NOTES

CHAPTER 1: Chemical Reactions and Equations

Key Points and Concepts

- A complete chemical equation represents the reactants, products, conditions of reaction and their physical states symbolically.
- **Oxidation:** loss of electrons.
- **Reduction:** gain of electrons.
- **Rust** is mainly hydrated iron (III) oxide, $Fe_2O_3.xH_2O$.

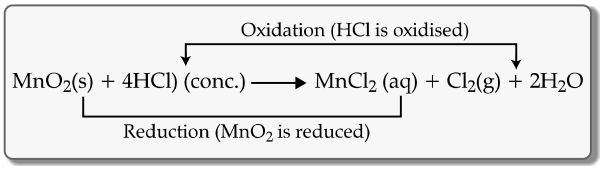
Important Equations

- **Types of Reactions:**

S. No.	Name and Definition	Example
1.	In a **combination reaction**, two or more reactants combine to give a single product.	$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)$ (Quick lime) (Slaked lime)
2.	In a **decomposition reaction**, a single reactant breaks down into two or more simpler products.	$2Pb(NO_3)_2 \xrightarrow{Heat} 2PbO(s) + 4NO_2(g) + O_2(g)$ (Lead nitrate) (Lead oxide) (Nitrogen dioxide) (Oxygen)
3.	When decomposition reaction is carried out by heating, it is called **thermal decomposition reaction.**	$CaCO_3(s) \xrightarrow{Heat} CaO(s) + CO_2(g)$ (Calcium carbonate) (Quicklime)
4.	When decomposition reaction is carried out in the presence of sunlight, the process is called **photochemical decomposition.**	$2AgBr(s) \xrightarrow{Sunlight} 2Ag(s) + Br_2(g)$ (Silver bromide) (Silver) (Bromine)
5.	**Electrolysis:** When decomposition reaction is carried out with the help of electric current, the process is called electrolysis.	$2H_2O(l) \xrightarrow{Electric\ current} 2H_2(g) + O_2(g)$ (Water) (Hydrogen gas) (Oxygen gas)
6.	In a **displacement reaction**, a more reactive element displaces a less reactive element from a compound.	$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$ (Iron) (Copper sulphate) (Iron sulphate) (Copper)

7.	Those reactions in which two 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**.	$Na_2SO_4(aq)$ + $BaCl_2(aq)$ ⟶ $BaSO_4(s)$ + 2NaCl(aq) (Sodium sulphate) (Barium chloride) (Barium sulphate) (Sodium chloride)
8.	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 ⟶ Na_2SO_4 + H_2O (Sodium hydroxide) (Sulphuric acid) (Sodium sulphate) (Water)

- **Some usually asked equations in exams for balancing:**
  - $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$
    (Carbon monoxide) (Oxygen) (Carbon dioxide)
  - $ZnCO_3 \xrightarrow{\text{Heat}} ZnO + CO_2$
  - $2FeSO_4(s) \longrightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$
  - $Pb(NO_3)_2 + 2KI \longrightarrow 2KNO_3 + PbI_2$
    (Lead nitrate) (Potassium iodide) (Potassium nitrate) (Lead Iodide)
  - $CaO(s) + H_2O \longrightarrow Ca(OH)_2$ + Heat
    (Quick lime) (Slaked lime)
  - $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$
    (Sodium chloride) (Silver nitrate) (Silver chloride) (Sodium nitrate)
  - $Ca + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2\uparrow$
  - $Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2\uparrow$
  - $2Al + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2\uparrow$
  - $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$
  - $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
  - $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$
  - $Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$
  - $4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$
  - $Zn + 2NaOH \xrightarrow{\text{Heat}} Na_2ZnO_2 + H_2\uparrow$
- **Redox (Oxidation and Reduction) Reaction:**



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CHAPTER 2: Acids, Bases and Salts

Key Points and Concepts

- Those substances which turn blue litmus solution red are called acids. Acids are sour in taste. They give H^+ ions in aqueous solution. e.g.:

  $HCl, H_2SO_4, HNO_3, CH_3COOH$
- Those acids which dissociates into ions completely are called strong acids, e.g., H_2SO_4, HCl.
- Those acids which do not dissociates into ions completely are called weak acids, e.g., citric acid, acetic acid.
- **Chemical properties of acids:**
  (a) Reaction with metal:

  Acid + Metal ⟶ Salt + Hydrogen gas

  $2HCl(aq) + Zn(s) \longrightarrow ZnCl_2(aq) + H_2(g)$

(b) Reaction with metal carbonate and metal hydrogen carbonates:

Metal carbonate/metal hydrogen carbonate + Acid → Salt + CO_2 + H_2O

$$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

$$NaHCO_3(s) + HCl(aq) \longrightarrow NaCl(aq) + CO_2(g) + H_2O(l)$$

Test for carbon dioxide (Lime water test): When carbon dioxide gas is passed through calcium hydroxide (lime water), it turns milky due to the formation of calcium carbonate.

$$Ca(OH)_2(aq) + CO_2(g) \longrightarrow \underset{\text{(White ppt.)}}{CaCO_3(s)\downarrow} + H_2O(l)$$

$$CaCO_3(s) + H_2O(l) + CO_2(g) \longrightarrow Ca(HCO_3)_2(aq)$$

When excess of carbon dioxide is passed through lime water, milkiness disappear due to the formation of calcium hydrogen carbonate.

(c) Neutralization reaction: It is a reaction in which an acid react with base to give salt and water as product.

$$\text{Acid} + \text{Base} \longrightarrow \text{Salt} + \text{Water}$$

$$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

(d) Reaction with metal oxide:

$$\text{Metal oxide} + \text{Acid} \longrightarrow \text{Salt} + \text{Water}$$

$$CuO(s) + 2HCl(aq) \longrightarrow CuCl_2(aq) + H_2O(l)$$

(e) Reaction with water: Acid reacts with water and produces hydrogen ions in solution.

$$HCl(g) + H_2O(l) \longrightarrow H^+(g) + Cl^-(aq)$$

➢ **Chemical properties of base:**

(a) Reaction with metal:

$$\text{Base} + \text{Metal} \longrightarrow \text{Salt} + \text{Hydrogen}$$

$$2NaOH(aq) + Zn(s) \longrightarrow Na_2ZnO_2(s) + H_2(g)$$

(b) Reaction with non - metallic oxide:

$$\text{Non - metallic oxide} + \text{Base} \longrightarrow \text{Salt} + \text{Water}$$

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

(c) Reaction with water: Bases give OH^- ions in presence of water.

$$NaOH + H_2O \longrightarrow Na^+ + OH^-$$

➢ **Amphoteric oxides:** Some metallic oxides that react with both acids and bases are called amphoteric oxides.

➢ **Alkalies:** An alkali is a base that dissolves in water. e.g., NaOH, KOH, $Ca(OH)_2$, NH_4OH.

➢ All alkalies are bases but all bases are not alkalies.

➢ Strength of an acid and base can be determined with the help of universal indicator and pH scale.

➢ pH scale gives the measure of hydrogen ion concentration in a solution. It measures from 0 (very acidic) to 14 (very alkaline). 7 indicates neutral pH.

➢ **Examples of pH in our daily life:**

- Stomach produces HCl, which help in digestion of food.
- pH change in the mouth is the cause of tooth decay.
- Bee sting leaves an acid which causes pain and irritation.
- Plants require a specific pH range for healthy growth.
- Change in pH (less than 5.6) of rain may cause acid rain, which has a deleterious effects on aquatic life.

➢ **Hydrated salts which are white in colour:**

- **Washing soda:** $Na_2CO_3.10H_2O$
- **Gypsum:** $CaSO_4.2H_2O$
- **Plaster of Paris:** $CaSO_4.\frac{1}{2}H_2O$

➢ **Reaction of different solutions with different indicators:**

S. No.	Name of the solution	Colour change (if any) Phenolphthalein	Colour change (if any) Blue litmus
1.	Sodium carbonate	turns pink	no change
2.	Hydrochloric acid	no change	turns red
3.	Sodium chloride	no change	no change

➢ **Important Compounds:**

- **Baking Soda:**

  The chemical formula of baking soda is $NaHCO_3$ (sodium hydrogen carbonate).

  It is prepared by using sodium chloride.

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

  On heating:

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + H_2O + CO_2$$

- **Green Vitriol:**

  The chemical formula of Green Vitriol is $FeSO_4.7H_2O$.

  $FeSO_4.7H_2O$ is green in colour and loses water of crystallisation when it is heated.

  It is then decomposed to Fe_2O_3 (brown coloured), SO_2 and SO_3.

$$FeSO_4.7H_2O \xrightarrow{\Delta} FeSO_4 + 7H_2O$$

$$2FeSO_4(s) \xrightarrow{\Delta} Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

- **Plaster of Paris:**

  The chemical formula of Plaster of Paris is $CaSO_4.\frac{1}{2}H_2O$ (Calcium sulphate hemihydrate)

  When Plaster of Paris reacts with water, it forms gypsum.

$$\underset{\text{(Plaster of Paris)}}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}.H_2O \longrightarrow \underset{\text{(Gypsum)}}{CaSO_4.2H_2O}$$

- **Washing Soda and its Properties:**

  The chemical formula of washing soda is $Na_2CO_3.10H_2O$ and its chemical name is sodium carbonate.

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

$$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$$

$$Na_2CO_3 + 10H_2O \xrightarrow[32°C]{\text{lower than}} Na_2CO_3.10H_2O$$

  It is a basic salt because when dissolved in water it gives a strong base NaOH.

  It is used as a cleansing agent for domestic purposes and also used in paper and glass industry. It is also used for manufacture of Borax.

- **Bleaching Powder and its uses:**

  The chemical formula of bleaching powder is $CaOCl_2$.

  By passing chlorine into dry slaked lime $Ca(OH)_2$, bleaching powder is obtained.

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

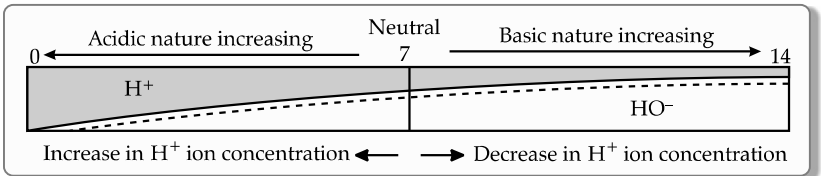
  Two uses:

  (i) Used for bleaching cotton and linen in the textile industry and wood pulp, paper industry, etc.

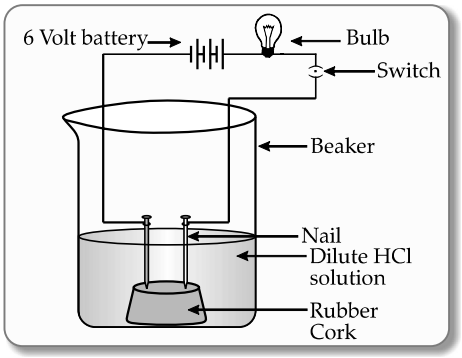
  (ii) It is used for disinfecting drinking water.

➢ **Important Diagrams:**

- **pH Indicator**



- **Setup which shows acid solution in water conducts electricity**



CHAPTER 3: Metals and Non-Metals

Key Points and Concepts

- Elements can be classified as metals and non-metals.
- **Electronic configuration of some metals and non-metals:**

Type of element	Element	Atomic number	Number of electrons in shells			
			K	L	M	N
Noble gases	Helium (He)	2	2			
	Neon (Ne)	10	2	8		
	Argon (Ar)	18	2	8	8	
Metals	Sodium (Na)	11	2	8	1	
	Magnesium (Mg)	12	2	8	2	
	Aluminium (Al)	13	2	8	3	
	Potassium (K)	19	2	8	8	1
	Calcium (Ca)	20	2	8	8	2
Non-metals	Nitrogen (N)	7	2	5		
	Oxygen (O)	8	2	6		
	Fluorine (F)	9	2	7		
	Phosphorus (P)	15	2	8	5	
	Sulphur (S)	16	2	8	6	
	Chlorine (Cl)	17	2	8	7	

- **Properties of Ionic Compounds:**
  - Ionic compounds are solids and are somewhat hard because of the strong force of attraction between the positive and negative ions. These compounds are generally brittle and break into pieces when pressure is applied.
  - Ionic compounds have high melting and boiling points.
  - Electrovalent compounds are generally soluble in water and insoluble in organic solvents such as kerosene, petrol, etc.
  - Ionic compounds conduct electricity in the molten state.
- **Activity Series:**

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Reactivity decreases
Fe	Iron	
Pb	Lead	
[H]	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

➢ **Chemical Properties of Metals:**

Condition	Chemical Equation
Metals are burnt in air	Metal + Oxygen ⟶ Metal oxide **Example 1:** $2Cu + O_2 \longrightarrow 2CuO$ (Copper) [Copper(II) oxide] **Example 2:** $4Al + 3O_2 \longrightarrow 2Al_2O_3$ (Aluminium) (Aluminium oxide)
Metals react with water	Metal + Water ⟶ Metal oxide + Hydrogen Metal oxide + Water ⟶ Metal hydroxide **Example 1:** $2K(s) + 2H_2O(l) \longrightarrow 2KOH(aq) + H_2(g) + \text{heat energy}$ **Example 2:** $2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g) + \text{heat energy}$ **Example 3:** $Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$ **Example 4:** $2Al(s) + 3H_2O(g) \longrightarrow Al_2O_3(s) + 3H_2(g)$ $3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$ **Example 5:** $K_2O + H_2O \longrightarrow 2KOH$
Metals react with acids	Metal + Dilute acid ⟶ Salt + Hydrogen $Cu(s) + 2HCl(aq) \longrightarrow CuCl_2(aq) + H_2(g)$
Metals react with solutions of other metal salts	**Metal A + Salt solution of B ⟶ Salt solution of A + Metal B** $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

➢ **Chemical Properties of Non-metals:**

(a) Reaction with oxygen: Non-metals form acidic oxides.
e.g., $C(s) + O_2(g) \longrightarrow CO_2(g)$

(b) Reaction with water: Non-metals do not react with water, because they do not release any electrons.

(c) Reaction with dilute acids: No reaction

(d) Reaction with salt solutions: A more reactive non-metal will displace less reactive non-metal from its salt solution.

(e) Reaction with chlorine: Non-metals react with chlorine to form chloride.
e.g., $H_2 + Cl_2 \longrightarrow 2HCl$

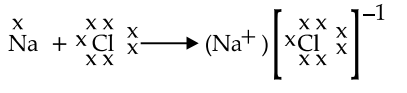
(f) Reaction with hydrogen: Non-metals reacts with hydrogen to form hydrides.
e.g., $H_2 + S \longrightarrow H_2S$

➢ **Reaction between metals and non-metals:**

- Reactivity of an element is the tendency to attain a completely filled valence shell.
- Atoms of metals can lose electrons from valence shells to form cations while atoms of non-metals can gain electrons in valence shell to form anions.
- Opposite charged ions attract each other and held by strong electrostatic forces of attraction forming ionic compounds.

➢ **Formation of Sodium Chloride**

$Na \longrightarrow Na^+ + e^-$
2, 8, 1 2, 8
(Sodium cation)
$Cl + e^- \longrightarrow Cl^-$
2, 8, 7 2, 8, 8
(Chloride anion)



or NaCl

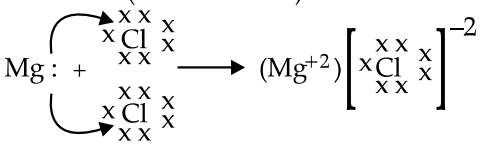
- **Formation of Magnesium Chloride**

$$\underset{2,8,2}{Mg} \longrightarrow \underset{2,8}{Mg^{2+}} + 2e^-$$

(Magnesium cation)

$$\underset{2,8,7}{Cl} + e^- \longrightarrow \underset{2,8,8}{Cl^-}$$

(Chloride anion)



or $MgCl_2$

- **Extraction of Metals:**

Scenario	Example
Low in the activity series	$2HgS(s) + SO_2(g) \xrightarrow{Heat} 2HgO(s) + 2SO_2(g)$ $2HgS(s) \xrightarrow{Heat} 2Hg(l) + 2S(g)$ $2Cu_2S(s) + 3O_2(g) \xrightarrow{Heat} 2Cu_2O(s) + 2SO_2(g)$ $2Cu_2O(s) + Cu_2S(s) \xrightarrow{Heat} 6Cu(s) + SO_2(g)$
Middle in the activity series	**Roasting:** $2ZnS(s) + 3O_2(g) \xrightarrow{Heat} 2ZnO(s) + 2SO_2(g)$ **Calcination:** $ZnCO_3(s) \xrightarrow{Heat} ZnO(s) + CO_2(g)$
Top in the activity series	**During Electrolysis:** At cathode $Na^+ + e^- \longrightarrow Na$ At anode $2Cl^- \longrightarrow Cl_2 + 2e^-$

- **Corrosion:** It is the deterioration of a metal as a result of chemical reaction between it and surrounding environment. e.g.,

  (i) Silver reacts with sulphur in air to form silver sulphide and articles become black.

  (ii) Copper reacts with moist carbon dioxide in air and forms green coat of copper carbonate.

  (iii) Iron acquires a coating of brown flaky substance called rust. Rust is hydrated Iron (III) oxide, i.e., $Fe_2O_3.\ xH_2O$.

- **Prevention of corrosion:** By painting, oiling, greasing, galvanizing and by making alloys.
- **Galvanisation:** It is the process of coating of iron articles with zinc. The oxide thus formed is impervious to air and moisture, thus protects further layers from getting corroded.
- **Alloys:** These are homogenous mixture of metals with metals and non - metals. e.g., stainless steel, brass, bronze and solder.
- **Amalgam:** If one of the metals in alloy is mercury, then the alloys are known as amalgam.
- **Some important balanced equations usually asked:**

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

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

  (c) $ZnO(s) + C(s) \xrightarrow{Heat} Zn + CO$

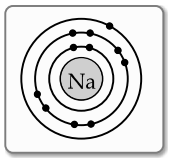
  (d) $2HgS(s) + 3O_2(g) \xrightarrow{Heat} 2HgO(s) + 2SO_2(g)$

  (e) $3MnO_2(s) + 4Al(s) \xrightarrow{Heat} 3Mn(s) + 2Al_2O_3(s)$

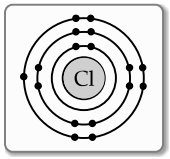
➢ Important Diagrams:

- **Electron dot structure**

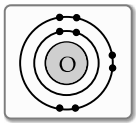
Sodioun (Na) – 2, 8, 1



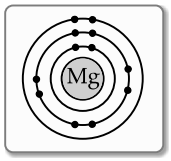
Chlorine (Cl) – 2, 8, 7



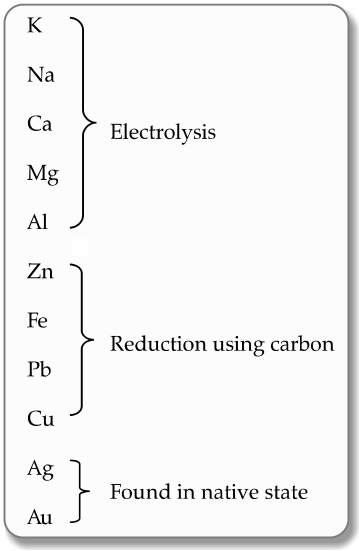
Oxygen (O) – 2, 6



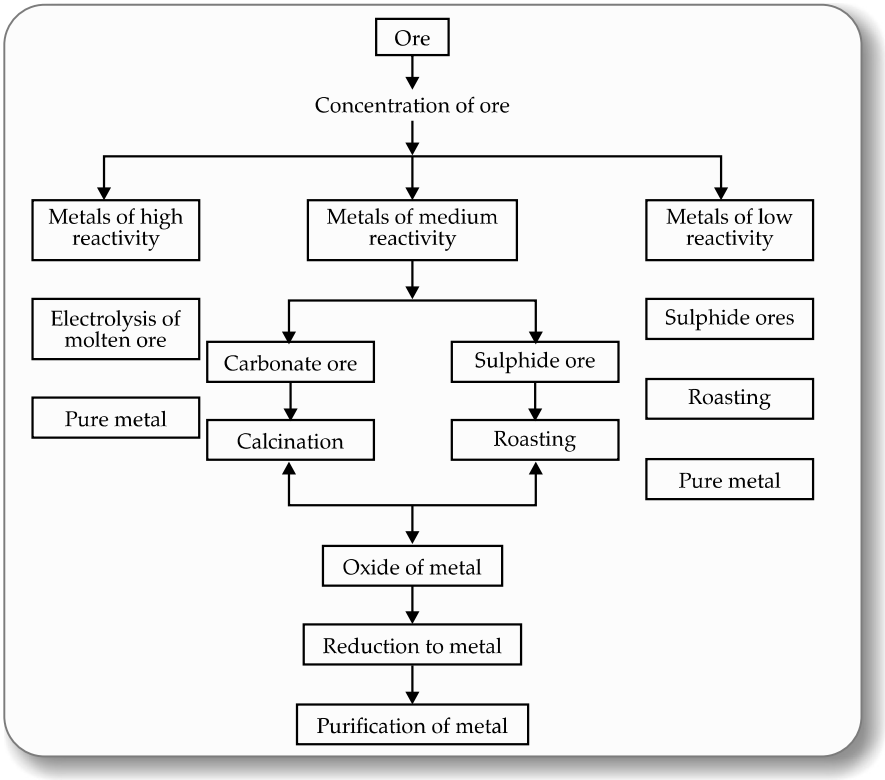
Magnesium (Mg) – 2, 8, 2



- **Activity Series and related metallurgy**



- **Extraction of metals from ores**



CHAPTER 4: Carbon Compounds

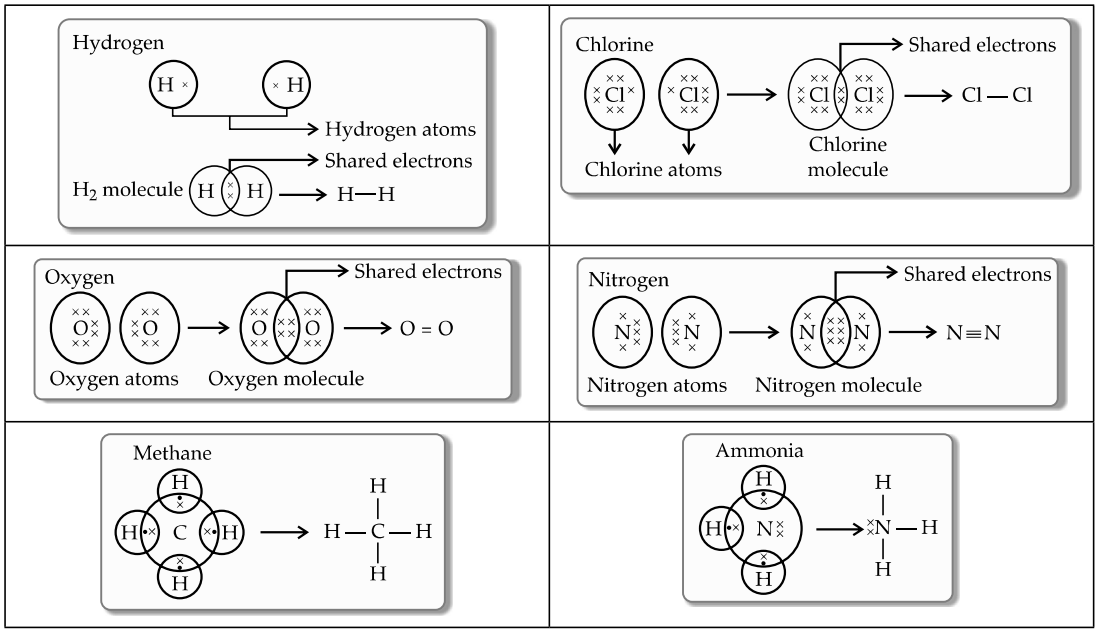
Key Points and Concepts

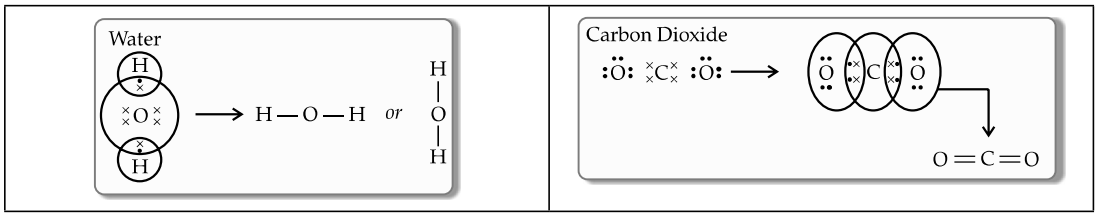
- Carbon is a tetravalent non-metal. It forms covalent bond. It is because:
  - The atomic number of carbon is 6 and its electronic configuration is 2, 4.
  - So, to attain a noble gas configuration it requires four more electrons in its valence shell.
  - Carbon attains the noble gas configuration by sharing its valence electrons with other atoms. Such mutual sharing of electrons between atoms to attain a stable noble gas configuration is called covalent bonding.
- Carbon compounds are mostly covalent compounds formed by the sharing of the outermost electrons.
- Properties of carbon which enable it to form enormously large number of compounds are catenation and tetravalency.
- **Catenation** is the property of carbon atom to form covalent bonds with other atoms of carbon.
- **Tetravalency:** Carbon requires 4 electrons to form tetravalent. It is because it has a valency of 4. As a result, carbon atom is capable of bonding with atoms of oxygen, hydrogen, nitrogen, sulphur, chlorine and other elements. The smaller size of carbon atom enables nucleus to hold the shared pair of electrons strongly, thus carbon compounds are very stable in general.

- **Covalent and Ionic Compounds:**

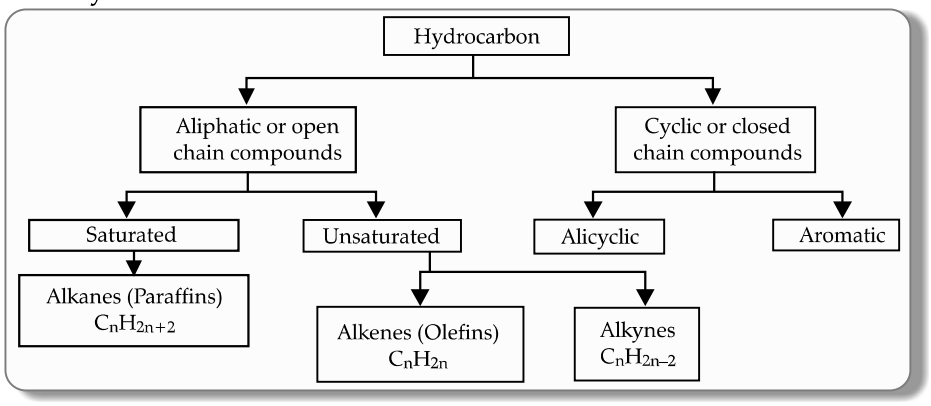
S. No.	Covalent Compounds	Ionic Compounds
1.	They are readily soluble in organic solvent.	They are not soluble in organic solvent.
2.	They do not ionise.	They ionise in organic medium.
3.	They are bad conductors of heat and electricity.	They are good conductors of heat and electricity.
4.	They have weak force of attraction between the molecules.	They have strong force of attraction between the molecules.

- **Formation of Molecules:**





➢ **Classification of Hydrocarbons:**



➢ **IUPAC Nomenclature:**

- **Some Common Alkanes:** Formula for Alkane: C_nH_{2n+2}

No. of carbon atoms	Name	Molecular formula	Molecular Mass (u)
1	Methane	CH_4	16
2	Ethane	C_2H_6	30
3	Propane	C_3H_8	44
4	Butane	C_4H_{10}	58
5	Pentane	C_5H_{12}	72
6	Hexane	C_6H_{14}	86
7	Heptane	C_7H_{16}	100
8	Octane	C_8H_{18}	114
9	Nonane	C_9H_{20}	128
10	Decane	$C_{10}H_{22}$	142

- **Alkyl Group:**

Alkyl group—C_nH_{2n+1}	Derived from Alkane	Name of Alkyl group
— CH_3	Methane	methyl
—C_2H_5	Ethane	ethyl
—C_3H_7	Propane	propyl
and so on		

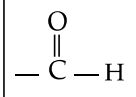
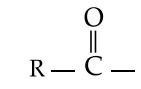
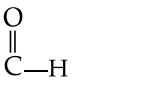
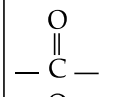
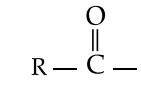
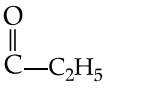
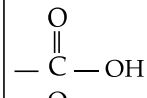
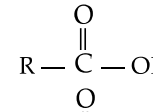
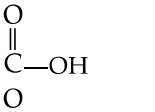
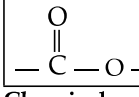
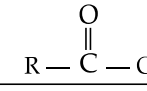
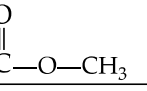
- **Homologous Series of Alkene:** Formula for Alkene: C_nH_{2n}

No. of carbon atoms	Name of the Alkene	Molecular formula
2	Ethene	C_2H_4
3	Propene	C_3H_6
4	Butene	C_4H_8
5	Pentene	C_5H_{10}

- **Homologous Series of Alkyne:** Formula for Alkyne: C_nH_{2n-2}

No. of carbon atoms	Name of the Alkyne	Molecular formula
2	Ethyne	C_2H_2
3	Propyne	C_3H_4
4	Butyne	C_4H_6
5	Pentyne	C_5H_8

- **Common Functional Groups:**

Functional group	Class	General Formula	Example
> C = C <	Alkene	C_nH_{2n}	$H_2C = CH_2$
— C ≡ C —	Alkyne	C_nH_{2n-2}	HC ≡ CH
— X (F, Cl, Br, I)	Haloalkane	R—X	CH_3—Cl
—OH	Alcohol	R—OH	CH_3—OH
	Aldehyde		
	Ketones		
	Carboxylic acid		
	Ester		

➢ **Chemical properties of carbon compounds:**

(a) Combustion: Carbon compounds burn in air to give carbon dioxide, water, heat and light.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{heat} + \text{light}$$

(b) Oxidation: Alcohols can be converted to carboxylic acids by oxidizing them with alkaline $KMnO_4$.

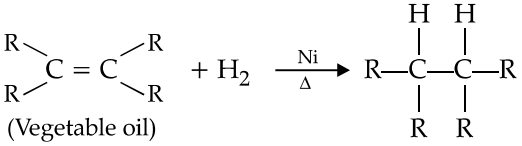
$$CH_3 - CH_2OH \xrightarrow[\text{Or acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

Alkaline $KMnO_4$ add oxygen to the reactant thus, are called oxidising agent.

(c) Addition reactions: Unsaturated hydrocarbons (alkene, alkyne) undergo addition reactions. They add hydrogen in the presence of catalyst nickel and palladium to give saturated hydrocarbons.

$$CH_2{=}CH_2 + H_2 \xrightarrow[\text{Heat}]{\text{Ni/Pd}} CH_3{-}CH_3$$

Addition reaction is commonly used in hydrogenation of vegetable oil using nickel catalyst. Addition of hydrogen at the multiple bond is known as hydrogenation process. This process is used for making vegetable ghee from oil.



(Vegetable oil) (Vegetable ghee)

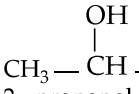
(d) Substitution reaction: Saturated hydrocarbons undergo substitution reaction in the presence of sunlight.

$$CH_4 + Cl_2 \xrightarrow{h\nu} CH_3Cl + HCl \text{ (in the presence of sunlight)}$$

A chain reaction is initiated in the presence of sunlight. One hydrogen atom is replaced by Cl group at each step resulting in the formation of CH_2Cl_2, $CHCl_3$, CCl_4.

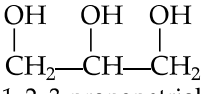
- **Some Common Alcohols:**

CH_3OH
Methanol



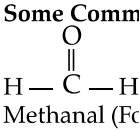
2 - propanol (Rubbing alcohol)

C_2H_5OH
Ethanol

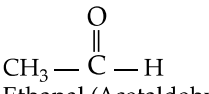


1, 2, 3-propanetriol (Glycerine)

- **Some Common Aldehydes:**

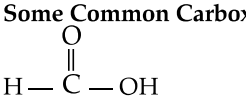


Methanal (Formaldehyde)

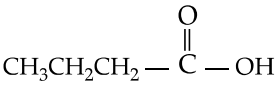


Ethanal (Acetaldehyde)

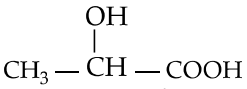
- **Some Common Carboxylic Acids:**



Formic acid (From ants)

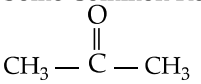


Butyric acid
(Present in rancid butter)

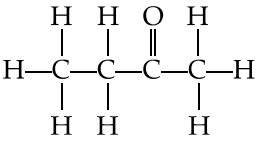


Lactic acid

- **Some Common Ketones:**

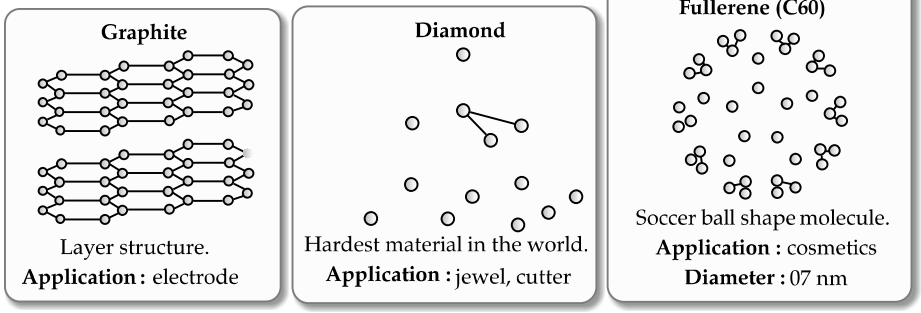


Propanone (Acetone)



Butanone

- **Graphite, Diamond and Fullerene:**



➢ **Ethanol:**

Chemical properties:

(a) Reaction with sodium: Formation of sodium ethoxide and hydrogen.

e.g., $2CH_3CH_2OH + 2Na \longrightarrow 2CH_3CH_2ONa + H_2$

(b) Reaction with acid: Formation of ester (ethyl ethanoate) – a sweet smelling ester. This process is called as esterification.

$$CH_3COOH + CH_3CH_2OH \underset{}{\overset{\text{conc. } H_2SO_4}{\rightleftharpoons}} CH_3COOCH_2CH_3 + H_2O$$

Uses of ethanols: In preparation of soap, cosmetics, in alcoholic beverages, in medicines, and in laboratory reagent.

➢ **Ethanoic acids:**

- **Vinegar:** 5-8 % solution of acetic acid in water.
- **Glacial acetic acid:** Pure acetic acid.

➢ **Properties of ethanoic acid:**

(a) Reaction with sodium carbonate:

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$$

(b) Reaction with sodium hydrogen carbonate:

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

Brisk effervescence marks the presence of carboxylic acid.

(c) Reaction with NaOH:

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

(d) Reaction with ethanol (Esterification):

$$CH_3COOH + CH_3CH_2OH \underset{}{\overset{\text{conc. } H_2SO_4}{\rightleftharpoons}} CH_3COOCH_2CH_3 + H_2O$$

On hydrolysis, ester gives parent alcohol and sodium salt of carboxylic acid. Alkaline hydrolysis of ester is called **saponification**.

➢ **Soap and detergents:**

- A soap is the sodium or potassium salt of long chain of fatty acids, which has the cleansing properties.
- Soap are made by saponification process. It has two ends, one is hydrophilic and other is hydrophobic.
- When soap is dissolved in water, micelle formation takes place. The hydrophobic end attach itself to dirt particle and remove it from the cloth.
- A detergent is the sodium salt of long chain benzene sulphonic acid.
- **Scum:** The magnesium and calcium salts present in hard water reacts with soap molecule to form insoluble products called scum. This obstructs the cleansing action.
- Use of detergents overcome this problem as the detergent molecule prevents the formation of insoluble product and thus clothes get cleaned.

●●

CHAPTER 5 : Life Processes

Key Points and Concepts

- **Life processes:** These are the basic functions performed by living organisms for their survival and body maintenance.
- Life processes includes Nutrition, Respiration, Transportation, Excretion, etc.
- **Nutrition:** There are two modes of nutrition: autotrophic and heterotrophic.
- **Photosynthesis:** It is the process by which green plants make their own food with the help of CO_2 and H_2O in the presence of chlorophyll and sunlight.
- **Raw Materials for Photosynthesis** are carbon dioxide and water.
- **Site of Photosynthesis** is chloroplast in the leaf. Chloroplast contain a green colour pigment called chlorophyll.
- **Main Events of Photosynthesis:**
  - Absorption of light energy by chlorophyll.
  - Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.
  - Reduction of CO_2 to form carbohydrates.
- **Stomata** are tiny pores present on the surface of the leaves. Exchange of gases and transpiration takes place through stomata.
- The opening and closing of stomata is a function of the guard cells.
- **Heterotrophic nutrition is of three types:** Holozoic (e.g., *Amoeba*, animals), Saprophytic (e.g., fungi) and Parasitic (e.g., *Cuscuta*, ticks and mites).
- **Nutrition in *Amoeba*:** *Amoeba* takes in food using temporary finger-like extensions of the cell surface (known as pseudopodia), which fuse over the food particle forming a food-vacuole.
- **Human digestive system:** In humans, digestion begins from the mouth and gets completed in small intestine.
- **Respiration:** It is a process in living organisms involving the production of energy.
- **There are two modes of respiration:** Aerobic (in the presence of oxygen) and anaerobic (in the absence of oxygen).
- **Human Respiratory System:** It involves the passage of air through the respiratory system.
- **Mechanism of Breathing:** It involves two processes: Inhalation and exhalation.
- In human beings, oxygen is transported by haemoglobin. Haemoglobin is a respiratory pigment present in RBCs, which have a very high affinity for oxygen.
- Terrestrial organism uses atmospheric oxygen for respiration.
- Aquatic organisms uses oxygen dissolved in water.
- **Respiration in Plants:** Gaseous exchange occur through stomata in leaves, lenticels in stems, general surface of the roots and transpiration.
- The **circulatory system** in human beings consists of a circulatory medium (blood and lymph), blood vessels (veins, arteries and capillaries) and heart.
- Humans have double circulation. In this, the blood travels twice through the heart in one complete cycle of the body.
- **Pulmonary circulation:** Blood moves from the heart to the lungs and back to the heart.
- **Systemic circulation:** Blood moves from the heart to rest of the body and back to the heart.
- **Blood** is a fluid connective tissue. It comprises four components– Plasma, RBCs, WBCs, and platelets.
- **Lymph** is a yellowish fluid that escapes from the blood capillaries into the intercellular spaces. Lymph flows from the tissues to the heart assisting in transportation and destroying germs.
- **Transportation** in plants occurs via xylem and phloem.
- **Xylem** carries water and minerals from roots to other parts of plants while phloem carries food from leaves to other parts of the plants.
- **Transpiration** is the process by which plants lose water in the form of vapours.
- **Translocation** is the transport of food from leaves (food factory) to different part of the plant.
- The process of the removal of the harmful metabolic wastes from the body is called **excretion.**
- Excretory system of human beings includes a pair of kidney, a urinary bladder, a pair of ureter and a urethra.
- Kidney removes waste product from the blood i.e., urea which is produced in the liver.
- **Nephron** is the structural and functional unit of kidney.
- The urine formation involves three steps: Glomerular filtration, tubular re-absorption and secretion.
- **Hemodialysis** is the process of purifying blood by an artificial kidney. It is meant for kidney failure patient.

Important concepts

- **Function of blood vessels:**

S. No.	Blood vessels	Function
1.	Arteries	They carry blood away from the heart to various organs of the body.

2.	Veins	They collect the blood from different organs and bring it back to the heart.
3.	Capillaries	Exchange of material between the blood and surrounding cells takes place across the thin walls of capillaries.

➢ **Arteries and Veins:**

S. No.	Arteries	Veins
1.	They are thick walled.	They are thin walled.
2.	Arteries have no valves.	They have valves.
3.	Carry oxygenated blood except pulmonary artery.	Carry deoxygenated blood except pulmonary vein.

➢ **Glands and their Secretions:**

S. No.	Name of the Gland	Secretion (*s*)
1.	Salivary glands	Saliva contains enzyme named ptyalin.
2.	Gastric glands	Secretes gastric juice, HCl, mucus and pepsin.
3.	Liver	Bile juice.
4.	Intestinal glands	Intestinal juice.
5.	Pancreas	Pancreatic juice which contains trypsin, lipase and amylase.

➢ **Aerobic and Anaerobic Respiration:**

S. No.	Aerobic Respiration	Anaerobic Respiration
1.	It takes place in the presence of oxygen.	It takes place in the absence of oxygen.
2.	Products obtained are CO_2 and H_2O.	Products obtained vary.
3.	More energy is produced.	Less energy is produced.

➢ **In human, air takes the following path:**

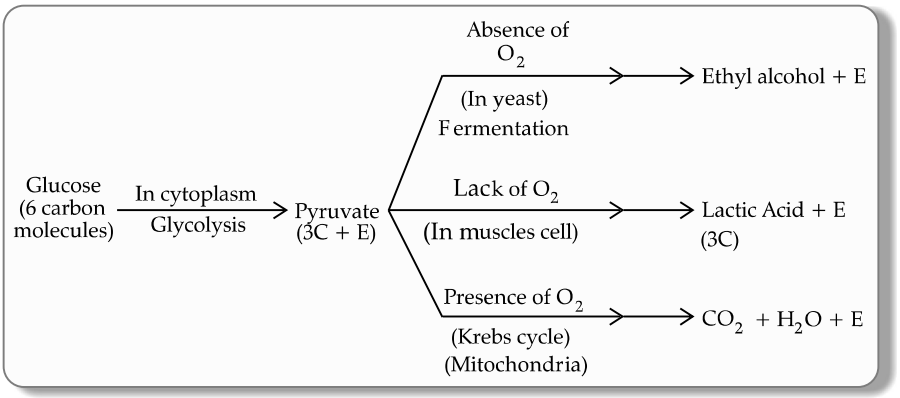
Nostrils → Nasal passage → Pharynx → Larynx → Trachea → Bronchus → Bronchiole → Alveolus.

➢ **Important Equations:**

- **Photosynthesis Process:**

$$6CO_2 + 6H_2O \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2\uparrow$$

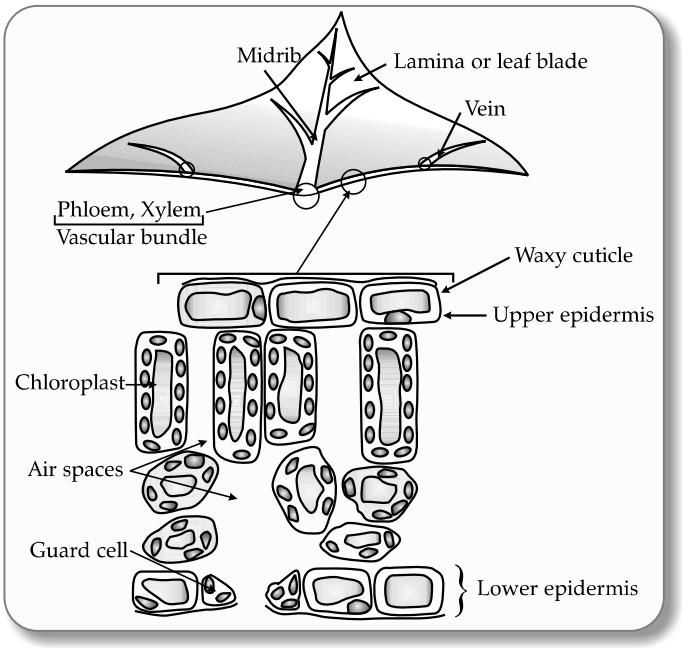
- **Glucose Breakdown**



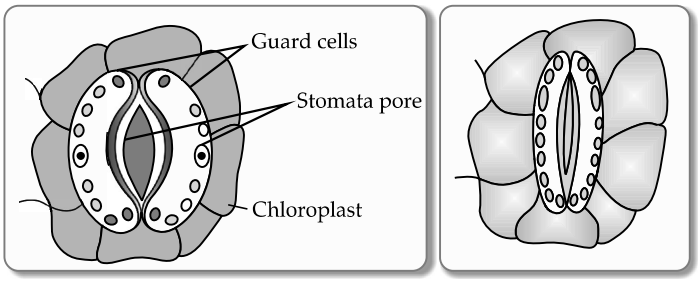
- **Note:** E is energy.

➢ **Important Diagrams:**

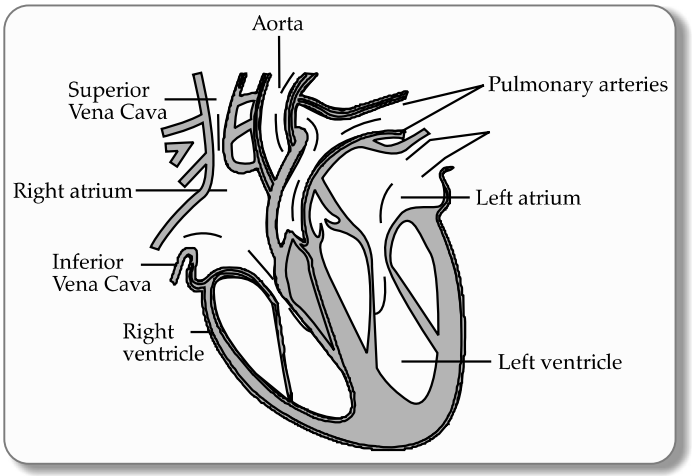
- **Cross-sections of a Leaf:**



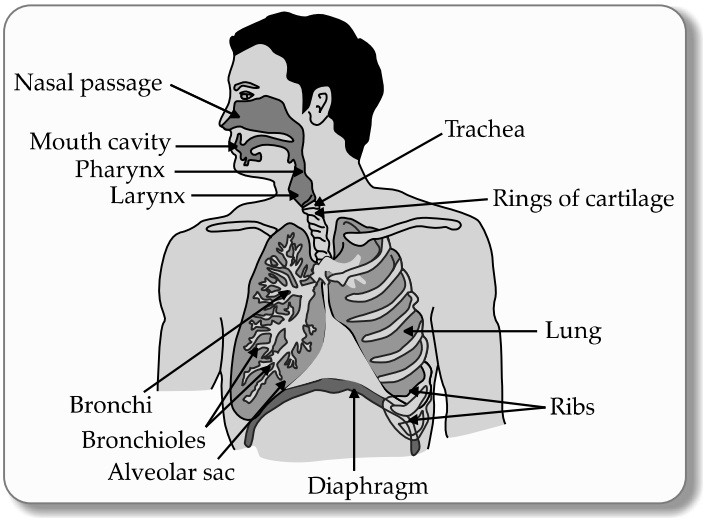
- **Open and Closed Stomatal Pore:**



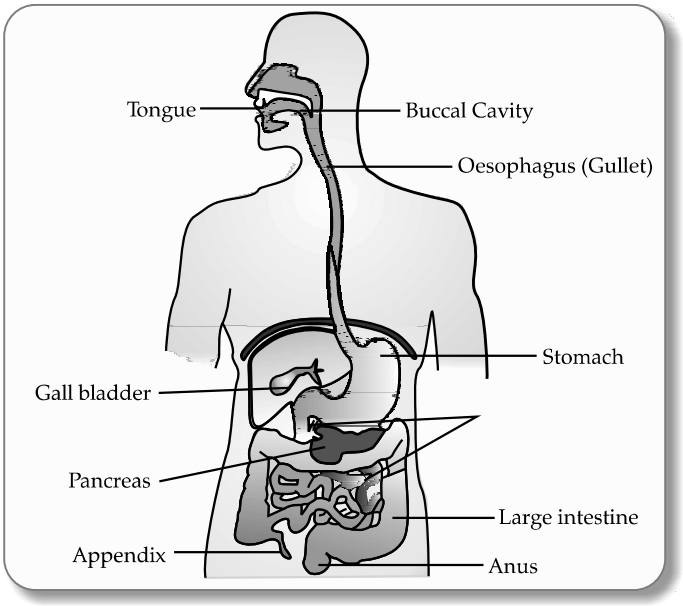
- **Cross-section of Human Heart:**



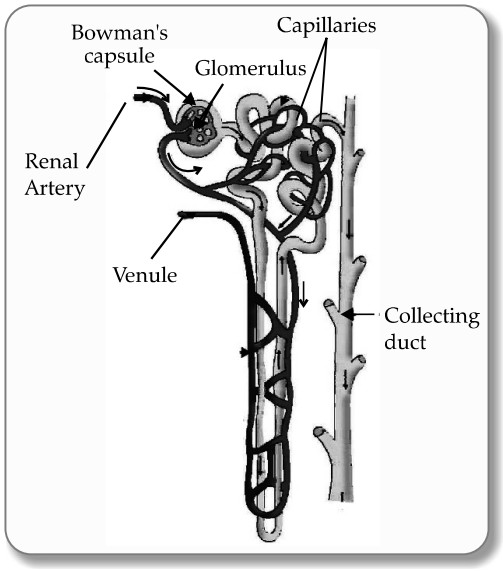
- **Human Respiratory System:**



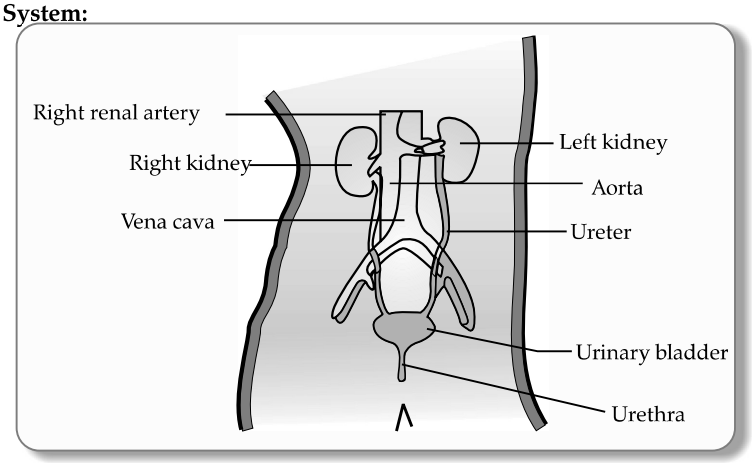
- **Human Alimentary Canal:**



- **Excretory Unit of Human Kidney:**



- **Human Excretory System:**

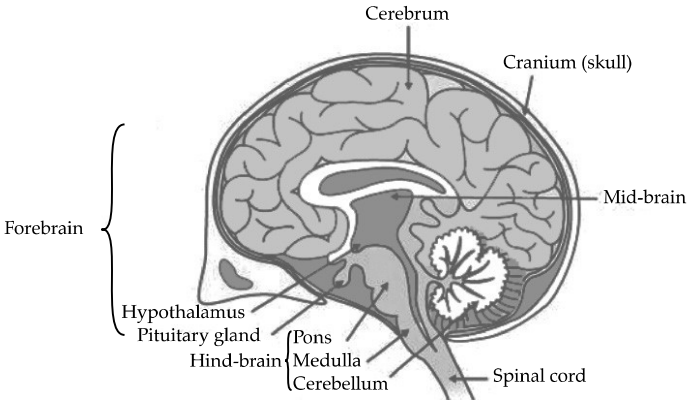


CHAPTER 6: Control and Co-ordination in Animal and Plants

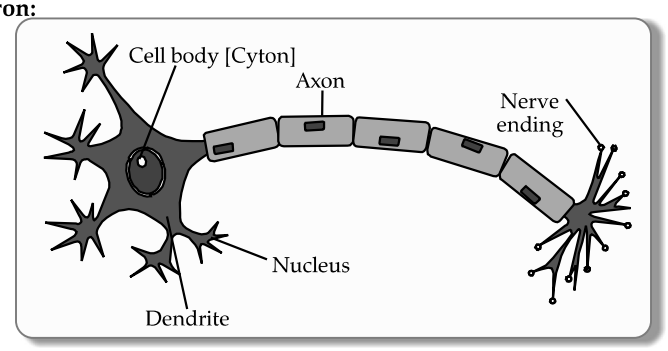
Key Points and Concepts

- Control and co-ordination are the functions of the nervous system and hormones in our bodies.
- The structural and functional unit of nervous system is neuron.
- **Structure of a neuron:** It comprises soma (cell body), the axon (a long slender projection that conducts electrical impulses away from the cell body), dendrites (tree-like structures that receive messages from other neurons), and synapses (specialised junctions between neurons).
- The axon (nerve fibre) transmits electrical signals from the cell body. The dendrites are branching fibres that receive electrical signals from other neurons.
- Synapse is the point of contact between the terminal branches of axon of one neuron with the dendrite of another neuron.
- Reflex action is an automatic response of the body to a stimulus. e.g., withdrawal of hand, knee jerk etc. on touching a hot plate.
- Reflex arc is the pathway taken by nerve impulses in a reflex action.
- **Stimulus:** Any change in environment to which the organisms respond is called stimulus. e.g., touching a hot plate.
- **Response:** The reaction of our body to a stimulus. e.g., withdrawal of our hand on touching hot plate.
- The human nervous system is divided into the central nervous system (CNS) and the peripheral nervous system (PNS).
- CNS consists of the brain and the spinal cord. The spinal canal contains the spinal cord, while the cranial cavity contains the brain.
- The human brain is the command center for the human nervous system. It receives input from the sensory organs and sends output to the muscles.
- It is enclosed in cranium (brain box) and is protected by cerebrospinal fluid which acts as a shock absorber. It has several layers called meninges.
- Human brain has three major parts or regions: **(a)** Forebrain **(b)** Midbrain **(c)** Hindbrain.
- The most complex and specialised part of the brain is cerebrum or the forebrain.
- Mid brain connects the forebrain with the hindbrain. It is the portion of the central nervous system associated with vision, hearing, motor control, sleep/wake, arousal (alertness), and temperature regulation.
- Hind-brain includes cerebellum, medulla, and pons.
- Spinal cord is enclosed in the vertebral column.
- **Coordination in plants:** Plants show two different types of movement – one dependent on growth and the other independent of growth.
- Movement dependent growth are tropic movement. They are directional movement in response to stimulus.
- It includes phototropism (towards light), geotropism (towards gravity), chemotropism (towards chemicals) and hydrotropism (towards water).
- Movement independent growth are immediate response to stimulus. e.g., Drooping of leaves of Touch-me-not plants on touching it. This is known as thigmotropism.
- Plant hormones are chemical compounds which help to coordinate growth, development and responses to the environment.

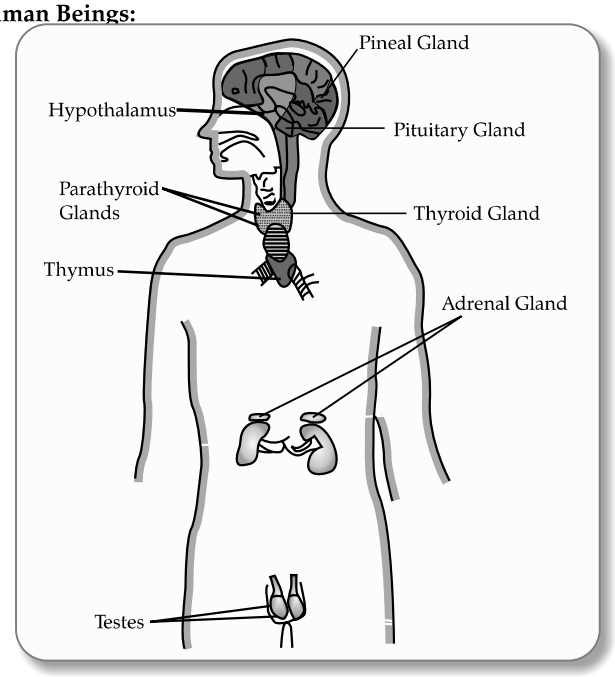
- Main plant hormones are: Auxin, Gibberellin, Cytokinins, and Abscisic acid.
- Hormones in animals are the chemical substances secreted by the endocrine glands. They are transmitted by the blood to the tissues on which it has a specific effect.
- Thyroid gland needs iodine to make thyroxine which helps in regulating the metabolism of carbohydrates, fats and proteins.
- Deficiency of iodine causes a disease called goitre.
- Deficiency of insulin causes diabetes.
- Diabetes can be treated by injecting insulin hormone in the patient's body.
- The excess or deficiency of hormones has a harmful effect on our body. Feedback mechanism makes sure that hormones are secreted in precise quantities and at right time. For example, if the sugar levels in blood rise, they are detected by the cells of the pancreas which respond by producing more insulin. As the blood sugar level falls, insulin secretion is reduced.
- **Important Graphs and Diagrams:**
  - **Human Brain:**



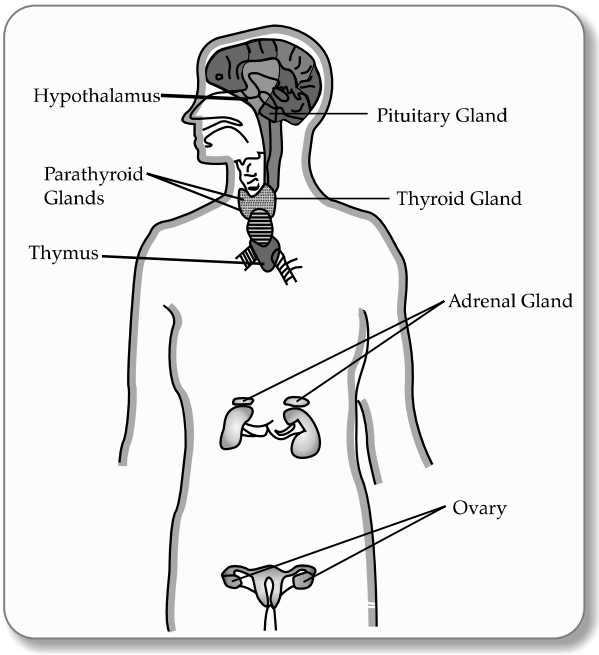
  - **Structure of Neuron:**



- **Endocrine Glands in Human Beings:**



Male



Female

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CHAPTER 7: Reproduction

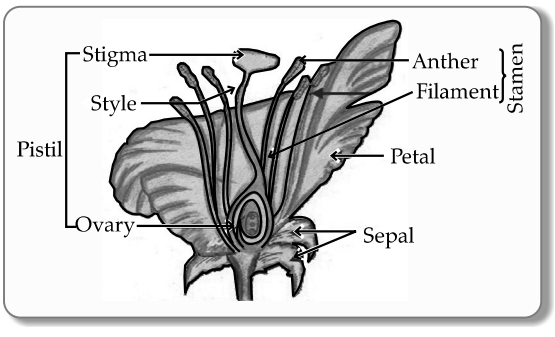
Key Points and Concepts

- **Sexual and Asexual Reproduction:**

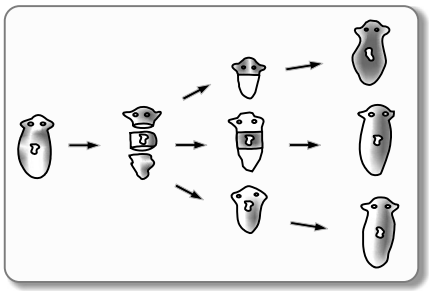
S. No.	Sexual Reproduction	Asexual Reproduction
1.	It produces new organism from two parents. *i.e.,* it is biparental.	It produces new organism from a single parent. i.e., it is uniparental.
2.	It involves sex cells or gametes.	It does not involve sex cells or gametes.
3.	Offsprings are not identical to the parents.	Offsprings are identical to the parents.

- Asexual reproduction takes place through fission, fragmentation, budding, vegetative propagation and spore formation.
- **Advantages of Vegetative Propagation:**
  - **(a)** Plants raised by vegetative reproduction can bear flowers and fruits earlier than those produced from seeds.
  - **(b)** This process helps those plants to propagate that have lost the capacity to reproduce.
  - **(c)** It is a quicker method of multiplication.
  - **(d)** It helps to preserve good qualities of a variety or race indefinitely.
- Humans use sexual mode of reproduction.
- The formation of male germ cell (sperms) takes place in the testes. Testes are located outside the abdominal cavity in scrotum.
- Scrotum has a relatively low temperature needed for the production of sperms by testes.
- Testes release a male sex hormone called testosterone. It regulates the production of sperm and bring about changes in appearance seen in boys at the time of puberty.
- 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.
- The female germ cells or eggs are produced in the ovaries.
- One egg is produced every month by one of the ovaries.
- Fertilization occurs in the fallopian tube of female genital tract.
- The fertilized egg also called zygote ($2n$) gets implanted in the lining of the uterus, and starts dividing. Actually uterus is richly supplied with blood to nourish the growing embryo. If zygote is not formed, the inner wall of uterus breaks which causes bleeding through vagina. This process is called menstruation.
- The embryo gets nutrition from the mother's blood with the help of a special tissue called placenta.

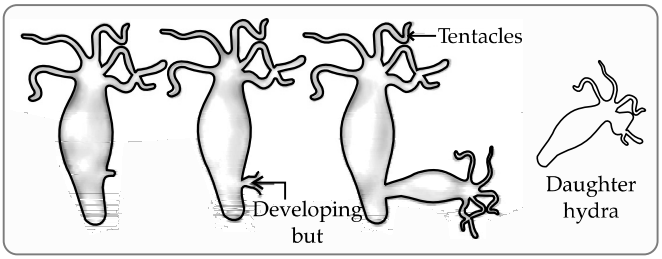
- **Functions of placenta:**
  - It provides a large surface area for glucose and oxygen to pass from the mother to the embryo.
  - The wastes from developing embryo are removed to mother's blood through placenta.
- The time period from fertilization upto the birth of the baby is called Gestation Period. In humans, it is about nine months (36 weeks).
- Reproductive Health is total well-being in all aspects of reproductive, i.e., physical, emotional, social and behavioural.
- **Contraception:** It is the avoidance of pregnancy.
- **Methods of Contraception:**
  - **(i) Barrier method:** In this method, a mechanical device is used to prevent the entry of sperms in the female genital tract during sexual intercourse.
    Example: Condom, diaphragm, cervical cap, vault cap and femidom etc.
  - **(ii) Chemical method:** It involves the use of specific drugs by females.
    Example: Oral pills, vaginal pills, OC.
  - **(iii) Surgical method:** It involves surgical removal or ligation of vas deferens in males and the fallopian tube in females, thereby preventing passage of male and female gametes through the corresponding genital tract.
- **STD (Sexually Transmitted Diseases):**
  Disease caused by virus—AIDS, Genital warts and herpes.
  Disease caused by bacteria—Gonorrhea, Syphilis.
- **Prevention of STDs:**
  - **(a)** By using contraceptive devices.
  - **(b)** By educating people and maintaining hygiene.
  - **(c)** By avoiding sex with unknown/multiple partners.
- Sexual Reproduction in plants takes place in flowers. Flower is the reproductive organ of plants.
- A typical flower consists of four main whorls namely Calyx (Sepals), Corolla (Petals), Androecium (Stamens) and Gynoecium (Carpels).
- Flowers can be of two types: Unisexual (e.g., papaya) and bisexual (e.g., Hibiscus).
- Pollination is the transfer of pollen grain from anther to stigma. It is of two types: self-pollination and cross-pollination.
- The transfer of pollens is achieved by agent like wind, water or animals.
- After pollination, a pollen tube grows out of pollen grains, through which male germ cell reaches the ovary and fuses with the female germ cell.
- Fertilization is the process of fusion of male and female gamete to produce zygote. It occurs inside the ovary.
- **After fertilization:**
  - **(i)** Zygote divides several times to form an embryo within the ovule.
  - **(ii)** The ovule develops a tough coat and is converted into a seed.
  - **(iii)** Ovary ripens to form a fruit.
  - **(iv)** Sepal, petals, stamens, style and stigma may shrivel off.
  - **(v)** The seed contains the future plant or embryo which develops into a seedling under suitable condition. This process is known as Germination.
  - **DNA Copying:**
    - **(i)** Cells use chemical reactions to build copies of their DNA. This creates two copies of the DNA in a reproducing cell. DNA copying is accompanied by the creation of an additional cellular apparatus to facilitate the DNA copies to separate with its own cellular apparatus.
    - **(ii)** DNA copying gives rise to variation during reproduction which is the basis for evolution.
- **Important Graphs and Diagrams:**
  - **Longitudinal Section of a flower:**



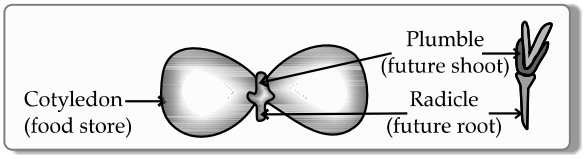
- **Regeneration in Planaria:**



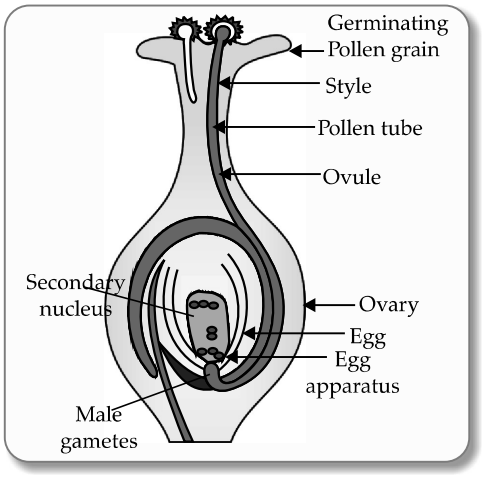
- **Budding in Hydra:**



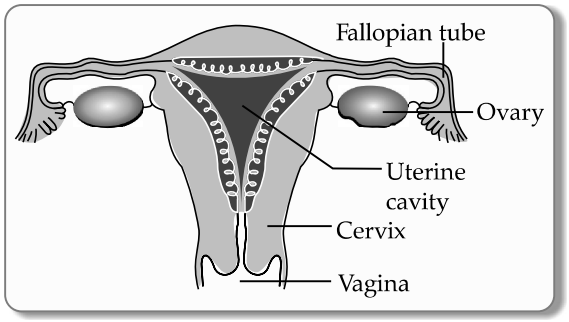
- **Germinated Seed:**



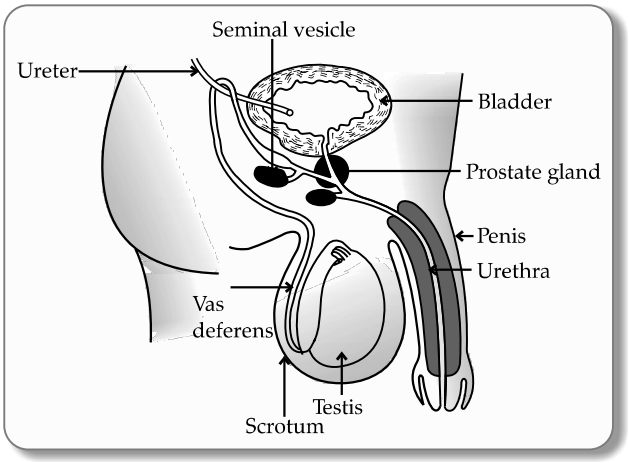
- **Germination of pollen on stigma:**



- **Human Female Reproductive System:**



- **Human Male Reproductive System:**



CHAPTER 8: Heredity and Evolution

Key Points and Concepts

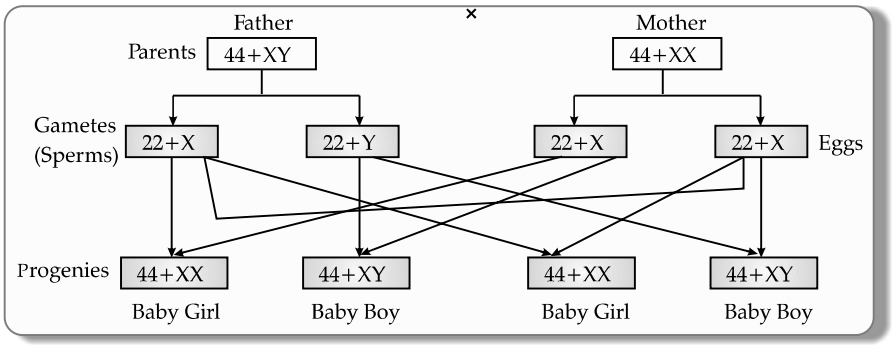
- Tendency of similarity between parents and offsprings is called heredity.
- The transmission of traits from one generation to the next with the help of genes is the mechanism of heredity.
- **Acquired and Inherited Traits:**

S. No.	Acquired Traits	Inherited Traits
1.	The traits that develop during the lifetime of an individual.	The traits that are obtained from the parents.
2.	They are somatic variations and die with the death of the individual.	They are genetic variations which are transmitted to the next generation.
3.	*e.g.* Muscular body of wrestler.	*e.g.* Fused and free ear lobes.

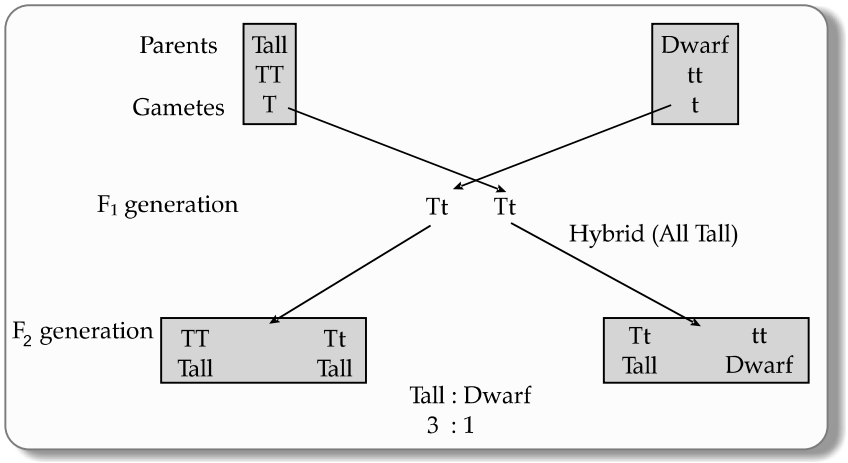
- Genetic drift and natural selection could lead to the rise of new species.
- **Mendel and His Work on Inheritance:**
  - Gregor Johann Mendel started his experiments on plant breeding and hybridization.
  - He proposed the laws of inheritance in living organisms.
  - Mendel was known as Father of Genetics.
  - The plant selected by Mendel was *Pisum sativum* (garden pea).
  - Mendel used seven pairs of contrasting characters in garden pea.
- In case of monohybrid cross with pure variety of plants, the phenotypic ratio obtained in F_2 generation is 3: 1.
- In case of di-hybrid cross involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation is 9: 3: 3: 1.
- Genes carry information for synthesizing proteins, which in turn control the various body characteristics.
- Humans have 22 pairs of autosomes and one pair of sex chromosomes.
- Females have similar sex chromosomes XX, whereas males have dissimilar sex chromosomes *i.e.*, XY. All eggs carry X chromosome while sperms may have X or Y chromosome.
- The sex of the child depends on the type of sperm that fuses with the egg. If the egg fuses with the sperm carrying X chromosome, it results in a girl and if it fuses with the sperm carrying Y chromosome, it results in a boy.

➢ **Important Graphs and Diagrams:**

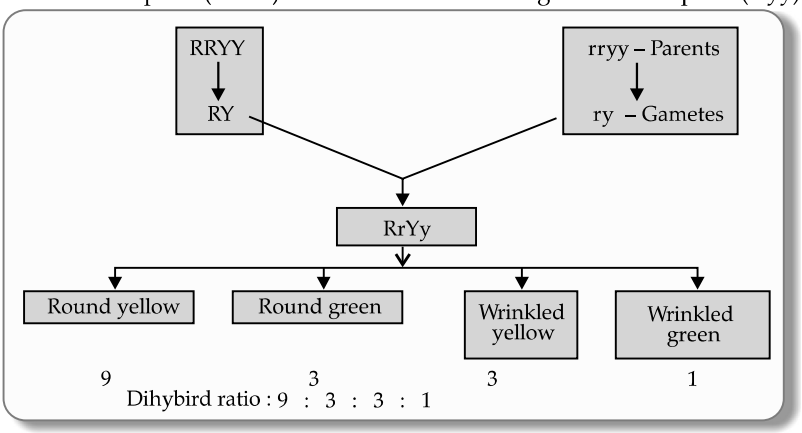
- **Determination of sex of a child:**



- **Work Done by Mendel:** Ratio of tall to dwarf plants in F_2 generation is 3: 1:



- Inheritance of two pairs of contrasted characters over two generations by making a cross between dominant round and yellow seeded plant (RRYY) with recessive wrinkled green seeded plant (rryy).



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CHAPTER 9: Light-Reflection and Refraction

Key Points and Concepts

➢ **Reflection of light:** When light ray falls on a highly polished surface, it bounces back in certain direction. This phenomenon is called reflection.

- **Laws of reflection of light:**
  - The incident ray, the reflected ray, and the normal at the point of incidence all lie in the same plane.
  - Angle of incident is always equal to angle of reflection *i.e.* angle i = angle r.
- **Real image:** Image which can be obtained on screen. Real image is formed when light rays falling on the surface actually meet at a point after reflection. Real image is inverted.
- **Virtual image:** Image which cannot be obtained on screen. Virtual image is erect. It is formed when light rays after reflection appears to pass through the point.
- **Image formed by plane mirror:**
  - Virtual, and erect. The image do not form on screen.
  - The image is laterally inverted.
  - Size of image is equal to that of object.
  - Image formed is far behind the mirror as the object is in front of it.
- **Spherical mirror:** Mirror who's reflecting surfaces are curved inward or outward spherically are called spherical mirror.
- Spherical mirror are of two types: concave (converging mirror) and convex (diverging mirror).
- Relation between radius of curvature (R) and focal length (f) is $f = R/2$.
- **Uses of concave mirror:**
  - Used in torch, search light, and in vehicle head lights to get powerful parallel beams of light.
  - Used as shaving mirror to see a larger image of the face.
  - Used by dentists to examine the larger images of the teeth of the patient.
  - Used in solar furnaces to concentrate sunlight to produce heat.
- **Uses of convex mirror:**
  - Convex mirror is used as rear view mirror in vehicles, because, they always give an erect image. It also enables the driver to view much larger area.
- **Magnification:** It is expressed as ratio of the height of the image to height of the object.
- **Refraction of light:** When light travel obliquely from one medium to another, the direction of propagation in the second medium changes. This phenomenon is known as refraction of light. Refraction is due to the change in speed of light when it travel from one transparent medium to another.
  - Speed of light decreases as the beam of light travel from rarer medium to the denser medium.
- **Laws of refraction of light:**
  - The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.
  - The ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media. This law is also known as Snell's law of refraction.

$$\frac{\sin i}{\sin r} = \text{constant}$$

  - The constant value is the refractive index for a given pair of medium. It is the refractive index of the second medium with respect to first medium.
- **Refractive index:** The refractive index of glass with respect to air is given by ratio of speed of light in air to the speed of light in glass.
  - Spherical lens is a transparent material bound by two surfaces, of which one or both surfaces are spherical.
- **Convex lens** is a lens bounded by two spherical surfaces, curved outwards. It is thicker at the middle. These are converging lens as it converges the light.
- **Concave lens** is a lens in which both the spherical surfaces are curved inward. Concave lens is diverging lens as it diverges the light.
- **Power of Lens:** It is defined as the reciprocal of its focal length.
- SI unit of power of a lens is "dioptre", denoted by 'D'.
- **Important Formulae and ray diagrams:**
  - **Mirror Formula:** $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$
  - **Lens Formula:** $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

- **Linear Magnification:**

$$m = \frac{v}{u} = \frac{h'}{h} \text{ (in lens)}$$

$$m = \frac{v}{u} = \frac{h'}{h} \text{ (in mirror)}$$

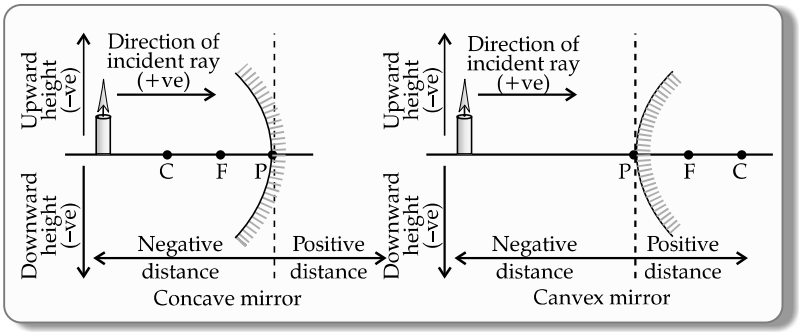
h = Height of object

h' = Height of image

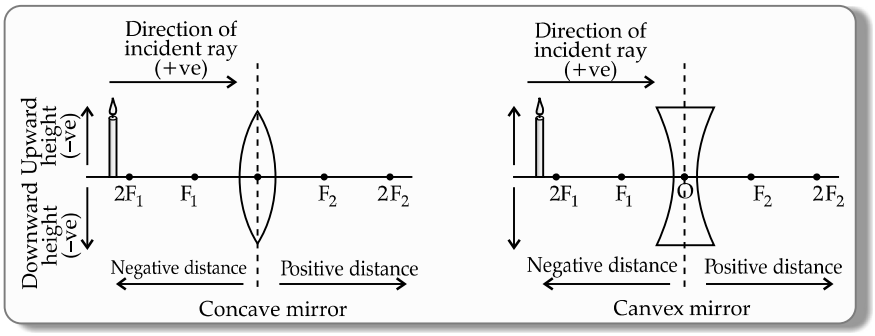
v = Image distance

u = Object distance

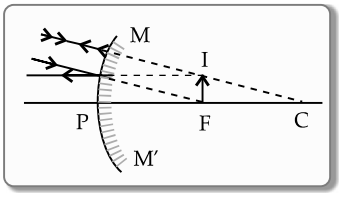
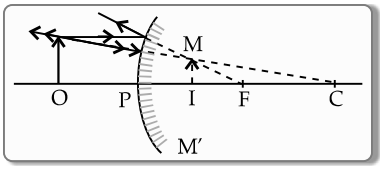
➢ **Sign Convention in Mirror:**



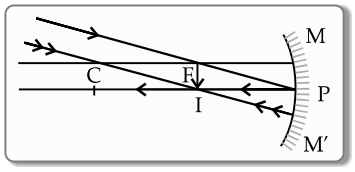
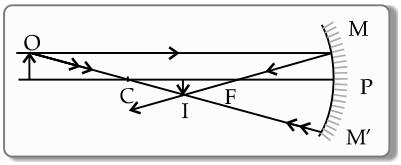
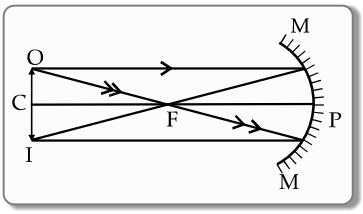
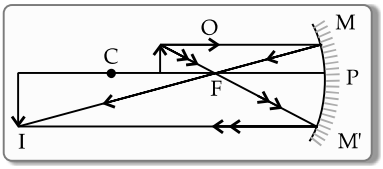
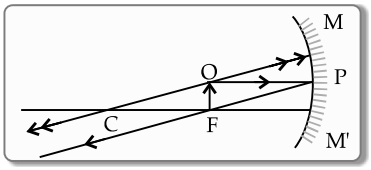
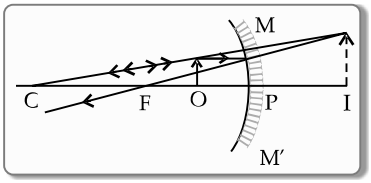
➢ **Sign Convention in Lens:**



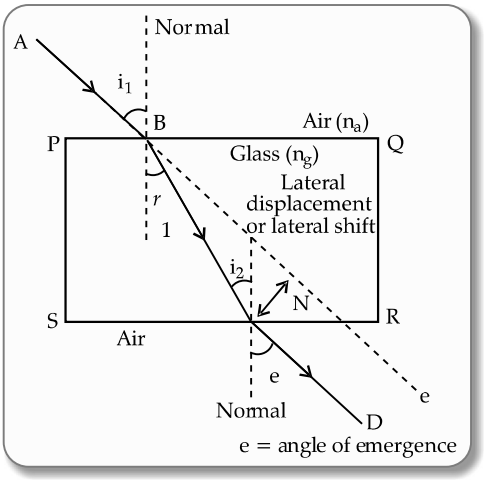
➢ **Image formation by convex mirror:**

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Virtual, erect, very small ($m << +1$), at F.
2.	In front of mirror		Virtual, erect, diminished ($m < +1$), between P and F.

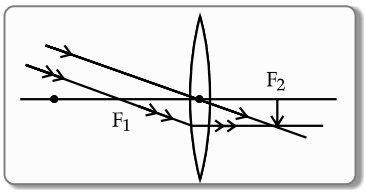
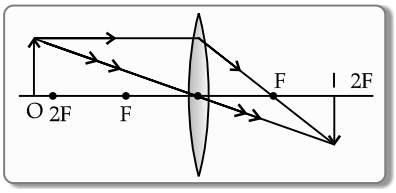
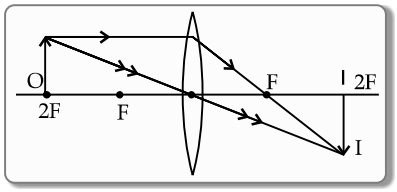
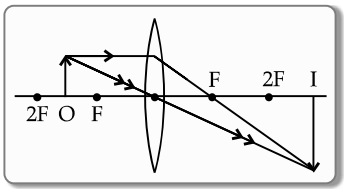
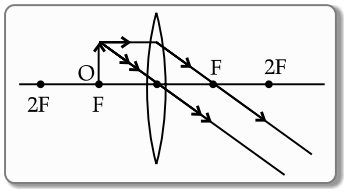
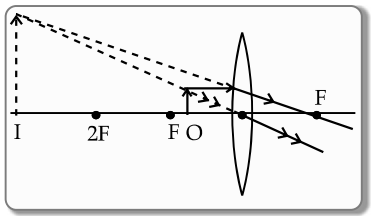
➢ **Image formation by concave mirror:**

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Real, inverted, diminished ($m << -1$), at F.
2.	Beyond C		Real, inverted, small ($m < -1$), between F and C.
3.	At C		Real, inverted, equal ($m = -1$), at C.
4.	Between F and C		Real, inverted, enlarged ($m > -1$), between C and ∞.
5.	At F		Real, inverted, very large ($m >> -1$), at infinity.
6.	Between F and P		Virtual, erect, enlarged ($m > +1$), behind the mirror.

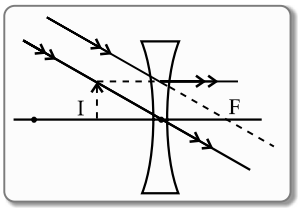
➢ **Refraction through glass slab:**

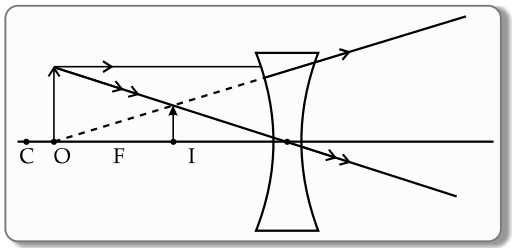


➢ **Image formation by convex lens:**

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Real, inverted, diminished ($m << -1$), at F.
2.	Beyond 2F		Real, inverted, small ($m < -1$), between F and 2 F.
3.	At 2F		Real, inverted, equal ($m = -1$), at 2F.
4.	Between 2F and F		Real, inverted, large ($m > -1$), between 2F and ∞.
5.	At F		Real, inverted, enlarged, ($m >> -1$) at infinity.
6.	Between F and O		Virtual, erect, magnified ($m > +1$), between ∞ and object on the same side as that of object.

➢ **Image formation by concave lens:**

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Virtual, erect, diminished ($m << +1$), at F.

2.	In front of lens		Virtual, erect , diminished ($m < +1$), between F and optical centre.

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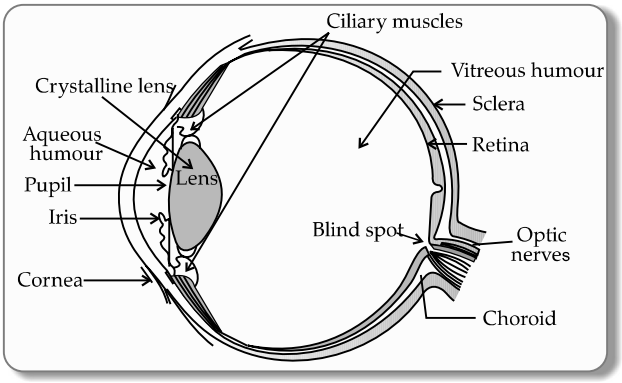
CHAPTER 10: Human Eye and Colourful World

Key Points and Concepts

- The ability or the property of the eye lens to adjust its focal length in order to be able to focus both near and distant objects is known as the power of accommodation.
- The minimum distance at which objects can be seen most distinctly without strain is called the least distance of distinct vision.
- Retina contains light sensitive cells known as rod and cones. These cells get activated upon illumination and generate electrical signals or pulses. The electrical signals are sent to the brain through optic nerves. In the brain, the signals are processed, interpreted and the objects in front of the eye are perceived.
- Rods are sensitive to the brightness of light and cones tells us the colour of the object.
- **Defects of vision and their corrections:**
  - **(a) Myopia (Near sightedness):**
    Reason of the defect:
    - Excessive curvature of eye lens i.e., eye lens becomes thick and its focal length decreases.
    - Elongation of the eye ball.

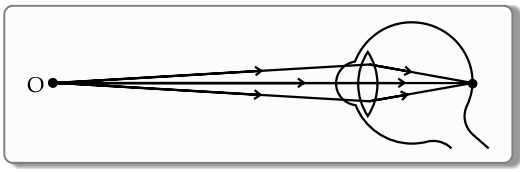
    Correction: This defect is corrected by using concave lens of suitable power.
  - **(b) Hypermetropia (Far sightedness):**
    Reason of the defect:
    - Increase in focal length of the eye lens.
    - Eye ball has become too small.

    Correction: Corrected by using convex lens of suitable power.
  - **(c) Presbyopia:**
    Reason of defect: Gradual weakening of ciliary muscles, thereby decreasing the flexibility of the eye lens.
    Correction: Using Bifocal lens with appropriate power.
  - **(d) Cataract:** The image cannot be seen distinctly because eye lens become milky and cloudy. This condition is known as cataract, it can cause complete or partial loss of vision. This can be corrected by surgical removal of extra growth (cataract surgery).
- **Refraction of light through glass prism:**
  - A glass prism has two triangular bases and three rectangular lateral surfaces which are inclined to each other.
  - The angle between two lateral surfaces of a prism is called angle of the prism.
  - **Angle of deviation:** It is the angle between the incident ray and emergent ray.
- The process of splitting up of white light into its constituent colour as it passes through a refracting medium is known as dispersion of light.
- The phenomenon of scattering of white light by colloidal particles is known as Tyndall effect.
- The sky appears blue due to atmospheric refraction and scattering of light.
- Rainbow is formed due to dispersion, refraction and total internal reflection of light.
- In the morning, the sunlight covers a larger distance from thick layers of atmosphere, so except the red colour light, most of the other colours are scattered into the atmosphere. As only red colour light reaches our eye, the morning sun appears to be red.
- **Important Graphs and Diagrams:**
  - **The Human Eye:**

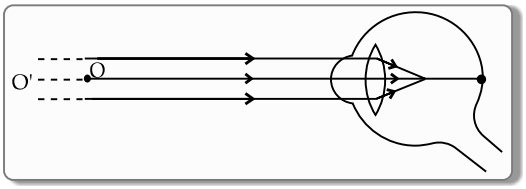


- **Myopia and its correction:**

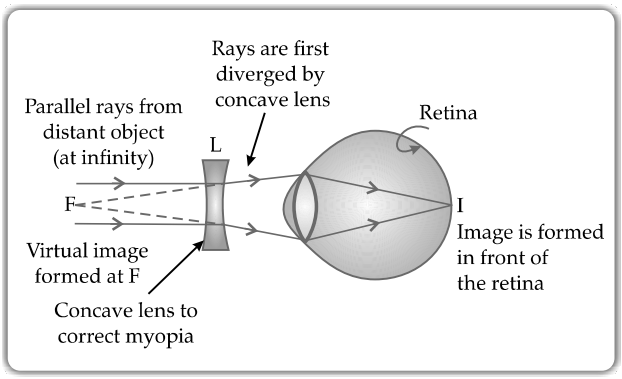
(a) Far point of a myopic eye:



(b) Myopic Eye:

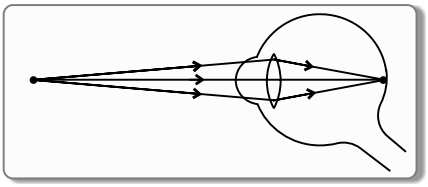


(c) Correction for myopia:

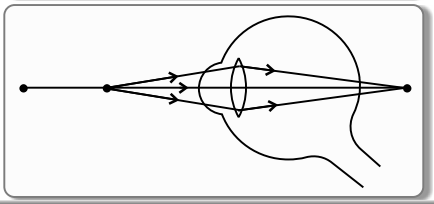


- **Hypermetropia and its correction:**

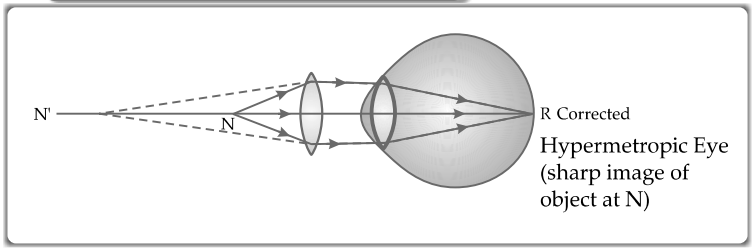
(a) Near point of a hypermetropic eye:



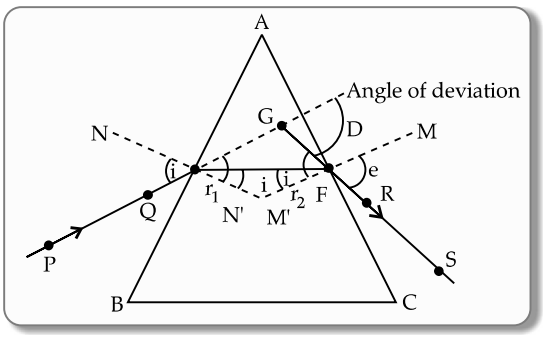
(b) Hypermetropic eye:



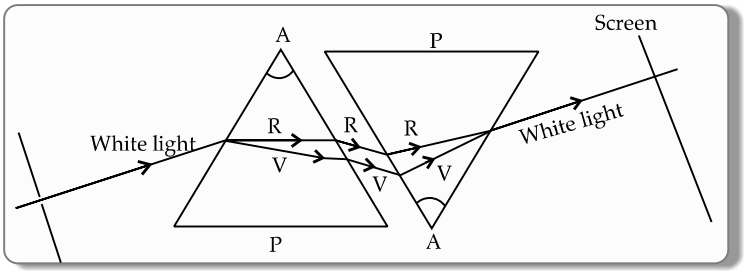
(c) Correction for hypermetropic eye:



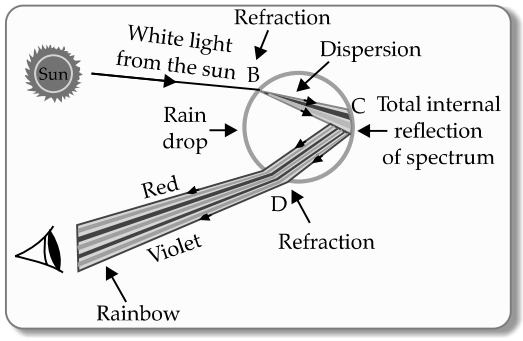
- **Refraction through a glass prism:**



- **Recombination of the spectrum of white light:**



- **Rainbow Formation:**



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CHAPTER 11 : Electricity

Key Points and Concepts

- **Coulomb's Law:** The force of attraction or repulsion between two point charges is **(i)** directly proportional to the product (q_1 q_2) of the two charges and **(ii)** inversely proportional to the square of the distance (r) between them.

  Mathematically,

$$F = \frac{Kq_1q_2}{r^2}$$

  The value of K depends on the nature of the medium between the two charges and the system of units chosen. For charges in vacuum, $K = 9 \times 10^9\ Nm^2/C^2$.

- Electric current = $\frac{\text{Charge}}{\text{Time}}$ or $I = \frac{Q}{t}$

- Potential difference = $\frac{\text{Work done}}{\text{Charge}}$ or $V = \frac{W}{Q}$

- 1 volt = $\frac{1\text{ Joule}}{1\text{ Coulomb}}$ or $1\text{ V} = \frac{1\text{ J}}{1\text{ C}}$

- **Ohm's law:** This law states that the current passing through a conductor is directly proportional to the potential difference across its ends, provided the physical conditions like temperature, density etc., remain unchanged.

$$I \propto V \text{ or } I = \frac{1}{R} \times V \quad \text{or} \quad V = I R$$

R is called resistance of the conductor.

- Resistance $= \dfrac{\text{Potential difference}}{\text{Current}}$ or $R = \dfrac{V}{I}$
- 1 Ohm $= \dfrac{1 \text{ Volt}}{1 \text{ Ampere}}$ or $1\ \Omega = \dfrac{1\ V}{1\ A}$
- **Factors on which resistance of a conductor depends:** The resistance R of a conductor depends on its length L, area of cross-section A and the nature of its material. It is given by

$$R = \rho \frac{L}{A}$$

The proportionality constant ρ is called resistivity of the conductor.

- **Joule's law of Heating:** It states that the heat produced in a conductor is directly proportional to **(i)** the square of the current I through it, **(ii)** its resistance R and **(iii)** the time *t*, for which current is passed. Mathematically, it can be expressed as

$$H = I^2Rt \text{ Joule} = \frac{I^2Rt}{4.18} \text{ cal}$$

or

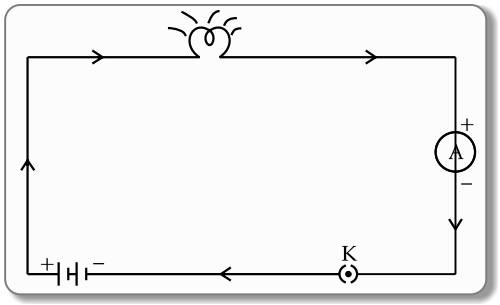
$$H = VIt \text{ Joule} = \frac{VIt}{4.18} \text{ cal}$$

$$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}$$

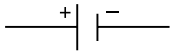
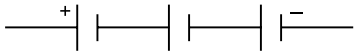
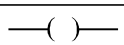
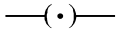
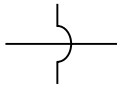
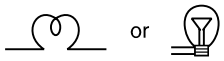
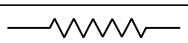
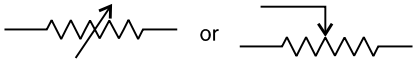
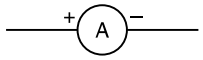
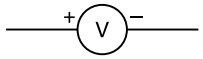
- Electric Power Efficiency, $\eta = \dfrac{\text{Output power}}{\text{Input power}}$
- **Quantities and Units:**

Quantities	S. I. Units
Charge	Coulomb
Electric Current	Ampere
Potential Difference	Volt
Resistance	Ohm
Resistivity	Ohm metre
Heat	Joule
Electric Power	Watt

- **Important Equations:**
  - Resistance in Series, $R_s = R_1 + R_2 + R_3 + ...$
  - Resistance in parallel, $\dfrac{1}{R_P} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} + ...$
- **Important Graphs and Diagrams:**
  - **Schematic Diagram of an electric circuit**



➢ **Components of an electric circuit:**

S. No.	Components	Symbols
1.	An electric cell	
2.	A battery or a combination of cells	
3.	Plug key or switch (open)	
4.	Plug key or switch (closed)	
5.	A wire joint	
6.	Wires crossing without joining	
7.	Electric bulb	
8.	A resistor of resistance	
9.	Variable resistance or rheostat	
10.	Ammeter	
11.	Voltmeter	

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CHAPTER 12 : Magnetic Effects of Electric Current

Key Points and Concepts

➢ **Magnetic field** is the region surrounding the magnet in which the force of the magnet can be detected.

➢ Magnetic field has both direction as well as magnitude.

➢ The direction of the magnetic field is taken to be the direction in which a north pole of the compass needle moves inside it.

➢ **Magnetic field line** is a path along which a hypothetical free north pole tend to move towards South Pole.

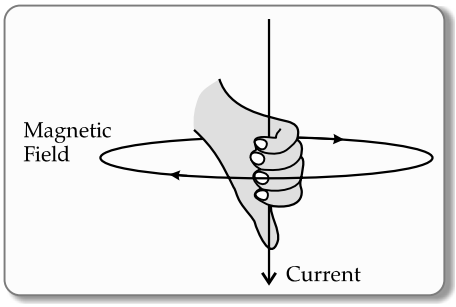
➢ When iron fillings are brought near the bar magnet, it gets influenced by the magnetic field of the bar magnet and arrange themselves in a pattern of curved lines called magnetic field lines.

➢ **Properties of magnetic field lines:**

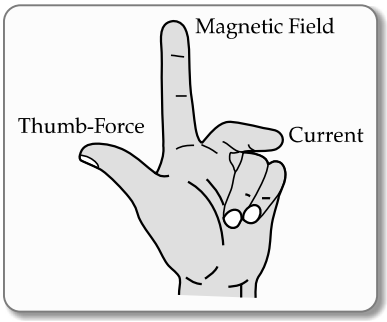
- Magnetic field lines are closed curves.
- They emerges from North and merge into South Pole.
- Inside the magnet, the direction of the field lines are from South to North Pole.
- Magnetic field lines never intersect each other.

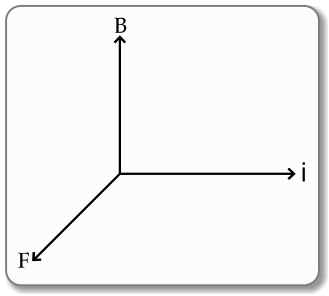
➢ **Electromagnet:** A strong magnetic field produced inside a solenoid can be used to magnetize a piece of magnetic material like soft iron. The magnet so formed is called an electromagnet. It is a temporary magnet.

➢ **Right Hand Thumb Rule:** Hold the wire carrying current in your right hand, such that the thumb indicates the direction of current, then the folded fingers will indicate the presence of magnetic field (lines) surrounding the wire.

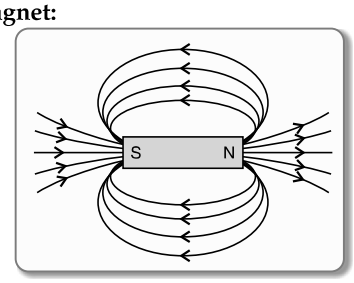


- **Fleming's Left Hand Rule:**

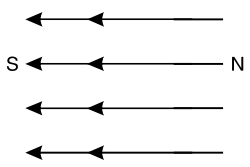




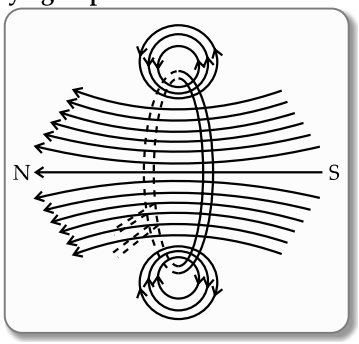
- **Galvanometer:** It is an instrument that can detect the presence of a current in a circuit. If pointer is at zero (the centre of scale), then there will be no flow of current. If the pointer deflect on either side right or left, this will show the direction of current.
- There are two types of current: Alternating current (AC) and Direct current (DC).
- The difference between the direct and alternating current is that the direct current always flows in one direction, whereas the alternating current reverses its direction periodically.
- In India, the AC changes direction after every 1/100 second, that is, the frequency of AC is 50 Hz.
- **Advantages of Alternate Current (AC) over Direct Current (DC):** Electric power can be transmitted to longer distances without much loss of energy. Therefore, cost of transmission is low.
- **Domestic Electric Circuits:** In our homes, the electric power supplied is of potential difference V = 220 V and frequency 50 Hz.
- **Earth wire:** It provide a low resistance to the current hence any leakage of current to the metallic body of the appliances, keep its potential equal to that of earth that means zero potential. Thus, the user is saved from severe electric shock.
- **Fuse:** It is a safety device that can prevent the circuit from overloading and short circuiting.
- **Important Graphs and Diagrams:**
  - **Magnetic Lines around a bar magnet:**



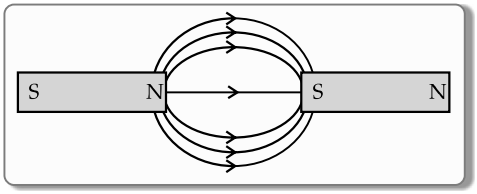
  - **Uniform Magnetic Field:**



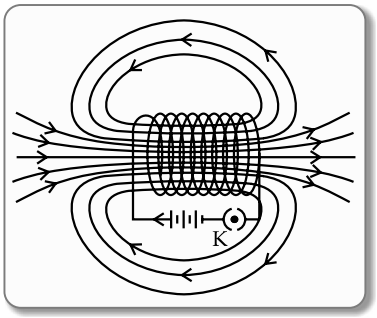
- **Magnetic Lines due to a current carrying loop:**



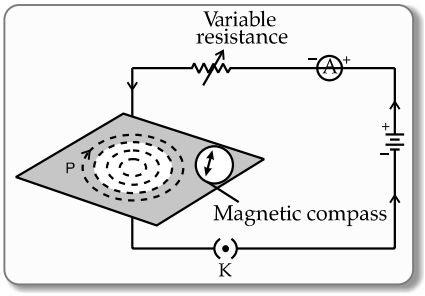
- **Magnetic Lines around two magnets:**



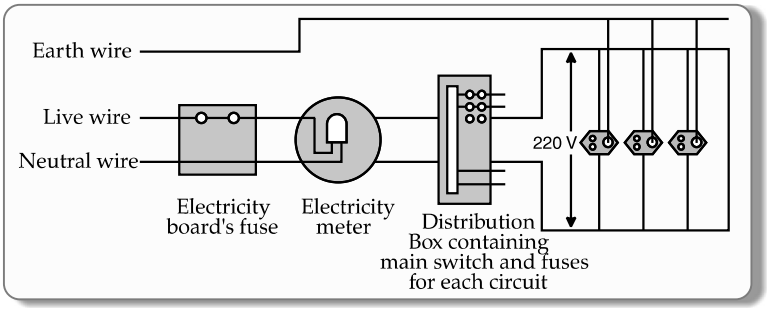
- **Magnetic field in a solenoid:**



- **Magnetic lines produced around a current carrying conductor:**



- Common Domestic Circuit:



CHAPTER 13: Our Environment

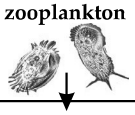
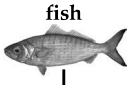
Key Points and Concepts

- All living organisms can be grouped into producers, consumers and decomposers, on the basis of nutrition.
- Producers are organisms which can make organic compound of their need from inorganic substances. These includes all green plants and certain bacteria.
- Consumers are organisms which depend on the producers directly or indirectly for their sustenance.
- Consumers can be classified into herbivores, carnivores, omnivores and parasites.
- Decomposers are microorganisms which can break down the dead remains and waste product of the organisms, such as fungi and bacteria.
- **Food chain:** It is the sequence of living organisms in which one organism consumes another organism for energy. It is unidirectional (single directional).
- Each step or level of the food chain forms a trophic level.
- **Ten percent Law:** There is only 10% flow of energy from one trophic level to the next higher level. Due to this energy loss, only 4 or 5 trophic levels are present in each chain. It is known as Ten Percent law.

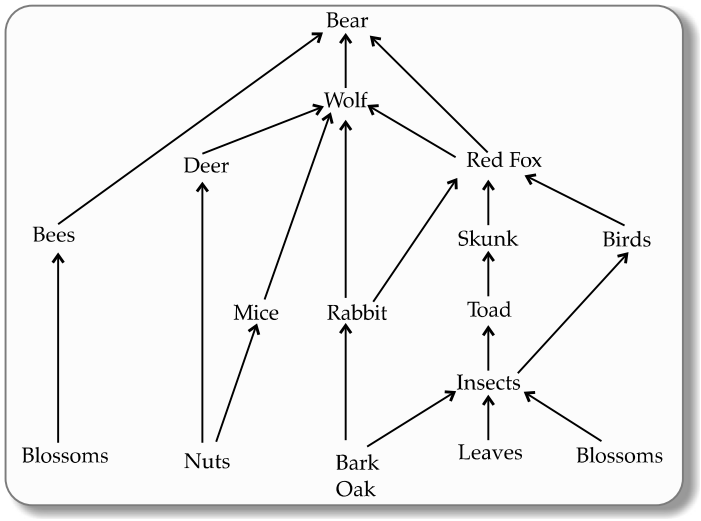
  Example:

Grass	→	Grasshopper	→	Frogs	→	Snakes
(4000 J)		(400 J)		(40 J)		(4 J)

- **Significance of food chain:**
  - It helps in understanding the food relationship and interactions among various organisms in an ecosystem.
  - It helps in following the basic mechanism of transfer of food energy and nutrients through various components of nature.
  - It helps to understand the movement of toxic substances in an ecosystem and the problem of their biological magnification.
- **Sample Food Chains:**

Trophic Level	Grassland Biome	Pond Biome	Ocean Biome
Primary Producer	Grass	algae	phytoplankton
Primary Consumer	grasshopper 	mosquito larva 	zooplankton 
Secondary Consumer	rat 	dragonfly larva 	fish 
Tertiary Consumer	snake 	fish 	seal 
Quaternary Consumer	hawk 	raccoon 	white shark 

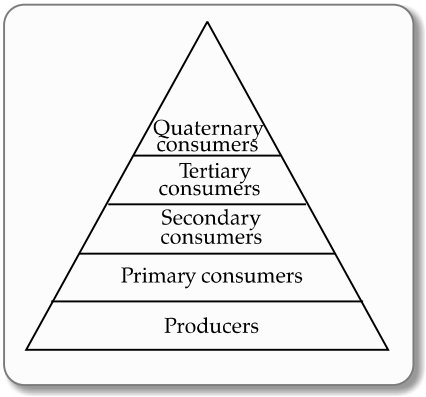
- **Sample Food Web:**



- **Biological magnification:** The concentration of harmful chemical increases with every next trophic level in a food chain. It is called bio-magnification. As human beings occupy the top of any food chain, the maximum concentration of these chemicals get accumulated in human body.
- **Ozone (O_3)** is a molecule formed by three atoms of oxygen.

$NO_2 \xrightarrow{\text{Light}} NO + O,$ $\quad O_2 \xrightarrow{UV} O + O,$ $\quad O + O_2 \rightarrow O_3$

- Due to **ozone layer depletion**, the ultraviolet rays reach the earth and causes certain ill-effects which are harmful to us and crops. Exposure to UV rays can lead to greater incidence of skin cancers, cataracts and damages the eye and immune deficiency.
- **Four appliances which releases chlorofluorocarbon are:**
  (a) Aerosol spray **(b)** Air conditioner **(c)** Refrigerator **(d)** Coolant
- **Non-biodegradable substance:**
  (i) These are poisonous substances that either do not degrade or degrade very slowly in nature.
  (ii) They affect environment. They may enter the food chain and show biological magnification.
  (iii) They contaminate water and soil resources as they cannot be decomposed by micro-organisms.
  (iv) The non-biodegradable waste have long lasting effect and cause environmental problems that affect much.
- **Some eco-friendly activities:**
  (i) Gardening and planting trees.
  (ii) Use of gunny bags / paper bags in place of polythene bags.
  (iii) Use of compost and vermi-compost in place of fertilizers.
  (iv) Separation of biodegradable and non-biodegradable substances.
  (v) Fostering compassion and respect to all living beings and the environment by educating youth.
- **Important Diagrams:**
  - **Trophic Levels:**



- **Flow of energy in an ecosystem:**