
(A) current (B) power (C) potential (D) energy

32. The unit of electrical power is
(A) watt (W) (B) ampere (A) (C) joule (J) (D) ohm (Ω)

33. In series combination of electrical appliances, total electrical power
(A) increases
(B) decreases
(C) may increase or decrease according to the situation
(D) no definite observation.

34. In parallel combination of electrical appliances, total electrical power
(A) increases
(B) decreases
(C) may increase or decrease according to the situation
(D) no definite observation.

35. Power voltage rating of an electric bulb is 100 W 200 V. Current drawn by it will be
(A) 1.0 A (B) 0.8 A (C) 0.5 A (D) 0.4 A

36. The total work done by an electrical appliance during its operation, is called electrical
(A) current (B) power (C) potential (D) energy

37. The unit of electrical energy is
(A) watt (W) (B) ampere (A) (C) joule (J) (D) ohm (Ω)

38. Number of joules in 1 kWh is
(A) 3.6×10^7 (B) 3.6×10^6 (C) 3.6×10^5 (D) 3.6×10^4

39. When electric current flow through a conductor the conductor becomes
(A) cold (B) hot (C) liquid (D) vapor

40. When electric current flows through a concoctor
(A) free electrons move
(B) atoms move
(C) atoms attract free electrons
(D) atoms repel free electrons

41. Heating of a current carrying conductor is due to
(A) loss of kinetic energy of moving atoms
(B) loss of kinetic energy of moving electrons
(C) attraction between electrons and atoms
(D) repulsion between electrons and atoms

42. The correct relation between heat produced (H) and electric current (I) flowing
(A) $H \propto I$ (B) $H \propto 1/I$ (C) $H \propto I^2$ (D) $H \propto 1/I^2$.

43. In Q. 42, the relation between H and I is called
(A) Newton's law
(B) Faraday's law

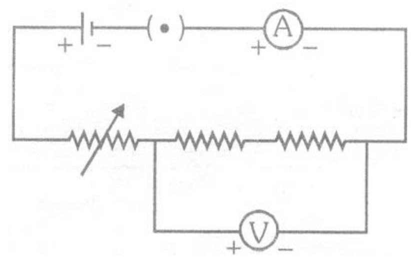
(C) Ohm's law
(D) Joule's law

44. In electric heating appliances the material of the heating element is
(A) brass (B) nichrome (C) silver (D) copper.

45. In domestic electric circuits, the cheapest appliance used is
(A) fuse (B) bulb (C) fan (D) television.

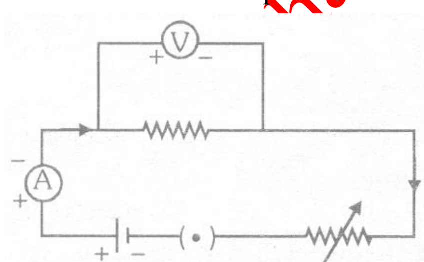
46. An ammeter has 20 divisions between mark 0 and mark 2 on its scale. The least count of the ammeter is
(A) 0.02 A (B) 0.01 A (C) 0.2 A (D) 0.1 A

47. To determine the equivalent resistance of two resistors when connected in series , a student arranged the circuit components as shown in the diagram. But he did not succeed to achieve the objective .



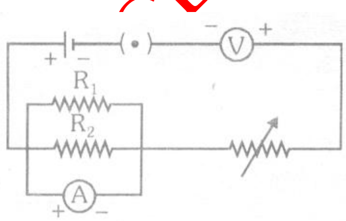
Which of the following mistake has been committed by him in setting up the circuit ?
(A) Position of ammeter is incorrect
(B) Position of voltmeter is incorrect
(C) Terminals of voltmeter are wrongly connected
(D) Terminals of ammeter are wrongly connected

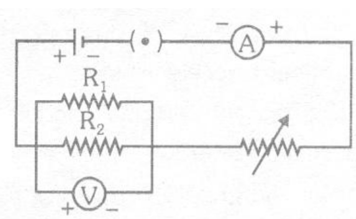
48. Which two circuit components are connected in parallel in the following circuit diagram ?

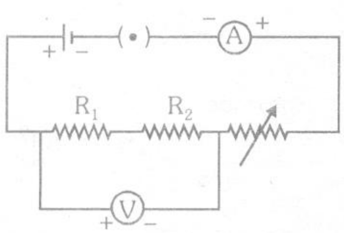


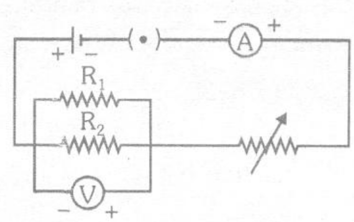
(A) rheostat and voltmeter (B) voltmeter and resistor
(C) ammeter and resistor (D) voltmeter and ammeter

49. The correct set up for determining the equivalent resistance of two resistors R_1 and R_2 when connected in parallel is :

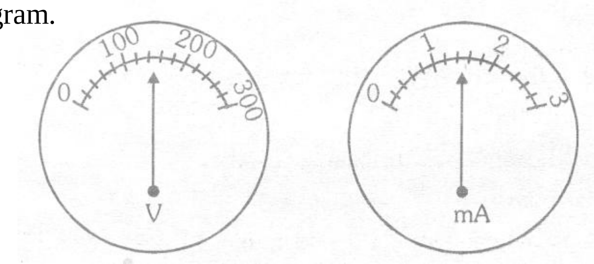
(A)


(B)


(C)


(D)


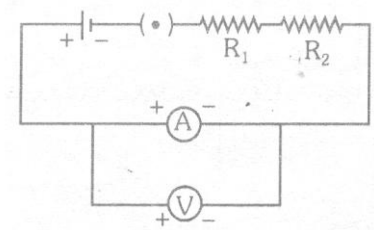
50. The current flowing though a resistor connected in electrical circuit and the potential difference developed across its ends are shown in the following diagram.



The value of resistance of the resistor in ohm is

(A) 10 (B) 15 (C) 20 (D) 25

51. To determine the equivalent resistance of a series combination of two resistors R_1 and R_2, a student arranges the following set up



Which one of the following statement will be true of this circuit ?

(A) incorrect reading for current I as well as potential difference V

(B) correct reading for current I but incorrect reading for potential difference V

(C) correct reading difference V but correct reading for current

(D) correct reading for both current as well as potential difference.

52. In a voltmeter there are 20 divisions between 0 mark and 0.5 mark. The least count of the voltmeter is

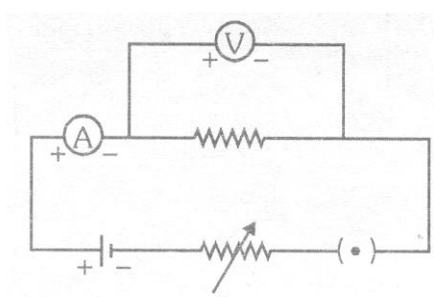
(A) 0.020 V

(B) 0.025 V

(C) 0.050 V

(D) 0.250 V

53. The following circuit diagram shown the experimental set up for the study of dependence of current on potential difference. Which two circuit components are connected in series ?



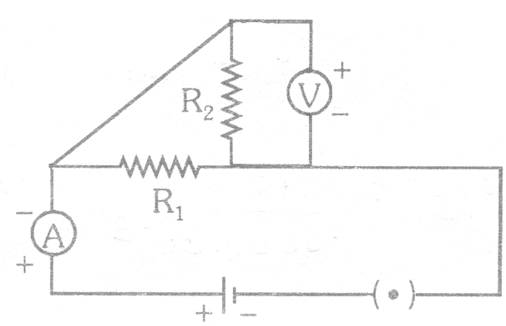
(A) Battery and voltmeter

(B) Resistor and voltmeter

(C) Ammeter and rheostat

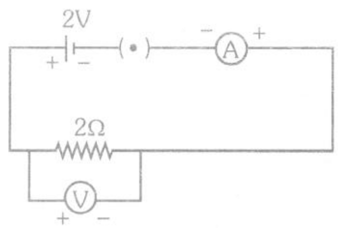
(D) Ammeter and voltmeter

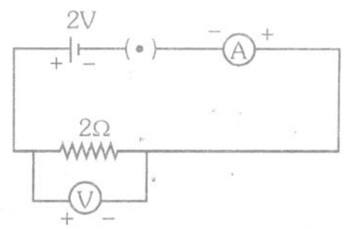
54. Which of the circuit components in the following circuit diagram are connected in parallel ?



(A) R_1 and R_2 only
(B) R_2 and V only
(C) R_1 and V only
(D) R_1 , R_2 and V only

55. For the circuit diagram shown in figures I and II voltmeter reading would be





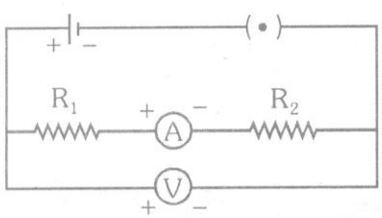
(A) 2 V in circuit (I) and 0 V in circuit (II)

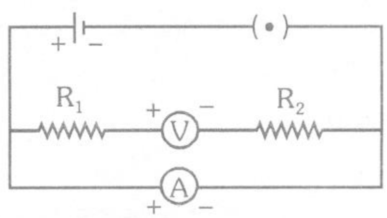
(B) 0 V in both circuits

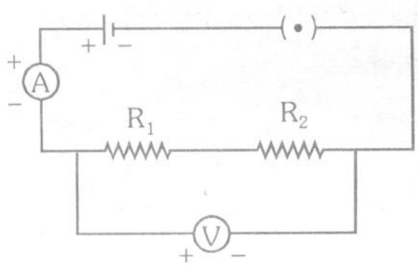
(C) 2 V in both circuits

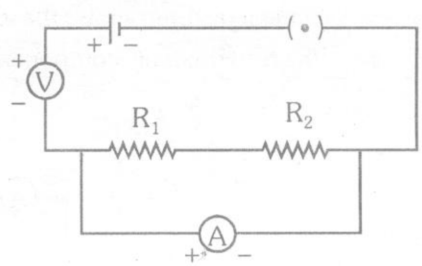
(D) 0 V in circuit (I) and 2 V in circuit (II).

56. In an experiment to determine equivalent resistance of two resistors R_1 and R_2 in series, which one of the following circuit diagrams shows the correct way of connecting the voltmeter in the circuit ?

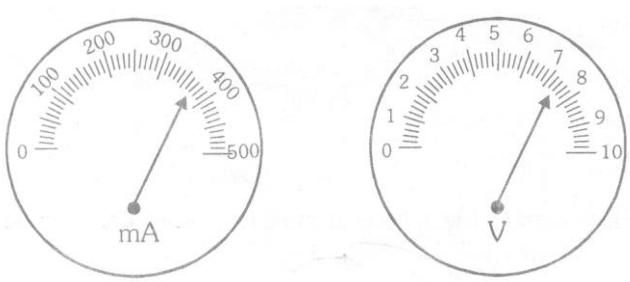
(A)


(B)


(C)


(D)


57. Current following through a conductor and the potential difference across its two ends are as per reading of the ammeter and voltmeter shown below. The resistance of the conductor and could be



(A) 0.02 Ω

(B) 20.0 Ω

(C) 0.024 Ω

(D) 24.0 Ω

58. The following instruments are available in a laboratory

Milli ammeter A_1 of least count 10 mA and range 0-300 mA

Milli ammeter A_2 of least count 20 ma and range 0-200 mA

voltmeter V_1 of least count 0.2 V and range 0-5 V

voltmeter V_2 of least count 0.3 V and range 0-3 V

Out of the following pairs of instruments which pair would be the best choice for carrying out the experiment to determine the equivalent resistance of two resistors connected in series ?

(A) milli ammeter A_1 and voltmeter V_2

(B) milli ammeter A_2 and voltmeter V_1

(C) milli ammeter A_1 and voltmeter V_1

(D) milli ammeter A_2 and voltmeter V_2

EXERCISE – 2 (FOR SCHOOL / BOARD EXAMS)

VERY SHORT ANSWER QUESTIONS

1. Write the unit of electric potential .

2. Define the potential a point.

3. Define the potential difference between two points.

4. A dry cell usually has a small cap at one and end and a flat surface at the other end. Which of the two is at a higher potential ?

5. Name the instruments used to measure electric current and potential difference respectively. Which of these is connected in series and which is connected in parallel in a circuit ?

6. What is the shape of graph between V and i, where V is the potential difference between the ends of a wire and i is the current in it ?

7. Consider the units volt, and ampere. One of them is the same as the product of other two. Which one is this ?

8. Name three electrical appliances in which the heating effect of electric current is used.

9. Two bulbs have ratings 100W, 220V and 60W, 220V. Which one has a grater resistance ?

10. You have two resistors of resistances 3 Ω and 60 Ω. What resistances can you get by combining the two ?

11. Dray a diagram to show two resistors R_1 and R_2 connected in series.

12. Two resistors of 5Ω and 10Ω are connected in series in a circuit . How does the current passing through them compare ?

13. A wire of resistance 10Ω is bent to form a closed circle. What is the resistance across a diameter of the circle ?

SHORT ANSWER QUESTIONS

14. What is the difference between a conductor and an insulator ? Give one example of each .

15. The current in a wire is one ampere. Explain this statement in terms of the charge flowing through the wire.

16. When do you say that the resistance of a wire is $1\,\Omega$?
17. Draw a circuit diagram for a circuit in which two resistors A and B are joined in series with a battery, and a voltmeter is connected to measure the potential difference across the resistor A.
18. When are resistors said to be connected in series ?
19. When are resistors said to be connoted in parallel ?
20. Why is tungsten suitable for making the filament of a bulb ?
21. Why is tungsten not used as a fuse wire ?
22. Alloys are preferred over metals for making the heating element of heaters. Why ?
23. Silver is a better conductor of electricity than copper. Why then do we use copper wire for conducting electricity ?
24. State Ohm's law. How can it be verified ?
25. When the terminals of a cell are connected to the ends of an iron rod, electric current flows through the rod. When the terminals are connected to the ends of a wooden rod, no current flows. Explain why, when the wooden rod also has a large number of electrons.
26. Define electric current and state its unit. How can Ohm's law be used to define ohm ?
27. Deduce the expression for the equivalent resistance of the parallel combination of two resistances R_1 and R_2.
28. Deduce the expression of the equivalent resistance of the two resistances R1 ad R2 connected in series.
29. Derive and expression for the heat produced in time t in a wire of resistance R_1 which is carrying a current it .

FILL IN THE BLANKS

1. The diameter of atom is of the order of ……………………………m.
2. The diameter of nucleus of the order of ……………………………………m.
3. The negative charge on an electron is …………………..C.
4. The sign of charge on a proton is …………………..
5. The value of charge on a neutron is ………………..
6. Conductors have ……………………..free electrons.
7. Insulators have……………………….free electrons.
8. Semiconductors have……………………..free electrons.
9. The sign of charge on a body which has gained electrons is…………………..
10. The sign of charge on a body which has lost electrons is…………………
11. The charge that produces electric field is called a………………………..charge.
12. The charge that measures the intensity of electric at a point is called a ………………………charge.
13. Electric potential at a point in an electric field is measured as the …………………..done in bringing, a unit positive test charge from infinity to that point.
14. Static electricity is constituted by electric charges……………….on the surface of a conductor.
15. Current electricity is constituted when the charges……………………..in a conductor.
16. The expression for eclectic current is…………………..
17. The S.I. unit of electric current is ………………………
18. The ratio V/I is called …………………..
19. S.I. unit of resistance is…………………….
20. A voltmeter measures ……………………between two points.
21. An ammeter measures …………………….through a conductor.
22. Resistance increases in ………………combination.
23. Resistance decreases in ………………combination.
24. In a series combination, resistance increases due to increase in…………………
25. In a parallel combination, resistance decreases due to increase in……………………..
26. Watt is the S.I. unit of electrical ………………

27. Joule is the S.I. unit of electrical ………………
28. In series combination, power …………....
29. In parallel combination, power ………………
30. Decrease of power of combination, is due to increase of ………………..
31. Increase of power of combination in due to decrease of ………………..
32. Filament of an electric bulb of low power has …………………….resistance.
33. The power is and electric bulb which takes 0.25 A current at 20 V is ………………W.
34. An electric current heats a conductor due to loss of kinetic energy of …………………
35. For same battery, heating of a wire will…………………if is resistance is increased.

MARK THE STATEMENT TRUE (T) OR FALSE (F)

1. An electron has a negative charge of 1.6×10^{-19} C.
2. A neutron has a positive charge of 1.6×10^{-19} C.
3. Conductors have more free electrons .
4. Insulators have few free electrons.
5. Proton has a positive charge.
6. Neutral atom has no charge.
7. A field charge has its own electric field.
8. The field intensity is measured by the field charge.
9. A point insider an electric field has an electric potential .
10. No work is done moving a test charge between two points at different potential.
11. Electric potential is a scalar quantity.
12. Electric field intensity is also a scalar quantity
13. Electric current is due to flow of electrons.
14. In electric current, electros flow from positive (higher) to negative (lower) potential/
15. A voltmeter measures electric potential difference between two poets.
16. A voltmeter has low resistance.
17. An ammeter measures electric current flowing through a resistance.
18. An ammeter has a high resistance.
19. In series combination, total resistance is more than the highest resistance.
20. In parallel combination, total resistance lies in between the lowest and the highest resistance.
21. Electrical power is time rate of production or consumption of electrical energy .
22. Kilo-watt-hour is the unit of electrical power.
23. To increase total power, we connect the appliances in parallel .
24. In house light, connecting the appliances in series will be easier and economical.
25. In parallel a 100W bulb glows more that a 25W bulb.
26. In series, a 25 W bulb glows less than a 100W bulb.
27. A high power bulb takes more current.
28. A high power bulb has more resistance.
29. More bulbs connected in parallel produce more light.
30. More bulbs connected in series produce more light .

NUMERICALS

1. How much work will be done in bringing a charge of 5.0 milli coulombs from infinity to a point P at which the potential is 12V ?
2. A particle with a charge of 1.5 coulombs is taken from a point A at a potential of 50V to another point B at a potential of 120 V. Calculate the work done.

3. How many electrons are required to get 1C of negative charge ?

4. Calculate the current a wire if 900C of charge passes through it in 10 minutes .

5. How much current will flow through a resistor of resistance $12\,\Omega$ if a battery of 18 V is connected across it ?

6. Calculate the resistance of a copper wire of length 1m and area of cross section $2mm^2$. Resistively of copper is $1.7 \times 10^{-8}\,\Omega$ m.

7. A copper wire has a resistance of $0.5\ \Omega$. Another copper wire of the same as the first one is double in length of the first. Find the resistance of the second wire.

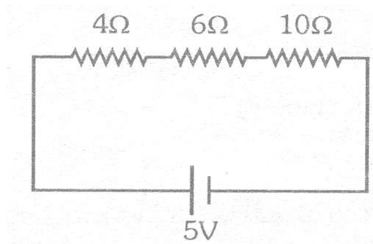
8. In an experiment to verify Ohm's law, the current through a resistor and the potential difference across it are measured. From the values given below, plot a graph of i versus V. Show that the data confirms Ohm's law, and find the resistance of the resistor.

Current (A)	**0.1, 0.2, 0.3, 0.4**
Potential difference (V)	**1.2, 2.4, 3.6, 4.8**

9. When a potential difference of 20 V is applied across a resistor, it draws a current of 3A. If 30 V is applied across the same resistor, what will be the current .

10. How will the resistance of a wire change if its diameter (d) is doubled , its length remaining the same ?

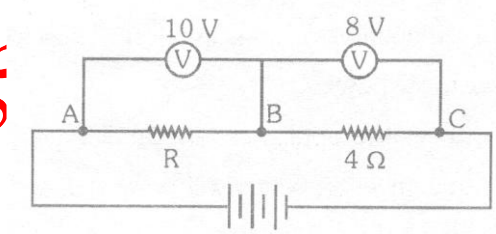
11. Calculate the potential difference across each resistor in the circuit shown in figure.



12. Three identical bulbs are connected in parallel with a battery. The current drawn from the battery is 6A. If one of the bulb gets fused, what will be the total current drawn from the battery ?

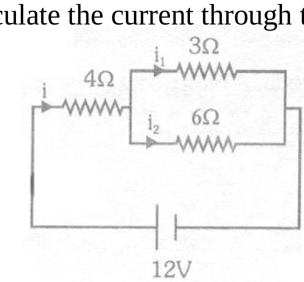
13. A uniform wire of resistance R is cut into three equal pieces. and these pieces are joined in parallel. What is the resistance of the combination ?

14. Consider the circuit shown in figure. The voltmeter on the left reads 10 V and that on the right reads 8V. Find **(a)** The current through the resistance R, **(b)** the value of R, and **(c)** the potential difference across the battery .



15. Three resistors of resistances $10\,\Omega$, $20\,\Omega$ and 30 are connected in parallel with a 6V cell. Find (a) The current through each resistor, (b) the current supplied by the cell, and (c) the equivalent resistance of the circuit.

16. Consider the circuit shown in fig. Calculate the current through the $3\,\Omega$ resistor .



17. When two resistors are joined in series, the equivalent resistance is $90\,\Omega$. When the same resistors are joined in parallel, the equivalent resistance is $20\,\Omega$. Calculate the resistance of the two resistors.

18. (a) How will you join three resistance of resistance 4Ω, 6Ω and 12Ω to get an equivalent resistance of 8Ω.
(b) What would be the highest and the lowest equivalent resistances possible by joining these resistors.

19. How many bulbs of resistance 6 ohms should be joined in parallel to draw a current of 2 amperes from a battery of 3 volts ?

20. A current 4A passes through a resistance of 100Ω for 15 minutes, Calculate the heat produced in calories.

21. A 12V battery is connected to a bulb. The battery sends a current of 2.5a through it. Calculate
(a) the power delivered to the bulb , and
(b) the energy transferred to the bulb in 5 minutes.

22. A current is passed through a resistor for some time. It produces 400 cal of heat in this period. If the current is doubled, how much heat will be produced for the same duration.

23. Calculate the wattage of an electric heater which draws 5A current connected to a 220V power supply.

24. A bulb draws 24W when connected to a 12V supply. Find the power if it is connected to a 6V supply. (Neglect resistance change due to unequal heating in the two cases.)

25. Two identical resistance R are connected in series with a battery of potential difference V for time t. The resistor are later connoted in patroller and the same battery is connected across the combination for time t. Compare the heat produced in the two cases .

26. A bulb is rated 40W, 220V. Find the current drawn by it when connoted to a 220V supply.

27. A bulb is rated 60W, 240V. Calculate its resistance when it is on. If the voltage drops to 192V, what will be the power consumed and the current drawn ?

28. A room has two the lights, a fan and a TV. Each tube light draws 40W. the fan drawn 80W, and the TV draws 60W. On the average, the tube lights are kept on for five hours. The fan for twelve hours and the TV for eight hours every day. The rate for electrical energy is Rs. 3.10 per kWh. Calculate the cost of electricity used in this room in a 30 day month.

29. When a particle of charge $10\,\mu$C is brought from infinity to a point P, 2.0 mJ of work is done by the external forces. What is the potential at P ?

30. Calculate the work done in taking a charge of 0.02C from A to B if the potential at A is 20V, and that at B is 30V.

31. How much charge flows through a wire in 10 minutes if the current through it is 2.5A ?

32. A 2V cell is connected to a 1Ω resistor. How many electrons same out of the negative terminal of the cell in 2 minutes ?

33. The amounts of charge passing through a cell in 4 seconds is 12C. What is the current supplied by the cell ?

34. A 6V battery is connected across a 5Ω resistor. Calculate the current passing through the resistor.

35. When a 24V battery is connected to a resistor, the current in it is 0.4A. What is the resistance of the resistor ? What would be the current through it when it is connected to a battery of 6V ?

36. In an experiment, the current flowing through a resistor and the potential difference across it are measured. The values are given below. Show that these values confirm Ohm's law, and the resistance of the resistor,

i (ampere)	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
V (volt)	**4.0**	**6.0**	**8.0**	**10.0**	**12**

37. The resistivity of copper is $1.7 \times 10^{-8}\ \Omega m$.
(a) What length of copper wire of diameter 0.1 mm will have a resistance of $34\ \Omega$.
(b) Another copper wire of same length but of half the diameter as the first is taken. What is the ratio of its resistance to that of the first wire ?

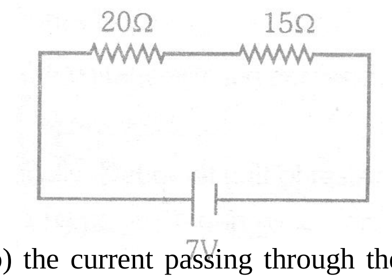
38. Three resistors, each of resistance 12Ω, are connected in parallel. What is the equivalent resistance ?

39. A uniform wire of resistance R is cut into two equal pieces. and these pieces are joined in parallel. What is the resistance of the combination ?

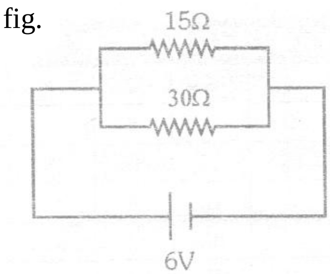
40. You have three resistors of 9 ohms each. By combining them what can be (a) the highest resistance, and (b) the lowest resistance ? (c) How can you combine them to get a resistance of $12\,\Omega$?

41. How will you join the resistors of resistance $3\,\Omega$, $6\,\Omega$ and $8\,\Omega$ to get an equivalent resistance of $10\,\Omega$?

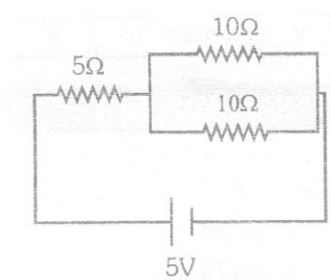
42. Find the current through the circuit shown in fig. Also find the potential difference across the $20\,\Omega$ resistor.



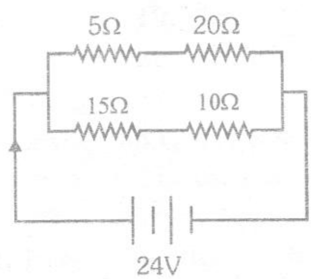
43. Find (a) the equivalent resistance, (b) the current passing through the cell, and (c) the current passing through the $30\,\Omega$ resistor in the circuit shown in fig.



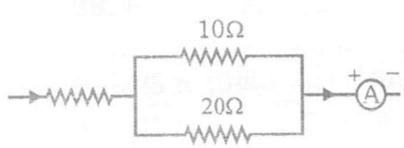
44. Find the current supplied by the cell in the circuit shown in fig.



45. In the circuit shown below, calculate the total resistance of the circuit and the current flowing through it.



46. Fig shows a part of an electric circuit. The reading of ammeter is 3.0A. Find the currents through the $10\,\Omega$ and $20\,\Omega$ resistors.



47. A 12V battery connoted to a bulb drives a current of 2.0A through if. Find the energy supplied by the battery in 10 minutes.

48. A current of 1.5A flows through a wire of $8\,\Omega$. Find the amount of heat produced in 10 seconds.

49. A current of 2A produces 200J of heat in a wire in a given period of time. If the current is increases to 4A how much heat will be produced in the same time.

50. A bulb is rated 5.0V, 100mA. Calculate its rated power and resistance .

51. Calculate the resistance of a bulb rated 40W, 230 V when in ON condition.

52. Calculate the current passing through a bulb rated 60W, 240V when it is connected to a 240V power supply.

53. Two resistors of resistances $10\,\Omega$ and $20\,\Omega$ are joined in series. A potential difference of 12V is applied across the combination. Find the power consumed by each resistor .

54. Two resistors of resistances $10\,\Omega$ and $20\,\Omega$ are joined in parallel. A potential difference of 12V is applied across the combination. Find the power consumed by each resistor.

55. Calculate the energy consumed in kilowatt hours by a 60W fan in 2 hours .

56. A heater draws 1100W at 220W.

(a) Find the resistance of the heater when in ON condition.

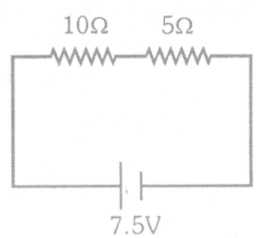
(b) Calculate the kilowatt hours consumed in a week if the heater is used daily for four hours at the rated voltage.

57. A bulb used in a car is rated 12V, 48W. Find the energy consumed in one minute when the bulb is connoted to (a) a 12V battery and (b) a 6V battery .

58. 6×10^7 electrons cross through an area per minute. What is the electric current ?

59. A 4V battery is connected to a lamp of resistance $4\,\Omega$. Calculate the current through the lamp.

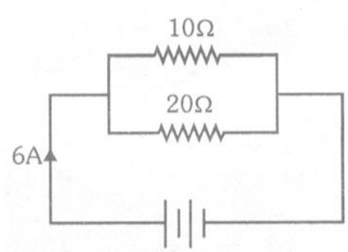
50. Calculate (a) the equivalent resistance, (b) the electric current, and (c) the potential difference across each resistor in circuit shown in Figure.



61. Two resistances of $3\,\Omega$ and $6\,\Omega$ are connected in parallel. Calculate their equivalent resistance.

62. A $1\,\Omega$ Resistor is connected in parallel to a $10\,\Omega$ resistor. Calculate the equivalent resistance.

63. Two resistors of resistances $10\,\Omega$ and $20\,\Omega$ are connected in parallel. A battery supplies 6A of current to the combination, as shown in Fig. Calculate the current in each resistor.



64. A 3V battery is connected across a $5\,\Omega$ resistance. Calculate the heat produced in 5 seconds.

65. An electric kettle is rated 500W, 220 V. It is used to heat water for 30 seconds. Assuming the voltage to be 220V, calculate the heat produced.

ANSWERS ELECTRICITY

EXERCISE – 1															
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	**B**	**C**	**A**	**D**	**D**	**C**	**B**	**C**	**D**	**A**	**B**	**A**	**A**	**B**	**C**
Que.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	**B**	**B**	**A**	**C**	**D**	**D**	**A**	**B**	**C**	**B**	**C**	**D**	**A**	**C**	**C**
Que.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	**B**	**A**	**B**	**A**	**C**	**D**	**C**	**B**	**B**	**A**	**B**	**C**	**A**	**B**	**As**
Que.	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**		
Ans.	**C**	**A**	**B**	**B**	**A**	**B**	**B**	**C**	**D**	**D**	**C**	**C**	**C**		

EXERCISE - 2

FILL IN THE BLANKS

1. 10^{-10}
2. 10^{-15}
3. 1.6×10^{-19}
4. positive
5. zero
6. more
7. No.
8. few
9. negative
10. positive
11. field
12. fest
13. work
14. at rest
15. flow
16. I = V/R or q/t
17. ampere
18. resistance
19. ohm
20. potential difference
21. current
22. series
23. parallel
24. length
25. area of cross-section
26. power
27. energy
28. decreases
29. increases
30. resistance
31. resistance
32. more
33. 50

TRUE AND FALSE

1. True **2.** False **3.** True **4.** False **5.** True **6.** False **7.** True **8.** False
9. True **10.** False **11.** True **12.** False **13.** True **14.** False **15.** True **16.** False
17. True **18.** False **19.** True **20.** False **21.** True **22.** False **23.** True **24.** False
25. True **26.** False **27.** True **28.** False **29.** True **30.** False **31.** False

NUMERICAL

1. 0.06 J
2. 105 J
3. 6.25×10^{18}
4. 1.5A
5. 1.5A
6. $8.5 \times 10^{-3}\Omega$
7. 2.4Ω
8. 12Ω
9. 4.5 A
11. 1V, 1.5V, 2.5V
12. 4A
13. $\frac{R}{9}$
14. 2A, 5Ω, 18V
15. 5.5 Ω
16. 1.33A
17. 30Ω
19. 4
20. 3.4×10^{5} cal
21. 30W, 9000J
22. 1600 cal
23. 1100W
24. 6W
26. $\frac{2}{11}A$
27. 38.4W, 0.2A
28. Rs. 171.12
29. 200 V
30. 0.2 J
31. 1500C
32. 1.5 $\times 10^{21}$ electrons
33. 3A
34. 1.2A
35. 60Ω, 0.1A
36. 4Ω
37. (a) 15.71 m, (b) 4 : 1 (4 times)
38. 4W
39. $\frac{R}{4}$
40. (a) 27Ω (b) 3Ω (c) one resistor connected in series to a combination of two resistors in parallel
41. 8Ω resistor connected in series to a parallel combination of 6Ω and 3Ω
42. 0.2A, 4V
43. (a) 10Ω (b) 0.6A (c) 0.2A
44. 0.5A
45. 12.5 W, 1.92 A
46. 2A, 1A
47. 14,400J
48. 180J or 43 cal
49. 800 J
50. 0.5 W 50Ω
51. 1322.5Ω
52. 0.25A
53. 1.6 W, 3.2W
54. 14.4W, 7.2 W
55. 012 kWh
56. (a) 44Ω (b) 30.8 kWh
57. (a) 2880 J (b) 720 J
58. 1.6 mA.
59. 1A
60. (a) 15Ω. (b) 0.5A (c) 5V, 2.5V
61. 2Ω
62. 0.99Ω
63. 4A, 2A
64. 9J
65. 15,000 J

EXERCISE -3 (FOR SCHOOL / BOARD EXAMS)

PREVIOUS YEARS BOARD (CBSE) QUESTIONS

VERY SHORT ANSWER QUESTIONS (CARRYING 1 MARK EACH)

1. Define resistivity of a material. **[2004]**

2. A cylinder of a material is 10 cm long and has a cross-section of 2 cm^2. If its resistance along the length be $20\,\Omega$, what will be its resistivity in number and units. **[2004]**

3. Why is tungsten metal selected for making filaments of incandescent lamps ? **[2005]**

4. A resistance of 10 ohm is bent in the form of a closed circle. What is the effective resistance between the two points at the ends of any diameter of this circle ? **[2005]**

5. A wire of resistance $5\,\Omega$ is bent in the form of a closed circle. What is the resistance between two points at the ends of any diameter of the circle ? **[2005]**

6. A wire of resistance $20\,\Omega$ is bent in the form of a closed circle. What is the effective resistance between the two points at the ends of any diameter of the circle ? **[2005]**

7. Why is much less heat generated in long electric cables than in filaments of electric bulbs ? **[2005]**

8. State which has a higher resistance : a 50 W or a 25W lamp bulb and how many times ? **[2005]**

9. What is the power of torch bulb rated at 2.5 V and 500 mA ? **[2005]**

10. There are two electric bulbs, (i) marked 60 W, 220 V and (ii) marked 100 W ; 220 V. Which one of them has higher resistance ? **[2006]**

11. Out of the two, a toaster of 1 kW and an electric heater of 2 kW, which has a greater resistance ? **[2006]**

12. What is the SI unit of electrical potential ? **[2007]**

13. What is meant by the statement "potential difference between two points A and B in an electric circuit is 1 volt ? **[2007]**

14. Why is series arrangement not used for connecting domestic electrical appliances in a circuit **[2008]**

15. Out of 60 W and 40 W lamps, which one has a higher resistance when in use ? **[2008]**

SHORT ANSWER QUESTIONS (CARRYING 2 MARKS EACH)

16. An electric bulb draws a current of 0.2 A when the voltage is 220 volts. Calculate the amount of charge flowing through it in one hour. **[2004]**

17. An electric iron draws a current of 0.5 A when the voltage is 200 volts. Calculate the amount of electric charge flowing through it in one hour. **[2004]**

18. An electric appliance draws a current of 0.4 A when the voltage is 200 volts. Calculate the amount of charge flowing through it in one hour. **[2004]**

19. Calculate the amount of charge that would flow in 1 hour through the electric bulb drawing a current of 0.2 A. **[2004]**

20. Calculate the amount of charge that would flow in 2 hours through the element of an electric bulb drawing a current of 0.25 A. **[2004]**

21. Calculate the amount of charge that would flow in 1 hour through the element of an electric iron drawing a current of 0.4 A. **[2004]**

22. Derive the relation $R = R_1 + R_2 + R_3$ when resistors are joined in series **[2005]**

23. (i) Draw a circuit diagram to show how two resistors are connected in series. **[2006]**
(ii) In a circuit if the two resistors of $5\,\Omega$ and $10\,\Omega$ are connected in series, how does the current passing through the two resistors compare ?

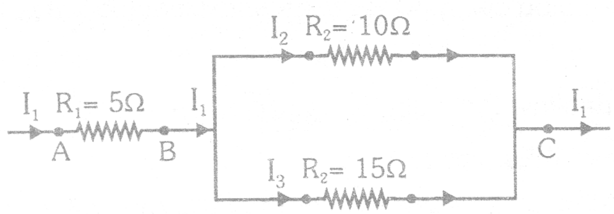
24. A bulb is rated at 5.0 V, 100 mA. Calculate its (i) power and (ii) resistance. **[2006]**

25. An electric iron has a rating of 750 W, 220V. Calculate **[2007]**
(ii) current passing through it, and (ii) its resistance, when in use.

26. An electric lamp in marked 100W, 220V. It is used for 5 hours daily. Calculate **[2007]**
(i) its resistance while glowing (ii) energy consumed in kWh per day.

SHORT ANSWER QUESTIONS (CARRYING 3 MARKS EACH)

27. Three resistors are as shown in Fig. Through a resistor of 5 ohm, a current of 1 ampere is flowing .



(a) What is the potential difference across AB and across AC ?
(b) What is the current through the other two resistors ?
(c) What is the total resistance ?

28. An electric bulb is rated at 200 V-100 W. What is its resistance ? Five such bulbs burn for 4 hours. What is electrical energy consumed ? Calculate the cost if the rate is 50 Paise unit. **[2003]**

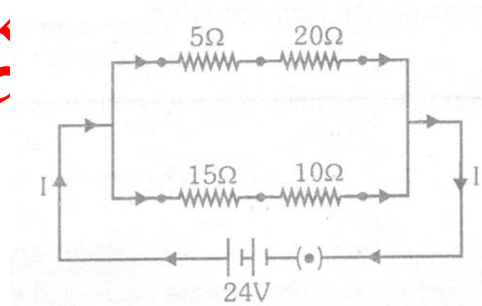
29. State the formula co-relating the electric current flowing in a conductor and the voltage applied across it. Also show this relationship by drawing a graph .
What would be the resistance of a conductor if the current flowing through it is 0.35 ampere when the potential difference across it is 1.4 volt. **[2004]**

30. (i) State the formula showing how the current I in a conductor varies when the potential difference V applied across it is increased stepwise **[2004]**
(ii) Show this relationship also on a schematic graph.
(iii) Calculate the resistance of a conductor if the current flowing through it is 0.2 ampere when the applied potential difference is 0.8 volt.

31. When a potential difference of 1.2 volt is applied across a conductor , the current flowing through it is 0.25 ampere. Calculate the resistance of the conductor. **[2004]**

32. A torch bulb is rated 5.0 V and 500 mA. Calculate its (i) power (ii) resistance and (iii) energy consumed when it is lighted for 4 hours. **[2005]**

33. If a 12 V battery is connected to the arrangement of resistance given in Fig. (with 5Ω replaced by 10Ω , 15Ω replace by 5Ω and 10Ω replaced by 25Ω). Calculate (i) the total effective resistance of the arrangement and (ii) the total current flowing in the circuit . **[2005]**

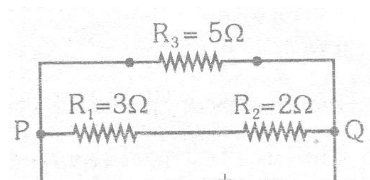


34. Two electric lamps of 100 W and 25 W respectively are joined to a supply of 200V. Calculate the total current flowing through the circuit . **[2005]**

35. Two identical resistors, each of resistance 2 Ω, are connoted in turn (i) in series, and (ii) in parallel to a battery of 12V. Calculate the ratio of power consumed in the two cases . **[2005]**

36. Two identical resistors, each of resistance 10Ω are connected (i) series, and (ii) in parallel, in turn to a battery of 10 V. Calculate the ratio of power consumed in the combination of resistors in the two cases. **[2005]**

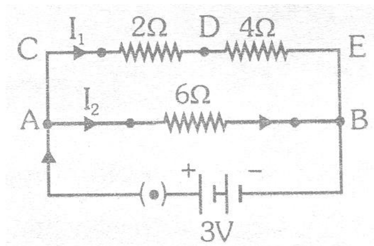
37. In the given circuit, calculate (i) total resistance of the circuit , and (ii) current shown by the ammeter. **[2005]**



38. (i) Draw a schematic diagram of a circuit consisting of a battery of five 2 V cells, a $5\,\Omega$ resistor, a $10\,\Omega$ resistor and a $15\,\Omega$ resistor, and a plug key, all connected in series . **[2006]**
(ii) Calculate the current passing through the above circuit when is closed .

39. In a household, 5 tube lights of 40 W each are used for 5 hours and an electric press of 500 W for 4 hour each day. Calculate the total energy consumed by the tube lights and press in a month of 30 days. **[2006]**

40. In the circuit shown in Fig. calculate : (a) total resistance in arm CE, (b) total current drawn from the battery , and (c) current in each arm, i.e. , AB and CE of the circuit. **[2006]**



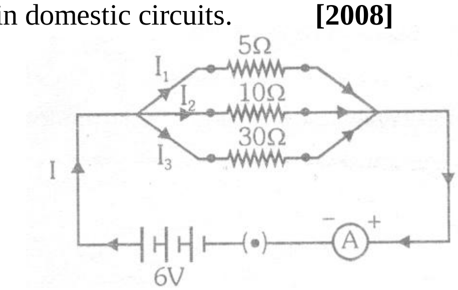
41. (a) What is meant by ‘Electric Resistance’ of a conductor ? **[2007]**
(b) A wire of length L and resistance R is stretched so that its length is doubled and area of cross, section is halved. How will its : (i) resistance change ? (ii) resistivity change ?

42. (a) State Ohm’s law. **[2007]**
(b) Draw a schematic diagram of the circuit for studying Ohm’s law .

43. Two lamps. One rated 60 W at 220 V and the other 40 W at 220 V, are connected in parallel to the electric supply at 220 V. **[2008]**
(a) Draw a circuit diagram to show the connections.
(b) Calculate the current drawn from the electric supply.
(c) Calculate the total energy consumed by the two lamps together when they operate for one hour.

44. (a) Distinguish between the terms ‘ overloading’ and ‘short-circuiting’ as used in domestic circuits. **[2008]**
(b) Why are the coils of electric toasters made of an alloy than a pure metal ?

45. For the circuit shown in Fig. calculate **[2008]**
(a) the value of current through each resistance
(b) the total current in the circuit
(c) the total effective resistance of the circuit.



LONG ANSWER QUESTIONS (CARRYING 5 MARKS EACH)

46. (a) Express Ohm’s law by a mathematical formula. **[2004]**
(b) Draw a circuit diagram to verify Ohm’s law.
(c) resent the relationship between the voltage applied across a conductor and the current flowing through it graphically .

47. State Ohm’s law. Express it mathematically. Define SI unit of resistance. Derive and expression for the equivalent resistance of three resistors R_1, and R_2 connected in series (or in parallel). **[2004]**

48. (a) Express Ohm’s law both a mathematical formula and by a graph line . **[2004]**
(b) State SI units of (i) resistance and (ii) resistivity .
(c) What will be the equivalent resistance of two resistors R_1 and R_2 (i) connected in series and (ii) connected in parallel

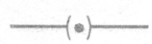
49. (a) What is meant by saying that potential difference between two points is 1 volt ? Name a device that helps to measure the potential difference a conductor. **[2008]**
(b) Why does the connection cord of an electric heater not glow hot while the heating element does ?

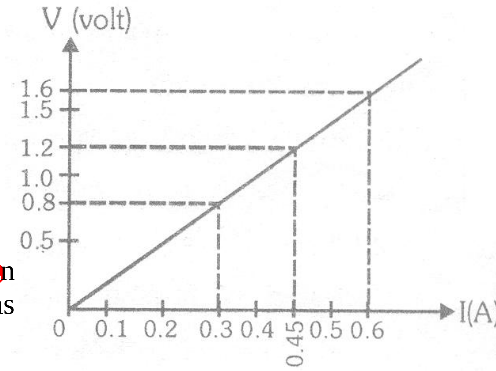
(c) Electrical resistivites of some substances at 20^0C are given below :

Silver	$1.60 \times 10^{-8} \Omega$ m
Copper	$1.62 \times 10^{-8} \Omega$ m
Tungsten	$5.20 \times 10^{-8} \Omega$ m
Iron	$10.0 \times 10^{-8} \Omega$ m
Mercury	$94.0 \times 10^{-8} \Omega$ m
Nichrome	$100 \times 10^{-6} \Omega$ m

Answer the following questions in relation to them :
(i) Among silver and copper, which one is better conductor ? Why ?
(ii) Which material would you advise to be used in electrical heating devices ? Why ?

50. (a) Name an instrument that measures electric current in a circuit. Define the unit of electric current **[2008]**
(b) What do the following symbols mean in circuit diagram ?

(i)  (ii) 



(c) An electric circuit consisting of a 0.5 m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5 V each and a plug key was set up.
(i) Draw a diagram of this electric circuit to study the relation between the potential difference maintained between the points 'X' and 'Y' and the electric current flowing through XY.
(ii) Graph shown Fig. was plotted between V and I values.
What would be the value of V/I ratios when the potential difference is 0.8 V, 1.2 V and 1.6 V respectively ?
What conclusion do you draw from these values ?

EXERCISE – 4 (FOR OLYMPIADS)

1. If a charged body attracts another body, the charge on the other body :-
(A) must be negative (B) must be positive
(C) must be zero (D) may be negative or positive or zero

2. 1 MeV is equal to :-
(A) 1.6×10^{-19} J (B) 1.6×10^{-14} J (C) 1.6×10^{-13} J (D) 1.6×10^{-13} J

3. A man has five resistors each of value $\frac{1}{5}\Omega$. What is the maximum resistance he can obtain by connecting them ?
(A) 1 Ω (B) 5Ω (C) $\frac{1}{2}\ \Omega$ (D) $\frac{1}{5}\ \Omega$

4. Materials which allow larger currents to flow through them are called :-
(A) Insulators (B) Conductors (C) Semiconductors (D) Alloys

5. If I is the current through a wire and e is the charge of electrons, then the number of electrons in t seconds will be given by :-
(A) $\frac{Ie}{t}$ (B) Ite (C) e/It (D) It/e

6. Conventionally, the direction of the current is taken as –
(A) the direction of flow to negative charge (B) the direction of flow of atoms

(C) the direction of flow of molecules (D) the direction of flow of positive charge

7. The unit of specific resistance is :-

(A) ohm (B) mho (C) ohm-metre (D) ohm per metre

8. If the length of a wire is doubled and its cross-section is also doubled, then the resistance will –

(A) increase eight times (B) decrease four times

(C) become four times (D) remain unchanged

9. A suitable unit for expressing the strength of electric field is –

(A) V / C (B) C / m (C) N / C (D) C/ N

10. 1 volt equals :-

(A) 1 joule (B) 1 joule per coulomb

(C) 1 coulomb per metre (D) 1 Newton per coulomb

11. 1 Vm^{-1} equals –

(A) 1 NC^{-1} (B) 1 NC^{-2} (C) 1 Jm^{-1} (D) I Jm^{-2}

12. The reciprocal of resistance is conductance. If the unit of resistance is ohm, the unit of conductance will be –

(A) ohm (B) volt (C) mho (D) ohm $metre^{-1}$

13. Good conductors have many loosely bound –

(A) atoms (B) molecules (C) protons (D) electrons

14. One ampere equals :-

(A) $10^6\ \mu A$ (B) $10^{-6}\ \mu A$ (C) $10^{-3}\ \mu A$ (D) 10 A

15. How many electrons constitute a current of one microampere ?

(A) 6.25×10^6 (B) 6.25×10^{12} (C) 6.25×10^9 (D) 6.25×10^{15}

16. If a wire of resistance 1Ω is stretcher to double its length, then the resistance will become :-

(A) $\frac{1}{2}\Omega$ (B) 2Ω (C) $\frac{1}{4}\Omega$ (D) 4Ω

17. The SI unit of specific resistance is :-

(A) ohm m (B) ohm m^{-1} (C) ohm m^2 (D) $(ohm)^{-1}$

18. The effective resistance of a circuit containing resistances in parallel is –

(A) equal to the sum of the individual resistances

(B) smaller than any of the individual resistance

(C) greater than any of the individual resistances

(D) sometimes grater and sometimes smaller than the individual resistances

19. Electric intensity is

(A) a scalar quantity (B) a vector quantity

(C) neither scalar nor vector (D) sometimes scalar and sometimes vector

20. Electric potential is

(A) A scalar quantity (B) a vector quantity

(C) neither scalar nor vector (D) sometimes scalar and sometimes vector

21. In Coulomb's law, the constant of proportionality k has the units –

(A) N (B) Nm^2 (C) NC^2 / m^2 (D) Nm^2 / C^2

22. The variable resistance is called :-

(A) resistor (B) rheostat (C) open switch (D) none of these

23. How much work is done in moving a charge of two coulombs from a point at 118 volts to a point at 128 volts ?

(A) 10 J (B) 20 J (C) $\frac{1}{10}$ J (D) None of these

24. The law that governs the force between electric charges is called –

(A) Ampere's law (B) Coulomb's law (C) Faraday's law (D) Ohm's law

25. A charge q is placed at the center of the line joining two equal charges Q. The system of the three charges will be in equilibrium, if q is equal to -

(A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$ (C) $+\frac{Q}{4}$ (D) $+\frac{Q}{2}$

26. Two small spheres each carrying a charge q are placed r mere apart. If one of the spheres is taken around the other one in a circular path of radius r, the work done will be equal to $.\approx$

(A) Force between them × r (B) Force between them × 2π r

(C) Force between them $/2\pi r$ (D) Zero

27. The force between two electrons separated by distance r varies as :-

(A) r^2 (B) r (C) r^{-1} (D) r^{-2}

28. When the distance between the charged particles is halved, the force between them becomes –

(A) One-fourth (B) Half (C) Double (D) Four times

29. There are two charge +1 μC and +5 μC. The ratio of the forces action on them will be –

(A) 1 : 5 (B) 1 : 1 (C) 5 : 1 (D) 1 : 25

30. Which one of the following is the unit of electric field intensity ?

(A) V × metre (B) V / joule (C) V × joule (D) V / metre

31. A charge q_1 exerts some force on second charge q_2. if third charge q_3 is brought near, the force of q_1 exerted on, q_2 :-

(A) Decreases

(B) Increases

(C) Remains unchanged

(D) Increases if q_3 is of the same sign as q_1 and decreases if q_3 is of opposite sign

32. If the charge is moved against the coulomb force of an electric field –

(A) Work is done by the electric field (B) Energy is used from some outside force

(C) The strength of the field is decreased (D) The energy of the system is decreased

33. The ratio of the forces between two small spheres with constant charge (a) in air (b) in a medium of dielectric constant K is -

(A) 1 : K (B) K : 1 (C) 1 : K^2 (D) K^2 : 1

34. Two charges are placed at a distance. If a glass slab is placed between them, force between them will be

(A) Zero (B) Increased (C) Decreased (D) Remains same

35. Electric intensity and electric potential are related with each other by the relation –

(A) $V=\frac{dE}{dx}$ (B) $E=\frac{dV}{dx}$ (C) $E=\frac{dV}{dx}$ (D) E = potential × distance

36. If a unit positive chare is taken from one point to another over an equipotential surface then –

(A) Work is done on the charge (B) Work is done by the charge

(C) Work done is constant (D) No work is done

37. Electric lines of force about negative point charge are –

(A) Circular, anticlockwise (B) Circular, clockwise

(C) Radial, inward (D) Radial, outward

38. Electric intensity at a place due to a, charge conductor is a –

(A) Scalar quantity (B) Vector quantity

(C) Neither scalar vector (D) None of these

39. If a glass rod is rubbed with silk, it acquires a positive charge because –

(A) Protons are added to it (B) Electrons are added to it

(C) Protons are removed from it (D) Electrons are removed from it

40. The magnitude of electric field intensity E is such that, an electron placed in it would experience an electrical force equal to its weight is given by -

(A) mge (B) $\frac{mg}{e}$ (C) $\frac{e}{mg}$ (D) $\frac{e^2}{m^2}.q$

41. Two resistors of resistance R_1 and R_2 having $R_1 > R_2$ are connected in parallel. For equivalent resistance R, the correct statement is -

(A) $R > R_1 + R_2$ (B) $R_1 > R < R_2$

(C) $R_2 < R < (R_1 + R_2)$ (D) $R < R_1$

42. If a 0.1% increases in length due to stretching, the percentage increases in its resistance will be –

(A) 0.2% (B) 2% (C) 1% (D) 0.1%

43. Two unequal resistances are connected in parallel. Which one of the statement is correct –

(A) The current flowing is same in both

(B) More current will flow from higher resistance piece

(C) The potential drop is same in both

(D) The conductivity of lower resistance is less

44. When the length and area of cross-section both are doubled, then its resistance-

(A) Will become half (B) Will be doubled

(C) Will remain the same (D) Will become four times

45. A galvanometer can be converted into an ammeter by connecting –

(A) Low resistance in series (B) High resistance in parallel

(C) Low resistance in parallel (D) High resistance in series

46. There are 8 equal resistances R. Two are connected in parallel, such four groups are connected in series, the total resistance

(A) R / 2 (B) 2R (C) 4R (D) 8R

47. In a conductor 4 coulombs of charge flows for 2 seconds. The value of electric current will be –

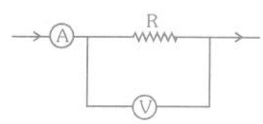
(A) 4 V (B) 4 A (C) 2 A (D) 2 V

48. In a conductor, the flow of current is :-

(A) Flow of molecules (B) Flow of free electrons

(C) Flow of positive charge (D) Flow of ions

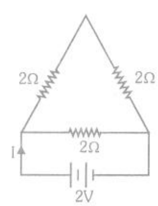
49. Three resistances of magnitude 2, 3 and 5 ohm are connected in parallel to a battery of 10 volts and of negligible resistances. The potential difference across $3\,\Omega$ resistance will be –



(A) 2 V (B) 3 V (C) 5 V

(D) 10 V

50. Which of the following have highest conductivity



(A) Cu (B) Insulator (C) Semiconductor

(D) All are equal

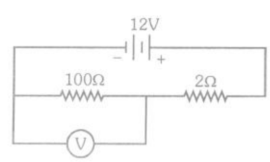
51. In the circuit shown below, the ammeter A reads 5A and the voltmeter V reads 20 V (Fig.). The correct value of resistance R is :-

(A) exactly $4\,\Omega$

(B) slightly greater than $4\,\Omega$

(C) slightly less than $4\,\Omega$

(D) zero

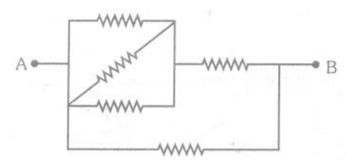


52. What is the current in the circuit shown (Fig.)-

(A) 1.5 A (B) 0.5 A (C) 2.5 A
(D) none these

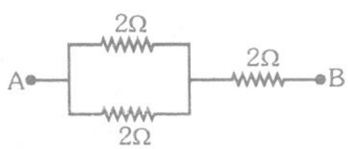
53. In the circuit shown in Fig., the reading of the voltmeter V will be :-
(A) 4 V (B) 2 V (C) 6 V
(D) 3 V

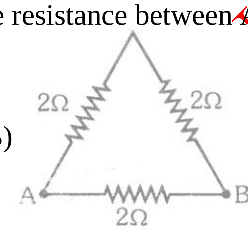
54. Five identical resistance coils are connected in the network as shown in fig. and ht resistance measured between A and B is 1Ω. Then the individual coils must have a resistances of :-

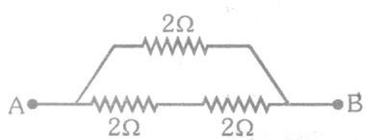


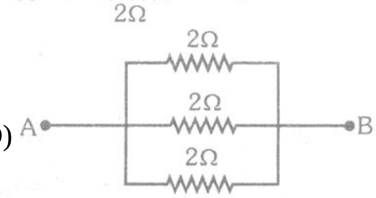
(A) 1Ω (B) $\frac{1}{4}\Omega$ (C) $\frac{7}{4}\Omega$ (D) $\frac{4}{7}\Omega$

55. Which of the following networks yields maximum effective resistance between A and B?

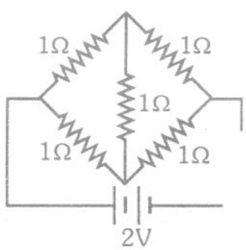
(A) 

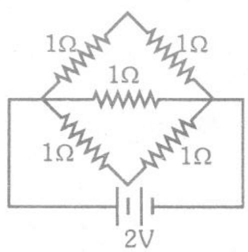
(B) 

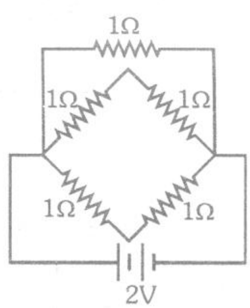
(C) 

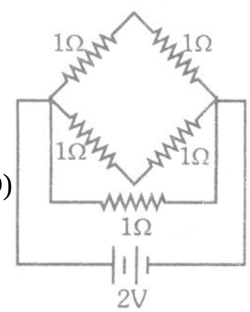
(D) 

56. What of the following network yields minimum current ?

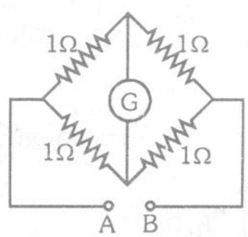
(A) 

(B) 

(C) 

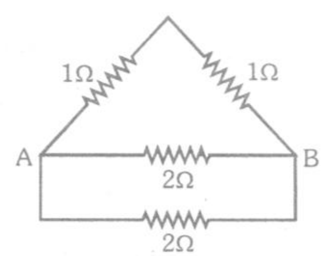
(D) 

57. What is the total resistance between A and B in the given network (Fig.)? (Given the resistance of the galvanometer as 40Ω)



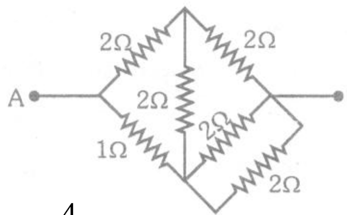
(A) 1Ω (B) 2Ω (C) $\frac{1}{2}\Omega$ (D) None of these

58. What is the resistance between A and B in the given network (Fig.)?



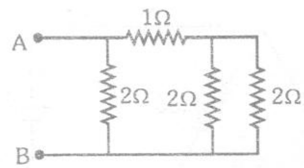
(A) 2Ω (B) 2Ω (C) $\frac{3}{2}\ \Omega$ (D) $\frac{2}{3}\ \Omega$

59. What is the resistance between A and B in the given network [Fig.] ?



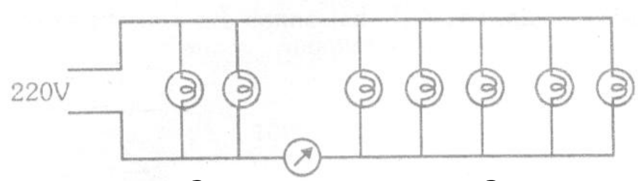
(A) $\frac{3}{4}\ \Omega$ (B) $\frac{4}{3}\ \Omega$ (C) $2\ \Omega$ (D) $\frac{1}{2}\ \Omega$

60. The equivalent resistance between A and B (Fig.) will be :-



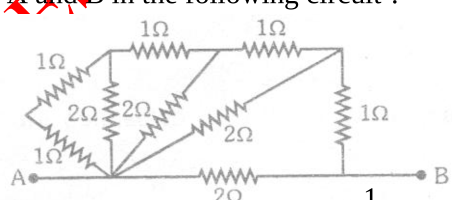
(A) 7Ω (B) 2Ω (C) $\frac{5}{3}\ \Omega$ (D) 1Ω

61. Seven identical lamps of resistance 220Ω each are connected to a 220 V line as shown in Fig. Then the reading in the ammeter will be :-



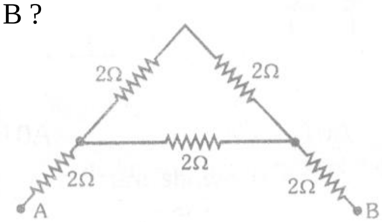
(A) $\frac{1}{10}A$ (B) $\frac{2}{5}A$ (C) $\frac{3}{10}A$ (D) $\frac{1}{2}A\ \Omega$

62. What is the resistance between A and B in the following circuit ?



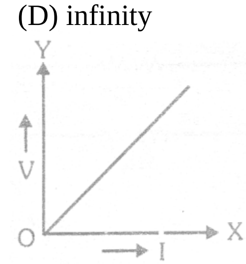
(A) 1Ω (B) 2Ω (C) $\frac{1}{2}\ \Omega$ (D) $\frac{3}{2}\ \Omega$

63. What is the resistance between A and B ?



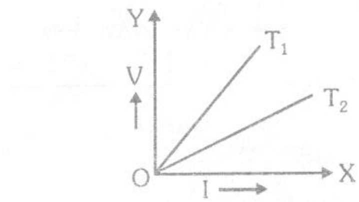
(A) $\frac{3}{4}\ \Omega$ (B) $\frac{4}{3}\ \Omega$ (C) $\frac{16}{3}\ \Omega$ (D) infinity

64. The slope of voltage (V) versus current (I) is called :-



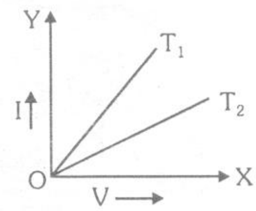
(A) resistance (B) conductance (C) resistivity
(D) conductivity

65. For a metallic conductor, current versus voltage graph is drawn at two different temperatures T_1 and T_2. From the graph it follows:-



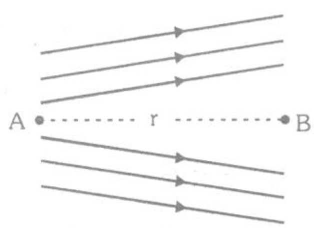
(A) $T_1 = T_2$
(B) $T_1 > T_2$
(C) $T_1 < T_2$
(D) None of these

66. For a metallic conductor, voltage versus current graph is drawn at two different temperatures T_1 and T_2. From the graph follows :-



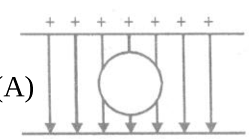
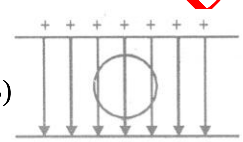
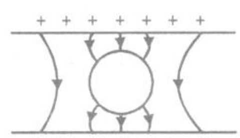
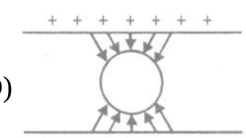
(A) $T_1 = T_2$
(B) $T_1 > T_2$
(C) $T_1 < T_2$
(D) None of these

67. Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement between A and B is r, then –

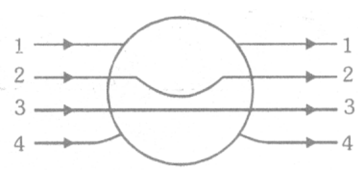


(A) $E_A > E_B$ (B) $E_A < E_B$ (C) $EA = \frac{E_B}{r}$ (D) $E_A = \frac{E_B}{r^2}$

68. An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like

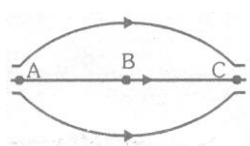
(A)  (B)  (C)  (D) 

69. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path (s) shown in figure as –



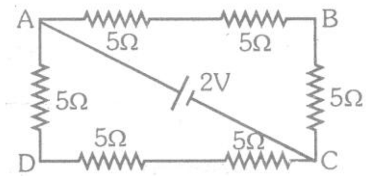
(A) 1 (B) 2 (C) 3 (D) 4

70. The figure shows some of the electric field lines corresponding to an electric field. The figure suggests



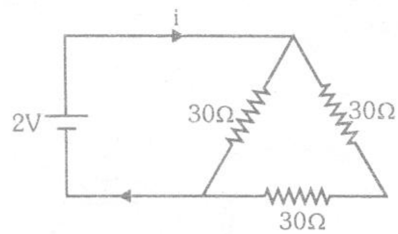
(A) $E_A > E_B > E_C$ (B) $E_A = E_B = E_C$
(C) $E_A = E_C > E_B$ (D) $E_A = E_C < E_B$

71. The potential difference between points A and B of adjoining figure is



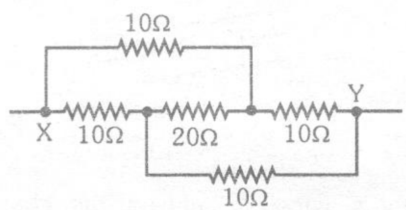
(A) $\frac{2}{3}$ V (B) $\frac{8}{9}$ V (C) $\frac{4}{3}$ V (D) 2 V

72. The current in the adjoining circuit will be –



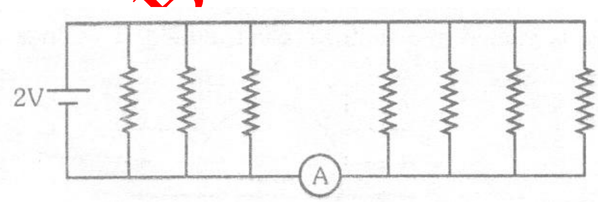
(A) $\frac{1}{45}A$ (B) $\frac{1}{15}A$ (C) $\frac{1}{10}A$ (D) $\frac{1}{5}A$

73. In the circuit shown five resistances are connected. The equivalent resistance between the two points X and Y will be -



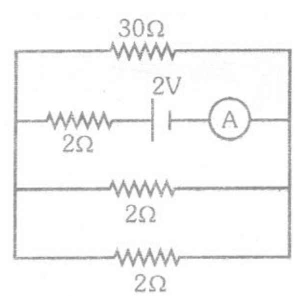
(A) 10Ω (B) 20Ω (C) 22Ω (D) 50Ω

74. Seven resistances each of $20\,\Omega$ are connected with 2 volt battery as shown in figure. The reading of ammeter will be :-



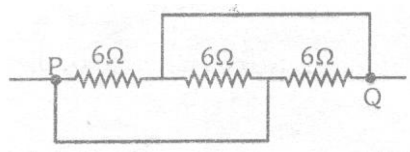
(A) 1 / 10A (B) 3 / 10A (C) 4 / 10A (D) 7 / 10A

75. The reading of the ammeter as per figure shown is :-



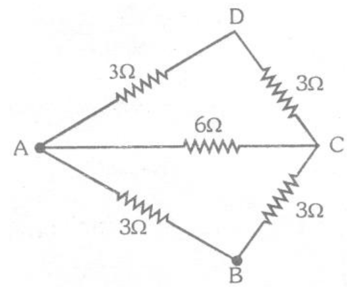
(A) $\frac{1}{8}$ A (B) $\frac{3}{4}$ A (C) $\frac{1}{2}$ A (D) 2A

76. The resultant resistance between P and Q as per the figure shown is :-



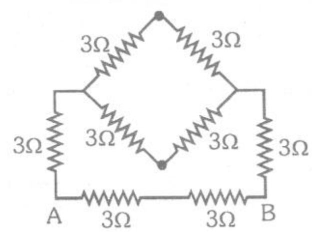
(A) 2Ω (B) 3Ω (C) 6Ω (D) 18Ω

77. The effective resistance between the points A and B in the figure is :-



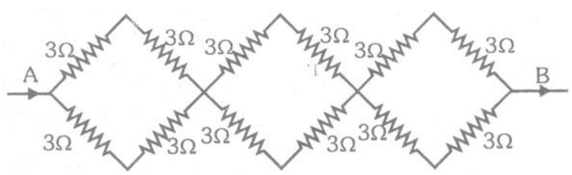
(A) 5Ω (B) 2Ω (C) 3Ω (D) 4Ω

78. Equivalent resistance between A and B will be –



(A) 2Ω (B) 18Ω (C) 6Ω (D) 3.6Ω

79. In the network of resistors shown in the adjoining figure, the equivalent resistance between A and B is :-



(A) 54Ω (B) 18Ω (C) 36Ω (D) 9Ω

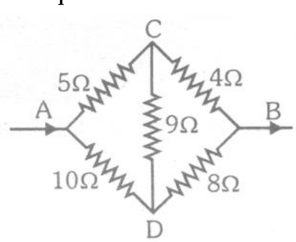
80. Five resistors are connected as shown in the diagram . The equivalent resistance between A and B is –

(A) 6Ω

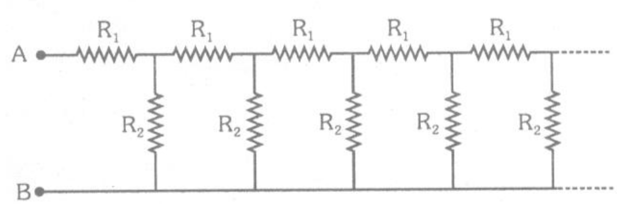
(B) 9Ω

(C) 12Ω

(D) 15Ω



81. An infinite sequence of resistance is shown in the figure. The resultant resistance between A and B will be when R_1 = 1Ω and R_2 = 2Ω :-

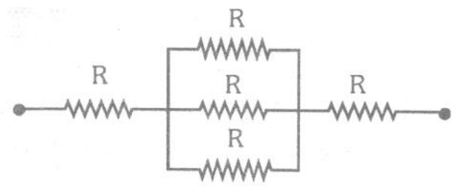


(A) Infinity (B) 1Ω (C) 2Ω (D) 1.5Ω

82. The resistance wires are made of the material having :-

(A) Low specific resistance and low temperature coefficient of resistance .
(B) High specific resistance and low temperature coefficient of resistance .
(C) Low specific resistance and high temperature coefficient of resistance .
(D) High specific resistance and high temperature coefficient of resistance .

83. The resistance between points A and B Fig. is :-



(A) $\frac{7}{3}$R (B) 3 (C) 5 R (D) $\frac{4}{3}$R

84. Two wires of same material and same mass have their lengths in the ration 1 : 2. Their electrical resistances are in the ratio

(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 1 : 4

85. A 24 V potential difference is applied across a parallel combination or four 6-ohm resistors. The current in each resistor is

(A) 1A (B) 4 A (C) 16 A (D) 36 A

86. Three resistors in parallel have an effective resistance of 1 ohm. When they are connected in series their resistance is 9 ohm. The resistance of each resistor is :

(A) 4, 4, 1 ohm (B) 6, 2, 1 ohm (C) 3, 3, 3, ohm (D) 2, 3, 4 ohm

87. A letter 'A' is constructed of a uniform wire of resistance 1 ohm per cm. The sides of the letter are 20 cm and the cross piece in the middle is 10 cm long. The resistance between the ends of the legs will be

(A) 32.4 ohm (B) 28.7 ohm (C) 26.7 ohm (D) 24.7 ohm

88. A 12 V car battery has an internal resistance of 0.2 ohm. What P.D. must be applied across its terminals by a battery has in order that the charging current be 5 A ?

(A) 13 V (B) 12 V (C) 11.4 V (D) 10.6 V

89. Four 20 ohm resistors are connected together to form a square. The resistance between opposite corners will be :-

(A) 20 ohm (B) 22 ohm (C) 24 ohm (D) 24.8 ohm

90. The cost of electricity is about 30 Paise per unit for household use. This unit is the same as

(A) ohm (B) ampere (C) volt (D) kilowatt-hour

91. A fuse wire should have

(A) low resistance and low melting point (B) low resistance and high melting point.
(C) high resistance and low melting point. (D) high resistance and high melting point.

92. Two lamps X and Y are connected in series. The lamp X glows lights than Y. Then

(A) the resistance of X is greater than the resistance of Y.
(B) the resistance of X is lesser than the resistance of Y.
(C) the resistance of X is equal to the resistance of Y.
(D) there is no relation between the resistances of X and Y.

93. A one-ohm and half-ohm resistor are connected in parallel across a 3 volt battery. Total energy given out per second is

(A) 27 J (B) 9 J (C) 4.5 J (D) 3 J

94. If it takes 8 minutes to boil a quantity of water electrically, how long will it take to boil the same quantity of water using the same heating coil but with the current doubled?

(A) 32 minutes (B) 16 minutes (C) 4 minutes (D) 2 minutes

95. Two electric lamps each of 100 watts 220 V are connected in series to a supply of 220 volts. The power consumed would be

(A) 100 watts (B) 200 watts (C) 25 watts (D) 50 watts

96. A galvanometer can be converted into' a voltmeter by connecting

(A) A high resistance in series with the galvanometer

(B) A high resistance in parallel with the galvanometer

(C) A low resistance in series with the galvanometer

(D) A low resistance in parallel with the galvanometer

97. A rheostat can be used in an electrical circuit as a

(A) standard resistance (B) potential divider (C) heat controller (D) on-off switch

98. Alternating current rather than direct current is normally used for the transmission of power over long distances because

(A) it can be rectified (B) it is easier to generate

(C) loss of energy can be minimized. (D) no question of polarity arises with electrical equipments.

99. A conductor has a positive charge of 3.2×10^{-7} coulombs.

(A) The conductor has 3.2×10^{7} electrons in excess.

(B) The conductor has 2×10^{26} electrons in excess.

(C) The conductor is deficient with 3.2×10^{7} electrons

(D) The conductor is deficient with 2×10^{26} electrons

110. Two bulbs of rating 220 V, 50 W and 220 V, 110 V, 110 W are put in series across 220 V mains. Then :

(A) both bulbs will glow equally (B) neither bulb will glow

(C) 100 W bulb will glow brighter (D) 50 W bulb will glow brighter

ANSWERKEY — Exercise -4

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	C	A	B	D	D	C	D	C	B	A	C	D	A	B
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	D	A	B	B	A	D	B	B	B	B	D	D	D	B	D
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	C	B	B	D	C	D	C	B	D	C	D	A	C	C	C
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	B	C	B	D	A	B	A	A	C	A	A	A	D	B	D
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans.	D	A	C	A	B	C	A	C	D	C	D	C	A	C	A
Que.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans.	A	B	D	D	A	C	B	A	C	B	C	C	A	A	D
Que.	91	92	93	94	95	96	97	98	99	100					
Ans.	A	B	A	D	D	A	B	C	D	D					

Important Notes

MAGNETIC EFFECT OF ELECTRIC CURRENT

MAGNETISM

The property due to which a substance attracts pieces of iron, nickel and cobalt towards itself, is called magnetism. A naturally occurring iron ore (black iron oxide $-Fe_2O_3$) having properties of attracting iron pieces, was found in Magnesia in the upper part of Greece. The name magnetism has been taken from the name of that place.
The substance having property of magnetism, is called magnetic substance and body up of a magnetic substance, is called a magnet.
Magnets are found is various shapes and sizes. A bar magnet is a long rectangular bar uniform cross-section, which can attract pieces of iron, steel, cobalt and. Magnet can be natural or artificial.

Poles of a magnet : When a magnet is dipped in iron filings, then maximum filings stick to its ends and almost no filings stick to its centre. It means that in magnets, centers of attraction are located near the ends only. These centers of attraction near the ends of a magnet, are called poles. Since a magnet has two poles hence it is also called magnetic dipole.
When this magnet is freely suspended, its two ends point in north south direction. The pole near the end pointing towards North (north-seeking end) is called North pole. The pole near the end pointing towards South (south-seeking end) is called South pole.
The magnetic poles exert forces on each other. Like poles repel each other, i.e., a north pole will repel another north pole or a south pole will repel another south pole. Unlike poles attract each other, i.e., a south pole will attract a north pole and vice versa .

Magnetic field of earth . Earth behaves as a huge magnet (or a giant solenoid). The source of this huge magnetism is given as the molten charged metallic giving rise to a current flowing inside the core of the earth. This core has a radius of about 3500 km (Earth's radius is 6400 km). Its strength is of the order of one gauss. Shape of the earth's magnetic field resembles with that of a bar magnet of length one fifth of earth's diameter buried at its centre.

Now it is believed that earth's magnetism is due to the magnetic effect of current which is flowing in the molten core at the centre of earth. Hence, earth is a huge electromagnet.

MAGNETIC FIELD AND MAGNETIC FIELD LINES (MAGNETIC LINES OF FORCE)

MAGNETIC FIELD

It is the space around a magnetic pole or a magnet in which its effect is experienced by another magnetic pole or magnet. Magnetic field is a quantity which has both direction and magnitude.

MAGNETIC LINES OF FORCE

A magnetic line of force is a line, straight or curved, in the magnetic field tangent to which at any point gives the direction of the magnetic field at that point.

OR

A line such that the tangent a any point on it gives the direction of the magnetic field at that point is called a magnetic field or magnetic line of force.

A free unit north pole (test pole) will move along the magnetic line of force in direction of the field if it is free to do so. Direction of the magnetic line of force at any point is the direction of the force acting on unit (north) pole (unit magnetic pole) when placed at that point. Since a free unit north pole (test pole) will move away from a north (N) pole, magnetic lines of force have outward direction [Fig. (a)]. Since the free unit north pole will move towards a south (S) pole, magnetic lines of force have inward direction [Fig. (b)]. A small magnetic compass when moved along the lines of force always sets itself parallel to the line of force.

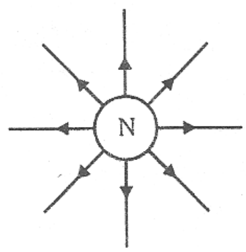


Fig.(a) due to north pole

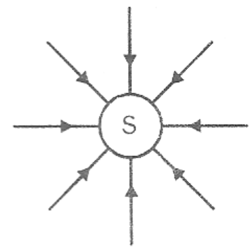


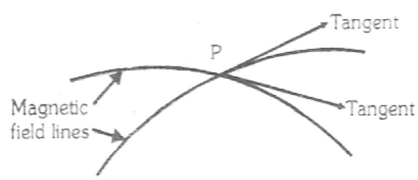
Fig.(b) due to south pole

Magnetic lines of force have the following properties :

1. All field lines are closed curves. They come out of magnet from the side of the north pole and go into it on the side of the south pole. i.e. They start from a north (positive) pole and end at a south (negative) pole. They continue inside the magnet too. Inside the magnet the direction of field lines is from its south pole to its north pole.

2. They are always normal to the surface of the magnet at every point .

3. Two lines of force do not intersect each other. If they intersect at a point, it would mean compass needle placed at the point of intersection would point towards two directions at that point which is not possible .



4. The field lines are close together near the poles and spread out away from them. The field is stronger where the field lines are more closely spaced. So the field is stronger near the poles than at other point.

5. The number of magnetic lines of force passing normally per unit area about a point, gives the intensity of the magnetic field at that point.

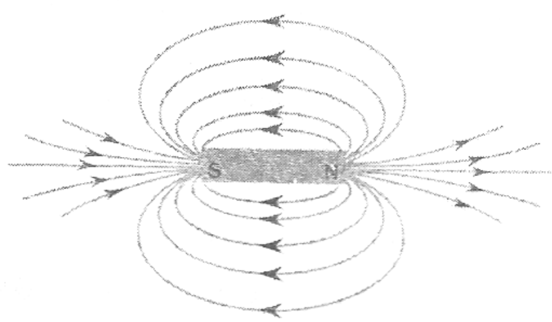
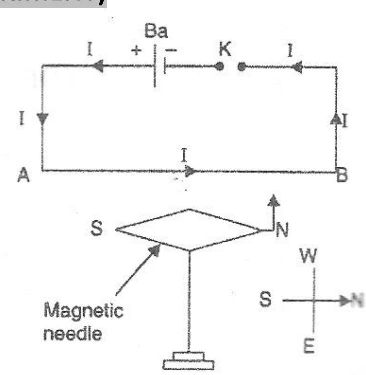


Fig. Magnetic field lines around a bar magnet

MAGNETIC FIELD DUE TO ELECTRIC CURRENT (OERSTED'S EXPERIMENT)

Hans Christian Oersted (1820) was the first to discover the magnetic effect of current, He found that if a compass needle is placed near a current carrying wire, needle gets deflected. He said that as compass needle is a tiny magnet and can be deflected only by some other magnetic field, hence a current carrying wire produces some magnetic field around itself. magnetic effect of current is also known as electromagnetism. Magnetic effect of current is very useful in electric motors, generators, telephone etc.



Experimental arrangement used by Oersted is shown in Fig. A straight wire AB is connected to a battery Ba and key K. The wire is held horizontally north-south over a magnetic needle. In this arrangement, when key is closed, current flows in the wire in the direction as shown in Fig. The north pole of the needle gets deflected towards west. When key is taken out and current in the wire becomes zero and the needle returns back to its initial position (S – N) . This shows that a magnetic field is associated with an electric current.

When direction of current in the wire is reversed, direction of deflection of needle also gets reversed. If direction of current is kept same and the wire is put under the needle then, direction of deflection of needle again gets reversed.

Amount of deflection depends on the distance of the needle from the current carrying wire.

But we know that a magnetic needle is deflected by a magnetic field only. Hence we can conclude that current flowing in a wire gives rise to some magnetic field around it.

Position of the wire (conductor) carrying the current, direction of current and direction of deflection of the needle can be related by SNOW rule given below.

If current flows in the conductor from South towards North, with conductor kept over the needle, then North pole of the needle will be deflected towards West.

MAGNETIC FIELD DUE TO CURRENT CARRYING STRAIGHT

CONDUCTOR (WIRE) AND CURRENT CARRYING CIRCULAR COIL

Case 1. When Current carrying conductor is Straight, Magnetic Field is Circular.

It means that when the current flows in a straight wire, the magnetic field produced has circular lines of force surrounding the wire, having their centres at the wire as shown in Fig. This can be shown by sprinkling iron filings on the cardboard C When current flows through the conductor, iron filings get magnetized and now if the cardboard C is tapped gently iron filings arrange themselves in circles around the wire. Hence we can say that magnetic lines of force around a straight current carrying conductor are circular. The plane of circular lines is perpendicular to the length of the wire. Their direction is marked by arrows.

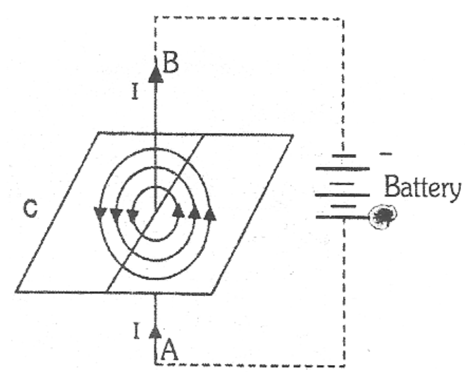


Fig.Current straight, magnetic field circular

When current I flows through a straight wire, the magnetic field strength (B) at a small distance r from it is given by

$$\boxed{B = \frac{\mu_0 I}{2\pi r}}$$

From the above expression we see that magnitude of magnetic produced by a straight carrying wire at a given point is :

(i) directly proportional to the quantity of current flowing through the wire.

(ii) inversely proportional to the distance of point from the wire. Thus, if current is more, magnetic field will be stronger and vice versa.

DIRECTION OF MAGNETIC FIELD

The direction of the magnetic lines of force is related with the direction of the current by the **right hand thumb rule.**

This rule states that :

> **Curl the four fingers of the right hand on the palm, keeping the thumb stretched out at right angles. The thumb is straight and the fingers are circular, then**

(i) **If thumb represents the direction of the current in the straight wire then curling of fingers represents the direction of the circular magnetic lines of force. (Fig. (a))**

(ii) **If curled fingers represents the direction of the current in circular wire then thumb represents the direction of the straight magnetic lines of force. (Fig. (b))**

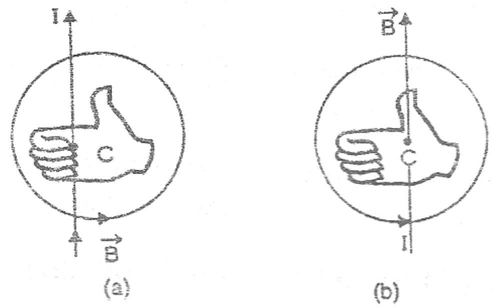


Fig. Right hand thumb rule for direction of magnetic field.

Maxwell's right hand thumb rule is also known as Maxwell cork screw rule . Cork screw is a device consisting of a handle and a spiral metal rod as shown in fig. (c).

When the cork screw is moved in the direction of current then the direction in which its handle is turned gives us the direction of the magnetic field. In short we can say that **when current flows vertically upward then direction of magnetic field produced is anticlockwise and when current flows vertically downward then direction of magnetic field is clockwise.**

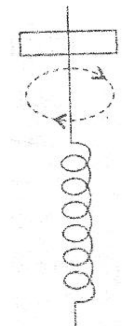


Fig. (c) Cork screw

Case 2. When Current is Circular, Magnetic Field is Straight .

When the current flows in a circular wire (coil), the magnetic field produced has straight lines of force near the centre of the coil, as shown in Fig. The parallel lines are lines are in a plane perpendicular to the plane of the coil. Their direction is marked by the arrows.

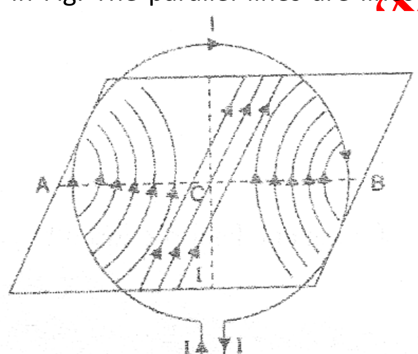
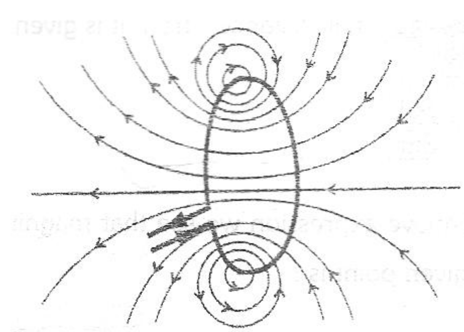


Fig. Current circular, magnetic field straight



Straight lines at the middle of the coil are due to the fact to the that each small segment of the circular coil is surrounded by the magnetic lines of force. At the centre of the coil, all lines of force add to each other resulting in the increase in strength.

It is found that magnitude of the magnetic field (B) at the centre of a circular coil carrying currents is directly proportional to amount of current flowing through the wire (I), inversely proportional to the radius of the coil (r) and directly proportional to the number of turns in the coil.

Mathematically,

$$B = \frac{\mu_0 n I}{2r}$$ Here, n is number of turns of the coil.

MAGNETIC FIELD DUE TO CURRENT IN A SOLENOID

A coil of many turns of wire wrapped in the shape of a cylinder is called a solenoid i.e., a solenoid is a long cylindrical coil wound over a hollow cylinder (non conducting). It is shown in Fig.(a).

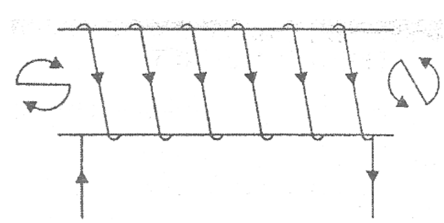


fig. (a) Solenoid carrying a current and polarity of its face

A solenoid differs from a circular coil in that the length of the solenoid is much greater than its diameter.

A solenoid behaves as if a large number of coils have been put one behind the other on the same axis over a length i.e., magnetic field produced by a current carrying solenoid is similar to the magnetic field produce by a bar magnet . Current in solenoid produces magnetic field in each turn, which becomes **additive**.

Polarity of magnetic field exists only at the ends of the solenoid, as shown in Fig.(a).

One end of the coil acts as a north pole while the other end acts like a south pole.

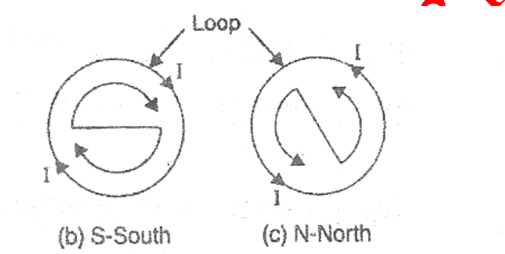


Fig.(b & c) Direction of current in loop.

Inside the solenoid the magnetic field is uniform (same at all points). It is represented by parallel and straight field lines. Magnetic field outside the solenoid is non-uniform.

Magnetic lines of force inside the solenoid are from south pole to north pole, while outside the solenoid these lines are from north pole to south pole.

RULE FOR POLARITY AT THE ENDS : If at any end, the current in the coil (or loop) is clockwise, the face of the coil towards the observer behaves as a south pole. [Fig. (b)]

If at any end, the current in the coil is anticlockwise, the face of the coil towards the observer behaves as a north pole [Fig. (c)]

Fig. (d) shows the magnetic field around a current carrying solenoid.

(i) Number of turns per unit length (n) of the solenoid and $B \propto n$

(ii) Strength of the current (I) in the solenoid and $B \propto I$

(iii) Nature (relative permeability, μ_r) of the core material of the solenoid and $B \propto \mu_r$

or $B \propto \mu_r \; nI$ or $\boxed{B = \mu_0 \mu_r nI}$

where μ_0 represents permeability of free space.

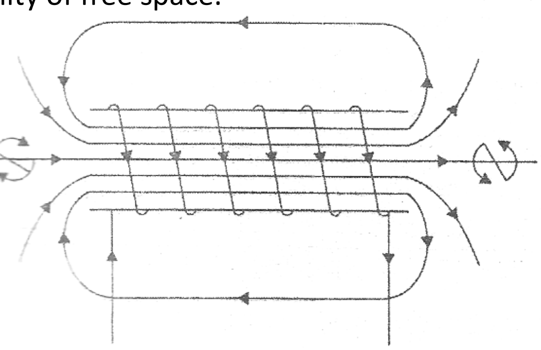


Fig. (d) Magnetic field around a solenoid : the-field is straight inside it.

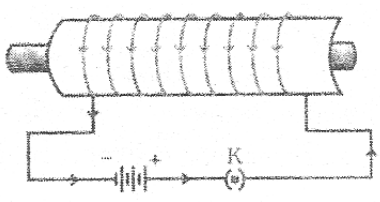
Note : Permeability is a magnetic property a material related to magnetism.

Que. How are the fields of a current-carrying solenoid and coil different ?

Sol. The field inside a current carrying solenoid is quite uniform for the most part. It only decreases near the ends. The field of a current carrying coil is not uniform. It changes with distance from the centre.

ELECTROMAGNET

Strong magnetic field which can be produced due to the flow of current can be used to magnetize a piece of magnetic material like steel rod, soft iron etc, when placed inside the coil. Magnet so produced is called electromagnet. Thus we can say that an electromagnet consists of many turns of insulated copper wire wound over a soft iron core or horse-shoe-magnet .



Strength of the electromagnet depends on :

(i) Number of turns in the coil : If number of turns in the coil are more, electromagnet will be strong.

(ii) Current flowing in the coil : Strength of electromagnet is directly proportional to the current flowing through the coil, and

(iii) Length of air gap between the pole : Strength of the electromagnet is inversely proportional to the distance between its poles.

Electromagnets are used to extract bullets from the body, to lift big machines and in electronic devices. Large values of μ_r n and I can produce very strong magnetic field inside the solenoid.

Electromagnets are better than permanent magnets as their strength can be controlled by changing the number of turns in the coil or by changing the current flowing through the coil.

Permanent magnets are usually made of some alloys of steel of because permanent magnets made from alloys are very strong than those made from ordinary steel.

Difference between an Electromagnet and a Permanent magnet

	Electromagnet	Permanent magnet
1	It behaves as a magnet as long as electric current passes through the solenoid surrounding it. It is demagnetized when electric current stops passing through the solenoid. Thus, electromagnet is a temporary magnet.	It cannot be demagnetized easily
2	Electromagnet gives a strong magnetic field and the strength of the magnetic field produced by these electromagnet can be increased or decreased by increasing or decreasing electric current through the solenoid.	Magnetic field of a permanent magnet is weak. The strength of magnetic field of the permanent magnet cannot be changed.
3	The polarity (i.e. North and South poles) of an electromagnet can be reversed by reversing the direction of electric current through the solenoid.	The polarity of a permanent magnet cannot be reversed.

DO YOU KNOW

- Hard steel, alnico (an alloy of aluminum, nickel, cobalt, iron and Nipermag (an alloy of aluminum, iron and titanium) are used to make permanent magnets.
- Soft iron is used to make electromagnets.
- A steel rod can be made a permanent magnet if it is placed inside a solenoid carrying direct current.
- Permanent magnets are used in loudspeakers, galvanometers, voltmeters, ammeters and speedometers.
- Permanent magnet can be demagnetized by heating it.

FORCE ON A CURRENT CARRYING CONDUCTOR PLACED IN A MAGNETIC FIELD AND FLEMING'S LEFT HAND RULE

A current carrying conductor produces a magnetic field around it. When it is placed in a magnetic field, the two magnetic fields interact with each other and a net force acts on the conductor.
If the conductor of length ℓ carrying current I is lying inside a magnetic field of intensity B and is making an angle θ with it, then force acting on the conductor is given by

$$\boxed{F = I\ell B \sin\theta}$$

If the conductor is lying perpendicular to the magnetic field, then $\theta = 90^0$ [sin θ = 1] and the force becomes F = I ℓ B.
This force acts in a direction which is perpendicular to the plane containing the conductor and the magnetic field (Fig.) is maximum.
If the conductor is lying parallel to the magnetic field, then θ = 0^0 (sin θ = 0) and the torque becomes zero and is minimum.

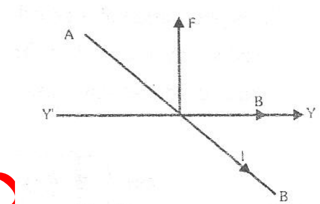


Fig. Force on a conductor

FLEMING'S LEFT HAND RULE

Direction of the force action on a current carrying conductor when placed in a magnetic field is given by Fleming's left hand rule, which states that :
If the forefinger, second finger and thumb of the left hand are stretched at right angles to each other, with the forefinger in the direction of the field and the second finger in the direction of the current then the thumb indicates the direction of the force.

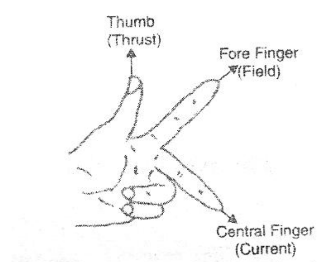


Fig.Fleming's left hand rule

FACTORS ON WHICH THE FORCE ACTING ON THE CURRENT CARRYING CONDUCTOR DEPENDS

The force acting on a current carrying conductor is placed in the magnetic field depends upon :

(i) **The strength of the magnetic field :** If the conductor is placed in a strong magnetic field , it experiences a large force. That is, F $\propto$ B (strength of magnetic field)

(ii) **The strength of the electric current :** If large current flows through the conductor placed in the magnetic field , it experiences a large force. That F $\propto$ I.

(iii) **The length of the conductor :** A long conductor experiences a greater force than the short conductor, when placed in the magnetic field. That is , F $\propto$ ℓ .

That is $\quad F \propto BI\ell$
or $\quad F = kBI\ell$
If k = 1 , $\quad F = BI\ell$

then $B = \dfrac{F}{I\ell}$

If I = 1 amp. and ℓ = 1m then B = F

Thus, magnetic field strength (B) is defined as the force acting per unit current per unit length of a conductor placed perpendicular to the direction of the magnetic field.
SI unit of magnetic field strength is Tesla.

$$1 Tesla = \frac{1 Newton}{1 Ampere \times 1 metre} = 1 N\, A^{-1} m^{-1}$$

ELECTROMAGNETIC INDUCTION

The phenomenon in which an electric current is induced in a circuit because of a changing magnetic field is called electromagnetic induction.

When a straight metallic wire is moved up and down in a magnetic field between the two poles of a horse shoe magnet then magnetic flux (number of magnetic lines of force) linked with the wire changes and an electric current is produced in the wire. A galvanometer connected across the two ends of the wire shows some deflection indicating that some current is produced. This current lasts only as long as the change in the flux continues.

This phenomenon is called electromagnetic induction. In short we can say that electromagnetic induction means production of electricity from magnetism. The electric current produced, is called induced current. The e.m.f. which produces this current , is called induced e.m.f.

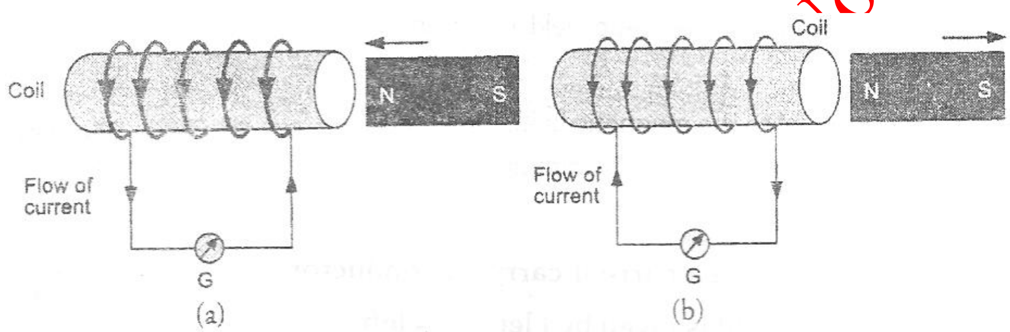


Fig. – Electromagnetic induction

FACTORS OF WHICH INDUCED CURRENT DEPENDS

The value of induced current depends upon :

(i) **The number of turns in the coil :** If coil has large number of turns, then large induced current is produced in the closed coil.

(ii) **The strength of the magnet :** A strong magnet moved towards or away from the closed coil produced a large induced current.

(iii) **The speed with which the magnet moves towards the coil :** If the magnet moves very quickly, then large induced current is produced in the closed coil.

FARADAY'S KISCOVERY OF ELECTROMAGNETIC INDUCTION

Michael Faraday in 1831, discovered phenomenon of electromagnetic induction. His experimental set up is shown in fig.

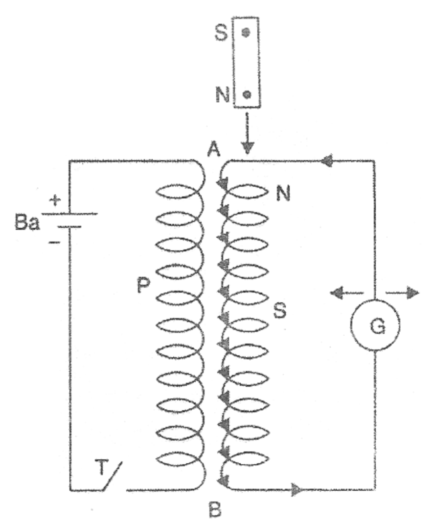


Fig.Faraday's Experiment

When north pole of a magnet was held above end A of secondary coil S, no deflection was seen in galvanometer G. As the pole was moved towards the coil, galvanometer showed some deflection to the right. When magnet was left inside coil, galvanometer deflection become zero. When he took the magnet out of the coil, deflection in the galvanometer to the left side was observed. Hence current flow only when magnet was in motion and not when it was at rest near the coil or inside the coil.

Faraday performed a similar experiment by putting a primary coil P near coil AB. He completed primary circuit with a battery Ba and tapping key T.
So long as key was open, no deflection was seen in the galvanometer G. As the key was pressed and primary circuit was closed, galvanometer showed some deflection to the right. Deflection became zero when key was kept pressed. When key was left to open, deflection in the galvanometer to the left side was observed.
The closing and opening of circuit changed the current in primary coil, which produced changing magnetic flux in the primary. This changing magnetic flux become linked with secondary and produces induced current (just as done by moving magnet), in the secondary.

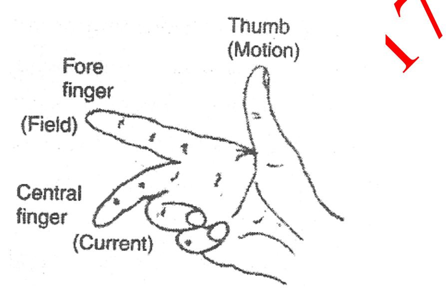


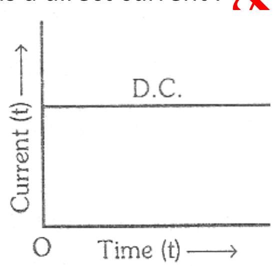
Fig.Fleming's Right Hand Rule

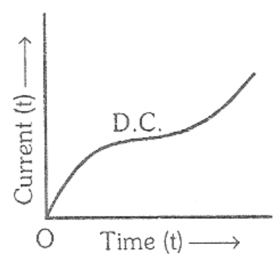
Direction of the induced current is given by **Fleming Right Hand rule which states that** Stretch the thumb, the fore finger and central finger of right hand in such a way that they are mutually perpendicular to each other. Then, if fore finger represents direction of Field and thumb represents direction of Motion of the conductor, then Central finger will represent the direction of induced Current (fig.).

DIRECT AND ALTERNATING CURRENT

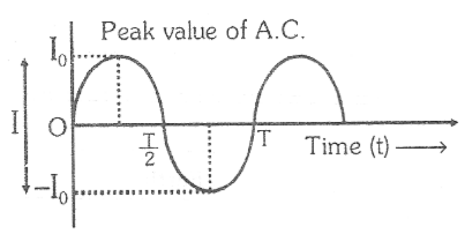
DIRECT CURRENT (D.C.) : A current which has a constant magnitude and same direction, is called a direct current

Current due to a cell or a battery is a direct current .





ALTERNATING CURRENT (A.C.) : A current which changes in magnitude and direction at regular intervals of time is called an alternating current .
The frequency of household supply of a.c. in India is 50 Hz. This means, a.c. completes 50 cycles in one second. Thus, a.c. changes direction after every $\frac{1}{100}$ second. In other words, a.c. used in India changes direction 100 times in one second.
Current changes direction after each rotation of the coil.



Frequency : Frequency of A.C. is the number of cycles per second completed by the current. One cycle is completed when the A.C. rises from zero to maximum positive then back to zero and then the maximum negative and zero again .

ADVANTAGES AND DISADVANTAGES OF A.C. OVER D.C.

A.C. has following merits (advantages) over D.C. :

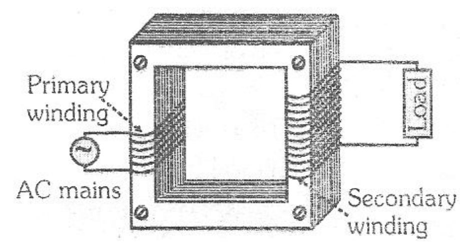
1. A.C. can be transmitted over long distances without much loss of energy.
2. A.C. can be produced easily and cheaply than D.C.
3. A.C. voltage can be transformed to any desired value with the help of a transformer.
4. Transmission of A.C. at "high-voltage" and "low-current' reduces line losses.
5. A.C. motors or other A.C. appliances are easier to operate.
6. A.C. can easily by converted in D.C. when required.

A.C. has following demerits (disadvantages) over D.C. :

1. A.C. attracts a person who touches its line whereas D.C. gives a repelling shock.
2. A.C. gives a huge and sudden shock which becomes fatal.
3. A.C. is conducted over the surface of a conductor (skin effect). It increases effective resistance of the conductor.
4. Commercial generators do not produce pure A.C.
5. In certain applications like electroplating, battery charging etc. only D.C. is required.
6. A.C. is more dangers than D.C.

DO YOU KNOW

Transformer is a device which changes small a.c. potential difference to a large a.c. potential difference. Transformer consists of two coils of wire wound around a core of soft iron. One coil is known as primary coil and the other is known as secondary coil as shown in figure.



Transformer is used to transmit a.c. to distance places through conductors (called transmission lines) without much loss of electric energy or power.

DOMESTIC ELECTRIC CIRCUITS

SUPPLY FROM POWER STATIONS : Electricity is generated at power station. In our homes, we receive the supply of electric power either supplied through overhead poles or underground cables using two thick aluminum wires.

MAIN BOARD : It is provided outside the building under a covered poach (verandah or poach). It contains the meter (energy-meter) and the main switch. (Fig.)

From the street electric pole, a thick rubber insulated cord reaches the main board. It contains two thick copper or aluminum wires, one covered with red and the other covered with black (or brown) plastic covering.

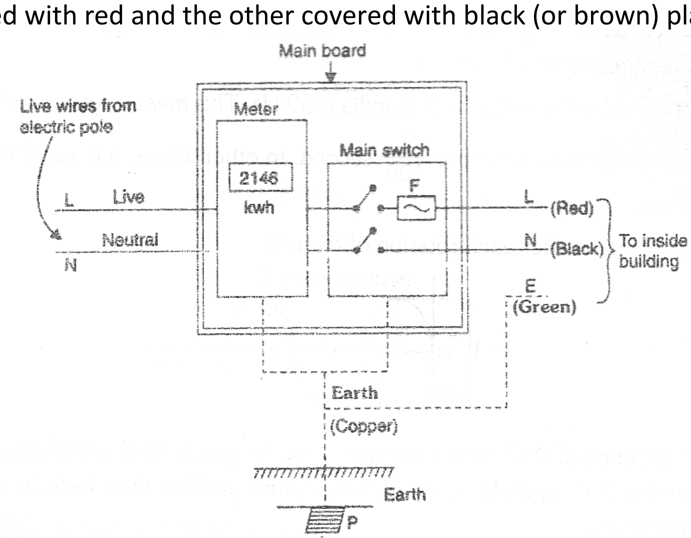


Fig . Main board outside the building

They form the lifeline wire (L) and neutral line wire (N) respectively.

Live line wire has a potential or 220 V whereas the neutral wire has zero potential (with respect to the earth). They enter the main board and are connected to the meter.

Wiring ahead is provided by the house owner himself. These wires are also red black plastic covered. From the meter the wires enter the main switch. In the main switch, a fuse F is provided in the path of live wire.

From outside the main switch, the wires become free to be used inside the building as required.

A third wire is a thick bare wire of copper. Called earth wire E. It is connected to an earth connection which consists of a thick copper plate P buried deep inside the moist earth.

INSIDE THE BUILDING : It is a well known fact that inside the house, connections to all the devices are made in parallel, each having independent switch and fuse (if necessary). Thus, whenever some fault occurs in circuit of one particular device in one room, devices in other rooms do not suffer.

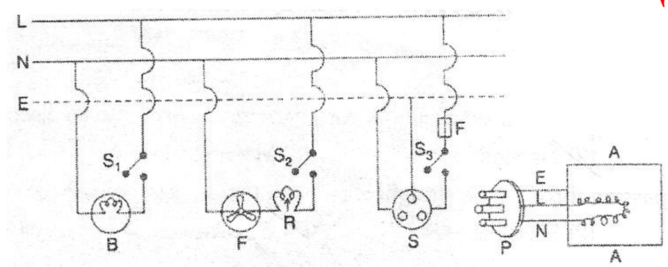


Fig. Circuit inside the building .

As shown in Fig. , connection to low power devices like bulb B and fan F are made with lines N and L only, putting switch in line L. For devices of more power and with whom the body remains in contact (like electric press or refrigerator), we use connections through a 3 pin plug socket (shoe) system .

A three pin plug P and three pin socket S are shown in Fig. . The three points of the socket are connected to the three lines as shown in the diagram. A fuse F is also introduced to avoid damage to the appliance.

The three pin plug uses a three wire cord which has three plastic wires inside a single rubber insulating cover. The wires are colored : red, black (or brown) and green respectively to serve as an extension of live, neutral and earth wires for the appliance. The three wire are connected to there holes in the socket as shown in Fig. When the plug is inserted in the socket, proper lines get connected to the appliance.

ELECTRIC FUSE : An electric fuse is a safety device used to save the electrical appliances like electric bulbs ,electric tubes, T.V. etc. from burning when large current flows in the circuit. Electric fuse is a wire made of copper or aluminum or tin-lead alloy. The melting point of the material of which the electric fuse wire is made should be low.

Suppose a fuse is not connected in the path of a live wire of the circuit. In such case, the circuit may be over heated if the current in the circuit exceeds the safe limit. There is a change of short circuiting of the circuit which causes the fire. So to avoid short circuiting of the circuit, a fuse must be but in the path of the circuit .

FUNCTION OF EARTH WIRE : Due to the long use, some covered wires inside the appliance may become bare and may make contact with metallic body of the appliance. In such a case the appliance gives a shock if not earthed. The earth wire keeps the potential of the of appliance zero and shock is avoided

USE OF SWITCH : All electrical appliances are provided with separate switches. All switches are connected with live wire as well as with neutral wire. When we switch off an appliance, then it gets disconnected from the live wire. Now if one touches the metallic body of the appliance there is no danger of electric shock. But, if connections to the switch are in such a way that on switching off the appliance, neutral wire gets disconnected but not live wire, then is danger of electric shock.

SHORT CIRCUIT

Fig. (a) normal eclectic circuit (b) Short circuit

When the live wire and the neutral wire come into direct contact, this occurs when the insulation of wires is damaged or there is a fault in the appliance. In such a situation, the current in the circuit abruptly increases. This is called short-circuiting. When short circuiting occurs, the resistance of the circuit becomes very small and hence huge amount of current flows through it. Large amount of current in the circuit produces large amount of heat which raises the temperature of circuit to very high value. As a result of this, the circuit catches fire.

OVERLOADING: means flow of large amount of current in the circuit beyond the permissible value of current. It occurs when many electrical appliances of high power rating like geyser, heater, refrigerator, motor etc. are connected in a single socket or in a single circuit. High current flowing in the circuit due to overloading causes fire.

EXERCISE # 1 (FOR SCHOOL / BOARD EXAMS)

OBJECTIVE TYPE QUESTIONS

Choose the Correct One

1. The fact that magnetic field is produced around a wire carrying, was discovered by

(1) Faraday (2) Oersted (3) Maxwell (4) Joule.

2. When the current is passing through the straight wire then, the associated magnetic field is

(1) Straight (2) Elliptical (3) Circular (4) Parabolic.

3. When current is circular, the associated magnetic field is

(1) Straight (2) Elliptical (3) Circular (4) Paralytic

4. When current flows clockwise in a loop, the polarity of its face is

(1) East (2) South (3) West (4) North

5. When current flows anticlockwise in a loop the magnetic polarity of the face is

(1) East (2) South (3) West (4) North

6. For a solenoid carrying a current I and having n turns per unit length, wrapped on a core of permeability μ, the correct expression for magnetic field intensity (2) is

(1) $B = \frac{\mu_0}{\mu} nI$ (2) $B = \frac{\mu_0 \mu I}{\mu}$ (3) $B = \mu_0 \mu nI$ (4) $B = \frac{\mu_0 \mu n}{I}$

7. Magnets having temporary magnetism are called

(1) Electromagnets (2) Bar magnets (3) Circular magnets (4) Horse-shoe magnets.

8. Direction of force acting on a current carrying conductor kept in magnetic field is given by

(1) Fleming's right hand rule (2) Fleming's left hand rule

(3) Lenz's rule (4) Faraday's rule

9. The electric device which works on the phenomenon of force on a current carrying conductor in a magnetic field is

(1) Generator (2) Accelerator (3) Motor (4) Transformer.

11. Electromagnetic induction was discovered by

(1) Oersted (2) Maxwell (3) Thomson (4) Faraday.

11. Direction of induced current produced by motion of a conductor in a magnetic field is given by

(1) Fleming's right hand rule (2) Fleming's left hand rule

(3) Lenz's rule (4) Faraday's rule

12. In domestic electric circuits, fuse must be placed in series with

(1) Earth wire (2) Neutral wire

(3) Live wire (4) Any or the three wires.

13. Elective and main switch is contained in a main board fitted usually

(1) At street electric pole (2) At main gate of building
(3) In verandah or parch (4) In bed or study room.

14. High powered electrical appliances are earthed to
(1) Avoid shock (2) Avoid wastage
(3) Make the appliance look beautiful (4) Reduce the bill.

15. In a three pin socket (shoe) the bigger hole is connected to
(1) Any wire (2) Live wire (3) Neutral wire (4) Earth wire

16. Due to overloading, the current in circuit becomes
(1) Less (2) More (3) Zero (4) Not definite .

17. Coming of live and neutral wire in direct contact causes
(1) Sort-circuiting (2) Over-loading (3) No damage (4) Unknown effect.

18. Melting point of material of a fuse wire must be
(1) Moderate (2) High (3) Low (4) Infinite.

19. A high powered electric appliance has used inferior wires and is not earthed. It is source of
(1) No concern (2) Less concern (3) Moderate concern (4) Hazard.

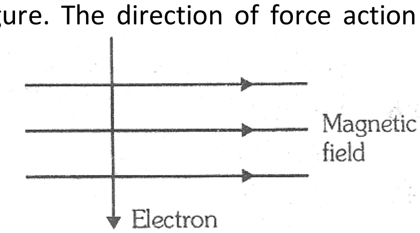
20. Which of the following correctly describes the magnetic field near a long straight wire ?
(1) The field consists of straight lines perpendicular to the wire
(2) The field consists of straight lines parallel to the wire.
(3) The field consists of radial lines originating from the wire.
(4) The field consists of concentric circles scented on the wire.

21. The phenomenon of electromagnetic induction is
(1) The process of charging a body
(2) The process of generating magnetic field due to a current passing through a coil
(3) Producing induced current in a coil by relative motion between a magnet and the coil
(4) The process of rotating a coil of an electric motor.

22. The device used for producing electric current is called a
(1) Generator (2) Galvanometer (3) Ammeter (4) Motor

23. At the time of short-circuit, the current in the circuit
(1) Reduces substantially (2) Does not change
(3) Increases heavily (4) Vary continuously

24. An electron enters a magnetic field at right angles to it as shown in figure. The direction of force action on the electron will be
(1) To the right
(2) To the left
(3) Out of the page
(4) Into the page



25. Which of the following property of a proton can change while it moves freely in a magnetic field ? (The may be more then one correct answers)
(1) Mass (2) Speed (3) Velocity (4) Momentum.

26. A positively-charged particle (alpha particle) projected towards west is deflected towards north by a magnetic filed. The direction of magnetic field is
(1) Towards south (2) Towards east (3) Downward (4) Upward.

27. A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each

(1) Two revolutions (2) One revolution (3) Half revolution (4) One-fourth revolution.

28. The magnetic field inside a long straight solenoid carrying current

(1) Is zero (2) Decreases as we move towards its end

(3) Increases as we move towards its end (4) Is the same at all points.

29. A magnetic field exerts no force on :

(1) An electric charge moving perpendicular to its direction (2) an unmagnified iron bar

(3) a stationary electric charge (4) a magnet

30. Which of the following instruments works by electromagnetic induction ?

(1) telephone receiver (2) simple motor

(3) dynamo (4) moving coil galvanometer.

31. The use of fuses in electric power-lines is :

(1) to keep main voltage constant

(2) to open the line permanently when there is an overload

(3) just to show an indication when there is an overload

(4) as a switch to use in an emergency

32. When the main switch of the house circuit is put off, it disconnects the :

(1) live wire (2) neutral wire (3) earth wire (4) live and neutral wires

33. When a fuse is rated at 8 A, it means :

(1) it will not work if current is less than 8 A (2) it has a resistance of 8 ohm

(3) it will work only if current is 8 A (4) it will burn if current exceeds 8 A.

34. Acceding to international Convention of colour coding of wires used in household electrical circuits :

(1) live is red, neutral is black and earth is green

(2) live is red, neutral is green and earth is black

(3) live is brown, neutral is blue and earth is black

(4) live is brown, neutral is light blue and earth is green

35. The magnetic field lines inside a current carrying solenoid are :

(1) along the axis and parallel to each other

(2) perpendicular to the axis and equidistant from each other

(3) circular and they do not intersect each other

(4) circular at the ends but they are parallel to the axis inside the solenoid

36. Potential difference between a live wire and the neutral wire is :

(1) 150 V (2) 210 V (3) 200 V (4) 220 V

37. Which of the following statements is incorrect regarding magnetic field lines :

(1) The direction of magnetic field at a point is taken to be the direction in which the north pole of a magnetic compass needle pints

(2) Magnetic field lines are closed cruces

(3) If magnetic field lines are parallel and equidistant, they represent zero strength

(4) Relative strength of magnetic field is shown by the degree of closeness of the field lines

38. Magnetic field liens determine :

(1) The shape of the magnetic field

(2) Only the direction of the magnetic field

(3) Only the relative strength of the magnetic field
(4) Both the direction and the relative strength of the magnetic field

39. The magnetic field near a long straight wire is described by :

(1) Straight field lines parallel to the wire (2) Straight field lines perpendicular to the wire
(3) Concentric circles centered on the wire (4) Radial field lines starting from the wire

40. The phenomenon of electromagnetic induction is :

(1) The process of charging a sphere.
(2) The process of producing magnetic field in a coil
(3) The process of producing induced current in a coil whenever there is a relative motion between the coil and the magnet
(4) The process of producing cooling effect.

41. Potential difference between a live wire and the neutral wire is :

(1) 200 volt (2) 150 volt (3) 210 volt (4) 220 volt

42. A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each :

(1) One revolution (2) One-fourth revolution (3) Half revolution (4) Two revolutions

43. Magnetic field inside a long solenoid carrying current is :

(1) Same at all pints (2) Minimum in the middle
(3) More at the ends than at the centre (4) Found to increase from one end to the other.

44. At the time of short circuit, the current in the circuit :

(1) Vary continuously (2) Reduces considerably (3) Increases heavily (4) does not change.

45. The frequency of direct current is :

(1) Zero (2) 50 Hz (3) 60 Hz (4) 100 Hz

46. The frequency of household supply of a.c. in India is :

(1) Zero (2) 50 Hz (3) 60 Hz (4) 100 Hz

47. The most important safety device method used for protecting electrical appliances from short circuiting or overloading is:

(1) Earthling (2) Use of stabilizers (3) Use of electric meter (4) Use of fuse

48. Current flowing in conductor A is 2A and current flowing in conductor B is 4A. The ratio of magnetic field produced around conductor A to the magnetic field produced around conductor B at a distance 10 cm from both the conductors is :

(1) 2 : 1 (2) 1 : 2 (3) 4 : 1 (4) $\sqrt{2}$: 1

49. Current flowing in conductors A and B is same, what is the ratio of the magnetic field produced around the conductor A at a distance of 5 cm from the conductor to the magnetic field produced around the conductor B at a distance of 2 cm from this conductor is

(1) 0.04 (2) 0.4 (3) 4.0 (4) 10

50. Same amount of current flows in the same direction . long the two parallel conductors separated by a small distance :

(1) Both conductors attract each other
(2) Both conductors repel each other
(3) Conductors neither attract each other nor repel each other
(4) Both conductors rotates about their axis

51. When an electric current flows through a long solenoid, magnetic field is set up in and around the solenoid :

(1) Magnetic field inside the solenoid is non-uniform and weak
(2) Magnetic field outside the solenoid is uniform and strong
(3) Magnetic field inside the solenoid increases as we move towards the ends of the solenoid
(4) Magnetic field of solenoid resembles the magnetic field of the bar magnet .

52. Magnetic field produced at the centre of a current carrying circular wire is :
(1) Directly proportional to the square of the radius of the circular wire
(2) Directly proportional to the radius of the circular wire
(3) Inversely proportional to the square of the radius of the circular wire
(4) Inversely proportional to the radius of the circular wire.

53. The direction of the magnetic field at a pint P above the current carrying wire is
(1) Down the page (2) Up the page (3) Into the page (4) Out of the page

54. Which of the following properties of a proton can change while t moves freely in a magnetic field ?
(1) Mass (2) Speed (3) Velocity (4) Momentum

55. A positively charged particle say an alpha particle projected towards west is deflected towards north by a magnetic field . The direction of the magnetic field is :
(1) Upward (2) Downward (3) Towards south (4) Towards east

56. Magnitude of magnetic field intensity at a point around a current carrying conductor is B. If the strength of current in the conductor becomes double, then the magnitude of magnetic field intensity at the point around the conductor is :
(1) $\frac{B}{2}$ (2) B (3) $\frac{B}{4}$ (4) 2B

57. Two parallel conductor carrying current in the same directions
(1) Repel each other
(2) Attract each other
(3) Sometimes attract and sometimes repel each other
(4) None of these

58. Two parallel conductor carrying current in the opposite directions
(1) Repel each other (2) Attract each other (3) Sometimes attract and sometimes repel each other
(4) None of these

59. Force acting on a stationary charge Q in the magnetic field B is :
(1) $BQ\upsilon$ (2) BQ/υ (3) $B\upsilon/Q$ (4) Zero

60. If the plug of the key is taken out (i.e. the circuit is made open) and magnetic field lines are drawn over the horizontal plane white sheet of paper, the lines are :
(1) Concentric circles (2) Elliptical in shape
(3) Straight lines parallel to each other (4) Parabolic in shape

61. When current passes through a long straight solenoid, N and S poles are created at the two ends of the solenoid. Which of the following statutes is incorrect ?
(1) The field lines inside the solenoid are in the form of straight lines indication that magnetic field is same at all the points inside the solenoid.
(2) The pattern of the magnetic field liens associated with the solenoid is different from the patter of the magnetic field lines around a bar magnet .
(3) N-and S-poles exchange portions when the direction of the current through the solenoid is reversed.
(4) Magnetic field produced inside the solenoid can be used to magnetize a bar of magnetic material like soft iron, when placed inside the solenoid.

In these type of Questions, two statements are given. Choose the current option by following directions given below: (Q. 80 to 83)

(1) Statement I is correct and Statement II is correct explanation of the statement I.

(2) Statement I is correct but Statement II is not the correct explanation of the statement I.

(3) Statement I is true but statement II is not true.

(4) Statement I is not true but statement II is true.

62. **Statement I :** A soft iron bar placed inside a solenoid carrying current is magnetized.

Statement II : Magnetic field inside a long solenoid carrying current is non-uniform.

(1) A (2) B (3) C (4) D

63. **Statement I :** The strength of magnetic field of a permanent magnet decreases with the increase n temperature.

Statement II : A permanent magnet can be demagnetized by heating it.

(1) A (2) B (3) C (4) D

64. **Statement I :** A charged particle moving parallel to the direction of of magnetic field experiences a force.

(1) A (2) B (3) C (4) D

65. A current carrying conductor placed perpendicular to the magnetic field experience a force. The displacement of this conductor in the magnetic field can be increased by.

(1) Decreasing the magnetic field (2) Decreasing the current in the conductor

(3) Increasing the magnetic field (4) Decreasing the length of the conductor.

66. A conductor of length 50 cm , carrying current of 0.1 A, when placed perpendicular to direction of magnetic field 0.2 T experience force :

(1) 1.0 N (2) 0.1 N (3) 0.01 N (4) 0.01 N

67. A charged particle having charge 3.2×10^{-19} C is traveling with a speed of 1.0×10^{6} ms^{-1} . When it passes perpendicular to the magnetic field 0.4 T, then the force experienced by it is :

(1) 12.8×10^{-13} N (2) 1.28×10^{-13} N

(3) 19.2×10^{-15} N (4) 1.92×10^{-15} N

68. A charged particle having charge 1.6×10^{-19} C travels with a speed of 3.2×10^{6} ms^{-1} in a direction parallel to the direction of magnetic field 0.04 T. The force experienced by the particle is :

(1) 2.0×10^{-14} N (2) 0.2×10^{-14} N

(3) Zero (4) 4.0×10^{-14} N

69. A magnetic compass is placed near a current carrying wire. The deflection of the needle of the magnetic compass increases. It shown that :

(1) Current in the wire is decreasing

(2) Current in the wire is increasing

(3) Current in the wire has nothing to do with the deflection of the needle of the magnetic compass

(4) Magnetic compass has been disturbed by some one.

70. A charged particle moving in a magnetic field experience a maximum force, when it moves at right angle to the direction of magnetic field. However, a student observes that a charged particle moving in the region of a magnetic field experiences no force and continues to move in a straight line. The observation of the student is correct only if :

(1) Charged particle moves at an angle of 30^0 with the magnetic field

(2) Charged particle moves at an angle of 60^0 with the magnetic field

(3) Charged particle either moves parallel or anti-parallel to the magnetic field

(4) Charged particle can never move in a straight line in the magnetic field

71. A soft iron rod can be made an electro-magnet. Which of the following procedures would be adopted to test that the soft iron rod had become a magnet ?

(1) Place the iron rod near a bar magnet and observe if attracts iron pins

(2) Place the iron near a current carrying wire and observe if it attracts iron pins

(3) Place the iron rod inside a current carrying solenoid and observe if it attracts iron pins

(4) None of these.

72. Current can be made to flow through a coil without connecting the coil with a battery. Which of the following procedures would be most suited to test this fact ?

(1) Connect a galvanometer across the ends of the coil and observe if galvanometer shows a deflection, when a bar magnet is placed near the one end of the coil

(2) Connect a galvanometer across the ends of the coil and observe if galvanometer shows a deflection, when a bar magnet is placed inside the coil.

(3) Connect the galvanometer across the ends of a coil and observe if galvanometer shows a deflection, when a bar magnet is moved towards or away from the coil and along the axis of the coil .

(4) Connect the galvanometer across the ends of the coil and observe if galvanometer shows a deflection, when a bar magnet is moved at right to the axis of the coil.

73. Two coil A and B placed close to each other. If current in the coil A is changed, some current will be induced in the coil B. This is because of electromagnetic induction. In this statement

(1) Inference is correct but reasoning is not correct

(2) Inference is incorrect but reason is correct

(3) Inference as well as reasoning are correct

(4) Neither inference nor reasoning is correct.

ANSWER – KEY															
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	**2**	**3**	**1**	**2**	**4**	**3**	**1**	**2**	**3**	**4**	**1**	**3**	**3**	**1**	**4**
Que.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	**2**	**1**	**3**	**4**	**4**	**3**	**1**	**3**	**4**	**3**	**4**	**3**	**4**	**3**	**3**
Que.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	**2**	**4**	**4**	**4**	**1**	**4**	**3**	**4**	**3**	**3**	**4**	**3**	**1**	**3**	**1**
Que.	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Ans.	**2**	**4**	**2**	**2**	**1**	**4**	**4**	**4**	**3**	**4**	**4**	**2**	**1**	**4**	**3**
Que.	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**		
Ans.	**2**	**3**	**1**	**4**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**		

EXERCISE # 2 (FOR SCHOOL / BORARD EXAMS)

FILL IN THE BLANKS

1. The phenomenon of production of magnetic field around a current carrying conductor is called ………………effect of current.

2. The rule which relates direction of deflection of magnetic needle with direction of field is called ………………..rule

3. When a wire is wrapped into many close turns over a cylindrical core, it forms a ………………..

4. To have north polarity at a face, the current in loop must flow in ………………..direction.

5. To have south polarity at a face, the current in loop must flow in ………………..direction.

6. In electromagnets, magnetism is ………………

7. In electromagnetic induction, motion of a………………in a fixed coil produces electric current .

8. An electric current having a constant magnitude and direction, is called a …………………current .

9. An electric current having a changing magnitude and direction, is called an …………..current.

10. In domestic electric circuit

(i) Fuse is connected in …………..wire

(ii) The colour of live wire is…………..

(iii) The colour of neutral wire is …………..

(iv) The colour of earth wire is ………………..

(v) Shock is avoided by ………………the appliance.

11. For earthling of an appliance we use…………..pin plug and socket (shoe).

12. A large current flows in the circuit due to …………………..and ……………………

13. To avoid damage due to large current we must use a…………………………..

WRITE TRUE OR FALSE IN THE FOLLOWING STATEMENTS

1. When some electric current flows through a wire, magnetic field is produced around the wire.

2. Electric current in a straight wire produces straight magnetic field .

3. A wire wrapped into many close turns over a cylindrical core forms a solenoid.

4. A coil with large number of turns forms a solenoid.

5. Direct current has a constant magnitude and direction.

6. Alternating current has a changing magnitude with no change in direction.

7. Fuse wire saves the electrical appliances from being damaged by excess current .

8. Fuse wire is used in parallel with the appliance.

9. Earthing the high powered electrical appliances saves them from electric shocks.

10. Earth wire has red colour.

11. The field at the centre of a long circular coil carrying current will be parallel straight lines.

12. A wire with a green insulation is usually the live wire.

13. Like magnetic poles attract each other and unlike magnetic poles repel each other .

14. Magnetic field lines determine only the direction of magnetic field but not the relative strength of the magnetic field.

15. Magnetic field lines are crowded in a region of strong magnetic field.

16. Two magnetic field lines can cross each other.

17. Magnetic field lines around a current carrying wires are concentric circles with their centres on the wire.

18. Two parallel wires carrying current in the same direction repel each other .

19. Two parallel wires carrying current in opposite direction attract each other.

20. The field at the centre of long circular coil carrying current will be parallel straight lines.

21. The magnetic field inside a current carrying solenoid is uniform magnetic field.

22. Direction of force experienced by a current carrying wire placed perpendicular to the magnetic field is determines by Fleming's left hand rule.

23. A static charge placed in a magnetic field experiences a force.

24. Potential difference is set up across the ends of a wire when it is placed in the uniform magnetic field.

25. The malting point of the material of which electric fuse wire is made should be low.

26. During short circuiting, the resistance of the circuit is very small.

27. A wire with a black colour is the earth wire of an electric supply.

28. A wire with a green colour is the live wire of an electric supply.

VERY SHORT ANSWER TYPE QUESTION

1. What is meant by magnetic field ?

2. How is the direction of magnetic field at a point determined ?

3. Define a magnetic field lien

4. At what place of the magnet are the magnetic field liens denser ?

5. How is the strength of the magnetic field around a wire related to the strength of the electric current flowing in the wire ?

6. How can it be shown that magnetic field exists around a wire through which direct current is passing ?

7. An alternating current has frequency of 50 Hz. How many times does it change its direction in one second ?

OR

How many times does AC used in India change direction in one second ?

8. What is the nature of magnetic field lines around a current carrying wire ?

9. State the rule used to determine the direction of magnetic field produced around a straight conductor carrying current.

10. Name the rule used to determine the direction of magnetic field due to a current carrying circular loop of a wire .

11. Write and expression for the force acting on a conductor of length (ℓ) carrying current **(I)** and placed perpendicular to the magnetic field **(B)**.

12. State the rule to determine the direction of a force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular.

13. What is a solenoid ?

14. Write one application of magnetic field of current carrying solenoid.

15. Define electromagnetic induction.

16. When is the force experienced by a current-carrying conductor placed in a magnetic field largest ?

17. What is the frequency of direct current (D.C) ?

18. What is the meaning of the term "frequency" of an alternating current ? What is its value in India ?

19. What do you understand by the current rating of an electric fuse ?

20. Name the material generally used to make electric fuse.

21. Why is an alternating current considered to be advantageous over direct current for long range transmission of electric energy ?

22. State the rule of determine the direction of current induced in a coil due to its rotation in a magnetic field .

23. How is induced current in a secondary coil related to current in a primary coil ?

ANSWER THE FOLLOWING QUESTIONS

1. Why does a compass needle get deflected when brought near a bar magnet ?

2. Draw magnetic field lines around a bar magnet .

3. List the properties of magnetic lines of force.

4. Why don't two magnetic lines of force intersect each other ?

5. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

6. The magnetic field in a given region is uniform. Draw a diagram to represent it .

7. State Fleming's left-hand rule.

8. Explain different ways to induce current in a coil.

9. Name some sources of direct current .

10. Which sources produce alternating current ?

11. An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5A. What result do you expect? Explain.

12. Name two safety measures commonly used in electric circuits and appliances.

13. What precaution should be taken to avoid the overloading of domestic electric circuits ?

14. In household circuits, is a fuse wire connected in series or in parallel ?

15. In which wire, (in A.C. circuit) , switch is introduced to operate the light ?

16. List three coerces of magnetic fields.

17. How does a solenoid behave like a magnet ? Can you determine the north and south poles of current carrying solenoid with a help of bar magnet ? Explain.

18. When is the force experienced by a current carrying conductor placed in a magnetic field is largest ?

19. Think that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field ?

20. A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is
(i) pushed into the coil, (ii) withdrawn from inside the coil, (iii) held stationary inside the coil ?

21. Two circular coils A and B placed c closed to each other. If the current in the coil A is changed, will some current be induced in the coil B ? Give reason.

22. State the rule to determine the direction of a

(i) magnetic field produced around a straight conductor carrying current.

(ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and

(iii) current induced in a coil due to its rotation in a magnetic field.

23. What is the function of an earth wire ? Why is it necessary to earth metallic appliances ?

24. A current through a horizontal power line flows in east to west direction. What is the direction of magnetic field at a point directly below it and at a point directly above it ?

ANSWER KEY

EXERCISE # 2

FILL IN THE BLANKS :

1.	Magnetic	**2.**	Right hand thumb rule	**3.**	Solenoid	**4.**	Anticlockwise
5.	Clockwise	**6.**	Temporary	**7.**	Magnet	**8.**	Direct
9.	Alternating						

10.(i) Series **(ii)** Red **(iii)** Black **(iv)** Green **(v)** Earthy

11. Three **12.** Overloading, Short circuiting **13.** Fuse

TRUE & FALSE

1.	T	**2.**	F	**3.**	T	**4.**	T	**5.**	T
6.	F	**7.**	T	**8.**	F	**9.**	T	**10.**	F
11.	T	**12.**	F	**13.**	F	**14.**	F	**15.**	T
16.	F	**17.**	T	**18.**	F	**19.**	F	**20.**	T
21.	T	**22.**	T	**23.**	F	**24.**	F	**25.**	T
26.	T	**27.**	F	**28.**	F				

DEFINITION

Light is form of energy which enables up to see objects which emit or reflect light.
Light is a type of (form of) energy which can produce sensation in our eyes. So we can experience the sensation of vision.
If is travel in straight line in form of particles and waves. With the help of light we see all colours of nature. Our eyes are mostly sensitive for yellow colour and least sensitive for violet and red colour. Due to this reason commercial vehicle's are painted with yellow colour, sodium lamps are used in road lights.

PROPERTIES OF LIGHT

Light energy propagates (travels) via two processes.

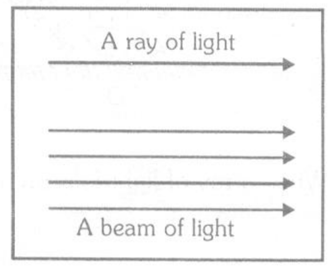
(i) The particles of the medium carry energy from one point of the medium to another.
(ii) The particles transmit energy to the neighboring particles and in this way energy propagates in the form of a wave.
(iii) It propagates in straight line.
(iv) It's velocity in vacuum is maximum whose value is 3×10^8 m/sec. (297489978 m/s)
(v) Light does not need a material medium to travel that is it can travel through a vacuum.
(vi) It exhibits the phenomena of reflection, interference, diffraction, polarization and double refection.

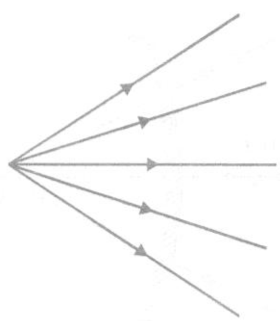
RAY OF LIGHT

A straight line show the direction moment of light is called ray of light.

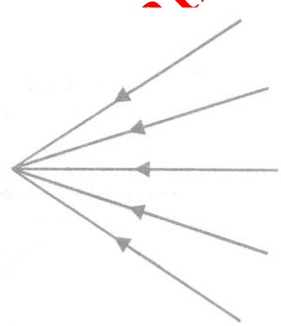
BEAM OF LIGHT

A bunch of light rays or bundle of rays at a point is called beam of light,





A divergent beam of light



A convergent beam of light

HOW WE SEE ?

When a light ray is falling (strike) on the surface of any object which reflect and reached to our eyes. Due to this our eyes feel a sensation then we see the object.

REFLECTING OF LIGHT

When rays of light falls on any object it return back in the same medium from the surface this phenomenon is called reflection of light. Due to reflection of light we can see all the nature.

INCIDENT RAY

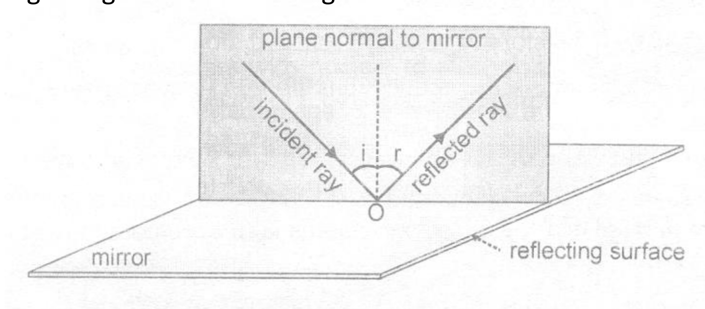
The ray light which falls on a polished surface (or a mirror) is called the incident ray of light.

REFLECTED RAY

The ray of light which gets reflected from a polished surface (or a mirror) is called the reflected ray of light.

NORMAL

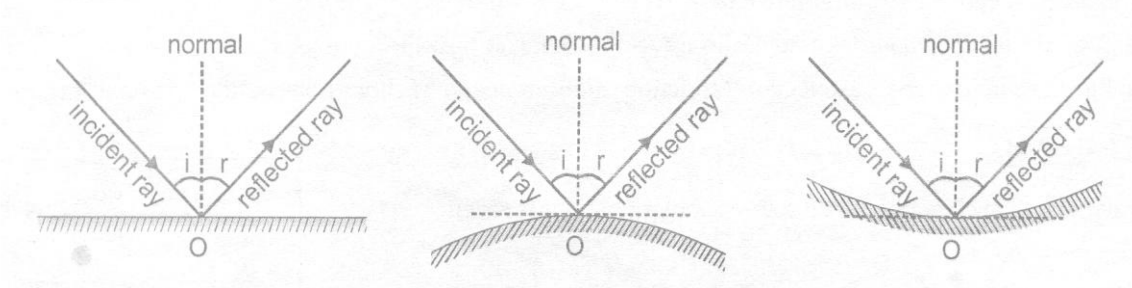
The normal is a line at right angle to the reflecting surface.



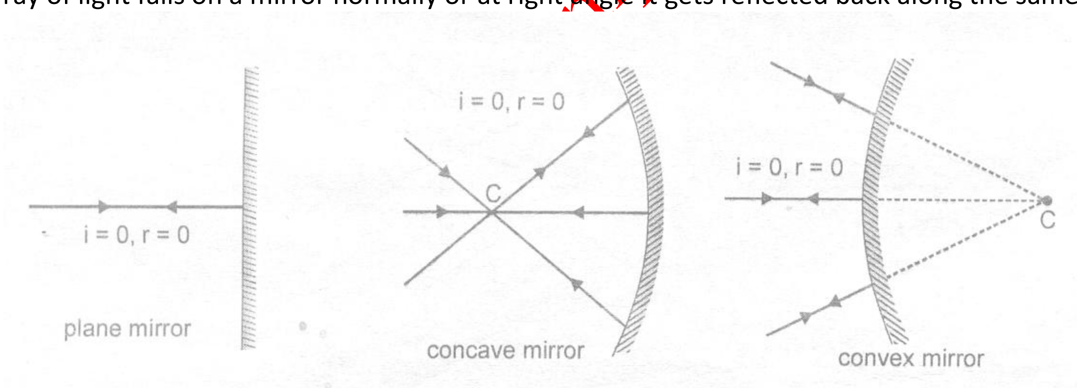
LAWS OF REFLECTION

(i) The incident ray, the reflected ray and the normal to the surface at the point of incidence all lie in the same plane.

(ii) The angle of incidence ($\angle i$) is always equal to the angle to reflection ($\angle r$) i.e. $\angle i = \angle r$



▸▸ When a ray of light falls on a mirror normally or at right angle it gets reflected back along the same path.

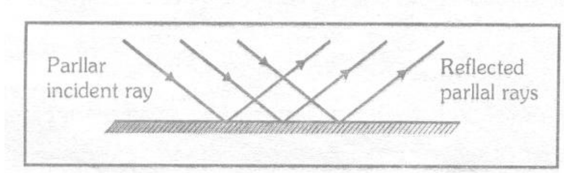


Depending on the nature of the reflecting surface there are two types of reflection :-

(i) Regular (specular) reflection (ii) Irregular (diffused) reflection

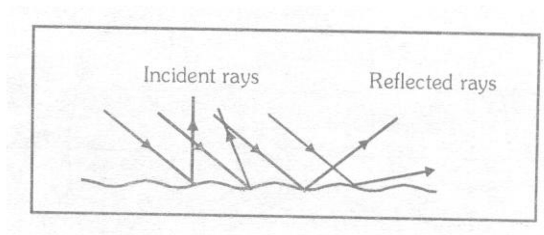
REGULAR REFECTION

When parallel light rays fall on smooth plane surface like mirror, if all rays of light are reflected parallel along a definite direction. Then this kind of reflection is called regular reflection.



IRREGULAR REFLECTION (DIFFUSED REFLECTION)

When parallel light rays fall on a rough surface all the rays of light are reflected in all possible (Different) direction this is called diffused or irregular reflection.

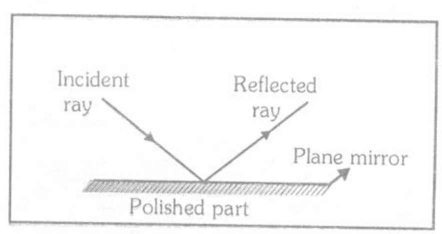


MIRROR

A smooth, highly polished reflecting surface is called a mirror.
When a glass plate is polished on one sided with reflecting material such silver or nickel then is becomes a mirror.

From the reflecting surface of mirror there are two types of mirror.
(i) Plane mirror (ii) Spherical or curved mirror

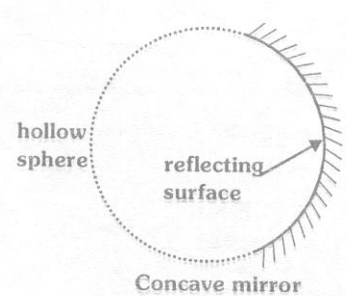
(i) **Plane mirror :** A highly polished plane surface is called a plane mirror or if a flat (totally plane) surface of a glass plate is polished one side of reflecting material is called plane mirror.

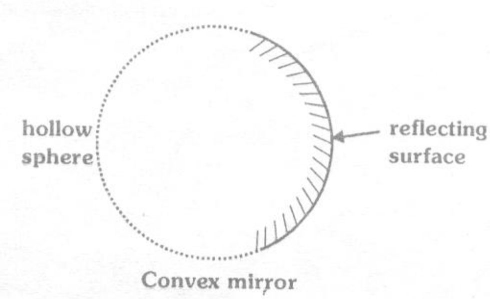


(ii) **Spherical mirror :** A mirror whose polished, reflection surface is a part of hollow sphere of glass is called a spherical mirror. For a spherical mirror, one of the two curved surfaces is coated with a thin layer of silver followed by a coating of red lead oxide paint. Thus one side of the spherical mirror is made opaque and the other side acts as a reflecting surface.

For the polishing side there are two type of spherical mirror.

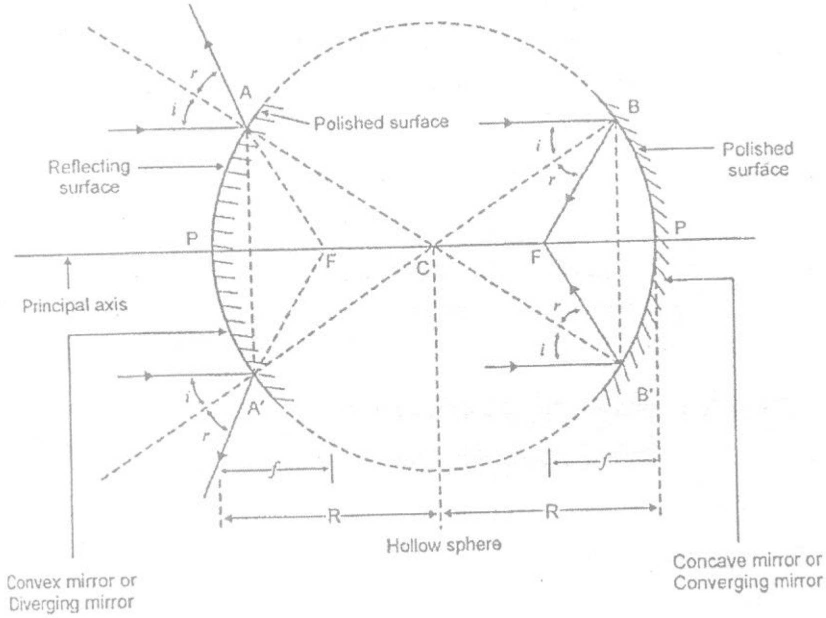
(A) Convex mirror (B) Concave mirror





(A) **Concave (Converging) mirror :** A spherical mirror whose inner hollow surface is the reflecting surface .
(B) **Convex (diverging) mirror :** A spherical mirror whose outer bulging out surface is the reflecting surface.

TERMINOLOGY FOR SPHERICAL MIRRORS



(a) **Aperture :** The effective width of a spherical mirror from which reflection can take place is called its aperture AA' & BB'.

(b) **Pole (Vertex) :** The centre of a spherical mirror is called its pole it is denoted by letter P.

(c) **Centre of curvature :** The centre of the hollow sphere of which the spherical mirror is a part is called centre of curvature. It is denoted by letter C.

(d) **Radius of curvature :** The radius of the hollow sphere of which the spherical mirror is a part called the radius of curvature (R).

(e) **Principal axis :** The straight line passing through the centre of curvature C and the pole P of the spherical mirror.

(f) **Normal :** The normal at any point of the spherical mirror is the straight line obtained by joining that point with the centre of curvature C of the mirror.

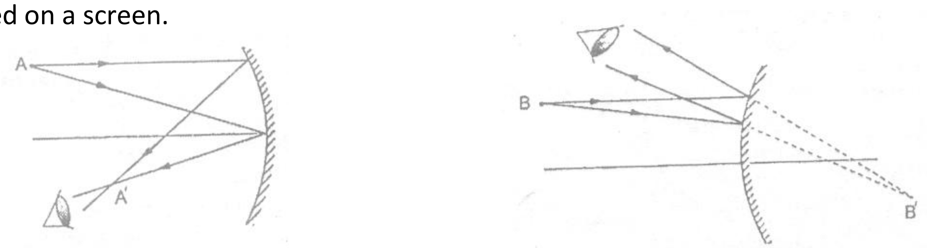
(g) **Principal focus or focus :** The point on the principal axis where all the rays coming from infinity (parallel rays) after reflection either actually meets or appears to meet is called the focus (or focal point) of the mirror. It is denoted by letter F.

(h) **Focal length :-** The distance between the pole (P) and the focus (F) is called focal length (f) and $f = \frac{R}{2}$

(i) **Focal plane :-** An imaginary plane passing through the focus and at right angles to the principal axis.

(j) **Real image :-** When the rays of light after getting reflected from a mirror (or after getting refracted from a lens) – actually meet at a point, a real image is formed. A real image can be obtained on a screen.

(k) **Virtual image :-** When the rays of light after getting reflected from a mirror (or after getting refracted from a lens) appear to meet at a point, a virtual image is formed. Such an image can only be been through a mirror (or a lens) but cannot be obtained on a screen.

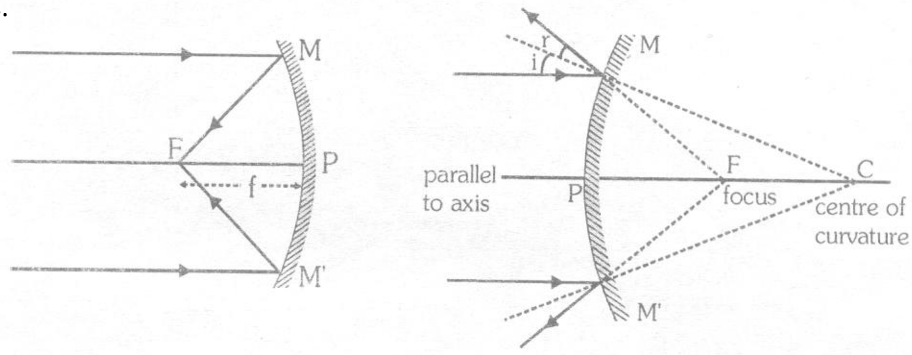


(a) Real image　　(b) Virtual image

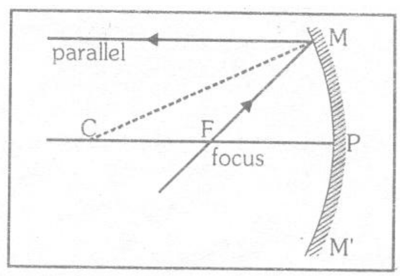
RULES OF IMAGE FORMATION FROM THE SPHERICAL MIRROR

The rules of reflection from the spherical mirror are based of incident and reflection angel.

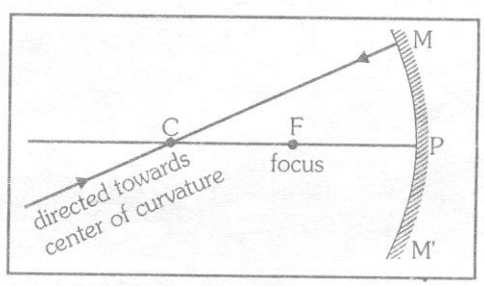
(i) A ray parallel to principal axis after reflection from the mirror passes or appears to pass through its focus by definition of focus.



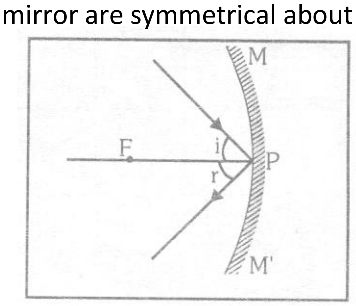
(ii) A ray passing through or directed towards focus after reflection from the mirror it will become parallel to the principal axis.



(iii) A ray passing through or directed towards centre of curvature after reflection from mirror, retraces its path. As for it $\angle$ i = 0 and so $\angle$ r = 0.



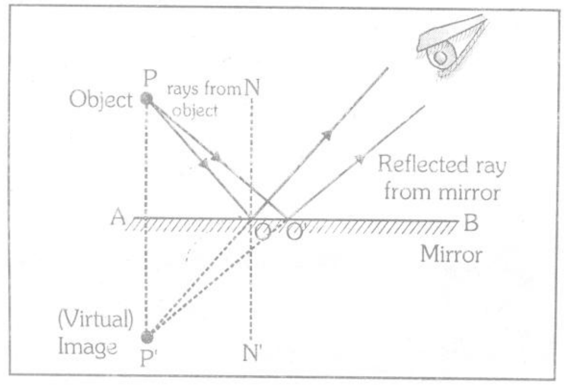
(iv) Incident and reflected rays at the pole of a mirror are symmetrical about the principal axis.



Difference between Real and Imaginary image

S.No	Real image	Virtual image
(1)	When reflected or refracted light rays actually intersect at a point.	When reflected or refracted light rays do not actually intersect at a point but appear to meet at a point
(2)	It can be obtained on a screen.	It can not be obtained on a screen.
(3)	It is always inverted.	It is always erect.
(4)	It is always formed in front of mirror.	It is always formed behind the mirror.

FORMATION OF IMAGE BY A PLANE MIRROR



Properties of image from flat (Plane) Mirror

(i) Virtual and erect.

(ii) Same in size of object.

(iii) The image is formed behind of the mirror (as far as the object from the mirror).

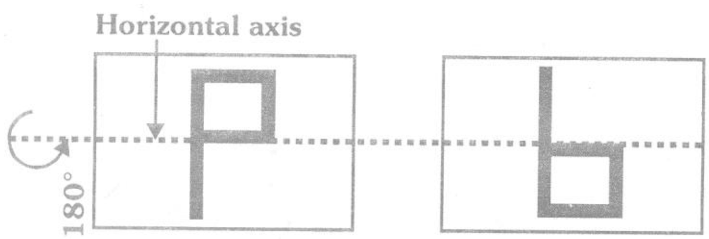
(iv) The image formed is laterally inverted.

LATERAL INVERSION AND INVERSION

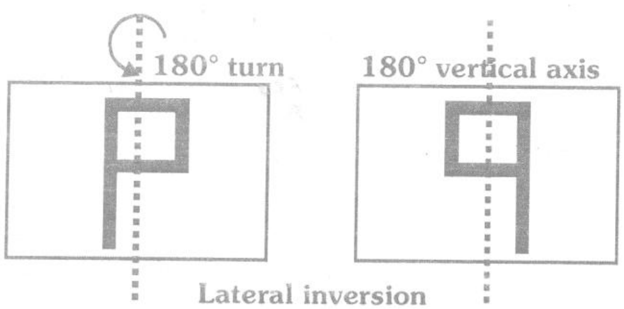
The phenomenon due to which the image of an object turns through an angle of 180^0 through vertical axis rather than horizontal axis, such that the right side of the image appears as left or vice versa is called **lateral inversion.**

INVERSION

During inversion image turns around horizontal axis through an angle of 180^0.

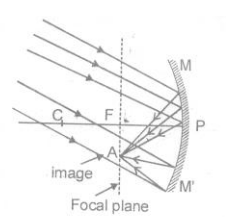


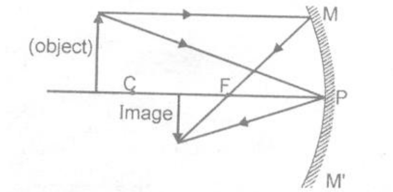
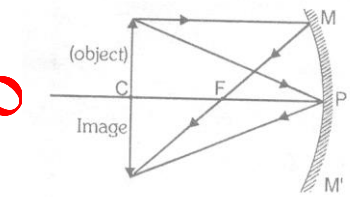
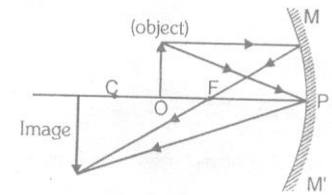
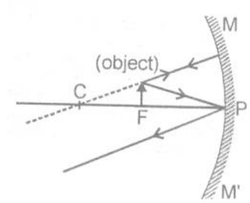
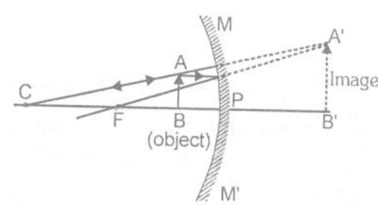
Inversion of image



Lateral inversion

Image formation from Concave mirror

S.No.	Position of the Object	Position of the image	Nature & size of the image	Ray diagram
(1)	At infinity.	At focus F	Real. inverted and highly diminished. (point size)	

(2)	Between infinity and C	Between C & F	Real. inverted and smaller than the object	
(3)	At C	At C	Real. inverted and same size.	
(4)	Between C & F	Between C and infinite.	Real. inverted and enlarged.	
(5)	At F	At infinity.	Real. inverted and infinitely large.	
(6)	Between focus and pole	Behind the mirror.	Virtual. erect and enlarged.	

Use of Concave mirror

(i) It is used as a shaving mirror.

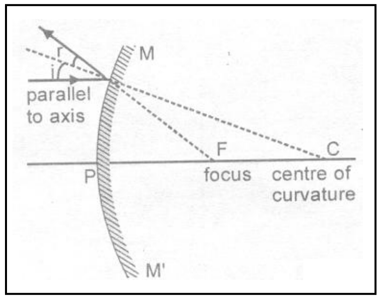
(ii) It is used as a reflector in the head light of vehicles.

(iii) It is used by doctor to focus a parallel beam of light on a small area.

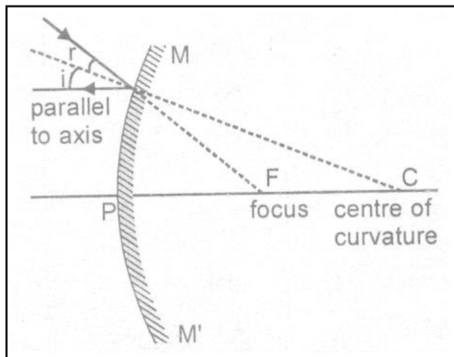
FORMATION OF IMAGE FROM A CONVEX MIRROR

There are rules of drawing images in convex mirror

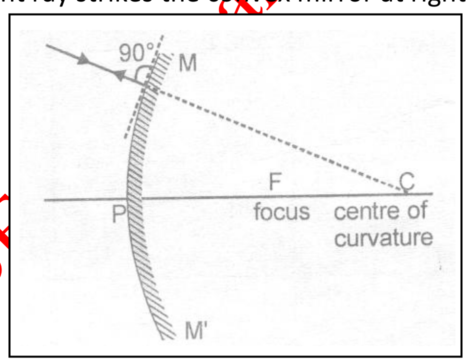
(i) Any ray of light travelling parallel to the principal axis of a convex mirror of the appears to diverge from the principal focus of the convex mirror.



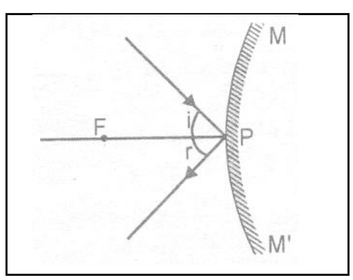
(ii) Any ray of light which travelers towards the direction of principal focus of a convex mirror, after reflection, it will travel for parallel to the principal axis of the mirror.



(iii) If ray of light which is incident along to the centre of curvature of a convex mirror after reflection it returns back on the same path. It is because the light ray strikes the convex mirror at right angle.



(iv) When the ray of light incident on the pole which is reflects or returns back on same angle from principal axis than it will reflect on the same angle of incident $\angle i = \angle r$.

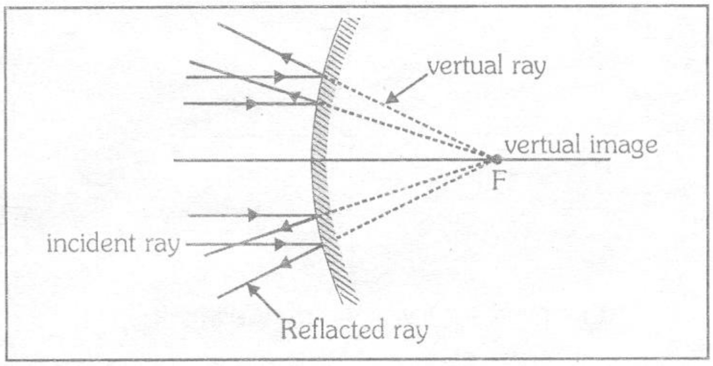


MAKING OF IMAGE FROM A CONVEX MIRROR

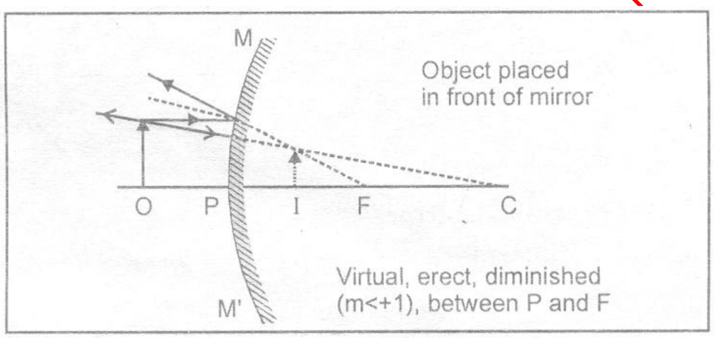
(i) When the object is at infinity

When the rays of light coming (diverging) from an object, situated at infinity are always parallel these parallel rays, strike the convex mirror, and reflected to diverge outward from convex mirror. These rays seems (appear) come from focus.

The characteristic of the image is virtual, erect, diminished to a point and formed at principal focus behind the convex mirror.



(ii) When the object is at a finite distance from the pole then the image is formed between pole and principal focus behind the convex mirror and image is virtual, erect and diminished.



Note :

There are only two position of the object for showing the image formed by a convex mirror that is –

(i) When the object is at a infinity.

(ii) When the object is at a finite distance from the pole of the convex mirror. Beside this positions are hot possible because the focus and the centre of curvature is behind the reflecting surface of the convex mirror.

Now we can study the image formation by following table

S.No.	Position of the object	Position of the image	Size of image of the image	Nature of the image
(1)	At infinity	At F, behind mirror	Highly diminished	Virtual and erect.
(2)	Between infinity and pole of mirror	Between P & F behind the mirror	Diminished	Virtual and erect.

Used of Convex mirror

(i) It is used as a rear view mirror in automobile.

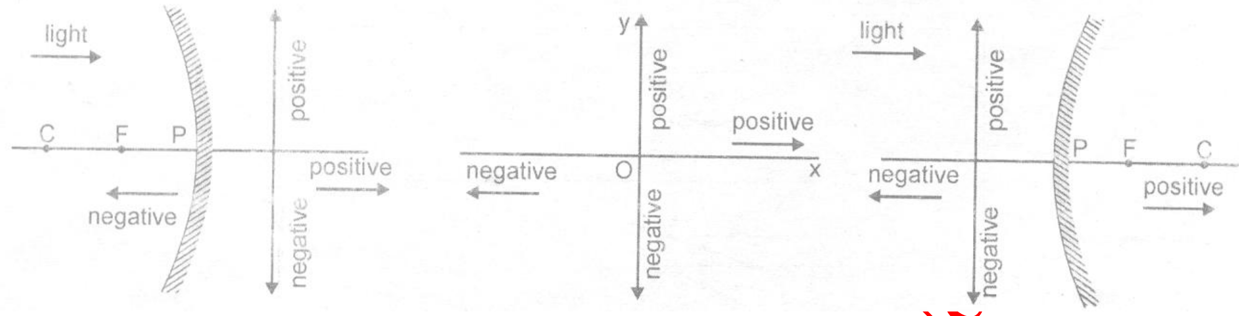
(ii) It is used as a reflector for street light.

Note : A plane mirror is not useful as a rear view mirror, because its field of view is very small.

COMPETITION WINDOW

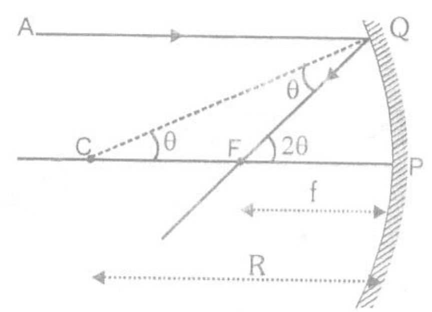
SIGN CONVENTION OF SPHERICAL MIRROR

- Whenever and wherever possible the ray of light is taken to travel from left to right.
- The distances above principal axis are taken to be positive while below it negative.
- Along principal axis, distances are measured from the pole and in the direction of light are taken to be positive while opposite to it is negative.



RELATION FROM SPHERICAL MIRROR

Relation between f and R for the spherical mirror



If Q is near to line P then from ΔQCP $\tan\theta \approx \theta = \dfrac{QP}{R}$

and from ΔQFP $\tan 2\theta \approx 2\theta = \dfrac{QP}{f}$

so $\dfrac{2QP}{R} = \dfrac{QP}{f} \Rightarrow f = \dfrac{R}{2}$

Relation between u, v and f for curved mirror

If an object is placed at a distance u from the pole of a mirror and its image is formed at a distance v (from the pole)

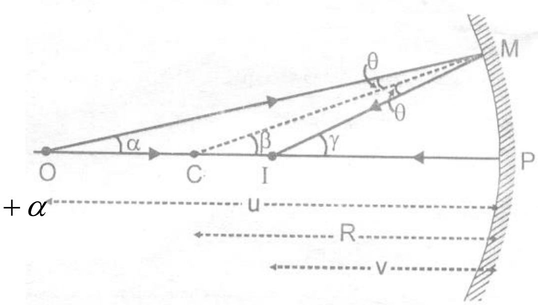
If angle is very small : $\alpha = \dfrac{MP}{u}, \beta = \dfrac{MP}{R}, \gamma = \dfrac{MP}{v}$

from ΔCMO, $\beta = \alpha + \theta \Rightarrow \theta = \beta - \alpha$

from ΔCMI, $\gamma = \beta + \theta \Rightarrow \theta = \gamma - \beta$

so we can write $\beta - \alpha = \gamma - \beta \Rightarrow 2\beta = \gamma + \alpha$

$\therefore \dfrac{2}{R} = \dfrac{1}{v} + \dfrac{1}{u} \Rightarrow \dfrac{1}{f} = \dfrac{1}{u} + \dfrac{1}{v}$

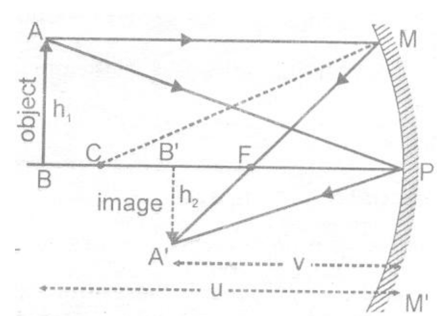


MAGNIFICATION

Linear magnification $m = \dfrac{size\ of\ image}{size\ of\ object} = \dfrac{I}{O}$

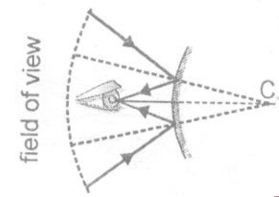
ΔABP and ΔA'B'P are similar $\dfrac{-h_2}{h_1} = \dfrac{-v}{-u} \Rightarrow \dfrac{h_2}{h_1} = -\dfrac{v}{u}$

Magnification $m = -\dfrac{v}{u} \Rightarrow m = -\dfrac{v}{u} = \dfrac{f}{f-u} = \dfrac{f-v}{f} = \dfrac{h_2}{h_1}$



POWER OF A MIRROR

The power of a mirror is defined as $P = -\frac{1}{f(m)} = -\frac{100}{f(cm)}$



◎ **Convex mirrors** gives erect, virtual and diminished image.
In convex mirror the field of view is increased as compared to plane mirror.
It is used as rear-view mirror in vehicles.
Concave mirrors give enlarged, erect and virtual image, so these are used by dentists for examining teeth. due to their converging property concave mirror are also used as reflectors in automobile head lights and search light
A real image can be taken on a screen, but a virtual image cannot be taken on a screen.

As focal length of a spherical mirror $f = \frac{R}{2}$ depends only on the radius of mirror and is independent of wavelength of light and refractive index of medium so the focal length of a spherical mirror in air or water and for red or blue light is same.

☐ MIRROR FORMULA

The relation between the distance of the object from the pole of the spherical mirror (u), the distance of the image from the pole of the spherical mirror (v) and its focal length (f) is given by the mathematical formula:

$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ It must be remembered that focal length (f) of a spherical mirror is half the radius of curvature (R). Thus,

(i) R = 2f, (ii) $f = \frac{R}{2}$

Important points in using the mirror formula

(i) Put the correct signs of known variables according to the sign convention.
(ii) Do not put the sign of an unknown variable. The sign will be automatically come up during calculations.
(iii) If the calculated sign turns out to be positive, then the variable calculated is behind the mirror. However,. if calculated sign turns out to be negative, then variable is to be in front of the mirror.

Linear magnification produced by spherical mirrors :

The ratio between the height of the image produced by the spherical mirror to the height of the object is called the linear magnification.

Thus, linear magnification = $\frac{\text{Height of the image}}{\text{Height of the object}}$ or $m = \frac{h_i}{h_0}$

Linear magnification when the image is real :

As we normally take object above the principal axis, therefore, h_o is always positive. The real image is always inverted and is formed below the principal axis.

Therefore, h_i is always negative. thus, Linear magnification for real images $= -\frac{h_i}{h_0}$ is always negative.

Linear magnification when the image is virtual :

In case of virtual image. It is erect and formed above the principal axis. Thus, h_o and h_i are both positive.

▶▶ The linear magnification produced by a spherical mirror is equal to the ratio of the distance of the image from the pole of the mirror (v) to the distance of the object from the pole of the mirror (u) with a minus sign.

Liner magnification, $m = -\frac{v}{u}$, Thus Linear magnification, $m = \frac{h_i}{h_o} = -\frac{v}{u}$.

Important points in using magnification formula :

(i) Put the correct signs of known variables according to the sign convention.

(ii) If ‘m’ is known, take the sign for virtual image positive and for real image negative.

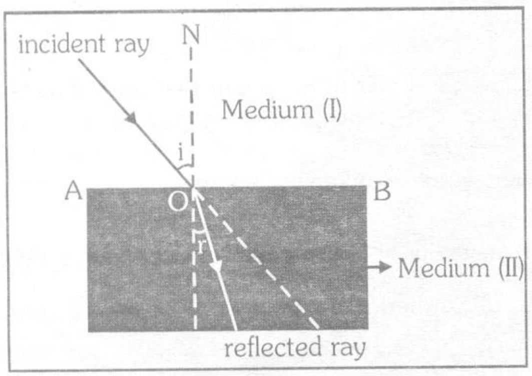
(iii) Do not put the sign of unknown variables. The sign will automatically come up during calculations.

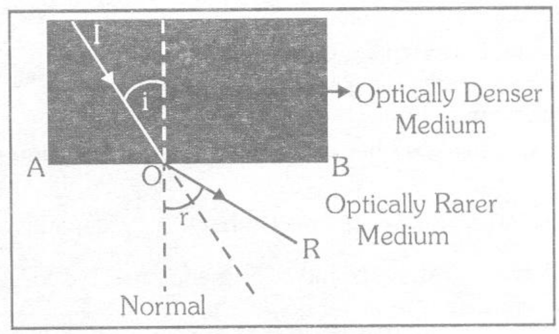
REFRACTION OF LIGHT

The bending of a ray of light as it passes from one medium to another is called refraction. It is due from change in velocity of light while travelling from one medium to another.

(i) The maximum velocity of light is 3×10^8 m/sec in vacuum or air.

(ii) The velocity is less in denser medium.



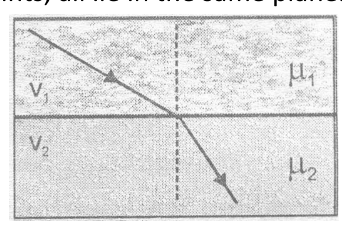


THE LAWS OF REFRACTION

(i) The ratio of sine of the angle of incidence to the sine of the angle of refraction for a particular pair of media constant. Thus if the angle of incidence is i, and that of refraction is r, then

$$\frac{\sin i}{\sin r} = \text{constant} = \mu \text{ it is known as Snell's law.}$$

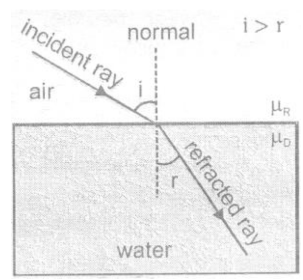
(ii) The incident ray, the refracted ray and the normal at the point of incidence points, all lie in the same plane.



RELATIVE REFRACTIVE INDEX

When light passes from one medium to the other, the refractive index of medium 2 relative to 1 is written as $_1\mu_2$ and is defined as

$$\mu_{21} \quad \text{or} \quad {}^1\mu_2 \quad \text{or} \quad {}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{(c/v_2)}{(c/v_1)} = \frac{V_1}{V_2}$$



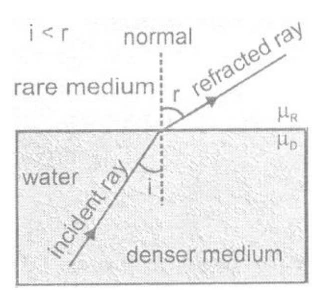
◎ **Bending of light ray**

According to Snell’s law, $\mu_1 \sin I = \mu_2 \sin r$

(i) If light passes from rarer to denser medium

$$\mu_1 = \mu_R \quad \text{and} \quad \mu_2 = \mu_D$$

so that $\dfrac{\sin i}{\sin r} = \dfrac{\mu_D}{\mu_R} > 1 \Rightarrow \quad \angle i > \angle r$



in passing from rarer to denser medium, the ray bends towards the normal.

(ii) If light passes from denser to rarer medium $\mu_1 = \mu_D$ and $\mu_2 = \mu_R$

$$\frac{\sin i}{\sin r} = \frac{\mu_D}{\mu_R} < 1 \Rightarrow \quad \angle i < \angle r$$

In passing from denser to rarer medium, the ray bends away from the normal

Refractive index depends on nature and density of medium and colour of light refractive index is maximum for violet and minimum of red light.

COMPETITION WINDOW
APPARENT DEPTH AND NORMAL SHIFT

If a point object in denser medium is observed from rarer medium and boundary is plane, then from Snell's law we have $\mu_D \ \sin i = \mu_R \ \sin r$ .....(i)

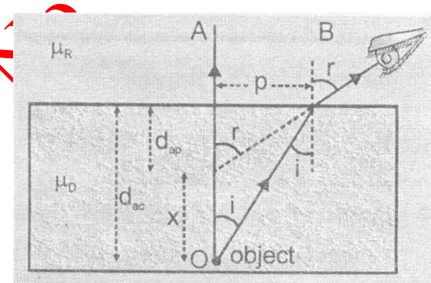
If the rays OA and OB are close enough to reach the eye.

$\sin i \approx \tan i = \frac{P}{d_{ac}}$ and $\sin r \approx \tan r = \frac{P}{d_{ap}}$

So that eqn. (i) becomes d_{ac} = actual depth d_{ap} = apparent depth

$\mu_D \frac{P}{d_{ap}} \mu_R \frac{P}{d_{ap}}$ i.e., $\frac{d_{ac}}{d_{ap}} = \frac{\mu_R}{\mu_D} = \frac{\mu_1}{\mu_2}$ (If $\mu_R = 1, \ \mu_D = \mu$)

$d_{ap} = \frac{d_{ac}}{\mu}$ so $d_{ap} < d_{ac}$ ......(ii)

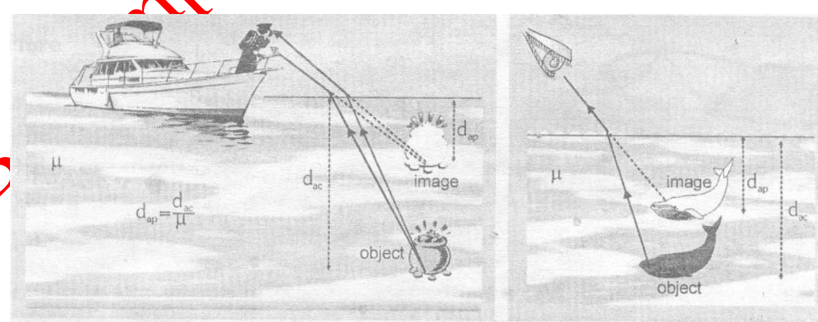


The distance between object and its image, called normal shift (x)

$x = d_{ac} - d_{ap}$ $[\because d_{ap} = \frac{d_{ac}}{\mu}]$

$x = d_{ac} - \frac{d_{ac}}{\mu} = d_{ac}\left[1 - \frac{1}{\mu}\right]$ ...(iii)

if $d_{ac} = d$, $x = d\left[1 - \frac{1}{\mu}\right]$

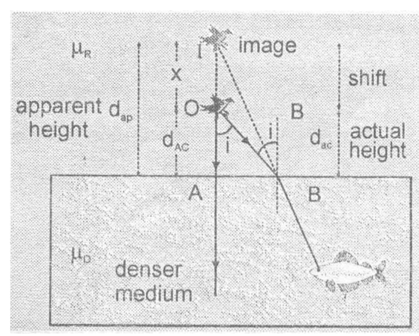


Object in a rarer medium is seen from a denser medium

$\frac{d_{ac}}{d_{ap}} = \frac{\mu_1}{\mu_2} = \frac{\mu_R}{\mu_D} = \frac{1}{\mu} (< 1)$

$d_{ap} = \mu d_{ac}$

$d_{ap} > d_{ac}$



A high flying object appears to be higher than in really

$x = d_{ap} - d_{ac}$ $\Rightarrow$ $x = [\mu - 1]d_{ac}$

Lateral Shift

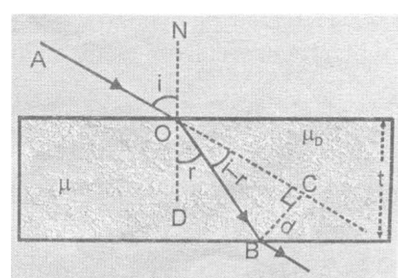
The perpendicular distance between incident and emergent ray is known as lateral shift.

Lateral Shift d = BC and t = thickness of slab

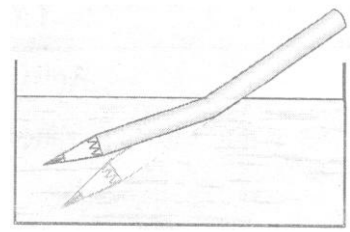
In Δ BOC

$\sin(i - r) = \frac{BC}{OB} = \frac{d}{OB}$ $\Rightarrow$ $d = OB \sin(i - r)$ ...(i)

In $\Delta OBD \cos r = \frac{OD}{OB} = \frac{t}{OB}$ $\Rightarrow$ $OB = \frac{t}{\cos r}$ ...(ii)



From (i) and (ii) $d = \dfrac{t}{\cos r}\sin(i - r)$



SOME ILLUSTRATIONS OF REFRACTION

◎ **Bending of an object**

When a point object in a denser medium is seen from a Rarer medium it appears to be at a depth $\dfrac{d}{\mu}$

◎ Twinkling of stars

Due to fluctuations in refractive index of atmosphere the refraction become irregular and the light sometimes reaches the eye and sometimes it does. This gives rise to twinkling of stars.

COMPETITION WINDOW

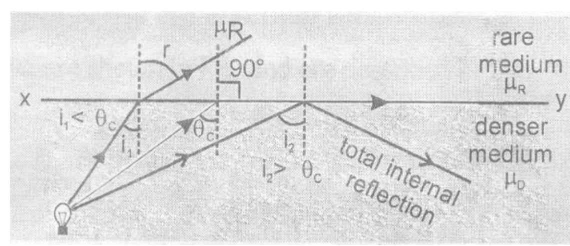
Total Internal Reflection (TIR)

When light ray travel from denser to rarer medium in bend away from the normal if the angle of incident is increased angle of refraction will also increased. At a particular value of angle of incidence the refracted ray subtend 90^0 angle with the normal, this angle of incident is known as critical angle (θ_C.) If angel of incident further increase the ray come back in the same medium this phenomenon is known as total internal reflection.

CONDITIONS

◎ Angle of incident > critical angle [i > θ_C]

◎ Light should travel from denser to rare medium $\Rightarrow$ Glass to air, water to air, Glass to water



Snell Law at boundary x – y, $\mu_D \sin\theta_C = \mu_R \sin 90^0 \Rightarrow \sin\theta_C = \dfrac{\mu_R}{\mu_D}$

As $\mu \propto \dfrac{1}{\lambda} \propto \dfrac{1}{v}$ $\qquad \sin\theta_C = \dfrac{\mu_R}{\mu_D} = \dfrac{V_D}{V_R} = \dfrac{\lambda_D}{\lambda_R}$

◎ When light ray travel from a medium of refractive index μ to air then $\mu_R = 1, \mu_D = \mu$

$$\sin\theta_C = \frac{1}{\mu} \Rightarrow \sin\theta_C = \frac{1}{\mu} \propto \lambda \Rightarrow \theta(red) > \theta_C(violet)$$

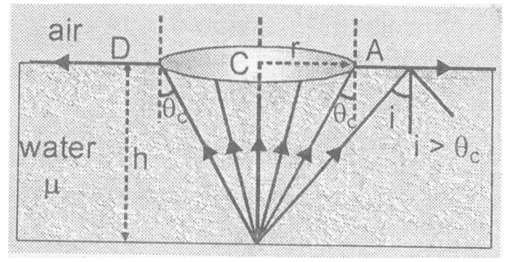
◎ For TIR i > θ_C $\Rightarrow \sin i > \sin\theta_C \Rightarrow \mu > \dfrac{1}{\sin i}\left(\because \sin i = \dfrac{1}{\mu}\right)$

◎ When ray travel from glass to air $\sin\theta_C = \dfrac{\mu_R}{\mu_D} = \dfrac{1}{\frac{3}{2}} \approx 42^0 \Rightarrow$ i > 42^0(TIR), i < 42^0 (refraction)

◎ When ray travel from water to air $\sin\theta_C = \dfrac{\mu_R}{\mu_D} = \dfrac{1}{\frac{4}{3}} \approx 49^0$ i > 49^0(TIR), i < 49^0 (refraction)

◎ When rays travel from glass to water $\sin\theta_C = \dfrac{\mu_R}{\mu_D} = \dfrac{4/3}{3/2} \approx 63^0$ i > 63^0(TIR), i < 63^0 (refraction)

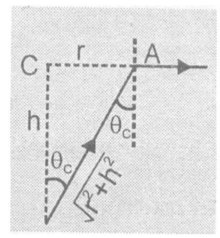
◎ A point object is situated at the bottom of tank filled with a liquid of refractive index μ up to height h. It is found light from the source come out of liquid surface through a circular portion above the object then radius and area of circle



$$\sin\theta_C = \frac{r}{\sqrt{r^2+h^2}}$$

$$\sin\theta_C = \frac{1}{\mu} \quad \Rightarrow \quad \frac{1}{\mu} = \frac{r}{\sqrt{r^2+h^2}} \Rightarrow \frac{1}{\mu^2} = \frac{r^2}{\sqrt{r^2+h^2}}$$

$$\Rightarrow \mu^2 r^2 = r^2 + h^2 \qquad \Rightarrow (\mu^2-1)r^2 = h^2 \Rightarrow r = \frac{h}{\sqrt{\mu^2-1}}$$ and area πr^2



$$\Rightarrow \tan\theta_C = \frac{1}{h} \qquad \Rightarrow r = h\tan\theta_C$$

Angle which the eye of fish make = $2\theta_C = 2\times 49^0 = 98^0$. This angle does not depend on depth of liquid

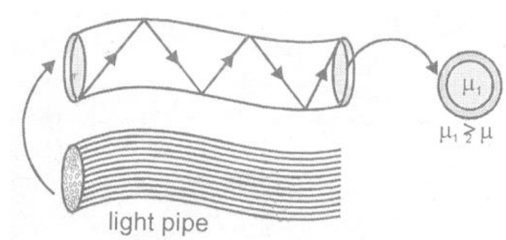
SOME ILLUSTRATIONS OF TOTAL INTERNAL REFLECTION

◎ **Sparkling of diamond**

The sparkling of diamond is due to total internal reflection inside it. As refractive index for diamond is 2.5 so $\theta_C = 24^0$. Now the cutting of diamond are such that I > θ_C. So TIR take place again and again inside it . The light which beams out from a few places in some specific directions makes it sparkle.

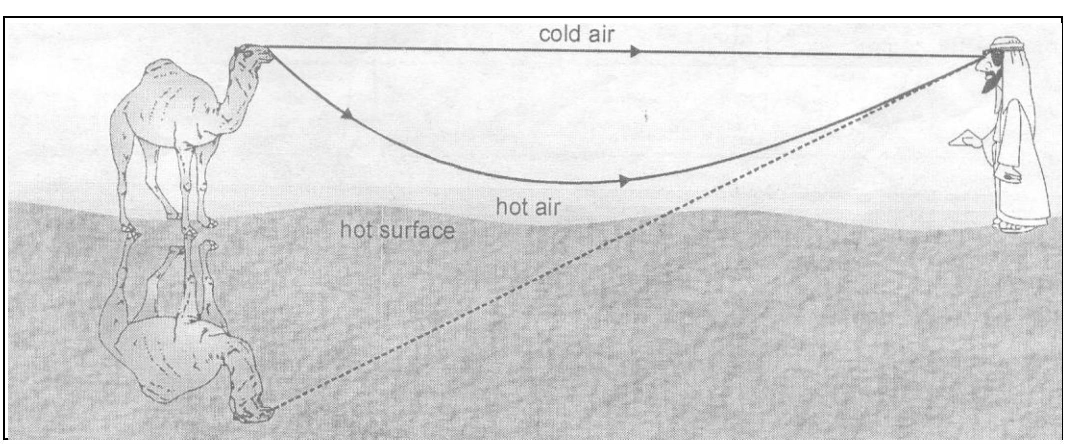
◎ **Optical Fiber**

In it light through multiple totals internal reflections is propagated along the axis of a glass fiber of radius of few microns in which index of refraction of core is greater then that of surroundings.

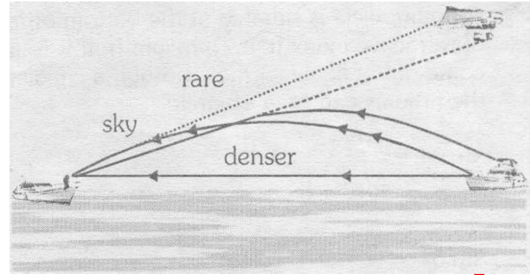


◎ **Mirage and looming**

Mirage is caused by total internal reflection is deserts where due to heating of the earth, refractive index of air near the surface earth becomes lesser than above it. Light from distant objects reaches the surface of earth with i > θ_C so that TIR will take place and we see the image of an object along with the object as shown in figure .



Similar to ‘mirage’ in deserts, in polar regions ‘looming’ takes place due to TIR. Here μ decreases with height and so the image of an object is formed in air if (i>θ_C) as shown in Fig.



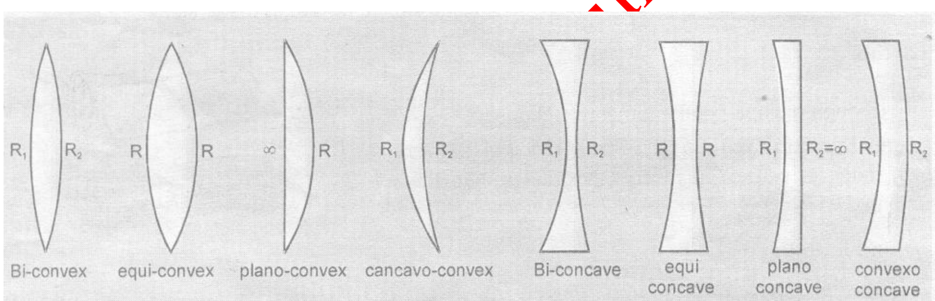
GOLDEN KEY POINTS

- A diver in water at a depth d sees the world outside through a horizontal circle of radius. r = d tan θ_C.
- For total internal reflection to take place light must be propagating from denser to rarer medium.
- In case of total internal reflection, as all (i.e. 100%) incident light is reflected back into the same medium there is no loss of intensity while in case of reflection from mirror or refraction from lenses there is some of intensity as all light can never be reflected or refracted. This is why images formed by TIR are much brighter . than formed by mirrors or lenses.

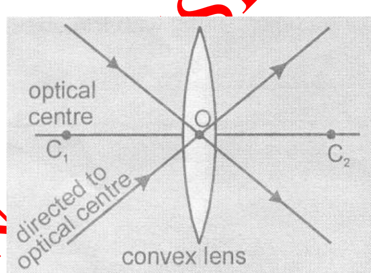
LENSES

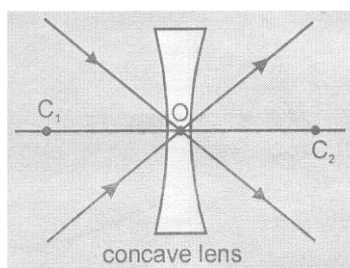
A lens is a piece of any transparent material bound by two curved surfaces or by one curved and one plane surface.
Lens are of two types :

(i) Convex or convergent lens. **(ii) Concave or divergent lens.**



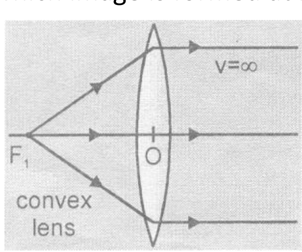
◎ **Optical Centre :** O is a point for a given lens through which any ray passes undedicated

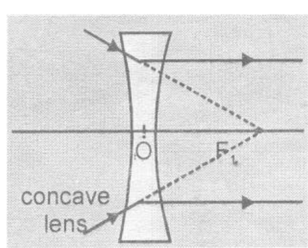




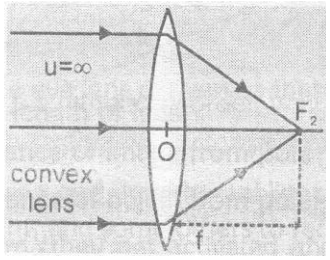
◎ **Principal Axis : C_1C_2** is line passing through optical centre and perpendicular to the lens.

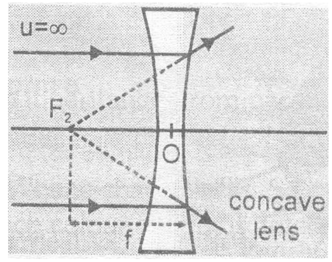
◎ **Principal Focus :** A lens has two surfaces and hence two focal points. First focal point is an object point on the principal axis for which image is formed at infinity.





While second focal point is an image point on the principal axis for which object lies at infinity





Focal Length f is defined as the distance between optical centre of a lens and the point where the parallel beam of light converges or appears to converge.

Aperture : In reference to a lens, aperture means the effective diameter. Intensity of image formed by a lens which depends on the light passing through the lens will depend on the square of aperture, i.e., $I \propto (\text{Aperture})^2$

RULES FOR IMAGE FORMATION

A ray passing through optical center proceeds undeviated through the lens.

A ray passing through first focus or directed to towards it, after refraction from the lens, becomes parallel to the principal axis.

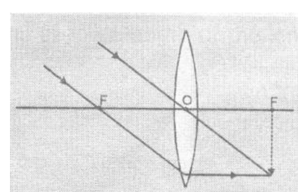
A ray passing parallel to the principal axis after refraction through the passes or appears to pass through F_2

For Convergent or Convex Lens

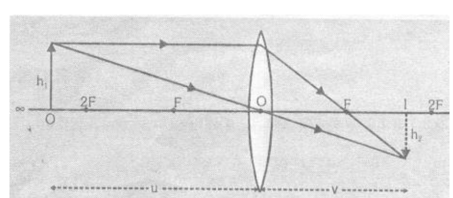
Object	Image	Magnification
∞	**F**	**m << - 1**
∞ - 2F	**F – 2F**	**m < - 1**
2F	**2F**	**m = - 1**
F – 2F	∞ - 2F	**m > - 1**
F	∞	**m >> -1**
F – O	In front of lens	**m > + 1**

IMAGE FORMATION FOR CONVEX LENS (CONVERGENT LENS)

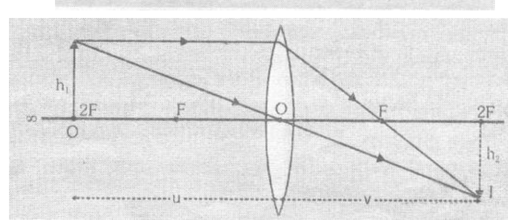
(i) Object is placed at infinity
Image : at F
real
inverted
very small in size
m << - 1



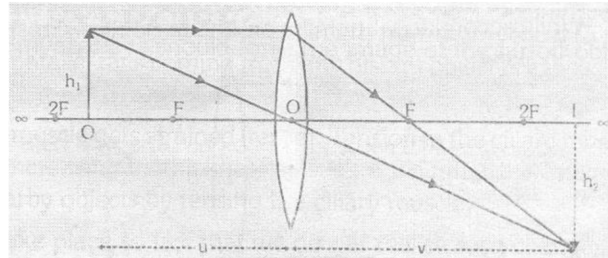
(ii) Object is placed in between
∞ - 2F
Image: real (F – 2F)
inverted
small in size
(diminished)

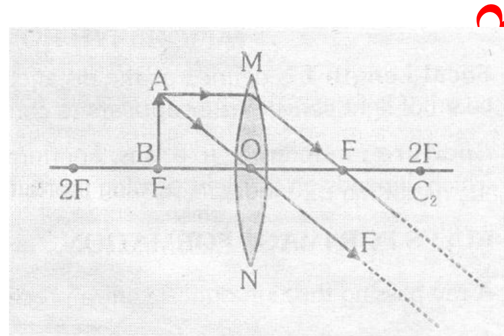


(iii) Object is placed at 2F
Image: real (at 2F)
inverted
equal (of same size)
(m = - 1)

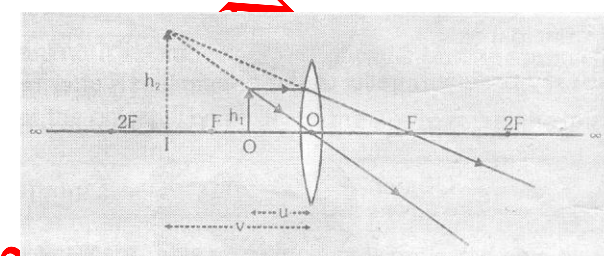


(iv) Object is placed in between
2F – F
Image: real (2F - ∞)
inverted
enlarged
m > 1





(v) Object is placed at F



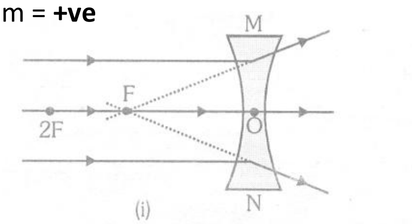
(vi) Object is placed in between
F – O
Image: virtual (in front of lens)
erected
enlarge
(m > + 1)

Given	Real	Virtual
u	-	-
v	+	+
h_1	+	+
h_2	-	+
m	-	+

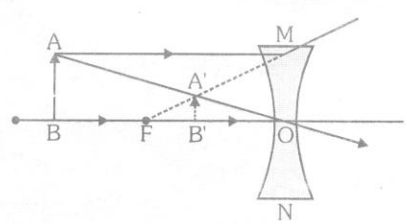
IMAGE FORMATION FOR CONCAVE LENS (DIVERGENT LENS)

Image is virtual, diminished, erect, towards the object, m = **+ve**

(i) Object is placed at infinity
Image : At F
virtual
erected
diminished
(m << + 1)



(ii) Object is placed in front of lens
Image : between F and optical centre
virtual
erected
diminished
(m < + 1)



Formula of lens : Focal length of a lens can be find out by the following formula.

$$\frac{1}{f} = \frac{1}{v} = \frac{1}{u}$$

Where – f = Focal length of lens.
v = Distance of image from pole
u = Distance of object from pole.

Uses of this formula

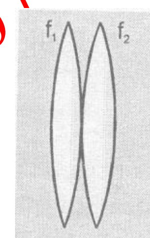
(i) Put the correct signs of known variables according to the sign conventions.

(ii) Do not put the sign of unknown variable. The sign will automatically show up during calculations.

(iii) If the calculated sign of a variable turns out positive, then the variable calculate is on the other side of the lens, i.e., on the opposite side to the object. However if calculated variable is of negative sign, then it is on the same side as the object.

COMBINATIONS OF LENSES

Two thin lens are placed in contact to each other

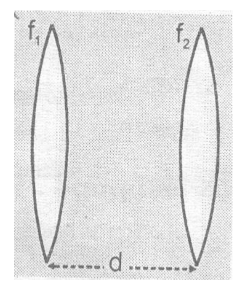


power of combination.

$P = P_1 + P_2$ $$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

Use sign convention while solve Numericals.

Two thin lens are placed in a small distance d



$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$

$P = P_1 + P_2 - d\ P_1 P_2$

Use sign convention when solve Numericals.

Power of lens : The power of a lens is defined as reciprocal of focal length of the lens. Focal length should always be measured in meters.

$$P = \frac{1}{f(m)}$$

$$\boxed{P = \frac{u - v}{uv}}$$

Unit of power of lens is 1/meter which is called **DIOPTER**

Magnification of lens : The magnification is defined as the ratio of the height of the image and the height of the object it is represented by M.

$$M = \frac{\text{Height of the image } (h_1)}{\text{Height of the object } (h_0)} = \frac{\text{Size of the image (I)}}{\text{Size of the object (O)}} = \frac{v}{u}$$

USES OF LENSES IN DAILY LIFE

Lenses are using is microscope, telescope. Prism, binoculars and slide projector etc.

RELATION BETWEEN FOCAL LENGTH (F) AND RADIUS OF CURVATURE (R)

Focal length of a lens depends on following factors :-

(i) Refractive index of the material of the lens.
(ii) Radius of curvature R_1 and R_2 of both in curved surfaces of the lens.
(iii) Colour (wave length) of the light.

Formula of making a spherical lens of specific focal length.

$$\boxed{\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}$$

Where f is the average value of focal length for all the colour. μ is the refractive index of the material of the lens with respect to air. R_1 and R_2 are the radius of curvature of the curved surfaces respectively. R_1 is positive and R_2 is negative for convex lens. R_1 is negative and R_2 positive for concave lens.

THE HUMAN EYE & COLOURFUL WORLD

Our eye is the most important natural optical instrument. The eye resembles a – camera in many ways. It has "nearly a spherical shape.

What are the essential parts of the eye and their functions

The essential parts of the eye are shown in Fig. and are described below :

(a) **Cornea :** The front of the eye is covered by a transparent spherical membrane called the cornea. Light enters the eye through cornea. The space behind the cornea is filled with a clear liquid called aqueous humor.

(b) **Iris and pupil :** The iris and pupil form the variable aperture system of the eye. Iris is a dark colored muscular diaphragm which has a small circular opening in its middle. The central circular aperture of iris is called pupil. The iris regulates the amount of light entering the eye by adjusting the size of the pupil. This is explained below:

(i) When the light is very bright (as on a sunny day), the iris makes the pupil to contract. As a result, the amount of light entering the eye decreases.
(ii) When the light is dim (as in a dark room), the iris makes the pupil to expand. As a result, more light can enter the eye.

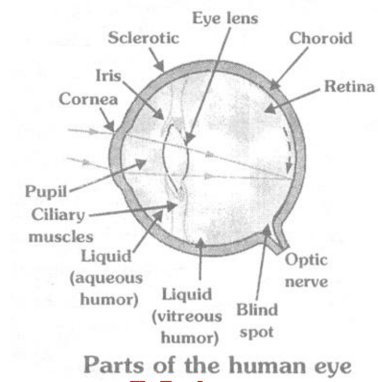
(c) **Eye lens :** The eye lens is a convex lens (converging lens) made of a transparent jelly-like pertinacious material. The eye lens is hard at the middle and gradually becomes soft towards the outer edges. The eye lens is held in position by Ciliary muscles. The curvature and therefore the eye lens may be changed by the action of the Ciliary muscles.

(d) **Retina :** The inside surface of the rear part of the eye ball where the light entering the eye is focused is called retina. The surface of retina consists: of about 125 million light sensitive receptors. The receptors are of two types – rods and cones. When the light falls on these receptors, they send electrical signals to the brain through the optic nerve.

(e) **Blind spot :** There are no rods cones at the point where optic nerves the eye ball to go to the brain. So , it any image is formed in this part of the retina, then no signal is sent to the brain. As a result the object is not seen. This part is therefore called the blind spot of the eye.

HOW DOES THE EYE WORK

The light coming from an object enters the eye through cornea and the pupil. The eye lens converges these light rays to form a real, inverted and high diminished image on the retina. The surface of retina consists of large number of light sensitive cells. When light calls on them, they get activated and generate electrical signals. These signals are then sent to the brain by the optic nerves. and the observer sees the actual-sized, erect image of the object.



Parts of the human eye

Ex. Why does it take some time to see objects in a dim room when you enter the room from bright sunlight outside ?

Sol. In bright sunlight, iris makes the pupil to become small, so that only a small amount of light is able to enter the eye. When someone enters a dim room, very little light is available to the eye. The iris then makes the pupil to gradually expand (open up) to allow more light to enter the eye. This process takes some time. That is why the pupil takes a little time to adjust itself to dim light.

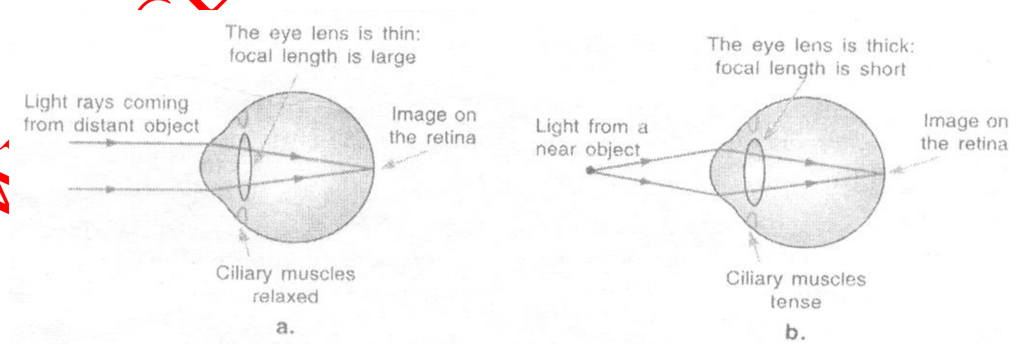
What is meant by the far point, near point , and the least distance of distinct vision ?

(a) **Far point :** The farthest point up to which an eye can see clearly is called the far point of the eye. **For a normal eye, the far point is at infinity.**

(b) **Near point :** The closest (nearest) point up to which an eye can see clearly is called the near point of the eye. The near point for a healthy normal eye of an adult lies about 25 cm from the eye.

(c) **Least distance of distinct vision :** The minimum distance up to which an eye can see clearly without any strain is called the least distance of distinct which vision (denoted by d or D). The least distance of distinct vision is thus equal to the distance between the eye and its near point For a normal eye of an adult, the least distance of distinct vision is about 25cm. This distance usually increases with age.

POWER OF ACCOMMODATION OF THE EYE



What is meant by accommodation of the eye ?

A normal eye can see both the distant and the nearby objects clearly. For a clear vision, the image of any object must fall on the retina. For a person, the distance between the retina and the eye lens is fixed. So, the distance of the image (v) from the eye lens is fixed. For objects at different distances, the values of u are different. So, to get the image at the same v, the focal length of the eye lens should be different.

The eye can focus the images of all the objects, distant or nearby, at the same place (on the retina) by changing the focal length of its lens. The eye lens can change its focal length by changing its thickness with the help of its ciliary muscles.

The property due to which eye lens is able to change its focal length is called accommodation of the eye.

When the eye is focused on distant objects (objects at infinity), the Ciliary muscle is fully relaxed. When the Ciliary muscle is in the relaxed state, the thickness of the lens is minimum and the focal length maximum; equal to the distance of the retina from the eye lens. Therefore, the parallel rays coming from any distant object are focused on the retina, and the object is seen clearly.

When the eye is focused on a nearby object, the ciliary muscle gets strained (tense). Tension in the ciliary muscle decreases the focal length of the eye lens by slightly increasing its thickness in such a way that the image is formed on the retina. Thus, the eye focuses on the nearby objects by tensing the ciliary muscle.

These adjustments in the focal length of the eye lens take place so fast that we do not realize such changes.

What is meant by the limit of accommodation?

The eye can accommodate only up to a limit. A normal eye can accommodate up to the least distance of distinct vision: about 25 cm for a healthy adult. The objects which are very close to the eye produce blurred image. Thus, a normal eye can accommodate objects lying between infinity and the least distance of distinct vision.

What is the range of vision ?

The range of distance over which the eye can see clearly is its range of vision. A normal human eye can see objects clearly which lie between infinity and the least distance of distinct vision. So, the range of vision of a normal healthy human eye is from infinity to the least distance of distinct vision, i.e. from infinity to about 25 cm from the eye.

What is meant by the persistence of vision ?

The image formed on the retina of the eyes is not permanent. It also does not fade away instantaneously after the object is removed or we have stopped seeing the object. The image formed on the retina persists for $1/16^{th}$ of a second even after we have stopped looking at the object. The ability of the eye to retain the image (or the sensation caused by the light coming from the object) for about $1/16^{th}$ of a second even after we have stopped seeing the object is called persistence of vision.

The phenomenon of persistence of vision is made use of in motion-picture projection (or cinematography). Sequences of still pictures are recorded on a film by a movie camera. This recorded film is projected on a screen at the speed of about 24 pictures per second. Due to the persistent of vision, the successive images on the screen merge smoothly into one another giving an impression of continuity. In this way, we are able to see the pictures in motion.

COLOUR VISION

How do we see the colour

We see an object only when its image is formed at the retina.

Our retina has a large number of light-sensitive cells. These cells are of two shapes – rods and cones.

- The rod-shaped cells respond to the intensity of light, i.e. the degree of brightness or darkness is sensed by the rod-shaped cells on the retina of the eye.
- The cone-shaped cells respond to the colors. These cells are sensitive to red, blue and green colors to different extents. It is due to these cone-shaped cells that we are able to distinguish between different colors.

The cone-shaped cells become active only in bright light, That is why, we can't differentiate between colors in dim light. There are in fact three different kinds of the cone-shaped cells : one sensitive to red, second to green and the third to blue color. So, depending upon the colour of the light entering the eye, one or more kinds of the cone-shaped cells get activated.

How do certain animals including birds differ in their colour perception

The structure and the and the number of rod-shaped and cone-shade cells are different for different animals/birds. As a result, therefore, their colour perceptions are also different. For example.

- Bees have cones that are sensitive to ultraviolet light (light beyond violet colour). So, bees can see the ultraviolet light present in sunlight.

- Human beings cannot see the ultraviolet light because the cones in their retina are not sensitive to the ultraviolet light .
- The retina of chicken has mostly cone-shaped cells and only a few rod shaped cells. It is because of this reason that a chicken can see only in bright and wake up only when the sun rises and goes to sleep at sunset .

What is colour blindness

Colour blindness is a defect of vision or defect of eye. When a person is unable to distinguish between certain colors, he/she is said to be colour blind. Thus, colour blindness is that defect of the eye due to which a person is not able to distinguish between certain colors.

Colour blindness is a genetic disorder, which occurs due to inheritance (from parents to their children).

Cause of colour blindness

The retina of human eye consists of three different types of cone-shaped cells. Some are sensitive to blue light, some to green light, and some others to red light. Thus, each colour of light is detected only by the cones which are sensitive to that light. Sometimes, a person may not have a particular kind of cones on its retina. Then, such a person will not be able to distinguish between certain colors. For example. a person not having cones sensitive to the blue in his/her eye will not be sensitive to blue colour.

DEFECTS OF VISION AND THEIR CORRECTION

Abnormalities in the normal vision of the eye are called defects of vision or defects of eyes.

The most commonly observed defects of vision (or defects of eyes) are :

(i) Myopia or shortsightedness or nearsightedness

(ii) Hypermetropia or long-sightedness or hyperopic or farsightedness

(iii) Astigmatism

WHAT IS SHORTSIGHTEDNESS (OR MYOPIA)

Shortsightedness (or myopia) is the defect due to which the eye is not able to see the distant objects clearly though it can see the nearby objects clearly. So, shortsighted or myopic eye has its far point nearer than infinity.

WHAT CAUSES SHORTSIGHTEDNESS (OR MYOOPIA)

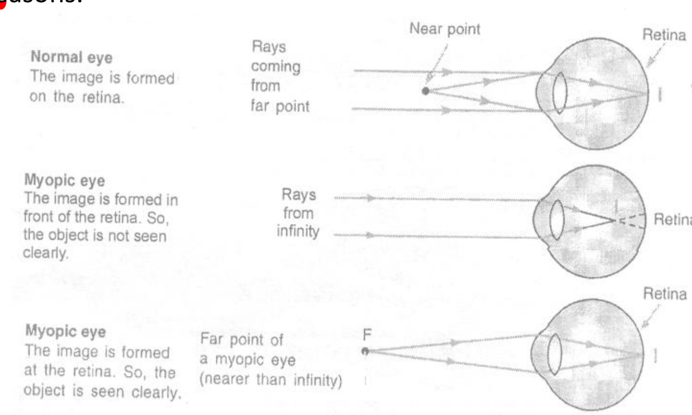
Myopia or shortsightedness is caused by the following reasons.

(a) Decrease of focal length of the eye lens,

i.e. the eye lens becomes more convergent .

(b) Elongation of the eyeball,

i.e. the increased length of the eyeball.

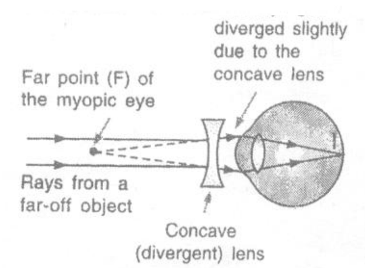


A normal and a shortsighted (or myopic) eye

How is shortsightedness (or myopia) corrected ?

The shortsightedness (myopia) can be corrected by making the eye lens less convergent. This can be done by placing a concave lens (divergent lens) of suitable focal length before the eye lens.

The rays of light coming from a distant object after passing through the concave (diverging) lens of the spectacles diverge slightly. As a result, the rays entering the eye appear to come from the far point of the myopic eye, and therefore get focused at the retina to form a clear image.



Correcting myopic (shortsighted) eye by using a concave (divergent) lens

How to calculate the focal length and power of the lens used for correcting a myopic eye

The corrective lens (concave lens) needed to correct a myopic eye should form the image of the far-off object (e.g. at infinity) at the far point (d) of the myopic person.

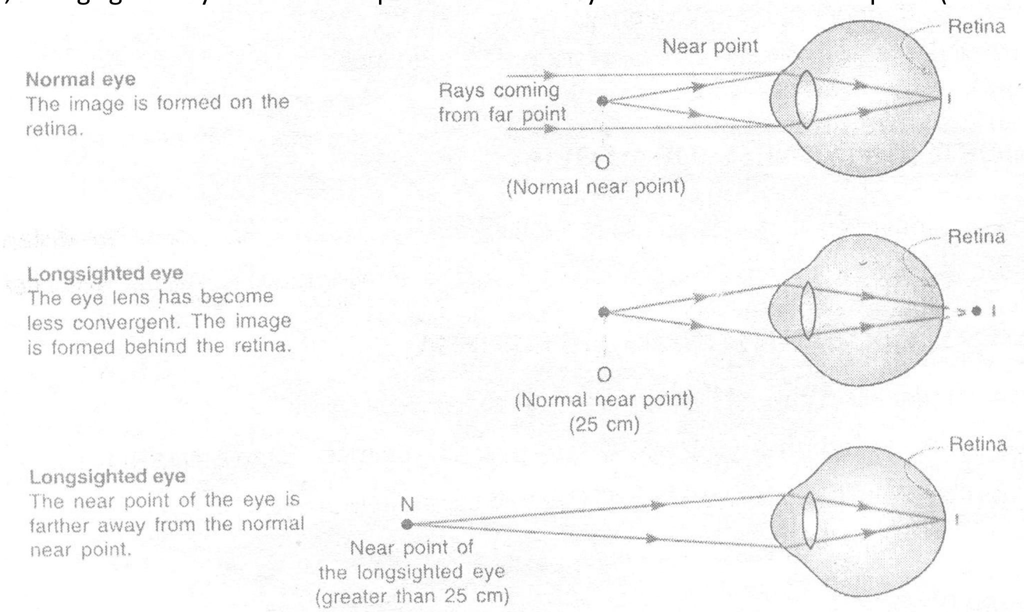
Thus, $u = -\infty,\ v = -d,\ f = ?$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = -\frac{1}{d} \qquad \Rightarrow \qquad f = -d$$

WHAT IS LONGSIGHTEDNESS (OR HYPERMETROPIA OR HYPEROPIA)

The long-sightedness (or Hypermetropia) is the defect due to which the eye is not able to see clearly the nearby objects though it can see the distant objects clearly.

So, a longsighted eye has its near point farther away from the normal near point (about 25 cm for a an adult).



Focussing of light rays by a longsighted eye

WHAT CAUSES LONGSIGHTEDNESS (OR HYPERMETROPIA)

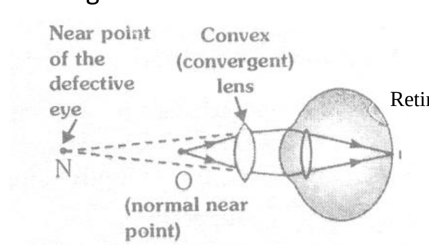
Hypermetropia or long-sightedness is caused due to the following reasons :

(i) Increase of the focal length of the eye lens, i.e. the eye lens becoming less convergent.

(ii) Shortening of the eye ball, i.e. the length of the eye ball has decreased.

HOW IS LONGSIGHTEDNESS (OR HYPERMETROPIA) CORRECTED

Long-sightedness (Hypermetropia) can be corrected by making the eye lens more convergent. This is generally done by placing a convex lens (converging lens) of suitable focal length before the eye lens. This is shown in Fig. in next page.



Correcting the longsightednes (hypermetropia) by using a convex (convergent) lens

The rays from a nearby object (about 25 cm) after passing through the convex lens of the spectacles converge slightly. As a result, the rays entering the eye appear to come from the near point of the longsighted eye, and therefore get focused at the retina to form a clear image. How to calculate the focal length and power of the lens used for correcting a Hypermetropic eye

The corrective lens (a convex lens) needed to correct a Hypermetropia (or longsighted) eye should form the image of the object placed at the normal near point (the least distance of distinct vision is 25 cm) at the near point of the Hypermetropia person. Thus.

v = Near point distance of the Hypermetropia eye = - d

u = Near point distance for the normal eye = - D = - 25 cm Using the lens formula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}=\frac{1}{-d}-\frac{1}{25cm}$$

WHAT IS ASTIGMATISM

A normal eye can focus all the light from any object at the same point. Sometimes, the light coming in the horizontal and vertical planes do not come to focus at the same point. As a result, the horizontal and vertical views of an object are not seen with the same clarity. Such a defect of eye is called astigmatism. A person suffering from astigmatism is not able to see in all directions equally well.

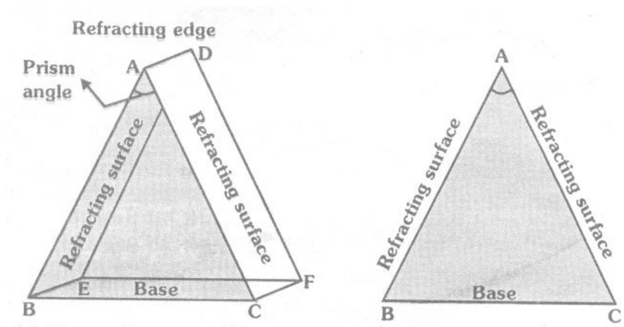
- Cause of astigmatism. Astigmatism occurs when the cornea or the eye lens or both are not perfectly spherical, i.e. the cornea or the eye lens or both are more curved in one plane than in the other.

- Correcting astigmatism. Astigmatism can be corrected by using cylindrical lenses. Cylindrical lenses have different curvature in the horizontal and vertical directions.

REFRACTION OF LIGHT THROUGH A PRISM

What is a prism

A prism is a transparent refracting medium bound by two plane surfaces inclined to each other at certain angle (commonly 60^0 or 45^0),



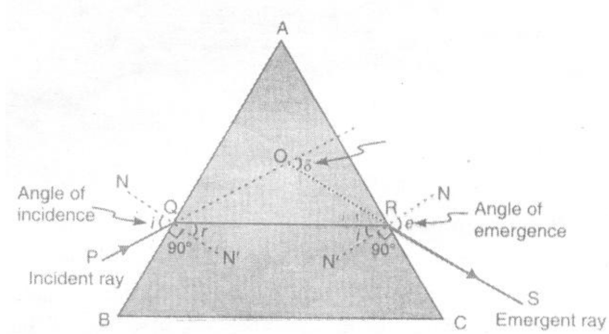
(a) Three-dimensional view of a glass prism

(b) The principal section of a glass prism

- The faces ABED and ACFD are refracting surfaces of the prism.
- The face BEFC is the base of the prism.
  The angle BAC is the prism angle.
- The line of intersection of the two refracting surfaces is called refracting angle (the line AD in the diagram) or the prism.
- The face ABC is the principal section of the prism.
  The principal section of a prism is perpendicular to its refracting edge.

HOW DOES LIGHT GET REFRACTED BY A PRISM

The incident ray suffers a deviation (or bending) through an angle δ due to refraction through the prism. The angle δ is called the angle of deviation.



Refraction through a triangular glass prism

Note :

- The prism is in the position a the minimum deviation when angle of emergence = angle of incidence.

  or $\angle e = \angle i$

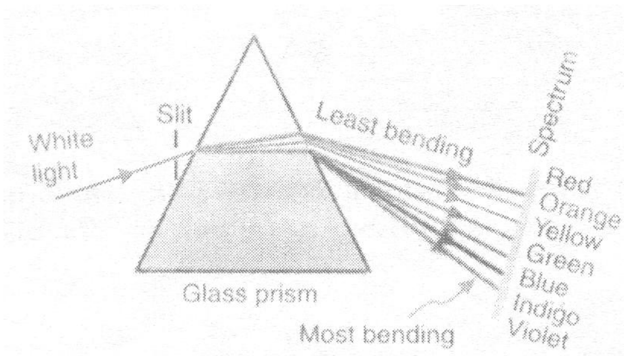
- The refractive index of the material of prism is given as

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}}$$

DISPERSION OF WHITE LIGHT BY A GLASS PRISM

What is meant by dispersion of light

The process of splitting white light into its seven constituent colors is called dispersion of white light. The band of seven colors formed on a screen due to the dispersion of white light is called spectrum of visible light or spectrum of white light.



What causes dispersion of white light

Dispersion of white light into seven colors occurs because the light of different colors has different wavelength. In this band of seven colors, red light has the longest wavelength and violet has the shortest.

Lights of all colors travel at the same speed in vacuum. But, in any transparent medium, such as glass or water, the lights of different colors travel with different speeds.

Due to difference in their speeds, the lights of different colors bend through different angles. In any transparent medium, the red light travels the fastest, and the violet light the slowest of all the seven colors. Therefore, the red light bends the least, and violet light bends the most.

Thus, dispersion of white light into seven colors occurs because the lights of different colour bend through different angle while passing through a glass prism.

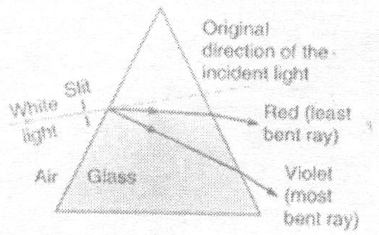
What is meant by monochromatic and polychromatic light

The light of one single colour, or one single wavelength is called monochromatic light (chrome means colour). Sodium light is golden yellow in colour. So, sodium light is monochromatic light.

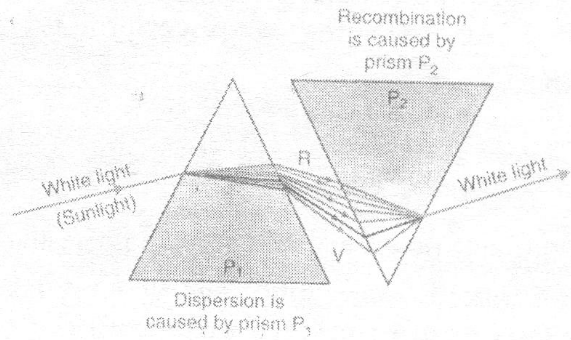
The light made up of many colors, or light consisting of radiations of many wavelengths, is called polychromatic light, white light is made up of seven colors. So, white light (or sunlight) is a polychromatic light.

How is the dispersed white light recomposed

Recombination of the colors of the dispersed white light to get white light is called recomposing of the dispersed white light.



Different colours bend through different angles during refraction through a glass prism. Other colours lie in between the two.



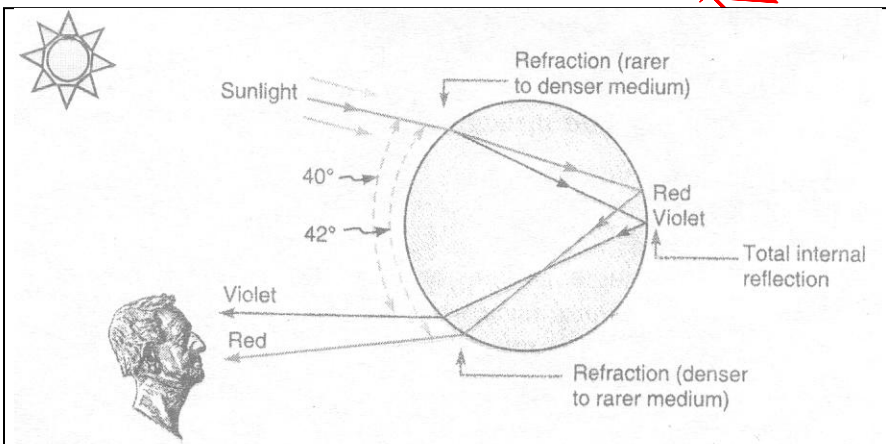
Recomposing the dispersed white light

How does a rainbow form?

Rainbow is an example of the dispersion of white light.

Just after the rain, a large number of small droplets of water remain suspended in the air. Each drop acts like a small prism. When sunlight falls on these drops, the white light splits into seven colors. The dispersed light form a large number of drops forms a continuous band of seven colors. This colored band is called rainbow. Thus, rainbow is produced due to dispersion of white light by small raindrops hanging in the air after the rain.

The rainbow is seen when the sun is behind the observe.



Refraction of sunlight by a spherical raindrop leading to the formation of the rainbow

SOLVED NCERT EXERCISE

1. A lens has power of -2.5 D. What is the focal length and nature of the lens ?

Sol. P = -2.5 D, f = ?

From relation, $P=\frac{1}{f}$

$$f\frac{1}{P}=\frac{1}{-2.5}=-0.4m=-40cm$$

Negative sign indicates that it is a concave lens.

2. A doctor has prescribed a corrective lens of power + 1.5 D. Find the focal length of the lens Is the prescribed lens diverging or converging ? [NCERT]

Sol. P = + 1.5D

f (in meters) = $\frac{1}{P}=\frac{10}{15}=\frac{2}{3}=66.6cm$

As the focal length and power of the lens is positive therefore, lens is a convex (converging) lens).

3. A person with a myopic eye cannot see beyond 1.2 m distinctly. What should be the nature of the corrective lens used to restore proper vision ?

Sol. Corrective lens required is 'concave lens' of suitable power to restore proper vision. In this cases.

$$u = -\infty, \; v = -1.2 \text{ m}$$

Using lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-1.2m} - \frac{1}{\infty} = -\frac{1}{1.2m}$

f = - 1.2 m

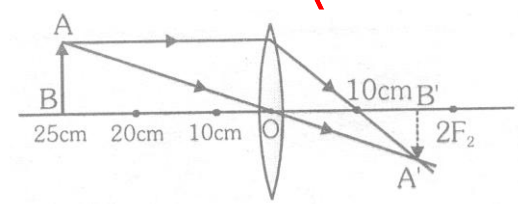
Power of lens, $P = -\frac{1}{1.2m} = -\frac{1}{1.2} D = -0.83D.$

4. An object 5 cm in length is held 25 cm away form a converging lens of length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed. [NCERT]

Sol.

$$f = -+10cm$$

$$u = -25cm$$



Using lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{10} = \frac{1}{v} - \left(\frac{1}{-25}\right)$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{25}$$

$$\frac{1}{v} = \frac{3}{50} cm$$

$$\Rightarrow v = \frac{50}{3} = 16.7m$$

The image is real at a distance of 16.7 cm behind the lens

$$m = \frac{h'}{h} = \frac{v}{u}$$

$$\frac{h'}{5} = \frac{50/3}{-25} \Rightarrow h' = \frac{50/3 \times 5}{-25} = -\frac{10}{3} cm$$

Height of the image is 3.3 cm in height.

5. The refractive index of diamond is 2.47 and that of glass is 1.51. How much faster does light travel in glass than in diamond. ?

Sol. Let n_1 and n_2 be the refractive indices and v_1 and v_2 be the velocity of light in diamond and glass respectively, then

$$n_1 = \frac{c}{v_1} \quad or \quad v_1 = \frac{c}{n_1} = \frac{3 \times 10^8 m/s}{2.47} = 1.215 \times 10^8 m/s$$

$$n_2 = \frac{c}{v_2} \quad or \quad v_2 = \frac{c}{n_2} = \frac{3 \times 10^8 m/s}{2.51} = 1.987 \times 10^8 m/s$$

$$v_2 - v_1 = (1.987 - 1.215) \times 10^8 = 0.772 \times 10^8 m/s$$

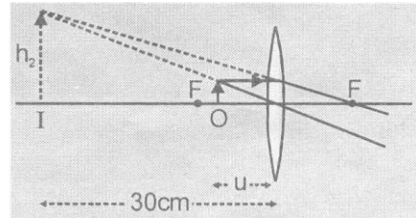
$$= 7.72 \times 10^7 m/s$$

Thus light travels 7.72 ×107 m/s faster in glass than diamond.

6. A magnifying lens has a focal length of 10cm. (a) Where should the object if the image is to be 30 cm from the lens ? (b) What will be the magnification ?

Sol. (a) In case of magnifying lens, the lens is convergent and the image is erect, enlarged, virtual, between infinity and object and on the same side of lens.

f = 10 cm and v = - 30 cm



and hence from lens-formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

we have $\frac{1}{-30} - \frac{1}{u} = \frac{1}{10}$ i.e., u = - 7.5 cm

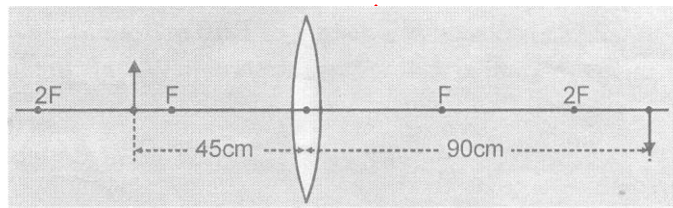
So the object must be placed in front of lens at a distance of 7.5 cm (which is < f) from it.

(b) $m = \left[\frac{h_2}{h_1}\right] = \frac{v}{u} = \frac{-3}{-7.5} = 4$ i.e., image is erect, virtual and four times the size of object.

7. An object 25 cm high is placed in front of a convex lens of focal length 30 cm. If the height of image formed is 50 cm find the distance between the object and the image ?

Sol. As object is in front of the lens, is is real and as

$h_1 = 25cm,\ f = 30cm,\ h_2 = -50cm$



$m = \frac{h_2}{h_1} = \frac{-50}{25} = -2$

$m = \frac{f}{f+u} \Rightarrow -2 = \frac{30}{30+u}$

$u = -45cm \Rightarrow m = \frac{v}{u} \Rightarrow -2 = \frac{v}{-45} \Rightarrow v = 90\ cm$

As in this situation object and image are on opposite sides of lens, the distance between object and image

$d_1 = u + v = 45 + 90 = 135\ cm$

If the image is erect (i.e., virtual)

$m = \frac{f}{f+u} \Rightarrow 2 = \frac{30}{30+u} \Rightarrow u = -15cm \Rightarrow m = -\frac{v}{u} \Rightarrow 2 = \frac{-v}{-15} \Rightarrow v = 30\ cm.$

As in the situation both image and object are in front of the lens, the distance between object and image

$d_2 = v - u = 3015 = 15\ cm.$

8. A needle placed 45 cm from a lens forms an image on a screen placed 90 cm on other side of the lens. Identify the type of lens and determine its focal length. What is the size of the image, it the size of the needle is 5 cm ?

Sol. Here, u = - 45 cm, v = 90 cm, f = ?, h_1 = 5 cm,

$\because \frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \therefore \frac{1}{90} + \frac{1}{45} = \frac{1}{f} \Rightarrow \frac{1+2}{90} = \frac{1}{f}$ or $f = 30\ cm$

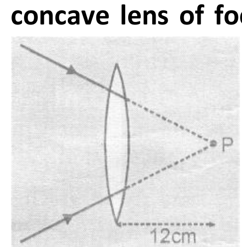
As f is positive, the lens is converging

$\because \frac{h_2}{h_1} = \frac{v}{u} \quad \therefore \frac{h_2}{5} = \frac{90}{-45} = -2 \Rightarrow h_2 = -10\ cm.$

Minus sign indicates that image is real and inverted

9. A beam of light converges to a point. P. A lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is (a) a convex lens of focal length 20 cm. (b) a concave lens of focal length 16 cm.

Sol. Here, the point P on the right of the lens acts as a virtual object,



$\therefore$ u = 12 cm, v = ?

(a) f = 20 cm $\quad \therefore \frac{1}{v}-\frac{1}{u}=\frac{1}{f} \quad \therefore \frac{1}{v}-\frac{1}{12}=\frac{1}{20}$

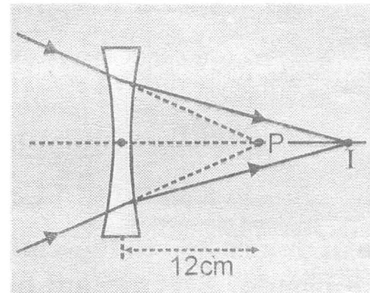
$$\Rightarrow \frac{1}{v}=\frac{1}{20}+\frac{1}{12}=\frac{3+5}{60}=\frac{8}{60} \qquad \Rightarrow v=\frac{60}{8}=7.5\ cm$$

(b) f = -16 cm, u = 12 cm

$$\therefore \frac{1}{v}=\frac{1}{f}+\frac{1}{u}=\frac{1}{-16}+\frac{1}{12}=\frac{3+4}{48}=\frac{1}{48}$$

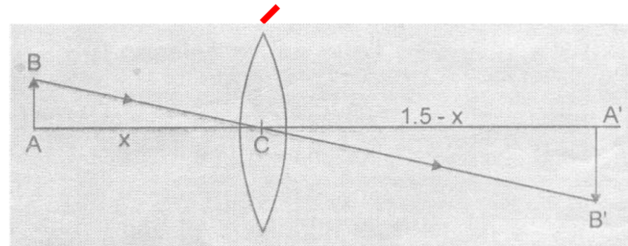
$\Rightarrow$ v = 48cm

Hence image is at 48 cm to the right of the lens, where the beam would converge.



10. An object is placed at a distant of 1.50 m from a screen and a convex lens placed in between produces an image magnified 4 times on the screen. What is the focal length and the position of the lens.

Sol. $m=\frac{h_2}{h_1}=-4$



Let lens is placed at a distance of x from the object.

Then u = - x, and v = (1.5 - x)

using $m=\frac{v}{u}$, we get $-4=\frac{1.5-x}{-x} \Rightarrow x=0.3$ meter

The lens is placed at a distance of 0.3 m from the object (or 1.20m from the screen)

For focal length, we may use

$$m=\frac{f}{f+u} \quad \text{or} \quad -4=\frac{f}{f+(-0.3)} \Rightarrow \quad f=\frac{1.2}{5}=0.24\ cm$$

11. A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water ? If water is replaced by a liquid of refractive index 1.63 up to the same height. What will be apparent depth ?

Sol. Here, real depth = 12.5 cm: apparent depth = 9.4 cm : $\mu = ?$

$$\because \quad \mu \frac{realdepth}{apparent\ depth} \quad \therefore \quad \mu=\frac{125}{9.4}=1.33$$

Now, in the second case, $\mu = 1.63$, real depth = 12.5 cm: apparent depth d_{ap} = ?

$$\therefore \quad 1.63=\frac{12.5}{d_{ap}} \quad \Rightarrow \quad d_{ap}=\frac{12.5}{1.63}=7.67\ cm$$

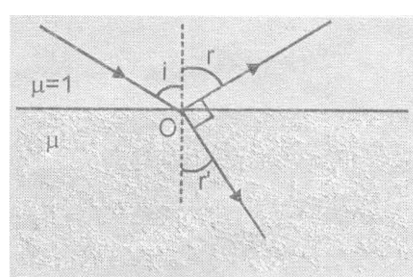
12. A ray of light is incident on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, what is the angle of incidence ? [$\tan^{-1}(1.62) = 58.3^0$]

Sol. According to given problem, r + 90^0 + r' = 180^0

i.e. r' = 90^0 – r

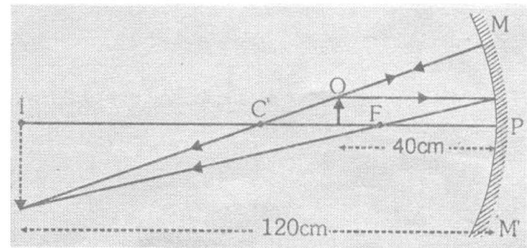
or r' = (90^0 – i) $\quad \Rightarrow \quad \sin\ i=\mu \cos\ i [\because \ \sin(90-i)=\cos i]$

or $\tan i=\mu$ $\quad$ or $\quad i=\tan^{-1}\ \mu=\tan^{-1}(1.62=58.3^0)$



13. The focal length of a concave mirror is 30cm. Find the position of the object in front of the mirror, so that the image is three times the size of the object.

Sol. As the object is in front of the mirror it is real and for real object the magnified image formed by concave mirror can be inverted (i.e., real) or erect (i.e., virtual), so there are two possibilities.

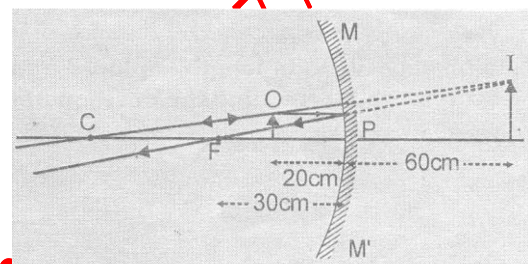


(a) If the image is inverted (i.e., real)

$$m = \frac{f}{f-u} \Rightarrow -3 = \frac{-30}{-30-u} \Rightarrow u = -40\ cm$$

Object must be at a distance of 40 cm in front of the mirror (in between C and F).

(b) If the image is erect (i.e., virtual)



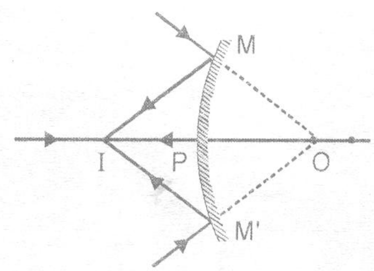
$$m = \frac{f}{f-u}$$

$$3 = \frac{-30}{-30-u} \Rightarrow u = -20cm$$

Object must be at a distance of 20 cm in front of the mirror (in between F and P).

14. A beam of light converges towards a point O, behind a convex mirror of focal length 20 cm. Find the nature and position of image if the point O is (a) 10 cm behind the mirror (b) 30 cm behind the mirror.

Sol. (a) For the situation object will be virtual as shown in figure



Here u = + 10cm and f = + 20cm.

$\therefore \quad \frac{1}{v} + \frac{1}{10} = \frac{1}{+20}$ i.e., v = -20 cm

i.e., the image will be at a distance of 20 cm in front of the mirror and will be real, erect and enlarged with

$$m = -\left[-\frac{20}{10}\right] = +2$$

(b) For this situation also object will be virtual as shown in Figure.

Here, u = + 30 cm and f = + 20cm

$\therefore \quad \frac{1}{v} + \frac{1}{+30} = \frac{1}{+20}$ i.e., v = + 60 cm

i.e., the image will be a distance of 60 cm behind the mirror and will be virtual, inverted and enlarged with

$$m = -\left[+\frac{60}{30}\right] = -2$$

15. An object of size 7.0 cm is placed at 27cm in front of a concave mirror focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focused image can be obtained ? Find the size and the nature of the image.

Sol. Mirror : concave u=-27cm, f = -18 cm, v = ?

Using mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-18} + \frac{1}{27} = \frac{-3+2}{54} = -\frac{1}{54}\ cm \qquad v = -54\ cm$$

The screen should be placed at a distance of 54 cm from the mirror in front of it.

$$m = -\frac{v}{u} = -\frac{-54}{-27} = -2$$

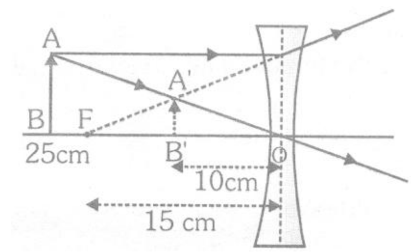
Image is real and magnified, two times the object $\quad -2 = \frac{h'}{h}$

$h' = -2 \times 7cm = -14cm$ high

The image is real, inverted, enlarged and 14 cm high.

16. A concave lens of length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens ? Draw the ray diagram – [NCERT]

Sol. Using lens formula. $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$



$$\frac{1}{-10cm} - \frac{1}{u} = \frac{1}{-15cm}$$

$$\frac{1}{u} = \frac{1}{15} - \frac{1}{10} = \frac{2-3}{30} = -\frac{1}{30} \qquad u = -30cm$$

Thus, the object is placed at a distance of 30 cm from concave lens.

17. An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex morror of radius of curvature 30 cm. Find the position of the image, its nature and size.

Sol. Radius of curvature of convex mirror (R) = 30 cm

$\therefore$ Focal length of convex mirror $(f) = \frac{R}{2} = \frac{30cm}{2} = 15\ cm$

Using mirror formula , $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

Object distance, u = - 20 cm

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} + \frac{1}{20} = \frac{4+3}{60} = \frac{7}{60}cm \qquad v = \frac{60}{7}cm = 8.57cm$$

The image is virtual, behind the mirror and erect.

$$m = \frac{h'}{h} = -\frac{v}{u} = \frac{h'}{5cm} = \frac{-60/7cm}{-20cm} \Rightarrow h' = \frac{-60/7cm \times 5cm}{-20cm} = \frac{3}{7} \times cm = \frac{15}{7}cm$$

h' = + 2.14 cm [It is erect and diminished].

18. The near point of a certain eye is 100cm in front of the eye. What lens should be used to see clearly an object 25 cm in front of the eye ?

Sol. u = - 25 cm $\qquad$ v = - 100 cm

using lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-100cm} - \frac{1}{-25cm} = \frac{-1+4}{100cm} = \frac{3}{100}cm$

$$f = \frac{100}{3}cm = 33.3cm$$

Hence a converging lens of focal length 33.3 cm is required.

19. Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass ? The speed of light a vacuum is 3 × 10^8m/s.

Sol. Refractive index $\mu_g = 1.5$

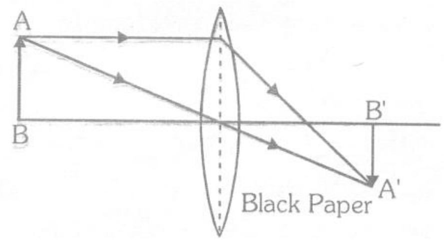
Speed of light in vacuum c = 3 × 10^8 m/s

Speed of light in glass, v = ?

$$\mu_g = \frac{c}{v}$$

$$v = \frac{c}{\mu_g} = \frac{3\times10^8}{1.5} = 2\times10^8 \;\; m/s$$

20. One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object ? Verify your answer experimentally. Explain your observations. [NCERT]



Sol. Yes, it will produce a complete image of the object, as shown in fig. This can be verified experimentally by observing the image of a distance object like tree on a screen, when half of the is covered with a black paper. However, the intensity of brightness of image will reduce.

21. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image. [NCERT]

Sol. Here, object distance, u = - 10 cm focal length, f = 15 cm, image distance, v = ?

As $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$,

$$\therefore \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} + \frac{1}{10} = \frac{5}{30} = \frac{1}{6}, \qquad f = 6 \;\; cm$$

Here, + sign of v indicates image is at the back of the mirror. It must be virtual, erect and smaller in size than the object .

22. The magnification produced by a plane mirror is +1. What does this mean ?

Sol. As $m = \frac{h_2}{h_1} = +1, \quad h_2 = h_1$

i.e., size of image is equal to size of the object. Further, + sign of m indicates that the image is erect and hence virtual.

23. Find the focal length of a lens of power - 2.0 D. What type of lens is this ?

Sol. Here, focal length f = ?, power P = - 2.0 D

As $\quad f = \frac{100}{P}$

$$\therefore \quad f = \frac{100}{-2.0} = -50 \;\; cm$$

24. A person needs a lens of power -5.5 dioptres for correcting his distant vision. For correcting his near vision he needs a lens power + 1.5 dioptre. What is the focal length of the lens required for correcting (i) distant vision, and (ii) near vision ?

25. The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem ?

Sol. Distance of far point, x = 80 cm, P = ?

For viewing distant objects, focal length of corrective lens,

f = - x = 80 cm

$P = \frac{100}{f} - \frac{100}{-80} = -1.25 \;\; D$. The lens is concave.

26. Make a diagram to show how Hypermetropia is corrected. The near point of a Hypermetropia eye is 1 m. What is the power of the lens required to correct this defect ? Assume that the near point of the normal eye is 25 cm.

Sol. Make diagram yourself

Here , x’ = 1m = 100 cm, d = 25, f = ?

From $f = \dfrac{x'd}{x'-d}$

$$f = \frac{100\times 25}{100-25} = 33.3\ cm$$

$$P = \frac{100}{f} = \frac{100}{33.3} = 3D$$

27. Why is a normal eye not able to see clearly the objects placed closer than 25 cm ? [NCERT]

Sol. This is because the focal length of eye lens cannot be decreased below a certain minimum limit.

EXERCISE – 1 (FOR SCHOOL/BOARD EXAMS)

OBJECTIVE TYPE QUESTIONS

Choose the Correct One

1. A mirror forms a virtual image of a real object.

(A) It must be a convex mirror.
(B) It must be a concave mirror.
(C) It must be a plane mirror.
(D) It may be any of the mirror mentioned above.

2. The angle of incidence is the angle between

(A) the incident ray and the surface of the mirror
(B) the reflected ray and the surface of the mirror
(C) the normal to the surface and the incident ray
(D) the normal to the surface and the reflected ray

3. The angle of reflection is the angle between

(A) the incident ray and the surface of the mirror
(B) the reflected ray and the surface of the mirror
(C) the normal to the surface and the incident ray
(D) the normal to the surface and the reflected ray

4. An object is placed at the centre of curvature of a concave mirror. The distance between its image and the pole is

(A) equal to f (B) between f and 2f (C) equal to 2f (D) greater then 2f

5. An object of size 2.0 cm is laced perpendicular to the principal axis of a concave mirror. The distance of the object from the mirror equals the radius of curvature. The size of the image will be

(A) 0.5 cm (B) 1.5 cm (C) 1.0 cm (D) 2.0 cm

6. The magnification m of an image formed by a spherical mirror is negative. It means, the image is

(A) smaller than the object
(B) larger than the object
(C) erect
(D) inverted

7. A point object is placed on the principal axis of a spherical mirror. The object-distance u is

(A) definitely negative
(B) definitely positive
(C) positive if the object is to the left of the centre of curvature
(D) positive if the object is to the right of the centre of curvature

8. $f = \dfrac{R}{2}$ is valid

(A) for convex mirrors but not for concave mirrors
(B) for concave mirror but not for convex mirrors
(C) for both convex and concave mirrors
(D) neither for convex mirrors nor for concave mirror

9. A ray of light is incident on a concave mirror. If it is parallel to the principal axis, the reflected ray will

(A) pass through the focus
(B) pass through the centre of curvature
(C) pass through the pole

(D) retrace its path

10. If an incident ray passes through the centre of curvature of a spherical mirror, the reflected ray will

(A) pass through the pole (B) pass through the focus

(C) retrace its path (D) be parallel to the principal axis

11. To get an image larger than the object, one can use

(A) a convex mirror but not a concave mirror

(B) a concave mirror but not a convex mirror

(C) either a convex mirror or a concave mirror

(D) a plane mirror

12. A ray of light travelling in air falls obliquely on the surface of a calm pond. It will

(A) go into the water without deviating from its path (B) deviate away from the normal

(C) deviate towards the normal (D) turn back on its original path

13. A ray of light goes from a medium of refractive index μ_1 to a medium of refractive index μ_2. The angle of incidence is i and the angle of refraction is r. Then, sin i/sin r is equal to

(A) μ_1 (B) μ_2 (C) $\frac{\mu_1}{\mu_2}$ (D) $\frac{\mu_2}{\mu_1}$

14. A thin lens and a spherical mirror have a focal length of + 15 cm each.

(A) both are convex.

(B) the lens is convex and the mirror is concave.

(C) the lens is concave and the mirror is convex.

(D) both are concave.

15. A convex is

(A) is thicker at the middle than at edges (B) is thicker at the edges than at the middle

(C) has uniform thickness everywhere (D) is called a diverging lens

16. A convex lens forms a virtual image when an object is placed at a distance of 18 cm from it. The focal length must be

(A) greater than 36 cm (B) greater than 18 cm (C) less than 36 cm (D) less than 18 cm

17. An object is placed before a convex lens. The image formed

(A) is always real (B) may be real or virtual (C) is always virtual (D) is always erect

18. An object is placed before a concave lens. The image formed

(A) is always erect (B) may be erect or inverted (C) is always inverted (D) is always real

19. A lens has a power of +0.5 D. If is

(A) a concave lens of focal length 5 m (B) a convex lens of focal length 5 cm

(C) a convex lens of focal length 2 m (D) a concave lens of focal length 2 m

20. A parallel beam of light falling on the eye gets focused on the retina because of refractions at

(A) the cornea (B) the crystalline lens (C) the vitreous humor (D) various surfaces in the eye

21. The combination responsible for admitting different amounts of light into the eye is

(A) Ciliary muscles and crystalline lens (B) Ciliary muscles and pupil

(C) iris and pupil (D) rods and cones

22. The muscles of the iris control the

(A) focal length of the eye-lens (B) opening of the pupil

(C) shape of the crystalline lens (D) optic nerve

23. When the eye is focused on an object very far away, the focal length of the eye-lens is

(A) maximum (B) minimum

(C) equal to that of the crystalline lens | (D) half its maximum focal length

14. Other names for myopia are

(A) hyperopia and Hypermetropia | (B) long-sightedness and hyperopia
(C) near-sightedness and Presbyiopia | (D) hear-sightedness and short-sightedness

25. The inability among the elderly to see nearby object clearly because of the weakening of the Ciliary muscles is called

(A) far-sightedness (B) near-sightedness (C) Presbyiopia (D) astigmatism

26. When white light passes through a prism, it splits into its component colors. This phenomenon is called

(A) spectrum (B) reflection (C) refraction (D) dispersion

27. The number of surface bounding a prism is

(A) 3 (B) 4 (C) 5 (D) 6

28. A deviation in the path of a ray of light can be produced

(A) by a glass prism but not by a rectangular glass
(B) by a rectangular glass slab but not by a glass prism
(C) by a glass prism as well as a rectangular glass slab
(D) neither by a glass prism nor by a rectangular glass slab

29. The wavelengths corresponding to violet, yellow and red lights are λ_v, λ_y and λ_r respectively.

(A) $\lambda_v > \lambda_y > \lambda_r$ (B) $\lambda_v < \lambda_y < \lambda_r$ (C) $\lambda_y < \lambda_v < \lambda_r$ (D) $\lambda_y < \lambda_r < \lambda_v$

30. If you want to see your full image then the , minimum size of the plane mirror

(A) should be of your height | (B) should be half of your height.
(C) should be twice of height. | (D) depends upon your distance from the mirror

31. An object A is placed at a distance d in front of a plane mirror. If one stands directly behind the object at a distance S from the mirror, then the distance of the image of A from the individual is

(A) 2 S (B) 2 d (C) S + d (D) S + 2d

32. A light bulb is placed between two plane mirrors inclined at an angle of 60^0. the number of image formed are

(A) 6 (B) 5 (C) 4 (D) 2

33. A person of height 1.8 standing at the centre of a room having equal dimensions of 10 m wishes to see the full image of the back wall in the mirror fixed on the front wall. The minimum height of the plane mirror needed for this purpose is

(A) 0.9 m (B) 1.8 m (C) $\frac{10}{3}$ m (D) 10 m

34. Two plane mirrors inclined at an angle to one another have an object placed between them. If five images of the object are observed, the maximum possible angle between the mirrors is

(A) 45^0 (B) 60^0 (C) 72^0 (D) 90^0

35. In case of a thick plane mirror multiple images arc formed. The brightest of all the images will be

(A) first (B) second (C) third (D) fourth

36. Indicate the only correct statement.

(A) The image formed by a convex mirror can be taken on the screen.
(B) A convex mirror can produce a parallel beam of light from a point source.
(C) The image of an object placed at the focus of a convex mirror will be formed at infinity.
(D) A concave mirror can never form a diminished virtual image.

37. The focal length of concave mirror is f and the distance from the object to the principal focus is x. The magnification obtained will be

(A) (f + x)/f (B) f / x (C) $\frac{\sqrt{f}}{\sqrt{x}}$ (D) f^2 / x^2

38. In a museum a child walks towards a large concave mirror. He will see that

(A) his real, erect image goes on decreasing in size.

(B) his virtual, erect image goes on increasing in size.

(C) his real, inverted image goes on diminishing in size and suddenly it becomes virtual, erect and magnified.

(D) his real, erect image goes on diminishing in size and suddenly it becomes virtual, erect and magnified.

39. The magnification of an object placed 10 cm from a convex mirror of radius of curvature 20 cm will be

(A) 0.2 (B) 0.5 (C) 1 (D) 20 cm

40. A concave mirror of focal length 10 cm produces an image five times as large as large as the object. It the image is in front of the mirror, the distance of the object from the mirror will be

(A) 10 cm (B) 12 cm (C) 16 cm (D) 20 cm

41. To form an image twice the size of the object, using a convex lens of focal length 20 cm, the object distance must be –

(A) < 20 cm (B) > 20 cm

(C) < 20 cm and between 20 cm and 40 cm (D) Cannot say

42. Refractive index of glass with respect to air is 3/2. What is the refractive index of air with respect to glass ?

(A) 2/3 (B) 1 (C) Zero (D) $(3/2)^2$

43. The mirage is formed due to

(A) reflection (B) refraction (C) total internal reflection (D) dispersion

44. A glass prism has refractive index 1.5 and the refracting angle 90^0 If a ray falls on it at an angle of incidence

(A) 60^0 (B) 45^0

(C) 30^0 (D) the ray will not emerge at all

45. When monochromatic light passes from vacuum to a material medium and vice versa : which of the following characteristics of light beam does not changes ?

(A) velocity (B) intensity (C) wavelength (D) frequency

46. A piece of glass when immersed in a transparent solution of refractive index 1.48 becomes almost invisible. The refractive index of glass used is

(A) zero (B) 1 (C) 1.48 (D) infinite

47. Which of the following conditions are necessary for total internal reflection to take place at the boundary of two optical media ?

I. Light is passing from optically denser medium to optically rarer medium.

II. Light is passing from optically rarer medium to optically denser medium.

III. Angle of incidence is greater than the critical angle.

IV. Angle of incidence is less than the critical angle.

(A) I and III only (B) II and IV only (C) III and IV only (D) I and IV only

48. The speed of light in vacuum is 3.0×10^8 m/s. If the refractive index of a transparent liquid is 4/3, then the speed of light in the liquid is

(A) 2.25×10^8 m/s (B) 3×10^8 m/s (C) 4×10^8 m/s (D) 4.33×10^8 m/s

49. The refractive indices of water and glass are 4/3 and 3/2 respectively. The refractive index of water with respect to glass is

(A) $\frac{8}{9}$ (B) 2 (C) $\frac{2}{3}$ (D) $\frac{1}{6}$

50. Which of the following can be used to form a virtual image of an object ?

I. convex lens II. concave lens III. concave mirror

(A) II only (B) II and III only (C) I and III only (D) I, II and III

ANSWER KEY															
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	**D**	**C**	**D**	**C**	**D**	**D**	**A**	**C**	**A**	**C**	**B**	**C**	**D**	**A**	**A**
Que.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	**B**	**B**	**A**	**C**	**D**	**C**	**B**	**A**	**D**	**C**	**D**	**C**	**A**	**B**	**B**
Que.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	**C**	**B**	**C**	**C**	**B**	**D**	**B**	**C**	**B**	**B**	**C**	**A**	**C**	**D**	**D**
Que.	**46**	**47**	**48**	**49**	**50**										
Ans.	**C**	**A**	**A**	**A**	**D**										

EXERCISE - 2 **(FOR SCHOOL/BOARD EXAMS)**

1. An object is placed in front of a plane mirror. If the mirror is moved away from the object through a distance x, be how much distance will the image move

2. A ray of light on a plane mirror. Show that if the mirror is tilted through an angel θ, the reflected ray tilts through an angle 2θ.

3. A 2cm high object is placed at a distance of 32cm from a concave mirror. The image is real, inverted and 3 cm in size. Find the focal length of the mirror and the position where the image is formed.

4. A ray of light travelling in air falls on the surface of a glass slab. The ray makes an angle of 45^0 with the normal to the surface. Find the angle made by the refracted ray with the normal within the slab. Refractive index of glass = 3/2.

5. Yellow light of wavelength 590 nm travelling in air is refracted into water $\left(\mu = \frac{4}{3}\right)$. Find the wavelength of this light in water.

6. A cube of edge 6 cm is placed over a printed page. At what distance from the top surface of the cube will be letters appear when seen from above ? Refractive index of glass = 1.5.

7. An object is placed on the principal axis of a concave lens at a distance of 20 cm from it. If the focal length of the lens is also 20 cm. find the location of the image.

8. A beam of light travelling to the principal axis of a concave lens appears to diverge from a point 20 cm behind the lens after passing through the lens. Find the power of the lens.

9. A convex lens of power 4D is placed at a distance of 40 cm from a wall. At what distance from the lens should a candle of be placed so that its image is formed on the wall ?

10. A convex lens of focal length 20 cm is placed in contact with a concave lens of focal length 12.5 cm in such a way that they have the same principal axis. Find the power of the combination.

11. A convex mirror used for rear-view on an automobile has a radius of curvature of 3.00 m. If a bus is located at 5.00 m from this mirror, find the position, nature and size of the image .

12. An object, 4.0 cm in size, is placed at 25.0 cm in front of a concave mirror of focal length 15.0 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image ? Find the nature and the size of the image.

13. A concave lens has focal length of 15 cm. At what distance should the object from the lens be placed so that it forms an image at 10 cm from the lens ? Also, find the magnification produced by the lens.

14. A 2.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 10 cm. The distance of the object from the lens is 15 cm. Find the nature, position and size of the image. Also find its magnification.

15. An object placed in front of a diverging mirror at a distance of 30 cm, forms a virtual and erect image which is 1/5 of the size of the object. Calculate : (i) the position of the image , (ii) the focal length of the diverging mirror.

16. A light of wavelength 500 nm in air enters a glass block of refractive index 1.5. Find (a) speed; (b) frequency ; (c) wavelength of light in glass. Velocity of light in air is 3×10^8 m/s.

17. Consider a system of two plane mirror inclined to each other at a right angel. Show that a ray of light is incident on the system, the outgoing ray is parallel to the incident ray and this result is independent of the incident direction.

18. A near sighted person wears eye glass with power of -5.5D for distance vision. His doctor prescribes a correction of + 1.5D in near vision section of his bifocals, which is measured relative to main part of the lens.

(I) What is the focal length of his distant viewing port of lens ?

(II) What is the focal length of near vision section of the lens ?

19. The radius of curvature of a convex mirror used on a moving automobile is 2.0 m. A truck is coming behind it at a constant distance of 3.5 m. Calculate (i) the position, and (ii) the size of image relative to the size of the truck. What will be the nature of the image ?

20. The refractive index of dense flint is 1.65, and for alcohol, it is 1.36 with respect to air. What is the refractive index of the dense flint glass with respect to alcohol ?

21. A convex lens forms a real and inverted image of a needle at a distance of 50 cm from the lens. Where is the needle placed in front the convex lens, so that this image is of the same size as the object ? Also, find the power of the lens.

22. A person can not see objects distinctly at distances less than 1 m. Calculate the power of the spectacles lens that he should use in order to read a book at a distance of 25 cm.

23. Name the type of mirror used in the following situations:

(a) Head lights of a car.

(b) Side rear view mirror of a vehicle.

(d) Solar furnace.

Support your answer with reason.

24. What kind of lens can form a (i) Virtual, erect diminished image ? (ii) virtual, erect, magnified image ?

25. Which lens has greater power, a convex lens of focal length 10 cm or a convex lens of focal length 20 cm ?

26. A man standing in front of a special mirror finds his image having a small face, big tummy and legs of normal size. What are the shapes of three parts of the mirror ?

27. Can you change focal length of a given spherical mirror by changing the object distance from the mirror ?

28. Can you change linear magnification of a spherical mirror by changing the object distance from the mirror ?

29. What is the basic cause of refraction ?

30. What are the conditions for no refraction of light ?

31. A concave mirror is used as a head mirror by ENT specialists. The same mirror also be used as a shaving mirror. Why ?

ANSWER KEY **EXERCISE -2(X)CBS**

1. 2x **3.** f = -192 cm, v = - 48 cm **4.** 28^0 **5.** 442.5 nm **6.** 4 cm **7.** – 10 cm **8.** - 5D **9.** $-\frac{200}{3}$ cm

10. -3D **11.** 1.15 m, +0.23 **12.** - 37.5 m, - 6.0 cm **13.** – 30 cm, + 0.33 **14.**+30 cm – 4.0 cm, m = - 2

15. (i) 6 cm (ii) 7.5 cm **16.** (a) 2×10^8 m/s (b) Same (c) 333.3 nm

18. (i) -18.18 cm (ii) -25 cm **19.** (i) 0.78 m (ii) 0.22 **20.** 1.21 **21.** - 50 cm, 4 D **22.** + 3D

EXERCISE – 3 **(FORSCHOOL/BOARDEXAMS)**

PREVIOUS YEARS BOARD (CBSE) QUESTIONS :

VERY SHORT ANSWER QUESTIONS (CARRYING 1 MARKS FACH)

1. If the magnification of a body of size 1 m is 2, what is the size of the image ? **(2003)**

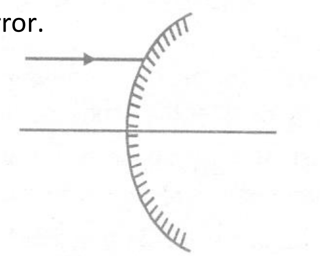
2. What is the power of a concave lens of focal length 25 cm? **(2004)**

3. What will be the focal length of a lens whose power is given as + 2.0 d ? **(2004)**

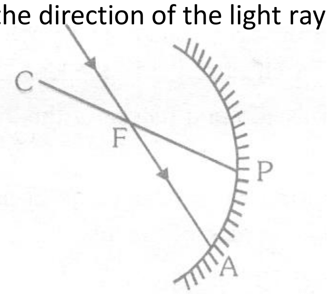
4. Where will the image be formed by a concave mirror when an object is placed between the pole and the focus point of the mirror ? **(2005)**

5. What is the value of focal length of a plane mirror ? **(2005)**

6. A ray of light is incident on a convex mirror as shown in fig. redraw the above diagram after completing the path of the light ray after reflection from the mirror. **(2006)**

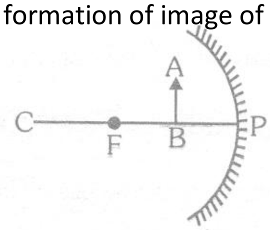


7. Copy fig. in your answer book and show the direction of the light ray after reflection . **(2008)**

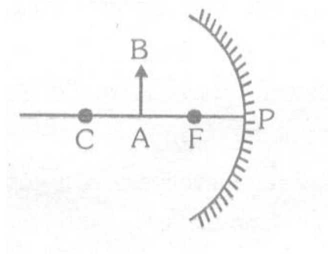


8. The refractive index of diamond is 2.42. What is the meaning of this statement in relation to speed of light ? **(2008)**

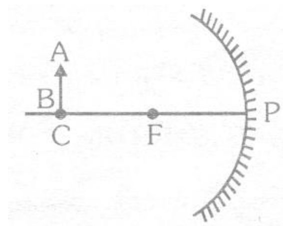
9. Draw fig. in your answer book and show the formation of image of the object AB with the help of suitable rays.



10. Draw fig. in your answer book and show the formation of image of the object AB with the help of suitable rays.



11. Draw fig. in your answer book and show the formation of image with the help of suitable rays.



SHORT ANSWER QUESTIONS (CARRYING 2 MARKS EACH)

12. Give the characteristics of image formed by a plane mirror. **(2003)**

13. An object is placed at 0.06 m from a convex lens of focal length 0.1 m. Calculate the position of the image? **(2004)**

14. An object is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position and nature of the image. **(2004)**

15. Light enters from air diamond, which has a reflective index of 2.42. Calculate has speed of light in diamond. The speed of light in air is 3×10^8 ms^{-1}. **(2005)**

16. With the help of ray diagrams, show the formation of the image of an object by a concave mirror. When it is placed (i) beyond the centre of curvature (ii) at the centre of curvature. **(2005)**

17. Draw ray diagrams to show the formation of image of an object by a concave mirror, when it is placed (i) between its centre of curvature C and focus F (ii) between pole P of mirror and its focus F. **(2005)**

18. With respect to air, the refractive index of ice is 1.31 and that of rock salt is 1.54. Calculate the refractive index of rock salt w.r.t. ice. **(2005)**

19. Draw ray diagrams to show the formation of image of an object by a concave lens when the object is placed. (i) at infinity (ii) between infinity and optical centre of the lens. **(2005)**

20. Draw a ray diagram to show the position and nature of the image formed when an object is placed between focus F and pole P of a concave mirror . **(2006)**

21. Draw ray diagrams to show the formation of the image of an object by a convex mirror, when it is placed (i) at infinity and (ii) between infinity and pole of the mirror . **(2006)**

22. Draw a labeled ray diagram to locate the image of an object formed by a convex lens of focal length 20 cm when the object is placed 20 cm away from the lens. **(2008)**

23. Explain with the help of a diagram, why a pencil partly immersed in water appears to be bent at the water surface. **(2008)**

24. Draw the ray diagrams to represent the nature, position and relative size of the image formed by a convex lens for the object placed (i) at 2 F_1 (ii) between F_1 and optical center O of the lens. **(2008)**

SHORT ANSWER QUESTIONS (CARRYING 3 MARKS EACH)

25. Calculate the distance at which an object should be placed in front of a thin convex lens of focal length 10 cm to obtain a virtual image of double it size. **(2003)**

26. A convex lens of focal length 40 cm is placed in contact with a concave lens of focal length 25 cm. What is the power is combination ? **(2003)**

27. Find the position of an object , which when placed in front of a concave mirror of focal length 20 cm produces a virtual image, which is twice the size of the object. **(2003)**

28. a concave lens made of a material of refractive index n_1 is kept in medium of refractive index n_2. A parallel beam of light is incident on the lens. Complete the path of rays of light emerging from the concave lens if
(i) $n_1 > n_2$ (ii) $n_1 = n_2$ (iii) $n_1 < n_2$.

29. Find the position, nature and size of the image formed by a convex lens of focal length 20 cm of an object 4 cm high placed at a distance of 30 cm from it. **(2004)**

30. A convex lens has focal length of 30 cm. Calculate at what distance should the object be placed from the lens so that it forms an image at 60 cm on the other side of the lens ? Find the magnification produced by the lens in this case. **(2004)**

31. Find the option, nature and size of the image of an object 3 cm high placed at a distance of 9 from a concave of focal length 18 cm. **(2004)**

32. An object 4 cm high is placed 40-0 cm in front of a concave mirror of focal length 20 cm. Find the distance from the mirror, at which a screen be placed in order to obtain a sharp image. Also find the size and nature of the image **(2005)**

33. An object is placed at a distance of 12 cm in front of a concave mirror. It forms a real image four times larger than the object. Calculate the distance of the image from the mirror.

34. A 5.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal 20 cm. The distance of the object from the lens from the lens is 30 cm. By calculation, determine (i) the position (ii) the size of the image formed.

35. An object 320 cm high is placed perpendicular to the principal axis of a concave lens of length 7.5 cm. The image s formed at a distance of 5.0 cm from the lens. Calculate (i) distance at which object is placed, and (ii) size and nature of image formed. **(2006)**

36. A concave lens has focal length of 20 cm At what distance from the lens 5 cm tall object be placed so that it forms an image at 15 cm from the lens ? Also, calculate the size of the image formed. **(Delhi, 2007)**

37. An object 50 cm tall is placed on the principal axis of a convex lens. Its 20 cm tall image is formed on the screen placed at a distance of 10 cm from the lens. Calculate the focal length of the lens. **(2007)**

LONG ANSWER QUESTIONS (CARRYING 5 MARKS EACH)

38. Draw ray diagrams to show the formation of images when the object is placed in front of a concave mirror
(i) between its pole and focus point.
(ii) between the centre of curvature and focus point.

39. (a) State the relation between object distance, image distance and focal length of a spherical mirror .
(b) Draw a ray diagram to show the image formed by a concave mirror when an object is placed between pole and focus of the mirror.
(c) A concave mirror of focal length 5 cm forms an image of an object kept at a distance of 10 cm from the mirror. Find the position, nature and size of the image formed by it.

VERY SHORT ANSWER QUESTIONS (CARRYING 1 MARKS EACH)

40. What is meant by persistence of vision ? **(2003)**
41. What kind of lens is used in the spectacles of a person suffering from myopia (near sightedness) ? **(2006)**
42. List three common defects of vision that can be corrected with the use of spectacles. **(2006)**
43. Write the function of Iris in the human eye. **(2007)**
44. To an astronaut, why does the sky appear dark instead of blur ? **(2008)**
45. Why does the sun appear reddish at sunrise ? **(2008)**
46. Why is red colour selected for danger signal lights ? **(2008)**

SHORT ANSWER QUESTIONS (CARRYING 2 MARKS EACH)

47. The far point of a myopic person is 80 cm in front of the eyes. What is the nature and power of the lens required to enable him to see very distant object distinctly ? **(2003)**
48. Explain about the colour of the sun at sunrise and sunset. **(2007)**

SHORT ANSWER QUESTIONS (CARRYING 3 MARKS EACH)

49. What are the conditions for formation of rainbow ? **(2003)**
50. Draw a labeled diagram of human eye.
What is power of accommodation of eye ? Define colour blindness. **(2005)**
51. (a) Draw a diagram to show the formation of image of a distant object by a myopic eye. How can such an eye defect be remedied ?
(b) State two reasons due to which eye defect may be caused.
(c) A person with myopic eye cannot see objects beyond a distance of 1'5 m. What would be the power of the corrective lens used to restore proper vision ? **(2008)**

LONG ANSWER QUESTIONS (CARRYING 5 MARKS EACH)

52. (a) State two main causes of a person developing near sightedness. With the help of a ray diagram, suggest how he can be helped to overcome this disability ?
(b) The far point a myopic person is 150 cm in front of the eye. Calculate the focal length and power of a lens required to enable him to see distant object clearly. **(2004)**
53. What is long sightedness ? List two causes for development of long-sightedness. Describe with a ray diagram, how this defect may be corrected by using spectacles.
(2005)
54. (a) Explain the following terms used in relation to defects of vision and corrections provided for them : (i) Myopia
(ii) Astigmatism (iii) Bifocal lenses (iv) Far sightedness.
(b) Describe with a ray diagram how a person with myopia can be helped by spectacles. **(2005)**
55. A 14 year old student is not able to see clearly the questions written on blackboard placed at a distance of 45 m from him. (a) Name the defect of vision he is suffering from. (b) With the help of labeled ray diagrams, show how this defect can be corrected. (c) Name the type of lens used to correct the defect. **(2007)**
56. (a) What is meant by dispersion of white light ? Describe the formation of rainbow in the sky with the help of a Diagram.
(b) What is Hypermetropia ? Draw ray diagrams to show the image formation of an object by (i) Hypermetropia eye (ii) correction made with a suitable lens for Hypermetropia eye . **(2008)**
57. (a) Give reasons for the following :
(i) Colour of the clear sky is blue.

(ii) The sun can be seen about two minutes before actual sunrise.
(iii)We cannot see an object clearly if it is placed very close to the eyes.
(b) What is Presbyiopia ? Write two causes of this defect .

EXERCISE – 4 **OPTICS**

1. When does the total internal reflection take place :-
(A) Refraction from air into any denser medium
(B) Refraction of ray incident from rarer medium
(C) Ray incident from denser medium, with angle of refraction 90^0.
(D) Ray incident from denser medium with refractive index is [n > 1 /(sin of angle of incidence)]

2. When the ray of light is incident from denser medium having refractive index 2, what should be the angle of incidence for the ray to go out :-
(A) Less than 30^0 (B) Less than 45^0 (C) Less than 60^0 (D) Less than 90^0

3. A monochromatic beam of light passes from a denser medium into a rarer medium as a result :-
(A) Its velocity increase (B) Its velocity decrease
(C) Its frequency decrees (D) Its wavelength decreases

4. Immiscible transparent liquids A, B, C, D and E are placed in a rectangular container of glass with the liquids making layers according to their densities. The refractive index of the liquids are shown in the adjoining diagram. The container is alluminated from the side and a small piece of glass having refractive index 1.61 is gently dropped into the liquid laxo. The glass piece as descends downwards will not be visible in :-
(A) Liquid A and B only
(B) Liquid C only
(C) Liquid D and E only
(D) Liquid A, B D and E

$\mu = 1{\cdot}64$	A
$\mu = 1{\cdot}63$	B
$\mu = 1{\cdot}61$	C
$\mu = 1{\cdot}64$	D
$\mu = 1{\cdot}6$	E

5. Sensitivity of eye is maximum for :-
(A) 4000 $\mathring{A}$ (B) 8000 $\mathring{A}$ (C) 5550 $\mathring{A}$ (D) 6000 $\mathring{A}$

6. A bird in air looks at a fish vertically below it and inside water. x is the height of the bird above the surface of water an y is the depth of the fish below the surface of water. The distance of the fish as observed by the bird is : (Given μ = refractive index of water w.r.t. air) :-
(A) x + y (B) $x+\frac{y}{\mu}$ (C) μ x + y (D) μ x + μ y

7. In the previous question, the distance of the bird as observed by the fish is :-
(A) x + y (B) $x+\frac{y}{\mu}$ (C) μ x + y (D) μ x + μ y

8. An object is placed between two parallel plane mirror. The number of image formed is
(A) four (B) one (C) two (D) infinite

9. An object is placed between two plane mirrors inclined at some angle to each other . If the number of images formed is 7 then angle of inclination is
(A) 15^0 (B) 30^0 (C) 45^0 (D) 60^0

10. Which of the following letters do not surface lateral inversion.
(A) HGA (B) HOX (C) VET (D) YUL

11. A clock hung on a wall has marks instead of numbers on its dial. On the opposite wall there is a mirror, and the image of the clock in the mirror if read , indicates the time as 8.20. What is the time in the clock –
(A) 3.40 (B) 4.40 (C) 5.20 (D) 4.20

12. If you want to see your full image, then minimum size of the mirror

(A) Should be of your height (B) Should be of your height

(C) Should be twice of your height (D) Depends upon distance from the mirror

13. If an object is placed unsymmetrical between two plane mirrors, inclined at an angle of 72^0, then the total number of image formed is-

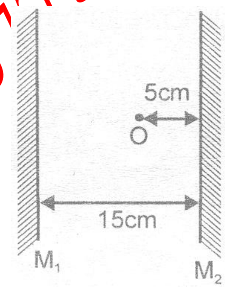
(A) 5 (B) 4 (C) 2 (D) Infinite

14. At what angle must two plane mirrors be placed so that incident and resulting reflected rays are always parallel to each other

(A) 0^0 (B) 30^0 (C) 60^0 (D) 90^0

15. Figure shows two plane mirrors parallel to each other and an object O placed between them. Then the distance of the first three images from the mirror M_2 will be : (in cm)

(A) 5, 10, 15 (B) 5, 15, 30 (C) 5, 25, 35 (D) 5, 15, 25



16. If an object is placed 10 cm in front of a concave mirror a focal length 20 cm, the image will be :-

(A) diminished, upright, virtual (B) enlarged, upright, virtual

(C) diminished, inverted, real (D) enlarged, upright, real

17. The magnification m, the image position v and focal length f are related to one another by the relation –

(A) $m = \dfrac{f-v}{f}$ (B) $m = \dfrac{f}{f-v}$ (C) $m = \dfrac{f+v}{f}$ (D) $m = \dfrac{f}{f-v}$

18. The relation between magnification m, the object position u and focal length f of the mirror is

(A) $m = \dfrac{f-v}{f}$ (B) $m = \dfrac{f}{f-u}$ (C) $m = \dfrac{f+u}{f}$ (D) $m = \dfrac{f}{f+u}$

19. v_1 is velocity of light in first medium, v_2 is velocity of light in second medium, then refractive index of second medium with respect to first medium is

(A) v_1/v_2 (B) v_2/v_1 (C) $\sqrt{v_1/v_2}$ (D) $\sqrt{v_2/v_1}$

20. The ratio of the refractive index of red light to blue light in air is

(A) Less than unity

(B) Equal to unity

(C) Greater than unity

(D) Less as well as greater than unity depending upon the experimental arrangement

21. The refractive index of glass and water with respect to air 3/2 and 4/3 respectively. The refractive index of glass with respect to water is

(A) 8/9 (B) 9/8 (C) 2 (D) 1/2

22. If ${}_i\mu_j$ represents refractive index when a light ray goes from medium i to medium j, then the product ${}_2\mu_1 \times {}_3\mu_2 \times {}_4\mu_3$ is equal to

(A) ${}_3\mu_1$ (B) ${}_3\mu_2$ (C) $\dfrac{1}{{}_1\mu_4}$ (C) ${}_4\mu_2$

23. What is the basic reason for the shining of a diamond ?

(A) Reflection (B) Refraction (C) Dispersion of light (D) Total internal reflection

24. Total internal reflection of a ray of light is possible when the (i_c = critical angle, i = angle of incidence)

(A) Ray goes from denser medium to rarer medium and $i < i_c$

(B) Ray goes from denser medium to rarer medium and $i > i_c$

(C) Ray goes from rarer medium to denser medium and $i > i_c$

(D) Ray goes from rarer medium to denser medium and $i < i_c$.

25. A convex lens of focal length A and a concave lens of focal length B are placed in content. The focal length of the combination is

(A) A + B (B) (A – B) (C) $\frac{AB}{(A+B)}$ (D) $\frac{AB}{(B-A)}$

26. Near and far points of a human eye are

(A) zero and 25 cm (B) 25 cm and 50 cm (C) 50 cm and 100 cm (D) 25 cm and infinite

27. The focal length of a concave mirror is f and the distance from the object to the principal focus is x. Then the ratio of the size of the image to the size of the object is-

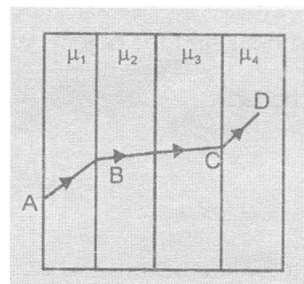
(A) $\frac{(f+x)}{f}$ (B) $\frac{f}{x}$ (C) $\sqrt{\frac{f}{x}}$ (D) $\frac{f^2}{x^2}$

28. Light travels through a glass plate of thickness t and having refractive index n. If c is the velocity of light in vacuum. The time taken by the light to travel this thickness of glass is :-

(A) $\frac{t}{nc}$ (B) tnc (C) $\frac{nt}{c}$ (D) $\frac{tc}{n}$

29. A ray of light passes through four transparent media with refractive indices μ_1, μ_2, μ_3 and μ_4 as show in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have :

(A) $\mu_1 = \mu_2$ (B) $\mu_2 = \mu_3$ (C) $\mu_3 = \mu_4$ (D) $\mu_4 = \mu_1$



30. Which of the following is used in optical fires ?

(A) Total internal reflection (B) Scattering

(C) Diffraction (D) Refraction

31. Electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively :-

(A) $\frac{n}{\mu}, \frac{\lambda}{\mu}, \frac{v}{\mu}$ (B) $n, \frac{\lambda}{\mu}, \frac{v}{\mu}$ (C) $n, \lambda, \frac{v}{\mu}$ (D) $\frac{n}{\mu}, \frac{\lambda}{\mu} v$

32. A plane glass slab is kept over various colored letters ; the letter which appears lest raised is

(A) blue (B) violet (C) green (D) red

33. A convex lens of focal length f will form a magnified real image of an object if the object is placed

(A) anywhere beyond 2f (B) anywhere beyond f

(C) between f and 2f (D) between lens and f

34. A convex lens is making full image of an object . if half of lens is covered by an opaque object, then

(A) half image is not seen (B) full image of same intensity is seen

(C) full image of decreased intensity is seen (D) half image of same intensity is seen

35. When a thin convex lens is put in contact with a thin concave lens of the same focal length , the resultant combination has a focal length equal to

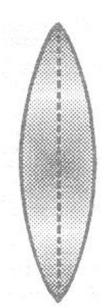
(A) f / 2 (B) 2f (C) 0 (D) ∞

36. Focal length of a convex lens will be maximum for

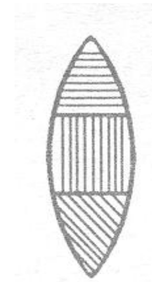
(A) blue light (B) yellow light (C) green light (D) red light

37. A convex lens has a focal length f. It is cut into two parts along the dotted line as show in the figure. The focal length of each part will be

(A) $\frac{f}{2}$ (B) f (C) $\frac{3}{2} f$ (D) 2f



38. A convex lens is made up of three different materials as shown is the figure. For a point object placed on its axis, the numbers of image formed are:



(A) 1 (B) 3 (C) 4 (D) 5

39. Myopia is the defect of vision due to which a person finds difficulty in seeing

(A) distance object (B) near object (C) object at all distances (D) colors

40. Loss of the ability of eye to focus on near and far object with advancing age is called

(A) Presbyiopia (B) Astigmatism (C) Hypermetropia (D) Myopia

41. Astigmatism can be corrected by

(A) Bifocal lenses (B) Cylindrical lenses (C) Concave lenses (D) Plano convex lenses

42. A normal eye is not able to see objects closer than 25 because

(A) The focal length of the eye is 25 cm

(B) The distance of the retina form the lens is 25 cm

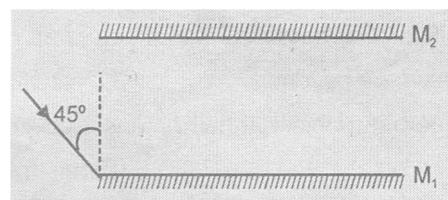
(C) The eye is not able to decrease the distance between the eye lens and the retina beyond a limit

(D) The eye is not able to decrease the focal length beyond a limit

43. Myopia can be removed by using a lenses of

(A) concave lens (B) convex lens (C) cylindrical lens (D) by surgical removal

44. Two plane mirrors M_1 and M_2 each have length 1m and separated by 1 cm, A ray of light is incident on one end of mirror M_1 at angle 45^0 . How many reflections the ray will have before going at from the other end



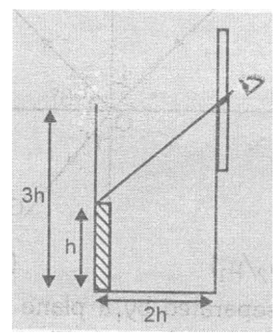
(A) 50 (B) 51 (C) 100 (D) 101

45. 'Mirage' is a phenomenon due to :-

(A) reflection of light (B) refraction of light

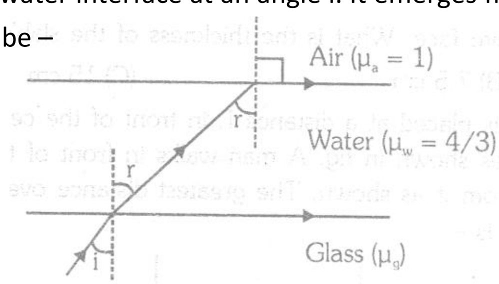
(C) total internal reflection of light (D) diffraction of light

46. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure, the beaker height is 5h and its radius h. when the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is –



(A) $\frac{5}{2}$ (B) $\sqrt{\frac{5}{2}}$ (C) $\sqrt{\frac{3}{2}}$ (D) $\frac{3}{2}$

47. A ray of light is incident at the glass-water interface at an angle i. It emerges finally parallel to the surface of water as shown in fig. the value of μ_g would be –



(A) $\left(\frac{4}{3}\right)$ sin i (B) $\frac{1}{\sin i}$ (C) $\frac{2}{\sqrt{3}\sin i}$ (D) 1.5

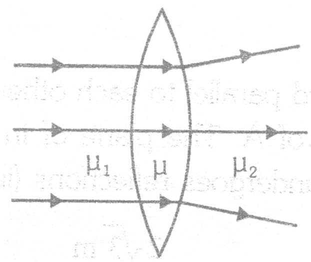
48. When a ray of light enters a glass slab from air –

(A) Its wavelength decreases.
(B) Its wavelength Increases.
(C) Its frequency increases
(D) Neither wavelength nor frequency changes.

49. The distance between the object and the real image formed by a convex lens is d. if the magnification is m, the focal length of the lens is -

(A) $\frac{md}{(m+1)^2}$ (B) $\frac{md}{(m+d)}$ (C) $\frac{md}{(m-1)^2}$ (D) $\frac{md}{m-1}$

50. A parallel beam of light falls on a convex lens. The path of the rays is shown in fig. It follows that –



(A) $\mu_1 > \mu > \mu_2$ (B) $\mu_1 < \mu < \mu_2$ (C) $\mu_1 = \mu < \mu_2$ (D) $\mu_1 = \mu > \mu_2$

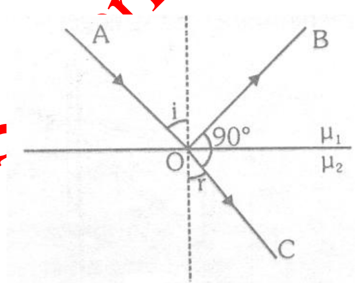
51. A person is looking at the image of his face in a mirror by holding it close to his face. The image is virtual. When he moves the mirror away from his face, the image is inverted. What type of mirror is he using ?

(A) Plane mirror (B) Convex mirror (C) Concave mirror (D) None of these

52. Two objects A and B when placed in turn in front of a concave mirror of focal length 7.5 cm, give images of equal size. If A is three times the size of B and is placed 30 cm from mirror, what is the distance of B fro the mirror –

(A) 10 cm (B) 12.5 cm (C) 15cm (D) 17.5 cm

53. A ray of light in medium of refractive index μ_1 is partly reflected and refracted at the boundary of a medium of refractive index μ_2 as shown fig. If $\angle$ BOC = 90^0. The value of angle i is given by –



(A) $\tan^{-1}(\mu_1/\mu_2)$ (B) $\tan^{-1}(\mu_2/\mu_1)$ (C) $\sin^{-1}(\mu_2/\mu_1)$ (D) $\cos^{-1}(\mu_1/\mu_2)$

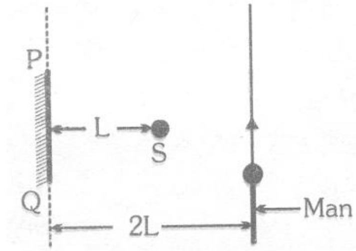
54. Two transparent media A and B separated by a plane boundary. The speed of light in medium A is 2.0 × 10^8 and in medium B 2.5 × 10^8 ms^{-1}. The critical angle for which a ray of light going from A to B it totally internally reflected is –

(A) $\sin^{-1}\left(\frac{1}{2}\right)$ (B) $\sin^{-1}\left(\frac{2}{5}\right)$ (C) $\sin^{-1}\left(\frac{4}{5}\right)$ (D) None of these

55. An air bubble in a glass slab ($\mu = 1.5$) is 6 mc deep when viewed through one face and 4 cm deep when viewed through the opposite face. What is the thickness of the slab ?

(A) 7.0 cm (B) 7.5 cm (C) 15 cm (D) 10.5 cm

56. A point source of light S is placed at a distance L in front of the centre of a plane mirror PQ. of width d hung vertically on a wall as shown in fig. A man walks in front of the mirror along a line parallel to the mirror at a distance 2L from it as shown. The greatest distance over which he can see the image of the light source in the mirror is –

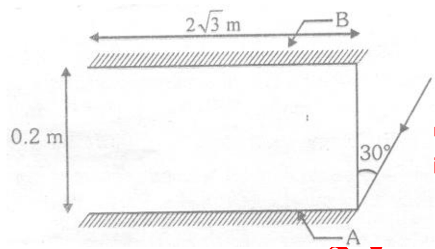


(A) $\frac{d}{2}$ (B) d (C) 2d (D) 3d

57. Two plane mirrors, each 1.6 m long, are help parallel and facing each other at a separation of $20\sqrt{3}$ cm. A ray of light is incident at a the end of one mirror at an angle of incidence of 30^0. The total number of reflections the ray suffers before emerging from the system of mirrors is –

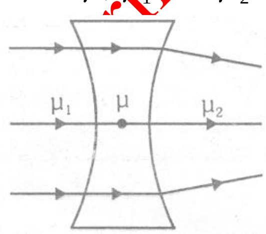
(A) 10 (B) 12 (C) 14 (D) 16

58. Two plane mirrors A and B are aligned to each other, as shown in Fig. A light ray is incident at an angle of 30^0 at a point just inside one end of A. The plane of incidence coincides with the plane of the figure. The maximum number of times the ray undergoes reflections (including the first one) before it emerges out is –



(A) 28 (B) 30 (C) 32 (D) 34

59. What is the relation between refractive indies μ, μ_1 and μ_2 if the behaviour of light rays is as shown in fig.



(A) $\mu > \mu_2 > \mu_1$ (B) $\mu < \mu_2 < \mu_1$ (C) $\mu < \mu_2 : \mu = \mu_1$ (D) $\mu_2 < \mu_1 : \mu : \mu_2$

60. A lens of power +2.0D is placed in contact with another lens of power -1.0D, the combination will behave like :-

(A) A converging lens of focal length 100 cm
(B) A diverging lens of focal length 100 cm
(C) A converging lens of focal length 50 cm
(D) A diverging lens of focal length 50 cm

61. Which of the following statements is / are correct ?

(A) The laws of reflection of light hold for plane as well as curved reflecting surfaces.
(B) The size of a virtual image can be measured by receiving it on a screen.
(C) A dentist uses a convex mirror to examine a small cavity.
(D) The focal length of a spherical mirror is half the radius of curvature for all rays.

62. Choose the correct statement (s) from the following :

(A) To a fish under water looking obliquely at a man standing on the bank of lake, the man looks taller then his actual height.

(B) The apparent depth of a tank of water more for oblique viewing than for normal viewing.

(C) The focal length of a concave mirror will not change if it is immersed in water

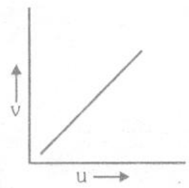
(D) In no situation will a converging lens behave like a diverging lens.

63. An air bubble under water shines brightly because of the phenomenon of -

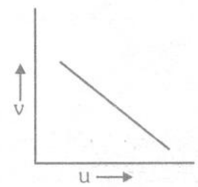
(A) Dispersion (B) Interference

(C) Diffraction (D) Total internal reflection

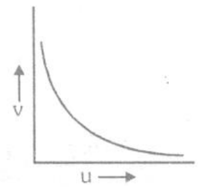
64. The distance v of the real image formed by a convex lens is measured for various object distances u. A graph is plotted between v and u. Which one of a the graphs shown in fig. is approximately correct ?



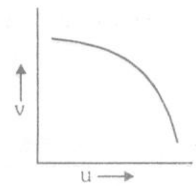
(A)



(B)

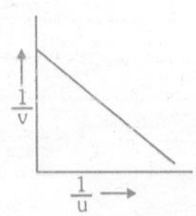


(C)

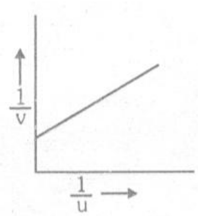


(D)

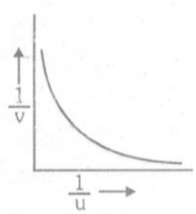
65. If a graph is plotted between 1/v and 1/u, which one of the graphs shown in fig. approximately correct ?



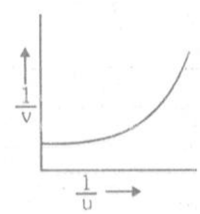
(A)



(B)



(C)



(D)

GENETICS

HEREDITY AND VARIATIONS

It is commonly seen that members of a species are largely alike. An elephant resembles other elephants, a rose plant looks alike other rose plant, and children resemble their parents, even grandparents or great grandparents. This resemblance among the individuals of a species has given rise to a general truth **'like begets like'** which implies continuity of life. It is, however, not absolutely true as the members f a species are seldom exactly alike. For instance, in human beings, the children often have some individual characters in which they differ from one another, and also from their parents. In fact, their differences are as marked as their resemblances. This is true about other species as well.

The similarities and differences among the members of a species are not coincidental. They are received by the young ones from their parents. The hereditary information, in fact, is present in the gametes (egg and sperm) which fuse to form the fertilized egg or zygote during sexual reproduction. The zygote then develops into an organism of a particular type. For instance, fertilized egg of sparrows hatch into sparrows only and the fertilized eggs of pigeons hatch into pigeons only. Similarly, a cow gives birth to calves only. The wheat plant gives rise to seeds which, in turn, in turn, develop into wheat plants.

Heredity :- The transmission of characters [or traits] from one generation to another generation.

Or

The transmission of characters from the parents to their off springs.

Variations :- The differences in the characters [or traits] among the individuals of a species are called variations. **e.g.**

Plant height – Tall, dwarf & middle.

Ear lobe in human being: - The lowest part of our ear is called earlobe.

◆ In most of the people, the ear lobe is hanging and it is called free earlobe.

◆ In some people, the earlobe is closely attached to the side of the head and it is called attached ear lobe.

ACCUMULATION OF VARIATIONS DURING REPRODUCTION

Heredity involves inheritance of basic body design (similarities) as well as subtle changes (variations) in it from one generation to the next generation, i.e., from parents to the offspring. When individuals of this new generation reproduces, the offsprings of second generation will have the basic body design, the differences that they inherit from first generation as well as newly developed differences.

Asexual reproduction involves single parent. When a single individual reproduces asexually, the resultant two individuals again after sometime reproduce to form four individuals. All these individuals would be similar. However, there would be only very minor differences between them. These very minor differences arise due to small inaccuracies in **DNA** copying.

Sexual reproduction, on the other hand, generates even greater diversity. This is so because sexual reproduction involves two parents (father and mother) and every offspring receives some characters of father and some characters of mother. Since, different off springs receive different combination of characters of their parents (father and mother), they show distinct differences (variations) among themselves as well as from their parents. The variations accumulate and pass on to more and more individuals with each generation.

During sexual reproduction the variation caused by –

(i) Chance separation of chromosomes during gamete formation (Gametogenesis).

(ii) Crossing over during meiosis.

(iii) Chance coming together of chromosomes during fertilization.

(iv) Mutations, i.e., alterations in the genetic material.

All the variations in a species do not have equal chances of surviving in the environment in which they are generated. Depending upon the nature of variations, different individuals would have different kinds of advantages. For instance, bacteria that can withstand heat will survive better in a heat wave than the others. In other words, environmental factors select the variants and this and this selection forms the basis of evolution.

GREGOR JOHANN MENDEL (1822-1884)

Mendel was born on 22 July 1822 at Heinzendorf in Austria at Silesia village. Mendel had worked in Augustinian Monastery as monk at Brno city, Austria.

In 1856-57, he started his historical experiments of heredity on pea **(Pisum sativum)** plant. His experimental work continued on pea plant till 1865 (19th centaury).

The results of his experiments were published in science journal. **"Nature For Schender Verein"** in 1866.

This journal was in Germen language. This is **'**Versuche über Pflanzenhybriden**'.**

This journal was published by **'Natural History society of Bruno'.**

A paper of Mendel by the name of **Experiment in plant Hybridization** published in this journal.

Mendel were unable to got any popularity no one understand of him. He died in 1884 (due to kidney disease (Bright disease)) without getting any credit of his work.

After 16 years of Mendel's death in 1900 Mendel's postulates was rediscovered. Mendel experiment remain hidden for 34 years.

Rediscovery by three scientists independently:

1. **Carl Corens –** Germany – (Experiment on Maize)
2. **Hugo deVries** (Holland) (Experiment on Evening Primerose)
3. **Erich von Tschermak Seysenegg** – (Austria) (Experiment on different flowering plants)

CHARACTER

A recognizable feature of human beings or any other organisms are called characters.

eg. (i) Height

(ii) Complexion

(iii) Shape of hair

(iv) Colour of eyes

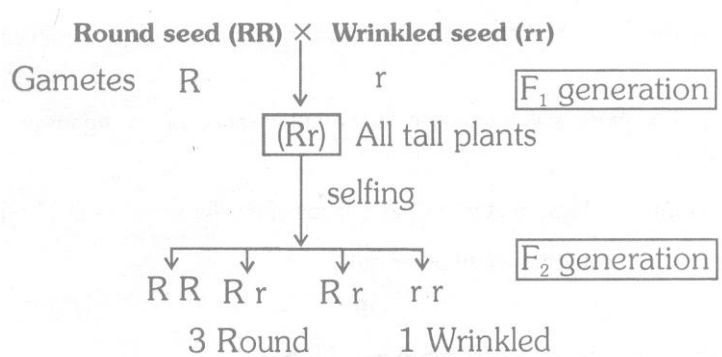
(v) Shape of nose

Traits :- Various forms of a character are called **traits.**

S.No.	Character	Dominant	Recessive
1.	Length of Plant	Tall	Dwarf
2.	Flower position	Axial	Terminal
3.	Shape of pod	Inflated	Constricted
4.	Colour of pod	Green	Yellow
5.	Shape of seed	Round	Wrinkled
6.	Colour of cotyledon	Yellow	Green
7.	Colour of flower	Violet	White

MENDEL'S MONOHYBRID CROSS

A breeding experiment dealing with **a angle character is called a monohybrid cross.**
Mendel first selected **'pure line' plants** (i.e. the plants that produced similar traits generation after generation). He, then, cross pollinated such plants having the contrasting traits, considering one trait at a time. For instance, in one such cross breeding experiment, he cross bred garden pea plant having round seeds with plant having wrinkled seeds. In this monohybrid cross, the pollen grains from the flower of the desired plant raised from round seeds were transferred over the previously emasculated flower of a plant raised from wrinkled seeds or vice-versa. After the transfer of pollen grains, the cross pollinated flower was properly covered and seeds produced were allowed to mature. All the seeds **F_1 generation** were carefully observed. Mendel observed that all the seeds of F_1 generation were of round type and there were no intermediate characteristics. He raised plants from F_1 seeds and allowed the flowers to self-pollinate to produce the seeds of F_2 generation. The flowers were kept covered from the beginning to avoid unwanted pollens to reach these flowers. In F_2 generation, Mendel observed the appearance of both round and wrinkled seeds in approximately 3 : 1 proportion.



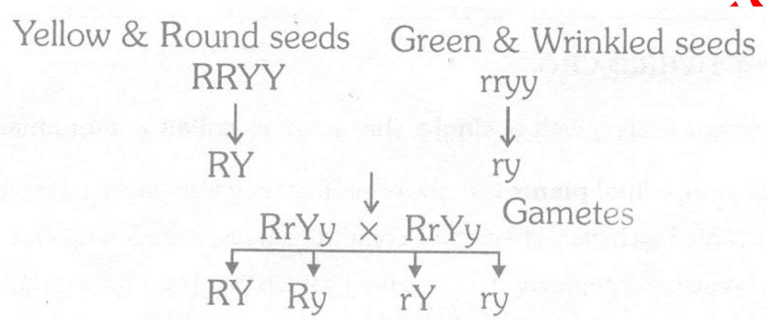
MENDELS DITHERED CROSS

A cross involving two pairs of contrasting characters.

Or

A cross in which two pair of contrasting characters are studied at a time.

In one such cross, Mendel considered **shape** as well as **colour of the seeds** simultaneously. He selected pure line plants and then cross pollinated flowers rose from seeds of round shape and yellow colour with those from wrinkled seeds and green colour. Mendel observed that in F_1 generation all seeds had the features of only one parental type, i.e., round shape and yellow colour. He raised plants from F_1 generation seeds and allowed the flowers to self pollinate to produce the seeds of F_2 generation. Theses flowers were kept covered from the beginning. In F_2 generation, Mendel observed the appearance of four types of combinations. These included **two parental types** (round shaped and yellow colored seeds, and wrinkled shaped and green colored seeds) and **two new combinations** (round shape d and green colored seeds, and wrinkled and yellow colored seeds) in approximately same proportion.



	RY	Ry	rY	ry
RY	RRYY Round Yellow	RRYy Round Yellow	RrYY Round Yellow	RrYy Round Yellow
Ry	RRYy Round Yellow	RRyy Round Green	RrYy Round Yellow	Rryy Round Green
rY	RrYY Round Yellow	RrYy Round Yellow	rrYY Wrinkled Yellow	rrYy Wrinkled Yellow
ry	RrYy Round Yellow	Rryy Round Green	rrYy Wrinkled Yellow	rryy Wrinkled Green

SOME IMPORTANT DEFINITIONS

Dominant gene :- The gene which decided the appearance of an organism even in the presence of an alternative gene.

Recessive gene :- The gene which can decide the appearance of an organism only in the presence of another identical gene.

Chromosomes :- A thread – like structure in the nucleus of a cell formed of DNA which carries the genes.

Genotype :- The genetic constitution of an organism.

Or

The description of genes present in an organism e.g. TT, tt, Tt.

Phenotype :- External and morphological appearance of an organism for a particular character.

Allele :- Alternative forms of a gene which are located on same position [loci] on the homologous chromosome.

F_1 Generation :- When two parents cross or breed to produce progeny [or off springs], then their progeny is called F_1 generation or first filial generation.

Or

The offspring produced by the parental generation.

F_2 generation :- When the first generation progeny cross or breed among themselves to produce second progeny, then progeny is called filial generation or F_2 generation.

Or

The offspring produced by the F_1 generation

Hybrid :- A new form of plant resulting from a cross or breeding of different varieties of a plant is know as a hybrid.

Pure-breeding :- Characteristics that appear unchanged generation after generation.

Dominant characters :- Any character that appears in the F_1 generation offspring from a cross between parents possessing contrasting characters such as tallness & dwarfness in pea plants.

Recessive characters :- Any character present in the parental generation that does not appear in the F_1 generation but reappears in the F_2 generation.

Homozygous :- A condition in which the 2 members of an allelic pair are similar **e.g.** TT, tt.

Heterozygous :- A condition in which the 2 members of an allelic pair are dissimilar **e.g.** Tt.

Offspring :- Organisms produced as a result of sexual reproduction.

Homologous chromosomes :- All chromosomes found in pair & chromosomes of a pair are called homologous chromosomes.

Non-homologous chromosomes :- Chromosomes of different pair are called non-homologous chromosomes.

Genes :- Unit of heredity which transfers characters from parents to their offspring during reproduction.

Gene $\rightarrow$ Protein synthesis $\rightarrow$ Enzymes [Controls phenotype of a character]

LAWS OF MENDEL

On the basis of Mendel's work, 3 basis laws of inheritance were proposed.

(i) Law of Dominance

(ii) Law of Segregation

(iii) Law of Independent Assortment

Law of dominance :- In crossing between organisms pure for contrasting characters of a pair, only one character of the pair appears in the F_1 generation. This character is termed dominant while the one which does not express itself in F_1 generation is termed recessive.

Law of segregation :- Allele or genes remain together and segregate at the time of gamete formation. This means that the alleles do not mix in the hybrids [Non-mixing of alleles]

This is also known as the **Law of Purity of Gametes.**

Law of Independent Assortment :- This law states that – when individuals differing in 2 or more than 2 pairs of contrasting characters are crossed, the inheritance of any one pair is not affected by the presence of the other. **e.g.** The inheritance of tall character is not way related to the smooth character of the seed. Rather, the 2 characters are inherited independent of each other.

REVIEW QUESTION

GIVE ANSWER OF FOLLOWING QUESTIONS

1. Give definition of heredity.
2. What do you mean by variations ?
3. Where genes present in organisms ?
4. Differentiate between Autosomes & sex chromosomes.
5. Explain the terms genotype & phenotype.
6. Differentiate between monohybrid cross & Dihybrid cross.
7. Give definition of hybridization .
8. What do you mean by pure – breeding ?
9. Differentiate character and trait.
10. Give definition of Allele.

FILL IN THE BLANKS

1. Father of genetics is known as…………………
2. The term genetics was coined by ……………………
3. A cross in which a single pair of contrasting characters is studied at a time is called ……………………
4. A condition in which the 2 members of an allelic pair are similar is called…………………..
5. Cross between two individuals having stalest one different character is called…………………
6. External appearance of an organism for a particular character is called……………………
7. The gene which expresses himself in the presence of another or in heterozygous condition is called………
8. An unit of heredity which is responsible for a character is called……………………

DEOXYRIBONUCLEIC ACID (DNA)

The expanded from of DNA is deoxyribonucleic acid. It was first isolated by the scientist **Frederick Miescher** from the nucleus of the pus cells in 1869. He named it as **'Nuclein'** or nucleic acid because of its acidic nature. Later, it was experimentally proved by the scientists **Griffith (1928), Avery, McLeod and McCarty (1944)** that DNA is the carrier of the genetic information from generation to generation. It transmits the hereditary characters in a coded language from parents to off springs (i.e., from one generation to another).

DNA is a macromolecule or polymer. It is made of very large number of 'nucleotide' units and hence is termed **polynucleotide.**

Each nucleotide unit in a DNA molecule is made up of three components

1. **Deoxyribose sugar :-** It is a pentose sugar.

2. **Nitrogenous base :-** Each nucleotide unit has a nitrogen containing base. In a DNA molecule, nitrogenous bases are of two types :

(a) **Purines :-** The purines in a DNA molecule are **– Adenine (A) and Guanine (G).**

(b) **Pyrimidine :-** The pyrimidine in a DNA molecule are **– Cytosine (C) and Thymine (T).**

3. **Phosphate group :-** The phosphate group contains one phosphorus atom and four specifically linked oxygen atoms. Thus, there are four types of nucleotides in a DNA molecule depending upon the kind of nitrogenous base resent in **each** nucleotide.

Double Helical Model of DNA

J.D. Watson and **F.H.C. Crick** proposed the double helical model **of DNA** in **1953.** They were awarded the **Nobel Prize** for this discovery in **1962.** the important features of the double helical model are

(i) DNA molecule is made up of two **long polynucleotide strands** forming a **double helical structure (double helix)** just like a spiral staircase. Each helical turn of the DNA molecule is **3.4 nm** in length in which **ten nucleotide** base pairs are present.

(ii) **Deoxyribose sugar and phosphate molecules** are joined alternately to form the backbone of each polynucleotide strand. The **nitrogenous base** of each nucleotide is attached to the sugar molecule and projected towards are interior of the double helix.

(iii) In the interior of double helix, the nitrogenous base of two polynucleotide strands from a pair with the help of hydrogen bonds. **Adenine (A)** always pairs with **thymine (T) and guanine (G) always** pairs with **cytosine (C).**

Thus, the two polynucleotide strands of the DNA molecule are joined by hydrogen bonds between specific nitrogenous bases. **Such a specific of the bases of the opposite strands of the DNA molecule is called complementary pairing. Adenine (A) and thymine (T) are complementary to each other. Similarly, guanine (G) and cytosine (C) are complementary to each other.** The hydrogen bonding between the specific nitrogenous bases keeps the two strands to hold together. Therefore, all the base pairs remain stacked between the two strands.

BLOOD GROUP

Four different types of blood groups in human beings are : A, B, O, AB

O $\rightarrow$ universal donor

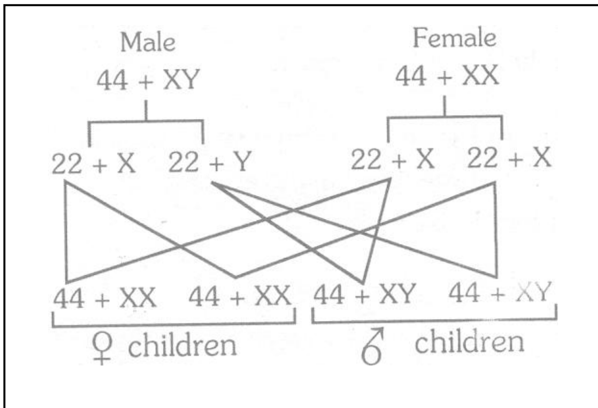
AB $\rightarrow$ universal recipient

Blood group	Genotype	Dominant	Recessive	Antigen	Antibody
A	I^AI^A I^AI^O	I^A	I^O	A	B
B	I^BI^B I^BI^O	I^B	I^O	B	A
AB	I^AI^B	I^A, I^B	-	A, B	-
O	I^OI^O	-	I^O	-	AB

SEX DETERMINATION

How is the sex of newborn individual determined? In human beings, the sex of the individual is largely genetically determined. In other words, the genes inherited from our parents have assumed that similar gene sets are inherited from both parents. If that is the case, how can genetic inheritance determine sex ?

All human beings these are 23 pairs of chromosomes are present out of these 23 pairs, are autosomes (similar in males and females) and 1 pair is called sex chromosome (different in males and females). In males sex chromosome are XY and in females' sex chromosome are XX.



So, it is clear from the above that male is responsible for producing male child.

POINTS TO REMEMBER

- The term Genetics comes from "gene" word – means "to grow".
- The term "Genetics" coined by **Bateson.**
- Study of heredity and variations is called **Genetics.**
- Father of Genetics – **Gregor Johann Mendel.**
- Father of Modern Genetics **– Bateson.**
- Father of Experimental Genetics – **Thomas Hunt Morgan.**
- "Heredity" term coined by **Spencer.**
- Bateson coined terms Genetics, Allele, Homozygous, Heterozygous, F_1 and F_2 Generation.

EXERCISE # 1 FOR SCHOOL / BOARD EXAM.

VERY SHORT ANSWER TYPE QUESTION

1. What is a gene ?
2. Write the scientific term used for 'science of heredity and variation'.
3. Define inheritance.
4. What term did Mendel use for what we now call the genes ?
5. How does the creation of variations in a species promote survival ?
6. Name the plant on which Mendel performed his experiments.
7. Define Variation.
8. What are the carriers of factors or genes ?
9. Name two human traits which show variation.
10. Write down five inherited 'characters' or traits.
11. Which of the following combinations of sex chromosomes produces a male child, XX or XY ?
12. Which type of sex chromosomes are carried by male gametes – sperms in human male ? What is their percentage ?
13. What experiment would we do to confirm that the F_2 generation did in fact have a 1 : 2 : 1 ratio of TT, Tt and tt trait combinations ?

SHORT ANSWER TYPE QUESTIONS

1. Why did Mendel choose pea plants for his experiment ?
2. What is Mendel's genetics ?
3. If a train A exists in 10% of a population of an asexually reproducing species and trait B exists in 60% of the same population, which trait is likely to have arisen earlier ?
4. A Mendelian experiment consists in breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them are short. This suggests that the genetic makeup of the tall parent can be depicted as :-

   (i) TTWW (ii) TTww (iii) TtWW (iv) TtWw
5. Explain the mechanism of the determination in human beings.
6. Define genetics. What is the contribution of Mendel in this branch of Biology ?
7. Why are asexually reproducing organisms capable of showing the hereditary features more ?
8. With suitable example highlight how temperature has an effect on sex determination in the animal world.
9. Explain with an example how trait is inherited in human beings.
10. Why are traits acquired during the life-time of an individual not inherited ?

11. How does the creation of variations in a species ensure survival ?

12. A man with blood group A marries a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits – blood group A or O – is dominant ? Why or why not ?

13. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics ?

14. Draw a schematic diagram to explain the independent inheritance of two separate traits, shape and colour of seeds.

15. How do Mendel's experiments show that traits are inherited independently ?

LONG ANSWER TYPE QUESTIONS

1. Explain diagrammatically a Mendel's Dihybrid cross.

2. Briefly explain contributions of Mendel in Genetics.

FILL IN THE BLANKS

1. The transmission of characters from the parents to their off springs is called.........................

2. The differences in the characters [or traits] among the individuals of a species are called........................

3. A recognizable feature of human beings for any other organisms are called..........................

4. Various forms of a character are called..........................

5. A cross in which a single pair of contrasting characters is studied at a time, called......................

6. A cross involving two pairs of contrasting characters is called...............................

7. The gene which decided the appearance of an organism even in the presence of an alternative gene is called ....

8. The gene which can decide the appearance of an organism only in the presence of another identical gene is called......................

9. Unit of heredity which transfers characters from parents to their off springs during reproduction is called ....

10. The genetic constitution of an organism is called..........................

ANSWERS KEY FOR SCHOOL / BOARD EXAMS.

FILL IN THE BLANKS

1. Heredity	**2.** Variations.	**3.** Character	**4.** Traits	**5.** Monohybrid cross
6. Dihybrid cross	**7.** Dominant	**8.** Recessive Gene	**9.** Genes	**10.** Genotype

1. Genetics is the branch of science which deals with the study of :-

(A) cell function (B) cell structure

(C) heredity and variation (D) relation between plant and environment

2. The term 'genetics' was coined by :-

(A) William Bateson (B) Gregor Mendel (C) Thomas hunt Morgan (D) W. Johannsen

3. The term 'gene' was introduced by :-

(A) Mendel (B) Bateson (C) Morgan (D) Johannsen

4. When a gene exists in more than one form, the different forms are termed :-

(A) alleles (B) heterozygotes (C) genotypes (D) complementary genes

5. The contrasting pairs of factors in Mendelian crosses are called :-

(A) alloloci (B) paramorphs (C) allelomorphs (D) multiple alleles

6. Alleles of a gene are found on :-

(A) same chromosome (B) any chromosomes

(C) homologous (D) nonhomolgous chromosomes

7. Which statement about alleles is not true :-

(A) There may be several at a locus (B) One may be dominant over another

(C) They may show incomplete dominance (D) They occupy different loci on the same chromosome

8. An organism which receives identical alleles of a particular gene from both parents is :-

(A) homozygote (B) hemizygote (C) homothallic (D) heterozygote

9. The genetic complement of an organism is known as :-

(A) genotype (B) physiotype (C) phenotype (D) morphotype

10. The physical appearance of an individual is known as :-

(A) heterotype (B) genotype (C) morphotype (D) phenotype

11. The terms 'genotype' and 'phenotype' were introduced by :-

(A) Bateson (B) Darwin (C) Johannsen (D) Mendel

12. What was Mendel's most important contribution to the modern understanding of biology:-

(A) The concept of meiosis (B) The concept of chromosome

(C) The concept the genes are ordered along chromosomes

(D) The concept that hereditary information comes in discrete units

13. Gregor Mendel was born in :-

(A) Austria (B) Russia (C) Czechoslovakia (D) United Kingdom

14. Mendelism is related with :-

(A) Heredity in living beings (B) Meiosis during sexual reproduction

(C) Mutations in living organisms (D) None of the above

15. Mendel published the results of his experiments in the year :-

(A) 1568 (B) 1773

(C) 1866 (D) 1921

16. In 1900 AD, three biologists independently rediscovered Mendel's principles. They were :-

(A) Sutton , Morgan and Bridges

(B) Bateson, Punnett and Bridges

(C) Avery, MacLeod and McCarty

(D) Hugo deVries, Corens and Tschermak

17. How many contrasting traits of pea were studied by Mendel:-

(A) Two (B) Four

(C) Seven (D) Three

18. Which one of the following traits of garden pea studied by Mendel was a recessive feature ?

(A) Green seed colour (B) Green pod colour

(C) Round seed shape (D) Axial flower position

19. Which of the following contributed to the success of Mendel :-

(A) His knowledge of biology

(B) Qualitative analysis of data

(C) Observation of distinct inherited traits

(D) consideration of one character at a time

20. The reason why pea plants were suitable than dogs for Mendel's experiments :-

(A) Dogs have many genetic traits

(B) Pea plants can be self fertilized

(C) There are no pedigree records of dogs

(D) The pea plans favor cross-fertilization

21. Mendel chose pea plants because they :-

(A) were cheap

(B) were easily available

(C) have great economic importance

(D) were having contrasting characters

22. Selection of homozygous plant is :-

(A) mass selection (B) pure line selection

(C) mixed selection (D) none of the above

23. When a cross is made between tow parents with respect to a single character, it is called :-

(A) Dihybrid (B) monohybrid

(C) Trihybrid (D) none of these

24. Which of the following is the monohybrid ratio :-

(A) 3 : 1 (B) 9 : 7

(C) 1 : 2 (D) 9 : 3 : 3 : 1

25. Mendel formulated the law of purity of gametes on the basis of :-

(A) test cross (B) Dihybrid cross

(C) back cross (D) monohybrid cross

26. How many types of gametes will be produced in F_2 generation of a monohybrid cross of Mendel :-

(A) 3 (B) 4 (C) 8 (D) 16

27. Recessive gene can express only in :-

(A) homozygous condition (B) heterozygous condition

(C) both above conditions (D) none of these conditions

28. Considering tallness and dwarfness , tallness is more wide spread among pea plants because :-

(A) Tallness is dominant over dwarfness

(B) Tallness is determined by one gene having many effects

(C) Tallness is determined by many genes having multiple effects

(D) None of these

29. A red-flowered pea plant was crossed with white-flowered plant. In F_1 generation all plants were red. It confirms that white colour is :-

(A) Recessive character (B) Dominant character

(C) non-genetic expression (D) none of the above

30. A woman with straight hair mates with a man with curly hair who is known to be heterozygous for that trait. What is the chance that their first child will have curly hair :-

(A) No chance (B) One in two (C) It is certain (D) One in four

ANSWER KEY FOR SCHOOL / BOARD EXAMS.

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	A	D	A	C	C	D	A	A	D	C	D	A	A	C
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	D	C	A	D	B	D	B	B	A	D	B	A	A	A	B

1. The main reason of Mendel's success in discovering the principles of inheritance was :-

(A) He considered each character separately (B) He was lucky not to encounter linkage problem

(C) The plant was each pure breeding (D) All the above

2. Mendel was lucky in the choice of the material of his experiments, among the following, which contributed, to his success ?

(A) He observed distinct inherited traits (B) He qualitatively analyzed his date

(C) He liked pea plants (D) He considered only one character at one time

3. The year 1990 AD is highly significant for genetics due to :-

(A) Principle of linkage (B) Chromosome theory of heredity

(C) Rediscovery of Mendelism (D) Discovery of genes

4. Genotype means :-

(A) Genetic composition of the individual (B) Genetic composition of the germ cell

(C) Genetic composition of plastids (D) Genetic composition of an organ

5. An organism with two identical alleles of a gene is a cell is called :-

(A) Homozygous (B) Dominant (C) Heterozygous (D) Hybrid

6. When an individual is having both the alleles of contrasting characters it is said to be :-

(A) Heterozygous (B) Dioecious

(C) Monoecious (D) Linked genes

7. When an allele fails to express itself in F_1 generation in the presence of other allele, the former is said to be :-

(A) Recessive (B) Co dominant

(C) Complementary (D) Epistatic

8. If a plant is heterozygous for tallness, the F_2 generation has both tall and dwarf plants. This proves the principle of :-

(A) dominance (B) segregation

(C) independent assortment (D) incomplete dominance

9. Mendel crossed a pure white flowered recessive pea plant with a dominant pure red flowered plant. The first generation of hybrids from the cross should show :-

(A) 50% white flowers and 50% red flowers (B) all red flowered plants

(C) 75% red flowered and 25% red flowered plants (D) all white flowered plants

10. If a couple has three daughters, what are the chances that the fourth child will be a son ?

(A) 100% (B) 75% (C) 50% (D) 0%

11. If a heterozygous tall plant is crossed with a homozygous dwarf plant, the proportion of dwarf progeny will :-

(A) 50% (B) 75% (C) 100% (D) 25%

12. The crossing of a homozygous tall plant with a dwarf would yield plants in the ratio of :-

(A) two tall and two dwarf

(B) one homozygous tall, one homozygous dwarf and two heterozygous tall

(C) all homozygous dwarf

(D) all homozygous tall

13. When a true breeding tall plant is crossed with a true breeding short plant and the F_1 produced is self pollinated to produce F_2 ratio of true breeding tall and true breeding short plant in F_2 will be :-

(A) 1 : 2 (B) 1 : 1

(C) 2 : 1 (D) 1 : 3

14. Blue eye colour in human is recessive to brown eye colour . The expected children of a marriage between blue-eyed woman and brown-eyed male who had a blue-eyed mother are likely to be :-

(A) all blue-eyed (B) three blue-eyed and one brown-eyed

(C) all brown-eyed (D) one blue-eyed and one brown-eyed

15. Allosomes are :-

(A) bead like structures (B) on chromosomes

(C) sex chromosomes (D) rounded bodies

16. Mutation is :-

(A) a change that is inherited

(B) a change, which affects the parents only but never inherited

(C) a change, which affects the offspring of F_2 generation only

(D) a factor responsible for plant growth

17. The plant that was made popular by "DeVries mutation theory" :-

(A) Triticum vulgare (B) Oenothera lamarckinana

(C) Pisum sativum (D) Primula vulgaris

18. "Barr body" is derived from :-

(A) Autosomes in males (B) Autosomes in females

(C) X-chromosome in female (D) X-chromosome in males

19. The **DNA** is the genetic material was proved conclusively by :-

(A) J D Watson (B) Hershey and Chase

(C) Alfred Griffith (D) Boveri and Sutton

20. Nobel Prize for "one gene one enzyme theory' was given to :-

(A) Beadle and Tatum (B) Schleiden and Schwann

(C) Watson and Crick (D) H Harris

21. Retrovirus has the following as its genetic material :-

(A) single stranded DNA (B) double stranded duplex DNA

(C) DNA-RNA hybrid (D) RNA

22. Of the following , which sequence is present in Rous Sarcoma Virus ?

(A) DNA $\rightarrow$ RNA $\rightarrow$ proteins (B) DNA $\rightarrow$ DNA $\rightarrow$ proteins

(C) RNA $\rightarrow$ DNA $\rightarrow$ proteins (D) RNA $\rightarrow$ DNA $\rightarrow$ RNA $\rightarrow$ proteins

23. The term genome is used for :-

(A) diploid set of chromosomes (B) polyploidy set of chromosomes

(C) triploid set of chromosomes (D) haploid set of chromosomes

24. The first successfully cloned mammal that gained world-wide publicity was :-

(A) Molly, a sheep (B) Polly, a sheep (C) Chance ; a bull (D) Dolly, a sheep

25. The transgenic animals are those that have :-

(A) foreign DNA in some of its cells (B) foreign DNA in all its cells

(C) foreign RNA in all its cells (D) both (A) and (C)

ANSWERS KEY FOR COMPETITIVE EXAMS

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	D	C	A	A	A	A	B	B	C	A	B	b	D	C
Que.	16	17	18	19	20	21	22	23	24	25					
Ans.	A	B	C	B	A	D	D	D	D	B					

HOW DO ORGANISMS REPRODUCE ?

INTRODUCTION

Reproduction is a process by which living organisms produce new individuals of their own kind and maintain their existence generation after generation.

Reproduction is not essential to maintain the life of an organism but it is essential to maintain life on earth and perpetuation of species from one generation to another.

Reproduction at its basic level (cellular reproduction) is involved in making similar or dissimilar body designs through the genetic material (DNA) present in the chromosomes of its nucleus.

DNA is the source of information for making proteins. Any change in the information leads to production of different proteins, which ultimately lead to altered body designs.

Basic event in reproduction is production of DNA copies in a reproducing cell the process is called DNA replication. When the cell divides into two, each cell gets a copy of each DNA of chromosome along with the whole cellular apparatus.

Complete accuracy in DNA copying leads to exactly identical cells but any error in duplication can lead to dissimilar cells or variations.

The inbuilt tendency for variations during reproduction form the basis for evolution.

Variations during reproduction enable the population of a species to get adapted easily to a particular inhabiting place/niche. Hence, reproduction is linked to the stability of populations of species.

Stronger variations are useful for the survival of species over time and enable the organisms to tide over any drastic alterations in their habitats.

IMPORTANCE OF REPRODUCTION

(i) **Maintenance of the existence :-** Organisms are maintaining the existence on the earth since their origin, million years ago only because of reproduction.

(ii) **Preservation of species :-** Species are preserved because of reproduction. It is possible because reproducing organisms produce new individuals which are very similar to themselves.

(iii) **Role in evolution :-** Some variations are produced in the new organisms during reproduction which play in important role in evolution.

TYPE OF REPRODUCTION

There are two main methods of reproduction in living organisms.
(1) Asexual reproduction.
(2) Sexual reproduction.

(1) Asexual Reproduction :

Production of offsprings by a single parent without the formation and fusion of gametes is called **asexual reproduction.**

It is a primitive type of reproduction in which **offspring** is produced by a cell or any vegetative organ of an organism.

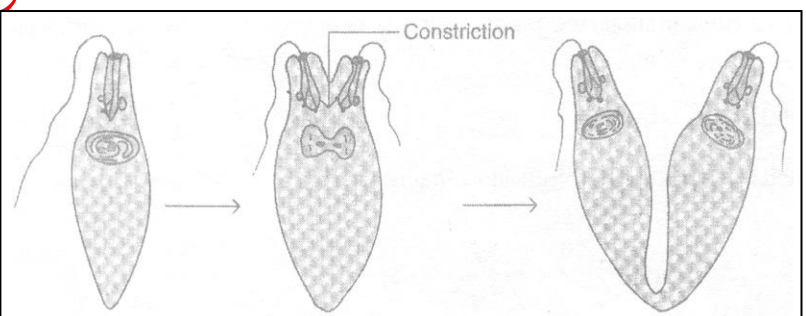
In this type of reproduction **offsprings** are generically identical to their parents.

- Asexual reproduction
  - Vegetative propagation
    - Natural
      - Tissue culture (Orchids)
      - Layering (Jasmine)
      - Grafting (Mango)
      - Cutting (Rose)
    - Artificial
      - Stem (Grasses)
      - Leaf (Bryophyllum)
      - Root (Sweet potato)
  - Regeneration e.g. Hydra. Planaria
  - Fragmentation e.g. Spirogyra
  - Spore formation e.g. Rhizopus
  - Budding e.g. Hydra, Yeast
  - Fission
    - Binary fission e.g. – Amoeba, Euglena, Paramecium
    - Multiple fission e.g. – Plasmodium – (Malarial parasite)

Modes of asexual reproduction are fission, budding, spore formation, fragmentation, regenerations and vegetative propagation.

(i) Fission. It is a kind of asexual reproduction in unicellular organisms to create two new individuals. It can be of two type :

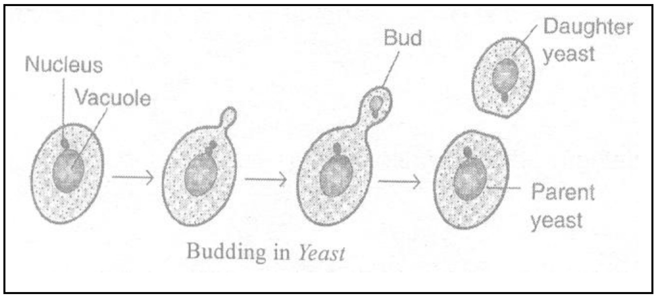
(a) Binary fission : One cell splits into two equal helve, e.g., many bacteria and protozoa like Amoeba, Paramecium and Leishmania.



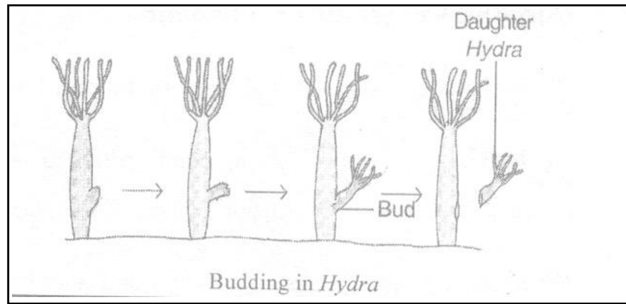
Binary fission in *Euglena*

(b) Multiple fission. One cell divides into many daughter cells simultaneously, e.g., Plasmodium (malarial parasite), Amoeba in unfavorable conditions.

(ii) Budding : Process in which an outgrowth (bud) is formed on the body of parent organism which then detaches and become a new organism. **e.g. Yeast** and Hydra.



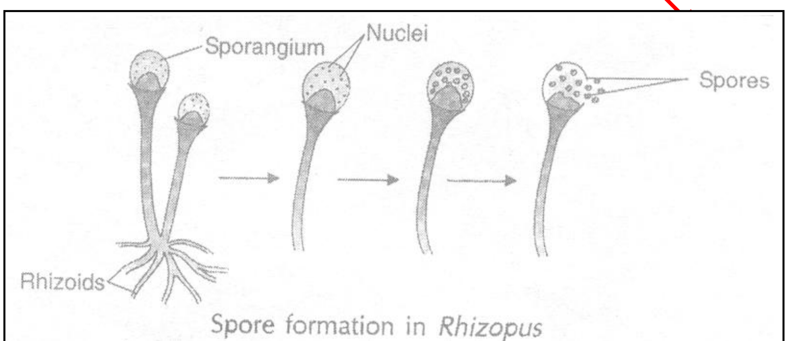
Budding in *Yeast*



Budding in *Hydra*

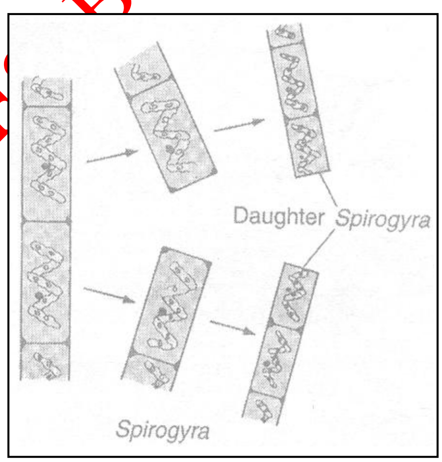
(ii) Spore formation : Spore are the microscopic asexual reproductive bodies with a thick wall. Spores are forded in **'sporangium'.**

Each spore on germination give rise to a new organism e.g.. **Rhizopus, Penicillium.**



Spore formation in *Rhizopus*

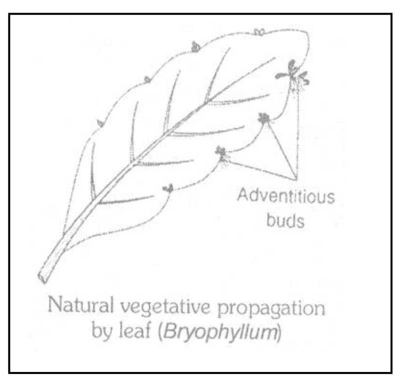
(iv) Fragmentation: In this process an organism breaks up into two or more fragments and each fragment develops into an adult organism. e.g. **Spirogyra.**



Spirogyra

(v) Regeneration : The process of getting back a full organism from the body parts of the present individual is called **regeneration,** Regeneration in carried out by specialized cells. e.g. Hydra, Planaria.

(vi) Vegetative Propagation : This is an asexual method of reproduction in plants where vegetative parts namely root, stem and leaves give rise to new plants.



Natural vegetative propagation by leaf (*Bryophyllum*)

Vegetative propagation is of two types :

(A) Natural vegetative propagation

(B) Artificial vegetative propagation.

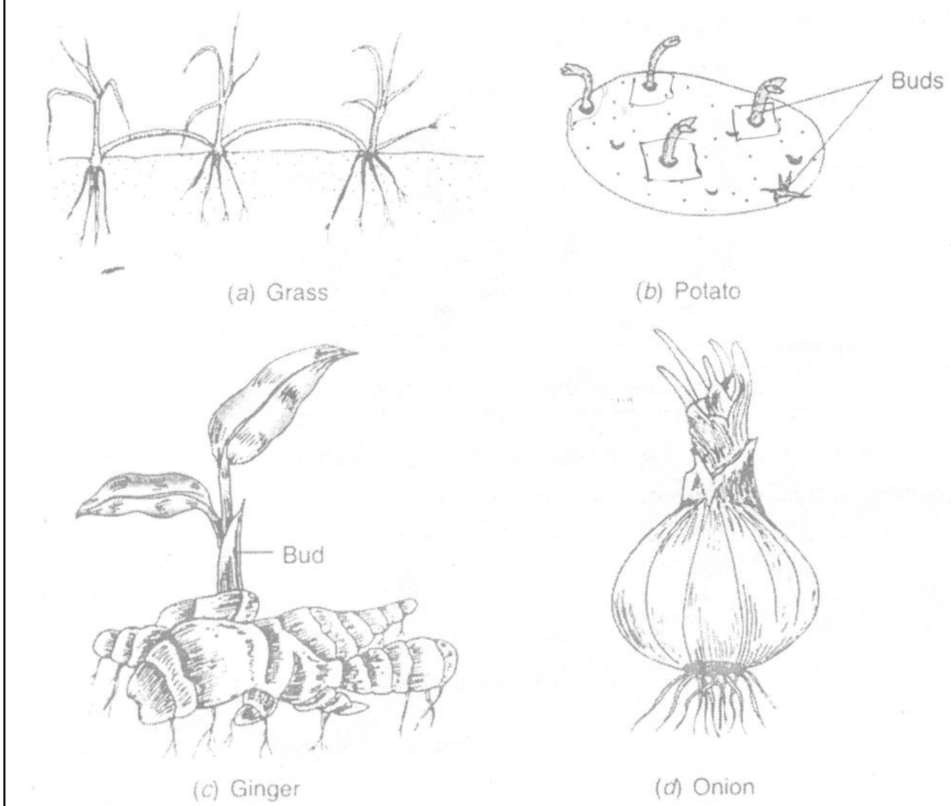
(A) Natural vegetative propagation :

Plant reproduce without the help of human being .

By leaves : Leaves of some points produce adventitious buds on their margin. Thus bubs develop into new plants e.g. Bryophyllum, Kalanchoe.

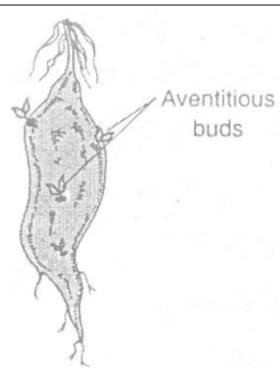
By stem : In many plant, underground stems produce aerial shoots annually under favorable conditions

e.g. Potato, Zinger, Onion, Grass.



Natural vegetative propagation by stems

● **By roots :** Roots produce adventitious buds which develops into new plants. e.g sweet potato .



Natural vegetative propagation by root (sweet potato)

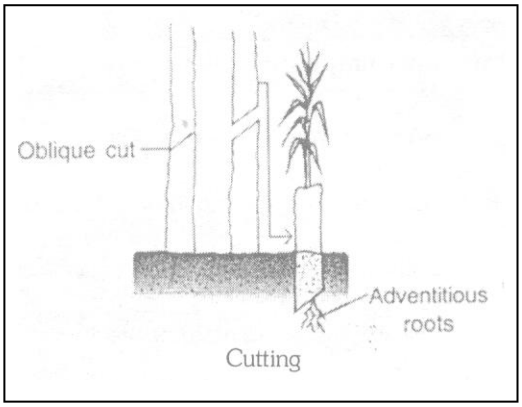
(B) Artificial vegetative propagation :

To prepare plants with desirable characters.

These are of four types.

(i) Cutting :

In this method small part of plant is cut and buried partly in the moist soil then cutting develops roots and grows into a new plant. e.g. Rose, Sugarcane, Potato, Cactus.



Cutting

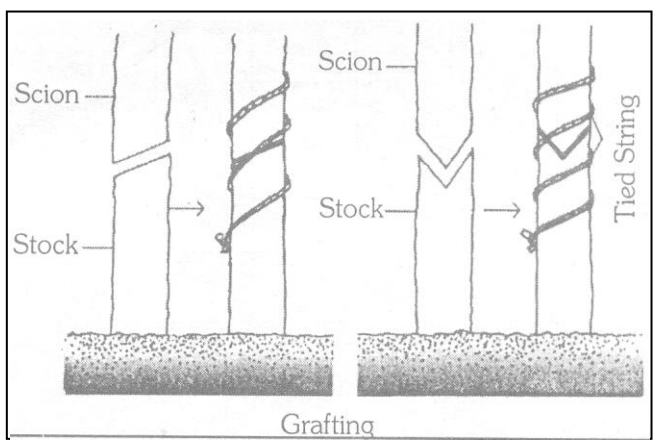
(ii) Grafting :

Two plants of closely related varieties are joined together so that they live as one plant .

The plant of which roots remain in the soil is called as **stock.**

Cutting part of a plant that is grafted on the other rooted plant is called **scion.**

e.g. Mango , Apple, Lemon.



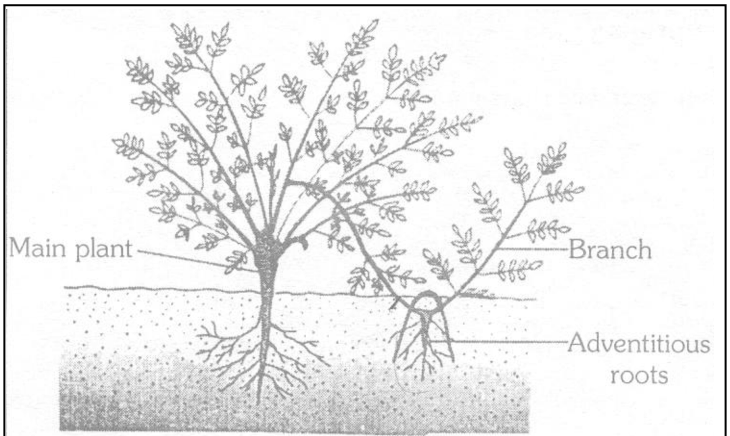
Grafting

(iii) Layering :

In this method a branch of the parent plant is buried in the soil.

The portion of the branch which is contact with the soil produces roots and this rooted branch is called **layer.**

Layer is then detached from the parent plant and act as a new plant . **e.g.** Jasmine, Hibiscus.



Vegetative propagation by layering

(iv) Tissue culture or microproagation :

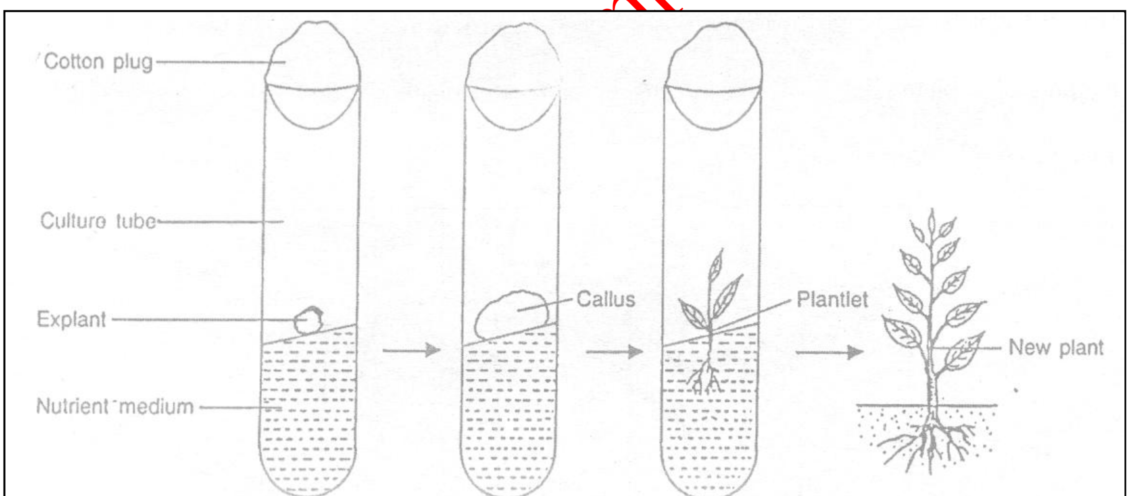
Cells or tissue which is isolated from the growing tip of plant called **explant.**

The explant develops into undifferentiated mass of cells called **callus** in the proper medium.

The callus is transferred to another medium containing hormones for growth and differentiation, that forms **plantlet.**

The plantlets are transplanted into pot or soil to form mature plant.

This technique is known as micro propagation. **e.g.** Orchids, Chrysanthemum.



Artificial vegetative propagation by tissue culture

ADVANTAGES OF VEGETATIVE PROPAGATION

It is a rapid, cheap and easy method of reproduction for the multiplication of plants.

Disease free plants can be produced.

Superior quality fruits or flowers can be produced by grafting.

Genetically identical plants are produced.

Plants raised by vegetative propagation can bear flowers and fruits than those produce from seeds.

Do you know ?

In fission the organism have lost their parental identity while in budding they have maintained their identity.

Grafting is not possible in monocot plants.

Cambium activity is essential for the union of stock and scion.

Tissue culture is also called micro-propagation because a large number of plants are formed from a small tissue.

Virus free plants are produced by micro propagation.

REVIEW QUESTIONS

1. What is meant by reproduction ?

2. What are two general methods of reproduction in organisms ?

3. Give two examples of organisms which reproduce by budding.

4. What is meant by vegetative propagation ?

5. What are the advantages of vegetative propagation ?

6. What is grafting ? Mention any two advantages of grafting.

7. In which part of Bryophyllum vegetative propagation takes place ?

8. What is micropropagation? Explain the process of micro propagation in Vitro.

(2) Sexual reproduction :-

It is a type of reproduction in which two different sexes (male and female) are involved. It involves the fusion of gametes from two different parents and results in the formation of new organism, which s genetically different from the parent.

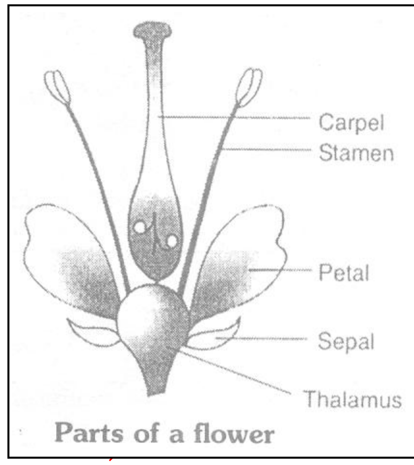
Differences between asexual and sexual reproduction

S.No.	Features	Asexual	Sexual reproduction
1	Number of parents in involved	One	Two
2	Resemblance with parents	Organisms produced resemble exactly with the parent.	Organisms do not resemble exactly with the parent but resemble in certain features with both the parents.
3	Type of cell divisions	Amitotic / mitotic.	Mitotic and meiotic both are present.
4	Time duration for multiplication	Takes less time.	Takes more time.
5	Variations	Variations are absent.	Variations are present.
6	Adaptability	Organisms produced have less adaptability	Organisms produced have more adaptability
7	Examples	Fission, budding, vegetative propagation.	Human beings, higher plants.

SEXUAL REPRODUCTION IN FLOWERING PLANTS

Sexual reproduction takes place through the agency of flowers in angiosperms (flowering plants).

Flower is a specialized condensed reproductive shoot of flowering plants on which the essential reproductive parts are inserted.



Parts of a flower

A typical flower has four whorls arranged on the **thalamus.**

1. Calyx
2. Corolla

} Non essential organs

3. Androceium
4. Gynoceium

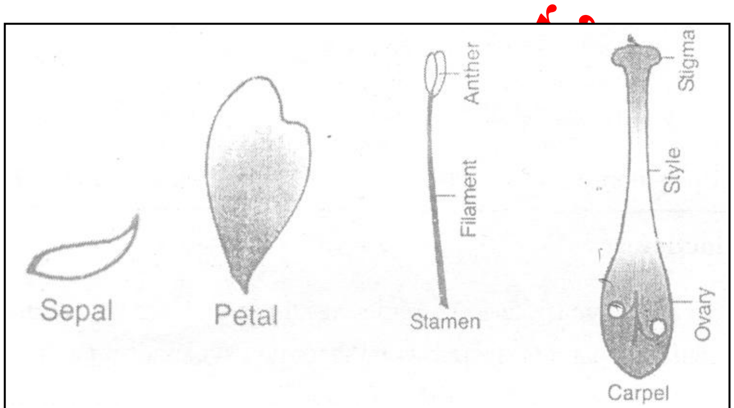
} Essential organs

1. CALYX

It is the outermost whorl consisting of **sepals.**

Sepals are green and leaf like structure.

Calyx protect the flower bud before it opens.



2. COROLLA

It is the second whorl, inner to calyx, consisting of **petals.**

Petals are generally large, colored and showy.

Corolla attract insects for pollination.

3. ANDROECIUM

It is the third whorl, inner to corolla, consisting of male reproductive parts called **stamens.**

Each stamen has two parts – Filament and anther.

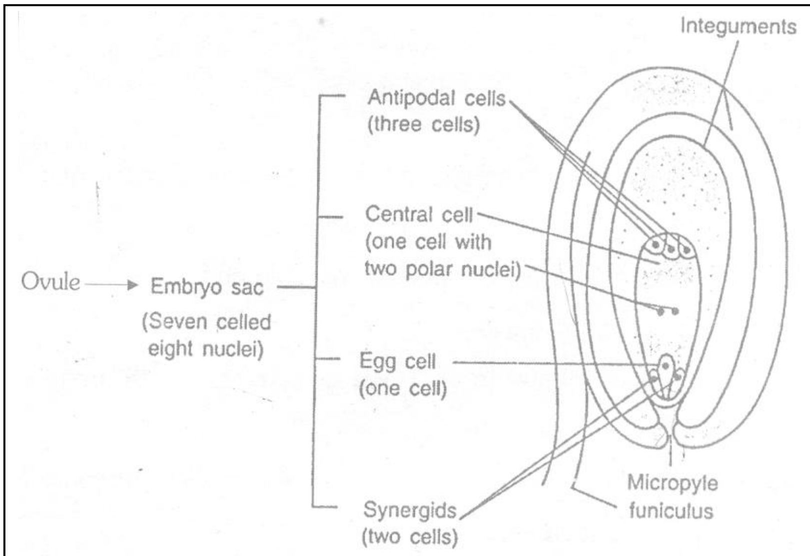
Anther is lobed structure present at the tip of filament. Each anther has pollen sacs (microsporangia) which contain pollen grains (microspores).

Each pollen grain produces two male gametes / male germ cells.

4. GYNOECIUM

It is the fourth and innermost whorl consisting of **carpels.**

Carpel is present in the centre of flower.
Each carpel has three parts – Ovary, Style and Stigma.
Ovary is a swollen basal part of carpel. It contains ovules which are attached to placenta.
Each ovule contain an embryo sac that bears a haploid egg (female gamete).
Style is the middle part of the carpel. It has stigma above it and ovary below it.
Stigma is the apical part of carpel. It receives pollen grains.



L.S. of Ovule

Do you know ?

Perianth :- If both sepals and petals are colored and can not be distinguished from each other, then their whorl is known as **perianth**.

Calyx and corolla are non essential parts of the flower because they are not directly involved in reproduction.

Bisexual flower :- When the male and female reproductive parts are present in the same flower are called bisexual flower e.g. **Hibiscus,** Mustard.

Unisexual flower :- When the male and female reproduction parts are present in different flowers.
e.g. : Papaya, Date palm, Mulberry, Gourd, Water melon.

POLLINATION

Process in which pollen grain are transferred from the ripe anther to the stigma. It is of two types :

(i) Self pollination : It is the transfer of pollen grains from an anther to the stigma of the same plant. If it is in the same flower it is called **Autogamy** (e.g. **Pea**) and if it is between flower of the some plant then it is called **Geitonogamy** (e.g. **Oxalis**) .

(ii) Cross pollination :- It is the transfer of pollen grains from anther to the stigma of different plants of the same species (e.g. Mango).

Agencies of pollination :- Transfer of pollen from one flower to another is achieved by agents like wind, water, animals, insects and birds.

Agencies of pollination

Biotic agencies → Bats (Chiropterophily), Birds (Ornithophily), Insect (Entomophily)

Abiotic agencies → Water (Hydrophily), Wind (Anemophily)

Significance of bright colour of flower :- The bright colour of flowers is meant to attract insects which help in pollination. White colour shine in dark which attracts insects at night. Similarly, bright colour day-blooming flowers attract insects.

FERTILIZATION

Fertilization is the process of fusion of the male and female gametes, which takes place in the **embryo sac** present in the ovule.

After pollination, pollen grains germinate on the stigma by producing pollen tube.

The nucleus in the pollen tube divides into two male gametes.

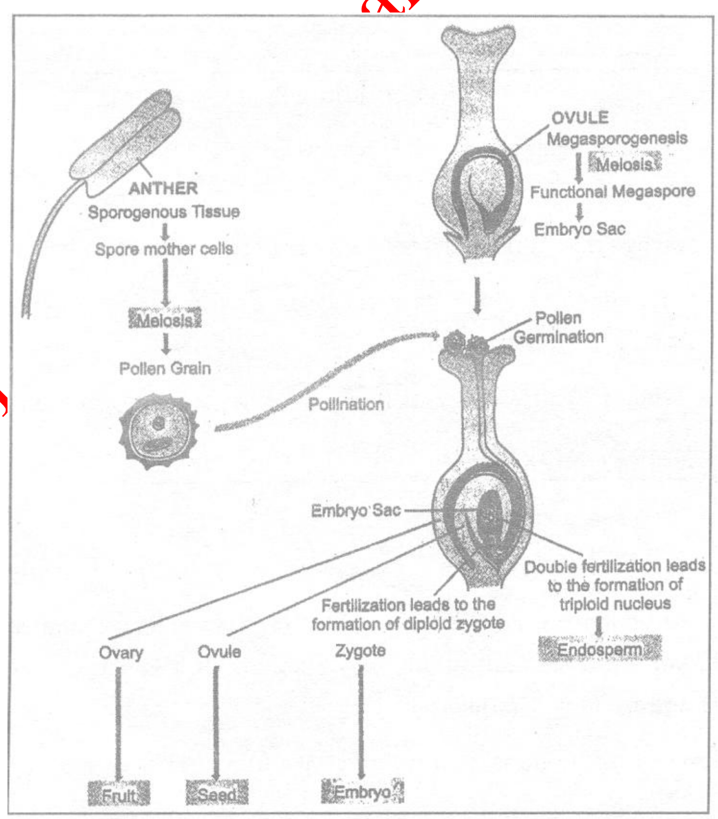
Pollen tube penetrates the stigma and passes through the style and enters the ovule through micropyle. It releases two male gametes in embryo sac.

One male gamete fuses with egg cell and second male gamete fuses with the two polar nuclei.

One male gamete + Egg cell $\xrightarrow{Syngamy}$ Zygote.

Second male gamete + Two polar nuclei $\xrightarrow{Triple\ \ fusion}$ Triploid nucleus (Primary Endosperm Nucleus)

Syngamy + Triple fusion = Double fertilization .



Do you known ?

POST FERTILIZATION CHANGES IN THE FLOWER

Sepals, petals and stamen withers off.

Style and stigma degenerates.

Ovary develops into fruit.

Ovule grows into seed.

The seed contains the future plant or embryo which develops into a seedling under appropriate conditions.

Ovule
- → Antipodal cells and Synergids become degenerate.
- → Triploid nucleus → Endosperm
- → Fertilize egg → Embryo
- → Integuments → Seed coat
- → Funiculus → Stalk of the seed

Endosperm: may be consumed by embryo

Endosperm, Embryo, Seed coat, Stalk of the seed — Seed

Endospermic seed : If endosperm is not consumed.

Non endospermic seed: Endosperm may be consumed.

REVIEW QUESTIONS

1. **Name the various parts of flower.**
2. **Write the name of non essential part of flowers.**
3. **Write the name of parts of stamen and carpel.**
4. **Name the swallow part of carpel.**
5. **Describe the unisexual and bisexual flower.**
6. **Fertilization takes place in which part of ovule.**

OBJECTIVE QUESTIONS

1. Vegetative propagation is *Bryophyllum* takes place by :-
(A) stem (B) leaf (C) root (D) none of these

2. The group of petals is called :-
(A) sepals (B) calyx (C) root (D) None of these

3. During grafting, the portion of plant that is grafted is called :-
(A) stock (B) scion (C) stalk (D) stem

4. In roses, the method commonly used to produce new plants is :-
(A) tissue (B) cutting (C) layering (D) None of these

5. Pollen grains are produced by :-
(A) ovary (B) anther (C) stigma (D) petal

6. Which one is applicable to insect pollinated flowers :-
(A) Flowers are very small produced in large quantities.
(B) Flowers are not prominent and without nectar.
(C) Flowers are conspicuous and scented having nectar.
(D) None of these

7. The group of sepals is called :-
(A) gynoceium (B) calyx (C) corolla (D) androceium

8. Maize is :-
(A) self pollinated (B) cross pollinated by rain
(C) cross pollinated by insects (D) cross pollinated by wind

9. Which of the following produces male gametes in a flower :-
(A) sepals (B) petals (C) carpels (D) stamens

10. During pollination, pollen grains get carried to which part of the carpel ?
(A) Ovary (B) Stigma (C) Ovule (D) Style

11. At the time of entering into ovule, pollen tube has :-
(A) three male nuclei (B) two meal nuclei (C) one gamete nucleus (D) four male gametes

12. The transfer of pollen grains from anther to stigma is termed :-
(A) ovulation (B) double fertilization (C) pollination (D) fertilization

13. Fertilization in plants occurs in the :-
(A) embryo sac (B) style (C) pollen tube (D) stigma

14. Stem cutting are commonly used for propagation in :-
(A) mango (B) jasmine (C) cotton (D) sugarcane

15. Vegetative reproduction in plants like citrus, jasmine and grapevine is done by the process of :-
(A) stem layering (B) stem cutting (C) stem grafting (D) none of these

16. Asexual reproduction are :-
(A) Fission (B) Budding
(C) Vegetative propagation (D) All of these

17. Binary fission occurs in :-
(A) Plasmodium (B) Hydra (C) Pomegranate (D) Amoeba

18. Multiple fission occurs in :-
(A) Euglena (B) Yeast (C) Plasmodium (D) Paramecium

19. In which of the following reproduction parental identity is lost :-
(A) Budding (B) Binary (C) Multiple fission (D) Both B and C

20. Which of the following organisms shows budding :-
(A) Spirogyra (B) Hydra (C) Amoeba (D) Paramecium

FILL IN THE BLANKS :

1. In Rhizopus asexual reproduction takes place by ………………..formation.
2. In Bryophyllum vegetative propagation takes place through their ………………..
3. The process in which new organisms are formed by existing organism is called ……………..
4. In Spirogyra, asexual reproduction, takes place by ………………..
5. Natural vegetative propagation takes place in sweet potato by ………………..
6. In…………………method a branch of parent plant is buried in the soil.
7. In…………………method a cutting part of a plant is grafted on the other plants part.
8. Unorganized mass of cells is known as…………………..
9. Tissue culture is also known as ………………………..
10. Grafting is not possible in…………………plants.
11. All floral leaves are placed on the ……………………..of flower.
12. Stalk of flower is known as…………………
13. …………………protects the flower bud before it opens.
14. If both sepals and petals are colored can not be distinguished from each other then their whorl is known as……………………
15. Each stamen has two parts filament and …………………
16. Each pollen grain produces ………………………male gametes.
17. A carpel has three parts ovary,………………and stigma.
18. ………………..is a swollen basal part of carpel.
19. ………………..of carpel receives pollen grains.
20. Second male gamete + Two polar nuclei = …………………

MATCH THE COLUMN :

Column I		Column II	
(a)	Calyx	(i)	Ovary
(b)	Corolla	(ii)	Sepal
(c)	Stamen	(iii)	Stigma
(d)	Carpel	(iv)	Petal
		(v)	Anther
		(vi)	Filament

VERY SHORT TYPE QUESTIONS :

1. Mention the reproductive parts of a flower.
2. Which parts of plants can grow vegetatively ?
3. What is the function of pollen gains in flowers ?
4. What is the other name of (i) Calyx (ii) Corolla (iii) Androceium (iv) Gynoceium ?
5. Give one example of each plant which propagates artificially by (a) cutting, (b) layering.
6. Which vegetative part is used in the propagation of *Bryophyllum* ?
7. What is stock in grafting ?
8. Name the agencies through which cross-pollination take place.
9. Name two abiotic agents of pollination.
10. Which group of plants shows double fertilization?

HOW DO ORGANISMS REPRODUCE — ANSWER KEY — EXERCISE # 1

● Objective Question :

Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	**B**	**D**	**B**	**B**	**B**	**C**	**B**	**D**	**D**	**B**
Q.No.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	**B**	**C**	**A**	**D**	**A**	**D**	**D**	**C**	**D**	**B**

● Fill In The Blanks :

1. spore **2.** leaf **3.** reproduction **4.** fragmentation **5.** root
6. layering **7.** grafting **8.** callus **9.** micro propagation **10.** monocot
11. thalamus **12.** pedicel **13.** calyx **14.** perianth **15.** anther
16. two **17.** style **18.** ovary **19.** stigma
20. primary endosperm nucleus

● Match The Following :

Ans. (a) –ii, (b) –iv, (c) –v, iv (d) –i, ii

● Very Short Answer Type Questions :

1. Stamen and carpel **2.** Root, stem and leaves
3. It produces male gametes which fertilizes the egg cell
4. (i) Sepal, (ii) Petal, (iii) Stamen, (iv) Carpel **5.** (a) Rose, (b) Jasmine
6. leaf **7.** Rooted plant is called stock **8.** Water, Wind, Insect, Bird, Man
9. Water and Wind **10.** Angiosperms

EXERCISE # 2 — FOR SCHOOL EXAMS.

SHORT TYPE QUESTIONS :

1. What methods will you use for growing jasmine and rose plant ?
2. Leaves of Bryophyllum fallen on the ground produce new plants whereas the leaves of rose do not. Why ?
3. What are the two possibilities of self-pollination ?
4. What are the advantages of tissue culture ?
5. Why is cross-pollination considered to be superior than the self-pollination ?
6. List two main advantages of sexual reproduction .
7. 'Grafting is a common method of obtaining a superior plant from two different plants'. Explain.
8. Describe about the different plant of a stamen in male reproduction organ of a plant.
9. What is vegetative propagation ? Classify it along with examples.
10. How are these ornamental plats propagated ? Mention the name of the method :
    (i) Jasmine (ii) Rose (iii) Bougainvillea (iv) Hibiscus

LONG ANSWER TYPE QUESTIONS :

1. Define the terms unisexual flower and bisexual flower giving one example of each.
2. Explain double fertilization in plants.
3. What is vegetative propagation ? When is it used ? Name three methods of vegetative propagation.
4. Differentiate between 'self-pollination' and 'cross-pollination'.
5. Draw a diagram of flower to show its male and female reproductive parts. Label on to :
   (i) The ovary (ii) The anther (iii) The filament (iv) The stigma
6. Draw a labeled diagram of the longitudinal section of a pistil showing pollen germination .
7. Give two advantages of vegetative propagation.
8. What is pollination ? Describe cross-pollination.

NCERT QUESTIONS

1. What is the importance of DNA copying in reproduction ?
2. Why is variation beneficial to the species but not necessary for the individual ?
3. How does binary fission differ from multiple fission ?
4. How will an organism be benefited if it reproduces through spores ?
5. Can you think of reasons why more complex organisms can not give rise to new individuals through regeneration ?
6. Why is vegetative propagation practiced for growing some types of plants ?
7. Why is DNA copying an essential part of the process of reproduction ?
8. How is the process of pollination different from fertilization ?
9. What are the advantages of sexual reproduction over asexual reproduction ?
10. Draw a labeled diagram of the longitudinal section of a flower.
11. How are the modes of reproduction different in unicellular and multicellular organisms ?
12. How does reproduction help in providing stability to population of species ?

EXERCISE # 3 — COMPETITIVE EXAMS.

1. If the pollen is transferred to the stigma of the same flower, it is termed :-
   (A) Allogamy (B) Geitonogamy (C) Autogamy (D) all of these

2. Which part of the flower forms the fruit ?

(A) Whole flower (B) Only stamens and carpel

(C) Only ovary (D) Only carpel

3. In angiosperm after the fertilization endosperm becomes :-

(A) Haploid (B) Diploid (C) Triploid (D) Tetrapoda

4. After fertilization ovule grows into :-

(A) seed (B) fruit (C) placenta (D) None

5. Which is not a part of carpel :-

(A) Stigma (B) Ovary (C) Anther (D) Style

6. Nucleus of the bud is formed by the division of :-

(A) Meiosis (B) Amitosis (C) Mitosis (D) All of theses

7. Clones are formed as a result of :-

(A) Budding (B) Regeneration

(C) Vegetative propagation (D) All of these

8. Malarial parasite reproduces by :-

(A) Multiple fission (B) Binary fission (C) Budding (D) Regeneration

9. The outgrowth of *Hydra* is termed as :-

(A) Bulb (B) Bud (C) Daughter (D) Tentacles

10. Asexual reproduction takes place by the process of budding :-

(A) Plasmodium (B) Amoeba (C) Yeast (D) Rhizopus

11. Asexual reproduction involves :-

(A) Only one parent (B) Two parent

(C) Meiosis and syngamy (D) Fusion of two gametes

12. Which is a part of stamen :-

(A) Stigma (B) Filament (C) Style (D) None

ANSWER KEY

Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Ans.	**C**	**C**	**C**	**A**	**C**	**C**	**D**	**B**	**C**	**C**	**A**	**B**

REPRODUCTION IN HUMAN BEINGS

Reproduction resulting from the fusion of male gamete and female gamete is called **sexual reproduction.**

OR

The type of reproduction in which fusion of male gamete & female gamete occur is called **sexual reproduction.**

Important features of sexual reproduction are given below :

(i) It involves two different parents i.e. one male and one female.

(ii) Each parent produces gametes.

(iii) Male gametes are called **sperms** while female gametes are called **ova** or **eggs.**

(iv) The fusion of male and female gametes is called **fertilization.** It results in to the formation of a single diploid cell **zygote.**

(v) The zygote undergoes repeated mitotic divisions to form embryo which differentiate to form full organism.

(vi) The organism produced in this type of reproduction are genetically different from both the parents and can resemble in certain features with parents.

HUMAN REPRODUCTIVE SYSTEM

Puberty :- The age at which the gametes and sex hormones to be produced and the boy and girl become sexually mature is called **puberty.**

Generally **female** pubertal age is **10-12 years, male** pubertal age is **13-14 years.**

Pubertal Changes (Secondary Sexual Characters) in Male :

Widening of shoulders.

Deepening of voice.

Growth of hairs under chest, armpits and around pubic area.

Appearance of beard and moustaches.

Growth of sex organs, [Testes & Penis].

Increased Activity of sweat and sebaceous glands.

Oily skin and appearance of pimples.

Darkening in skin colour of the genital area.

Pubertal Changes (Secondary Sexual Characters) in Female :

Widening of pelvis and hips.

High pitch voice

Growth of hairs under armpits and around pubic area.

Initiation of menstrual cycle.

Growth of mammary glands (breasts).

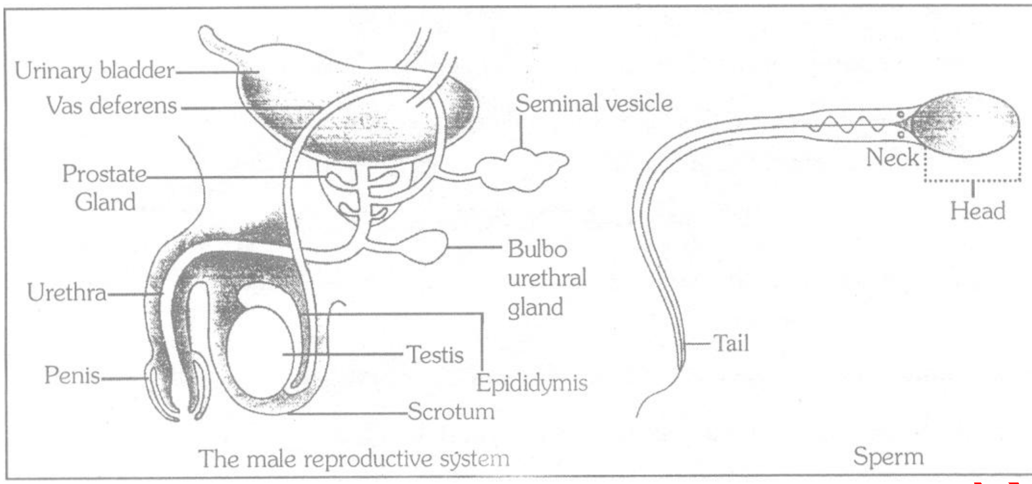
Darkening in skin colour of genital area.

Maturation of secondary sex organs like fallopian tubes, uterus.

MALE REPRODUCTIVE SYSTEM

Primary sex organs
- → Testes

Secondary sex organs
- → Epididymis
- → Vas deferens
- → Seminal vesicle
- → Prostate gland
- → Cowper’s gland
- → Penis



The male reproductive system

Sperm

The male reproductive system consists of portions which produce the germ-cells and other portions that deliver the germ-cells to the site of fertilization.

The formation of germ-cells or sperms takes place in the **testes.** These are located outside the abdominal cavity in **scrotum** because **sperm formation requires a lower temperature [1–3^0]C than the normal body temperature.**

Testes secrete male sex hormone called **testosterone.**

In addition to regulation the formation of sperms, testosterone brings about changes in appearance seen in boys at the time of puberty. These changes are called **secondary sexual characters.**

The sperms formed are delivered through the vas deferens which unites with a tube coming from the urinary bladder. The urethra thus forms a common passage for both the sperms and urine. Hence urethra is also known as **urinogenital tract .**

Along the path of the vas deferens, glands like the **prostate gland** and the **seminal vesicle** add their secretions so that sperms are now in a fluid which makes their transport easier and this fluid also provides nutrition.

The sperms are tiny bodies that consist of mainly genetic material and a long tail that helps them to move towards the female germ-cell (ovum).

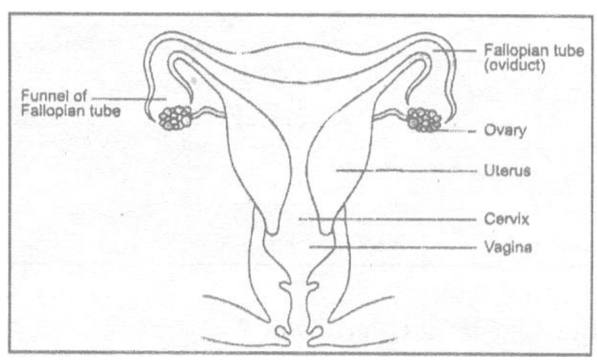
FEMALE REPRODUCTIVE SYSTEM

- Primary sex organs
  - Ovaries
- Secondary sex organs
  - Fallopian tubes
  - Uterus
  - Vagina
  - Mammary glands

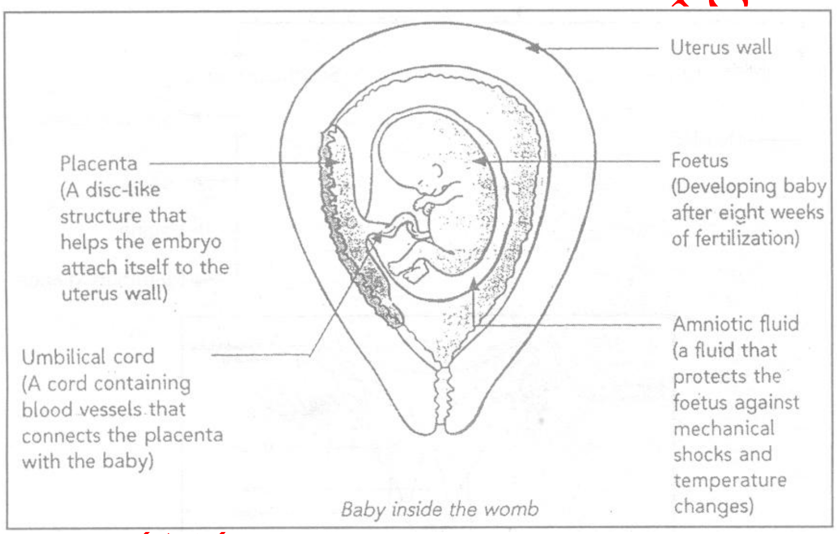
The female germ-cells or eggs are made in the ovaries. They are also responsible for the production of female sex hormones i.e., **Oestrogen** and **Progesterone.**

When a girl child is born, the ovaries already contain thousands of immature eggs. On reaching puberty, some of these start maturing.

One egg is produced every month by one of the ovaries.

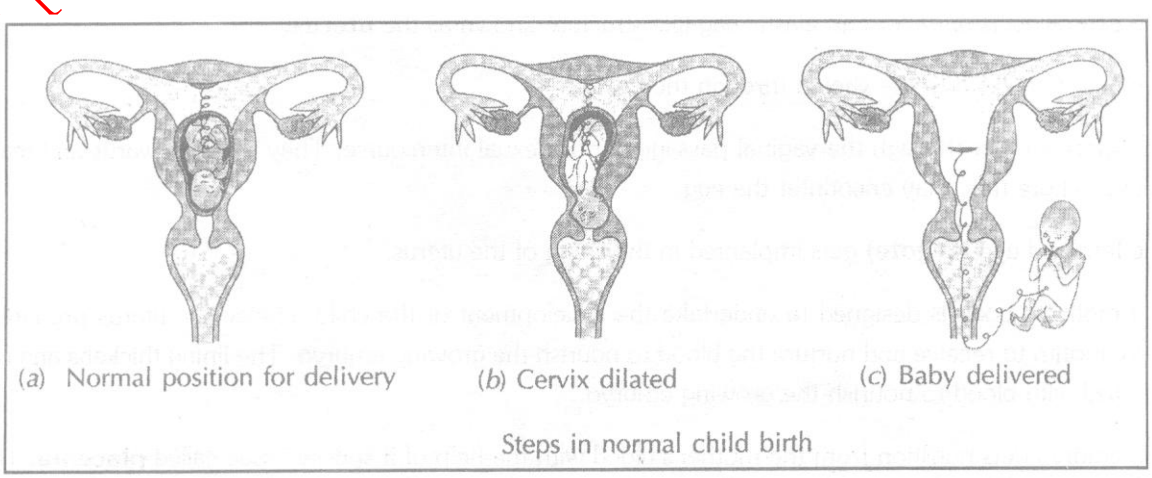


The egg is carried from the ovary to the womb through a thin **oviduct** or **fallopian tube.**
The two oviducts unite into an elastic bag-like structure known as the **uterus.**
The uterus opens into the vagina through the **cervix.**
The sperms enter through the vaginal passage during sexual intercourse. They travel upwards and reach the oviduct where they may encounter the egg.
The fertilized egg **(zygote)** gets implanted in the lining of the uterus.
The mother's body is designed to undertake the development of the child. Hence the uterus prepares itself every month to receive and nurture the blood to nourish the growing embryo. The lining thickens and is richly supplied with blood to nourish the growing embryo.
The embryo gets nutrition from the mother's blood with the help of a special tissue called **placenta.** This is a disc which is embedded in the uterine wall. It contains **villi.** On the mother's side are blood spaces, which surround the villi. This provides a large surface area for glucose and oxygen to pass from the mother to the embryo.
The developing embryo will also generate waster substances which can be removed by transferring them into the mother's blood through the placenta. The development of the child inside the mother's body takes approximately **nine months.** The child is born as a result of rhythmic contractions of the muscles in the uterus, called **labor pain.**



Baby inside the womb

What Happens When the Egg is not fertilized?
If the egg is not fertilized, it lives for about one day.
Since the ovary releases one egg every month, the uterus also prepares itself every month to receive a fertilized egg. Thus its lining becomes thick and spongy. This would be required for nourishing the embryo if fertilization had taken place.
This lining is not needed any longer. So, the lining slowly breaks and comes out through the vagina as blood and mucous. This cycle takes place roughly every month and is known as **menstruation.** It usually lasts for about two to eight days.



Steps in normal child birth

Reproductive Health :

Sexually Transmitted Diseases (STDs)

There are many infections diseases which are spread by sexual contact, called **Sexually Transmitted Diseases (STDs) e.g.** AIDS, Hepatitis.

STDs occur mostly in the individuals who are involved in sexual activities with many partners.

Some common sexually transmitted diseases (STDs)

S.No.	Name of STDs	Causal Organism	Symptoms
1	AIDS (Acquired Immuno Deficiency Syndrome)	HIV (Human Immuno Deficiency Virus)	Destroy the immune system of body. Persistent cough and fever. Body attacked by other diseases like pneumonia, T.B. and certain cancers.
2	Syphilis	Treponema pallidum (a bacterium)	Causes sores and lesions in the genital tract. Burning sensation at urination.
3	Gonorrhea	Nesseria gonorrhoeae (a bacterium)	Infects mucous membranes of the urinogenital tact. Genital discharge, painful urination.
4	Trichomoniasis	Trichomonas vaginalis (a protozoan)	Vaginal irritation, itching and discharge.

Methods of prevention of STDs :

(i) The people should be educated about various STDs

(ii) Extra marital relations should be avoided.

(iii) No sex without proper precaution.

(iv) High standard of moral education should be given to the people

Methods adopted for population control :- The prevention of pregnancy in women is called **contraception.**

1. **Planned control of population :**

(i) By education people about the advantages of small family

(ii) Raising the age of marriage can help in reducing population growth.

(iii) By family planning.

2. **Natural method :-**

(i) Intercourse is safe for a week before and week after menstruation

(ii) Coitus interrupts involves withdrawing penis before ejaculation.

3. **Mechanical methods :-**

(i) It includes use of condoms which are the rubber or plastic sheets put on the penis before coital activity.

(ii) Use of **diaphragms** or **cervical caps** fitted in vagina of female to check the entry of sperms into the uterus and also help in avoiding conception.

(iii) Use of **IUCD** i.e., **I**ntra **U**terine **C**ontraceptive **D**evices like **C**opper-**T** and **loops** fitted in the uterus, help to prevent fertilization. They can cause side effects due to irritation of uterus.

4. **Chemical methods :-**

(i) It consists of using some chemicals which are **spermicidal.** They may be in form of tablets, jellies, paste and creams introduced in the vagina before coital activity.

(ii) Another chemical method is the use of **oral contraceptive** (OC) **pills** which inhibit the secretion of FSH and LH from the anterior lobe of pituitary gland and thus inhibiting ovulation from the ovary. These contraceptive therefore change the hormonal balance so that egg cell are not released and hence prevent fertilization.

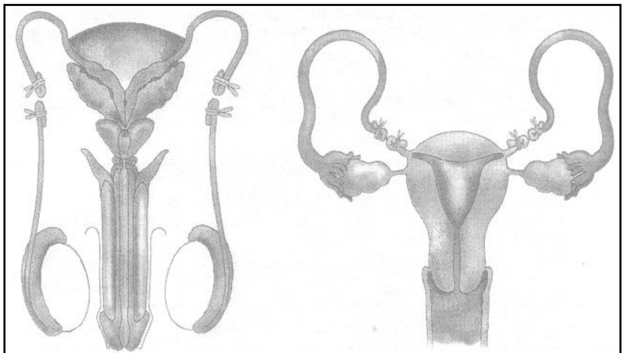
5. **Surgical methods :-**

(i) **Tubectomy** involves cutting of fallopian tubes in females and **Vasectomy** involves cutting of vas deferens of each side.

(ii) Removal of ovaries surgically is known as **ovariectomy** and removal of testes is known is **castration.**

(iii) Another surgical method is **MTP** i.e. Medical Termination of Pregnancy or abortion.

(iv) Other method is **tubal ligation** in which fallopian tubes are blocked by an instrument called **laparoscope.**



(a) Vasectomy in male (b) Tubectomy in female

Surgical methods of contraception

REVIEW QUESTIONS

1. Expand the following terms :

(i) IUCD (ii) STD (iii) HIV (iv) AIDS

2. How do oral contraceptives function ?

3. What is contraception ?

4. What is family planning ?

5. What is vasectomy ?

6. What do you understand by fertilization ?

7. What is the product of fusion of a sperm and an ovum known as ?

8. What changes occur in girls in the age group of 10-13 years ?

9. Draw a well-labeled diagram depicting vasectomy and tubectomy.

10. Why is fertilization in humans possible, if copulation takes place during the middle of the menstrual cycle ?

COMPETITIVE WINDOW

India was the first country to adopt family planning as the government sponsored programme in 1951.

Menarche : The onset of menstruation in a young female at about the age of 13 years is termed as **menarche.**

Menopause : The permanent stoppage of menstruation at about the age of 45 years is termed as **menopause.**

Menstrual cycle is also called **ovarian cycle.**

In human female, ovulation starts only after puberty and occurs once in a month and midway through the menstrual cycle.

Menstrual cycle is absent before puberty and temporarily stopped during pregnancy.

Menstrual cycle occurs **only in the primates** among the mammals.

Parthenogenesis: A primitive type of sexual reproduction in which unfertilized eggs develop to form haploid adult organisms. It is found in female aphids, drones (males) of honey bees and termites, and certain lizards. In fresh water sponges **(Spongilla),** internal buds are formed within the parent body. Such buds are called **gemmules.** The gemmules, on arrival of favorable conditions, develop into a sponge colony.

After fertilization, membrane appears around the egg to prevent further entry of sperms. It is called **monospermy.** After the entry of sperm, ovum completes its maturation division.

Amniocentesis :- Amniocentesis is a prenatal diagnostic technique to determine the genetic disorders, if any, of the fetus. Unfortunately, the useful technique of amniocentesis is being misused to kill the normal female fetuses as it can help to detect the sex of fetus also. Determination of sex by amniocentesis has been banned.

EXERCISE # 1 FOR SCHOOL / BOARD EXAMS.

OBJECTIVE QUESTIONS

1. Binary fission occurs in :-
(A) Amoeba (B) Paramecium (C) Planaria (D) A & B both

2. Which one of the following is concerned with asexual reproduction ?
(A) Zygote (B) Spores (C) Gametes (D) Gonads

3. Which type of reproduction of Hydra is most common ?
(A) Budding (B) Fragmentation
(C) Sexual reproduction (D) Gametogenesis

4. The most fundamental characteristics of living being :-
(A) Locomotion (B) Regeneration (C) Fragmentation (D) Reproduction

5. Multiple fission occurs in :-
(A) Hydra (B) Plasmodium (C) Planaria (D) All of these

6. The animals consist of both male & female sex known as :-
(A) Viviparous (B) Oviparous (C) Sterile (D) Hermaphrodite

7. Animals which give birth to young ones are called :-
(A) amphibious (B) oviparous (C) Triploblastic (D) viviparous

8. Tests of man occur :-
(A) inside body (B) upper side of kidney
(C) on either side of dorsal aorta (D) in scrotal sacs

9. Fertilization of ovum takes place in :-
(A) ovary (B) fallopian tube (C) cervix (D) uterus

10. Oogenesis is a process of formation of :-
(A) Sperms (B) Ova (C) Sperms and ova (D) None of these

11. Middle piece of a mammalian sperm contains :-
(A) nucleus (B) acrosome (C) vacuole (D) mitochondria

12. Male hormone is :-
(A) Corpus luteum (B) Testosterone (C) Progesterone (D) Gonadotropin

13. Sperms move by :-
(A) head (B) acrosome (C) middle piece (D) tail

14. Binary fission is a from of :-
(A) sexual reproduction (B) asexual reproduction
(C) both of these (D) none of these

15. Fertilization of frog takes place in :-
(A) Uterus (B) Fallopian tube
(C) Water (D) Cervix

16. Which of the following can reproduce thorough regeneration ?
(A) Hydra (B) Planaria (C) Wall lizard (D) Both (A) and (B)

17. Development of an organism from an unfertilized ovum is called :-
(A) oogenesis (B) parthenogenesis
(C) vegetative propagation (D) asexual reproduction

18. Egg-producing animals such as birds are called :-

(A) unisexual (B) oviparous (C) viviparous (D) hermaphrodite

19. What is true for gametes ?

(A) They are diploid (B) They form gonads

(C) They are formed from gonads (D) They produce hormones

20. Which of these secretes seminal fluid ?

(A) Prostate gland (B) Cowper's gland (C) Seminal vesicle (D) All of these

21. The normal duration of menstrual cycle is :-

(A) 7-8 days (B) one day (C) 3-4 days (D) none of the above

22. Female sex hormones are :-

(A) Progesterone (B) Estrogen (C) Testosterone (D) A & B Both

23. The process of attachment of blastocyst in the endometrium of uterus is known as :-

(A) placentation (B) implantation (C) gestation (D) cleavage

24. Which of the following is an IUCD ?

(A) Copper-T (B) Diaphragm (C) Oral pills (D) Tubectomy

25. The Primary reason for increase in human population is :-

(A) the increase in agricultural production

(B) the increases in birth rate and decreases in death rate

(C) the improvement in medical technology

(D) all of the above

FILL IN THE BLANKS

1. The…………………..is also called womb.
2. The…………………is primary reproductive organ in male.
3. The …………………is connecting structure which helps in the transfer of substance to and from the fetus body.
4. The process of laying eggs in large number is called………………………..
5. ………………………is the primary reproductive organ in female.
6. Testes produce……………………….
7. The cells involved in sexual reproduction are called…………………
8. In animals like fish and frog……………………….fertilization take place.
9. The human zygote gets implanted in the ………………….
10. IVF stands for……………………

CHOOSE TRUE AND FALSE STATEMENTS

1. Internal fertilization takes place outside the female's body.
2. Birds and snakes are young oviparous animals.
3. A tadpole is the young one of a frog.
4. Animals like **Amoeba** multiply by budding.
5. The fusion of male and female sex cells is called fertilization.

MATCH THE COLUMNS

	Column-A		**Column-B**
1	Tapeworm	(a)	Uterus
2	Vasectomy	(b)	STD
3	Copper-T	(c)	IUCD
4	Implantation	(d)	Vas deferens
5	AIDS	(e)	Hermaphrodite

● **Objective Question :**

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	B	A	D	B	D	D	D	B	B	D	B	D	B	C
Que.	16	17	18	19	20	21	22	23	24	25					
Ans.	D	B	B	C	D	C	C	B	A	D					

● **Fill In The Blanks :**

1. Uterus **2. Testis** **3. Placenta** **4. Super ovulation**

5. Ovary **6. Testosterone** **7. Germ cells** **8. External**

9. Uterus **10. In vitro fertilization**

● **True & False :**

1. F **2.** T **3.** T **4.** F **5.** T

● **Match The Column :**

1. (1) –e, (2) –d, (3) –c, (4) –a, (5) –b

EXERCISE # 2 FOR SCHOOL / BOARD EXAMS

VERY SHORT ANSWER TYPE QUESTIONS :

1. Where does fertilization take place ?

2. What is a fetus ?

3. How is an embryo produced ?

4. What is a zygote ?

5. Write three examples of animals in which external fertilization occur.

6. Draw a labeled diagram of male reproductive system.

7. Name the parts present in human sperm. Show by labeled diagram.

8. What is Syngamy ?

9. What is the name given to primary sex organs ?

10. What are copulatory organs ?

SHORT ANSWER TYPE QUESTIONS :

1. What are the parts of a male reproductive system ?

2. Define metamorphosis .

3. How is internal fertilization differ from external fertilization ?

4. How does a sperm differ from an ovum ?

5. Draw a labeled diagram of female reproductive system.

6. What are oviparous & viviparous animals ?

7. Describe the process of development from zygote to fetus in brief.

8. What is puberty ?

9. At what age do human males and females attain puberty ?

10. What is tubectomy ?

11. Why is it important to study about reproductive health ?

12. What is ovulation ?

13. Which organ enables the developing fetus to obtain nourishment from the mother's blood ?

14. What are Graffian follicles ?

15. What is gestation ?

16. How many follicles mature every month during the reproductive phase of a human female ?

17. What is internal fertilization ? Give an example.

18. What happens if the mature ovum is not fertilized in a female ?

19. Distinguish between

(i) Egg and Embryo (ii) Male and Female Urethra

20. Why is vagina called as 'birth canal' ?

LONG ANSWER TYPE QUESTIONS :

1. Why do female frogs produce eggs in large number ?

2. "Sexual reproduction is more advance than asexual reproduction" why ?

3. How fetus is different from embryo ?

4. In which female reproductive organ does the embryo get embedded and why ?

5. How could a single cell become such a big individual ?

NCERT QUESTIONS :

1. What is the role of the seminal vesicles and the prostate gland ?

2. What are the change seen in girls at the time of puberty ?

3. How does the embryo get nourishment inside the mother's body ?

4. If a woman is using a copper-T, will it help protecting her from sexually transmitted diseases ?

5. What are the functions performed by the testis in human beings ?

6. Why does menstruation occur ?

7. What are the different methods of contraception ?

8. What could be the reason for adopting contraceptive methods ?

EXERCISE # 3 COMPETITIVE EXAMS.

1. The importance of reproduction in organisms is because of :-

(A) Formation of new individuals

(B) Production of individuals with same traits

(C) Production of individuals with different traits so as to being varieties in a population

(D) All of the above

2. Twins absolutely resembling each other in sex and external appearance result when :

(A) Two similar sperms fertilize two similar eggs

(B) Same sperm fertilizes two eggs

(C) Two halves of the same egg develop separately after it is fertilized by one sperm

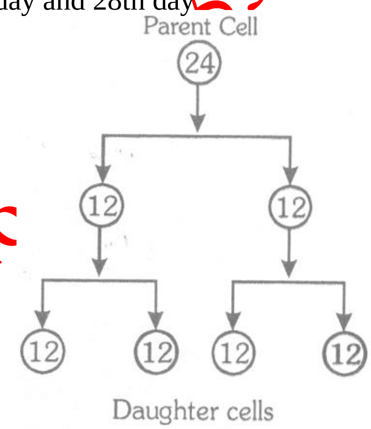
(D) Two halves of the same egg are fertilized by two separate sperms

3. Copulation in human beings may result in fertilization during (normal menstrual cycle is for 28 days)

(A) 4th day and 10th day (B) 21th day and 28th day

(C) 11th day and 21st day (D) any day between 1st day and 28th day

4. The chart given here shows a cell division. The division is :-



(A) Mitosis

(B) Meiosis

(C) Division of a zygote during development

(D) Division of an Amoeba during binary fission

5. The gametes are formed as a result of :-

(A) Vegetative propagation (B) Asexual reproduction

(C) Meiosis (D) Mitosis

6. Which of the following tests is for determining, the sex of the fetus ?

(A) Blood group test (B) Amniocentesis (C) Blood sugar test (D) pH value test

7. The structure which provides a place for attachment and exchange of materials between mother and the fetus is called :-

(A) Uterus (B) Umbilical cord (C) Oviduct (D) Placenta

8. Reproduction by budding takes place in :-

(A) Hydra and Earthworm (B) Hydra and Yeast

(C) Yeast and Bacteria (D) Bacteria and Amoeba

9. During mitosis which of the following is / are equally distributed in daughter cells ?

(A) Chloroplasts (B) Cytoplasm

(C) Chromosomes (D) Centrosomes

10. In cells after they attain a certain size, growth stops and the sell undergoes division. The probable reason for this is :-

(A) The volume increases more than the surface area and the ratio between the two becomes less

(B) Both the volume and surface area increases in equal proportion

(C) The surface area increases faster than the volume

(D) The surface area is several times more than the volume.

11. Puberty age in girls is between :-

(A) 12-18 years of age (B) 10-16 years of age

(C) 14-20 years of age (D) 15-18 years of age

12. Fertilization of an ovum with a sperm takes place in :-

(A) Uterus (B) Vagina

(C) Fallopian tube (D) Cervix

13. A human zygote has :-

(A) 46 chromosomes (B) 23 chromosomes

(C) 47 chromosomes (D) 48 chromosome

14. Regeneration is a process in which :-

(A) A tumor is produced (B) A new individual is produced

(C) Missing parts grow again (D) Old individuals are replaced by new ones

15. As compared to human egg the spermatozoa has less :-

(A) Chromosomes (B) Centrosomes

(C) Cytoplasm (D) Mobility

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	C	C	B	C	B	D	B	C	A	B	C	A	C	C

Important Notes

LIFE PROCESS – NUTRITION

WHAT IS LIFE PROCESS ?

All the living organisms including human beings perform a number of activities such as nutrition, reparation, excretion, growth and reproduction. These activities are characteristics of living organisms, and through such activities they maintain their lives these maintenance function of living organisms are known as **life processes.**

Chemical reactions which takes place within cells or organisms during various vital activities are called **biochemical reactions.**

Metabolism is a word used to describe the sum total of all the chemical and physical changes that are constantly taking place in living matter and are necessary for life. The word **metabolite** refers to a substance which undergoes various changes during metabolism. For example, carbon dioxide and water metabolites used in the process of photosynthesis.

The metabolic pathways are of two types :

(i) **Anabolic pathways** or **biosynthetic pathways** in which biosynthesis of organic compounds occurs, or in other words, complex substances are synthesized from simpler ones ; foe example photosynthesis.

(ii) **Catabolic pathways** in which the breakdown of complex organic substances into simpler ones occurs (as in respiration)

In anabolic pathways or processes of **anabolism** energy is used **(endothermic reactions),** while in catabolic pathways or **catabolism,** energy is released **(exothermic reactions).**

Criteria to define something is alive :-

1. **Nutrition :-** The processes by which the organisms obtain and utilize the nutrients (food).
2. **Respiration :-** The process that involves breakdown of respiratory substrates through oxidation and release of usable energy
3. **Transport :-** The process in which the substances absorbed or synthesized in one part of the body are carried to other parts to the body.
4. **Excretion :-** The process involved in removal of the excess or toxic waster from the body.
5. **Control and coordination :-** The process which helps the living organisms to receive information from the surroundings and behave accordingly in order to survive in the changing environment around them.
6. **Growth and development :-** Permanent increases in the size of the organisms is called growth. The whole series of changes which an organism goes through during its life cycle, is called **development.**
7. **Movement and Locomotion**

Definition :- The basic function preformed by living beings to sustain themselves are called life processes.

NUTRITION

Nutrients are inorganic as well as organic substances which the organisms obtain from their surroundings in order to synthesize their body constituents and use them as a source of energy.

The process of intake of nutrients and its utilization by an organism in various biological activities.

Or

A process to transfer a source of energy from outside the body of the organism (food), to the inside is called nutrition.

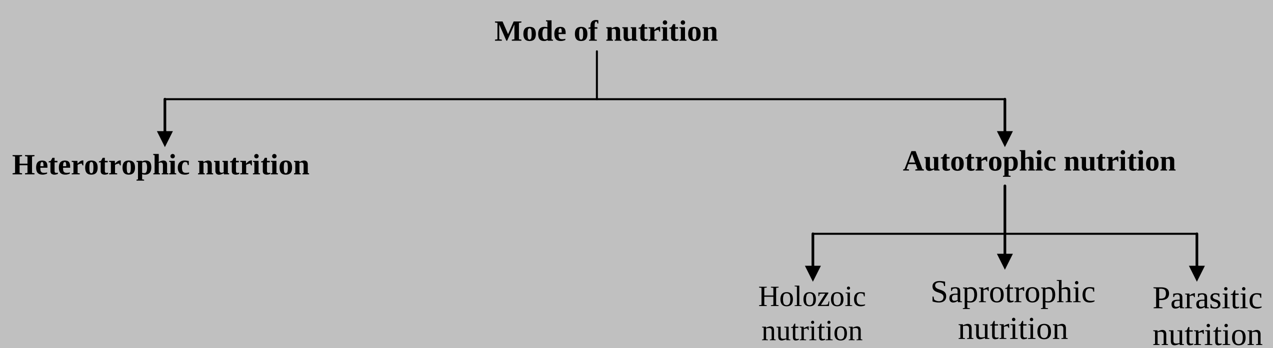
There are various type of nutrients on the basis of function they perform :-

e.g. **Energy foods :- Carbohydrates and fats.**

Body building foods :- Proteins and mineral salts.

Regulating foods :- Vitamins and minerals.

Modes of nutrition :- Method of obtaining food by the organism is called mode of nutrition.



(A) Autotrophic (Holophytic) nutrition :- The mode of nutrition in which the organisms prepare (or synthesize) their own organic food by using inorganic raw material (CO_2 & H_2O). They are also called **autotrophs.**

e.g. Plants, Photosynthetic and chemosynthetic bacteria and Cyanobacteria etc.

(B) Heterotrophic nutrition :- The mode of nutrition in which the organisms derive their nutrition from other organisms. They take ready mead organic food from other dead or living plants or animals. The living organisms showing heterotrophic nutrition, are called **heterotrophy.**

e.g. All animals, fungi, many bacterial and some non-green plants (insectivorous plants) and man.

Types of heterotrophic nutrition ;- Depending upon the mode of obtaining food, the heterotrophic nutrition is of following types.

(i) Holozoic nutrition (Holo-Complete + Zoon-animal)

The mode of nutrition in which all animals take in complex solid food material is called Holozoic nutrition.

It contains following steps :-

(i) **Ingestion :-** Taking in complex organic food through mouth opening.

(ii) **Digestion :-** Change of complex food into simple diffusible from by the action of enzymes.

(iii) **Absorption :-** Passing of simple, soluble nutrients into blood or lymph.

(iv) **Assimilation :-** Utilization of absorbed food for various metabolic processes.

(v) **Egestion ;-** Expelling out the undigested food.

e.g. All animals including vertebrates and Invertebrates.

★ Depending upon the **type of the food habit,** animals are divided into three categories :-

(a) **Herbivores :-** Animals that depend up on green plants are known as herbivores . **e.g.** Goat, Cow, Deer, Rabbit.

(b) **Carnivores :-** Animals which eat flesh of other animals as food are called carnivores. **e.g.** Lion, Tiger.

(c) **Omnivores :-** Animals which eat both plants and animals as food are known as omnivores. **e.g.** Rat, Pigs, Crows, Cockroaches and Humans.

(ii) **Saprotrophic (Sapro-Rotten : Trophos - Feeder) Nutrition :-** In this type of nutrition the organisms obtain their food from decaying organic substances. Organisms are also called **saprotrophs.**

e.g. Bacteria, Fungi.

(iii) **Parasitic nutrition (Para-other) :-**

The mode of nutrition in which one organism (called parasite) derive its food from other living organism (Host) is called parasitic nutrition. e.g. Tape worm, Ascaris, Plasmodium, Liver flukes, Cuscuta etc.

Differences between Autotrophic & heterotrophic nutrition :-

Characters	**Autotrophic**	**Heterotrophic nutrition**
(1) Source of Energy	Sunlight or chemical energy	Readymade food
(2) Mode of Nutrition	Photosynthesis of Chemosynthesis	Feeding upon dead or living plants or animals
(3) Occurrence	Found in green plants, Blue-green algae, certain Bacteria	Found in Animals, fungi, Most of the bacteria

Differences between Holozoic and Saprotrophic nutrition :-

Feature	**Holozoic nutrition**	**Saprotrophic nutrition**
1. Nature of food	Solid food (Whole plant or animal or their parts) is ingested	Liquid food (Dead and decaying organic matter) is ingested
2. Site of digestion	Inside the body	Outside the body as enzymes are released on the food material that convert solid food into simple soluble form
Examples	Most of the Animals	**Fungi –** Yeast, Slime moulds, Bacteria.

DO YOU KNOW ?

Animals which depend upon the blood of other animals known as **sanguivores.**

e.g. Bedbug, Mosquito, Leech etc

Some organisms take in predigested food through their body wall by the process of diffusion. This process of nutrition is known as **osmotrophic nutrition.**

e.g. Tapeworm, Trypanosoma.

Mutualistic nutrition :- The Mutualistic nutrition can be defined as the interdependent nutrition in which each organism is dependent mutually on the other.

e.g. The lichens share Mutualistic nutrition between a fungus and a Algae.

Review Questions

FILL IN THE BLANKS :

1. An organism which manufactures its own food from simple inorganic raw materials is known as…………………
2. Organisms which feed upon dead and decaying organic matter are known as ……………..
3. ……………………and……………..are examples of saprophytes.
4. Yeast is …………………..in nutrition.
5. Amarbel is……………………..in nutrition.
6. Define life process.
7. Define nutrition .
8. What is heterotrophic mode of nutrition ?
9. What criteria do we use to decide whether something is alive ?
10. What processes would you consider essential for maintaining life ?

Nutrition in unicellular organisms (Example – Amoeba) :-

▶▶ **Food –** Amoeba is Holozoic and omnivorous animal. It feeds upon microscopic organisms like bacteria, paramecium, Diatoms, Algae and dead organic matter.

Mechanisms. Nutrition in Amoeba involves the following steps :

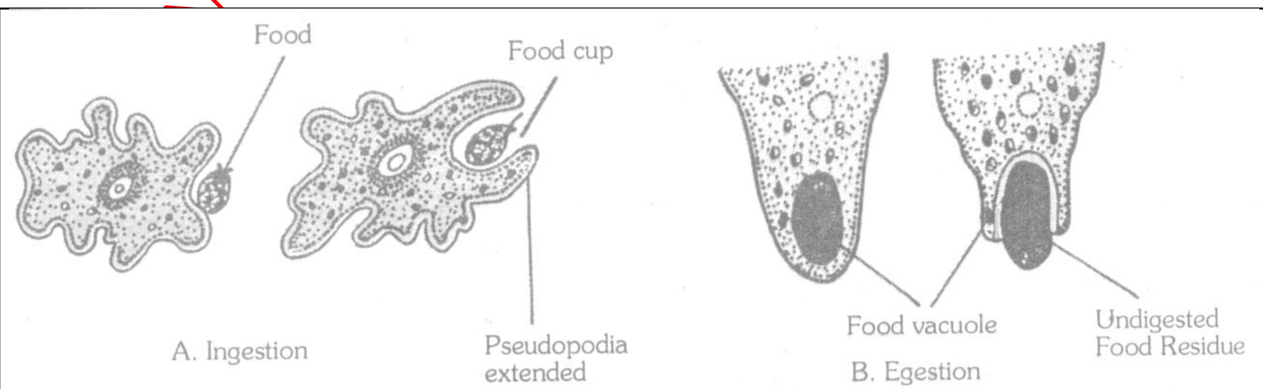
(i) Ingestions :- Amoeba has no mouth, so ingestion may occur at any point of body surface but generally it occurs at the advancing end of the body. ingestion occurs with the **help of pseudopodia.** The opening of food cup gradually becomes narrower and narrower, and finally closes. So the food is finally enveloped and taken inside a **food-vacuole** (called **phagosome**) along with a drop of water.

(ii) Digestions :- Amoeba shows **intracellular** and **vacuolar digestion.** In the cytoplasm, food vacuole fuses with Lysosome containing digestive enzymes, In this, the complex and non-diffusible nutrients are changed into simple and diffusible nutrients, Medium insider the food vacuole is **first acidic but later becomes alkaline,** (as in the alimentary canal of man).

(iii) Absorption and assimilation :- In absorption, the diffusible nutrients pass through vacuolar membrane into cytoplasm by diffusion and are then distributed to all the body parts by **streaming movements** of cytoplasm called **cyclosis.** Due to this, the size of food vacuole gradually decreases.

In the cytoplasm, a part of the absorbed food is oxidized to produce energy, most of simple nutrients are combined to synthesize complex compounds.

(iv) Egestion :- Amoeba has no anus, so Egestion may occur at any point on the body surface.



Nutrition in Amoeba

COMPETITION WINDOW

1. **Food :-** The substance which is palatable, delicious enough and energy provider is called food.
Chemically food consists of six essential components :-
(i) Carbohydrates (ii) Fats (iii) Proteins (iv) Minerals (v) Vitamins (vi) Water

2. **Digestion :-** Digestion is a catabolic process, in which the complex, non-diffusible and larger components of the food, are broken down into their respective simpler, diffusible and smaller form with the help of various hydrolytic enzymes in the alimentary canal of living organisms.

3. **Intracellular and Extra-cellular Digestion :-**
Intracellular Digestion : This type of digestion occur inside the cell cytoplasm. The food inside the cell occurs as food vacuole. The digestive enzyme in this case are secreted inside the cell. They digest the contents of the food vacuole. So the entire process of digestion occurs inside the cell. e.g. Protozoans [Amoeba], Sponges
Extracellular Digestion :- It takes place outside the cell [i.e. in the intercellular space or a cavity formed by many cells or tissue]. In all animals this cavity is found as a large canal, called **Alimentary canal.**

4. **Hydrolysis : -** It is a kind of catabolic reaction in which a compound is broken [lysis – break] down into smaller compounds, with the help [addition] of water [hydro = water].

5. **Carbohydrates :-** These are the hydrates of carbon in which the ratio among carbon, hydrogen & oxygen is 1 : 2 : 1. Carbohydrates are the quickest source of energy .
On the basis of their composition, carbohydrates are of following types :
(a) Monosaccharide :- The simplest sugars are called monosaccharides. These sugars cannot be further degraded to produce more sugars. e.g. Glucose, Fructose, Galactose, Ribose and Deoxyribose.
(b) Oligosaccharides :- These are complex sugars, formed by the polymerization of a few [1 to 10] units of monosaccharide.
Sucrose – Glucose + Fructose
Maltose – Glucose + Glucose
Lactose – Glucose + Galactose
(c) Polysaccharides :- These are most complex carbohydrates, which are the polymers of thousand of units of monosaccharide. e.g. Starch – Stored food in plants, Glycogen – Stored food material in Animals. Cellulose – Constituent of cell wall.

6. **Fats :-** These are energy rich compounds. These are the esters of higher fatty acids. [Esters are formed by the addition of alcohol with acids] **Alcohol** – generally Glycerol.

7. **Proteins :-** Proteins are the polymers of amino acids. Amino acids are held together by means of peptide bond to form polypeptide chains.

8. On the basis of gross size of food, the mechanism in different animals may be of two main types :-
(a) Microphagy – Feeding on microscopic organisms, e.g. Amoeba, Paramecium.
(b) Macrophagy – Feeding on larger forms of organisms. e.g. Majority of non-chordates and some chordates.

9. In Paramecium, ingestion is aided by beating of cilia. It has definite food passage, mouth (cytostome) and anus (cytopyge).

10. Food vacuole is commonly called **temporary stomach** or **gastriole** as it is the site of storages of food.

11. Most common mode of ingestion in Amoeba is **circumvallation.** In this, pseudopodia extend and form a cup-like structure, called **food cup,** around the prey.

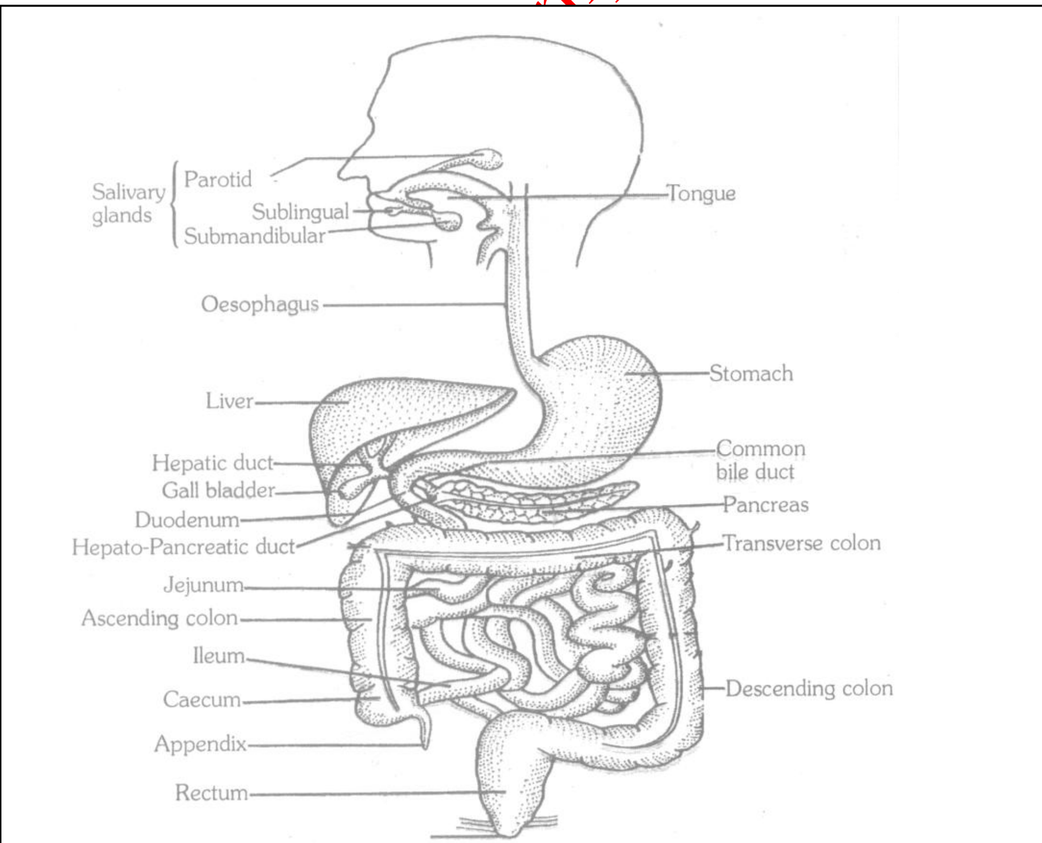
DIGESTIVE SYSTEM OF HUMAN

Human digestive system consists of the alimentary canal and digestive glands and it involves mastication, swallowing, digestion of food and elimination of undigested matter.

It consists two parts :-

[A] Alimentary canal :- The alimentary canal is basically a long tube extending from the mouth to the anus. It is differentiated into following parts.

- Alimentary canal
  - Mouth
  - Bucco-Pharyngeal cavity
  - Esophagus
  - Stomach
  - Intestine
    - Small Intestine
      - Duodenum
      - Jejunum
      - Ileum
    - Large Intestine
      - Caecum
      - Colon
      - Rectum



Alimentary canal of man

(1) **Mouth :-** It is a transverse slit bounded by movable lips. The lips serve to close and open mount, holding the food in between and also help in speaking.

(2) **Buccoupharyngeal cavity / Mouth cavity :** Mouth leads into the **mouth cavity** or **oral** or **Buccal cavity.** The roof of mouth cavity is formed by palates i.e., **hard** and soft **palate,** the floor by **tongue** and the sides by the **cheeks.** The other conspicuous structures are **teeth** and **salivary glands.**

(a) **Tongue :-** The floor of the mouth cavity is occupied by muscular, large, mobile tongue. It remains attached on its under surface to the floor by fold of mucous membrane called the **lingual frenum.** The tongue is covered with mucous membrane and its upper surface is raised into **lingual papillae** which contain microscopic taste buds.

(i) **Lingual papillae :-** Our tongue has a rough uppper surface due to three types of lingual papillae – filiform, fungiform and circumvallates.

(ii) **Taste buds :-** Tongue is an organ of taste, richly supplied with sensory heaves which end in taste buds in the papillae of the upper surface. The taste buds for **sweet taste** are located on the anterior end of the tongue, for **bitter taste** at the posterior end, for **sour taste** on its sides and for **salty taste** on a small part just behind the anterior end of the tongue.

Functions of tongue :-

(i) It acts like a spoon during ingestion of food.
(ii) It brings food under teeth for mastication
(iii) It moves food in buccal cavity for mixing of saliva.
(iv) It helps in swallowing food.
(v) It cleans teeth by removing small food particles form their surface.
(vi) It helps in speaking.
(vii) It is the main organ of taste.
(viii) It keeps the moth moist by the secretion of both mucus and serous or water like fluid .
(ix) In dogs during panting it helps in thermoregulation by quick evaporation of water of saliva.
(x) In some mammals tongue is used to clean skin by licking.

(b) **Teeth :-** Thecodont (Teeth present in bony socket), Heterodent (Teeth are of four types) and Diphyodont (Teeth that come two time in life).

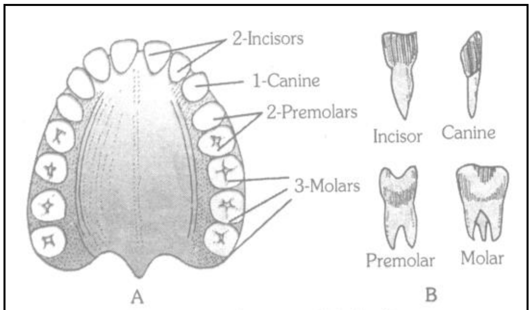
Teeth are of following types :

(i) **Incisors –** Biting the food.
(ii) **Canines –** Wearing and tearing of food.
(iii) **Premolars –** Crushing and grinding the food.
(ii) **Molars –** Crushing and grinding the food .

How can the dental caries be prevented ?

(i) Avoid sugar rich eatable .
(ii) Regular brushing of teeth after meals.
(iii) Vigorous chewing of fibrous food.
(iv) Consumption of water containing 1 ppm of fluoride.

(c) **Palate :-** The septum like structure which separates nasal path from oral path. The hard palate is the anterior part of the roof of mouth cavity. It is supported by **palatine and maxillary bones** that is why it is known as **hard palate.** There are no premaxillary bones present in our hard palate. The lower surface of hard palate covered with mucous membrane of mouth cavity is raised into transverse ridges called **palatine rugae** which serve to grip the food firmly. Soft palate is the posterior muscular part having no skeletal support. It carries a fleshy cone shaped projection called **uvula** which hangs down from it in the middle line. Uvula serve to block the internal nares during swallowing by rising up, preventing entry of food in the nasal cavities.



Various types of permanent teeth of man.

(iii) Pharynx :

The Buccal cavity opens into a short narrow chamber called **pharynx or throat.** Pharynx is incompletely divided into three parts by soft palate – the nasopharynx dorsal to the soft palate, oropharynx below the soft palate and laryngopharynx into which both these parts communicate round the freely hanging uvula. The oropharynx and laryngopharynx are associated with swallowing. The laryngopharynx communicates with esophagus through gullet and with larynx through glottis. The glottis is guarded by an elastic and muscular flap called epiglottis which closes glottis during swallowing to prevent food from entering into wind pipe. Thus pharynx serves two ways – (i) as a passage between nose and wind pipe (trachea) (ii) as food passage between mouth cavity and esophagus. Resonance of voice also occurs due to pharynx.

(iv) **Esophagus (food pipe) :-** It conducts the food by **peristalsis.**

The esophagus is a collapsible muscular tube 25-30 cm long and about 25-30 mm thick, leading from the pharynx to stomach. It runs down the neck, behind trachea and through thorax, finally piercing the diaphragm to open into stomach. The upper 1/3rd part is composed of voluntary muscles and the lower 2/3rd of voluntary muscles. The muscular coat has a peristaltic action for driving the food towards the stomach. There are no digestive glands but only mucous glands in esophagus.

(v) **Stomach :-** It is a thick, muscular and J-shaped sac present on the left side of upper part of abdomen. Beneath diaphragm lying to the left side of abdomen is sickle-shaped stomach. It is the widest part of alimentary canal, size and shape of which varies according to the contents and sex. The stomach of a woman in general is more slender and smaller than that of a man. It can be distinguished into three regions – Fundic part, Body part and Pyloric parts. Pyloric part is the lower end of stomach which narrows down like a funnel and curves to the right like – 'J' leading into duodenum. The exit is guarded by a pyloric sphincter or pylorus. The partly digested paste like food is forced into intestine through pyloric sphincter, due of peristaltic wavers of stomach.

Functions of Stomach :-

(1) Temporary storage of food.

(2) Partial digestion of food by gastric juice.

(3) Churning of food.

(4) The stomach regulates the flow of partially digested food into the small intestine.

Intestine :- It distinguished into two parts :-

(a) Small Intestine (b) Large Intestine

(a) Small intestine :- It is a long (about 6 meter) narrow (average diameter 4 cm), tubular and coiled part. It is differentiated into anterior duodenum, middle jejunum and posterior ileum. It is mainly concerned with completion of digestion and absorption of food.

(i) Duodenum : This proximal part starts after pyloric end of stomach. It is about 25 cm long lying against the posterior abdominal wall. It is served like 'C' or a horseshoe and ends behind the stomach. A common bile duct and a pancreatic duct opens in middle of 'C' of duodenum by a common aperture over a raised area called ampulla of vater.

(ii) Jejunum ; The Jejunum (a Latin word meaning empty) is so called because it is always found empty after death.

(iii) Ileum : It is the last part of small intestine.

Small intestine designed to absorb digested food as :

(i) It is lengthy about 6 meters.

(ii) Inner lining has two types of folds called villi and microvillus.

(iii) Each villus has blood capillaries and a lymph capillary.

(b) Large intestine :- It is shorter (about 1.5 meter) and wider (Average diameter 6 cm) than small intestine. It is differentiated into caecum, colon and rectum. It is the site of abortion of water from digested food. It helps in formation and temporary storage of faeces.

★ Caecum is vestigial in human beings.

Anus :- It lies at the base of trunk and is for Egestion.

[B] digestive glands :- They secrete digestive juices which contain digestive enzymes. These are of following types.

(i) Salivary glands :- In man, there are three pairs of salivary glands. these secrete saliva which contains a digestive enzyme called **ptyalin** or **Salivary amylase.**

Do you know ?

★ Saliva is an antiseptic as it kills germs and bacteria due to presence of an enzyme called **Lysozyme.** Saliva makes the food soft, slippery and helps in digestion of starch due to presence of salivary amylase enzyme.

★ Our mouth starts **watering on eating** food of our interest, This water is basically the saliva secreted by the salivary gland which get activated on eating or seeing or thinking of a food.

★

Involuntary contraction & relaxation movement is called **peristalsis.**

(ii) Gastric glands :- Gastric glands are present in the wall of stomach and secrete gastric juice.

(iii) Liver :- It is lobed and reddish-brown colored largest gland of body present in the right side of upper part of the abdomen. It synthesize and secretes bile juice. Gall bladder is present below the right lobe of liver. It stores and secretes bile.

(iv) **Pancreas :-** It is yellow – colored gland present just behind the stomach. It secretes pancreatic juice. Pancreatic duct carries pancreatic juice to small intestine.

(v) **Intestinal glands :-** These lie in the wall of small intestine and secrete intestinal juice.

[C] Physiology of nutrition :-

(i) **Ingestion :-** Man is **omnivorous** in feeding and is **Holozoic.**

Ingestion involves carrying the food to the mouth with the help of hands and cutting of food with incisors or canines depending upon the nature of food.

(ii) **Digestion :-** In man, digestion is started in **Buccal cavity** and completed in **intestine.**

(a) **In Buccal cavity :-** Here, food is chewed with the help of premolars and molars which increases the rate of action of **salivary amylase.** Food is mixed with saliva of salivary gland.

$$\text{Starch} \xrightarrow[6.8PH.CI^{-}]{Salivary\ amylase} \text{Maltose}$$

(b) **In stomach :-**

Food is mixed with gastric juice which contains mucus, hydrochloric acid, pepsin, rennin and a weak lipase enzyme .

Mucus, lubricates the food and protects the inner lining of the stomach from the action of acids.

Functions of Hydrochloric acid.

(i) Stops the action of salivary amylase in stomach.

(ii) Kills the bacteria present in the food.

(iii) Activates pepsin.

(iv) Provides acidic medium.

Pepsin hydrolyses proteins into proteases and peptones.

Lipase enzymes hydrolyses small amounts of fats into fatty acids and glycerol.

Curdling of milk is done by the enzyme **rennin.** (Rennin is not found in human beings, it found only in cattles)

(c) **In small intestine :-**

The small intestine is the site of the **complete digestion** of carbohydrates, proteins and fats.

Food is mixed with three **digestive juices,** bile juice, pancreatic juice and intestinal juice.

Bile juice provide **alkaline medium** and **emulsifies fats** [conversion of larger fat globules into smaller fat droplets] but is a non enzymatic digestive juice so has no chemical action on food.

Pancreatic juice contains **trypsin, pancreatic amylase and pancreatic lipase** enzymes which digest the peptones, starch and fact into peptides, maltose and fatty acids.

Intestinal juice contains **amino peptidase, intestinal amylase, maltase, surcease and lipase** enzymes :-

$$\text{Peptides} \xrightarrow{Aminopeptidese} \text{Amino acid}$$

$$\text{Maltose} \xrightarrow{Maltase} \text{Two glucose}$$

$$\text{Fats} \xrightarrow{Lipase} \text{Fatty acid + Glycerol}$$

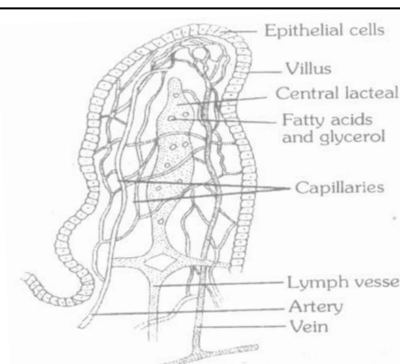


Diagram showing absorption of food in the intestine (single villus)

Lactose $\xrightarrow{Lacase}$ Glucose + Galactose

Sucrose $\xrightarrow{Sucrase}$ Glucose + Fructose

(iii) Absorption :-

Absorption of the digested food occurs though the epithelial surface of the villi & microvillus of small intestine.

★ Inner surface of small intestine is raised into 4 millions of finger-like folds called **villi.**

★ Each cell of villus is with electron microscopic processes called **microvillus.**

★ Each villus is with blood capillaries and a lymph capillary.

(iv) Assimilation :- It is a process by which absorbed nutrients are utilized to resynthesize complex molecules like carbohydrates, proteins and fats inside the cells.

(v) Egestion :- Removal of waste products from the body is known as **egestion**.

S.No.	Vitamin	Diseases due to deficiency	Symptoms of disease
1	Vitamin-A	Night blindness	Patient can't see in dim light or at night
2	Thiamine (Vitamin-B^1)	Beriberi	Reduced heart beat, muscles and nerves become weak.
3	Niacin (Vitamin-B^3)	Pellagra	Scaling on tongue and skin
4	Ascorbic acid (Vitamin-C)	Scurvy	Bleeding-gums, formation of spots on skin.
5	Calciferol (Vitamin-D)	Rickets in children and Osteomalacia in adults.	Bending of bone of legs.

S.No.	Name of the element	Main sources	Main functions
1	Sodium	Common salt, fish, meat, eggs, milk	Muscle contraction, neural impulse conduction.
2	Potassium	All food materials	Muscle contraction, neural impulse conduction.
4	Phosphorus	Milk, green leafy vegetables, millets, dry fruits. liver,	Strengthening of bones and teeth .
5	Iron	Liver, eggs, oat, green leafy vegetables	Formation of haemoglobin in blood
6	Iodine	Common salts, sea food, green leafy vegetable.	Goiter disease is caused due to deficiency of Thyroxin hormone.

POINTS TO BE REMEMBER

1. **Emulsification :-** Emulsification is the phenomenon of physically breaking of large sized fat globules into large number of fat droplets by the bile-salts of the bile juice. This increases the surface area for digestion of fats by lipase enzyme.

2. **Enzymes are classified into 3 groups :-**

(a)	Amylolytic enzymes	–	Carbohydrate digestion
(b)	Proteolytic enzymes	–	Protein digestion
(c)	Lipolytic enzymes	–	Lipid digestion

3. **Alimentary Canal :-** The digestive canal where the entire process of digestion a accomplished, called alimentary canal.

- It is the site for ingestion, digestion, absorption and Egestion of food material.
- In man it is about 7-8 meter long.
- The alimentary canal of herbivores is longer then the alimentary canal of carnivores, because herbivores have to digest the cellulose, which is difficult to digest.

4. **Mucus in stomach :-** Mucus is a viscous secretion. The mucus also forms a thick coating over the mucosal cells and prevents them from the harmful effects of HCl and pepsin.

5. Pepin is the chief photolytic enzyme.

6. **Castle's Intrinsic factor :-** This intrinsic factor is secreted by Fundic glands of the stomach mucosa. It combines with vitamin B_{12} [which is known as extrinsic factor].

The vitamin B_{12} from this combined complex can easily be extracted and absorbed by the intestinal mucosa. Intrinsic factor, thus, helps in the absorption of vitamin B_{12}.

7. **Colitis :-** An inflammation of the colon and rectum is called colitis. Inflammation of the mucosa reduces absorption of water and salts, producing watery, bloody faces and in severs cases, dehydration and salt depletion.

8. Digestion of proteins in man starts from stomach. In Buccal cavity there is no digestion of proteins because saliva contains no Proteolytic (protein digesting) enzyme.

EXERCISE # 1 FOR SCHOOL EXAM.

VERY SHORT ANSWER TYPE QUESTIONS :

1. Define nutrition.
2. Name the enzymes present in stomach.
3. Which part of the body secretes bile ? Where is bile stored ?
4. Define peristalsis.

5. What is emulsification of fat ?
6. Name the enzyme present in human saliva. What type of food material is digested by this enzyme ?
7. Define assimilation.
8. Name the most common method of ingestion in Amoeba.
9. Why is food vacuole of Amoeba celled temporary stomach ?
10. Name different types of teeth present in man.
11. Which part of alimentary canal is adapted for complete digestion and absorption of food ?
12. What is succus entericus ?
13. Name the largest gland of the human body.
14. Name the protein-digestion enzymes present in pancreatic juice of man.
15. What are the end-products of fat digestion ?
16. What structure prevents the entry of food particles into wind pipe ?

SHORT ANSWER TYPE QUESTIONS :

1. Describe various modes of nutrition.
2. Mention various steps of nutrition in Amoeba.
3. Draw the position of salivary glands in mouth.
4. What is the role of hydrochloric acid in our stomach ?
5. State two functions of large intestine of man.
6. What criteria do we use to decide whether something is alive ?
7. What are the differences between autotrophic nutrition and heterotrophic nutrition ?
8. How is the small intestine designed to absorb digested food ?
9. What is difference between ingestion and Egestion ?
10. How can the dental caries be prevented ?

FILL IN THE BLANKS :

1. Hard palate has transverse ridges, the ....
2. Human teeth are Thecodont, ...and ....
3. Man bears 4 kinds of teeth :
   (i) .... (ii) .... (iii) ....and (iv) ....
4. Bile and pancreatic ducts open into.......................
5. Villi are found in................and....................
6. Appendicitis is inflammation of ....
7. Man's three pairs of salivary glands are................and.................
8. Succus entericus is the secretion of ....
9. Enzymes enterokinase actives.......................
10. Kwashiorkor is the disease caused by extreme.....................deficiency.

EXERCISE # 2 OBJECTIVE QUESTION

1. Human beings are -
   (A) Omnivorous (B) Herbivorous (C) Carnivorous (D) Autotrophic
2. Gastric juice is –

(A) Acidic (B) Alkaline (C) Neutral (D) Slightly alkaline

3. Bile is produced and secreted by –

(A) Gall bladder (B) Pancreas (C) Spleen (D) Liver

4. The main function of intestinal villi is –

(A) Stimulate Peristalsis (B) Prevent anitperistalsis

(C) Provide large surface area for absorption (D) Distribute digestive enzymes uniformly.

5. Major function of HCl of gastric juice is –

(A) Providing acidic medium for pepsin (B) Kill microorganisms

(C) Dissolve food (D) Facilitate absorption of food

6. The end product of fat digestion is –

(A) Glucose (B) Fatty acids and Glycerol

(C) Amino acids (D) Alkaloids

7. The action of bile can be called –

(A) Oxidation (B) Emulsification (C) Esterification (D) Dehydrogenation

8. Saliva converts –

(A) Proteins into amino acids. (B) Glycogen into glucose

(C) Starch into maltose (D) Fats into vitamins

9. Which set is mixed with the food in small intestine ?

(A) Saliva, gastric juice, bile (B) Gastric juice, bile, pancreatic juice

(C) Bile, pancreatic juice, succus entericus (D) Bile, pancreatic juice and saliva

10. A good source of lipase is –

(A) Saliva (B) Gastric juice (C) Bile (D) Pancreatic juice.

11. Ptyalin is an enzyme present in –

(A) Gastric juice (B) Pancreatic juice (C) Intestinal juice (D) Saliva

12. Which one does not produce any digestive enzyme ?

(A) Pancreas (B) Liver (C) Stomach (D) Duodenum

13. The number of salivary glands present in human beings is –

(A) 5 pairs (B) 4 pairs (C) 3 pairs (D) 2 pairs

14. Largest gland in the body is –

(A) Liver (B) pancreas (C) Gastric gland (D) Adrenal

EXERCISE # 3 FOR COMPETITIVE EXAMS

1. Prorenin occurs in

(A) Saliva (B) Gastric juice (C) Pancreatic juice (D) Intestinal juice

2. Interokinase is found in

(A) Saliva (B) Gastric juice (C) Pancreatic juice (D) Intestinal juice

3. HCl of gastric juice is produced by

(A) Chief cells (B) Oxyntic cells (C) Goblet cells (D) Columnar cells

4. Bile is released by

(A) Gastrin (B) Secretin (C) Cholecystokinin (D) Enterocrinin

5. The digestion of food starts in the mouth where starch is converted into sugar by the action of

(A) Pepsin (B) Trypsin (C) Ptyalin (D) Surcease

6. Digestion is accomplished by a chemical process called

(A) Condensation (B) Hydrolysis (C) Deamination (D) Transamination

7. Which of the following organs are not directly connected to each other ?

(A) Esophagus-stomach (B) Buccal cavity-stomach

(C) Colon-rectum (D) Stomach-duodenum

8. The major anion present in the pancreatic juice obtained through the stimulating of Secretin is

(A) Chloride (B) Bromide (C) Phosphate (D) Bicarbonate

9. Chylomicrons that enter the lacteals are composed of –

(A) Triglycerides alone (B) Triglycerides around a protein core

(C) Protein coat around triglycerides (D) Proteins alone

10. Vitamin K is required for

(A) Change of prothrombin to thrombin (B) Synthesis of prothrombin

(C) Change of fibrinogen to fibrin (D) Formation of Thromboplastin

---

ANSWER KEY

EXERCISE # 1 **FOR SCHOOL EXAMS.**

Fill in the blanks

1. Rugae **2.** Heterodent, Diphyodont **3.** (i) Incisors (ii) Canines (iii) Premolars (iv) Molars

4. Duodenum **5.** Jejunum, Ileum **6.** Vermiform Appendices

7. Parotid, Sublingual and sub maxillary **8.** Intestinal glands

9. Trypsinogen **10.** Proteins

EXERCISE # 2 OBJECTIVE QUESTIONS

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ans.	A	A	D	C	A	B	B	C	C	D	D	B	C	A

EXERCISE # 2 OBJECTIVE QUESTIONS

1	2	3	4	5	6	7	8	9	10
B	D	B	C	C	B	B	D	C	B

NORTON IN PLANTS

Green plants are autotrophic. They synthesize their own food by the process of photosynthesis. Autotrophic plants are able to produce food so they are known as producers.

Photosynthesis :- Photosynthesis is a process by which green plants syntheses organic food (carbohydrate) from carbon dioxide and water using solar energy by chlorophyll pigments.

The sugar produced is strode is the form of starch in plants.

COMPETITION WINDOW

First true and oxygenic photosynthesis starts in Cyanobacteria (blue green algae).
90% of total photosynthesis is carried out by hydrophytes (mostly marine algae.)
"The process of absorption and conversion of light energy into chemical energy by green plants is called as photosynthesis".
This chemical energy is stored in the form of adenosine triphosphate (ATP) and reduced nicotinamide adenine dinucleotide phosphate ($NADH_2$).

Importance of photosynthesis :-

Photosynthesis is an anabolic process in nature for providing food supply to the living organisms .

It purifies the atmospheric air , by consuming CO_2 and evolving oxygen.

The over all equation of photosynthesis is :-

$$6CO_2 + 12H_2O \xrightarrow[Chlorophyll]{Sunlight} C_6H_{12}O_6 + 6H_2O + 6H_2O + 6O_2$$

Requirements for photosynthesis :-

(1) Sunlight **(2) Photosynthetic pigment** **(3) Carbon Dioxide** **(4) water**

CO_2 and water work as raw materials which are obtained from the atmosphere and the soil respectively.

1. **Sunlight :-** Sun is a natural source of light for photosynthesis .

Sunlight is an electromagnetic spectrum.

Photosynthetic pigments absorb only visible / white light from electromagnetic spectrum.

White light (380 nm to 160 nm) is composed of wavelength of seven different colors violet, indigo, blue, green, yellow, orange and red (VIBTGYOR).

COMPETITION WINDOW

Types of chlorophyll :-
There are six different types of chlorophyll : Chl.-a, Chl.-b, Chl.-c, Chl.-d, Chl,-e and bacteriochlorophyll .
Beside chlorophyll certain other pigments are also resent in plants like –
Carotenoid $\rightarrow$ Carotenes (orange colour) and xanthophylls (yellow colour).
Phycobilins : It is present in Blue- green algae and Red algae etc.

2. **Photosynthetic pigment :-** These are chlorophylls cartenoides (carotenes and xanthophylls) and Phycobilins. These pigments absorb only visible light.

Chl-a and b absorb only blue and red light and reflect green light .

3. **Carbon Dioxide:-**

All the plants need carbon dioxide to form carbohydrates. The carbon dioxide is obtained by the plants from the atmospheric air. In the terrestrial plants, the CO_2 enters into the cells of leaves through tiny pores called **stomata** which always remain present on the surface of leaves.

COMPETITION WINDOW

Compensation point
The intensity of light at which amount of CO_2 used during photosynthesis becomes equal to the amount of CO_2 released during respiration by plants is called as compensation point.
Compensation point occurs at low light intensity that is during morning and during evening hours.
The structure of guard cells in monocots is dumb-bell shaped.

Stomata :- These are tiny pores or microscopic aperture guarded by two kidney shaped or bean shaped guard cells.

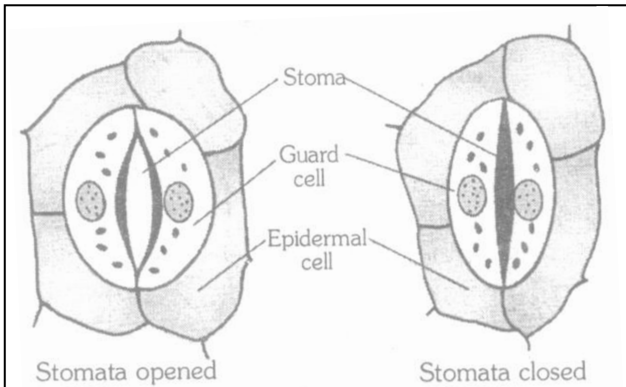
Functions :-

(i) Massive amount of a gaseous exchange take place in the leaves through stomata. Exchange of gasses also occurs across the surface of , root and leaves.

(ii) Large amount of water is lost through stomata.

Guard cells :- These are kidney shaped cells which cover single stoma. They contain chloroplast also.

Function :- They regulate the opening and closing of the stoma and also perform photosynthesis.



Opened and closed stomata

OPENING AND CLOSING OF STOMATA :-

When the guard cells swell due to the entry of water, the stomata gets opened. But when the guard cells shrink due to the loss of water, the stomata gets closed.

Do you know ?

Desert plants take up CO_2 at night and prepare an intermediate which is acted by the energy absorbed by the chlorophyll during the day and form glucose.

In aquatic plants, CO_2 is obtained from the water where it remains present in dissolved form. Such plants absorb carbon dioxide in solution form, all over their surface from the surrounding water.

4. Water :

Water is always needed by the plants for its use during photosynthesis.

Inside the chloroplasts of the leaves, the water molecules split into hydrogen and oxygen with the help of light energy of solar light.

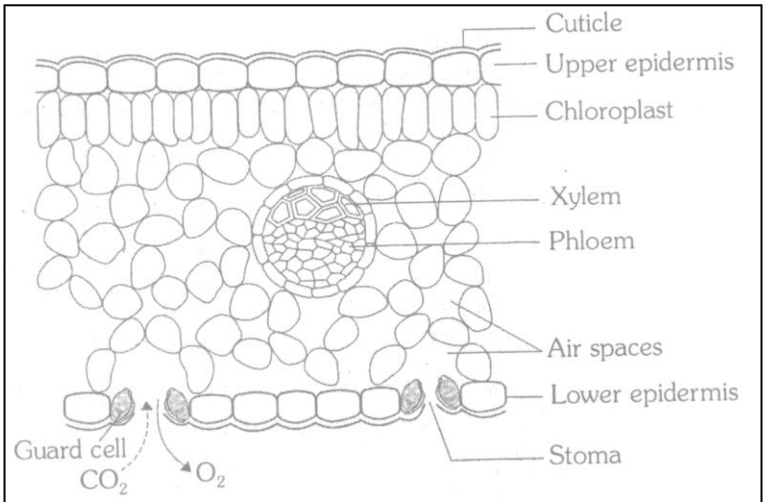
Some mineral salts like N, P, K, Fe, Mg required by the plants are also transported to different parts of the plant along with the water.

Nitrogen is an essential element used in the synthesis of proteins and other compounds (chlorophyll, DNA and RNA).

Nitrogen is taken up in the form of inorganic nitrates or nitrites which have been prepared by symbiotic bacterial from atmospheric N_2.

Site of Photosynthesis :- Green Plastid (Chloroplast or Kitchen of the cell).

When we observe the cross section of a leaf under microscope, we can see the Mesophyll cells full of green dots. These green dots are chloroplasts containing chlorophylls.



Cross section of leaf

COMPETITION WINDOW

Schimper classified plastids into 3 types or the basis of presence and absence of pigments. They are following

(a) Leucoplast :- They are colorless and generally found in those parts of the plants which are deprived of sunlight (underground parts).

(b) Chromoplasts :- They are colored plastids other than green. Chromoplast are abundantly present in the petals of flowers and abundantly present in the petals of flowers and provide them attractive colors.

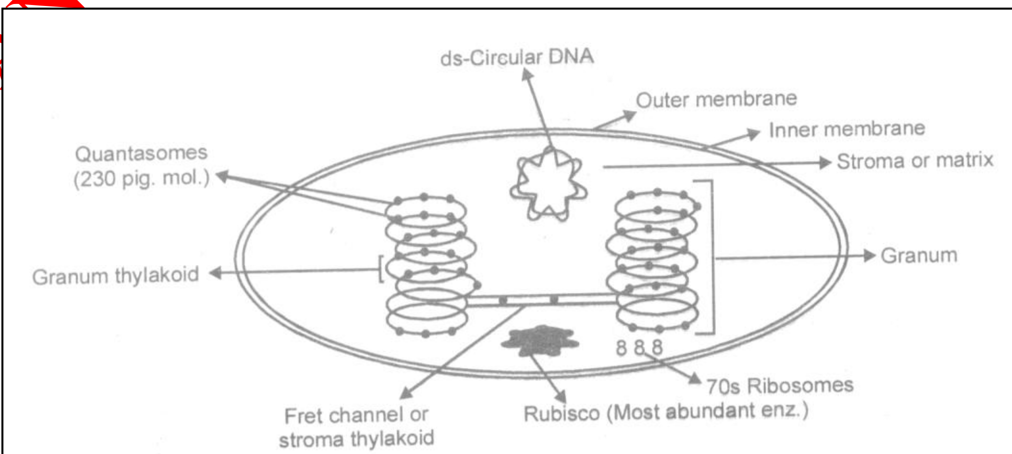
(c) Chloroplasts :- They are green colored plastids.

Plastids are found in all green cells except fungi and prokaryotes like bacterial and

Chloroplast :- They are green colored plastids. Their green colour is due to the presence of green pigments the chlorophylls. Each developed chloroplast has two distinct areas – grand and stroma.

Grana (Singular-granum) :- The light reaction of photosynthesis takes place in this part of chloroplast. In a granum large number of lamellae remain arranged like a stack of coins. These lamellae are called as **Thylakoid,** which contain chlorophyll pigments.

Stroma :- It forms the matrix of the chloroplast. The dark reactions of photosynthesis take place in stroma.



Chloroplast

MECHANISM OF PHOTOSYNTHESIS

During photosynthesis following events occur :-

(i) Absorption of light energy by chlorophyll.

(ii) Conversion of light energy into chemical energy and splinting of water molecule into hydrogen & O_2

(iii) Reduction of CO_2 to carbohydrates.

All these events can be categorized into two main phases :-

(A) Light phase (B) Dark phase

Dark reaction

$$6CO_2 + 12H_2O \xrightarrow[Chlorophyll]{Light\ energy} C_6H_{12}O_6 + 6H_2O + 6O_2$$

Light reaction

(A) Light reaction :- This step occurs inside Thylakoid membranes of chloroplasts. In this step firstly absorption of solar energy by chlorophyll molecules takes place. During light reaction, light energy breaks up water molecules into hydrogen and oxygen and this process is called photolysis of water.

Light energy converts into chemical energy in the form of ATP and $NADPH_2$.

Oxygen is relapsed as a by product of light reaction occurring during photosynthesis.

COMPETITION WINDOW

Light reaction was discovered by 'Robert Hill'. Therefore it is also called as **Hill's reaction.** Light reaction is a photochemical process.

Photophosphorylation :-

The process of formation of ATP in the presence of sunlight is known as photophosphorylation. Oxygen released during photosynthesis comes from water instead of CO_2 as was earlier thought .

(B) Dark reaction :- In this step synthesis of carbohydrates from carbon dioxide takes place. It is not light dependent hence it is celled as dark reaction.

This reaction occurs inside stroma of chloroplasts where light energy is not captured.

During this reaction, the chemical energy formed during light reaction (ATP and $NADPH_2$) is utilized for the fixation and conversion of carbon dioxide into simple carbohydrate, that is glucose.

The glucose molecules thus formed are further converted by the cellular machinery into various chemicals required by the plants.

COMPETITION WINDOW

Dark reaction was discovered by **Melvin Calvin and Benson** therefore it also called as Calvin Cycle.

Dark reaction is a thermo chemical reaction.

CO_2, $NADPH_2$, ATP, RUBP and Rubisco enzymes all are required in Dark reaction.

RUBP – Ribulose phosphate.

Rubisco – Ribulose phosphate carboxylase.

Difference between light and dark reaction

S.No.	Features	Light reaction	Dark reaction
1	Requirement of light	Required	Not required
2	Takes place inside	Thylakoid membranes of the chloroplast	The stroma region of chloroplast
3	ATP and $NADPH_2$	ATP and $NADPH_2$ are produced by the conversion of light energy into chemical energy	ATP and $NADPH_2$ formed during light reaction are used for the fixation of CO_2 into carbohydrate
4	Sugar formation	No sugar formation takes place	Sugar formation takes place
5	Release of oxygen	Oxygen is released	No oxygen is released

Factors affecting photosynthesis :-

(a) Light (b) Water (c) Temperature (d) CO_2 (e) Oxygen

(a) Light

The source of light for planet earth is sun, although some marine algae utilize the light of moon.

Out of the total solar energy , only 2% solar energy is used in photosynthesis.

The quality and intensity of light also affects photosynthesis.

Quality – Red and blue lights are most effective in photosynthesis.

But the rate of photosynthesis is maximum in red light.

There is no photosynthesis in presence of green light because green parts of plants reflect whole of the green light.

Intensity – The increase in intensity on light increases photosynthesis.

Intensity of sunlight $\propto$ Rate of photosynthesis

At very high light intensity the photosynthesis is decreased due to photo-oxidation of constituents (solarization).

(b) Water

Water is an essential raw material in photosynthesis. Only 1% of the absorbed water is utilized in photosynthesis. Less availability of water reduces the rate of photosynthesis. Under water deficient conditions the Stomatal aperture remains closed to reduce the loss of water by transpiration. As a consequence the entry of CO_2 is also stopped into the leaves.

(c) Temperature

The rate of photosynthesis increases by increases in temperature up to 40^0C. Above the temperature, there is a decrease in the photosynthesis. Similarly, low temperature also inhibits photosynthesis. The temperature affects photosynthesis by affection the activity of enzyme. We known that the dark reaction of photosynthesis involves several enzymes. These enzymes function at a specific of temperature. Low temperature lowers the activity of enzymes and high temperature causes inactivation of enzymes.

(d) Carbon-dioxide

Atmosphere is the main source of CO_2 for terrestrial plants.

In atmosphere CO_2 is present at the tune of 0.03%.

The rate of photosynthesis increases by increasing the concentration of CO_2. But after a certain limit, the excess concentration of CO_2. proves to be toxic to the cells.

(e) Oxygen

Over concentration of oxygen stops photosynthesis .

It increases the rate of respiration manifold and disturbs the excited condition of the chloroplast. In theses conditions photosynthesis is not possible.

COMPETITION WINDOW

Bacterial Photosynthesis

It is a special kind of photosynthesis in which solar energy is utilized for the synthesis of carbohydrates and H_2S is the hydrogen donor instead of water as in normal photosynthesis. So O_2 is not liberated in bacterial photosynthesis .

e.g. *Chlorobium* (Green sulphur), *Chromatium* (Purple sulphur), *Rhodospirilium, Rhodopseudomonas* (Purple non sulphur)

REVIEW QUESTIONS

1. Name two inorganic substances required by autotrophs to carry on photosynthesis.
2. What is chlorophyll ?
3. Name the pigments which can absorb solar energy.
4. What is stroma lamella ?
5. Name the pigment other chlorophyll, which can absorb sunlight energy.
6. What are Thylakoid ?
7. Name the two stages of photosynthesis.
8. What is granum ?
9. Name the gas used in photosynthesis.
10. Name the gas produced in photosynthesis.

EXERCISE # 1 (FOR SCHOOL EXAMS)

OBJECTIVE QUESTIONS :

1. Leaf is made up of :
(A) Palisade cells (B) Mesophyll cell (C) Guard cell (D) Parenchyma cell

2. Each stoma is guard by :
(A) Guard cell (B) Palisade cell (C) Mesophyll cell (D) Parenchyma cell

3. Mesophyll consists of :
(A) Spongy parenchyma cell (B) Palisade parenchyma cell
(C) Both (A) and (B) (D) None of these

4. Xerophytes have :
(A) Stomata on both sides of leaf (B) Stomata on one side of the leaf
(C) Sunken stomata (D) No stomata

5. Stomata controls :
(A) The loss of food material from the plant (B) The loss of water from the plant
(C) The loss of air from the plant (D) The loss of energy from the plant

6. Each guard cells contain :
(A) Leucoplasts (B) Chloroplasts (C) Starch (D) Oil and protein granules

7. Grana are present inside :
(A) Mitochondria (B) Golgi bodies (C) Chloroplast (D) Ribosome

8. In dark, the guard cells are :
(A) More turgid (B) Not turgid (C) Less turgid (D) None of these

9. In dicot plants, stomata are found in :
(A) Lower and upper surface of the leaf (B) Lower surface of the leaf
(C) Tip of the leaf (D) Upper surface of the leaf

10. The shape of stomata in monocot plant is :

(A) Kidney shape (B) Dumb-bell shape (C) Bean shape (D) Heart shape

11. In aquatic plant – *Hydrilla* stomata are :

(A) Present on leaves (B) Present on stem (C) Present on roots (D) Absent

12. The following light witch is more effective in opening of stomata :

(A) Green (B) Red (C) Blue (D) (B) and (C) both

13. In light phase of photosynthesis there is formation of –

(A) ATP (B) $NADPH_2$

(C) Both ATP and $NADPH_2$ (D) Carbohydrates.

14. Photosynthesis proceeds in sequence of –

(A) Dark phase and light phase (B) Light phase alone

(C) Light phase and dark phase (D) Dark phase alone

15. The energy change in photosynthesis is from –

(A) Light energy to electrical energy (B) Light energy to molecular energy

(C) Light energy to chemical energy (D) Light energy to activation energy.

16. Photosynthetic pigments are located in the chloroplast in –

(A) Intrathylakoid space (B) Thylakoid membranes

(C) Intermembrane space (D) Inner membrane of envelope

17. The oxygen in photosynthesis is released from –

(A) CO_2 (B) H_2O (C) Carbohydrate (D) Chlorophyll

18. The process in which water is split during photosynthesis is –

(A) Photolysis (B) Hydrolysis (C) Plasmolysis (D) Hemolysis

19. Dark reaction of photosynthesis occurs in –

(A) Grana (B) Stroma (C) Matrix (D) Cytoplasm

20. In bacterial photosynthesis, the hydrogen donor is –

(A) H_2O (B) H_2SO_4 (C) NH_3 (D) H_2S

MATH THE COLUMN :

1. Match the contents of the columns-I, II and III (Double matching)

Column-I		Column-II		Column-IIII	
(1)	Water split into	(A)	Chemical energy	(P)	Photolysis
(2)	CO_2	(B)	Hydrogen and oxygen	(Q)	Raw materials for photosynthesis
(3)	White light	(C)	Water	(R)	Electromagnetic spectrum
(4)	Light energy	(D)	VIBGYOR	(S)	Photosynthesis

TRUE AND FALSE :

1. Rate of photosynthesis the maximum in green light.
2. Oxygen and water are the raw material for photosynthesis.
3. CO_2 is release as a by product of light reaction.
4. Dark reaction occurs inside the stroma of chloroplast.
5. In photosynthesis chemical energy converts into light energy .
6. Guard cells regulate the opening and closing of stomata.
7. White light is composed of seven different colour.
8. Light reaction takes place in the presence of light.

FILL IN THE BLANKS :

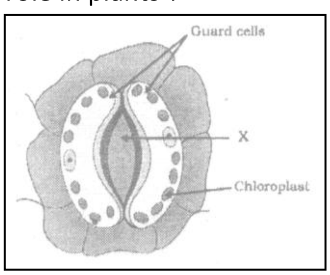
1. …………………is a natural source of light for photosynthesis.
2. Photosynthetic pigments absorb only ………………………light from electromagnetic spectrum.
3. Chl-a and b absorb only ……………………light and reflect …………………..light .
4. "The process of absorption and conversation of …………………energy into…………..energy by green plants is called as photosynthesis".
5. …………….regulate the opening and closing of ht stoma and also perform photosynthesis.
6. When the guard cells swell due to the entry of water, the stomata gets …………………….
7. The water molecules split into hydrogen and oxygen with the help of…………energy.
8. ……………………is released as a by product of light reaction occurring during photosynthesis.
9. ……………………reaction occurs inside stroma of chloroplasts where light energy is not captured.
10. At very high light intensity the photosynthesis is . ……………………….

VERY SHORT ANSWER TYPE QUESTION :

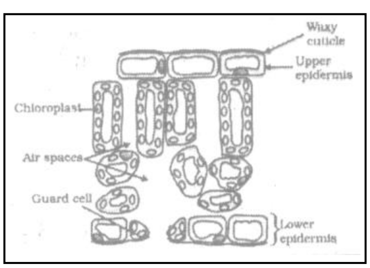
1. Name the factors which affect photosynthesis.
2. Write complete reaction of photosynthesis.
3. Name any two types of pigment present in plants which can absorb sun light energy.
4. Name the cellular organelle where photosynthesis process occurs.
5. Give the function of guard cells.

LONG ANSWERS TYPE QUESTIONS:

1. Look at the figure and identify X. What is its role in plants ?



2. Which is the site of Photosynthesis ? In the given figure showing a section of leaf as seen under microscope. What is role of waxy layer on upper epidermis ?



3. Look at the figure. Answer the following questions

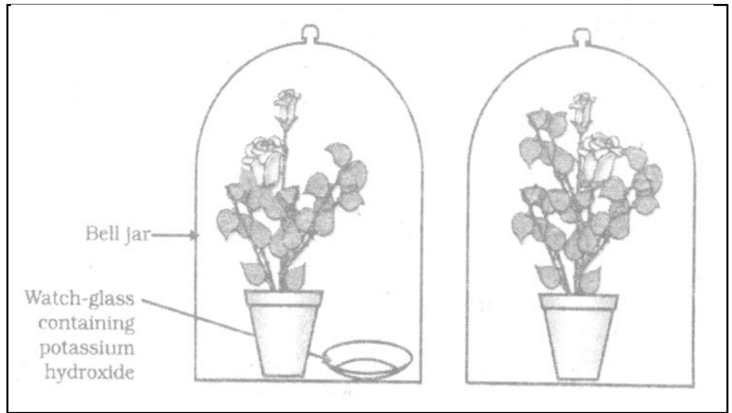
(a) What is the need to use potassium hydroxide

(b) Why do we need tow plants ?

(c) Why do we cover both plants with polyanthuses sheets or bell jars ?

(d) What observation do you expect at the end of experiment and why ?

(e) What is the aim of activity ?



4. If plant is kept covered with a polythene sheet, we notice some water drops on the inner side of the sheet after some time. What are they due to ? Name and define the process. What is the significance of this process in plants and nature ? How does transpiration help in upward movement of water from roots to leaves ?

5. An activity was performed in the laboratory to show that chlorophyll is necessary for photosynthesis. Now answer the following question :

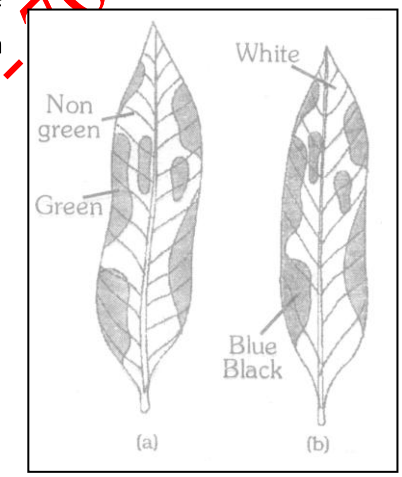
(a) What king of leaf has been used in this activity ?

(b) Wow do we de-starch a plant ?

(c) Why is the leaf heated in alcohol ?

(d) What precautions should be taken while heating the alcohol and why ?

(e) State reason for observation as shown in (ii) .



EXERCISE # 2 (FOR COMPETITIVE EXAMS)

1. The function of leaf in a plant is :

(A) Respiration (B) Transpiration (C) Photosynthesis (D) All the above

2. Leaves are destarched by keeping the plant in :

(A) 10-12 hours in night (B) 10-12 hours in day

(C) 2 hours in sun light (D) Only 2 hours in night

3. Covering with black strips should be tested for presence of :

(A) Water in leaf (B) CO_2 in leaf (C) O_2 in leaf (D) Starch in leaf

4. The type of starch produced during photosynthesis is :

(A) Polysaccharides (B) Monosaccharide (C) Oligosaccharides (D) None of these

5. If the intensity of light is increased, the rater of photosynthesis :

(A) Decreases into certain limit (B) Increases into certain limit

(C) Remain the same (D) Increase and decreases at regular at regular interval

6. The colour of light in which rate of photosynthesis is minimum :

(A) Red light (B) Blue light (C) Green light (D) Yellow light

7. Chlorophyll-a present in :

(A) Algae (B) Bacteria (C) Croton (D) Both (A) and (C)

8. A non-green cell will not have the following activity :

(A) Required water (B) Evolve carbon dioxide

(C) Requires carbohydrates (D) Evolve O_2

9. The teacher instructed a student to place a healthy potted shoe flower plant in a dark room for 24 hour prior to an experiment on photosynthesis. The purpose of placing it in a dark rook is :

(A) To increase the intake of CO_2 (B) To activity the chloroplast in the leaves

(C) To destarch the leaves (D) To denature the enzymes in the leaves

10. During light reaction photosynthesis pigments chlorophyll-a absorbs visible light energy in the form of :

(A) Quanta or photons (B) Electrons (C) Protons (D) Neutrons

NUTRITION IN PLANT **ANSWER KEY** **EXERCISE # 1**

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	C	C	B	B	C	B	B	B
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	D	C	C	C	B	B	A	B	D

- **MATCH THE FOLLOWING :**

1-(B,P), 2-(C,Q), 3-(D,R), 4-(A,S)

- **1.** F **2.** F **3.** F **4.** T **5.** F **6.** T **7.** T **8.** T

- **FILL THE BLANKS :**

1. Sun **2.** White / Visible **3.** Blue and Red, Green **4.** Light, Chemical
5. Guard Cells **6.** Opened **7.** Light **8.** Oxygen **9.** Dark
10. Decreased

- **VERY SHORT ANSWER QUESTIONS :**

1. Light, Water, Temperature, CO_2 **2.** $6CO_2 + 12\ H_2O \xrightarrow[Chlorophyll]{Sunlight} C_6H_{12}O_6 + 6H_2O + 6O_2$

3. Chlorophyll and Carotenoid **4.** Chloroplast

5. Regulates opening and closing of stomata

EXERCISE # 2

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	D	A	D	A	B	C	D	D	C	A

RESPIRATION

All living organisms need energy to carry out their functions. The digested food is absorbed. The absorbed food components are subsequently assimilated in the body cells. these assimilated molecules hold energy in their chemical bonds. Their bond energy is released by oxidation in the cells. the process of oxidation is carried out with the help of oxygen .

Energy is released in this process. This energy is trapped by forming bonds between ADP (Adenosine diphosphate) and inorganic phosphate (Pi) to synthesize ATP (Adenosine triphosphate) molecules.

- **Breathing :**
The process involving intakes of air or oxygen [inspiration] and removal of air or carbon dioxide [expiration] is called breathing. No enzymes are involved in this process.

- **Respiration :**
The process of respiration involves taking in oxygen (or air) into the cells, using it for releasing energy by burring by food, and then eliminating the waste products (carbon dioxide and water) from the body.

OR

The process of acquiring oxygen from outside the body and to use it in the process of break-down of food sources for cellular needs, is called Respiration.

$C_6H_{12}O_6$(Glucose)+$6O_2 \longrightarrow 6H_2O+6CO_2$+Energy (in the from of ATP) Respiration is actually a biochemical process which occurs in stages and requires many enzymes.

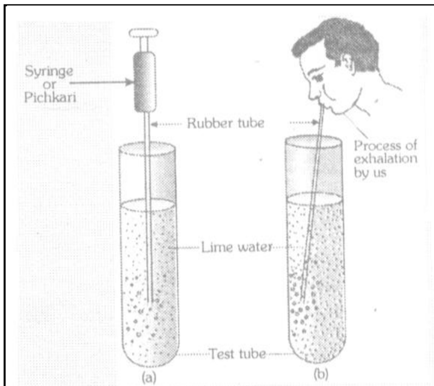
Environment	Environment
↑	↓
[Foul air in comparison to inhaled air Less% of CO_2 More% of CO_2]	[Fresh air More% of CO_2 Less% of CO_2]
↑	↓
Lungs	Lungs
↑ CO_2	↓ O_2
Blood	Blood (Hb + O_2)
↑	↓ O2
Tissue Fluid	Tissue Fluid
	↓
↑ $CO_2 \xleftarrow[\text{of food}]{\text{Oxidation}}$ Cells	

Flow chart of Respiration

- **Differences Between Breathing and Respiration :**

	Breathing		Respiration
1.	It is a physical process. It involves inhalation of fresh air and exhalation of foul air	1.	It is a biochemical process. It involves exchange of respiratory gases and also oxidation of food.
2.	It is an extracellular process.	2.	It is both an extracellular as well as intracellular process.
3.	It does not involve enzyme action.	3.	It involves a number of enzymes required for oxidation of food.
4.	It does not release energy, rather it consumes energy.	4.	It releases energy.
5.	It is confined to certain organs only	5.	It occurs in all the cells of the body.

Activity : To study the release of carbon dioxide during exhalation.
Take a hard glass test tube. Fill 3/4 th of this tube with freshly prepared lime water.
Close the mouth of test tube with a cark having a thin hole. Insert one thin glass through cork up to the bottom of the test tube. Make the apparatus airtight.



(a) passing of air into the lime water with a syringe
(b) Blowing of air into lime water

Now breathe out air from the mouth in the test tube through the glass tube.
We will observe that on exhaling through the tube, the limewater turns milky. This proves that exhaled air contains CO_2.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

Lime water — Calcium carbonate (milky)

RESPIRATORY SUBSTRATES :-

In respiration many types of high energy compounds are oxidized. These are called **respiratory substrates** and may include **carbohydrates. fats and proteins.** Of these, carbohydrates such as **glucose, fructose** (Hexose) sucrose (disaccharide) are the main substrates. Hexose are the first energy rich compounds to be oxidized during respiration. Complex carbohydrates are hydrolyzed into hexose sugars before being utilized as respiratory substrates.

Under certain conditions (mainly when carbohydrate reserves have been exhausted) fats are also oxidized. In the absence of carbohydrates and fats, proteins also serve as respiratory substrates. **Blackman** termed the reparatory oxidation of carbohydrates as **floating respiration** and that of protoplasmic protein as **protoplasmic respiration.**

Respiration and Combustion : Combustion of wood, coal , paper, etc., are also oxidation processes like respiration which also involve releases of energy in the form of heat. But respiration and combustion differ in many fundamental futures.

Oxidation of carbohydrates during respiration is not a single reaction because there is no enzyme that can catalyze the complete of glucose into carbon dioxide and water in a single step. Instead, the oxidation of glucose consists of a sequence of reactions. In such step wise oxidation energy is released slowly. It allows cells to capture more energy than would be possible if the energy is released in one big burst.

Differences Between Respiration and Combustion		
S.No	**Respiration**	**Combustion**
1	It is a vital process.	It
2	Energy is released bit by bit.	All the energy is released suddenly.
3	There is very small rise in temperature	There is large increase in temperature
4	The energy released during respiration is again stored I chemical compounds. (e.g. ATP)	Most of the energy released is lost in the form of heat.
5	Respiratory reactions are regulated by enzymes.	Enzyme are not present.

Types of respiration : Process of respiration can be divided into the following two categories :
AEROBIC RESPIRATION :- When oxygen is used for respiration it is called aerobic respiration.

$$\text{Glucose} \xrightarrow[\text{(in cytoplasm)}]{\text{Glycolysis}} \text{Pyruvate or Pyruvic acid} \xrightarrow[\text{(in Mitochondria)}]{\text{Oxygen}} 6CO_2 + 6H_2O + \text{Energy [38 ATP]}$$

(1 molecules)   (2 molecules)

Mechanism of Respiration :- The mechanism of respiration involves following two processes :

(i) **Glycolysis – a series of reactions which does not require oxygen and by which glucose molecule is broken into Pyruvic acid.**

(ii) **Further breakdown of Pyruvic acid molecules by aerobic (in the presence of oxygen) or anaerobic (in the absence of oxygen) methods.**

Respiration involves stepwise breakdown of glucose by a series of reactions in which the energy is released in some of the Exergonic steps. Glucose, the most common respiratory substrate, may be broken either aerobically or anaerobically. Both processes start the same way by using the anaerobic reaction pathway called **Glycolysis.** Under aerobic conditions the products of Glycolysis are completely oxidized and CO_2 and H_2O are formed as the end products, and under anaerobic conditions alcohol or lactic acid CO_2 are produced.

Breakdown of Pyruvic acid in the presence of oxygen :
In the presence of oxygen the Pyruvic and is completely oxidized and CO_2 and H_2O are formed as the end products. This oxidation is carried out by a cyclic series of reactions known as **tricarboxylic acid cycle** or **citric acid cycle or**

Krebs cycle. All reactions of Krebs cycle occur within mitochondria. Complete oxidation of each Pyruvic acid molecule produces 15 ATP molecules, therefore, **aerobic oxidation of each glucose molecule produces :** 15 × 12 = 30 ATP (from Krebs cycle) + 8 ATP (from Glycolysis) = 38 ATP

ANAEROBIC RESPIRATION :-

When food is oxidized without using molecular oxygen, the respiration is called anaerobic respiration. In this type of respiration incomplete oxidation of food takes place and in comparison to aerobic respiration, much less amount of energy is produced. It also includes Glycolysis which takes place in the cytoplasm. During this process one molecule of glucose is degraded into two molecules of Pyruvic acid (pyruvate) and little energy (2 ATP).
The Pyruvic acid is further oxidized into ethyl alcohol (ethanol) or lactic acid.

Differences between aerobic and anaerobic respiration :

S.No.	Features	Aerobic Respiration	Anaerobic respiration
1	O_2 requirement	O_2 required	Not required
2	Occurs in	Cytoplasm and mitochondria	Cytoplasm
3	Breakdown	Complete breakdown of glucose takes place	Incomplete breakdown of glucose takes place
4	End products	CO_2 and H_2O	CO_2 and ethyl alcohol or lactic acid
5	Energy produced from one glucose molecule	38 ATP	2 ATP

Fermentation : Fermentation is a kind of anaerobic respiration, carried out primarily by fungi and bacteria. A special feature of fermentation is that the substrate lies outside the cell in a liquid medium. Literally, fermentation refers to a chemical change accompanied by **effervescence.**
In fermentation anaerobic breakdown of carbohydrates and other organic compounds occur and form alcohol, organic acids, gases etc.

$$\text{Glucose} \xrightarrow[\text{(in cytoplasm)}]{\text{Glycolysis}} \underset{\text{(2 molecules)}}{\text{Pyruvate}} \xrightarrow[\text{(yeast)}]{\text{No } O_2 \text{ requrired}} \text{Ethanol} + CO_2 + \underset{\text{(2 ATP)}}{\text{Energy}}$$

In certain bacteria and parasitic worms (Ascaris, tapeworm) glucose is metabolized to lactic acid without the use of O_2 and without the formation of CO_2.
In human beings, anaerobic respiration occurs in certain tissues such as RBC of mammals and skeletal muscles.

$$\text{Glucose} \xrightarrow[\text{(in cytoplasm)}]{\text{Glycolysis}} \text{Pyruvate} \xrightarrow[\text{(in cytoplasm)}]{\text{No } O_2 \text{ required}} \text{Lactic acid} + \text{Energy (2 molecules)}$$

Glucose
(6-carbon molecule)
↓ In cytoplasm (Glycolysis)
Pyruvate
(3-carbon molecule + energy)

Absence of oxygen (In yeast) → Ethanol + Carbon dioxide + energy (2-C compound)

Lack of oxygen (In muscle tissue) → Lactic acid + energy (3-C compound)

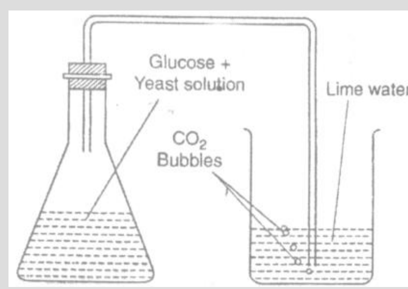
Presence of oxygen (In mitochondria) (Krebs cycle) → Carbon dioxide + water + energy

Breakdown of Glucose by Various Pathways (Aerobic and anaerobic respiration)

Differences Between Respiration and Fermentation.		
S.No.	**Respiration**	**Fermentation**
1	It may occur both in the presence and absence of oxygen.	It does not require oxygen.
2	Occurs only in living cells.	It does not occur within the living cells. It requires only enzymes and substrate.
3.	Sugar is oxidized and CO_2 and H_2O are formed as end products.	Different substrates are oxidized to form alcohol or organic acids.
4	Complete oxidation of substrates occurs, hence produces large amount of energy .	Incomplete oxidation of substrates occur and , hence less energy is produced.
5	It can occur in any living cell.	It occurs mainly with the help of yeast or bacterial cells.

Comparison Between Oxidative Phosphorylation and Photophosphorylation		
S.No.	**Oxidative photophosphorylation**	**Photophosphorylation**
1	This process occurs during respiration	It occurs during photosynthesis.
2	It occurs within mitochondria.	It occurs in the chloroplasts.
3	ATP is synthesized in the F_1 particles located on the cristae in the inner mitochondria membrane.	ATP is synthesized on the lamellae of the chloroplast.
4	This Phosphorylation requires oxygen	It does not require oxygen but is related to photosystem-I and photosystem-II

Experiment :- To demonstrate the process of fermentation.



Method :- take some fruit juice or sugar solution in a test tube and add some yeast into it. Close the opening of test tube with a one holed cork. Insert a bent glass tube in the cork and dip the other end of tube into the other test tube containing lime water (solution of calcium hydroxide). Observe after few hours.

Observation and conclusion :- The lime water turns milky. This shown that CO_2 is liberated from the mixture of sugar solution and yeast. Fermentation of sugar results in the production of ethyl alcohol and CO_2.

Organs of Respirations :

1. **Skin** or general body surface , as in earthworm.
2. **Air tubes** or **trachea,** as in insects (grasshopper, cockroach, housefly)
3. **Gills** as in aquatic animals like fish and prawn.
4. **Lungs** as in land animals like frog, lizard, birds, rat, humans.

Frog respires through skin as well as lungs (being amphibious).

It is worth nothing that all respiratory organs whether skin, trachea, gills or lungs have three common features.

1. All the respiratory organs have a large surface area so as to get enough oxygen.
2. All have thin walls for easy diffusion and exchange of respiratory gases.

3. The respiratory organs like the skin, gills and lungs have a rich blood supply for transport of gases. In the tracheal system air reaches cells directly and blood plays no role in the transport of gases.

As a medium water is less suitable for respiration in comparison to air. Water is more dense (about 1000 times) than air and thus more energy is needed in passing it over the respiratory surface. Also since solubility of oxygen is very low in water, under similar conditions a given volume of water contains less amount of oxygen in comparison to same volume of air which contains more oxygen. Another problem faced in aquatic environments is that less oxygen is available in water as the temperature increase. Warm water contains less oxygen. However, as the temperature increases the rate of respiration increases and the animal requires more oxygen to meet with the metabolic demand.

Just as the animals in aquatic habitats have developed adaptations to tide over the problems. the terrestrial animals also have to adapt to the problems such as protection to the respiratory surface from dryness and maintaining the respiratory surface always moist. The air has an evaporative power and the air breathing land animals loose plenty of water by evaporation from the respiratory surface.

(a) Respiration through gills – Bronchial respiration

(b) Respiration through skin – Coetaneous Respiration

(c) Respiration through Lungs – Pulmonary Respiration

Respiratory organs in frogs :-

(i) Skin (iii) Bucco-pharyngeal cavity (iii) Lungs

DIFFERENCES BETWEEN RESPIRATION IN PLANTS AND ANIMALS

S.No.	Respiration in plants	S.No.	Respiration in animals
1	Respiration is carried out by all parts of the plants i.e., roots, stem, leaves.	1	Respiration occurs only in the reparatory organs.
2	It occurs at slower rate.	2	It is faster in animals .
3	In plants, there is little transport of gases to various part of the plant.	3	Transport of gases to various parts is more.
4	Products of anaerobic respiration of glucose in plants are ethanol and CO_2.	4	Products of anaerobic respiration of glucose is lactic acid and no CO_2.
5	There is no special gas transport system.	5	Blood transports oxygen .
6	Green plants have additional oxygen source from photosynthesis.	6	Animals do not have any additional source of oxygen.

DIFFERENCES BETWEEN PHOTOSYNTHESIS AND RESPIRATION.

S.No.	Characters	Photosynthesis	Respiration
1	**Site**	**It takes place in green cells of plats.**	**It takes place in all living beings.**
2	**Time**	**It occurs during day time**	**It occurs throughout the life of an organism.**
3	**Energy**	**Stored**	**Released**
4	**CO_2 and H_2O**	**Used up**	**Released**
5	**Food and oxygen**	**Produced**	**Used up**
6	**Dry weight**	**Increased**	**Decreased**
7	**Metabolism**	**Anabolic process**	**Catabolic process**

Q.1 What advantage does a terrestrial organism have over an aquatic organism with regard to obtaining oxygen for respiration ?

Ans. Terrestrial animals breathe the oxygen in the atmosphere, but animals that live in water such as fishes need to use the oxygen dissolved in water.

Since ht amount of dissolved oxygen is fairly low compared to the amount of oxygen in the air, the rate of breathing in aquatic organic is much faster than that seen in terrestrial organisms.

Q.2 What are the different ways in which glucose is oxidized to provide energy to various organisms?

Ans. In all organisms the first step in which glucose is oxidized is the breakdown of glucose, a six carbon molecule, into a three-carbon molecule pyruvate. This process takes place in cytoplasm.

The fate of pyruvate depends upon the presence or absence of oxygen.

Pyruvate may be converted into ethanol and carbon dioxide in the absence of oxygen. This process takes place in yeast during fermentation. It is called anaerobic respiration.

Q.3 Compare the functioning of alveoli in the lungs and Nephrons in the kidneys with respect to their structure and functioning.

Ans. Both alveoli in the lungs and Nephrons in the kidneys possess network of blood capillaries. The exchange of gases takes place in alveoli where impure blood (deoxygenated blood) is purified to oxygenated blood, similarly the Nephrons purify the blood by filtering out its waste products in the from of urine.

Q.4 What is difference between emphysema and asthma ?

Ans. Emphysema is caused by the gradual breakdown of the thin walls of the alveoli so that the air spaces becomes larger and the total gaseous exchange diseases. Asthma is a form of difficult or heavy breathing caused by spasm f smooth muscle in the walls of bronchioles.

Respiration in human :

External nostrils $\longrightarrow$ Nasal cavity $\longrightarrow$ Pharynx $\longrightarrow$ Larynx $\longrightarrow$ Trachea $\longrightarrow$ Bronchi $\longrightarrow$ Bronchioles $\longrightarrow$ Alveolar sacs.

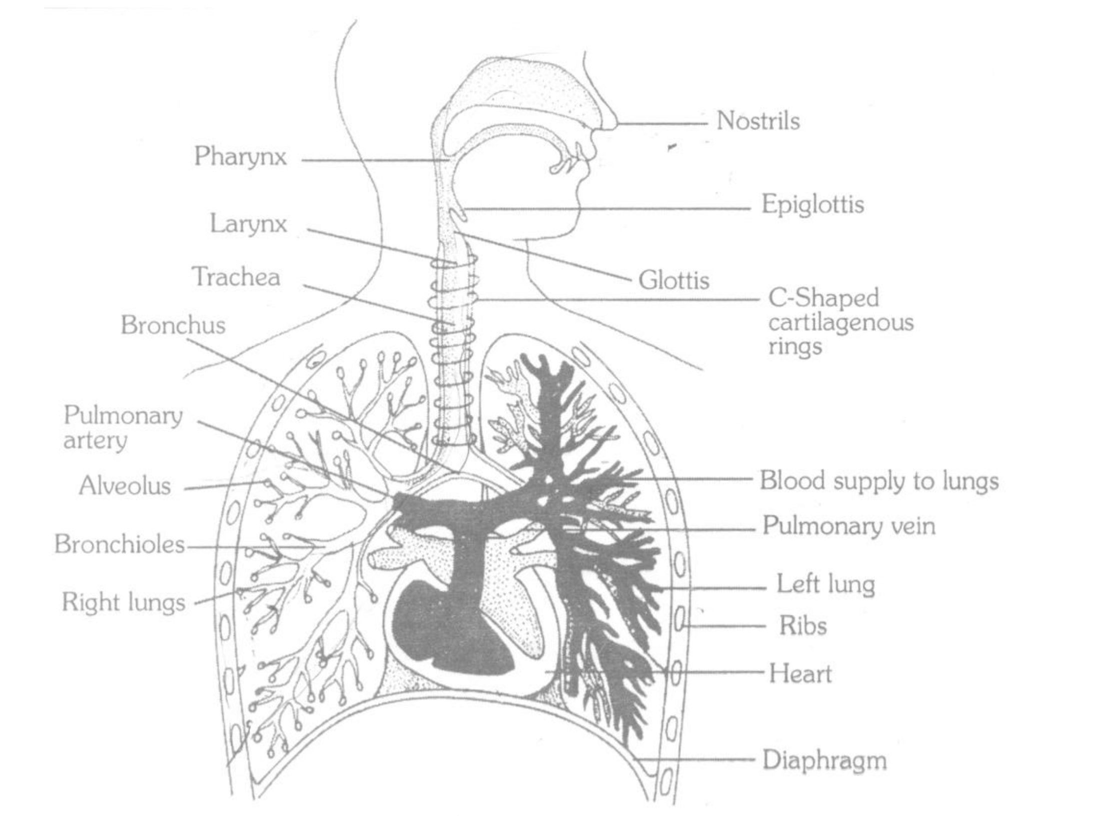
1. **The respiratory tract :-** The respiratory tract of human respiration system begins from a pair of external nostrils situated at the lower end of the nose. The air enters through the nostrils and reaches into a pair of nasal cavities. The two nasal cavities are separated from each other by a nasal septum. The nasal cavities are separated from the oral cavity by a bony palate. It is due to this reason we can breathe in air while we eat. The nasal passages are linked by ciliated epithelium and mucus secreting cells, so that the inspired air get warmed, moistened and becomes dust free. The dust particles are entrapped in the mucus secreted by mucus cells. Nasal cavity is also lined with **olfactory epithelium** which acts are organ of smell. The nasal chambers open into pharynx through internal nares.

The pharynx is a short vertical tube located in the head at the back of Buccal cavity. It provides passage into which the internal and nares and Buccal cavity open to pass the air into it. The pharynx provides passage into trachea or wind pipe through a slit like aperture, called **glottis.** The glottis always remains open except during swallowing. The glottis bears a leaf like cartilaginous flap, the **epiglottis,** at its anterior margin. During swallowing, the epiglottis closes the glottis to glottis to check the entry of food into it. Entry of food into the respiratory tract can be fatal.

Trachea is about 11 cm in length and 2.5 cm in diameter. Its wall has incomplete (C-shaped) cartilaginous rings, which prevent the trachea from collapsing even if there is not much air in it. Trachea is lined internally by ciliated epithelium and mucus secreting cells. The mucus and cilia both prevent the entry of dust particles and microbes. Trachea runs down the neck and extends into thoracic cavity.

On entering the thoracic cavity, trachea divides into bronchi (singular : bronchus). On entering the lungs the right bronchus enter into right lung and left bronchus energy into left lung.

2. **The voice box :-** The voice box is also called **larynx.** It is an enlarged upper part of trachea. Before puberty, the larynx is inconspicuous and similar in both sexes. In males, if often becomes prominent and protrudes out and often called **"Adam's apple".** In side the larynx are the two vocal cords. These are folds of mucous membrane that extend into the lumen from the sides. Vibration in the vocal cords results in the production of sound which is altered and converted into speech with the help of Buccal cavity, soft palate, tongue and lips.



Respiratory system in man

3. **Lungs :-** The lungs are a pair of spongy, highly elastic, solid and bag-like organs. They are roughly cone-shaped and situated in the thoracic cavity. The lungs enclosed by a double layered membrane or covering called **pleura.** The pleural membranes are separated by a thin space filled with pleural fluid which lubricates the membrane to avoid friction.

Within the lung, each bronchus divides and redivides to form finer branches called **bronchioles.** Each bronchus with all its branches is called **bronchial tree.** After repeated divisions each bronchiole ends into a cluster of tiny air chambers called air sacs or **alveoli**.

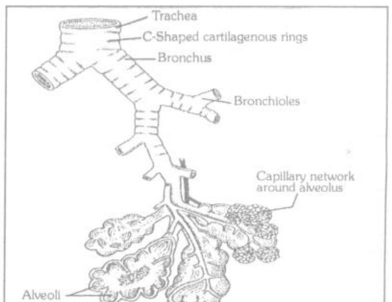


Diagram showing organs involved in exchange of gases i.e., alveoli and network of capillaries

Alveoli are functional units of as these are **actual site of respiratory exchange.**

There are about 750 million of alveoli present in lungs which have a total surface area of about 80 m^2. Alveoli are covered with a network of capillaries.

Mechanism of Breathing :- Lungs cannot expand or contract of their own. The contraction and expansion of lungs is brought about by diaphragm muscles and external intercostals muscles.

(a) **Inhalation (Inspiration) :-** Inhalation is intake of fresh air form outside into the alveoli of the lungs. It occurs by expansion of lungs which is brought about by enlargement of thoracic cavity. Inhalation involves the following steps :-

1. The diaphragm (a sheet of tissue that separates thoracic cavity from abdominal chamber) muscle contracts so that the diaphragm lowers down and becomes flat.

2. Lowering of diaphragm pushes the abdominal viscera downward resulting in the enlargement of thoracic cavity vertically.

3. External intercostals muscles contract so that the ribs and sternum are pulled upward and outward. This causes enlargement of thoracic cavity.

4. Enlargement of thoracic cavity results in the expansion of lungs.

5. Expansion of lungs reduces the pressure of air inside so that fresh air is pulled from outside into the lungs passing through nostrils, trachea and bronchi.

6. Fresh air has a rich supply of O_2 which goes into the blood passing through thin membranes of alveoli and blood capillaries. As a result the blood in the capillaries becomes loaded with oxygen and expels carbon dioxide into the alveoli for exhalation.

(b) **Exhalation [Expiration] :-** The mechanism of berating out of carbon dioxide is called exhalation.

1. During exhalation, the phrenic muscle of the diaphragm relaxes so that the abdominal viscera pushes the diaphragm upward, making it convex.

2. The external intercostals muscles also relax with the result the thoracic cavity is educed in sized and lungs also contract.

3. Contraction of lungs raises the air pressure so that foul air moves out.

An average rate of breathing in a normal adult man is 15 to 18 times per minute.

EXCHANGE OF GASES

Breathing is the first step of respiration which involves exchange of gases between the air in alveoli and the blood capillaries (around the alveoli). In this exchange, the blood takes up oxygen from the alveolar air and releases CO_2 to the alveolar air. This exchange of gases is called **external respiration** and results in the oxygenation of blood. the heart supplies the oxygenated blood to he body tissues.

The living cells perform oxidation of simple food (glucose) to release energy. This s the process of **aerobic respiration,** which utilizes O_2 and releases CO_2. The aerobic respiration occurs partly in the cytosol and partly in the mitochondria of cells. This catabolic process is called cellular respiration.

The concentration of C_2 is more in the blood and less in the tissue cells. So, the O_2 moves from blood to the tissues by the physical process of **diffusion.** Similarly, CO_2 concentration is more in tissues and less in the blood, So, the CO_2 moves from tissues to the blood. The oxygenated blood now becomes deoxygenated.

Differences between inspiration and expiration

S.No.	Characters	Inspiration [inhalation]	Expiration [exhalation]
1	Definition	Process of inhaling of fresh air in the lung alveoli	Process of exhaling of foul air out of lung alveoli

2	EICM (External inter costal muscles)	Contraction	Relaxation
3	Ribs	Moves Outward	Moves inward
4	Sternum	Moves forward	Moves backward
5	Movement of diaphragm	Towards abdominal cavity	Away from abdominal cavity
6	Shape of diaphragm	Flat	Dome shaped
7	Size of thoracic cavity	Increases	Decreases
8	Lungs	Decompression	Decreases
9	Pressure of air in lungs as compared to atmosphere	Deceases	Increases
10	Movement of air	From atmosphere to lungs	From lungs to atmosphere

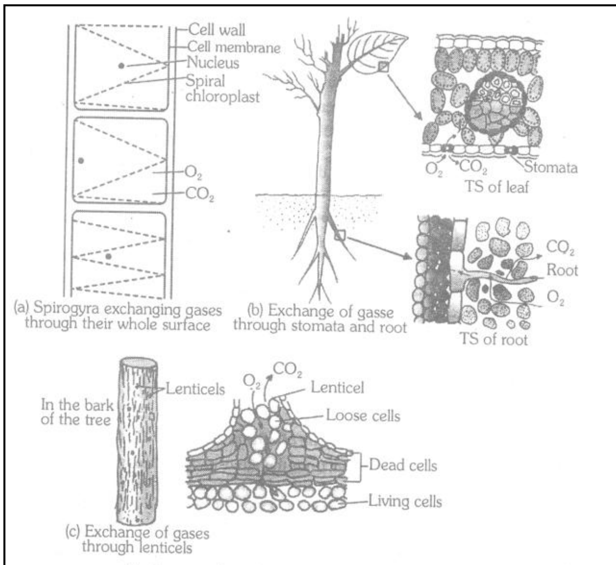
Location, structure and function of respiratory system

Organ or region	Location	Structure and function
Nasal cavity	Above the mouth cavity	● Two external nostrils help in intake of oxygen
		● Lined by ciliated and sensory epithelial cells which help in filtering of air (by hair) and warming or cooling of the inhaled air.
		● Mucous secreted by them prevent dust particles for entry.
		● Two internal nostrils act as the end of this cavity from which the air enters into pharynx.
Pharynx	Behind the nasal cavity leading into the trachea	● Posteriorly it has two openings ; dorsal opening or gullet (leading to esophagus) and ventral opening or glottis (aperture of trachea).
		● A cartilaginous flap (epiglottis) guards the glottis to prevent the entry of food into the trachea.
Larynx or voice box or Adam's apple	Lies at the back of the neck	● A pair of membranes (called vocal cords) stretched in the internal cavity, partially close the air passage. Theses membranes can be relaxed or stretched. When the air passes over the vocal cords. they vibrate and produce sounds.
Trachea or Wind	Tube running through the neck in front of esophagus	● Its walls are supported by C-shaped cartilages to prevent it from collapsing. It divides into two bronchi (singular bronchus) which enter the respective right and the left lung.
Lungs	Present in the thoracic cavity	● Surrounded by two pleural membranes containing a fluid in between to reduce friction.
		● Spongy organ formed by the sub-divisions of the bronchus called bronchioles.
		● Each bronchiole ends in a structure like bunch of grapes or balloon-like structures called alveoli or air sacs. Alveoli provide the surface for the exchange of gases.
		● Each alveolus is surrounded by network of blood capillaries.

RESPIRATION IN PLANTS :

INTRODUCTION

The plants do not have any special reparatory system so they have to respire in all of their individual parts like leaf, stem and root. The plants also have to exchange gases with the atmosphere by simple diffusion process.



Various modes of gaseous exchange in plants (a) whole body surface, (b) stomata and roots and (c) lenticels

Mode of gaseous exchange (oxygen and carbon dioxide) in plats.

In terrestrial plants gaseous exchange occurs through

(a) Stomata – In leaves and green stem

(b) Lenticels – In woody stem and roots.

(c) Root hairs – In young roots.

Respiration through stomata :

Stomata are small apertures found on the surface of leaf.

For the process of respiration,

oxygen enters stomata by the process of diffusion and then into other cells of the leaf.

When concentration of CO_2 increases inside the cells diffused out through stomata.

Respiration through lenticels :

Lenticels are the opening in the bark of woody stems.

They also serve as a place of gaseous exchange.

Respiration through general surface of the roots :

Ploughing or tilling of the soil creates small air spaces around soil particles which provides the sources of oxygen for the roots.

This oxygen present between the soil particles diffuses into root hairs (these are the extensions of epidermal cell of the root), by the process of diffusion.

From the root hairs, oxygen diffuse into other cells of the roof. After utilization of oxygen, CO_2 is diffused out into the soil.

In **older roots** there are no root hairs present. Instead they have layer of dead cells which is protective in nature and encloses opening (lenticels). These are used for gaseous exchange between soil and inner living cells.

Do you know ?

Aquatic plants can carry out gaseous exchange by diffusion over their whole surfaces.

Direction of diffusion depends upon the environmental condition and the requirement of the plant.

During the day time O_2 release is the major event.

Review questions

1. From which part of stem bark does gaseous exchange occur ?

2. Name the respiratory gases.

3. Name the part through which gaseous exchange takes place in plants.

4. How does diffusion occur in submerged aquatic plants ?

EXERCISE # 1 FOR SCHOOL EXAMS

VERY SHORT ANSWER TYPE QUESTIONS :

1. What are the end products of aerobic respiration & anaerobic reparation.
2. What happens to the diaphragm when diaphragm muscles contract ?
3. Name the respiratory organs of (i) fish, (ii) mosquito, (iii) earthworm, (iv) dog.
4. From where do the following take in oxygen ? (i) prawn (ii) rat.
5. Using only flow chart, write the path of C_2 from trachea to respiring tissue cell.
6. Define breathing .
7. ‘Respiration is a vital function of the body’. Justify.
8. When we blow exhaled air into the solution of lime water, it turns milky. What actually happens in the solution ?
9. Arrange the following incorrect order through which the air flows up to alveoli –
   Larynx, alveoli, trachea, pharynx, external nostrils, internal nostrils, nasal cavities.
10. Explain how oxygen enters the blood in the lungs.

SHORT ANSWER TYPE QUESTIONS :

1. Why is diffusion insufficient to meet the oxygen requirements of multicellular organisms like humans ?
2. What advantage over an aquatic organism does a terrestrial organism have with regard to obtaining oxygen for respiration ?
3. How is oxygen and carbon dioxide transported in human beings ?
4. How are the lungs designed in human beings to maximize the area for exchange of gases.
5. What are the differences between aerobic and anaerobic respiration ? Name some organisms that use the anaerobic mode of respiration.
6. Compare the functioning of alveoli in the lungs an Nephrons in the kidneys with respect to their structure and functioning .
7. Name the cavity in which the lungs of man are enclosed ? What is its function ?
8. What is difference between emphysema and asthma ?
9. How is respiration different from breathing ?
10. What is photosynthesis ? How it differs form respiration ?

LONG ANSWER TYPE QUESTIONS :

1. Explain the mechanism of gaseous exchange between tissues and blood.
2. Write short notes on the following :
   (i) Exchange of gases in tissues (ii) Mechanism of inhalation and exhalation.
3. Give reasons for the following :
   (i) The glottis is guarded by epiglottis.
   (ii) The lung alveoli are covered with blood capillaries.
   (iii) The wall of trachea is supported by cartilage rings.
4. **Explain the process of respiration in plants.**

WHICH OF THE FOLLOWING ARE TRUE (T) OR FALSE (F) :-

1. Fishes respire with the lungs.
2. Lungs become empty after forceful expiration.
3. Lactic acid is produced in anaerobic respiration.
4. Maximum contraction of diaphragm causes maximum expiration.
5. Expiration is normally brought about by the relaxation of aspiratory muscles.

COMPLETE THE FOLLOWING SENTENCES :-

1. Nasal chambers are separated from the oral cavity by ……………………….
2. Larynx communicates with the ……………………….by glottis.
3. The……………………check the entry of food into the respiratory tract.

4. Lungs lie in the thoracic cavity separated by……………………from the abdominal cavity.
5. Wall of alveoli consists of simple ……………………Squamous epithelium.
6. Gaseous exchange in plants lake place through …………………..and …………………..
7. ………………..are the opening in the bark of woody stem.
8. During the day time………………release is the major event.

MATCH THE COLUMN :-

1. Match the items of Column A with items of Column B.

A	B
(a) Stomata	(i) In woody part
(b) Lenticels	(ii) Release in night
(c) CO_2	(iii) In herbaceous stem
(d) O_2	(iv) Release in day

EXERCISE # 2 OBJECTIVE QUESTIONS

1. Respiration is the process in which -
(A) energy is stored in the form of ADP (B) energy is released and stored in the form of ATP
(C) energy is not released at all (D) energy is used up

2. Which of the following is the source of respiration –
(A) Stored food (B) Fats (C) Glucose (D) Proteins

3. The form of energy used in respiration is –
(A) Chemical energy (B) Electrical energy (C) Mechanical energy (D) Radiant energy

4. Respiratory structures in the insects are –
(A) Gills (B) Skin (C) Lungs (D) Trachea

5. The narrowest and most numerous tubes of lungs are termed as –
(A) Bronchus (B) Bronchioles (C) Alveoli (D) None of these

6. A normal man respires in a minute –
(A) 10-15 times (B) 14-18 times (C) 20-25 times (D) 5-30 times

7. In anaerobic respiration –
(A) O_2 is given out (B) CO_2 is given out (C) CO_2 is taken in (D) O_2 is taken in

8. The exchange of gases [O_2 and CO_2] in a mammal takes place in –
(A) Trachea (B) Bronchi (C) Bronchioles (D) Alveoli

9. During inspiration muscles of diaphragm –
(A) Contracts (B) Expands (C) No effect (D) Coiled like string

10. Expiration involves –
(A) Relaxation of diaphragm and intercostals muscles
(B) Contraction of diaphragm and intercostal muscles
(C) Contraction of diaphragm muscles
(D) Contraction of intercostals muscles

11. The structure which prevent the entry of food into respiratory tract is –
(A) Pharynx (B) Larynx (C) Glottis (D) Epiglottis

12. In fever breathing rate –

(A) Increase (B) Decrease (C) Stop (D) None

13. Mammalian lungs are –

(A) Hollow (B) Solid and spongy (C) Spongy (D) None

16. In respiration, air passes through –

(A) Pharynx, Nasal cavity, Larynx, Trachea, Bronchi, Bronchiole, Lungs

(B) Nasal cavity, Pharynx, Larynx, Trachea, Bronchi, Bronchiole, Lungs

(C) Larynx, Nasal cavity, Pharynx, Trachea, Lungs

(D) Larynx, Pharynx, Trachea, Lungs

18. Ratio of respiration is directly affected by –

(A) CO_2 concentration (B) O_2 in trachea (C) Concentration of C_2 (D) Diaphragm expansion

19. Oxygen in lungs ultimately reaches –

(A) Alveoli (B) Trachea (C) Bronchus (D) Bronchioles

20. Most of the carbon dioxide is carried in the blood as –

(A) Bicarbonates (B) Carbon monoxide (C) Carbonic acid (D) Carbonates

21. Respiration and photosynthesis are just the :

(A) Opposite process (B) Similar process (C) Burning process (D) None of these

22. In the experiment demonstrating respiration in geminating seeds, KOH is used to :

(A) Absorb carbon dioxide present in the flask (B) Absorb oxygen present in the flask

(C) Absorb water vapor released by the seeds (D) Liberate oxygen to be used by the seeds

23. In which part of the plant, respiration rate is higher :

(A) Root and stem tip (B) Buds (C) Germinating seeds (D) All of these

24. Plant cell can do :

(A) Breathing and Respiration (B) Respiration and photosynthesis

(C) Breathing and photosynthesis (D) All of these

25. Plant can respire in :

(A) Dark (B) Light

(C) Both in light and dark (D) Morning

EXERCISE # 3 FOR COMPETITIVE EXAMS

1. Exchange of gases in lung alveoli occurs thorough –

(A) Active transport (B) Osmosis (C) Simple diffusion (D) Passive transport

2. Hemoglobin is –

(A) Vitamin (B) Skin pigment (C) Blood carrier (D) Respiratory pigment

3. The maximum affinity of hemoglobin is with –

(A) Carbon monoxide (B) Carbon dioxide (C) Oxygen (D) Ammonia

4. Vocal cards occur in –

(A) Pharynx (B) Larynx (C) Glottis (D) Bronchial tube

5. Oxygen is carried by :

(A) Leucocytes (B) Erythrocytes (C) Platelets (D) None of these

6. Epiglottis guards the opening of :-

(A) Esophagus (B) Eustachian tubes (C) Larynx (D) Internal nares

7. Lungs are covered by :-

(A) Pericardium (B) Perichondrium (C) Pleura (D) Periosteum

8. Breathing is controlled by a centre in the

(A) Lungs (B) Heart (C) Cerebellum (D) Medulla oblongata

9. Oxygen passes into the blood from the alveoli by a process called :-

(A) Osmosis (B) Diffusion (C) Active transport (D) Pinocytosis

10. Exchange of gases between the blood and the tissue of the body is called :-

(A) External respiration (B) Internal respiration (C) Cellular respiration (D) counter-current exchange

11. The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because :-

(A) CO_2 is actively transferred

(B) The alveolar area available for CO_2 diffusion is larger

(C) CO_2 is more soluble in H_2O than O_2, which enables it to pass the membrane more readily

(D) The CO_2 pressure gradient in larger

12. Which of the following are respiratory organs of scorpion ?

(A) Lungs (B) Book-lungs (C) Gills (D) Ceridian

13. Carbon monoxide has greater affinity for hemoglobin as compared to oxygen by –

(A) 1000 items (B) 200 times (C) 20 times (D) 2 times

14. P_{CO_2} released from the body is about –

(A) 15 % (B) 23 % (C) 30 % (D) 70 %

15. Trachea is lined with incomplete rings of –

(A) Fibrous cartilage (B) Calcified cartilage (C) Elastic cartilage (D) Hyaline cartilage

16. Sound is produced in mammals

(A) By syrinx (B) By bronchus (C) During inhalation (D) During exhalation

ANSWER KEY

EXERCISE # 1 FOR SCHOOL EXAMS

Which of the following are True (T) or False (F) :-

1. F
2. F
3. T
4. F
5. T

Complete the following sentences :-

1. Plate
2. Laryngopharynx
3. Epiglottis
4. Diaphragm
5. Non-ciliated
6. Stomata & Lenticels
7. Lenticels
8. Oxygen

Match the column :-

1. (A) –(iii), (B) –(i), (C) –(ii), (D) –(iv),

OBJECTIVE QUESTIONS **EX # 2**

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	A	A	D	B	B	B	D	A	A	D	A	B	B	A
Que.	16	17	18	19	20	21	22	23	24	25					
Ans.	A	A	C	D	A	A	A	D	B	C					

FOR COMPETITIVE EXAMS. **EX # 3**

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ans.	C	D	A	B	B	C	C	D	B	B, C	C	B	B	C	D	D

CIRCULATORY SYSTEM

☐ **CIRCULATION :**

The process of transporting the absorbed food, water and waster products from one place to another in body is called circulation.

COMPETITION WINDOW

Circulatory system : There are two types of circulatory system found in the animals :-

(i) **Open Circulatory System :** In this types of circulatory system, the main blood vessels arising from heart and pour the blood into tissue spaces (sinuses). **e.g. Arthropoda** (Cockroach). **Echinodermata**

(ii) **Closed Circulatory System :** In this types of circulatory system the blood remains only in the blood vessels and carried to various organ through vessels and capillaries. **e.g. human beings. Annelida** (Earthworm). **Some mollusks**

◆ In human beings, the circulatory (transport) system is divided into two system :

(i) Blood Circulatory System	**(ii) Lymphatic System**
(a) Blood	(a) Lymph
(b) Blood vessels	(b) Lymph vessels
(c) Heart	(c) Lymph muscles

BLOOD CIRCULATORY SYSTEM

☐ **BLOOD**

Blood is an important fluid conducting tissue, which transport the materials to different body parts.

◆ **Composition of Blood :**

Liquid part - (Matrix) – Blood plasma

Solid part - Blood corpuscles – (RBC, WBC and Platelets)

Plasma :

It composes 55 % of blood.

The plasma has 90-92 % water and remaining 8 %-10 % are other materials.

The plasma is a faint yellow viscous fluid.

Plasma contains some soluble proteins (serum albumin , serum globulins, prothrombin and fibrinogen), inorganic salts, food materials, waste products, dissolved gases, anticoagulants and antibodies.

Function of Plasma :

(i) Transportation of nutrients, respiratory gases, excretion of wasters and hormones of endocrine glands.

(iii) Prothrombin and fibrinogen plasma proteins help in blood clotting at injuries.

(iv) Globulins of blood plasma act as antibodies and provide immunity (disease resistance) to body.

(v) Plasma also help in transportation of minerals like iron, copper etc.

☐ **BLOOD CORPUSCLES :**

They form 45 % part of blood

◆ Erythrocytes or Red Blood Corpuscles (RBC)

◆ Leucocytes or White Blood corpuscle (WBC)

◆ Platelets or Thrombocytes

COMPARATIVE STUDY OF BLOOD CORPUSCLES

	Characters	**RBCs**	**WBCs**	**Platelets**
1	Shape	Circular, Biconcave	Rounded, Irregular	Rounded or Oval
2	Size (Diameter in μ m)	7-8, Smaller than WBCs	12-12 , Larger than RBCs	2-5, Smallest blood corpuscles
3	Number or Count (Per cubic millimeter)	5.5 million in male, 4.5 million in female	8000-11000	1.5-4.5 Lakhs
4	Colour	Red due to hemoglobin	Colorless	Colorless
5	Structure	At maturation they lost all	They contain are cell	Non-nucleated cells

		cell organelles	organelles	
6	Life Span	120 days	1-7 days	2-5 days
7	Functions	Transport oxygen and small amount of carbon di-oxide	Act as the soldiers, scavengers and builders of body	Help is blood clotting

Functions of Blood :

1. **Transportation of oxygen from lungs to tissues .**
2. **Transportation of carbon dioxide from the tissue to the lungs.**
3. **Transportation of excretory material from the tissues to the kidneys :** Some of the chemical activities in the body form nitrogenous end products, like urea, that are poisonous. These substances diffuse into the capillaries and are carried by plasma. When they eventually reach the kidneys, a large proportion of them is removed and excreted.
4. **Transportation of digested food from the small intestine to the tissue.**
5. **Distribution of hormones and enzymes.**
6. **Formation of clots to prevent blood loss.**
7. **Distribution of heat and temperature control :** Muscular and chemical activities release heat. The heat so produced locally is distributed all around the body by the blood and in this way an even temperature is maintained in all body regions.
8. **Presentation of infection and wound healing :** WBCs in the blood help in wound healing. Bacteria are destroyed by the WBCs before they can enter the general circulation. Also , the WBCs provide defense to the body against disease germs and foreign substances.

COMPETITION WINDOW

- **HAEMOPOIESIS :** The process of formation of blood is called hoemopoiesis. This process occurs in red bone marrow and lymphoid tissues (spleen, thymus and lymphatic nodes)
- Study of blood - Hematology
- Blood by weight - 5-6 litres in male and 4-5 litres in female
- Process of RBC formation – Erythropoiesis.
- Decrease in RBC cont – Anaemia
- Number of RBC count increases at high altitude, this condition known as **polycythemia**
- Blood red in colour due to red colored respiratory pigment **hemoglobin** is present in RBC.
- Iron (Ferrous ion Fe^{+2}) element found in **Haem** component of hemoglobin (Hb).
- **Leukemia –** Abnormal increase in TLC (Total Leukocyte Count). It is also called **blood cancer.**
- On the basis of nucleus and nature of cytoplasm WBCs are of following types :-

(i) Agranulocytes :- (a) Monocytes (b) Lymphocytes

(ii) Granulocytes :- (a) Acidophil (b) Basophil (c) Neutrophils

LIFE PROCESSES PART - 2

Maintenance By Platelets

When we are injured and start bleeding. Naturally the loss of blood from the system has to be minimized. In addition, leakage would lead to a loss of pressure which would reduce the efficiency of the pumping system. To avoid this, the blood has platelet cells which circulate around the body and plug these leaks by helping to clot the blood at these points of injury.

BLOOD CLOTTING

- Blood flows from cut or wound but after sometimes it stops automatically. It is called clotting of blood .
- **Mechanism of blood clotting :** (Enzyme Cascade theory)
- Proposed by **Macfarlane** and Co-workers
- According to this theory, there are 3 steps of blood clotting.
- **Step – 1 :-** Injured tissues and Damaged platelets release

$$\downarrow$$

$$\text{Thromboplastin} + Ca^{+2} \longrightarrow \text{Thrombokinase (An enzyme)}$$

- **Step – 2 :-** Prothrombin (soluble plasma protein) $\xrightarrow[Ca^{-2}]{Thrombokinase}$ Thrombin (An active enzyme)
- **Step – 3 :-** Fibrinogen (soluble plasma protein) $\xrightarrow{Thrombin}$ Fibrin fibers + blood corpuscles $\rightarrow$ Blood clot
- Serum is blood plasma from which fibrinogen, the blood clotting protein, has been removed.
- 13 clotting factors are helpful in blood clotting.
- Clotting factor I $\rightarrow$ Fibrinogen
- Clotting factor II $\rightarrow$ Prothrombin
- Clotting factor III $\rightarrow$ Thromboplastin
- Clotting factor IV $\rightarrow$ Calcium
- Vitamin-K is necessary for the synthesis of clotting factor in liver.

REVIEW QUESTIONS

1. What is meant by circulatory system ?

2. What are the components of blood circulatory system in humans ?

3. Name the mineral, Which helps in formation of RBC's.

4. Give other name for blood platelets.

FILL IN THE BLANKS

(i) The two principal fluids involved in transpiration in our body are ……………..and ………………

(ii) The fluid matrix of blood is called……………………

(iii) The RBCs are involved in transportation of ……………….from lungs to tissues.

(iv) Oxygen combines with hemoglobin present in RBC and forms …………………..

(v) The chief function of WBCs is to ……………………..

(vi) Platelets help in…………………

(vii) The plasma without its fibrinogen is called……………………

(viii) Fibrinogen is converted into fibrin by…………………..

BLOOD VESSELS

In human, three types of blood vessels are present.

1. **Arteries :** The vessels which carry blood from heart to various organs of the body.
2. **Veins :** They collect the blood from different parts of the body and pour it into the heart.
3. **Capillaries :** These are smallest blood vessels and one-cell thick.

The major differences between various blood vessels have been given in Table.

Comparative Study of Blood Vessels				
S.No.	**Features**	**Arteries**	**Veins**	**Capillaries**
1	Direction of blood flow	Take the blood away from heart to different parts of body.	Bring the blood towards the heart from various body parts.	Blood flows from arterioles (capillaries) to venues.
2	Kind of blood	Oxygenated blood except in pulmonary artery.	Deoxygenated blood except in pulmonary vein.	Blood changes from oxygenated to deoxygenated.
3	Blood pressure	Pressure is high.	Pressure is low.	Pressure is extremely low.
4	Blood flow	Blood flows rapidly with jerks.	Blood flows smoothly without jerks.	Blood flows smoothly without jerks.
5	Lumen	Narrow	Wide	Very small
6	Semilunar valves	Absent	Present	Absent
7	Location	Mostly deep seated.	Mostly superficial .	Form a network all over the body and in the organs.

HEART

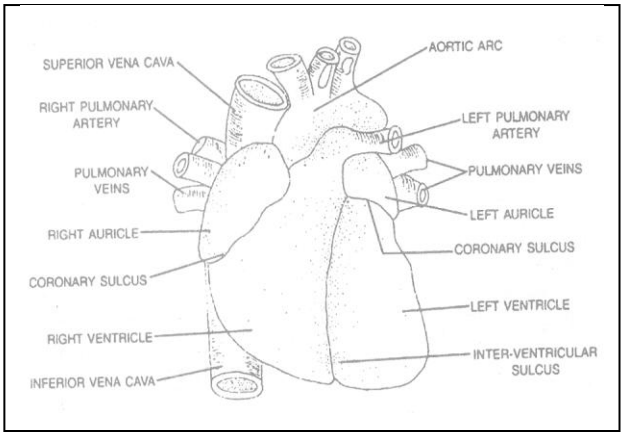
Size – 5 × 3.5 inches	**Colour** – Pink
Shape – Conical	**Weight** – 300 gm.

- **Position :** It is situated in thoracic cavity, between the lungs slightly on the ventral surface.
- Its triangular, superior-broad portion is tilted slightly towards right (dorsal) side, its lower narrow portion is tilted towards left side.
- Heart is enclosed from all the side by an envelope of two membranes called pericardial membranes (pericardium.)
- The narrow space in between these two membranes is called **pericardial cavity.** A fluid is present in this cavity, called **pericardial fluid.**
- Pericardial fluid prevents the heart from external jerks.
- It reduces the friction during contraction.
- The human heart is divisible into four chambers.
- The upper two chambers are **auricles** (atria) while the lower two chambers are called **ventricles.**
- In between the auricles and ventricles, a clear groove is present which is known as **coronary sulcus.**

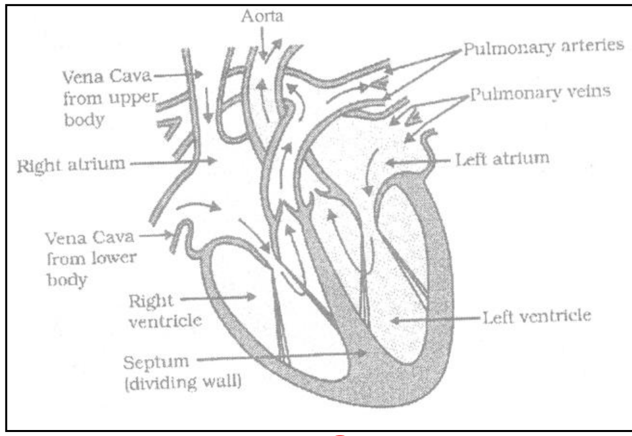
☐ **External structure of Heart :**

- Auricular part of heart is smaller and its walls are thin.
- It is divided into right and left auricles, by a groove called **inter-auricular sulcus.**

- Ventricular part is broad and muscular.
- Ventricles have thicker wall than auricles.
- The groove which divides the two ventricles is termed as **inter-ventricular sulcus.**



Heart : External Structure



Heart : Internal Structure

☐ **Internal structure of Heart :**

- Partition between right and left auricle is known as **inter-auricular septum** while partition between the two ventricles is known as **inter-ventricular septum.**
- Partition between auricles and ventricles is known as **auricular-ventricular septum.**

(A) Right Auricle (Atrium) :

- The right auricle has the openings of the **superior vena cava, inferior vena cava** and **coronary sinus.**
- Deoxygenated blood from the veins of the head, neck and upper limbs enters the right auricles by superior vena cava and from the rest of the body and lower limbs by the inferior vena cava.
- The coronary sinus, which drains deoxygenated blood from the heart muscle.
- From the right auricle blood passes into the right ventricle through a **tricuspid valve,** (so called because it has three cusps.)

(B) Right Ventricle :

- Blood leaves the right ventricle through the **pulmonary artery.** It guarded by **Semilunar valve.**
- This artery further divides into right and left pulmonary arteries entering into the lungs where they further branch into pulmonary capillaries.

(C) Left Auricle (Atrium) :

- This chamber receives four pulmonary veins, two from each lung from where they bring oxygenated blood.
- The left auricle empties its blood into the left ventricle through a **mitral** or **bicuspid valve.**

(D) Left Ventricle :

- Blood leaves the left ventricle by the large, main artery of the body called the **aorta.**
- The opening from the left ventricle into the aorta is guarded by **aortic Semilunar valve.**
- Just beyond these , a pair of **coronary arteries** are present which supply blood to heart muscles.
- This blood is brought back to heart by coronary veins which join to form coronary sinus.

COMPETITION WINDOW

Haversian valve	-	Present on the opening of superior vena cava (SVC)
Eustachian valve	-	Present on the opening of inferior vena cava (IVC)
Thebesian valve	-	Present at the opening of coronary sinus.

Columnae carneae	-	Finger like projection from ventricle inner walls.
Papillary muscles	-	Present at the tip of Columnae carneae.
Chordae tendinae	-	Arise from papillary muscles and keep the valves in proper position.
Musculi Pectinati	-	Transverse muscular ridges present on auricles' inner walls.

REVIEW QUESTIONS

1. Name the groove, which demarcates two ventricles externally.

2. Name the thickest artery.

3. Name the blood vessel that brings oxygenated blood to the heart chamber.

4. Name the arteries, which supply blood to heart itself.

5. Give other term for bicuspid valve.

6. What is function of valves in circulatory system ?

7. Which chamber of heart receives oxygenated blood ?

8. Which chamber of heart pumps blood ?

9. Name the vein which brings blood to left atrium from lungs.

10. Name the major veins which pour blood into right atrium.

FILL IN THE BLANKS

(i) Blood vessels in human are…………………………..and ………………………..

(ii) Arteries carry blood from …………………to ………………………

(iii) Veins carry blood from ……………….to …………………..

(iv) Except…………………..all veins carry oxygenated blood.

(v) Except ……………..all veins carry deoxygenated blood.

(vi) The heart in human consists of …………………..chambers, comprising …………….and ………………..

(vii) The average pumping rater of heart in a healthy adult under rest is……………….times per minute.

(viii) Lymph contains………….but lacks………………and…………………

(ix) Lymph contains white cells called…………………

WORKING OF THE HEART

- The heart of the human works like a pump.
- Pure oxygenated blood enters the left auricle from lungs through pulmonary veins.
- The deoxygenated blood from various part of the body enters right auricle through veins and capillaries.
- The two auricles contract simultaneously so the oxygenated blood left auricle to left ventricle and deoxygenated blood from right auricle is pumped into right ventricle.
- Now both the ventricles contract simultaneously so the pressure is crated on the blood and the valves between auricle and ventricles close and the blood does not go back into auricle.
- Due to this pressure, aorta valve opens and the blood comes in aorta, from here, blood is sent to different parts of the body with the help of various arteries.
- By the contraction of right ventricle, blood reaches the lungs through pulmonary arteries where it gets reoxygenated.

HEART BEAT

- Rhythmic contraction and expansion of heart is called heart beat. Contraction and expansion occurs separately in atria and ventricles.
- The **Sinus-Atrial node (SA node)** found in the wall of the right atrium, is responsible to initiate and maintain the heart by generating impulses.
- SA node is also known **"Pacemaker"** of heart. In some heart patients, the heart does not beat normally. The muscle cells stop functioning. In such patients, a machine called pace maker is inserted in the patient's heart , so that heart beasts normally.

- Heart beat in human, 72 times in one minute.
- Each heart beat has two components, **systole** and **diastole.** Systole represents contraction while diastole represents expansion or distension of heart chambers.
- **Tachycardia :-** It is the condition where heart beat (rate) exceeds 90 per minute for an average adult man.
- **Bradycardia :-** It is the condition where heart beat falls below 60 per minute for an average adult man.
- **Cardiac Cycles :-** The sequence of events which takes place during the completion of one heart beat.

PULSE

- A wave of distention passes along the arteries following each ventricular systole. This waves of distension is called arterial pulse.
- It is generally felt by placing finders over the radial artery at the wrist.
- The pulse rate is same as heart beat rate.

HEART – SOUND

- **Ist Sound –** This is a contraction sound which denotes the beginning of ventricle-contraction. It arises due to closing of mitral valve and the tricuspid valve. It is weak and appears in the form of **"Lubb"** (L – U – B – B)
- **IInd Sound –** This is a diastolic sound which denotes the beginning of ventricular diastole. This arises due to the closing of the semi-lunar valves and is heard in the form of **"Dup".**
- These " Lubb" and " "Dup" sounds of the heart can be heard with the help of an instrument called **"Stethoscope.**

ELECTROCARDIOGRAM (ECG)

- The functioning of heart can be graphically recorded by an instrument called **electrocardiograph.**
- The heart muscles generate electric currents which bring about heart beats. The electrical changes during heart beat can be graphically recorded by placing electrodes on the chest above the heart and connecting electrodes to a sensitive galvanometer with recording device.
- The graphic recording called and electrocardiogram (ECG).
- It was first of all recorded by **"Waller"**
- **"Einthovan"** is known as the Father of Electro Cardio Graphy.

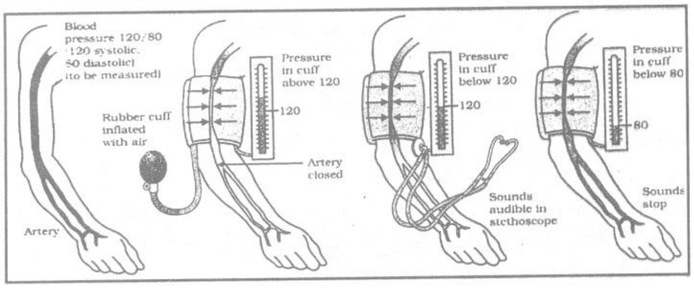
BLOOD PRESSURE

- Definition : Blood pressure is the pressure exerted by the flowing blood on the wall of blood vessel.
- **Types :** Blood pressure is of two types.

  (i) Systolic blood pressure (ii) Diastolic blood pressure

Characters	**Systolic blood pressure**	**Diastolic blood pressure**

1.	Definition	Blood pressure at the time of maximum contraction of ventricles.	Blood pressure at the time of maximum relaxation of ventricles.
2.	Value	120 mm Hg.	80 mm Hg.



- **Hypertension :-** A persistent increase in blood pressure is called **hypertension** or **high blood pressure.** It is caused by narrowing of arterial lumen and reduced elasticity of arterial walls.
- The instrument by which we can measure B.P. is called **"sphygmomanometer".**
- In man B.P. is measured in the **bronchial artery** of arm.
- Normal B.P. of a healthy person is **120/80 mm Hg.**

REVIEW QUESTIONS

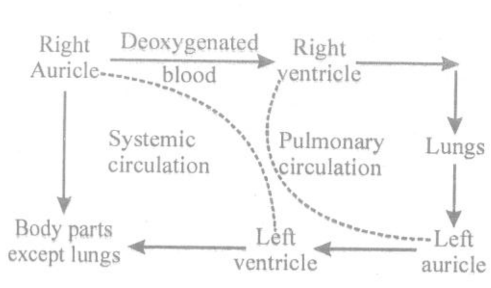
1. What is systole ?
2. What is diastole ?
3. Name the instrument used to measure blood presser.
4. Name the instrument used to hear heart sounds.
5. What is the range of normal systolic and diastolic blood pressure ?
6. Name the instrument, which is inserted in the heart of the patient whose heart does not work normally?

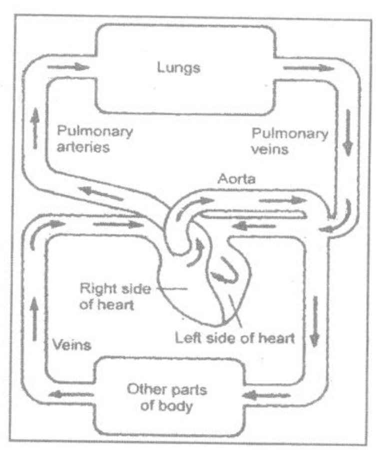
DOUBLE CIRCULATION

In double circulation, the blood passes twice through the heart to supply once to the body.

(i) Systemic circulation :
In this, blood completes its circulation form left ventricle to right auricle through the body organs. (systemic organs)

(ii) Pulmonary circulation :
In this, blood completes its circulation from right ventricle to left auricle thorough the lungs.





The right oration of heart is known as **pulmonary heart** and it have **deoxygenated blood.** The left portion of heart is known as **systemic** heart and it have **oxygenated blood.**

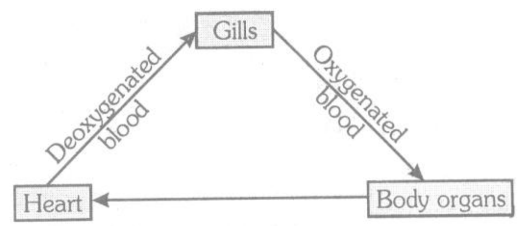
The separation of the right side and left side of the heart is useful to keep oxygenated and de-oxygenated blood from mixing.

Such separation allows a highly efficient supply of oxygen to the body. This is useful is animals that have high energy needs (e.g. birds and mammals) which constantly use energy to maintains their body temperature. In animals that doe not use energy for this purpose, the body temperature depends on the temperature of environment. (e.g. fishes, frogs)

COMPETITION WINDOW

Single circulation :

In this, the blood passes once through the heart to supply once to the body. It is found in fishes which have two-chambered heart one auricle and one ventricle. The heart receives only deoxygenated blood , which is first pumped to the gills for oxygenation and than oxygenated blood is supplied to rest of body parts by various arteries.



LYMPHATIC SYSTEM

It consists of **lymph, lymphatic capillaries, lymph vessels, lymph nodes and lymphoid organs (spleen thymus and tonsils).**

Lymph : When blood flows into thin capillaries some amount of plasma filters out of thin capillaries. This fluid is called **interstitial fluid** or **tissue fluid** or **lymph.** Lymph is also called **extracellular fluid .** It is colorless and contains lymphocyte cells. Unlike blood, lymph does not contain red blood corpuscles, but contains less plasma protein. Lymph flows only in one direction, that is from tissues to heart.

The functions of lymph are as under :

- It transports fatty acids and glycerol from small intestine to blood.
- Lymphocytes present in it which destroy harmful pathogens.
- It drains excess tissue fluid from intercellular spaces back into the blood.
- Lymph nodes localize the infection and prevent it from spreading to other body parts.

Blood	Lymph
It forms circulatory system.	It forms lymphatic system .
Red in colour due to presence of hemoglobin	Colorless as hemoglobin is
Contains plasma, RBC, WBC and platelets	Contains plasma land WBC
Flows inside arteries, veins and blood capillaries	Flows inside vessels and lymph capillaries
Its flow is rapid	Its flow is slow
It mainly transports materials from one organ to another in the body	It mainly conveys materials from the tissue cells into the blood.

REVIEW QUESTIONS

1. Define lymph.
2. How does lymph differ from blood?
3. What are the functions of lymph ?
4. How does lymph form ?
5. Describe double circulation.

FILL IN THE BLANKS

(i) Lymph contains……………….and ………………..

(ii) Lymph is also called……………….

(iii) Lymph flows through …………vessels.

CIRCULATORY DISEASES

- **Thrombosis :-** Thrombosis is the formation of a small blood clot or thrombus inside a blood vessel. A blood clot, or any other solid particle floating in the blood stream is known as an embolism.
- **Hardening of the arteries :-** As people get older the elastic and muscle layers of their arteries are gradually replaced by inelastic fibrous tissue. The artery walls become stiff and hare, a condition known as hardening of the arteries, or arteriosclerosis. This condition educes the flow of blood.
- **Atheroma :-** Blood flow along an artery is sometimes slowed or stopped altogether by a layer of fatty substance called cholesterol , stuck to the artery walls. This type of blockage is called an Atheroma. Arteriosclerosis and Atheroma are very dangerous when they occur in the heart or brain.
- **Heart attacks (heart failures) :-** A heart attack, or heart failure, is the sudden slowing or stoppage of the heart beat. A heart attack occurs when a coronary artery is blocked by a thrombosis or Atheroma. Coronary arteries supply heart muscle with food and oxygen. Consequently, when a coronary artery is blocked, a section of heart muscles stops working and eventfully dies. If the whole heart is affected, death is instantaneous.
- **Angina pectoris :-** If one or both of the coronary arteries is partly blocked due to Atheroma, heart muscle is unable to work properly during exercise . This causes pains in the chest known as angina pectoris.
- **Stroke :-** A stroke, or cerebral thrombosis, is a blood clot in the brain. The blood clot suddenly blocks an artery inside the brain causing the region served by this vessel to stop working, and dies. The results of a stroke depend on the area of the area of the brain affected. Muscles may be paralyzed, and speech or memory affected. Death occurs if the brain damage is extensive.
- **Prevention of circulatory diseases :-** Studies have shown that these diseases occur far less often among people :-

1. Who never smoke cigarettes.
2. Who take regular exercise (walking, cycling, cycling, swimming, active sports , etc.)
3. Who never drink alcohol or drink only moderate amounts.
4. Who eat balanced meals.

5. Who have seven or eight hours sleep a night .

IMPORTANT POINTS

- Two chambered heart is present in fishes.
- Three chambered heart is present in amphibians.
- In reptiles, heart is almost four chambered three are two well developed auricles and two less developed unclear ventricles, but in crocodiles all the birds and all the mammals, the heart is fully developed and four chambered.
- First heart transplantation was done by **Dr. Christian Bernard** in the world.
- In India first heart transplantation was done by **Dr. P. Venugopal** on 3^{rd} august 1994. This transplant was done on a 42 years old person named Deviram **(an AIIMS).**
- Spleen, liver and kidneys are called **filter apparatus** of blood.
- A human heart in an average life time of 70 years pumps approximately 40, 00, 00, 000 litres of blood through it.
- If all the human blood vessels (artery, veins & capillaries) are joined end to end then their total length is sufficient to go around the tropic of cancer four times.
- Study of Blood circulatory system including arteries and veins - **Angiology**
- Study of heart - **Cardiology**
- William Harvey – An English physiologist, for the first time discovered that blood flows in closed blood vessels and also known as **Father of Angiology.**
- **Mammalian erythrocytes (RBCs)**
- Have no nucleus – makes the RBCs biconcave, increasing the surface-volume ratio for more oxygen absorption.
- Have no mitochondria.
- Average life of an RBC is about 120 days.
- New born infants have a large number of erythrocytes (6-7 million RBC/microlitre).
- The person living at high altitudes (4200 m and above) RBCs are more in number by about 30 %.
- **Hemophilia :-** Hemophilia is an inherited blood disorder. The blood of a hemophiliac clots very slowly or not at all. There are two reasons why this can happen. Either hemophiliac has too few platelets, or the platelets cannot produce the chemical which causes fibrinogen to change into fibrin.

EXERCISE # 1 (FOR SCHOOL / BOARD EXAMS)

OBJECTIVE TYPE W\QUESTIONS

1. The smallest blood vessel in the body is ;

(1) Capillary (2) Artery (3) Vein (4) Vena cava

2. Arteries carry oxygenated blood except :

(1) Pulmonary (2) Cardiac (3) Hepatic (4) Systemic

3. Four chambered heart is found in :

(1) Cobra (2) Tortoise (3) Salamander (4) Crocodile

4. Right atrium of mammalian heart receives blood from :

(1) Sinus venosus (2) Pulmonary veins (3) Precavals (4) Pre-and postcavals

5. Mitral valve in mammals guards the opening between :

(1) Right atrium and right ventricle
(2) Left atrium and left ventricle
(3) Right atrium and left ventricle
(4) Left atrium and right ventricle

6. Tricuspid valve is present between :

(1) Right atrium and right ventricle
(2) The two atria
(3) The two ventricles
(4) Left atrium and left ventricle

7. Which of the following has the thickest walls ?

(1) Right ventricle (2) Left ventricle (3) Right auricle (4) Left auricle

8. The pacemaker of heart is :

(1) AV node (2) SA node (3) SV node (4) Tricuspid valve

9. Contraction of right ventricle pumps blood into ;

(1) Dorsal aorta (2) Pulmonary artery (3) Pulmonary vein (4) Coronary artery

10. The impulse of heartbeat originates from :

(1) SA node (2) Vagus nerve (3) AV node (4) Cardiac nerve

11. The heart of a healthy man beats normally per minute :

(1) 85-90 times (2) 80-90 times (3) 70-80 times (4) 60-70 times

12. Systole causes :

(1) Entry of blood into lungs
(2) Entry of blood into heart
(3) Exit of blood from heart
(4) Exit of blood from ventricles

13. Typical 'lubb-dupp' sounds heard during heartbeat are due to :

(1) Closing of bicuspid and tricuspid valves
(2) Closing of Semilunar valves
(3) Blood under pressure through aorta
(4) Closure of bicuspid-tricuspid valves followed by Semilunar valves

14. The instrument used to hear sound is ;

(1) Electrocardiograph (2) Sphygmomanometer (3) Stethoscope (4) Haemometer

15. In adult man, normal BP is :

(1) 100/80 mm Hg (2) 120/80 mm Hg (3) 100/120 mm Hg (4) 80/120 mm Hg

16. The instrument by which BP of man is determined:

(1) Ultrasound (2) BP meter (3) Stethoscope (4) Sphygmomanometer

17. William Harvey is known for discovery of:

(1) Blood circulation (2) Blood clotting (3) Respiration (4) Digestion

18. Mammals are said to have double circulation. It means:

(1) Blood vessels are paired

(2) There are two types of blood vessels attached to every organ

(3) There are two systems, one from the heart to the lungs and back to the rest of the body

(4) The blood circulates twice through the heart

19. In mammals, veins differs from arteries in having:

(1) Thicker walls (2) Deeply present

(3) Carry blood away from heart (4) Internal valves

20. Oxygenated blood returns from lungs to the heat through :

(1) Coronary vein (2) Pulmonary vein (3) Coronary artery (4) Pulmonary artery

FILL IN THE BLANKS :

1. Mineral which helps in formation of RBC's is ……………………….

2. Blood vessels without muscular walls are………………….

3. First heart sound is called ……………………….

4. Fishes have………………………..chambered heart.

5. Amphibians have ………………………..chambered heart .

6. ……………………heart pumps only oxygenated blood.

7. Blood goes through the heart twice during each cycle is called……………………..

8. High blood pressure is called ……………….

9. The force that blood exerts against the wall of a vessel is called. ……………………………

10. Contraction of heart chambers is called…………………

11. Relaxation of heart chambers is called………………..

12. ………………..help in blood clotting.

13. White colored fluid other that blood which help in transportation is called……………….

14. Lymph carries digested and absorbed fat from…………………

15. Lymph drains excess fluid from extra cellular space back into ……………….

16. Lymph drains into………………………….for the intercellular spaces.

17. Lymphatic capillaries join to from……………………..

18. Pumping organ in human body is…………………..

19. fluid medium of blood is called……………………….

20. Oxygen is carried by the ……………………………

21. Blood platelets are also called……………………….

22. Covering over heart is called………………………….

23. ………………………circulation is related with lungs.

24. The series of events which occur during one complete beat of the heart is known as………………..cycle.

25. The pressure wave transmitted all through the arterial system is known as…………………

MATCH THE COLUMNS :

Column A		Column B	
1.	capillaries	(a)	Carries digested fat
2.	Lymph	(b)	Oxygenated blood
3.	Left ventricle	(c)	Deoxygenated blood
4.	Pulmonary artery	(d)	RBC
5.	Hemoglobin	(e)	Exchange of materials
6.	Birds	(f)	Three chambered heart
7.	Amphibians	(g)	Four chambered heart
8.	Contraction of heart chambers	(h)	Two chambered heart
9.	Relaxation of heart chambers	(i)	Diastole
10.	Second heart sound	(j)	Limb
		(k)	Systole
		(l)	Dupp

TRUE OR FALSE STATEMENTS:

1. Vessels are able to contract and expand.

2. While there is only one type of RBC, there are many white cell types.

3. All animals have a system of vessels and tubes called a circulatory system.

4. Blood is not a tissue because it is a fluid.

5. Arteries are the widest blood vessels.

6. Humans have an open circulatory system.

7. The exchange of nutrients and waste products between the blood and cells occurs with in the arteries.

8. The liquid portion of the blood is called plasma.

9. Living organisms must maintain a constant internal environment.

10. Circulatory system also performs the function of homeostasis.

CIRCULATORY SYSTEM **ANSWER KEY** **EXERCISE # 1**

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	1	4	4	2	1	2	2	2	1
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	4	3	2	4	1	4	4	2

● **FILL IN THE BLANKS**

1.	Iron	**2.**	Capillaries	**3.**	Lubb	**4.**	Two
5.	Three	**6.**	Fishes	**7.**	double circulation	**8.**	hypertension

9.	blood pressure	**10.**	Systole	**11.**	diastole	**12.**	Platelets
13.	Lymph	**14.**	Intestine	**15.**	Blood	**16.**	lymphatic capillaries
17.	Lymph vessels	**18.**	Heart	**19.**	Plasma	**20.**	RBC
21.	Thrombocytes	**22.**	Pericardium	**23.**	Pulmonary	**24.**	Cardiac
25.	Pulse						

● **MATCH THE FOLLOWING :**

1-(e), 2-(a), 3-(b), 4-(c), 5-(d), 6-(g), 7-(f), 8-(k), 9-(i), 10-(ℓ)

● **TRUE AND FALSE :**

True of False										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	**T**	**F**	**F**	**F**	**F**	**F**	**F**	**T**	**T**	**F**

EXERCISER # 2 (FOR SCHOOL / BOARD EXAMS)

VERY SHORT ANSWER TYPE QUESTIONS :

1. Name the blood-receiving chamber of heart.
2. What makes RBC's red ?
3. What is pulmonary circulation ?
4. Which chamber of heart has thickest wall ?
5. Name the larger vines that pour blood into right auricle.
6. Name the largest artery of our body.
7. Which camber of heart receives oxygenated blood from lungs ?
8. Name the valve present between the :
(a) left auricle and left ventricle (b) right auricle and right ventricle
9. What is normal blood pressure ?
10. Name the artery that carry deoxygenated blood and the vein that carry oxygenated blood .
11. What is SA node ?
12. Which instrument can record electrical changes during heart beat ?
13. Name the thickest artery .
14. Name the part of the circulatory system that acts as filter for microorganisms .
15. Name the major circulation present in our body.
16. Give the technical term for the white vascular connective tissue.
17. What is the life span of human RBC's ?
18. Why is blood called river of life ?
19. Give the position of human heart ?
20. Why there is no backflow of blood from ventricles to auricles ?

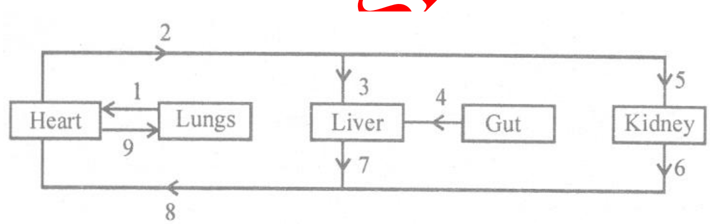
SHORT ANSWER TYPE QUESTIONS :

1. What are the components of the transport system in human beings ? What are the functions of these compound ?

2. Why is it necessary to separate oxygenated and deoxygenated blood in mammal and birds ?
3. Why is circulation in man known as "double circulation " ?
4. Writer three differences between lymph and blood.
5. Why is heart beat rate equal to the arterial pulse rate ?
6. Is human circulatory system open or closed ? Why ?
7. In which direction does O_2 diffuse between a capillary and a cell ? Why does it diffuse in that direction ?
8. What is the primary function or RBC's ?
9. Predict the effect on the heart if blood flow through the coronary artery is restricted or completely blocked.
10. Write two advantages of a closed circulatory system.
11. Point out three differences between artery and vein.
12. Why is SA node also called pacemaker ?
14. What is lymph ? What is its function in human body ?
15. Which part of the human heart is considered as pacemaker ? Why is it so called ?
16. What is the role of blood pressure in circulation ?
17. Give the difference between plasma and lymph .
18. What is the difference between plasma and serum ?
19. Give the difference between pulmonary artery and pulmonary vain.
20. Which blood cell in human blood carries hemoglobin ? What is its average life span ?
21. What is blood pressure ? How it is measured ?
22. Differentiate between systolic and diastolic pressure .
23. Give an account on different types of blood vessels.
24. Give the difference between pulmonary circulation and systemic circulation .

LONG ANSWER TYPE QUESTIONS :

1. What would be the consequences of a deficiency of hemoglobin in our bodies ?
2. Explain how oxygenated blood from left ventricle is sent to all parts of the body and how deoxygenated blood enter into the right auricle.
3. Describe the double circulation in human beings with the help of diagrams. Why double circulation is necessary ?
4.



(a) Name the blood vessels labeled from 1 to 9.

(b) Which of these carry maximum oxyhaemoglobin ?

(c) Which of these contain highest concentration of amino acids and glucose soon after a meal ?

2. How does blood circulate between lungs and heart in human beings ? Give two functions of lymph in human beiges.
3. (a) Name the blood vessel that brings oxygenate blood to the human heart.

(b) Which chamber of human heart receives deoxygenated blood ?

(c) Describe how deoxygenated blood from this chamber is sent to all parts of the body .

4. Draw a diagram of the vertical section of human heart to show the internal structure. Label any one of the heart chambers and any other five parts.

5. Name the blood vessel that brings deoxygenated blood to the human heart which chamber of the human heart receives deoxygenated blood ? Describe how deoxygenated blood from this chamber is sent to lungs for oxygenation .

6. Name the constituents of blood. Why are white blood corpuscles called 'Soldiers of the body' ?

CIRCULATORY SYSTEM — ANSWER KEY — EXERCISE # 2

● VERY SHORT ANSWER QUESTION :

1. **Right auricle** **2.** **Hemoglobin**

3. In this, blood completes its circulation from right ventricle to left auricle through the lungs.

4. Left ventricle **5.** Superior and inferior vena cave **6.** Aorta

7. Left auricle **8.** a. bicuspid value b. tricuspid valve **9.** $\frac{120}{80}mmHg$

10. pulmonary artery, pulmonary vein **11.** pacemaker of heart

12. Electrocardiograph **13.** Aorta **14.** Lymph nodes

15. Systemic circulation **16.** Lymph **17.** 120 days

18. because it transports the materials and help in survival of the organism.

19. In thoracic cavity between the lungs

20. due to presence of auriculo ventricular valves.

EXERCISE # 3 (FOR COMPETITIVE EXAMS)

1. How many molecules of C_2 can associate with a molecule of hemoglobin in man ?
(A) One (B) Two (C) Three (D) Four

2. Hemoglobin is having maximum affinity with :-
(A) NH_3 (B) O_2 (C) CO (D) CO_2

3. In which from CO_2 is carried by blood :-
(A) Sodium bicarbonate (B) Sodium carbonate
(C) Potassium carbonate (D) Magnesium carbonate

4. Amount of oxygen which is transported by one gram of hemoglobin is :-
(A) 20 ml (B) 13.4 ml (C) 1.34 ml (D) None of these

5. Mountain sickness result due to :-
(A) Anemic hypoxia (B) Arterial hypoxia
(C) Lack of sufficient Hb (D) Lack of sufficient RBCs

6. Heart with single circulation is found in :-
(A) Mammals land birds (B) Reptiles
(C) Fishes and amphibians (D) Fishes only

7. The blood pressure is measured by :-
(A) Electrocardiogram (ECG) (B) Stethoscope

(C) Sphygmomanometer (D) Pulse rate

8. Chemical basis of action of nerve on heart beat was discovered by :-

(A) Otto Loewi (B) Pavlov (C) Harvey (D) Landsteiner

9. Erythrocytes of adult rabbit and other mammals are formed in :-

(A) Kidney (B) Liver (C) Spleen (D) Bone marrow

10. The blood vascular of mammals is known as double vascular system because :-

(A) A group of veins carry oxygenated blood and other group conducts deoxygenated blood

(B) Oxygenated blood funs from heart to different organs by one set of veins, while deoxygenated blood runs from heart to lungs by another set

(C) Two different blood runs never meet

(D) All of these

11. Which of the following is helpful for erythropoietin :-

(A) Fe^{++} (B) Mg^{++} (C) Ca^{++} (D) Cu^{++}

12. Heart beat originates from :-

(A) Left atrium (B) Right ventricle (C) Pacemaker (D) Cadiac muscles

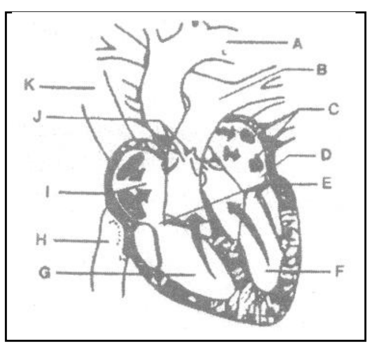
13. Match the different leucocytes given under Column I with their given under Column II. Choose the answer that gives the correct combination of alphabets of two columns :-

	Column –I (Leucocytes)		Column – II (Functions)
A	Eosinophils	p	Phagocytosis
B	Neutrophil	q	Produce antibodies
C	Lymphocytes	r	Role in allergic response
D	Monocytes	s	Prevents clotting
		t	Differentiate in macrophage

(A) A = t, B = p, C = q, D = f (B) A = r, B = p, C = q, D = t

(C) A = q, B = r, C = s, D = t (D) A = p, B = q, C = r, D = s

14. In the diagram of the vertical section of human heart given below certain parts have been indicated by alphabets. Choose the answer in which these alphabets have been correctly matched with the parts they indicate :-



(A) A = Aorta, B = Pulmonary vein, C = Pulmonary arteries, D = Left ventricle , E = Semi lunar valves, F = Left auricle, G = Right auricle, H = Superior vena cava, I = Right ventricle J = Tricuspid valves, K = Inferior vena cava

(B) A = Aorta, B = Pulmonary artery, C = Pulmonary veins, D = Left auricles, E = Tricuspid and Mitral valves, F = Left ventricles, G = Right ventricle, H = Inferior vena cava, I = Right auricle, J = Semi lunar valves K = Superior vena cava

(C) A = Aorta, B = Superior vena cava, C = Inferior vena cava, D = Right ventricles, E = Tricuspid and Mitral valves, F = Right auricle, G = Left auricles, H = Pulmonary vein, I = Left ventricle, J = Semi lunar valves, K = Pulmonary artery

(D) A = Aorta, B = Superior vena cave, C = Inferior vena cava, D = Left ventricles, E = Semi lunar valves, F = Left auricle, G = Right auricle, H = Pulmonary artery , I = Right ventricle, J = Tricuspid valves, K = Pulmonary vein

15. Cardiac cycle in man takes about :-
(A) 0.5 seconds (B) 1.0 seconds (C) 1.2 seconds (D) 0.8 seconds

16. Where are red blood cells formed ?
(A) Spleen (B) Liver
(C) Red bone marrow of short bones (D) Thyroid

17. The heart pumps only deoxygenated blood :-
(A) shark (B) frog (C) whale (D) crocodile

18. A sudden increase in the number of white blood cells in the blood is a sign of :-
(A) deficiency disease (B) better health (C) bacterial disease, infection (D) mental tension

19. Clotting of blood is achieved with the help of the following :-
(A) vitamin K, fibrinogen and calcium is ions
(B) prothrombin, fibrinogen and Thromboplastin
(C) vitamin K, fibrinogen, prothrombin and calcium ions
(D) vitamin B, fibrinogen, thrombin and potassium ions

20. The pH value of blood varies between :-
(A) 6.00-7.00 (B) 7.00-8.00 (C) 7.30-7.45 (D) 7.50-8.00

ANSWER KEY

Q.No	1	2	3	4	5	6	7	8	9	10
Ans.	D	C	A	C	B	D	C	A	D	D
Q.No	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	B	B	D	C	A	C	D	C

TRANSPORTATION IN PLANT

TRANSPORTATION : The transport of water, food, minerals , hormones and other substances from one part to another part inside the body of an organism is known as transpiration.

- Plants take in CO_2, photosynthesize and store energy in leaves. Besides CO_2 plants need other raw materials for growth. These raw materials like nitrogen, phosphorous etc., they get from the soil by the process of absorption by roots. These raw materials need to be transported to each and every part of the plant, mainly to leaves.
- If the distance between roots and leaves is small, then these raw materials can reach to the leaves easily by the process of diffusion.

COMPETITION WINDOW

Diffusion : The movement of molecules is in the direction of concentration gradient i.e., from a region of higher concentration to that of lower concentration.
In unicellular organisms like **Chlamydomona** transport of material mainly takes place by the process of diffusion. **Osmosis :** Osmosis is the flow of water molecules from the region of higher potential to the region of lower water potential through a semi permeable membrane. The osmotic entry of water into a cell, organ or system is called **endosmosis** while the osmotic withdrawal of water from the same is described as **Exosmosis.**

- In desistance between roots and leaves is more, then proper system of transpiration is required.
- In points, transportation is done by a specialized vascular system which is present in the root, stem and leaves.
- Vascular system is made up of two types of vascular tissues.

  1. Xylem 2. Phloem
- In plants the transport of materials can by divided into two parts.

(A) Transport of water and minerals through xylem tissue.

(B) Transportation of food and other substances thorough phloem tissue.

(A) TRANSPORT OF WATER AND MINERALS [ASCENT OF SAP].

- The plants require water and minerals for making food and performing other functions.
- The upward movement of water and minerals from the roots to various parts of the plant is known as **ascent of sap.**
- Ascent of sap is carried out by xylem tissue which consists of :-

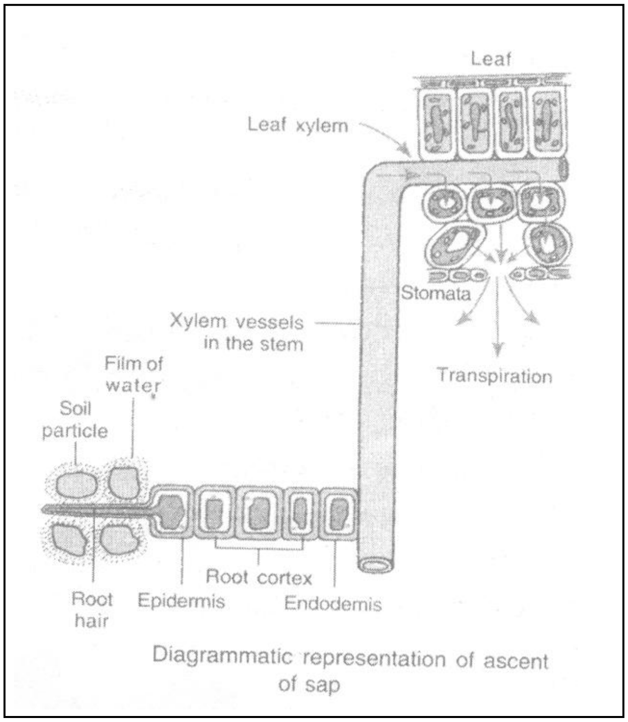
  1. Xylem vessels 2. Xylem Trachieds

  3. Xylem fibre 4. Xylem parenchyma.
- In flowering plants xylem vessels and tracheas conduct water and minerals upwardly.

  In non flowering plants, Trachieds are the only conducting cells.

MECHANISM OF ASCENT OF SAP :-

Absorption of water and minerals :- The water and minerals are absorbed by land plants from the soil where it is present in the form of soil solution. The main water and minerals absorbing organs are root hairs. The water is absorbed actively due to the water potential difference between soil solution and root hairs.



Diagrammatic representation of ascent of sap

Water molecules moves from higher water potential to lower water potential and then migrate from cell to cell passing from epidermis to cortex, from cortex to endodermis and from endodermis to xylem vessels and Trachieds. This is called lateral transportation.

The mineral slats move from higher partial pressure to lower partial pressure along the concentration gradient by passive absorption or against the concentration gradient by active absorption. Finally the water and minerals reach the vessels and Trachieds of xylem from where they move upward by the process called ascent of sap.

Many theories have been put forward to explain the upward movement of water by distinguished scientists. Two among them are important :

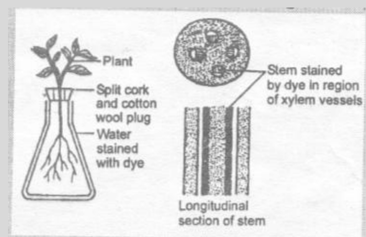
(a) Root pressure theory :- According to root pressure theory, the roots absorbs water and exert a pressure, the root pressure, which pushes the water upward. The root pressure develops in the treachery element of xylem (i.e., Trachieds and vessels) as a result of metabolic activities of roots. The root pressure theory is applicable in small herbs but not in tall trees. The effect of root pressure in transport of water is more important at night.

COMPETITION WINDOW

Experiment to show the Movement of water and minerals in the xylem.

Take a cut shoot of balsam plant and dip it in a dilute red colored dye, like eosin or safranin. Leave it for sometime. Then take sections from different parts of the stem starting from the tip region.

You will observe red color dye in the region of xylem .

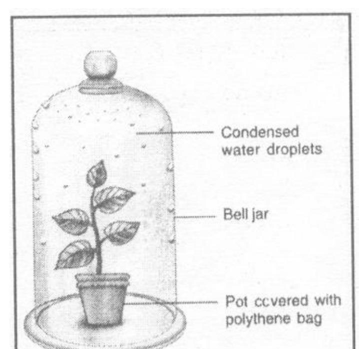


(b) Transpiration pull and cohesion-tension theory:-

Transpiration pull and cohesion-tension theory explains the upward movement of water in tall trees. According to this theory, the main force responsible for upward movement of water is transpiration pull generated in the leaves which pulls the water column filled in the xylem Trachieds and vessels.

During day period **Cohesion force** and **Transpiration pull** help in the upward movement of sap from roots to leaves.

- **TRANSPIRATION :** The loss of water in the form of water vapours from the aerial part of a plant is known as transpiration.
- Transpiration mainly occurs through stomata, (about 80 % to 90 %) but it may also occur through **cuticle (9 %) an lenticels (1 %).**



Transpiration in plants

FUNCTION OF TRANSPIRATION :

- It helps in absorption and upward movement of water.
- It helps in temperature regulation. The plants are protected from the burring due to transpiration. Evaporation of water produces cooling effect.

Do you know ?

The minimum transportation is found in succulent xerophytes and no transportation in submerged hydrophytes.

Photometer is an instrument used to measure transpiration.

Guttation : The loss of water from the uninjured part or leaves of the plant in the form of water droplets is called as guttation Exuded liquid of guttation is not pure water. The process of guttation takes place due to the **root pressures.**

Bleeding :- Fast flowing of liquid from the injured or cutting parts of the plants is called bleeding or exudation.

Wilting :- Drooping of soft part of the plants due to loss of turgidity in their cells is called wilting. Wilting is caused due to high rate of transpiration during mid-day or deficiency water in soil and also in prolonged drought conditions.

REVIEW QUESTIONS

1. Name the conducting tissue in plant.

2. Name the components of xylem tissue.

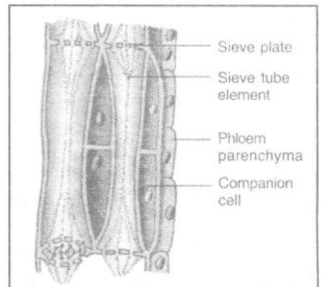
3. Name the tissue which transports water and minerals in plants.

4. Sate the term used for loss of water in vapor form from aerial part of the plants.

5. Define the term transpiration.

6. Define the ascent of sap.

(B) TRANSPORTATION OF FOOD AND OTHER SUBSTANCES



A part of the phloem tissue

- Sugar, amino acid and other substances are translocated from site of synthesize of site of storage through the phloem.
- Transport of food from leaves to different parts of plant is termed as translocation.
- Translocation may be in upward or downward direction depending on the need of the plant.
- Translocation of food takes place in the sieve tubes with the help of adjacent companion cells by phloem tissue.
- Phloem tissues consist of four components.

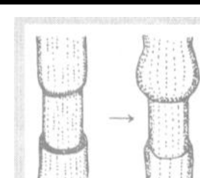
1. Sieve tubes   2. Companion cells
3. Phloem parenchyma   4. Phloem fibre

MECHANISM OF TRANSLOCATION

- Translocation takes place through energy in the form of ATP.
- Sugar (sucrose) made in leaves and loaded into the sieve tubes phloem by using energy from ATP.
- It increases the osmotic pressure of the sieve tubs.
- Water now enters into sieve tubes containing sugar by the process of osmosis.
- Soluble material is then transferred from phloem tissue to other tissues which have less pressure than in the phloem.
- Thus, according to plants requirement, the material is translocated from higher osmotic pressure to lower osmotic pressure areas.

COMPETITION WINDOW

Girdling experiments are also used to demonstrate that the transportation of sugar takes place through phloem tissue. Girdling of stem removes phloem tissue. If a stem is girdled, the downward and upward movement of food material gets blocked. So the trunk portion shows swelling above the girdle area due to accumulation of food material.


Girdling experiment

Do you known ?

Various theories have been proposed to explain translocation. Most widely accepted one is the **mass flow hypothesis** proposed by **Munch** in 1931.

In this way food material is translocated between the **source** of food material to the **sink** which is the site of utilization. This is **downward translocation of food.**

In spring, sugar stored in root or stem tissue would be transported to the buds which need energy t grow.

REVIEW QUESTIONS

1. Name the components of phloem tissue.

2. Which plant tissue is associated with translocation ?

3. Sate the term used for transport of food from leaves to other parts of the plant.

4. Which process in a plant is accomplished by utilizing energy from ATP. Transport of water or transport of food ?

5. Define the term translocation.

EXERCISE # 1 (FOR SCHOOL EXAMS)

OBJECTIVE TYPE QUESTION

1. Water will be absorbed by root hair when :

(A) Concentration of solutes in the cell sap is high

(B) Plant is rapidly respiring

(C) They are separated from soil by permeable membrane

(D) Concentration of salts in the soil is high

2. Which one of the following is connected with transport of water in plants ?

(A) Phloem (B) Xylem (C) Epidermis (D) Cambium

3. If the cut end of a tree s put in eosin solution :-

(A) Leaves remain fresh but ascent of sap stops

(B) Phloem gets colored because of ascent of sap

(C) Xylem elements get stained showing ascent of sap through them

(D) Ascent of sap stops

4. The principal pathways by which water is translocated in angiosperms is :-

(A) Xylem vessel system (B) Xylem and phloem

(C) Sieve tubes members of phloem (D) Sieve cells of phloem

5. The carbohydrate synthesized in the leaves are transported through sieve tubes most commonly in the form of :-

(A) Glucose (B) Triose (C) Sucrose (D) Soluble starch

6. Which of the following contributes most to transport of water form the ground to the leaves of a tall tree ?

(A) Breakdown of ATP (B) Cohesion of water and transpiration pull

(C) Root pressure (D) Capillary rise of water in xylem

7. Due to low atmospheric pressure the rate of transpiration will :-

(A) Increase (B) Decrease lowly (C) Decrease rapidly (D) Remain unaffected

8. The transpiration in plants will be lowest :-

(A) When there is high humidity in the atmosphere (B) There is excess of water in the cell

(C) Environmental conditions are very dry (D) High wind velocity

9. Rate of transpiration in a dorsiventral leaf is :-

(A) Greater at the upper surface (B) Greater at the lower surface

(C) Equal at both the surfaces (D) None of the above

10. Which of the following is not a function of transpiration ?

(A) Excretion of minerals (B) Cooling of leaves

(C) Uptake of water (D) Uptake of minerals

FILL IN THE BLANKS :

1. In plants food is transported through ……………………………………..
2. In plants water is transported through …………………..
3. Water enter into the root hair from soil by……………………..
4. Transport of water and minerals is called…………………………
5. The water moving upward forms a column, which is maintained up to a certain height due to …………..
6. Vascular tissues in plants are………………………..and…………………..
7. During day period……………………..and …………………help in the upward movement of sap from roots to leaves .
8. Transpiration mainly occurs through ………………………
9. Guttation takes place through…………………
10. Translocation takes place through energy in the form of ………………………..
11. Water enter into sieve tube containing sugar by the process of …………………
12. According to plants requirements, sugar is translocated from…………………..osmotic pressure to …………..osmotic pressure areas.

MATCH THE COLUMNS :

Match the items of Column A with items of Column B.

Column A		Column B	
1.	Living part of xylem	(a)	Sieve tube
2.	Dead part of phloem	(b)	Trachieds

3.	Living part of phloem	(c)	companion cell
4.	Dead part of xylem	(d)	Vessels
		(e)	Phloem fibre
		(f)	xylem parenchyma
		(g)	Phloem parenchyma
		(h)	xylem fibre

VERY SHORT ANSWER TYPE QUESTIONS :

1. What is transpiration ?

2. What is translocation ?

3. Name a plant which does not have a transport system.

4. What is the role of stomata in transpiration ?

5. Name the tissues responsible for the translocation of food in plants.

6. Name the process by which plants lose water.

7. Name that component of the vascular bundle which transports food from the leaves to different parts of a plant.

8. What is the transporting medium in higher plants ?

9. What is the upper movement of water and minerals called ?

10. Which process in plants creates suction force to help water column rise in plants ?

SHORT ANSWER TYPE QUESTIONS :

1. Write about the opening and closing of stomata.

2. Why is transportation of materials necessary ?

3. Describe transport of the following materials in plants.

4. Write the main difference between xylem and phloem.

5. How does transpiration help in ascent of sap ?

LONG ANSWER TYPE QUESTIONS :

1. Draw a sieve tube and label the various parts. Name the dead elements of the phloem.

2. Leaves of healthy potted plant were coated with Vaseline to block the stomata. Will this plant remain healthy for long ? State three reasons for your answer.

3. What is translocation ? Why is it essential for plants ? Where in plants are following synthesized.

(a) sugar (b) Hormones

[NCERT QUESTIONS :]

1. What are the components of the transport system in highly organized plants ?

2. How is food transported in plats ?

3. How are water and minerals transported in plants ?

4. What are the differences between the transport of materials in xylem and phloem ?

EXERCISE # 2 (FOR COMPETITIVE EXAMS)

---

1. The rate of transpiration during :-

(A) Cactus (B) Lily (C) Hydrilla (D) All of these

2. Maximum transpiration occurs in :

(A) Mesophytic plants (B) Xerophytic plants

(C) Hydrophytic plats (D) None of these

3. Transpiration stream is continued in plants due to :

(A) Chlorophyll (B) Phloem (C) Sieve tube (D) Stomata

4. Transpiration in plants takes place through :

(A) Stomata (B) Cuticle (C) Lenticels (D) All of these

5. We feel cool near a banyan tree during summer because of :

(A) Transpiration (B) Photosynthesis (C) Green leaves (D) All of these

6. Water movement against gravity is due to :

(A) Osmosis (B) Respiration (C) Photosynthesis (D) Transpiration

7. The instrument used to measure transpiration is :

(A) Barometer (B) Pedometer (C) Thermometer (D) Potometer

8. The factors which affects the rate of transpiration is :

(A) Speed of wind (B) Temperature

(C) Surface area of leaf (D) All of these

9. The rate of transpiration increases when :

(A) Soil is dry and air is humid (B) Soil is wet and air is dry

(C) Soil is we5 and air is humid (D) Soil is dry and air is dry

10. Role of transpiration is :

(A) Conduction of water, mineral, salts

(B) Cooling effect

(C) Maintenance of cell turgidity

(D) All of these

TRANSPORAION IN PLANTS **ANSWER KEY** **EXERCISE # 1**

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	B	C	A	C	B	A	A	B	A

● **FILL IN THE BLANKS :**

1. Phloem **2.** xylem **3.** diffusion **4.** scent of sap **5.** root pressure

6. xylem, phloem **7.** cohesion force, transpiration pull **8.** Stomata

9. Hydathodes **10.** ATP **11.** Osmosis **12.** Higher, lower

● **MATCH THE FOLLOWING**

1-(f), 2-(e), 3-(a, c, g), 4-(b, d, h),

● **VERY SHORT ANSWER QUESTION :**

1. Process by which plants lose water in vapor form into the surrounding air.

2. Process of transport of food from leaves to other parts of the plant body through phloem.

3. Chlamydomona

4. Stomata takes out the extra amount of water in the form of water vapours. The rate of transpiration is directly proportional to the number of stomata.

5. Phloem **6.** Transpiration **7.** Phloem tissue **8.** Water **9.** Ascent of sap **10.** Transpiration

EXERCISE # 2

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	D	D	A	D	D	D	B	D

EXCRETION IN ANIMALS

☐ **EXCRETION :**

The biological process of removal of harmful nitrogenous wastes from the body is called **excretion.** The waste products in animals include :

(i) Nitrogenous compounds like ammonia, urea and uric acid.

(ii) Carbon dioxide and water.

(iii) Excess salts and vitamins.

(iv) Unwanted medicines

COMPETITION WINDOW

Ammonotelic organisms are those which excrete ammonia. e.g. most aquatic animals.

Ureotelic organisms are those which excrete urea. e. g. sharks, frogs, mammals.

Uricotelic organisms are those which excrete uric acid e.g. birds, insects, lend snails, many reptiles

Excretory Organs / Structures in Animals :-

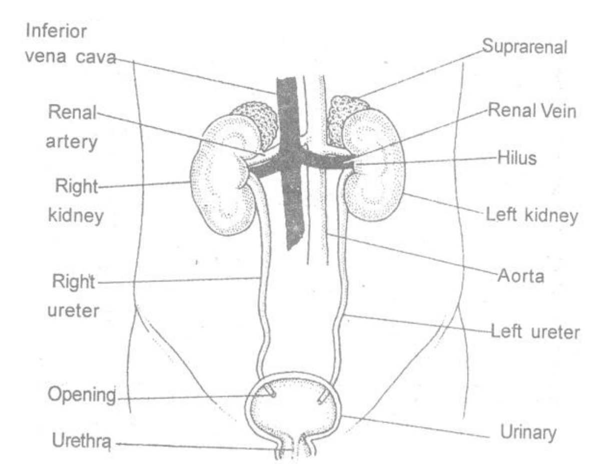
Animals	**Amoeba**	**Hydra**	**Flatworm**	**Earthworm**	**Insects e.g. cockroach**	**All chordates**
Excretory Structures	Cellular surface	Body Surface	Protonephridia (flame cells)	Nephridia	Malpighian tubules	Kidneys
Waste products	CO_2 and ammonia	CO_2 and Ammonia	Mainly ammonia	Ammonia and urea	Uric acid	Urea

REVIEW QUESTIONS :

1. Name the organ system responsible for exception.
2. Name the excretory is structure of Amoeba.
3. Name the excretory organs of vertebrates.
4. Name the major excretory product of human beings.
5. What is excretory organs of cockroach?

☐ **HUMAN EXCRETORY SYSTEM :**

- Human excretory system consists of :-
  - A pair of kidneys
  - A pair of Ureter
  - Urinary bladder
  - Urethra



External Structure of Urinary System

☐ **KIDNEY :**

- The main excretory organ of our body are **Kidneys.**

Colour	-	Dark red
Shape	-	Bean shaped
Weight	-	125-170 gms.
Size	-	10 cm length, 5 cm breadth, 3 cm thickness.
Position	-	Located laterally either sides of **vertebral column.**

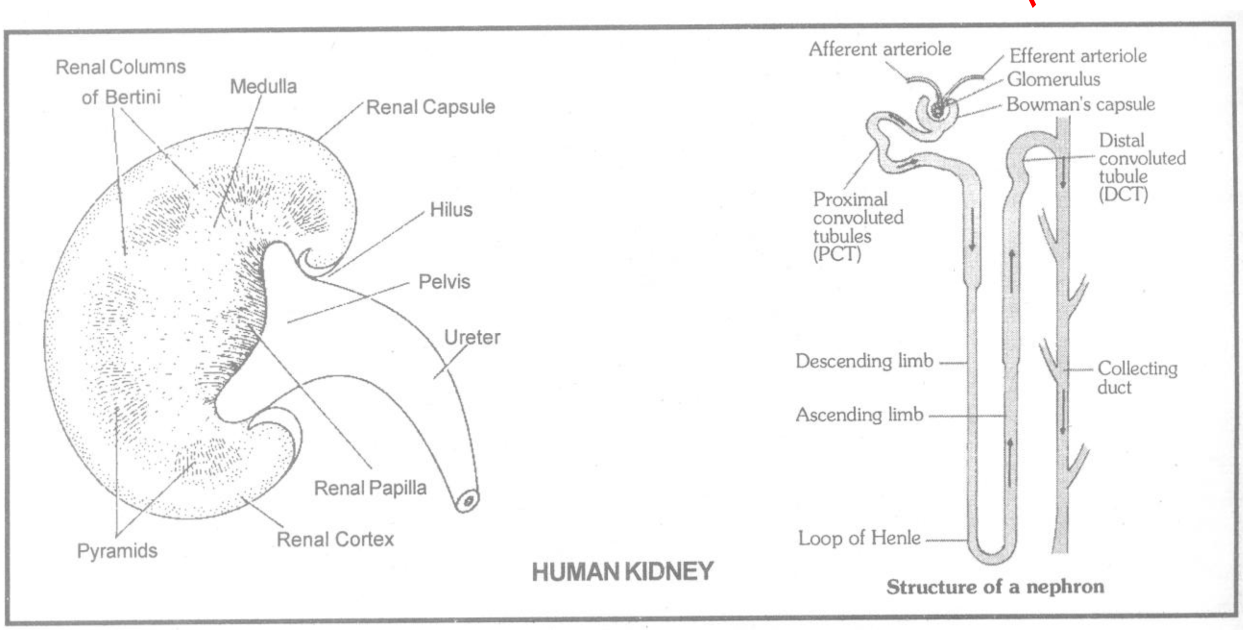
External Structure :-

- Each kidney is surrounded and covered by a tough, fibrous, capsule of connective tissue. This capsule is called **renal capsule .**
- Lateral surfaces of kidney are convex while medial surfaces are concave.
- On the inner border of each kidney is a depression called **hilum / hilus.**

★ **The human kidney are not located at similar positions due to presence of liver above right kidney so that the right kidney get slightly lower position.**

☐ **Internal Structure :**

- The internal structure of kidneys can be divided into two parts.
- Its outer part is called **cortex** and inner part is called **medulla.**
- Nephron is the structural and functional unit of excretion.
- A nephron consists of a long coiled tubule differentiated into **proximal nephron, loop of Henle** and **distal nephron.** The latter opens into the collecting tubule.
- At the proximal end of the nephron, a double walled cup shaped structure is present called **Bowman's capsule.**
- It consists of network of capillaries called **Glomerulus**.



- One end of the **Glomerulus** is attached to renal artery and the other end to the renal vein.
- In the Glomerulus, blood comes in through afferent arteriole and blood is drained out through efferent arteriole.
- Glomerulus and Bowman capsule are collectively called **Malpighian body** or **renal corpuscle.**
- The function of Glomerulus is to filter the blood passing through it. This process is called **ultra filtration.**

COMPETITION WINDOW

Structure of Nephron :-

Nephron is the structural and functional unit of kidney, which is about 3 cm long and 20-30 μm in diameter. Each kidney has about one million Nephrons in humans.

A nephron can be divided into three rations :

(I) Proximal nephron (Bowman's capsule + Proximal convoluted tubule)

(II) Loop of Henle (Ascending + Descending limb)

(III) Distal nephron (Distal convoluted tubule which opens into collecting duct)

(I) **Proximal nephron :** Nephron tubule is closed at its proximal (starting) end but its distal end is open and continues into the loop of Henle. At the proximal or closed end the nephron is expanded and curved inwardly to from a double walled cup shaped **Bowman's capsule.** Within the Bowman's capsule a network or tuft of capillaries is present, it called **Glomerulus.** Diameter of afferent arteriole is greater than efferent arteriole.

Malpighian corpuscle : Glomerulus and its surrounding Bowman's capsule together form this specialized structure.

(I) **Loop of Henle :** It stars after the proximal convoluted tubule, It ends before the distal convoluted tubule. This hairpin like loop has a descending limb, followed by an ascending limb.

(III) **Distal nephron :** The ascending limb of Henle's loop merge into distal **convoluted tubule.** The distal convoluted tubules of number of adjacent Nephrons open into a common **collecting duct** or tubule.

☐ **Ureter :**

- The collecting ducts open into the **Ureter.**
- Each Ureter originate from interior part of kidney.
- The anterior part of the Ureter is broad, like a funnel and called **pelvis** and its posterior part is in the form of long tubule.

☐ **Urinary Bladder :**

- Each Ureter opens into the **urinary bladder.**
- The structure of urinary bladder is muscular sac like and pear shaped.
- Its wall is flexible, it collect urine when necessary by the contraction of muscles, the urine is excreted through urethra.

☐ **Urethra :**

- It is a muscular and tubular structure, which extends fro the urinary bladder to the outside. It carries the urine to the outside .

☐ **Micturition :**

- Micturition is the term used for urination. (Passing out of urine)

☐ **Functions of Kidney :**

- Regulation of water and electrolyte balance. (Osmoregulation)
- Regulation of acid base balance.
- Regulation of blood pressure.
- Excretion of metabolic waste and foreign chemicals.

Physiology of Excretion :-

- The impure blood enters to each kidney through **renal artery.**
- The **afferent arterioles** which is branch of renal artery provides blood to the Glomerulus.
- Glomerulus is a group of blood capillaries formed by division of afferent arterioles located in Bowman capsule.

- The arterioles which carry blood away from Glomerulus are called **efferent arterioles**.
- The radius of afferent arterioles is greater than that of efferent arterioles so the pressure in Glomerulus increases. Which is necessary for ultra filtration.
- Due to the blood pressure, from the blood of afferent arteriole, water, glucose, urea, uric acid and some salt filter in Bowman capsule through **ultra-filtration.**
- It also contains glucose, amino acid and some useful salts along with filtrate.
- This liquid from the Bowman capsule moves through the glandular part of the nephron.
- From where glucose, useful salt and some part of water is **reabsorbed.** The amount of water reabsorbed depends on how much excess water there is in the body and on how much of dissolved water there is to be excreted.
- The remaining liquid now contain only waster material is called **urine.**
- The urine from the nephron s collected in urinary bladder through Ureter.
- Urine is stored in the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra.
- By the contraction of muscles of urinary ladder, the urine passes out of the body when necessary.
- All the system of our body keep the internal environment stable even on the changing conditions of external environment.
- This activity is called **homeostatic** activity.
- Usually the homeostatic activities are performed by excretory organ.
- They not only excrete out salts and nitrogenous waste products but also perform important role of water balance.

◆ **The processes of maintaining the right amount of water and proper ionic balance in the body is called osmo regulation.**

◆ **Urea is always formed in liver through Ornithine cycle.**

COMPETITION WINDOW

Urine Formation (Uropoiesis) :-

It involves three processes : glomerular filtration (ultra filtration), tubular reabsorption and tubular secretion .

(i) Ultrafiltration :

Walls of Glomerulus and Bowman's capsule are thin and semi permeable membrane. In the Glomerulus there are many minute pores are present.

Afferent arteriole is wider and releases the blood into Glomerulus, whereas efferent arteriole is narrow. Thus, there is development of high blood pressure.

Due to this pressure, separation of small, selective molecules ions form the large molecules in the blood occurs and called ultra filtration. Fluid which is filtered out from the blood is called as Glomerulus filtrate / capsular / filtrate / ultra filtrate.

(ii) Tubular Reabsorption :-

The ultra filtrate contains salts, glucose, amino acids, urea, urea acid and large amount of water.

Glucose , salts, amino acids and water are reabsorbed by various parts of nephron and finally they enter into the surroundings blood capillaries.

(iii) Tubular secretion :-

It is removal of wastes from the surrounding blood capillaries into the glomerular filtrate.

Glomerular filtrate entering collecting duct is called **urine.** Urine composition is different from filtrate by the loss as well as gain of many substance during the course of Nephrons.

☐ **Chemical composition of urine :**

- Urine is slightly acidic liquid, light yellow in colour.
- The healthy human being has 95 % water, 5 % urea, uric acid and salts of phosphoric acid .
- A young and healthy person excretes 1.5-1.8 litres urine per day.
- This quantity may increase due to intake of tea, coffee, wine etc.

REVIEW QUESTIONS

1. Name three nitrogenous wastes produced during the metabolism.

2. Name various parts of excretory system of man.

3. What are the functional units of human kidneys ?

4. Give the technical term for the process of expelling of urine.

5. Where is the urine carried through Ureter ?

6. What is urethra ?

7. Name the functional and structural unit to kidney ?

8. Name the U-shaped tubule of nephron ?

9. Why is urine yellow in colour ?

☐ **Regulation of excretion :**

Following two hormones regulate the functions of kidney :

(i) **Anti Diuretic Hormone (ADH) . Vasopressin**

It is secreted by pituitary gland, it promotes the reabsorption of water through Nephrons. (DCT part)

(ii) **Aldosterone :-** It is secreted by Adrenal gland.

Aldosterone promotes the reabsorption of salts (Na^+) in the nephron (DCT part) i.e. it checks the loss of Na^+ ions through urine.

☐ **Role of lungs in excretion**

Human lungs eliminate around 18L of CO_2 per hour and about 400ml of water per day in normal resting condition . Water loss via the lungs is small in hot humid climate and large in cold dry climates.

☐ **Role of skin in excretion :**

Human possess two types of glands :

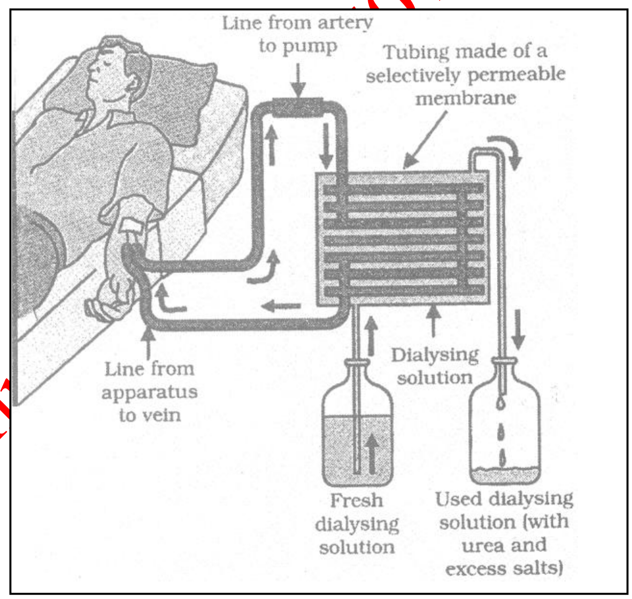
(1) Sweat glands : These excrete sweat, Sweat contain 99.5 % , Water , NaCl, Lactic acid , Urea, Amino acid and glucose.

(2) Sebaceous glands : These secrete sebum which contain waxes, sterols, other hydrocarbons and fatty acids.

- **Role of liver in excretion :**

  Liver is the main site for elimination of cholesterol, bile pigments (billirubin & biliverdin) , inactivated products of steroid hormones, some vitamins and many drugs. Bile carries theses materials to the intestine from where they are excreted with the faeces.

ARTIFICIAL KIDNEY OR HAEMODIALYSIS



Kidney dialysis also known as **haemodialysis or renal dialysis,** is a medical treatment used to remove nitrogenous waste materials from the blood of patients lacking kidney function or kidney failure, due to infections, injury or restricted blood flow to kidneys. In this procedure, the blood is circulated through a machine known as artificial kidney or dialyses that removes wastes and excess fluid from the bloodstream.

The blood from an artery is pumped through a dialyses or artificial kidney, where it flows through a semi permeable membrane which are made up of cellophane tubes. The cellophane tubes remain suspended in a tank with dialyzing fluid which has same osmotic pressure as blood and has the same composition as that of blood plasma but it lacks nitrogenous wasters. When the blood of the patient is passed through the cellophane tubes, the dialysis fluid passing on the other side of the membrane removes unwanted elements in the blood diffusion, the blood is then retightened to body through a vein.

Main difference of kidney & dialysis is that there is on reabsorption in dialysis. In kidney, initial filtrate is about 180L daily but actual excretion is only a litre or two a day

REVIEW QUESTIONS

1. Give the technical term for the dialyzing machine .
2. Name two functions of human kidneys.
3. Define uremia.
4. What is the main aim of excretion ?
5. Which part of kidney acts as dialysis long ?

COMPETITION WINDOW

☞ **Anuria :-** No production of urine

- **Polyuria ;-** Excess production of urine. More urine formation takes place due to less secretion of ADH. Due to less secretion of ADH, the amount of water increases in the urine . So, the patient feels thirsty again and again. This disease is called **Diabetes inspidus.**
- **Glyconsuria :-** Excretion of glucose through urine. This sign is present in **Diabetes mellitus.** This disease is caused mainly due to less secretion of insulin.
- **Uremia :-** Excess of urea in blood is termed as uremia.
- **Calculi and cast :-** It is also termed as **Kidney-stone.** Due to deposition of Calcium-oxalate in the kidney, stone is formed. Sometimes, calcium – phosphate and calcium-sulphate are also found. These are insoluble salts. Normally, these are not excreted by the urine.
- **Haematuria :-** Excretion of blood through urine.
- **Diuresis ;-** The process of excess formation of urine in the kidney's is termed as Diuresis.
- The urine on standing gives a pungent smell. It is due to conversion of urea into ammonia by bacteria
- The volume of urine produced per day will increase on a cold day, due to ↓ ADH secretion.
- If one kidney is removed, the remaining one enlarges and performs function of both kidneys.
- **Renal failure :** It is a syndrome characterized by renal dysfunction, oliguria, anuria, sudden rise in metabolic waste products like urea & creatinine in blood (uremia). It is either of acute (sudden onset) or chronic (slow onset) nature.
- **Diabetic nephropathy ;** It is a complication due to diabetes mellitus where the kidney progressively gets damaged leading to death ultimately due to renal failure.
- Pale yellow colour or urine is due to the **Urochrome** pigment. It is formed in the blood due to the reduction of Hemoglobin. So in the body of a healthy animal, Urochrome is found in very fewer amounts.

EXERCISE CHECK YOUR GREASE

OBJECTIVE TYPE QUESTIONS

1. Excretion is :-
(1) Removal of substances not required by body
(2) Removal of useless substances and substances resent in excess
(3) Formation of substances having some role in body
(4) All the above

2. In mammals, the urinary bladder opens into :-
(1) Uterus (2) Urethra (3) Vestibule (4) Ureter

3. Malpighian corpuscles occur in :-
(1) Medulla (2) Cortex (3) Pelvis (4) Pyramid

4. Loops of Henle occurs in ;-

(1) Cortex (2) Medulla (3) Pelvis (4) Ureter

5. "Homeostasis" term was proposed by :-

(1) Claude Bernard (2) Walter Cannon (3) Marcello Malpighi (4) Henle

6. Bile pigments are formed in :-

(1) Liver (2) Spleen (3) Every body cells (4) 1 & 2 both

7. Excretory materials are formed in :-

(1) Kidney (2) Rectum (3) Liver (4) Every cell in body

8. Diameter of renal afferent vessel is :-

(1) Same as that of efferent (2) Smaller than that of efferent

(3) Larger than that of efferent (4) There is no efferent vessel

9. Nitrogenous waster products are eliminated mainly as :-

(1) Urea in tadpole & ammonia in adult frog (2) Ammonia in tadpole and urea in adult frog

(3) Urea in both tadpole & adult frog. (4) Urea in tadpole and uric acid in adult frog.

10. Which blood vessel contains the least amount of urea ?

(1) Hepatic vein (2) Renal vein (3) Hepatic portal vein (4) Renal artery

11. Reabsorption of useful substances from glomerular filtrate occurs in :-

(1) Collecting tube (2) Loop of Henle

(3) Proximal convoluted tubule (4) Distal convoluted tubule

12. Which one is Uricotelic ?

(1) Frog and toads (2) Lizards and birds

(3) Cattle, monkey and man (4) Molluscs

13. What will happen if one kidney is removed from the body of a human being ?

(1) Death due to poisoning

(2) Uremia and death

(3) Stoppage of urination

(4) Stoppage of urination

14. In cockroach, the excretory product is :-

(1) Ammonia (2) Uric acid (3) Urea (4) Both 1 and 3

15. The mechanism of urine formation in nephron involves :-

(1) Ultrafiltration (2) Reproduction (3) Diffusion (4) Osmosis

16. In diabetes mellitus the patient drinks more water as there is urinary loss of :-

(1) Salt (2) Insulin (3) Protein (4) Glucose

17. The hormone that promotes reabsorption of water from glomerular filtrate is ;-

(1) Oxytocin (2) Vasopressin (3) Relaxin (4) Calcitonin

18. Main function of kidney is :-

(1) Passive adsorption (2) Ultrafiltration (3) Selective reabsorption (4) Both 2 and 3

19. Urea is transported by :-

(1) Plasma (2) RBC (3) WBC (4) All

20. Micturition is :-

(1) Removal of urea from blood (2) Removal of uric acid

(3) Passing out urine (4) Removal of faeces

21. Ornithine cycle performs :-

(1) ATP synthesis (2) Urea formation in spleen

(3) urea formation in liver (4) Urine formation in liver

22. The snakes living in deserts are mainly :-

(1) Ammonotelic (2) Ammonotelic (3) Ureotelic (4) Uricotelic

23. Which excretory material is less toxic :-

(1) Ammonia (2) Urea (3) Uric acid (4) All are equally toxic

24. Correct order of excretory organs in cockroach, earthworm and rabbit respectively :-

(1) Skin, Malpighian tubule, kidney (2) Malpighi tubules, Nephridia, kidney

(3) Nephridia, Malpighian tubules, kidney (4) Nephridia, kidney , green gland

25. The yellow colour of urine of the vertebrates is due to :-

(1) Cholesterol (2) Urochrome (3) Uric acid (4) Melanin

26. In the kidney, the formation of urine involve the following processes arranged as :-

(1) Glomerular filtration, reabsorption and tubular secretion

(2) Reabsorption, filtration and secretion

(3) Secretion, absorption and filtration

(4) Filtration, secretion and reabsorption

27. A condition of failure of kidney to from urine is called :-

(1) Deamination (2) Entropy (3) Anuria (4) None of these

28. Excretion is carried out by Nephridia in :-

(1) cockroach (2) amoeba (3) earthworm (4) human

29. Urea is formed in :-

(1) Liver (2) Spleen (3) Kidney (4) Lungs

FILL IN THE BLANKS :-

1. The excretory system of human beings includes a pair of…………………..a pair of …………., a………….and a……………

2. Kidneys are located in the ………………………..one on either side of the …………………..

3. Urine is stored in ……………………..

4. CO_2 is removed from the blood in the ……………………..

5. Nitrogenous waster in human beings is ………………………

6. Functional unit of kidney is …………….

7. The urinary bladder is muscular and is under ………………….control.

8. Passing of urine from body is called……………

9. An artificial kidney is a device to remove nitrogenous water products from the blood through ……………….

10. Artificial kidney contain a number of tubes with a……………………..lining, suspended in a tank filled with dialyzing fluid.

11. Dialyzing fluid has the……………….osmotic pressure as blood.

12. Glomerular filtration rate in one day in human beings is ……………………..L.

13. Excretory organs in fishes are……………………..

14. Artery which carry blood into kidney is………………

15. Double walled cup shaped structure in nephron is called……………………..

16. Tuft of capillaries in Bowman's capsule is called………………………..

17. Structure which help in excretion in tapeworm is …………………..

18. The structure which help in excretion in earth worm is…………………

19. Urine leaves the kidney through……………………

20. Substance which is completely reabsorbed by nephron is ………………..

MATCH THE COLUMNS :

1.

Column I		Column II	
(i)	Loop of Henle	(a)	Counter current system
(ii)	Glomerulus	(b)	Hypertonic urine
(iii)	Vasa recta	(c)	Urine concentration
(iv)	ADH	(d)	Ultrafiltration
(v)	Uricotelism	(e)	Frog
		(f)	shark

TRUE AND FALSE :

1. Micturition is carried out by a reflex.
2. ADH help in water elimination making the urine hypotonic.
3. Henle's loop plays an important role in concentration the urine.
4. Glucose is completely reabsorbed in the PCT.
5. Ureter is the reservoir of urine in the body.
6. Kidney filter about 180 L urine per day.
7. Functional unit of kidney is nephron.
8. Human being is Uricotelic.
9. Collecting duct is not a part nephron.
10. Glomerulus is a tuft of capillaries around loop of Henle.

EXCRETION IN ANIMAL						ANSWER KEY						EXERCISE # 1			
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	2	2	2	2	2	4	4	3	2	2	3	2	4	2	1
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Ans.	4	2	4	1	3	3	4	3	2	2	1	3	3	1	

● FILL IN THE BLANKS :

1. Kidneys, Ureter, bladder, urethra **2.** abdomen, backbone **3.** Urinary bladder

4. Lungs **5.** Urea **6.** Nephron **7.** Nervous

8. Micturition **9.** Dialysis **10.** Semi permeable **11.** Same

12. 180 **13.** Kidneys **14.** renal artery **15.** Bowman's cupsule

16. Glomerulus **17.** Flame cell **18.** Nephridia **19.** Urethra

20. Glucose

● MATCH THE FOLLOWING :

(i) – (b), (ii) – (d), (iii) – (a), (iv) – (c), (v) – (e, f)

● TRUE AND FALSE :

True or False										
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	T	F	T	T	F	T	T	F	T	F

EXERCISE # 2 (FOR SCHOOL / BOARD EXAMS)

VERY SHORT ANSWER QUESTION :

1. Name the structural and functional unit of kidney .
2. Why is urine yellow in colour ?
3. Name the structure which stores urine temporarily.
4. Name the U shaped tubule of nephron.
5. What is the main drawback of artificial kidney ?
6. Name the tube which passes out from urinary bladder.
7. Name the chief nitrogenous waster materials in human beings.
8. What is the advantage of presence of two kidneys in man ?

9. Name two parts of a nephron.

10. Where does ultra filtration occur in nephron ?

11. Name three parts of nephric tubule.

12. Define Glomerulus.

13. Give the technical term for passing the useful substances from nephric filtrate back into blood in blood capillaries.

14. Give the technical term for the process of excelling of urine.

15. Which part of skeleton protects the kidney ?

SHORT ANSWER QUESTIONS :

1. Define :

(a) Osmoregulation

(b) Hemo dialysis

(c) Malpighian body

2. Name the excretory matter in :

(a) Fishes (b) Birds (c) Tadpole (d) Human

(c) Frog (f) Earthworm

3. What is the role of afferent and efferent arteriole in glomerular filtration ?

4. Explain the role of ADH is excretion.

5. Differentiate between Ureter and urethra.

6. What will happen if there is no tubular reabsorption in the Nephrons of kidney ?

7. Differentiate between excretion and Osmoregulation.

8. How is the amount of urine produced regulated ?

9. What happens to glucose which enters the nephron along with filtrate during excretion in human beings ? State two vital functions of kidney.

LONG ANSWER QUESTIONS :

1. Where and how is urea produced in areodetic ? What happens to the kidney filtrate in descending limb of loop of Henle ?

2. Describe the structure of human nephron.

3. Briefly state the mechanism of urine formation in human kidney .

4. Explain the structure of kidney with the help of a well labeled diagram.

5. Explain the following , why ?

(a) Mammals are Ureotelic, but birds are Uricotelic

(b) Skin functions as an accessory excretory organ.

(c) Frog is Ureotelic but tadpole is Ammonotelic.

(d) Urine infection is more common in women than men.

(e) Frequency of urination increases after consuming alcoholic beverages.

EXCRETION IN ANIMALS	ANSWER KEY	EXERCISE # 2

● **VERY SHORT ANSWER QUESTIONS :**

1. Nephron **2.** due to pigment Urochrome **3.** Urinary bladder

4. Loop of Henle **5.** There is no reabsorption of useful substances **6.** Ureter

7. Ammonia, Urea, Uric acid **8.** If one kidney fails man can live on the other kidney.

9. Bowman's capsule and nephric tubule. **10.** Bowman's capsule

11. PCT, loop of Henle, DCT

12. A tuft of capillaries present in the cavity of Bowman's capsule.

13. Selective reabsorption **14.** Micturition **15.** 11^{th} , 12^{th} ribs.

EXERCISE # 3 (FOR SCHOOL / BOARD EXAMS)

1. Contraction of right ventricle pumps blood into :-

(A) right auricle (B) pulmonary artery (C) pulmonary vein (D) dorsal aorta

2. Urine leaves the kidney through :-

(A) Urethra (B) collecting duct (C) renal vein (D) Ureter

113. Urea, a nitrogenous waste, requires a large amount of waste. Therefore it is the excretory product in :-

(A) protozoan, amphibians and reptiles (B) elasmobranchii, adult amphibians

(C) reptiles, birds and mammals (D) insects, birds ad fishes

114. In which of the three groups of the following mammals is uric acid also excreted out :-

(A) Carnivore, insectivore and marsupials (B) Elephants, chiropteran, primates

(C) Lagomorphs, man, horse
(D) Man, apes, Dalmatian log

115. In Hydra and Amoeba, ammonia is the nitrogenous waster. Lizards, snakes, birds and insects excrete mostly uric but crocodiles and alligators excrete mainly ammonia through they are reptiles. So can we generalize that :-

(A) there is no uniform pattern of removal of nitrogen wastes

(B) aquatic and land animals excrete urea

(C) animals that fly excrete uric acid

(D) nitrogen waste excretion is closely related to the availability of water in the environment

116. The white matter in a bird's dropping is :-

(A) calcium carbonate
(B) calcium sulphate

(C) uric acid
(D) urea

118. Kidney is an excretory and regulatory organ. Which two of the following are regulated effectively by kidneys ?

(A) CO_2 and protein (B) Sugar and C_2 (C) Water and salts (D) Water and fat

119. The main function of the skin is to protect the underlying delicate tissues from environmental factors ; in addition, it performs several other functions. Some are given below. Which of the following functions is excretory in nature ?

(A) Giving out of urea and uric acid in sweat
(B) Detection of changes in temperature

(C) Regulation of body temperature
(D) Detection of pressure, pain or touch etc

120. Liver is an important gland of the body. in addition to function in digestion and food storage, the liver participates in excretion. Which of the following function (s) :-

(A) Deamination and urea formation
(B) Elimination of hemoglobin and bile salts

(C) Inactivation of chemicals after their role is over
(D) All the three mentioned above

122. Presence of a large number of mitochondria in the tubule cells of Nephrons suggests that the nephron is involved in the process of :-

(A) passive transport (B) active transport (C) formation of urea (D) diffusion

123. Which of the following parts of a kidney contains the lowest concentration of urea ?

(A) Loop of Henle (B) Branches of venal vein (C) Bowman's capsule (D) Glomerulus

124. Uriniferous tubules of a kidney are concerned with the formation of :-

(A) glucose (B) amino acids (C) hormones (D) urine

125. Removal of faeces or undigested food from the body is not an example of excretion because :-

(A) faeces is given out of the alimentary canal
(B) it has not been digested by the body
(C) undigested food is not a product of metabolism
(D) if is remains in the body, it produces foul gases

126. Dialysis is carried out in case :-

(A) both kidneys are damaged
(B) brain and spinal cord are damaged
(C) heart and lungs are damaged
(D) liver and spleen do not function

15. Excretory organs in Amoeba are :-

(A) Contractile vacuoles
(B) Cellular surface
(C) Mitochondria
(D) None of these

ANSWER KEY															
Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	**B**	**D**	**B**	**D**	**D**	**C**	**C**	**A**	**D**	**B**	**B**	**D**	**C**	**A**	**D**

EXCRETION IN PLANTS

EXCRETION : The process of removal of toxic waste products from the body of an organism is known as excretion.

- The main waste products produced by plants are carbon dioxide, water vapor and oxygen
- CO_2 and water are produced as wastes during respiration by plants.
- CO_2 produced during respiration in day time is all used by the plant itself in photosynthesis. Plants excrete oxygen as a waste only during day time.
- The gaseous wastes of respiration and photosynthesis in pants are removed through the **stomata** in leaves and **lenticels** in woody stem and released to the air.
- **Oxygen** is produced as a waster during photosynthesis.
- Plants get rid of excess water by **transpiration.**
- Many plant waste products are stored in cellular vacuoles.
- Plants also store some of the waste products in their body parts (leaves, bark and fruits).
  e.g. Tannins, essential oils, latex, gums, resins.
- Tea leaves, amla, betel nut and bark of tree contain tannins.
- Leaves of Eucalyptus, lemon, tulsi, contain essential oils.
- Leaves of yellow oleander contain latex.
- Gums are found in babul tree.
- **Resins** are found in stem of conifers.

COMPETITION WINDOW	
●	The plants carbon dioxide produced as a waste during **respiration** in night time.
●	Aquatic plants lose most of their metabolic wasters by direct diffusion into the water surrounding them.
●	Terrestrial plants excrete some waste into the soil around them. The plant get rid of stored solid and liquid wastes by the shedding of leaves pealing of bark and felling of fruits.

- Quinine and morphine are medicines derived from alkaloid stored in **Cinchona bark** and **Opium** fruits respectively .
- Caffeine found in coffee seeds and nicotine in tobacco leaves are also alkaloids.
- **Calcium Oxalate crystals** accumulate in some tubers like Yam (zamikand).

EXERCISE # 1 FOR SCHOOL EXAMS

OBJECTIVE QUESTIONS :

1. Plant gets rid of excess water by :-

(A) Photosynthesis (B) Respiration (C) Transpiration (D) None of these

2. Waste product /s produced by plants is / are :-

(A) CO_2 (B) Water (C) Oxygen (D) All of these

3. Waste product produced during respiration in plant :-

(A) CO_2 (B) Water (C) Oxygen (D) A and B

4. In photosynthesis the waste product is :-

(A) CO_2 (B) Oxygen (C) Nitrogen (D) None of these

5. The gaseous wastes of respiration and photosynthesis in plants are removed through :-

(A) Stomata of leaves (B) Lenticels of stem

(C) Stomata and lenticels (D) None of these

6. Which of the following statements (s) is / are correct :-

(A) Gum are found in babul tree (B) Leaves of tulsi contain essential oils

(C) Leaves of amla and tea contain tannins (D) All of the above

FILL IN THE BLANK

1. Plants get rid of excess water by ....

2. ....and water are produced as wastes during respiration by plants.

3. ....is produced as a waste during photosynthesis.

4. The gaseous wastes of respiration and photosynthesis in plants are removed through the ....in leaves and..........................in stem and released to the air.

5. The plants excrete CO_2 produced as a waste during ....process in night time.

6. Gums and resins are the ....products of plant.

7. The phenomenon of removing of waste product from the body is known as ....

8. Leaves of ....contain essential oils.

9. ....are found in stem of conifers as waste product.

10. Aquatic plants lose most of their metabolic wastes by ....process.

VERY SHORT ANSWER TYPE QUESTIONS :

1. Name the two part of a plant through which its gaseous waste products are released into the air.

2. Name a waste gas excreted by the plants only during the day time and only during the night time.

3. Name the process by which plants get rid of excess water.

4. Name the phenomenon of removing of waste product from the body.

5. Name the waste product which is produced by the stem of conifers.

6. Name the by products of photosynthesis.

7. Name some waste products which are stored by the plants .

8. Name the plant from which quinine is obtained .

9. Name the plant from which morphine is obtained.

10. From which part of opium morphine is obtained ?

11. From which part of cinchona quinine is obtained ?

MATCH THE COLUMN :

Match the items of Column A with items of Column B.

Column		**Column**	
(A)	Waste product of respiration	(i)	Resin
(B)	Waste product of photosynthesis	(ii)	CO_2
(C)	Leaves of lemon	(iii)	essential oil
(D)	Stem of conifers	(iv)	O_2

SHORT ANSWER TYPE QUESTIONS :

1. Define the excretion

2. Write about the various waste products produced by the plants.

LONG ANSWER TYPE QUESTION :

3. What are the methods used by plant to get rid of excretory process. [NCERT QUESTION]

EXCRETION IN PLANTS **ANSWER KEY** **EXCERCISE-1 (X) – CBSE**

- **OBJECTIVE QUESTION :**

1. (C) **2.** (D) **3.** (D) **4.** (B) **5.** (C) **6.** (D)

- **FILL IN THE BLANKS :**

1. transpiration **2. CO_2** **3.** Oxygen **4.** stomata ; lenticels

5. respiration **6.** waste **7.** excretion **8.** tulsi / lemon

9. Resins **10.** diffusion

- **VERY SHORT ANSWER TYPE QUESTIONS :**

1. (i) Stomata (ii) Lenticels **2.** O_2 ; CO_2 **3.** Transpiration **4.** Excretion

5. Resins **6.** Oxygen ; Water ; Starch **7.** Tanins ; Gums ; Resins ; Latex

8. Cinchona **9.** Opium **10.** Fruits **11.** Bark

- **MATCH THE FOLLOWING :**

1. A – (ii) **B –** (iv) **C –** (iii) **D –** (i)

ORIGIN AND EVOLUTION

EVOLUTION

The term evolution has been derived from the Latin word '**evolvere**' means unroll.

Evolution can be defined as sequence of gradual development of complex form of life from simple form of life over the course of geological time "Descent with modification."

Evolution is of two types – (i) Chemical evolution
(ii) Organic evolution.

S.No.	Features	Chemical	Organic evolution
1	**Definition**	It is the formation of the complex organic compounds from simple compound or element	It is formation of complex from of life from simple form of life.
2	**Time of occurrence**	It occurred at the time of origin of life	It is still occurring
3	**Reversibility**	Irreversible	Reversible
4	**Speed of evolution**	It is fast process	It is a slow process
5	**Index was given by**	**A.I oparin**	**Charles Robert Darwin**

Organic evolution :
After origin of a living cell the next questions that arose was how did so many different species of complex life form come into existence ? Here are various view points.

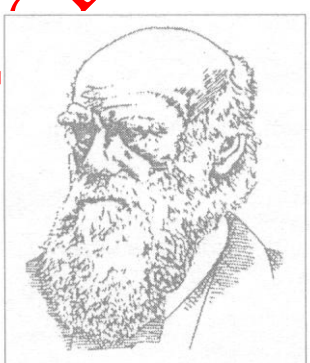
Carolus Linnaeus :- Said that no species is new i.e. each species originates from pre existing species.

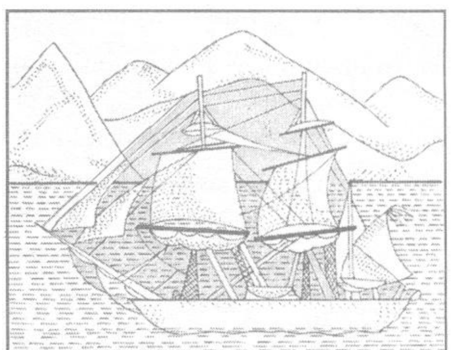
Jeans Baptist Lamarck :- Explained in his book namely **philosoophie zoologique.** The theory of inheritance of acquired characters of Lamarckism. This theory states that use and disuse of an organ leads to change in the organ. Which is inherited by the offsprings. The favorable variations which remain for longer period of time results in evolution of new species.

This theory was discarded by **August Weismann** as he experimentally proved that even after cutting tails of mice for 21 generation tailless mice was never born.

DARWINISM

Charles Robert Darwin was born on 12 Feb, 1809 in England. He travelled by **HMS Beagle** ship along with **Dr. Henslow**. He visited many islands of south America, South Africa, Australia and Galapagos Islands. Darwin was influenced by two book. **"Principal of population" of Malthus. "Principal of Geology of Charles levell.**


Charles Robert Darwin


H.M.S. Beagle

In this book **origin of species** he answered these questions. The theory presented by him is called **theory of natural selection or Darwinism.**

Alfred Russell Wallace :- He travelled south eastern Asia and south America. The idea of natural selection stroked in his mind Wallace wrote an assay and sent it to Darwin. **On the tendency of varieties to depart indefinitely from original type.** There is striking similarity between the views of Darwin and Wallace.

S.No.	Facts	Consequences (conclusions)
1.	(i) Enormous rate of reproduction among animals. (ii) Constant number of animals of a species.	Struggle for existence
2.	(i) Struggle for existence (ii) Heritable variations	Survival of the fittest or natural selection
3.	(i) Survival of the fittest (ii) Continues environment changes	Continuous natural selection leading to evolution of new species

Charles Darwin explained the mechanism of origin of new species by nature selection. But he failed to explain the mechanism of source of heritable variations. This was explained by **Hugo de Varies** a Dutch botanist. According to him heritable variations arise when there is a change in genes of the **germplasm** (protoplasm of germ cell). He called it **mutation.**

1. What do you mean by term Evolution ? Write the name of its two types.

2. Who said that "No species is new i.e. each species originates from pre existing species".

3. Name the organism on which Weismann conducted his experiment and what was his experiment ?

4. Who proposed the theory of natural selection ? Why was this theory criticized ?

5. Who first proposed the theory of inheritance of acquired characters ?

VARIATIONS

Variations are the structural, functional or behavioral changes from the normal characters developed in living organisms. There is an inbuild tendency to variation during reproduction. Both because of errors in DNA copying as a result of sexual reproduction.

Variations provide materials for evolution. These may be inheritable or non inheritable, only inheritable variation participate in evolution.

Type of variation :- On the basis of nature of calls where variations occur variations are of two types.

(i) Somatogenic variations or Acquired traits

(ii) Germinal (Blastomeric) variations.

S.No.	Somatogenic variation	Germinal variations (Blastomeric variations)
1	They occur only in **somatic** (non germinal) cells of an individual.	These occur on **germinal** cells of reproductive organs of an individual
2	Theses are **acquired** during the life span of an individual.	These occur at the time of formation of gametes in reproductive organs.
3	Theses are result of **environmental factors** like changes in light, temperature, food availability etc.	These are developed either due to mutation or recombination of genes.
4	DNA of cells is not changed so it is non-inheritable	These are inheritable variations. So they are transmitted from one generation to another e.g. – Polydactyl in man.

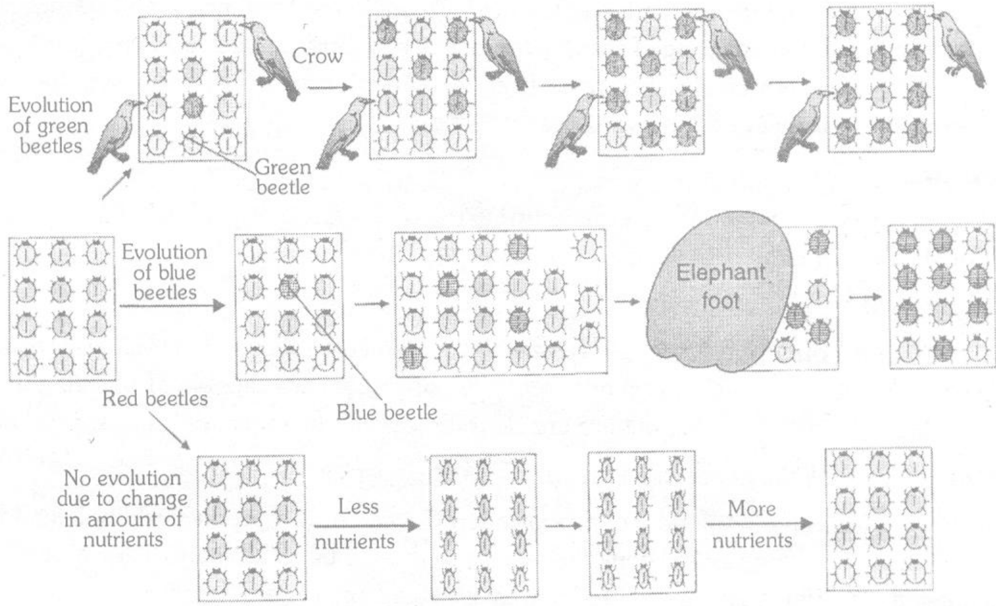
An Illustration :- Consider the following example.

1. A group of twelve **red beetles** living in bushes with **green leaves.**

2. Beetles in the population can generate variations because these are reproducing sexually.

3. Crow can eat the beetles. The more beetles the crow eat, the fewer beetles are left for reproduction.

A population of beetles



Variation in a population inherited and otherwise

Now consider the following situations :-

1st Situation	2nd Situation	3rd Situation
• A green colour variation rises during reproduction.	• A blue colour variation arises during reproduction.	**Condition 1 :** • Appearance of plant disease in the bushes.
• One beetle.	• This blue beetle can pass the blue to its progeny	• Amount of plant (leaf) material for the beetles decreases.
• This green beetle can pass the green colour to its progeny.	• Crows can see blue as well red beetles on the green leaves of bushes so can eat them	• Beetles are poorly nourished. **Observation 1:**

• Crows cannot see green beetles on the bushes to cannot eat them.	• Most of the beetles are killed by elephant foot.	• Average weight of beetles decreases.
Observation : More population as compared to red beetles. **Conclusion :**	• Beetles which survived are mostly blue. This is by chance.	**Condition 2 :** • Disappearance of plant disease in the bushes.
• Variations have survival advantage • Rare variation came as a common characteristic in the population.	**Observation :** Population of beetles grows slowly and blue beetles are more in number. **Conclusion :** Variations do not have survival advantage .	• Amount of plant (leaf) material for the beetles increases. • Beetles are properly nourished.
• In other words, frequency of certain gene traits (genes control the traits) changed over generations. This is the of the idea of evolution.	• Frequency of certain traits / genes can be changed by accidents in small	**Observation 2 :** • Size of the saturated beetles increases to normal.
• The number of red beetles decreases as the number of crows increases (Natural selection is directing the evolution).	• Both above changes provide diversity without any adaptations.	• The change in the weight of beetles is not inherited over generations. because it is somatic variation

HERITABLE VARIATION

The reason why organisms resemble their parents lie in the precise copying of their genes. Which carry hereditary characters from one generation to the next. On the other hand no two off springs have exactly the same genes. This is because offspring of sexually reproducing organisms reproducing receive varying combination of genetic material from both parents such variation result from mutations (errors in DNA copying). Variations also result from **genetic recombination** during sexual reproduction

Genetic drift :

The random changes in the gene frequency occurring by chance alone. The effect of genetic drift is very small in large population and large in small populations.

SPECIES AND SPECIATION

Biological species concept : A species is a sexually interbreeding group of individuals separated from other species by the absence of genetic exchange. Members of species are capable of breeding with one another and produce living, fertile off spring but are unable to breed with members of other species normally.

Gene pool : Sum of all the genes of all the members of a species.

Speciation occurs when the gene pool of a population is some how reproductively isolated from other sister population of the parent species and gene flow no longer occurs between them. Then a population splits into independent species. Which become reproductively isolated from each other.

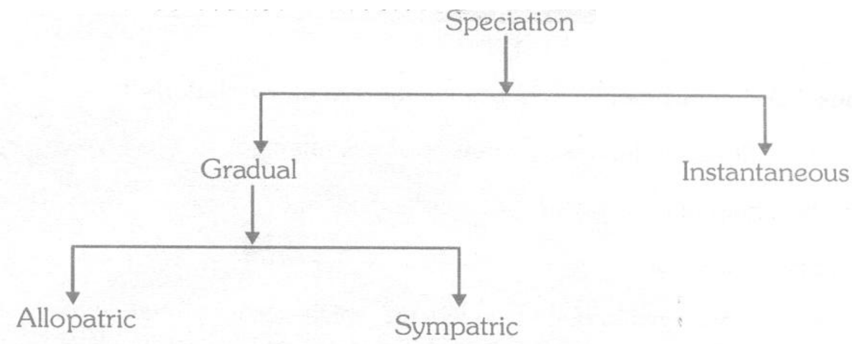
On basis of period taken in speciation there are two types of mechanism of speciation.

After years, two sub populations get reproductively isolated by natural selection and genetic drift from tow new species.

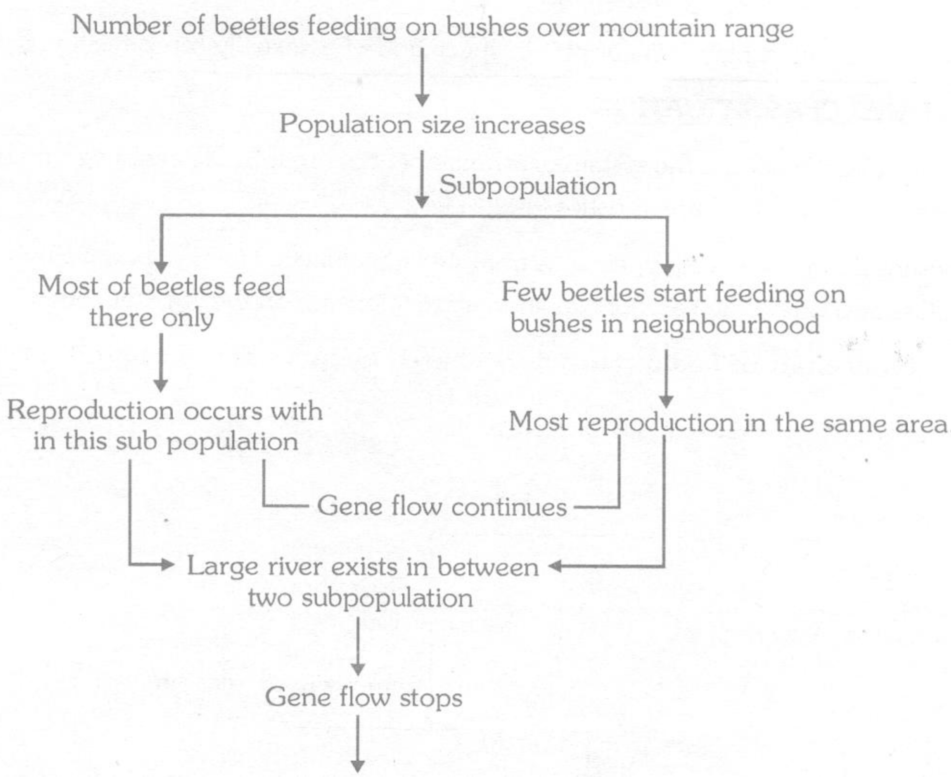
ABOVE EXAMPLE OF SPECIATION SHOWS

- Large population of beetles occur on a mountain range.
- Few beetles started feeding in neighborhood.
- Gene flow continued in places
- They may get isolated at larger distance because of existence of river.
- Gene flow decreases and finally stops.
- Two sub populations change with time because of genetic drifts and natural selection.
- Later they became reproductively isolated.
- Two new species came up.
- This can occur as a result of change in chromosome number.

◆ Micro evolution is very important this mean that the changes may be small but significant. Speciation due to inbreeding, genetic drift and natural selection will be applicable to all sexually reproducing animals geographical isolation does not play any role in the speciation of a sexually reproducing animals and self pollinating plants.



Speciation : The process of formation of one or more new species from an existing species is called speciation. Let us try to understand this concept by taking the example of beetles.



Questions :

1. What are variations ? Distinguish between germinal and somatic variations ?

2. Name two types of variations on the basis of nature of cell affected.

3. Which type of variation help in evolution ?

4. Name various sources of variation.

5. Give the term of random changes in gene frequencies which occur by chance fluctuations.

6. Define species ?

7. What do you mean by reproductive isolation.

8. Does geographical isolation play a major role in speciation of a sexually reproducing organisms. Explain ?

EVOLUTION AN CLASSIFICATION

Classification : Classification is the system of arrangement of organism in certain groups or subgroups on the basis of hierarchies of certain characteristics

The characteristics are the details of appearance from structure, function and behavior **Phylogenetic taxonomy** is branch of classification on the basis of evolutionary relationship on the basis of common ancestry.

Flow chart of basic characters shared by most of he organisms.

Cell is the basic structural and functional unit of life

↓ (Presence of nucleus)

- Prokaryotic cell (Presence primitive of nucleus)
- Eukaryotic cell (having nucleus)
  - ↓ Complexity of organism
    - Unicellular
    - Multicultural
      - ↓ Mode of nutrition
        - Autotrophs
        - Heterotrophs
          - ↓ Location and nature of skeleton
            - Skeleton inside the body
            - Skeleton out side the body

Questions :

1. Give the term for the branch of classification on the basis of evolutionary relationship on the basis of common ancestry.

2. Name the categories in which organisms are divided on the basis of complexity of organism.

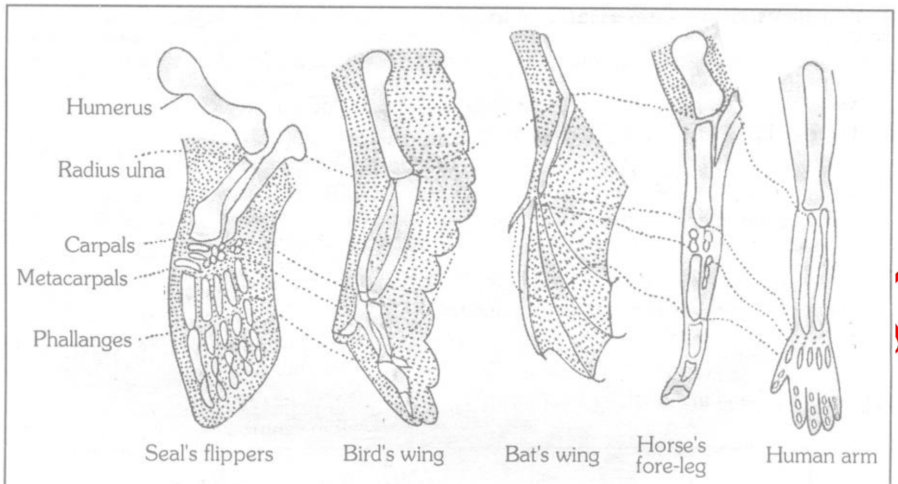
TRACING EVOLUTIONARY RELATIONSHIP

Studies on similarities in structure of different organisms suggests that present from have evolved through a process of slow and gradual change called evolution. They include the following :

1. **Homologous organs :** Homologous organs are those structures which are different in appearance and perform different functions but have similar basic structure and developmental origin. This relationship is called homology.

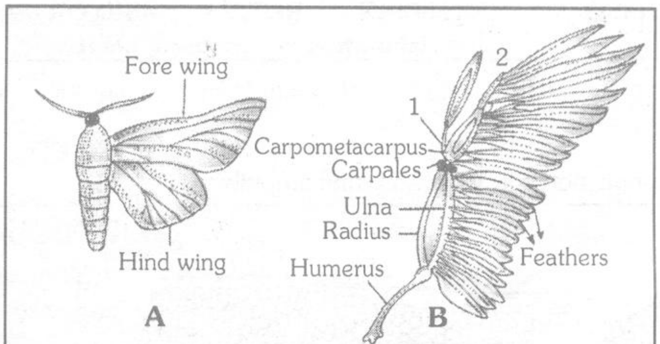
FORELIMB IN VERTEBRATES

	Seal	Bird	Bat	Horse	Man
Appearance	Flippers	Wings	Patagia	Elongated	Thumb opposability
function	Swimming	flying	Support, flying	Funning	Grasping



Fore limbs for vertebrates as homologous organs

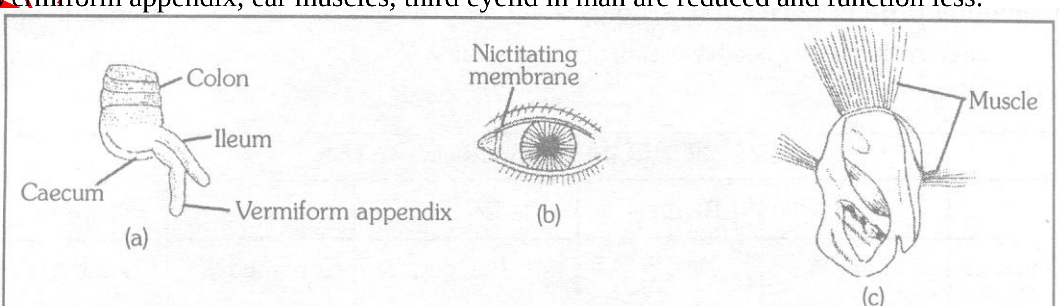
2. **Analogous :** Those organs which have different origin and structural plan but appear similar and perform similar functions are called analogous organs while this relationship is called convergent evolution or analogy.
e.g. : Wing of an insect and a bird, Hand of man & Trunk of elephant.



Analogous organs
A. Insect wing; B. Bird wing

Analogy in these organs is due to similar adaptations to perform similar functions rather than their common ancestry.

3. **Vestigial organs :** Those organs which no longer have a function are called vestigial organs. These organs have reduced structurally as well as functionally. It appears that these organs were once well developed and functional in ancestors and later on due to their less use they became reduced.
eg : Vermiform appendix, ear muscles, third eyelid in man are reduced and function less.



Vestigeal organs in man (a) Vermiform appendix (b) Nictitating membrane (c) ear muscles

Common ancestry and inter-relationship :

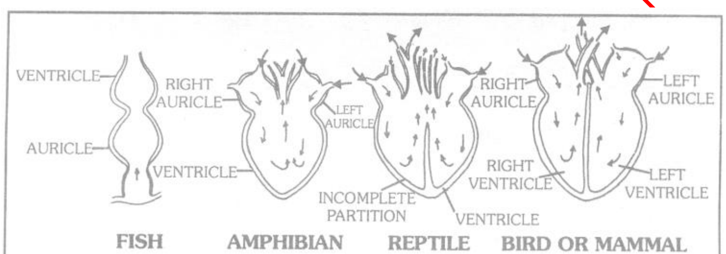
Various organisms are inter connected their resemblance suggest a common ancestry.

Eg : Heart of Fish $\rightarrow$ Only two chambers — One auricle, One ventricle

Heart of Amphibian $\rightarrow$ Three chambers — Two auricle, One ventricle

Heart of Reptilian $\rightarrow$ Three chambers and half — Two auricle, One incomplete partition in ventricle

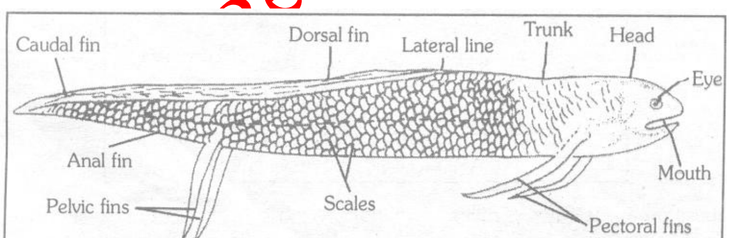
Heart of Bird and mammals $\rightarrow$ Four chambered — Two auricle, Two ventricles



Progressive elaboration in vertebrate heart

Connecting links : Some living organism have characteristics of two groups. They are known as connecting links.

Eg : Lung fish – show connection between fishes and amphibians.



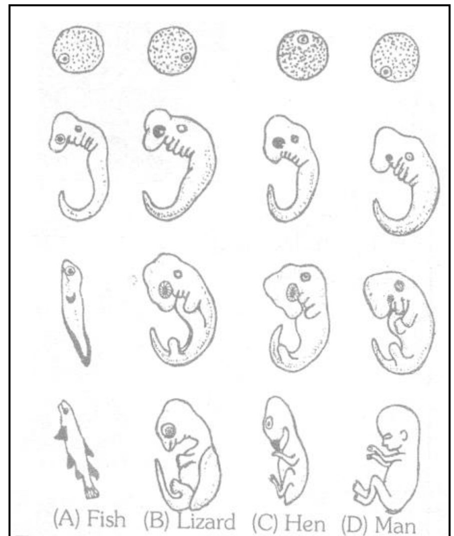
Lung fish, connecting link between fishes and amphibians.

Do you know

Various connection links

(i)	**Virus**	$\rightarrow$	Between living and non living
(ii)	**Euglena**	$\rightarrow$	Between plants and animals
(iii)	**Proterospongia**	$\rightarrow$	Between protozoa and Porifera
(iv)	**Neopilina**	$\rightarrow$	Between Annelida and Mollusca
(v)	**Peripatus**	$\rightarrow$	Between Annelida and Arthropoda
(vi)	**Archaeopteryx**	$\rightarrow$	Between reptiles and birds
(vii)	**Balanoglossus**	$\rightarrow$	Between non chordates and chordates
(viii)	**Chimera**	$\rightarrow$	Between cartilaginous fish and boney fish
(ix)	**Lung fish**	$\rightarrow$	Between fishes and amphibian
(x)	**Platypus**	$\rightarrow$	Between reptiles and mammals
(xi)	**Echidina**	$\rightarrow$	Between reptiles and mammals

Jurassic period is known as golden age of reptiles.
Dinosaur of dromaesaur family had feather on body and fore limb.
Huxley called birds as glorified reptiles.
Carnivorous dinosaur called velociraptor had a wish bone like birds.



Embryonic stage of various vertebrates

Evidences from embryology :

A comparative study of the stages of embryonic development of animals reveals that in their early stages they were very similar.

These embryonic stage reflect thus ancestry. The embryological stages of an organism give us an idea about the stages of its evolution.

For example when we study the human embryo, we find that at a certain stage it has gills. This suggests that fish is one of the earliest ancestors in the evolution of mammals including human beings.

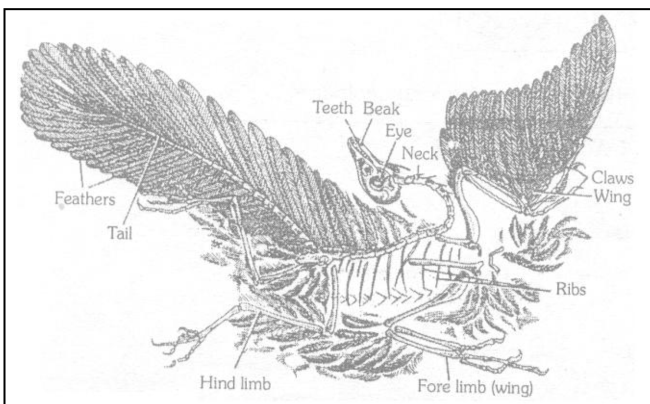
EVIDENCES FROM PALEONTOLOGY

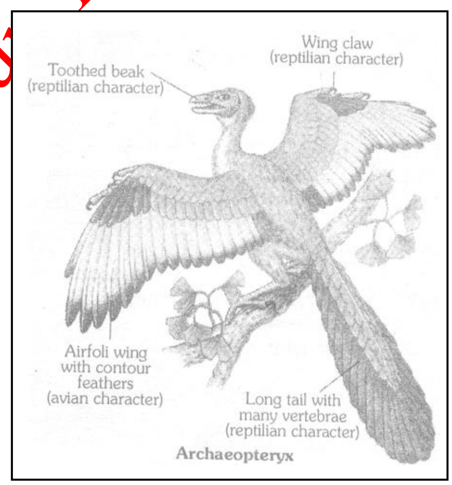
1. **Fossils :** Fossil is an organic relic of a long dead life form.

Or

Fossils are the petrified remains and for impressions of the hard parts of the extinct organism preserved in the sedimentary rock or other media.

Paleontology : Study of fossils is known as paleontology.



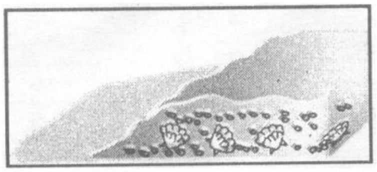


Do you know

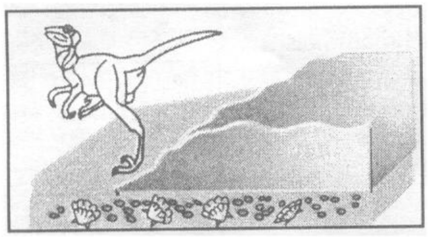
How do fossils form layer by layer ?

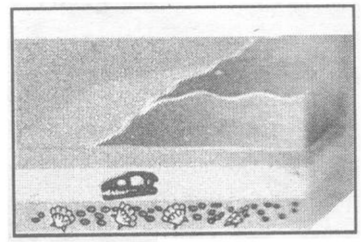
Let us start 100 million years ago. Some invertebrates on the seabed die, and are buried in the sand. More sand accumulates, and sandstone forms under pressure.

Millions of years later, dinosaurs living in the area die, and their bodies, too. are buried in mud. This mud is also compressed into rock, above the rock containing the earlier invertebrate fossils.

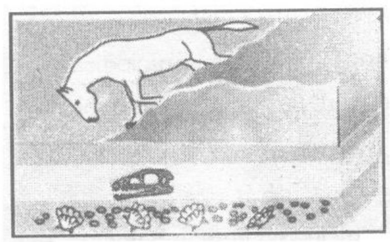


Again millions of years later, the bodies of horse-like creatures dying in the area are fossilized in rocks above these earlier rocks.

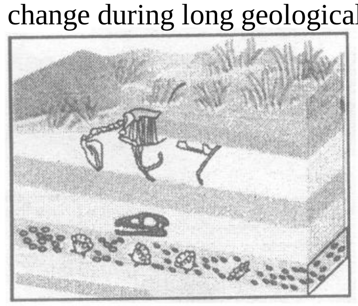




Much later. erosion by , sun, water flow, wears away some of the rock and exposes the horse like fossils. As we dig deeper, we will find older and older fossils.



Living fossils: The animals which underwent little change during long geological periods.



IMPORTANT LIVING FOSSILS

1. Peripatus, Limulus (Arthropoda)
2. Nautilus, Neopilina (Mollusca)
3. Lingula (Brachiopoda)
4. Latimeria (Coelacanth fish)
5. Spenodon (Reptila)

Determination of the age of fossil : There are three ways of determining age of the fossils.

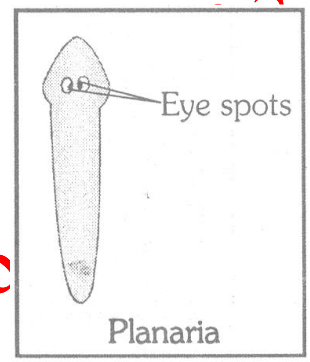
1. **Relative method :** If we dig into the earth and starts finding fossils it is reasonable to suppose that the fossils we find closer to the surface are more recent than the fossils we find in deeper layer.

2. **Using Radioactive Elements :** The age of a fossil is determined with the help of certain radioactive elements such as uranium present in the rock .

3. **Carbon dating :** Carbon dioxide of air contains a small proportion of radioactive carbon (C^{14}). CO_2 is used during photosynthesis and there is equal proportion of C^{14} among carbon atoms of all organisms.

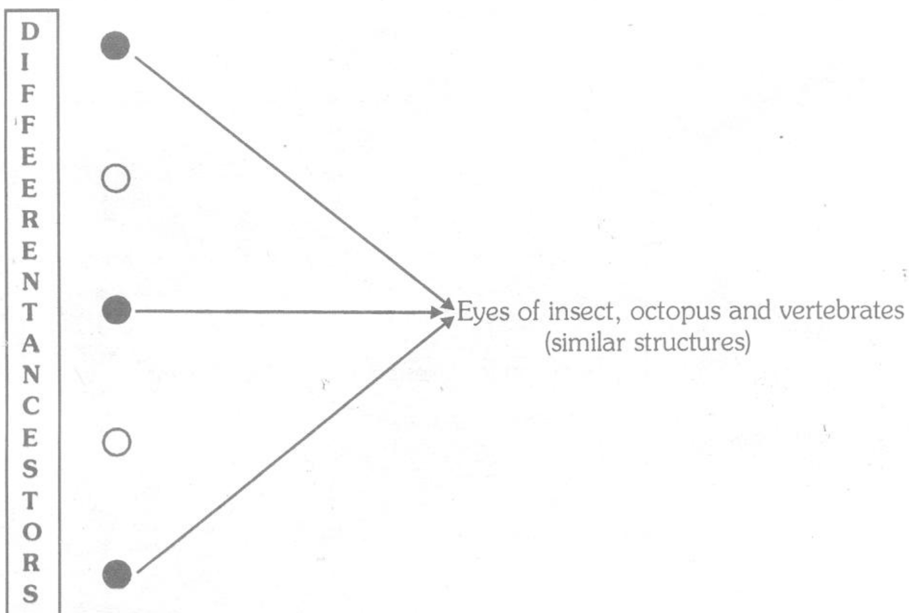
The radioactivity of C^{14} is lost at a precise rate half life of C^{14} is about 5,600 years.

If a fossil shows radioactivity one fourth of that found in the living organisms the organisms died about 11,200 years ago. (Two half lives.)



Evolution by stages : Evolutionary changes are fundamental characteristics of living organisms such changes may be convergent. It means that the similar looking structures may have different ancestral designs. This can be explained by example of eye.

Eye : Eyes of insects, octopus and vertebrates have similar looks but different structure and must have separate evolutionary origin or different ancestral designs. Rudimentary eye can be useful to some extend.



Examples of convergent evolution

Question :

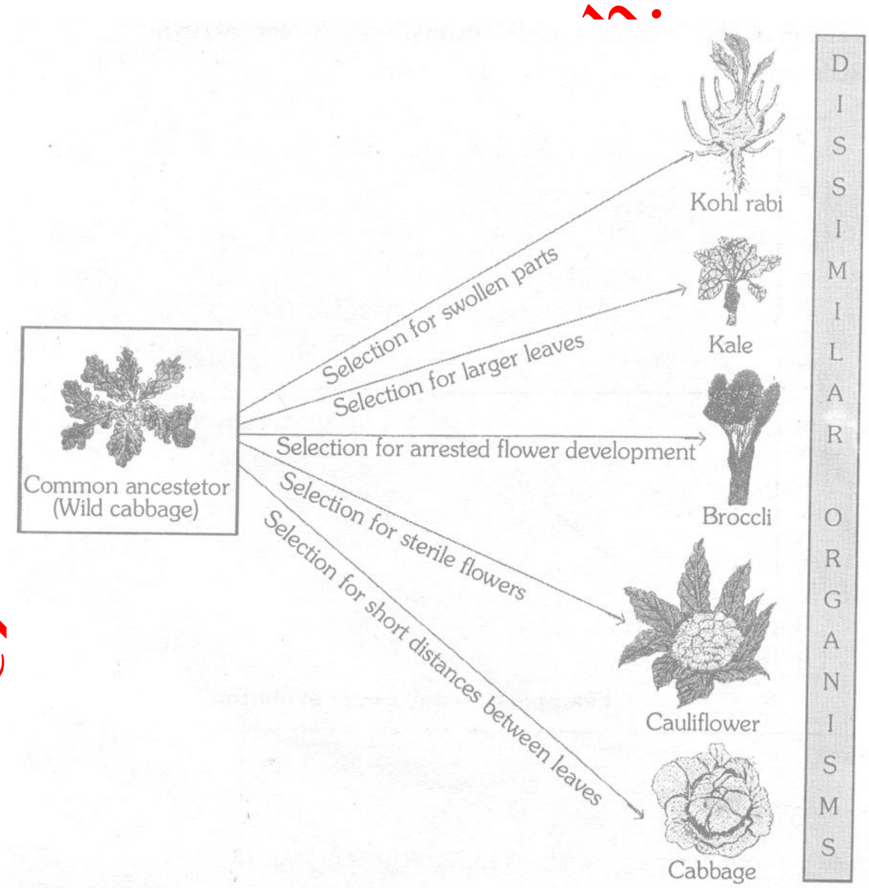
1. **Define homologous**
2. Differentiate between homologous organs and analogous organs.
3. What are vestigial organs ? Give an example.
4. How do embryological studies provide an evidence. for evolution ?

Feathers : The function of feathers was insulation cold weather later feature might have proved to be useful for the purpose of light.

Dinosaurs is example depicting presence of feathers in them but these were not used for flying later birds seem to have adaptation of flying using feathers. This shows close relationship of biers of reptiles and proves that characters appearing as an variation can be useful later to perform different functions.

Cabbage : Humans have developed different types of vegetables from the wild cabbage by artificial selection.

S.No.	Vegetable evolved	Edible part
1.	Cabbage	Selection of fleshy terminal buds and short distance between the leaves.
2.	Brussels' sprouts	Selection for fleshy lateral
3.	Kohl rabi	Selection for fleshy stem.
4.	Kale	Selection for large sized leaves so it is a leafy vegetable.
5	Broccoli	Selection for leafy sized and arrested flower developments.
6.	Cauliflower	Selection for fleshy sterile flower.



Evolution of wild cabbage [Divergent evolution]

MORE TO KNOW

MOLECULAR PHYLOGENY

Ancestors of different organism including humans can be traced by studying the change in their DNA.

A change in DNA means a change in its protein sequences. The ancestry or phylogeny determined by comparative study DNA sequences is called molecular phylogeny.

Studies in molecular phylogeny help in the classification of organisms.

Haeckel propounded **"The theory of recapitulation or 'Biogenetic law'.** Which states that an individual organism in its development (ontogeny) tends to repeat the stages passed through by its ancestors (phylogeny means ontogeny repeats phylogeny.)

EVOLUTION SHROUDS NOT BE EQUATED WITH PROGRESS

Though organic evolution involves descent with modification in which there is a progressive trend of emergence of more or more complex body designs from earlier similar body designs by gradual changes but evolution should not equated with progress because of following reasons.

1. In evolution older species are not eliminated during formation of new species and most of older and simple species still survive.

eg : Earliest organisms like bacteria are found even in many hospitable habitats like hot springs, deep-sea, thermal vents, Antarctic ice. etc.

2. The evolved species are not always better than the parental species evolution depends upon natural selection and genetic drift which is together result in population which is reproductively isolated from the parental species.

HUMAN EVOLUTION

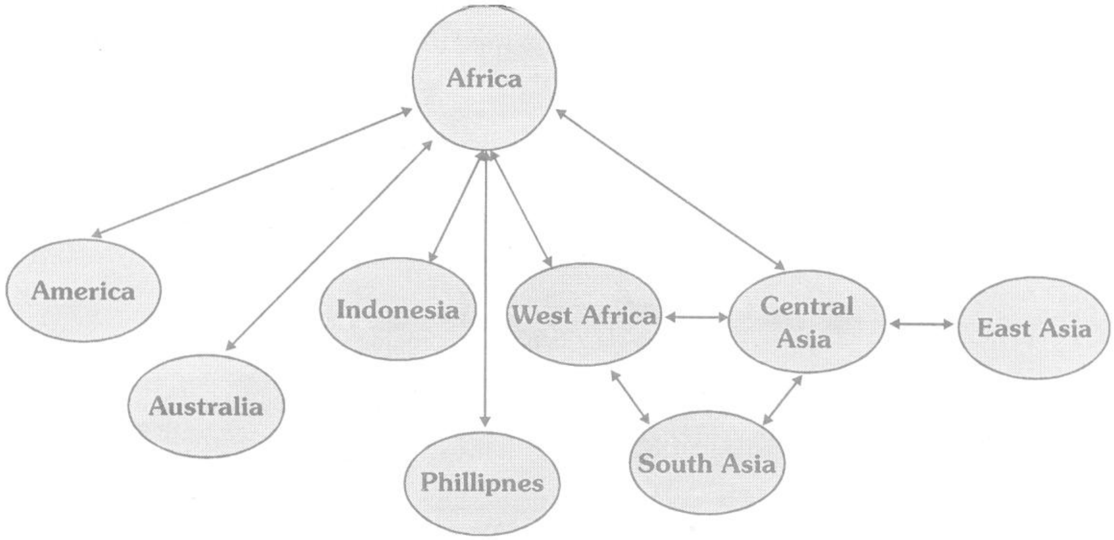
Evolutionary history of man has been guilt from the paleontology (fossil studies) and molecular biology (especially DNA changes).

For example :- It is not true that human beings have evolved from chimpanzees. Rather both human beings and chimpanzees have common ancestors a long time ago. That common ancestors is likely to have been nether human or chimpanzee. The two resultant species have probably evolved in their separate ways to give rise to the current forms.

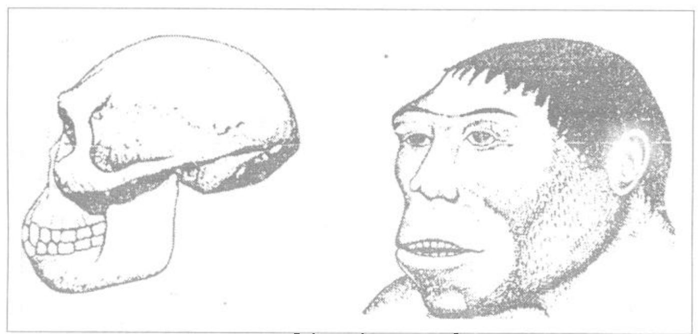
Anthropology : The scientific study of tracing of human evolution is called anthropology. Scientists involved in studying human evolution are called **anthropologists.**

Studies have revealed that human evolution started in Africa and earliest human type was Australopithecus Africans. African ape man fossil was discovered by **Prof. Raymond Dart** fossil of skull of 5-6 years old baby from old Pliocene rock to Tuang region (S. Africa). He name it Tuang baby. It had many ape like characters but had a bipedal locomotion like man. The cradle of human evolution is East Africa where genetic foot prints of earliest members of human species **Homosapiens** can be traced. A couple of hundred thousand years ago some of own ancestors left across the planet from Africa.

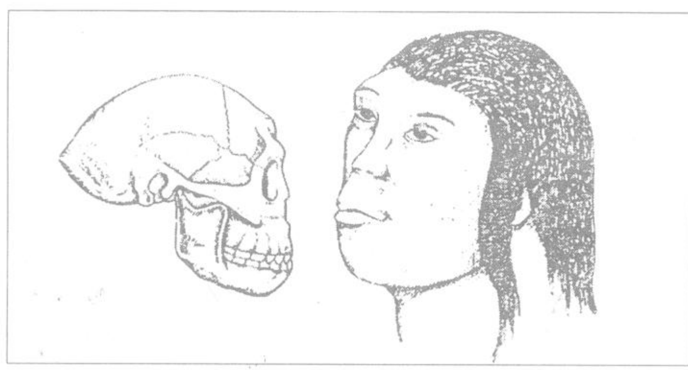
The first human types, evolved into modern man Homosapiens thorough a number of intermediate human types.



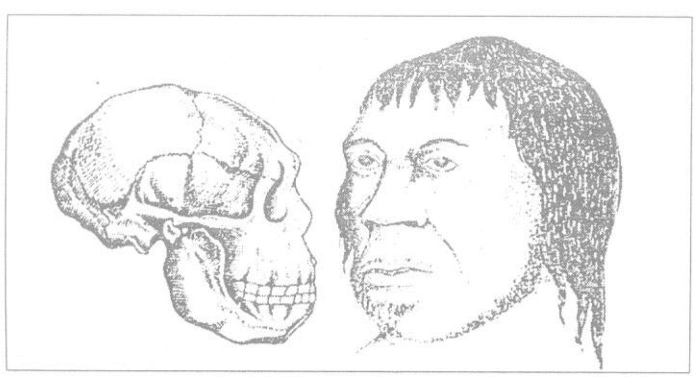
Homo erectus erectors $\rightarrow$ Jaw man



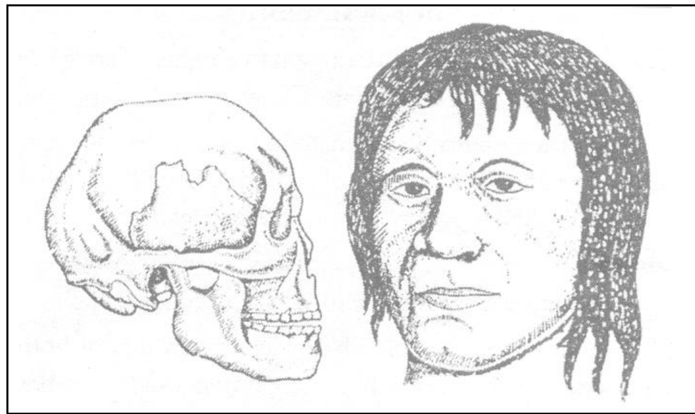
Homo erectus pekinesis $\rightarrow$ peking man



Homo sapiens neanderthalensis $\rightarrow$ Neanderthal man



In the course of their evolution theses migrant human types went forward and backwards and moved in and out of south Africa. Modern man evolved from Cro-Magnon man about 25000 years ago and spread all over the world about 10,000 years.



Homo sapiens fossils → Cro-Magnon man

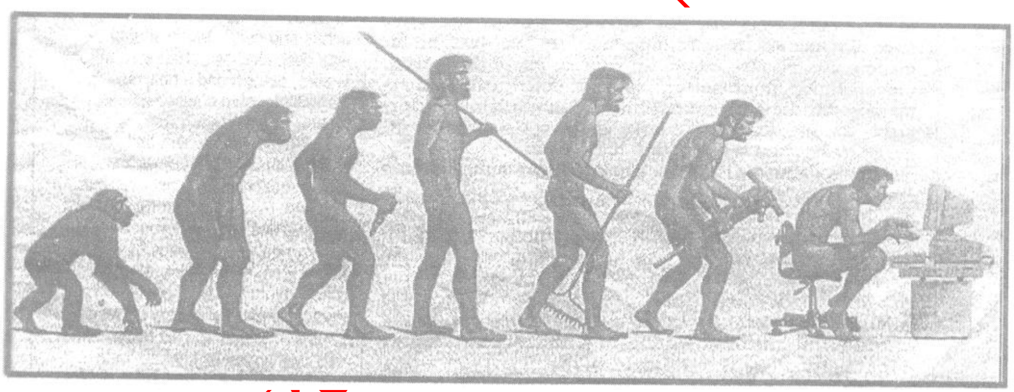
Modern man is divided into four ethnic groups :

Negroid : African Pygmies and bushman

Caucasian : Italian English

Eastern : Chinese Japanese Eskimos

Mongoloid : These ethnic group differ from one another in their skin coloration lips and hair pattern but all of these belong to same species because these are not reproductively isolated from one another. All human races have same chromosomes number and similar grass morphology of chromosomes.



Man of future :

Homo sapiens futuralis.

(A prediction by American anthropologist **Dr. Sapiro.**)

Questions :

1. Give one term for scientific study of human evolution.

2. Name some human type.

3. In evolutionary terms can we say which among bacteria, spiders fish and chimpanzees have a better body design why or why not ?

4. How human evolution took place over the years.

5. Define Anthropology ?

QUICK REVISION

1. **Heredity** is the continuity of features from one generation to another. Heredity information is present in fertilized egg or zygote. The zygote develops into an organism of a particular type only.

2. **Variation** can be define as the occurrence of differences among the individuals. No two individuals are exactly alike. Variations arising during the process of reproduction can be inherited. These variations may lead to increased survival of the individuals. Variations in species may confer survival advantages or merely contribute to the genetic drift.

3. Genetics is the branch of biology which deals with heredity and variation.

4. Accumulation of variation during reproduction : Nest generation inherit both a common basic body design and variations from the previous generation. The second generation will have differences that they inherit from the first generation, as well newly created difference. These variations may lead to increased survival of individuals.

5. The original organisms will give rise to two individuals B and C with similar body design but with subtle differences.

6. Each of the two will form two more individuals (B_1 and B_2) and (C_1 and C_2) in the next generation.

7. Each of the four individuals in the second generation will be different from each other. While some of the differences will be unique, others will be inherited from their respective parents, who were different from each other.
   In asexual reproduction, there would be minor differences generated due to errors in DNA copying but in sexual reproduction greater diversity will be generated.

8. Evolution : Evolution can be defined as a naturally occurring slow, continues and irreversible process of change. The gradual change of living organisms from pre-existing organisms since the beginning of life is called organic evolution. Whereas gradual change in elements from one form to another with time is termed as inorganic evolution.

9. Variations occur during reproduction both because of error in DNA copying and as a result of sexual re-production. Variations contribute to evolution.

10. Natural selection results in adaptations in population to fit their environment better. Thus, natural selection direct evolution in the population of a particular species.

11. Inherited traits are those which are passed from one generation to another through specific genes. Any change in DNA of the germ cells be passed.

12. Acquired traits are those traits which are acquired by the organism in its life time. e.g. removal of tail cannot change the genes of the germ calls of the mice thus cannot be passed to next generation.

13. Origin of life on earth : Darwin's theory of evolution tells us how life evolved from simple to more complex forms and Mendel's experiments give us the mechanism for the inheritance of traits from one generation to the next. But neither tells us anything bout how life began on earth in the first place.
   (i) **J.B.S. Haldane** suggested in 1929 that life must have developed from the simple inorganic molecules which were present on earth soon after it was formed. He speculated that the conditions on earth at that time could have given rise to more complex organic molecules that were necessary for life.
   The first primitive organism would arise from further chemical synthesis.
   (ii) **How did organic molecules arise ?**
   An answer was suggested by the experiment conducted by **Stanley L. Miller** and **Harold C. Urey.** They assembled an atmosphere similar to that which was thought to exist on early. They assembled molecules like methane, ammonia, hydrogen sulphide and water (no oxygen). This mixture was maintained at a temperature just below 100^0C and speaks ware passed through the mixture of gases to simulate lightning. At the end of a wee, 15% of the carbon had been converted to simple compound of carbon including amino acids which make up protein molecules. These simple organic compounds further form complex, organic compounds which later organized into tho living matter.

14. **SPECIATION** means origin of new species from the existing one.

   To explain the mechanism of speciation, consider a situation that the bushes on which beetles feed on are widely spread over a mountain rang. The beetle population becomes very large as a result of reproduction. Individual beetles do not travel far. So, in this huge population there will be sub-populations in neighborhoods. Mostly reproduction will be within these sub-populations. Occasionally adventurous beetle might go from one site to another or beetle is dropped to another site by crow. In either case, the migrant beetle reproduce with the local population. As a result genes of the migrant beetle enter a new population. This kind of gene flow occur between population that are partly but not completely separated.

If between two such sub-populations a large river comes into existence, the two populations will be further isolated. The level of gene flow between them will decrease.

Over generations, genetic drift will accumulate different changes in each sub-population. Natural selection may also operate simultaneously in different way in these geographically isolated sub-populations. Together, the processes of genetic drift and natural selection will result in these two isolated sub-populations of beetles becomes more and more deferent from-each other. Ultimately, members of these two groups will be incapable of reproducing with each other. [Thus reproductive isolation occur between these two groups]. Effectively, new species of beetles are being generated.

15. Evolution and classification : Characteristics are details if appearance or behaviour, in other words, a particular form or a particular function. e.g. we have four limbs is thus a characteristic. The more characteristics two species will have in common, the more closely they are related, the more recently they will have had a common ancestor. Classification of species is infect a reflection of their evolutionary relationship. We can thus build up small groups of species with recent common ancestors, then super groups of these groups with more distant common ancestors and so on. We can keep going backwards like this until we come to the notion of a single species at the very beginning of evolutionary time.

(A) **Tracing evolutionary relationships :** When we try to follow evolutionary relationship, we identify char-ataractics in common. These characteristics in different organism would be similar because they are inherited form a common ancestor.

(i) **Homologous organs** are those having similar basic structure but has been modified to perform different functions. e.g., forelimb of reptiles, frog, lizard bird and human (amphibians and mammals) are homologous organs. Such homologous characteristic helps to identify an evolutionary relationship between apparently different species.

(ii) Analogous organs are those oranges which are different in basic structure but perform same function. e.g., wings of bat and wings of birds.

(B) **Fossils :** Evolution can be worked out by the study of not just living species, but also fossils.

Fossils are the impression or remains of ancient of life found preserved in the sedimentary rocks. There are two ways to know the age of fossils :

(i) **One is relative.** If we dig into the earth and start finding fossil, the fossils we find closer the surface are more recent than the fossils we find in deeper layers.

(ii) **Second way is to date the fossils.** Dating fossils is done by detecting the ratios of different isotopes of the same element in the fossil material.

(C) **Evolution by stages**

(i) Complex organs may have evolved because of the survival advantage of even the intermediate stage e.g., In evolution of eye, an intermediate stage, such as rudimentary eye in Planarian give a fitness advantages to it.

(ii) A change that is useful for one property to start with, can become useful later four quite a different function. During course of evolution, features or organs may be adopted to new functions, e.g., feathers are thought to have been initially evolved for warmth and later adapted for flight.

(iii) Another way of tracing evolutionary relationships is to compare the DNA of different species. Comparing the DNA of different species give us direct estimates of how much the DNA has changed during formation of theses species.

Evolution cannot be said to prepress from lower forms to higher forms. There are multiple branches possible at each and every stage of this process. A new species has emerged but that does not man that the old species will disappear. In fact, there is no real 'progress' in the idea of evolution. Evolution is to simplify the generation of diversity and the shaping of the diversity by environmental selection. Emergence of more and more complex designs is the only progressive trend in evolution.

Human evolution : There is great diversity of human forms and features across the planet. Evolutionary studies showed that all humans are a single species. The earliest members of the human species, homo sapiens, can be traced to Africa. Like all other species, they developed genetic variations and gave rise to present forms of human beings.

16. **Dominant and recessive trait :** Sexually reproducing individuals have two copies of genes for the same trait. If the copies are not identical, the trait that gets expressed is called the dominant trait and the other is called the **recessive trait.**

Traits in one individual may be inherited separately, giving rise to new combinations of traits in the offspring of sexual reproduction.

EXERCISE # 1 — FOR SUMMATIVE ASSESSMENT

1. Who introduced the idea of a spontaneous generation ?
(A) Anaximander (B) Empedocles (C) Anaximus (D) Aristotle

2. Spontaneous generation of bacteria from decomposing broth was disproved in 1860 by :
(A) Joseph Lister (B) Louis Pasteur (C) Francesco Redi (D) Lazzaro Spallanzani

3. The principle of sterilization is based upon experiments carried by :
(A) Oparin (B) S.L Miller (C) L. Pasteur (D) V. Helmont

4. Life was created by some supernatural power. This theory is :
(A) Spontaneous generation (B) Spore theory
(C) Special creation (D) All of these

5. About how long ago was the earth formed ?
(A) 4.6 billion years ago (B) 10 billion years ago
(C) 3.0 billion years ago (D) 20 billion years ago

6. Modern theory of origin of life was propounded by :
(A) Miller (B) Darwin (C) Khoranaq (D) Oparin

7. Which of the following gas was absent on primitive earth :

(A) O_2 (B) CH_4 (C) CO_2 (D) NH_3

8. Which English scientist worked on origin of life and finally settled in India:

(A) A.I. Oparin (B) Louis Pasteur (C) J.B.S. Haldane (D) archbishop Ussher

9. Nucleoproteins most probably gave the first sign of :

(A) Proteins (B) Mimicry (C) Evolution (D) Life

10. Life originated :

(A) In water (B) On land (C) In air (D) In all of these

11. There is no life in moon due to the absence of :

(A) water (B) light (C) oxygen (D) temperature

12. Homologous organ are :

(A) similar in origin with similar or dissimilar functions

(B) similar in origin which are dissimilar functions

(C) dissimilar in origin and dissimilar in structures

(D) dissimilar in origin but similar in functions

13. Which of the following are homologous structures :

(A) ginger and sweet potato (B) trunk of elephant and hand of chimpanzee

(C) nail of man and claw of cat (D) wing of bird and butterfly

14. Evolution o diversified species due to environmental changes is called :

(A) Divergent evolution (B) Convergent evolution (C) Evolutionary inertia (D) None of these

15. Wings of birds and butterflies are :

(A) homologous organs (B) analogous organs (C) vestigial organs (D) grafted organs

16. Which of the following is a vestigial structure in man ?

(A) Muscle of glottis (B) Wisdom tooth

(C) Intestine (D) Ear Pinna

17. Which of the following is not a vestigial organ in man :

(A) wisdom tooth (B) vermiform appendix (C) ileum (D) muscles of ear Pinna

18. Peripatus is a connecting link between :

(A) annelids and mollusks (B) annelids and helminthes

(C) annelids and arthropods (D) reptiles and mammals

19. A connecting link between Protozoa and Porifera is :

(A) Chlamydomona (B) Euglena (C) Protopterus (D) Proterospongia

20. Which one represents a connecting link as an evidence from comparative anatomy in favor of organic evolution ? (A) Whale between fishes and mammals

(B) Duck-billed platypus between reptiles and mammals

(C) Java ape-man between modern man and Peking man

(D) Archaeopteryx between birds and mammals

21. Fossil remains of Archaeopteryx indicate that :

(A) reptiles gave rise to birds during Jurassic

(B) reptiles gave rise to birds during Permian

(C) it was a flying reptile from Permian

(D) it was a flying reptile from Triassic

22. "Ontogeny repeats phylogeny" was coined by :

(A) Darwin (B) Lamarck (C) Morgan (D) Haeckel

23. Study of human evolution is under :

(A) Paleontology (B) Anthropology (C) Arthrology (D) Mammology

24. Evolution of man is believed to have taken place in :

(A) Central America (B) Africa (C) Asia (D) Australia

25. The main advantage to bipedal locomotion is :

(A) Availability of hands for other uses (B) Increased speed

(C) Better body balance (D) Reduced weight

26. At the time of origin of life which was not existed on free stage :

(A) NH_3 (B) CH_4 (C) O_2 (D) H_2

27. At the time of formulation of theory of natural selection, Darwin was influenced by :-

(A) Essay of Malthus on population (B) Cell theory

(C) Mendel's laws of inheritance (D) None

28. The cause of mutation is :-

(A) Changes in DNA (B) Changes in chromosome

(C) Changes in gene (D) All

29. Galapagos island is associated with :-

(A) Lamarck (B) Darwin (C) Mendel (D) Wallace

30. If an organ is used , it gets developed and if an organ is not used , it gets reduced. It was given by :-

(A) Darwin (B) De Vries (C) Lamarck (D) Miller

31. The search of life on other planets or in the space is celled as :-

(A) Space biology (B) Exobiology (C) Planet biology (D) None

32. The colleague of Darwin on his ship Beagle was :-

(A) Dr. Hensley (B) Packard (C) Gado (D) None

33. The book written by Weisman:-

(A) Philosphie zoologic (B) Principles of geology (C) Germ fluid (D) None

34. The Spark-discharge apparatus to test chemical evolution of life was designed by :-

(A) Urey and Miller (B) Oparin and Haldane (C) Dixon and Jolley (D) Jacob and Monad

35. Swan-necked flask experiment was done by :-

(A) Francisco Redi (B) Aristotle (C) Robert Koch (D) Louis Pasteur

36. The presence of gill slits in the embryos of all vertebrates supports the theory of :-

(A) biogenesis (B) recapitulation (C) metamorphosis (D) organic evolution

MULTIPLE CHOICE OBJECTIVE QUESTIONS

37. Wings of locust, pigeon & bats are the example of :-
(A) Vestigial organs (B) Analogous organs (C) Homologous organs (D) Exoskeleton

38. Age of fossils can be detected by :-
(A) Residual quantity of calcium (B) Quantity of radioactive carbon compound
(C) Phylum of other mammals (D) Structure of bones

39. Term “evolution” was first used by :-
(A) Spancer (B) Mendel (C) Weismann (D) Kellogg

40. The factors which causes genetic drift :-
(A) Mutations & variations
(B) Natural selection & small size of population
(C) Random copulation
(D) All the above

41. Connecting link between Annelida & Mollusca is :-
(A) Cuttle fish (B) Octopus (C) Neopilina (D) Nautilus

42. “Struggle for existence” & survival of fittest are associated with :-
(A) Lamarckism (B) Oparin hypothesis (C) Mendelism (D) Darwinism

FILL IN THE BLANKS

1. The life arose from nonliving molecules was suggested by……………………..
2. Experimental evidence in favor of chemical origin of life provided by ………………and ………………
3. The process by which new species arise is called………………………………
4. The biogenetic law was proposed by………………………
5. The fossils of birds ……………………..show that birs have evolved from reptiles.
6. Darwin made an extensive study of the flora and fauna of the …………………….Islands in South America.
7. The origin of species was written by…………………………………..
8. Organs similar in structure and origin but different in function are called …………………
9. Vermiform appendix in human is a……………………organ.
10. The evolution of eye is an example of evolution by ………………………..

ASSERTION AND REASON TYPE

Each question contains STATEMENT -1(Assertion) and STATEMENT – 2 (Reason). Each questions has 5 choices (A), (B), (C), (D) and (E) out of which only one is correct.

(A) Statement-1 is True, Statement – 2 is True ; Statement – 2 is a correct explanation for Statement – 1
(B) Statement – 1 is True, Statement – 2 is True ; Statement – 2 is NOT correct explanation for statement – 1
(C) Statement – 1 is true, Statement – 2 is false.
(D) Statement – 1 is false, Statement – 2 is false.

1. **Statement – 1 :** Ear muscles of external ear in man are poorly developed.
Statement – 2 : These muscles are useful which move external ear freely to detect sound efficiently.

2. **Statement – 1 :** Although living organism always arise from other living organisms, life should certainly have had a beginning.
Statement – 2 : The study of the condition and the mechanism involved in the creation of most primitive living structures on earth is actually the problem of origin of life.

3. **Statement – 1 :** The establishment of reproductive isolation is an event of biological significance
Statement – 2 : In the absence of reproductive isolation species can merge back into single population.

4. **Statement – 1 :** The birds have large, light spongy bones with air sacs.
Statement – 2 : These adaptations help them during flight.

ANSWERS

OBJECTIVE QUESTIONS :

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	C	C	C	A	D	A	C	D	A	A	A	C	A	B
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	B	C	C	D	B	A	D	B	B	A	C	A	D	B	C
Que.	31	32	33	34	35	36	37	38	39	40	41	42			
Ans.	B	A	C	A	D	B	B	B	A	D	C	A			

FILL IN THE BLANKS :

1. Anaximander **2.** A.I. Oparin, J.B.S. Haldane **3.** Speciation **4.** Haeckel

5. Archaeopteryx **6.** Galapagos islands **7.** Charles Robert Darwin

8. Homologous organ **9.** Vestigial **10.** Stages

ASSERTION AND REASON TYPE :

1. C **2.** A **3.** A **4.** A

EXERCISE # 2 NCERT SOLVED EXERCISE

1. What factors could lead to the rise of a new species ?

Ans. Following factors could lead to rise of a new species :

(i) Natural selection (ii) Processes of genetic drift.

(iii) Mutation (sudden change in genetic makeup) (iv) Environmental factors.

(v) Local factors

(vi) The differences or variations from one generation to the next.

2. Give an example of characteristic being used to determine how close two species are in cautionary terms.

Ans. Forelimbs of human and birds show the closeness between theses species. The basic structure of the limbs is similar, though it has been modified to perform different functions.

3. Can the wing of a butterfly and the wing of a bat be considered homologous organs ? Why or why not ?

Ans. The wing of a butterfly and the wing of a bat cannot be considered homologous because they have a common use for flying but their origins and structure area not common. Rather, they are analogous organs.

4. What are fossils ? What do they tell us about the process of evolution ?

Ans. The remains of dead plants and animals which were buried under the rocks millions of years ago are called fossils. Fossils tells us about the process of evolution. The fossils of different organisms have some features similar to the other species. In this way, they show the link between two species. They tell us that one species evolves from the other species.

5. Why are human beings who look so different from each other in terms of size, colour and looks, said to belong to the same species ?

Ans. The human beings are different from each other in terms of size, colour and looks but they are said to belong to the same species. It is due to their fundamental characteristics. The fundamental characteristics of one species are more closer among these organisms than the other organisms of other species. All human have same fundamental characteristics. So they belong to the same species.

6. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a better body design ? Why or why not ?

And. Chimpanzees have a better body design because they a well-developed body system, well-developed brain, and the thumb opposite to the finger to catch very small and minute things.

7. How are the areas of study – evolution and classification – interlinked ?

Ans. Evolution and classification are interlinked with each other. Classification is the most important term to explain evolution. Classification is based on the similarities and differences between two species or among two organisms. More closer the characteristics, are the more closer is the evolution and more chances are to remain in the same group of classification. We can appreciate that classification of species is in fact a reflection of their evolutionary relationship.

8. Explain the importance of fossils in deciding evolutionary relationship.

Ans. Fossils are the remains of dead plants or animals which died millions of years ago. The study of fossils helps us to know about the evolution or the link between two species. Fossils tells us how new species are developed from the old. So fossils have an important deciding evolutionary relationship.

9. How does the creation of variations in a species promoter survival ?

Ans. Natural selection the individuals having useful variations which ensure their survival in the prevailing conditions of environment. Variant individuals that can withstand or cope with prevailing environment will survive better and will increase in number through differential reproduction.

10. What are the different ways in which individuals with a particular trait may increase in a population ?

Ans. Different ways are : variation, natural selection and genetic drift (isolation).

11. Why are traits acquired during the lifetime of an individual not inherited ?

Ans. Because acquired characters bring changes only in non reproductive tissue and cannot change the genes of the germ cells. Thus acquired traits cannot be passed to next generation.

12. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics ?

Ans. **(i)** If any natural calamity occurs and kills this small number of surviving tigers, they can become extinct resulting in the loss of some genes forever.

(ii) Small number will lead to little recombination and therefore lesser variations. These both are very important for giving better survival chances to the species.

(iii) Less number of species means lesser extent of diversity and lesser number of traits which reduces the chances of adaptability with respect to the change in the environment.

13. What factors could lead to the rise of a new species ?

Ans. Genetic variations, natural selection and reproductive isolation could lead to the rise of a new species.

14. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species ? Why or why not ?

Ans. No, because pollination occur on the same plant in self pollination plant species.

15. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually ? Why or why not ?

Ans. No, because asexual reproduction involves single parent or organism.

16. Give an example of characteristics being used to determine how close two species are evolutionary terms ?

Ans. Homologous organs, analogous organs and vestigial organs helps to identify evolutionary relationships amongst the species.

17. Can the wing of butterfly and the wing of a bat e considered homologous organs ? Why or why not ?

Ans. No, wing of a bat and wing of a bird cannot be considered as monologues organs because they have different basic structure.

18. What are fossils ? What do they tell us about the process of evolution ?

Ans. Fossils are the impression or remains of ancient life found preserved in the sedimentary rocks. Fossils are directs evidences of evolution. Fossils also help to identify evolutionary relationship between apparently different species. They also tell about the extent of evolution that has taken place.

19. The human hand, cat paw and horse foot, when studied in detail show the same structure of bones and point towards a common origin. What do you conclude from this ? What is the term given to such structures ?

Ans. **(i)** It shows an evolutionary relationship between apparently different species, i.e., one form has evolved from the other.

(ii) These are called as homologous organs.

20. What is molecular phylogeny ?

Ans. The approach of molecular phylogeny is based on the idea the organisms which are more distantly related will accumulate a greater number of differences in their DNA. Such studies traces the evolutionary relationships among different organisms and thus help in their classification.

21. How does the creation of variations in a species promote survival ?

Ans. Natural selection selects the individuals having useful variations which ensure their survival in the prevailing conditions of environment. Variant individuals that can withstand or cope with prevailing environment will survive better and will increase in number through differential reproduction.

22. Define heredity.

Ans. Heredity can be defined as, "resemblances among individuals related by descent" or transmission of traits from parents to the offsprings".

23. Define variation.

Ans. Variation can be defined as "the occurrence of differences among the individuals".

24. Give example of analogous organs.

Ans. Wings of bat and wings of insects.

25. Define speciation.

Ans. Speciation means origin of new species from the existing one.

26. Who gave the idea of evolution of species by natural selection ?

Ans. Charles Darwin gave theory of natural selection.

27. What are the basic events in evolution ?

Ans. The changes in DNA during reproduction are the basic events is evolution.

28. What is genetic drift ?

Ans. The change in the frequency of certain genes in population over generations.

29. What do you mean by natural selection ?

Ans. Natural selection is the phenomenon in the nature the selects traits favorable to species in adjusting, to its environment.

30. Define fossils .

Ans. Fossils are the impression or remains of ancient life found preserved in the sedimentary rocks.

31. What is meant by 'characteristics' ?

Ans. Characteristics are details of appearance or behaviour ; in other words a particular form or a particular function.

32. What are the tools used for studying human evolution ?

Ans. Excavating, time-dating and studying fossils.

33. How does the mechanism of heredity work ?

Ans. Cellular DNA is the information source for making protein. A section DNA that provides information for one protein is called the gene for that protein. Proteins control the characteristics.

34. Describe briefly four ways in which individuals with a particular trait may increase in a population.

Ans. Traits arise due to variations which occur due to sexual reproduction or inaccuracies during DNA copying or environmental factors. Now, the individuals with a particular trait may increase in a population due to the following factors :

(i) Natural selection : Those variations which give survival advantage to an organism are selected nature and such traits increase in population.

(ii) Genetic drift : It occurs due to change in gene frequency due to accumulation of particular type of genes.

(iii) Geographical isolation : It leads to change in gene frequency leading to expression of one type of traits in a geographically isolated population.

(iv) Migration : It leads to flow of a particular type of gene in a specific population.

35. Distinguish between homologous and analogous organs. To which of theses categories the spine of cactus and thorn of Bougainvillea belong and why ?

Or

Where are genes located ? What is the chemical nature of genes.

Ans. (a)

Homologous organs	**Analogous organs**
The orgs which show structural similarity in their origin but have different functions are called homologous organs.	The organs which are structurally different but perform the same function are called analogous organs.
e.g. the forelimbs of a frog , a bird and a human being ar homologous organs.	e.g., the wings of birds and insects are analogous organs.

(b) The spine of CACTUS and thorn of BOUGAINVILLEA are structurally different but they perform the same function and therefore, they will be called analogous organs.

Remember : Spine of cactus, is the modification of a leaf while thorn of bougainvillea is humidification of stem.

Or

Genes are located on a chromosome and occupy specific positions. Genes are the segments of DNA having specific sequence of nucleotides which determines the functional property of a gene.

36. Define acquired and inherited traits with examples.

Ans. Inherited traits are those traits which are passed from one generation to another through specific genes. Any change in DNA of the germ of cells will be passed to next generation resulting in variations. Acquired traits are those traits which are acquired by the organism in its life time. e.g., removal of tail cannot change the genes of the germ cells of the mice thus cannot be passed to next generation.

ENVIRONMENT

Environ – surrounding **– Everything which surrounds and influences the organism directly or indirectly** is included in the environment

OR

The environment is the sum total of all living and non-living factor that surround and an organism. It has two components :-

(a) Biotic components ⇓ All Animals, Plant, Micro-organisms

(b) Abiotic components ⇓ Air, Water, Temperature, Humidity, Topography etc.

★ The study of environment includes the study of its various components, and their protection, preservation & management.

Ecology :- Greek word Oikos – home + logos – to study

Ecology means study of habitat or living or living place of organisms or study of organisms at home.

OR

"The study of inter relationships of organisms between the biotic and abiotic components of their environments. The 'Ecology' term was coined by **Ernst Haeckel (1868).**

- **Ecosystem :**
  - ◈ Ecosystem is the structural & functional unit of biosphere.
  - ◈ It has a property of self perpetuation.
  - ◈ It is an open system and depend on sun light.
  - ◈ It may be small and also very large.
  - ◈ Ecosystem term coined by Sir Arthur Tansley (1935).
- **Definition :** According to **Eugene P. Odum-Ecosystem is the basic unit of ecology and the biotic and abiotic components present in it influence each other. Both the components are essential for the sustenance of life.**

OR

A self-contained unit of living things [Plants, animals & decomposers] and their non-living environment [soil, air & water].

TYPES OF ECOSYSTEM

In the biosphere, ecosystem may be classified on the basis of their nature, duration and size :

(A) Nature : On the basis of nature, ecosystem may be classified as :

(1) Natural ecosystem

(2) Artificial ecosystems

(1) Nature ecosystem : These ecosystem operate in the nature by themselves without any human interference. Common examples of natural ecosystem are : a pond , a lake, a meadow , a desert, a grassland , a forest, and ocean etc.

(2) Artificial ecosystem : These are maintained by man and hence are also termed **man-made** or **man-engineered** ecosystem. In these ecosystem, man maintains / disturbs the natural balance by the addition of energy and planned manipulations Common examples of artificial ecosystem are croplands, orchards, gardens, aquarium etc.

(B) Duration : On the basis of duration, ecosystem may be classified as :

(1) Temporary ecosystem : e.g. – short lived ecosystem, rain fed pond

(2) Permanent ecosystem : ex. – a lake, a forest, a desert

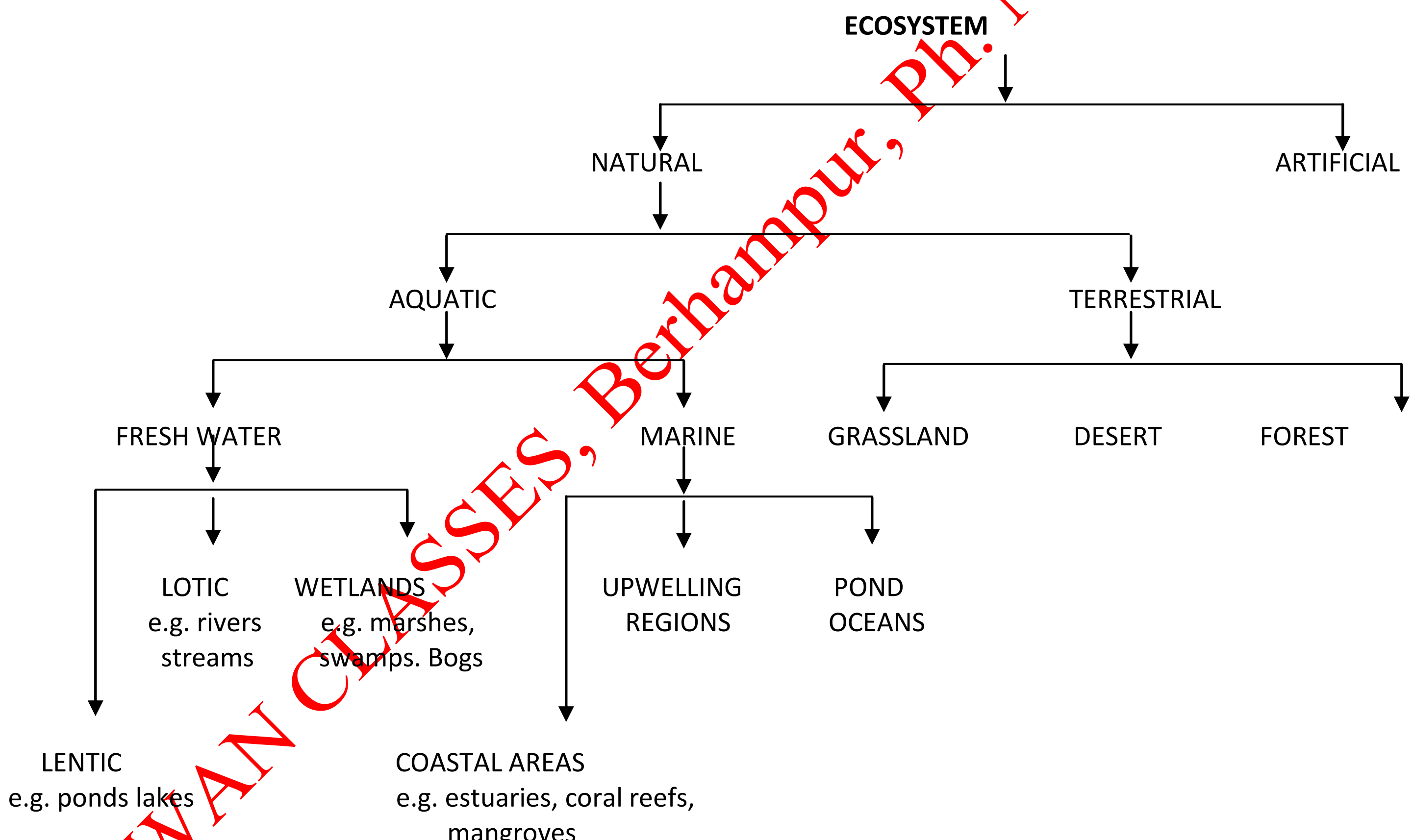
(C)Size :

(1) Small ecosystem : eg :- lake, a forest, a desert

(2) Large ecosystem : eg :- forest, desert, ocean.

Components of Ecosystem :

The various components of any ecosystem may be grouped into two main types :



(A) Abiotic (non-living) components

These include the non-living physio-chemical factors of the environment

ABIOTIC FACTORS INCLUDE :

(1) Inorganic substance **(2) Organic compounds** **(3) Climatic factors**

(1) Inorganic substance : Inorganic substances, e.g., carbon, nitrogen, oxygen, calcium, phosphorus etc. and their compounds (water, carbon, dioxide, etc.) constitute the main abiotic component.

(2) Organic compounds : These include carbohydrates, proteins, lipids, nucleic acids etc.

(3) Climate factors : These include light, temperature, humidity, wind , rainfall, water etc. and also **edaphic factors** (e.g., soil and substrate, topography, minerals, minerals, pH etc.)

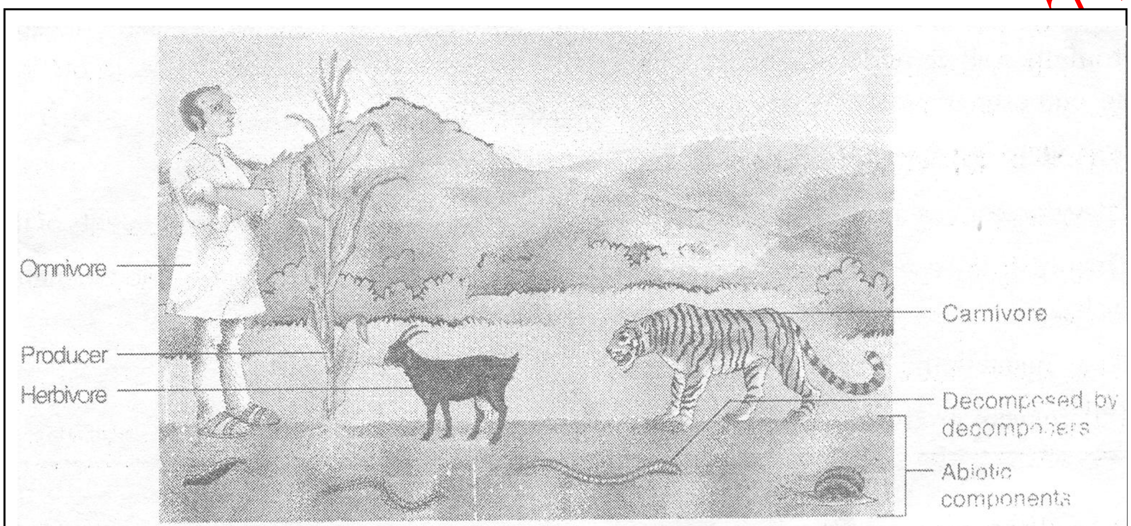
Example of Ecosystems – (i) Grass land [meadow] ecosystem, (ii) Forest ecosystem, (iii) Desert ecosystem (iv) Mountain ecosystem (v) Pound ecosystem

BIOTIC COMPONENTS :

The biotic community of an ecosystem includes 3 types of organisms :-

1. **Producers :** The organisms which can prepare their own food from simple inorganic substances like carbon dioxide and water by using sunlight energy in the presence of chlorophyll.

e.g. Green plants & Certain blue green algae.



Different components in an ecosystem

2. **Consumers :** Those organisms which consume food or eat food prepared by producers are called consumers. The consumers depends on producers for food, directly or indirectly. All the animals are consumers

Consumers can be further divided into three groups

(a) **herbivores –** Those animals which eat only plants are called herbivores.

e.g. Buffalo, Goat, Sheep, Horse, Deer, Camel.

Since herbivores obtain their food directly from plants or producers, therefore herbivores are primary consumers.

(b) **Carnivores :** Those animals which eat other animals as food are called carnivores.

Or

Those animals which eat the meat [or flesh] of other animals are called carnivores.

e.g. Lion, Tiger, Frog, Vulture, Kingfisher.

The small carnivores which feed on herbivores [primary consumers] are called secondary consumers.

e.g. Grasshopper. Rat, Frog.

The large carnivores [or top carnivores] which feed upon the small carnivores [secondary consumers] are called tertiary consumers.

e.g. Lion, Tiger, Hawk

(c) **Omnivores :** Those animals which eat both, plants & animals, are called omnivores.

Or

Those animals which eat plant food as well as the meat (or flash) of other animals.

e.g. Man, Dog, Crow, Sparrow, Bear & Ant.

(3) **Decomposers :** The micro-organisms which break down the complex organic compounds present in dead organisms like dead plants and animals and their products like faeces, urine into simple substances are called decomposes .

e.g. Bacteria & Fungi.

The decomposes help in decomposing the dead bodies of plants and animals and hence act as cleansing agents of environment.

Due to the presence of decomposers the various nutrient elements which were initially taken by plants from the soil, air and water are retuned to the soil, air and water after the death of plants animals thus decomposer organisms help in recycling the materials.

IMPORTANCE OF DECOMPOSERS

◇ They decompose the dead bodies of animals and plants, thus acts as cleansing gents of the environments.

◇ They help in recycling the material in biosphere thus play a vital role in biogeochemical or nutrient cycles.

◇ They maintain the futility of soil.

◇ If there were no decomposes, the earth would have been a heap of dead organisms.

COMPETITION WINDOW

Parasites : These organisms live on or inside the body of other organisms to obtain their food e.g. – Escherichia coli (bacteria) tapeworm.

Detritivores : These are organisms which feed on detritus (dead remains of plants & animals) They are also called as scavengers.

REVIEW QUESTIONS :

1. Name two non-biodegradable wastes ?

2. What are non-biodegradable wastes ?

3. Give the technical term for the sum of biotic and abiotic components of a specific area.

4. Give the importance of producers in an ecosystem.

5. Name some natural primary consumers of an aquatic (pond) ecosystem .

6. Give technical term for the group of organisms deriving from same source.

FOOD CHAIN

It is a sequence of organisms through which energy is transferred in the from of food by the process of one organisms consuming the other ?

Or

List of organisms [living beings] showing "who eats whom" is called a food chain.

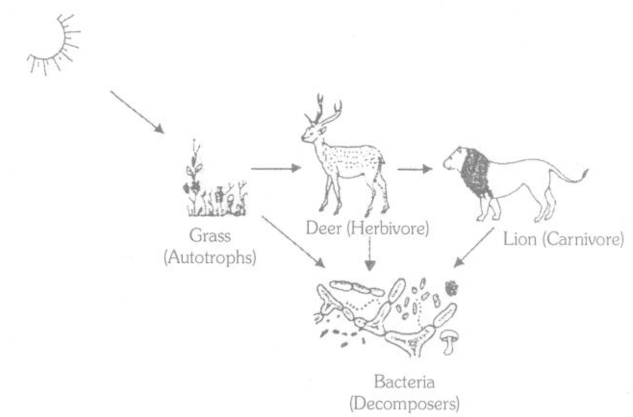
→ A food chain represents unidirectional transfer of energy

→ All the food chains begin with a green plants.

(i) Grass → Deer → Lion
(Producer) (Herbivore) (Carnivore)

(ii) Grass → Insects → Frog → Birds
(Producer) (Herbivore) (Carnivore) (Top carnivores)

CHARACTERISTICS OF FOOD CHAIN



A simple food chain

1. A food chain involves a nutritive interaction between the living organisms (biotic components) of an ecosystem in a food chain, there occurs **repeated eating ,** i.e., each group eats the other group and subsequently is taken by some other group organisms .
2. A food chain in always straight and proceeds in a progressive straight line.
3. In a food chain, there is unidirectional flow of energy from sum to producer and subsequently to series of different types of consumers.
4. Usually, there are 3 or 4 trophic levels in the food chain, In few chains, there may be maximum of 5 tropic levels.
5. Some organisms are omnivores. These occupy different trophic positions in different food chains.
6. At each transfer, generally 80-90% of energy is lost as heat in accordance with second law of thermodynamics. There are two types of food chains.

(a) Grazing food chains

Grazing type food chain					
Type of Ecosystem	**Producers**	**Herbivores**	**Primary Carnivores**	**Secondary carnivores**	**Tertiary carnivores**
(A) Grassland ecosystem	1. Grass 2. Grass 3. Grass	Insects (Grasshopper) Rats and mice Rabbits	Frog Snakes Foxes	Snakes Predatory birds Wolves	Predatory birds Lions
(B) Pond ecosystem	Phytoplanktons	Zooplanktons	Small fish	Large fish	Predatory birds

(b) Detritus food chain

Detritus food chain				
Detritus	**Detritivores**	**Detritivores consumers**	**Small carnivores**	**Large carnivore**
Mangrove fallen leaves and dead bodies of animals	**Fung, Bacteria and Protozoans**	**Insects larvae, certain crustaceans, mollusks and fish**	**Minnows, small game fish, etc.**	**Large fish, fish-eating birds**

SIGNIFICANCE OF FOOD CHAINS

The significance of food chains can be seen with the help of following functions :-

(i) It is a means of transfer of food from one trophic level to another.

(ii) It provides information about the living components of an ecosystem.

(iii) It helps us in understanding the interactions and interdependence amongst different organisms in an ecosystem .

(iv) It is pathway for the flow of energy in any ecosystem.

- ✦ Plants ⟶ Men (Two trophic levels)
- ✦ Plants ⟶ Goat ⟶ Men (Three trophic levels)
- ✦ Plants ⟶ Mice ⟶ Snakes ⟶ Peacocks (Four trophic levels)
- ✦ Plants ⟶ Insects ⟶ Frogs ⟶ Snakes ⟶ Eagles (Five trophic levels)
- ✦ Plants ⟶ Grasshoppers ⟶ Frogs ⟶ Snakes ⟶ Hawks (Five trophic levels)

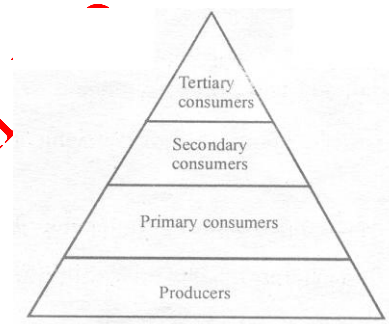
Trophic levels :- The distinct sequential steps in the food chain where transfer of energy occurs are referred to as different trophic levels. For example, green plants **(Producers)** form the **first trophic level –** the producer level ; the plant eaters **(herbivores)**, also called primary consumers, belong to **second trophic level –** the primary consumer level : and the flesh eaters **(carnivores),** also called secondary consumers, represent the **third consumer level –** the secondary consumer level and so on.

Producers – T_1 - Firs trophic level

Herbivores – T_2

Primary carnivores – T_3

Secondary carnivores – T_4



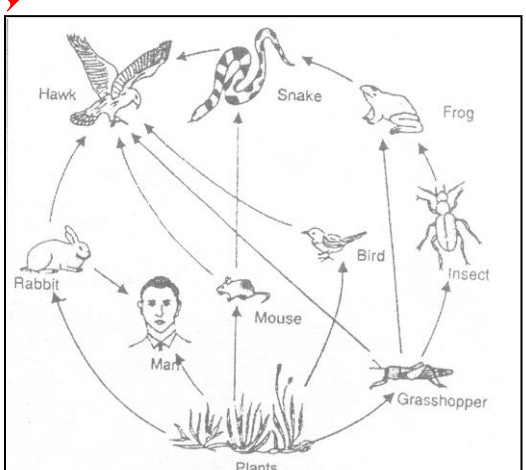
Trophic levels

FOOD WEB

The inter – connected chains operating in an ecosystem which establish a network of relationships between various species is called a food web.

Or

The network of a large number of food chains existing in an ecosystem is called a food web.



A food web

DIFFERENT BETWEEN FOOD CHAIN AND FOOD WEB

S.No.	Food Chain	Food Web
1	**The sequence of eating and being eaten among the living organisms to transfer food energy is called food chain**	**It is a system of interconnected food chains. The network of food chains develop a relationship between various organisms**
2.	**It is having 4-5 populations (trophic levels) of different species.**	**It is having numerous populations of different species.**
3.	**It is part of food web.**	**It contains many food chains**
4.	**Food chains do not help in increasing population of endangered species.**	**Food web helps in increasing the population of endangered species .**

TEN PERCENT LEW

It was put forth by Lindeman (1942). It is also termed as second law of thermodynamics or law of entropy . According to this law, transfer of energy from one trophic level to other trophic leave is never 100 percent. It is so because most of energy gets lost as heat in the environment during each transfer. **On an average, about 10% energy is actually available to the next trophic level .**

FLOW (TRANSFER) OF ENERGY IN AN ECOSYSTEM

Each organism needs energy to carry on vital activities, and for building up and repairing the body tissues.

- The ultimate source of entire energy, used by organisms, is the **sun** .
- In a community, each food chain, in fact, represents stepwise transfer of food (energy).
- Of the total solar radiations falling on the earth, only about 10% are captured by green plants in a terrestrial ecosystem and construed into food energy by photosynthesis. This energy is stored as **chemical energy of food.**
- When green plants are eaten by herbivores (primary consumers), a great of energy is lost as hest to the environment in accordance with the second law of thermodynamics. On an average, 10% of the food (energy) is turned into body of herbivores. In the same way. 10% of total energy available to the herbivores is made available for the next level of consumers. In other words, on an average, 10% of the amount of organic matter that is present at each step reaches the next consumer level.
- Since, amount of available energy goes on decreasing at each trophic level, food chains usually consist of only 3 or 4 steps and rarely maximum of 5 steps.
- In an ecosystem, generally the producers are maximum in number. As we move along the chain, the number of individuals at each trophic level decreases .

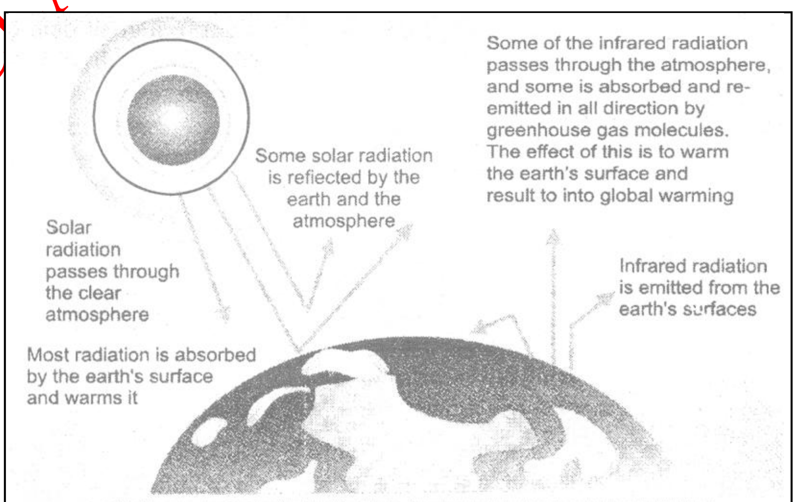


Diagram showing flow of energy in an ecosystem.

Do you know ?

- In an ecosystem, energy comes from the sunlight. It is converted from one form to another.
- Energy gets continuously transferred from one trophic level to other by repeated eating in a food chain.
- There occurs loss of energy as heat at each step of energy transfer (trophic level) in the environment.
- On an average, about 10% of available energy actually gets transferred from one trophic level to other in a food chain. This limits the steps to maximum of 4 or 5 in food chain.
- The phenomenon that involves progressive increase in concentration of harmful non-biodegradable chemical at different trophic levels in a food chain called **biomagnifications.**

REVIEW QUESTIONS

1. What is detritus ?
2. What is the branch of biology dealing with energy transfer ?
3. Define ecological pyramid .
4. Who proposed 10% laq ?
5. Which type of organisms belong to T_1 and T_2 trophic levels of a food chain ?
6. Which crop has maximum energy conserving efficiency ?
7. Give the technical term for the increase in the amount of a non-biodegradable substance in successive trophic levels of a food chain.

HOW DO ONE ACTIVITIES AFFECT THE ENVIRONMENTS?

There are two major environmental problems:

(1) Solid waste and their disposal

(2) Depletion of ozone layer.

(1) Solid waste and their disposal : Solid water generally comes from residences, cattle sheds, industries, agricultural fields, any many other places. It includes peelings of fruits and vegetables, other kitchen waste, ash, paper, cow dung, human excreta, glass, plastics, leather and rubber articles, brick, worn out clothes and metal objects etc. When accumulated, these heaps of solid waste make the surroundings dirty, and pollute the soil.

GARBAGE

The sight of a dustbin overflowing and the unpleasant smell rising from it are the familiar sights and smells of a crowded city. You look away from it and hold your nose as you cross it. Have you ever thought that you also have a role to play in the creation of this unpleasant odour ? Whether we can also play any role in reducing this smell and making this waste bin book a little more attractive if we follow proper methods of disposal of the waste generated in our houses ? What happens to the materials thrown away?

Type of solid wasted :- 2 Types

- **Biodegradable Wastes :** They are those waste materials which can be broken down into simpler, non-poisonous by the action of micro-organisms, for example, Cattle dung, Waste vegetables, fruits, and Compost etc.

- **Non-biodegradable Wastes :** The waste materials which cannot be broken down into simpler substances easily in nature, for example, Aluminum Cans, Coal, DDT, Plastics and Radioactive wastes.

S.No.	Biodegradable Waste	Non-biodegradable Waste
1.	They can be broken down into simper substances by the activity of biological catalysts called enzymes (present in surrounding bacteria or other saprophytes). Physical processes like heat and temperature help in the functioning of enzymes.	They can't be broken down into simpler and harmless products because the biological catalysts called enzymes can't act upon them. They can be acted upon only by some physical processes like heat and pressure.
2.	They can enter the biogeochemical cycles.	They cannot enter the biogeochemical cycles.
3.	They become pollutants only when they accumulate in large quantities and not degraded at the right time	They always act as pollutants whether present in small or large quantity.
4.	All the biodegradable wastes should be treated properly be before discharging them into water or soil.	They can't be treated properly before discharging them into water or soil. Instead, they can be either recycled or reused.
5.	They do not persist in the environment for a long time.	They persist in the environment for a long time .
6.	**Examples :** Urine and faecal matter, Sewage, Paper, Vegetable and fruit peels, Agricultural resides, Wood and cloth.	**Examples :** Heavy metals like Mercury, Lead, Arsenic, Radioactive wastes like Uranium. Plutonium, insecticides and Pesticides like DDT and BHC.

MODES OF WASTE DISPOSAL

Some prominent methods of waste disposal are :

1. **Land fills :** In urban areas, majority of the solid wastes are buried in low lying areas to level the uneven surface of land. This method of waste disposal is commonly called land fills.
2. **Recycling of wastes :** Number of solid wastes (paper, plastics, metal, etc.) can be recycled by sending them to respective recycling. For instance, paper is sent for recycling into special paper mills : brock plastic (e.g., plastic bags, buckets, bowls, dishes, mugs, disks, etc.) are sent to plastic processing factories.
3. **Preparation of compost :** Household waste such as peeling of fruits and vegetables. Left-over food, fallen dead leaves of kitchen garden plants and potted plants etc. can be converted into compost and used as manure.
4. **Incineration or burning at high temperature :** Incineration is the process of burning of substance at high temperature (usually more than 1000^{0}C) and ultimately converting them into ashes. This ash can be diposed of by land fills. In cities, municipal committees / corporations generally do large scale disposal of waste by incineration .
5. **Production of biogas and manure :** Biodegradable , waste can also be used in biogas plants to generated biogas and manure. Biogas is a cheap source of fuel, and manure, a cheap fertilizer.

DEPLETION OF OZONE LAYER

OZONE GAS

Ozone is poisonous in nature

- Ozone is formed in atmosphere by the action of ultraviolet radiation on oxygen gas.
- The high energy ultraviolet radiation (UV radiation) coming from the sun splits oxygen gas into free oxygen atoms

  $O_2 \xrightarrow[radiations\ \ from\ \ sun]{Ultraviolet} 2O$ (oxygen atom)

- The free oxygen atoms are highly reactive. One oxygen atom reacts with an oxygen molecule to form an ozone molecule .

  $O_2 + O \longrightarrow O_3$ (Ozone molecule)

- **OZONE LAYER**

It is a layer of the earth's atmosphere, where ozone is concentrated. The Ozone layer is very important for the existence of life on earth because it absorbs most of the harmful ultraviolet radiation coming from the sun and prevents them from reaching the earth.

The thinning of ozone layer is commonly called ozone depletion. Ozone is being depleted by air pollutants. Chlorofluorocarbons (CFCs) are air pollutants that are mainly responsible for the depletion of ozone layer in the stratosphere. Besides, methane (CH_4) and oxides of nitrogen (NO_x) also cause destruction of ozone.

EFFECT OF OZONE DEPLETION

(i) Ultra violet radiations cause skin cancer.

(ii) These cause damage to eyes and also can cause increased incidence of cataract disease in eyes.

(iii) These cause damage to immune system by lowering the body's resistance to diseases.

POINTS TO BE REMEMBER

(i) The depletion of ozone layer is due to the use of chemicals called CFC – chlorofluorocarbons. CFC used in Refrigerators, in fire extinguishers and in aerosol sprayers.

(ii) In 1987 in an attempt to protect ozone layer, the United Nations Environment Programmed (UNEP) forged an agreement among its member countries to freeze CFC production at 1986 levels.

(iii) Incineration – Reducing to ashes

The burning of substance at high temperature [more than 1000^0C] to form ash is called incineration.

(iv) The use of a lot of clay for making millions of kulhads daily led to the loss of fertile top soil from fields. So, the practice of using kulhads has been discontinued .

(v) Effects of lowering of ozone depletion are :-

(i) skin cancer

(ii) damaging for eyes – cataract

(iii) UV rays damage immune system by lowering the body's resistance to diseases.

(vi) Montreal Protocol (1987) – Identified eight chemicals as ozone layer depletors.

Vienna Convention for protection of ozone layer (1932) identified at total of 19 ozone depletors.

(vii) Ozone hole : Decline in thickness of ozone layer a restricted area is called ozone hole. Ozone hole was first discovered over Antarctica in 1985. Amount of atmospheric ozone is measure by Dobson spectrometer and is expressed in Dobson units (DU).

REVIEW QUESTIONS

1. What do you understand by environment ?

2. Define ecosystem.

3. Define trophic levels.

4. Give two examples each of (a) natural ecosystem, (b) terrestrial ecosystem.

5. Explain the statement that "the flow of energy in an ecosystem is always unidirectional".

6. Pick out biodegradable wastes from the following : excreta, pesticides, sewage, agricultural wastes, plastic , **lead** arsenic.

7. List two harmful effects of non-biodegradable wastes.

8. What is ozone ? How is it formed ?

9. Define consumers ?

10. List any three consequences of ozone layer depletion.

EXERCISE – 1

SHORT ANSWER TYPE QUESTIONS

1. Differentiate between biodegradable and non-biodegradable wastes.
2. Describe a forest food chain.
3. Distinguish between producers and consumers.
4. Mention the importance of decomposers in an ecosystem.
5. The number of malaria patients in a village increased tremendously when a large number of frogs a exported from the village. What could be the cause for it ? Explain with the help of food chain.
6. What is food chain ? Give an example of four step food operating in a large lake or grassland.
7. Study the following food chain. How much energy (in units) will pass from producers to herbivores and from herbivores to carnivores ?

Plants 20 units	→	Herbivore ?	→	Carnivore ?

OBJECTIVE QUESTIONS

1. **Components of environment are :**
(A) Biotic (B) Abiotic
(C) Resources and regulatory factor (D) All the above

2. **Which one is nearly absent in ozonosphere ?**
(A) Dust particles (B) Water vapors
(C) CO_2 (D) All the above

3. **How many ozone molecules can be destroyed by one chlorine fragment before other chemical processes remove the chlorine from the atmosphere :-**
(A) 10 (B) 100 (C) 1000 (D) 100, 000

4. **Ozone of ozonosphere is formed from :-**
(A) Nitrogen oxides and Oxygen (B) Chlorine, Water and Oxygen
(C) Oxygen and Oxygen (D) All the above

5. **Pedology is a study of :-**
(A) Locomotion of animals (B) Rocks
(C) Soil (D) Crop diseases

6. **Ecology (oekologic) was coined by :-**

(A) Linnaeus
(B) Haeckel
(C) Harvey
(D) Odum

7. Ecology is study of relationships between :-
(A) Members of a family
(B) Man and environment
(C) Organisms and environment
(D) Soil and water

8. Ecosystem may be defined as :-
(A) A species along with environment
(B) Plant found in water
(C) Plants found on land
(D) All plants and animal species along with environment

9. A food chain is :-
(A) Group of organisms which eat the same type of food
(B) Animals eating the plants
(C) Series of plants / animals which are interrelated in the form of organism being eaten as food by the other
(D) None of these

10. Lion is :-
(A) Producer
(B) Primary consumers
(C) Secondary consumers
(D) Top carnivore

11. A food chain always starts with :-
(A) Photosynthesis
(B) Respiration
(C) Nitrogen fixation
(D) Decay

12. Secondary consumers are :-
(A) Green plants
(B) Herbivores
(C) Carnivores
(D) All the above

13. Producers in any grazing food chain :-
(A) Feed the herbivores
(B) Feed the carnivores
(C) Clean the atmosphere
(D) Capture solar energy

14. Ultimate source of energy for living beings is :-
(A) Carbohydrates
(B) Fats
(C) Sunlight
(D) ATP

15. Food web is constituted by :-
(A) Various interlinked food chains in a community
(B) Relationship between animals and plants
(C) Relationship between animals plants and microbes
(D) Relationship between animals, plants and microbes

16. In pyramid of food, the producers occupy :-
(A) The base
(B) Position near the base
(C) Apex
(D) Position near apex

17. Energy flow in an ecosystem is :-
(A) Unidirectional
(B) Bidirectional
(C) Multidirectional
(D) All the above

18. Which forests have maximum diversity ?
(A) Subtropical ran forests
(B) Coniferous forests
(C) Tropical forests
(D) Deciduous forests

19. Which is correct food chain ?
(A) Phytoplankton $\longrightarrow$ Fishes $\longrightarrow$ Zooplankton
(B) Zooplankton $\longrightarrow$ Phytoplankton $\longrightarrow$ Fishes
(C) Phytoplankton $\longrightarrow$ Zooplankton $\longrightarrow$ Fishes
(D) Fishes $\longrightarrow$ Zooplankton $\longrightarrow$ Phytoplankton

20. Who proposed the term ecosystem ?
(A) Odum
(B) Gardner
(C) Warming
(D) Tansley

21. Which one is the correct food chain ?
(A) Eagle $\longrightarrow$ Snake $\longrightarrow$ Grasshopper $\longrightarrow$ Grass $\longrightarrow$ Frog

(B) Frog → Snake → Eagle → Grasshopper → Grass

(C) Grasshopper → Grass → Snake → Frog → Eagle

(D) Grass → Grasshopper → Frog → Snake → Eagle

22. Pick up the correct food chain :-

(A) Grass → Chameleon → Insect → Bird (B) Grass → Fox → Rabbit → Bird

(C) Phytoplankton → Zooplankton → Fish (D) Fallen leaves → Bacteria → Insect → larvae

23. Path of energy flow in an ecosystem is :-

(A) Herbivores → Producers → Carnivores → Decomposers

(B) Herbivores → Carnivores → Producers → Decomposers

(C) Producers → Carnivores → Herbivores → Decomposers

(D) Producers → Herbivores → Carnivores → Decomposers

24. Energy enters a food chain through :-

(A) Producers (B) Decomposers (C) Herbivores (D) Carnivores

25. The most stable ecosystem is :-

(A) Forest (B) Mountain (C) Desert (D) Ocean

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	110	11	12	13	14	15	16	17	18	19	20
Ans.	D	D	D	C	C	B	C	D	C	D	A	C	D	C	A	B	A	C	C	D
Que.	21	22	23	24	25															
Ans.	D	C	D	A	D															

EXERCISE – 2

VERY SHORT ANSWERS TYPE QUESTIONS

1. Name the protective carver in the atmosphere which absorbs harmful ultra-violet (UV) radiations.
2. What do you mean by ozone hole ?
3. Arrange the following in a food chain :

   Mouse, snake, owl, plant
4. Name the various steps in the food chain where food energy is transferred.
5. Name any two step food chain in forest ecosystem.
6. Name any artificial ecosystem
7. Expand the abbreviation CFCs.
8. What kind of cups are being used in railway trains etc. for serving tea, coffee etc, now a days ?
9. Why suggestion regarding use of kulhads (disposable cups made of clay) at very large scale has been discontinued ?
10. Name three biotic components of an ecosystem.

SHORT ANSWERS TYPE QUESTIONS

1. Write the importance of decomposers in any ecosystem.
2. Write characteristics of food chains.
3. Differentiate between biodegradable and non-biodegradable substances.

4. In which part of atmosphere ozone is concentrated ? Why is it important ?

5. What do you mean by 'waste disposal' ? Explain incineration method in detail.

LONG ANSWERS TYPE QUESTIONS

1. Explain biological magnification phenomenon by taking any suitable example.

2. What do you mean by ozone depletion ? List chemicals that cause it. How can we check ozone depletion .

3. How our life styles and attitude affect the environment ? Explain with suitable examples.

4. Give examples of following :-

(i) Two-step food chain in a forest ecosystem.

(ii) Three-step food chain in a forest ecosystem.

(iii) Four-step food chain in a pond ecosystem

EXERCISE – 3

REASONING QUESTIONS WITH SOLUTIONS

1. In which layer of atmosphere is present the ozone blanket ? How is ozone being maintained ?

Ans. Ozone blanket is present in the stratosphere layer of atmosphere. In the stratosphere, ozone is being photo dissociated and generated by the absorption of harmful, short wavelength ultraviolet (uv) radiations coming from the sun.

$$\underset{\text{Ozone}}{O_3} \xrightleftharpoons{\text{uv radiation from sun}} \underset{\text{oxygen molecule}}{O_2} + \underset{\text{Oxygen atom}}{[O]}$$

The two reactions (photo dissociation of O_3 and its generation) are in equilibrium there by maintaining steady concentration of ozone in the stratosphere.

2. Why was use of 'kulhads' (disposable cups made of clay) at a mass scale in the railways discouraged?

Ans. Use of 'kulhads' (disposable cups made of clay) at a mass scale in the railways was discouraged at making these kulhads on a large scale would have resulted in the loss of the fertile top soil.

3. Give reason why :

(i) Forest ecosystem is more stable than crop land ecosystem.

(ii) Available energy goes on decreasing at each trophic level in a food chain.

Ans. (i) Greater are the number of alternatives available at each trophic system, more stable is that ecosystem . In forest ecosystem. More alternative in the form of variety of organisms are available at each trophic level. This is not the case in cropland ecosystem. Hence, forest ecosystem is more stable.

(ii) According to second law of thermodynamics, at each step of energy transfer, majority of the energy is lost as unavailable heat. This is the reason why available energy goes on decreasing at each trophic level in a food chain.

4. Due to uncontrolled excessive hunting, the population of tigers in a forest becomes zero. Discuss the long term effects of this situation on the population of deer in that forest.

Ans. Tiger is the top carnivore of a number of food chains and is the symbol of richness of biodiversity of an area Uncontrolled hunting of tigers will lead to rapid increase in deer population, which in turn may cause ecological imbalance due to rapid consumption of vegetation of the area.

5. Why is energy flow a "one-way street" ?

Ans. Because the energy always flows in one direction in a food chain i.e. from sun to the producers (autographs) and then to various categories of consumers (heterotrophy) and not vice versa. So the energy trapped by the producers does not revert to the sun and the energy passed on to the herbivores cannot be returned to the producers.

6. What is the role of decomposers in the ecosystem ?

Ans. Decomposers are essential of ecosystem. They decompose dead remains of plants and animals and their waster organic products into simpler, inorganic substance. The latter are released into the environment for their reuse as raw materials by producers. These , therefore , provide space for new life to settle in the biosphere.