Unit -I : Chemical Substances : Nature and Behaviour

Chapter - 1 : Chemical Reactions And Equations

Revision Notes

Chemical Reactions and Equations

1. A chemical reaction

- A chemical reaction is a process in which the original substance(s) loses its nature and identity and forms new substance(s) with different properties.
- Breaking of the chemical bonds and formation of new chemical bonds is responsible for the occurrence of a chemical reaction.
- The substances which take part in a chemical reaction are called **Reactants.**
- The substances which are formed in a chemical reaction are called **Products.**
- **Examples of chemical reaction**:
  - **(i)** Digestion of food
  - **(ii)** Respiration
  - **(iii)** Rusting of iron
  - **(iv)** Burning of magnesium ribbon
  - **(v)** Formation of curd
- **A chemical reaction can be identified by either of the following observations:**
  - **(i)** Change in state
  - **(ii)** Change in colour
  - **(iii)** Evolution of gas
  - **(iv)** Change in temperature
  - **(v)** Formation of a precipitate

2. More about chemical equations:

- **A chemical equation is written in the following way:**
  - **(i)** The symbols of elements and the formulae of reacting substances (reactants) are written on the left hand side of the equation, with a plus (+) sign between them.
  - **(ii)** The symbols and formulae of the substances formed (products) are written on the right hand side of the equation, with a plus sign (+) between them.
  - **(iii)** An arrow sign (→) is put between the reactants and the products.
  - **(iv)** The physical states of the reactants and products are also mentioned in a chemical equation.
- **Balanced Equation:** The equation in which atoms of various elements on both sides of a chemical equation are equal in accordance with the law of conservation of mass.
- The process of equalizing the atoms of various elements both on either sides of an equation is called the balancing of chemical equation. This is known as hit and trial method. We can balance a chemical equation by following the steps given below:

Step 1. Write the chemical equation and draw boxes around each formula:

$$\boxed{Fe + H_2O \rightarrow Fe_3O_4 + H_2}$$

Step 2. Count the number of atoms of each element on both the sides of the arrow :

Element		No. of atoms at reactant side	No. of atoms at product side
1.	Fe	1	3
2.	H	2	2
3.	O	1	4

Step 3. Equalize the number of the atoms of element which has the maximum number of atoms (oxygen).

$$Fe + 4H_2O \rightarrow Fe_3O_4 + H_2$$

Step 4. Try to equalize all the atoms of elements on reactant and product side by adding coefficient in front of it.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

Now, all the atoms of elements are equal on both sides.

Step 5. Write the physical states of reactants and products.

$$3Fe\,(s) + 4H_2O\,(g) \rightarrow Fe_3O_4\,(s) + 4H_2\,(g)$$

Solid state = (*s*), Liquid state = (*l*), Gaseous state = (*g*), Aqueous state = (*aq*)

Step 6. Write necessary conditions of temperature, pressure or catalyst at above or below the arrow.

e.g.

(i) $CO(g) + 2H_2\,(g) \xrightarrow{340\ atm} CH_3OH(l)$

(ii) $6CO_2(g) + 6H_2O(l) \xrightarrow[chlorophyll]{sunlight} \underset{Glucose}{C_6H_{12}O_6(aq)} + 6O_2\,(g)$

Types of Chemical Reactions

➢ **Types of Chemical Reactions**

I. Combination Reaction: The reaction in which two or more reactants combine to form a single product.

e.g., (i) Burning of coal

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

(ii) Formation of water

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

(iii) $CaO(s) + H_2O(l) \rightarrow \underset{(Slaked\ lime)}{Ca(OH)_2\,(aq)} + Heat$

(Quick lime)

Exothermic Reactions: Reaction in which heat is released along with formation of products.

e.g., (i) Burning of natural gas.

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g) + Heat$

(ii) Respiration is also an exothermic reaction.

$\underset{(Glucose)}{C_6H_{12}O_6(aq)} + 6O_2(g) \rightarrow 6CO_2(aq) + 6H_2O(l) + energy$

II. Decomposition Reaction:

The reaction in which a compound splits into two or more simpler substances is called decomposition reaction.

$$A \rightarrow B + C$$

(a) Thermal decomposition: When decomposition is carried out by heating.

e.g., (i) $2FeSO_4(s) \xrightarrow{Heat} \underset{(Ferric\ oxide)}{Fe_2O_3(s)} + SO_2(g) + SO_3(g)$

(Ferrous sulphate)

Green colour Red-brown colour

(ii) $CaCO_3(s) \xrightarrow{Heat} \underset{(Quick\ lime)}{CaO(s)} + CO_2(g)$

(Lime stone)

(b) Electrolytic Decomposition: When decomposition is carried out by passing electricity.

e.g., $2H_2O(l) \xrightarrow[current]{Electric} 2H_2(g) + O_2(g)$

(c) Photolytic Decomposition: When decomposition is carried out in presence of sunlight.

e.g., (i) $2AgCl(s) \xrightarrow{Sunlight} 2Ag(s) + Cl_2(g)$

(ii) $2AgBr(s) \xrightarrow{Sunlight} 2Ag(s) + Br_2(g)$

This reaction is used in black and white photography.

Endothermic Reaction: The reactions which require energy in the form of heat, light or electricity to break reactants are called endothermic reactions.

III. **Displacement Reaction:** The chemical reactions in which more reactive element displaces less reactive element from its salt solution.

e.g., (i) $Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

(Iron) (Copper sulphate) (Ferrous sulphate) (Copper)

The iron nail becomes brownish in colour by deposition of Cu and blue colour of $CuSO_4$ changes into dirty green colour due to formation of $FeSO_4$.

(ii) Zinc displaces copper forming zinc sulphate. Zn is more reactive than copper.

$$Zn\ (s) + CuSO_4\ (aq) \rightarrow ZnSO_4\ (aq) + Cu\ (s)$$

(Zinc Sulphate)

IV. **Double Displacement Reaction:** A reaction in which new compounds are formed by mutual exchange of ions between two compounds.

$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

(Sodium sulphate) (Barium chloride) (Barium sulphate) (Sodium chloride)

White precipitate of $BaSO_4$ is formed, so it is also called precipitation reaction.

V. **Oxidation and Reduction:**

Oxidation: Loss of electrons

Reduction: Gain of electrons

Oxidation: It is a process of gaining oxygen during a reaction by an atom, molecule or ion.

$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

Reduction: It is the gain of electrons or a decrease in the oxidation state of an atom by another atom, an ion or a molecule.

$$CuO + H_2 \longrightarrow Cu + H_2O$$

In this reaction, CuO is reduced to Cu and H_2 is oxidised to H_2O. In other words, one reactant gets oxidised while the other gets reduced. Such reactions are called oxidation-reduction reactions or redox reactions.

Mnemonics

Concept: Types of chemical reactions	**Concept: Types of decomposition reaction**
Mnemonics: **ROC. D³**	Mnemonics: **PET**
Interpretation: **R**eduction **O**xidation **C**ombination **D**ecomposition **D**isplacement **D**ouble Displacement	**Interpretation:** **P**hotolyticreaction,**E**lectrolyticreaction,**T**hermal reaction
Concept: Oxidation and reduction reaction	**Concept: Preventive ways of rusting**
Mnemonics: OIL RIG	Mnemonics: **POGG**
Interpretation: **O**xidation: **L**oss of electrons **R**eduction: **G**ain of electrons	**Interpretation:** **P**ainting **O**iling **G**reasing **G**alvanising

Know the Terms

- **Chemical equation:** It is a complete symbolic representation of a chemical reaction involving reactants and products.
- **Electrolysis:** When a decomposition reaction is carried out with the help of electric current, the process is called electrolysis.
- **Redox reaction:** Those reactions in which oxidation and reduction take place simultaneously are called **redox reactions**.
- **Oxidising agent:** It is a substance which can add oxygen or an electronegative element to other materials. It can also remove hydrogen or an electropositive element from other materials.
- **Reducing agent**: It is a substance which can add hydrogen or an electropositive element to other materials. It can also remove oxygen or an electronegative element from other materials.

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Chapter - 2 : Acids, Bases and Salts

Revision Notes

Acids and Bases

Introduction

- Acids are sour in taste. They turn blue litmus red. Acids are the substances that furnish H^+ ions in aqueous solution.
- If in an aqueous solution, concentration of acid is low, it is called **dilute solution** and if concentration of acid is high, it is called **concentrated solution**.
- Hydrochloric acid is released in stomach to make medium acidic in nature. It leads to coagulation of protein and helps in their digestion. HCl kills bacteria coming in the stomach along with the food.
- When a burning matchstick is brought near the hydrogen gas, it burns with a pop sound.
- When CO_2 gas is passed through lime water, it turns milky. If CO_2 is passed in excess, milkiness disappears.
- There are many natural substances like red onion peels, red cabbage leaves, beetroot extract, coloured petals of some flowers, which are called indicators because they indicate the presence of acid or base by showing the change in colour.
- Acids react with certain metal oxides to form salt and water. Acids react with metal carbonates and hydrogen carbonates to produce carbon dioxide gas.
- Strong bases react with active metals to produce hydrogen gas. Bases react with non-metallic oxides to produce salt and water.
- Both acids and bases conduct free electric current in their aqueous solution due to the presence of free ions.
- Strength of an acid or base depends on the number of H^+ ions or OH^- ions produced by them respectively. More the H^+ ions produced by an acid, stronger is the acid. More the OH^- ions produced by a base, stronger is the base.
- **Indicators:** These are the substances which change their colour / smell in different types of substances.
- **Types of Indicators:**

	S. No.	Indicator	Smell/Colour In Acid Solution	Smell/Colour In Basic Solution
Natural Indicator	1.	Litmus	Red	Blue
	2.	Red cabbage leaf extract	Red	Green
	3.	Flowers of hydrangea plant	Blue	Pink
	4.	Turmeric	No change	Red
Synthetic Indicator	1.	Phenolphthalein	Colourless	Pink
	2.	Methyl orange	Red	Yellow
Olfactory Indicator	1.	Onion	Characteristic smell	No smell
	2.	Vanilla essence	Retains smell	No smell
	3.	Clove oil	Retains smell	Loses smell

- **Chemical Properties of Acids and Bases:**

1. Reaction of Metals with:

Acids	Bases
Acid + Metal → Salt + Hydrogen gas	Base + Metal → Salt + Hydrogen gas
e.g., $2HCl + Zn \rightarrow ZnCl_2 + H_2\uparrow$ (Zinc chloride)	e.g., $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2\uparrow$ (Sodium zincate)

Test for H_2 gas: Hydrogen gas released can be tested by bringing a burning candle near gas bubbles, it bursts with pop sound.

2. Reaction of Metal Carbonates / Metal Hydrogen Carbonates with:

Acids	Bases
Acid + Metal Carbonate / Metal hydrogen Carbonate ↓ Salt + CO_2 + H_2O	Base + Metal Carbonate / Metal Hydrogen Carbonate ↓ No Reaction

e.g., $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

$HCl + NaHCO_3 \rightarrow NaCl + CO_2 + H_2O$

Test for CO_2: CO_2 can be tested by passing it through lime water. Lime water turns milky.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

When excess CO_2 is passed, milkiness disappears.

$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

3. Reaction of Acids and Bases With Each Other

Neutralization Reaction: Reaction of acid with base is called neutralization reaction.

e.g., $HCl + NaOH \rightarrow NaCl + H_2O$

- **If:**

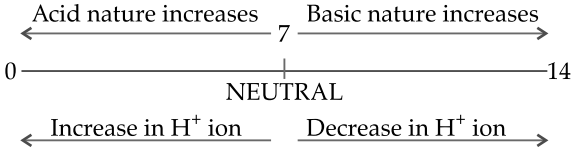
Strong Acid + Weak Base → Acidic salt + H_2O

Weak Acid + Strong Base → Basic salt + H_2O

Strong Acid + Strong Base → Neutral salt + H_2O

Weak Acid + Weak Base → Neutral salt + H_2O

- pH of stomach is 1.5-3.0 due to secretion of HCl. In case of indigestion, acidity increases, which can be neutralised by antacids like milk of magnesia.
- Cold drinks, chocolates and sweets are harmful to tooth. They produce acids in mouth which are responsible for tooth decay.
- Salts of a strong acid and a strong base are neutral with pH value of 7.
- Salts have various uses in everyday life and in industries.
- A salt is soluble if it dissolves in water to give a solution with a concentration of at least 0.1 moles per litre at room temperature.
- **pH Scale:** A scale for measuring H^+ ion concentration in a solution. p in pH stands for 'potentz' a German word which means power.
  - pH = 7 → neutral solution
  - pH < 7 → acidic solution
  - pH > 7 → basic solution
  - On diluting an acid: pH increases ↑
  - On diluting a base: pH decreases ↓



- **Importance of pH in everyday life:**
  - Plants and animals are pH sensitive.
  - Our body works within the pH range of 7 – 7.8.
  - When pH of rain water is less than 5.6, it is called acid rain.
  - Plants require a specific pH range for their healthy growth.

Salts, there Properties and Uses

- **Salts:** Salts are formed when an acid and base reacts with each other.
- **Types of Salts:**

1. **Common Salt (NaCl):**

   Preparation: $NaOH + HCl \rightarrow NaCl + H_2O$

   Properties: $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

   Users of common salt:

   1. Used it daily food

   2. Used as preservative

   3. Used in manufacture of metal (Na) & gas (Cl_2) in molten state by electrolysis.

2. **Bleaching Powder ($CaOCl_2$):**

   Preparation: It is produced by the action of chlorine on dry slaked lime.

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

   Properties:

   (a) It has a strong smell of Chlorine.

   (b) Soluble in water.

   (c) It loses Chlorine by the action of carbon di oxide.

   Uses:

   (a) Bleaching cotton and linen in textile industry.

   (b) Bleaching wood pulp in paper factories.

   (c) Oxidizing agent in chemical industries.

   (d) Disinfecting drinking water.

3. **Baking Soda (** Sodium hydrogen carbonate) ($NaHCO_3$**):**

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

   Baking soda

   Properties:

   It is mild non-corrosive base.

   When it is heated during cooking:

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

   Uses:

   (a) For making baking powder (mixture of baking soda and tartaric acid). When baking powder is heated or mixed with water, CO_2 is produced which causes bread and cake to rise making them soft and spongy.

   $NaHCO_3 + H^+ \rightarrow CO_2 + H_2O$ + Sodium Salt of an Acid

   (b) An ingredient in antacid.

   (c) Used in soda acids, fire extinguishers.

4. **Washing Soda ($Na_2CO_3.10H_2O$):**

   Preparation: Recrystallization of sodium carbonate gives washing soda. It is a basic salt.

   $$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$$

   Properties:

   (a) Transparent crystalline solid.

   (b) It has 10 molecules of water of crystallization.

(c) It dissolves in water and the aqueous solution is alkaline.

(d) It liberates Carbon di oxide when treated with Hydrochloric acid and Sulphuric acid.

Uses:

(a) In glass, soap and paper industry.

(b) Manufacture of borax.

(c) It can be used as cleaning agent.

(d) It can be used for removing permanent hardness of water.

5. **Plaster of Paris (Calcium sulphate hemihydrates) ($CaSO_4.½H_2O$):**

Preparation: On heating gypsum $CaSO_4.2H_2O$ at 373K, it loses water molecules and becomes Plaster of Paris (POP). It is white powder and on mixing with water it changes to gypsum.

$$CaSO_4.2H_2O \rightarrow CaSO_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O$$

Properties: $CaSO_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O \rightarrow CaSO_4.2H_2O$

Uses:

(a) Doctors use POP for supporting fractured bones.

(b) For making toys and material for decoration.

Mnemonics

Concept: Natural indicators	Concept: pH scale
Mnemonics: **PG.RCT**	Mnemonics: **Ph**one **l**ao **7A** mein
Interpretation: **P**etunia **G**eranium **R**ed cabbage **T**urmeric	**Interpretation:** **pH l**ess than **7** --- **A**cid

Know the Terms

- **Mineral acids:** The acids which are obtained from minerals are called **mineral acids**.
- **Organic acids:** Acids which are obtained from plants and animals are called **organic acids.**
- **Strong acids:** The acids which ionise almost completely are called **strong acids**, *e.g.*, mineral acids.
- **Weak acids:** The acids which ionise only partially or to a lesser extent are called **weak acids**, *e.g.*, organic acids.
- **Strong bases:** The substances / bases which ionise completely to furnish OH^- ions are called **strong bases**, *e.g.*, KOH, NaOH etc.
- **Weak bases:** The bases which ionize partially are called **weak bases**, *e.g.*, $Mg(OH)_2$, $Cu(OH)_2$ etc.
- **Alkalies:** Water soluble bases are called **alkalies**, *e.g.*, NaOH, KOH. Thus, all alkalies are bases but all bases are not alkali.

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Chapter - 3 : Metals and Non-Metals

Revision Notes

Properties of Metal and Non-Metals

Introduction

- Metals are mostly solids, possessing high density. They have high melting and boiling points. They are lustrous and sonorous. They are good conductors of heat and electricity.

- Most of the metals are hard. However, some of the metals like sodium, potassium are soft metals and can be easily cut with knife.
- All metals are solids except Mercury, Caesium, Francium, Germanium and Gallium which are solids with low melting point. Gallium becomes liquid if kept on palm but Gallium has very high boiling point which makes it useful for high temperature thermometers.
- **Physical Properties:**

Property	Metals	Non-Metals
1. Lustre	Metals have shining surface.	They do not have shining surface. ● Except Iodine.
2. Hardness	They are generally hard. ● Except Sodium, Lithium and Potassium which are soft and can be easily cut with knife.	Generally soft. ● Except Diamond, a form of carbon which is the hardest natural substance.
3. State	Exist as solids. ● Except Mercury that exists in liquid.	Exist as solids or gases ● Except Bromine that exists in liquid.
4. Malleability	Metals can be beaten into thin sheets. ● Gold, Silver and Aluminium are the most malleable metals.	Non-metals are non-malleable. ● They are brittle.
5. Ductility	Metals can be drawn into thin wires.	They are non-ductile.
6. Conductor of heat & electricity	Metals are good conductors of heat and electricity.	Non-metals are poor conductors of heat and electricity. ● Except Graphite.
7. Density and Melting point	Generally metals have high density and high melting point. ● Except Sodium and Potassium	Non metals have low density and low melting point.
8. Sonorous	Metals produce a sound on striking a hard surface.	They are not sonorous.
9. Oxides	Metallic oxides are basic in nature.	Non-metallic oxides are acidic in nature.

- **Chemical Properties:**

(A) Reaction with Air:

Metals combine with oxygen to form metal oxide.

Metals + $O_2 \rightarrow$ Metal oxide

Examples:

(i) $2Cu + O_2 \rightarrow 2CuO$

Copper (II) oxide (black)

(ii) $4Al + 3O_2 \rightarrow 2Al_2O_3$

Aluminium oxide

(iii) $2Mg + O_2 \rightarrow 2MgO$

Magnesium oxide

- Different metals show different reactivity towards O_2.
  - Na and K react so vigorously with oxygen that they catch fire if kept in open. So they are kept immersed in kerosene.
  - Surfaces of Mg, Al, Zn and Pb are covered with a thin layer of oxide which prevent them from further oxidation.
  - Fe does not burn on heating but iron fillings burn vigorously.
  - Cu does not burn but is coated with black copper (II) oxide.
  - Au and Ag do not react with oxygen.
- **Amphoteric Oxides:** Metal oxides which react with both acids as well as bases to produce salt and water are called amphoteric oxides.

Examples: $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

Aluminium chloride

$$Al_2O_3 + 2NaOH \rightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$$

(B) Reaction of Metals with Water:

Metal + Water → Metal oxide + Hydrogen

Metal oxide + Water → Metal hydroxide

Examples: $2Mg + 2H_2O \rightarrow \underset{\text{Magnesium oxide}}{2MgO} + 2H_2$

$$MgO + H_2O \rightarrow \underset{\text{Magnesium hydroxide}}{Mg(OH)_2}$$

(C) Reaction of Metals with Solutions of other Metal Salts:

Metal A + Salt solution B → Salt solution A + Metal B

- Reactive metals can displace less reactive metals from their compounds in solution form.

$$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$$

- All the metals do not react with the same rate. Some react very fast, some react moderately whereas others react very slowly. The series of metals in decreasing order of reactivity is called **reactivity** or **activity series of metals.** The metals at the top (K at the top most) are most reactive whereas metals at the bottom (Pt at the extreme bottom) least reactive.

K > Na>Ca>Mg,> Al > Zn > Fe>Sn> Pb,>H > Cu > Hg > Ag > Au > Pt.

- Metals react with dilute acids to form salt and hydrogen gas. The metal replaces hydrogen of the acid to form salt.
- **Aqua Regia** is a mixture of conc. HCl and conc. HNO_3 in the ratio of 3: 1. It can dissolve gold and platinum. Aqua Regia is a strong oxidizing agent due to the formation of NOCl (Nitrosyl chloride) and chlorine produced by reaction of two acids.
- **Alloys** are homogeneous mixtures of two or more metals. One of them can be non-metal also, *e.g.*, Brass is an alloy of copper and zinc. When a metal is alloyed with mercury, it is called an **amalgam**.
- Metals in reactivity series, if placed above hydrogen, can displace hydrogen from dilute acids (HCl and H_2SO_4).

Ionic compounds, Metallurgy and Corrosion

- **Ionic Compounds**

The compounds formed by the transfer of electrons from a metal to a non-metal are called ionic compounds or electrovalent compounds.

- **Properties of Ionic Compounds**
  - **(i) Physical nature:** They are solid and hard, generally brittle.
  - **(ii) Melting and Boiling Point:** They have high melting and boiling points.
  - **(iii) Solubility:** Generally soluble in water and insoluble in solvents such as kerosene, petrol etc.
  - **(iv) Conduction of electricity:** Ionic compounds conduct electricity in molten and solution form but not in solid state.
- **Occurrence of Metals**
  - **Minerals:** The elements or compounds which occur naturally in the earth's crust are called minerals.
  - **Ores:** Minerals that contain very high percentage of particular metal and the metal can be profitably extracted from it, such minerals are called ores.

Mnemonics

Concept: Activity series of metals

Mnemonics:
Popular **S**cientists **C**an **M**ake **A** **Z**oo **I**n**T**he **L**ow **H**umid **C**ountry **M**ore **S**atisfactorily

Interpretation:

P - Potassium
C – Calcium
A - Aluminium
I - Iron
L - Lead
C - Copper
S - Silver
S – Sodium
M – Magnesium
Z – Zinc
T - Tin
H – Hydrogen
M - Mercury

Know the Terms

- **Malleability:** The ability of a metal due to which it can be beaten into large thin sheets is called **malleability**.
- **Ductility:** It is the ability of metal due to which it can be drawn into thin and long wires. Copper, aluminium and iron can be drawn into wires. Silver, gold and platinum are highly ductile metals.
- **Electrical conductance:** It is the property due to which electric current can pass through the metal. It is due to presence of free electrons or mobile electrons. Copper, silver, gold and aluminium are good conductors of electricity.
- **Thermal conductivity:** It is the property due to which metals can conduct heat. *e.g.*, Copper, silver, aluminium, gold and iron are good conductors of heat.
- **Metallic lustre:** Metals in their pure state have bright shining surfaces. This property is called **metallic lustre**.
- **Sonorous:** When metals are struck with a hard substance, they produce sound. This property is called **sonority** and the metals are said to be **sonorous**.
- **Neutral oxides:** The oxides which are neither acidic nor basic in nature, are known as **Neutral oxides**. They neither react with acids nor with bases. Some non-metals form neutral oxides. Example CO, NO, N_2O etc.
- **Ore-dressing:** It is a process of removing unwanted substances from the ore. This is also known as concentration of the ore or enrichment of ore. It is usually done by hydraulic washing, magnetic separation or froth floatation process.
- **Froth floatation process:** It is the process based on the principle that the mineral particles are more wetted by the oil, whereas the gangue particles are wetted by water. Compressed air is bubbled through the mixture. As a result of agitation, oil froth is formed which contains minerals which float on the top of water and can be separated easily.
- **Gangue:** The unwanted material present in the ores mined from earth is called **Gangue**. It needs to be removed prior to the extraction process.
- **Leaching:** It makes use of difference in the chemical properties of minerals and gangue. The ore is treated with suitable reagent which reacts with the ore, but not with the gangue. The purified ore is regenerated by sequence of reactions. An example of leaching is Bayer's method of obtaining pure aluminium oxide from Bauxite.
- **Roasting:** It is the process in which ore is heated in the presence of air so as to obtain metal oxides, which can be reduced easily to get free metal. Sulphide ores are converted into oxides by roasting.

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

- **Calcination:** It is the process of heating ore in absence of air so as to remove moisture, volatile impurities and to convert carbonate ores into oxides.

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

- **Thermite process:** It is a process in which molten metal oxides are treated with aluminium powder. It is highly exothermic reaction. The molten metal obtained is used for welding of railway tracks or cracked machine parts.

$$\underset{\text{Aluminium}}{2Al} + \underset{\text{Haematite}}{Fe_2O_3} \longrightarrow \underset{\text{Molten iron}}{2Fe} + \underset{\text{Aluminium oxide}}{Al_2O_3} + \text{Heat}$$

- **Refining:** It is a process of converting impure metal into pure metal by different processes depending on the nature of metals. It is a process of purification of metal.
- **Flux:** The substance which reacts with gangue to form a fusible mass which can easily be removed is known as flux. *e.g.,* CaO (Calcium oxide) is used as flux so as to remove SiO_2 (Silica) as gangue.
- **Slag:** The fusible mass formed by the reaction of flux and gangue is known as **slag**. Slag is lighter than molten metal, hence floats over molten metal and can be easily removed. It prevents metal from oxidation.

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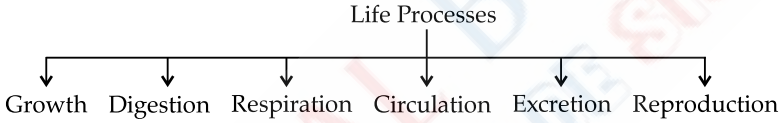
Unit -II : World of Living

Chapter - 4 : Life Processes

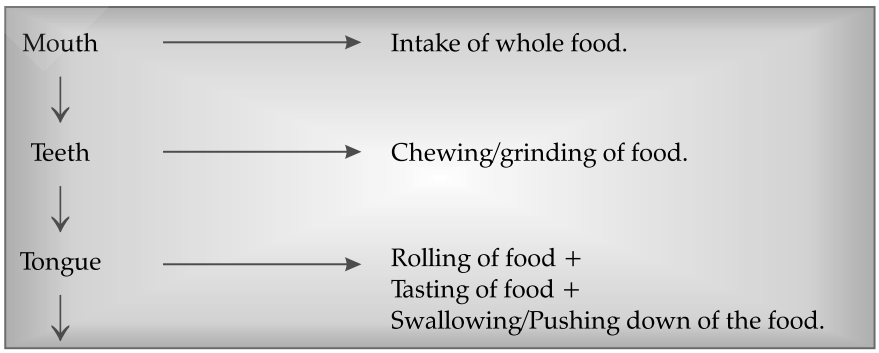
Revision Notes

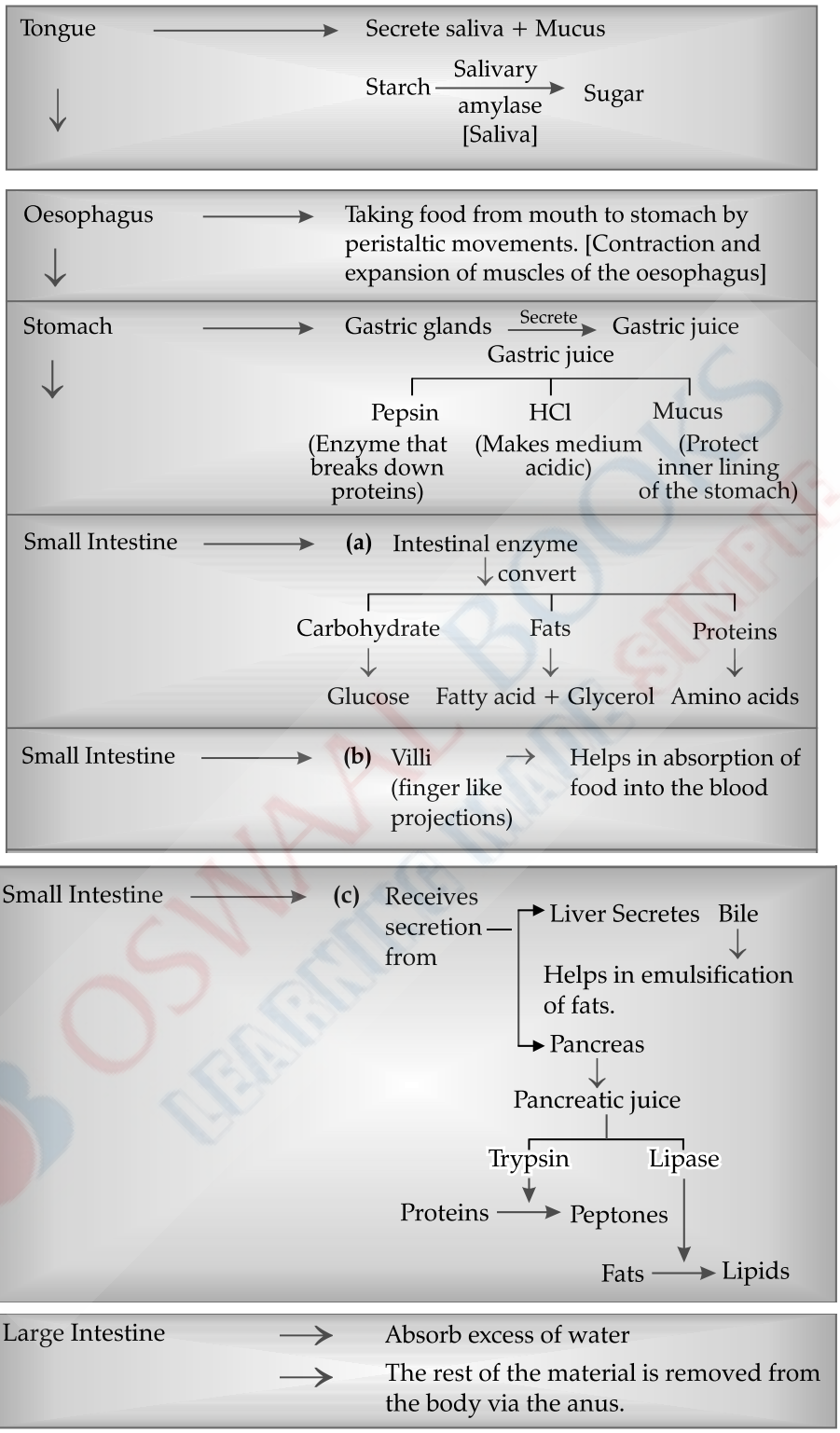
Nutrition

- All living things perform certain life processes like growth, excretion, respiration, circulation and reproduction etc.
- The basic functions performed by living organisms for their survival and body maintenance are called life processes.
- **Basic life processes are:**



- Energy required to carry out the different life processes, is obtained from carbon-based food sources through nutrition.
- Depending on the mode of nutrition, organisms are classified as autotrophs and heterotrophs.
  - **(i)** **Autotrophs** can prepare their own food from simple inorganic sources like carbon dioxide and water. (e.g., green plants, some bacteria).
  - **(ii)** **Heterotrophs** cannot synthesise their own food and are dependent on the autotrophs for obtaining complex organic substances for nutrition. (*e.g.*, animals)
- Green plants manufacture their food by the process of **photosynthesis**. Here, they utilise CO_2 and H_2O in presence of sunlight, with the help of chlorophyll and gives out O_2 as a by-product.
- In the light reaction of photosynthesis, light energy is absorbed and converted into chemical energy in the form of ATP and NADPH. Also, water molecules split into hydrogen and oxygen.
- Carbon dioxide is reduced to carbohydrates in the dark phase of photosynthesis.
- Plants carry out exchange of gases with surrounding atmosphere through stomata.
- In humans, digestion of food takes place in the alimentary canal, made up of various organs and glands.
- Liver secretes bile, which emulsifies fat.

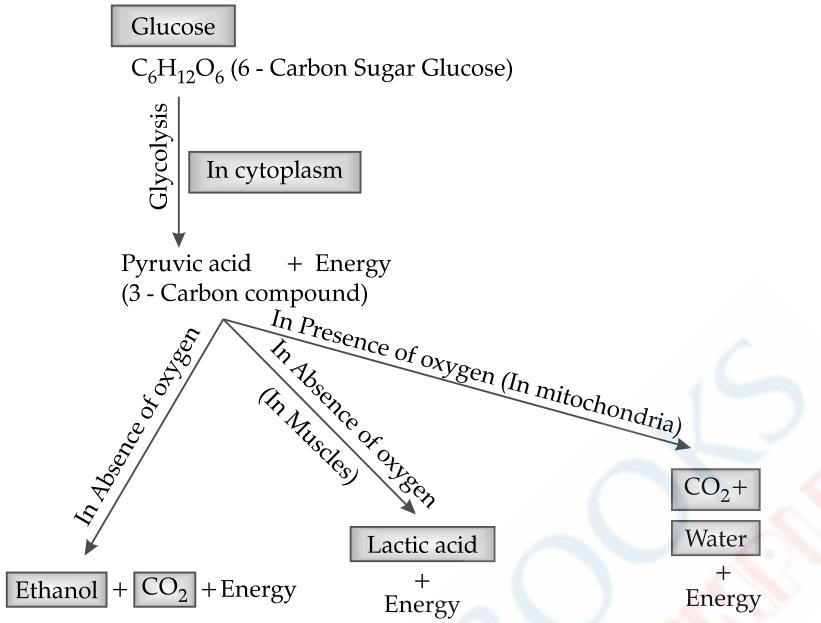




Respiration

- Respiration is the process in living organisms, which involves:
  (i) **Gaseous exchange:** Intake of oxygen from the atmosphere and release of CO_2 → Breathing
  (ii) Breakdown of simple food in order to release energy inside the cell → Cellular respiration

- **Breakdown of Glucose by Various Pathways:**



- **Types of Respiration:**

Respiration	
Aerobic	**Anaerobic**
Takes place in the presence of oxygen.	Takes place in the absence of oxygen.
Occurs in mitochondria.	Occurs in cytoplasm.
End products are CO_2 and H_2O.	End products are alcohol or lactic acid.
More amount of energy is released.	Less amount of energy is released.
Examples: Most plants and animals.	Examples: Muscles, bacteria, yeast and parasitic worm etc.

- **In humans, air takes the following path on entering the nostrils:**
  Nostrils → Nasal passage → Pharynx → Larynx → Trachea → Bronchus → Bronchiole → Alveolus.
- The alveoli of lungs are richly supplied with blood and are the sites where exchange of gases (O_2 and CO_2) occurs between blood and atmosphere.
- In humans, the respiratory pigment haemoglobin carries oxygen from lungs to different tissues of the body.
- In plants, gaseous exchange takes place through stomata in leaves, lenticels in stems, general surface of roots and transpiration.

Circulation and Transportation

Human Circulatory System

- 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 system. 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.
- **Differences between arteries and veins:**

Arteries		Veins	
1.	Carry oxygenated blood from heart to different body parts except pulmonary artery.	**1.**	Carry deoxygenated blood from different body parts to the heart except pulmonary vein.
2.	Also called distributing vessel.	**2.**	Also called collecting vessel.
3.	Walls thick, elastic and muscular.	**3.**	Thin, non muscular and less elastic.

4.	Deep seated	**4.**	Superficial as compared to arteries.
5.	Have no valves	**5.**	Have valves, which prevent backward flow of blood.

- There are two main conducting channels in vascular plants. These are Xylem and Phloem.

Xylem		Phloem	
1.	Transports water and minerals from the roots to upper parts of the plant.	**1.**	Transports product of photosynthesis from leaves to the non-photosynthesising parts of the plants such as root & stem.
2.	No energy is used for transport.	**2.**	Energy is used from ATP for transport.
3.	On maturity, the xylem becomes dead tissue and gives mechanical support to the plant.	**3.**	Phloem exists as living soft tissue.

- **Transpiration:** It is the process of loss of water as vapours from aerial parts of the plant.

Excretion

Excretion in Human

- During excretion, the harmful metabolic nitrogenous wastes like urea and uric acid generated are removed from the body.
- Nephrons are the basic filtration units of kidneys. They carry out filtration, selective reabsorption and tubular secretion to form urine in kidney, which is then passed out through the urethra, via the ureters and urinary bladder.
- Each kidney contains many filtration units called as nephrons.
- Nephrons are made up of a cluster of thin walled capillaries called glomerulus which is associated with a cup like structure called as Bowman's capsule and the long tube which terminates through this capsule.
- The renal artery brings oxygenated blood to the kidneys along with the nitrogenous wastes like urea and uric acid and many other substances.
- The blood gets filtered through the glomerulus and this filtrate enters the tubular part of nephron.
- As this filtrate moves down the tubular part, glucose, amino acids, salts and excess of water gets selectively reabsorbed by the blood vessels surrounding tubules.
- **The amount of water re-absorbed depends upon:**
  - **(A)** How much excess of water is there in the body and,
  - **(B)** How much nitrogenous wastes need to be excreted out.
- The fluid now flowing in the tubular part is urine, which gets collected in collecting ducts of nephrons.
- These collecting ducts together leave the kidney at a common point by forming the ureter.
- Each ureter drains the urine in the urinary bladder where it is stored until the pressure of expanded bladder leads to an urge to pass it out through urethra.
- This bladder is a muscular structure which is under nervous control.
- 180 litres of filtrate is formed daily but only 2 litres is excreted out as urine so the rest is reabsorbed in the body.
- In case of kidney failure, haemodialysis is the process of purifying blood by an artificial kidney.
- **Excretion in plants:** In plants, excretion of oxygen, CO_2 and water takes place through stomata by the process of transpiration.

Mnemonics

Concept: Parts of an alimentary canal in humans.

Mnemonics: MOSS DJ I LA – remember this as "Kate MOSS is a DJ In LA"

Interpretation:

M = Mouth
S = Stomach
D = Duodenum
I = Ileum
A = Anus
O = Oesophagus
S = Small Intestine (made up of)
J = Jejunum
L = Large Intestine

Know the Terms

- **Metabolism**: It is the sum total of all the chemical reactions which occur in a living being due to interaction amongst its molecules. It has two components: Anabolism (build-up reactions) and Catabolism (breakdown reactions).
- **Photosynthesis**: It is the process of synthesis of organic food from inorganic raw materials like $CO_2 + H_2O$ with the help of light energy, inside chlorophyll containing cells.
- **Photolysis**: Photolysis of water is photocatalytic splitting of water into its components, hydrogen and oxygen.

$$2H_2O \longrightarrow 4H^+ + 4e^- + O_2$$

- **Peristalsis:** It is a wave of contraction behind the food and expansion in the region of contained food that occurs in the alimentary canal for pushing the food from anterior to posterior ends.
- **Succus Entericus:** It is the name of digestive juice of small intestine, also known as intestinal juice.
- **Emulsification:** Emulsification of fats is conversion of large fat pieces into very fine fat globules.
- **Phagocytosis:** It is the process of ingestion of solid food particle by a cell or unicellular organism.
- **Circumvallation:** This is the method of intake of food when *Amoeba* comes in contact with a food particle or prey, it throws pseudopodia all around the prey. The tips of encircling pseudopodia fuse and the prey comes to lie in a vesicle or phagosome.
- **Cutaneous Respiration:** It is the mode of exchange of respiratory gases that occurs through skin.
- **Branchial Respiration:** It is the respiration performed with the help of gills.
- **Aerobic respiration:** It is the step-wise complete oxidative breakdown of respiratory substrate into carbon dioxide and water with the help of oxygen that act as terminal oxidant.
- **Glycolysis (EMP pathway):** It is the first step of breakdown of respiratory substrate which occurs in cytoplasm and produces two molecules of pyruvate from a molecule of glucose.
- **Kreb's Cycle:** It is a cyclic series of metabolic reactions of aerobic respiration that occur inside mitochondria.
- **Haemolysis:** It is the process of destruction of RBC's.
- **Serum:** It is a whitish watery fluid that is squeezed out from contracting blood clot.
- **Diapedesis:** It is the crawling of white blood corpuscles out of blood capillaries into surrounding tissues.
- **Pulse:** It is a repeated throb felt in a superficial artery of the body due to forceful pumping of the blood. It depends on the rate of heart beat.
- **Ascent of Sap:** It is the upward movement of absorbed water or sap from root to the top of the plant. It occurs through xylem.
- **Excretion:** It is the process of throwing out of waste products and other harmful chemicals from the body.
- **Nephric Filtrate:** It is the fluid passed out of glomerulus due to ultrafiltration in the malpighian capsule of a nephron.
- **Ultrafiltration:** It is the filtration under pressure of small particles, solutes and solvents, through a finely porous membrane.

- **Glomerulus:** It is a bunch of fine blood vessels or capillaries present in the depression of Bowman's capsule where ultrafiltration occurs.
- **Micturition:** It is the expulsion of urine from the body.
- **Bowman's Capsule:** It is a broad, blind, cup-shaped, proximal end of a nephron in which glomerulus is located for ultrafiltration.
- **Osmoregulation:** It is the maintenance of a fixed osmotic concentration of body fluids by controlling the amount of water and salts.

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Unit -III : Natural Phenomena

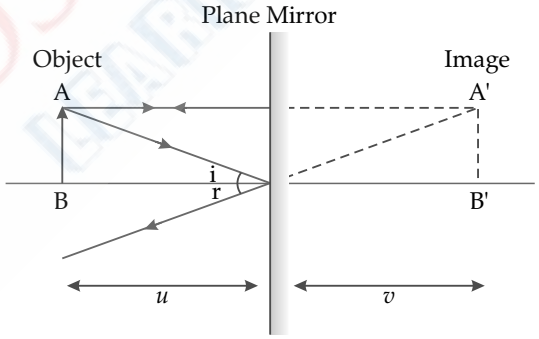
Chapter - 5 : Light Reflection and Refraction

Revision Notes

Reflection of Light, Images Formed by Spherical Mirrors

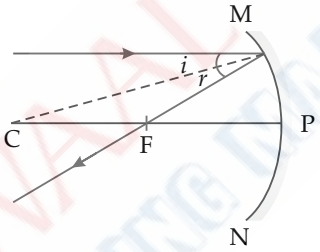
Introduction

- When light falls on a body, it may be absorbed, may be transmitted or light may get reflected back to the same medium.
- **Reflection of light** is the phenomenon of bouncing back of the light rays in the same medium.
- **Laws of Reflection:**
  - **(i)** The incident ray, the reflected ray, the normal, all lie in the same plane at the point of incidence.
  - **(ii)** The angle of in+*cidence is equal to the angle of reflection.
- **Real image** is obtained when the rays of light after reflection or refraction actually meet at some point. It can be obtained on the screen and can be seen with the eye.
- **Virtual image** forms when rays of light do not actually meet, but appear to meet when produced backwards. It cannot be obtained on the screen.
- **Image Formed by plane Mirror:**

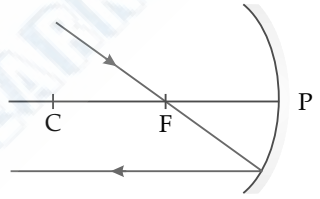


- **Characteristics of Image:**
  - **(i)** Virtual and erect.
  - **(ii)** Size of image is equal to the size of object.
  - **(iii)** Image is formed as far as behind the mirror as the object is in front of it.
  - **(iv)** Laterally inverted.
- **Lateral Inversion:** The phenomenon due to which the right side of the object appears as left and the left side of the object appears as right. *i.e.,* the image is inverted sideways.
- A spherical mirror whose reflecting surface recessed inward, is concave mirror.
- The spherical mirror, whose reflecting surface bulges towards light source, is a convex mirror.

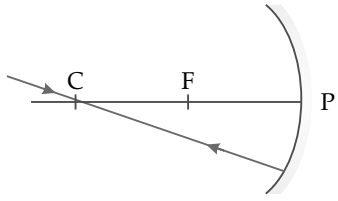
- Concave mirror mostly forms real images, which can be obtained on the screen. Convex mirror always forms virtual images, which cannot be obtained on the screen.
- **Differentiating between a plane mirror, a concave mirror and a convex mirror, without touching them:**
  - **(i)** If the formed image is erect, of same size and equidistant as of object, then it is a plane mirror
  - **(ii)** If the formed image formed is erect but smaller in size, then it is a convex mirror
  - **(iii)** If the formed image is erect, real and magnified when the mirror is close to the object, then it is a concave mirror
- Solar concentrators use huge concave mirrors to focus large amount of solar energy thereby producing high temperature conditions in a solar power plant.
- The centre of the reflecting surface of a spherical mirror is called the pole of the mirror and it is usually represented by P.
- The horizontal line passing through the centre of curvature and pole of the spherical mirror is known as principal axis.
- The centre of curvature of a spherical mirror is the centre of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by C.
- The radius of curvature of a spherical mirror is the radius of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by R.
- The diameter of the reflecting surface, *i.e.*, twice the radius is called its aperture.
- Radius of curvature (R) = 2 × focal length (f).
- **Rules for making ray diagrams by concave mirror:**
  - **(i)** A ray parallel to the principal axis will pass through the principal focus, after reflection.



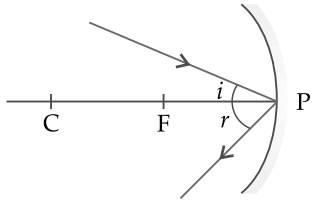
  - **(ii)** A ray passing through the principal focus of concave mirror will be parallel to principal axis after reflection.



  - **(iii)** A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path as it is a normally incident ray.



  - **(iv)** A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angle.



- **Image formation by a concave mirror for different positions of the object:**

Position of Object	Position of Image	Size of Image	Nature of Image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

- **Image formation by a convex mirror for different positions of the object:**

Position of Object	Position of Image	Size of Image	Nature of Image
At infinity	At the focus F, behind the mirror	Highly diminished, point-sized	Virtual and erect
Between infinity and the pole P of the mirror	Between P and F, behind the mirror	Diminished	Virtual and erect

- **Mirror Formula:**

$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$$

Where, v = Image distance
u = Object distance
f = Focal length

- **Magnification of Spherical Mirrors:**

It is the ratio of the height of image to the height of object.

$$m = \frac{\text{Height of image}}{\text{Height of object}}$$

$$m = \frac{h_i}{h_o} = -\frac{v}{u}$$

If 'm' is negative, image is real.
If 'm' is positive, image is virtual.
If $h_i = h_o$ then $m = 1$, *i.e.*, image is equal to object.
If $h_i > h_o$ then $m > 1$ *i.e.*, image is enlarged.
If $h_i < h_o$ then $m < 1$ *i.e.*, image is diminished.

- Magnification of plane mirror is always + 1.
  '+' sign indicates virtual image.
  '1' indicates that image is equal to object's size.
- If 'm' is '+ve' and less than 1, it is a convex mirror.
- If 'm' is '+ve' and more than 1, it is a concave mirror.
- If 'm' is '–ve', it is a concave mirror.
- The phenomenon of change in the path of light from one medium to another is called refraction of light.
- The angle formed between the incident ray and the normal is called angle of incidence and the angle formed between the refracted ray and the normal is called angle of refraction.
- The cause of refraction is the change in the speed of light as it goes from one medium to another medium.
- Larger the difference in speed of light between the two media across the interface, the greater will be the deviation and vice-versa.

- When a ray of light passes from a rarer medium to a denser medium, it bends towards the normal. Also, the angle of incidence is greater than the angle of refraction.
- When a ray of light passes from a denser medium to a rarer medium, it bends away from the normal. Also, the angle of incidence is less than the angle of refraction.

Refraction, Lenses and Power of Lens

- **Laws of refraction:**

  First law: The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.

  Second law: The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given color and for the given pair of media. This law is also known as **Snell's law** of refraction.

$$n = \frac{\sin i}{\sin r}$$

- **Refractive index (n):** The ratio of speed of light in a given pair of media,

$$n = \frac{\text{Velocity of light in medium 1}}{\text{Velocity of light in medium 2}}$$

  n_{21} means refractive index of second medium with respect to first medium and,

$$n_{21} = \frac{v_1}{v_2}$$

  n_{12} means refractive index of first medium with respect to second medium.

$$n_{12} = \frac{v_2}{v_1}$$

- **Absolute Refractive Index:** Refractive index of a medium with respect to vacuum or air.

$$n = \frac{c}{v} \text{ where, } c = 3 \times 10^8 \text{ ms}^{-1}$$

- Refractive index of one medium is reciprocal of other's refractive index in a given pair.

$$n_{12} = \frac{1}{n_{21}}$$

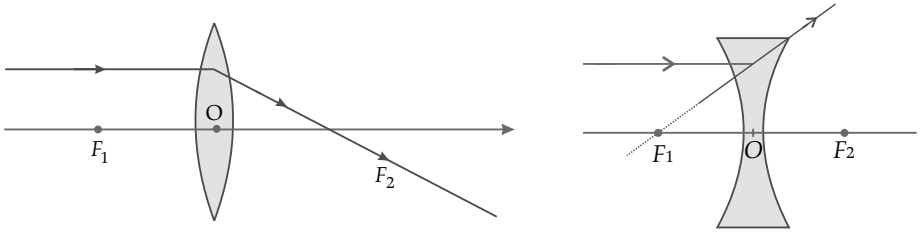
- If refractive index of medium 1 w.r.t. air is given as ${}_1n^{\text{air}}$ and if refractive index of medium 2 w.r.t. air is given as ${}_2n^{\text{air}}$, then refractive index of medium 1 w.r.t. medium 2 $= \frac{{}_1n^{\text{air}}}{{}_2n^{\text{air}}} = {}_1n^2$
- Refractive index of diamond is the highest till date. It is 2.42. It means speed of light is $\frac{1}{2.42}$ times less in diamond than in vacuum.
- **Lens Formula:** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$
- **Magnification:** $m = \frac{h_i}{h_o} = \frac{v}{u}$
- **Power of a lens:** It is defined as the reciprocal of focal length in meter.
- The degree of convergence or divergence of light rays is expressed in terms of power.

$$\text{Power} = \frac{1}{\text{Focal length (in meter)}} \text{ or P} = \frac{1}{f}$$

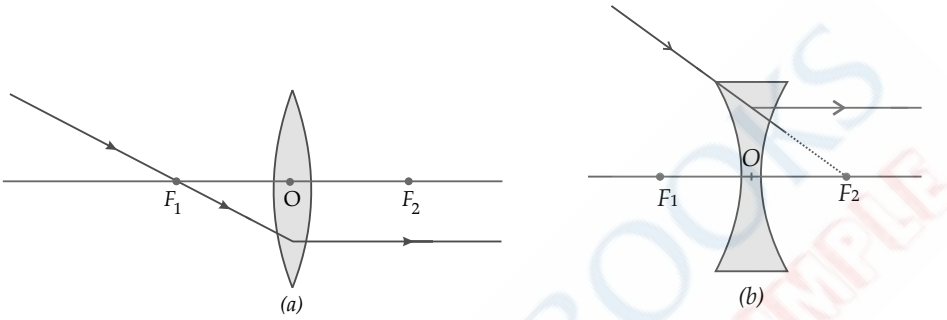
- SI unit of Power = dioptre = D, 1 D = 1 m^{-1}
- 1 dioptre is the power of lens whose focal length is one meter.

➢ **Rules for making ray diagrams by lens:**

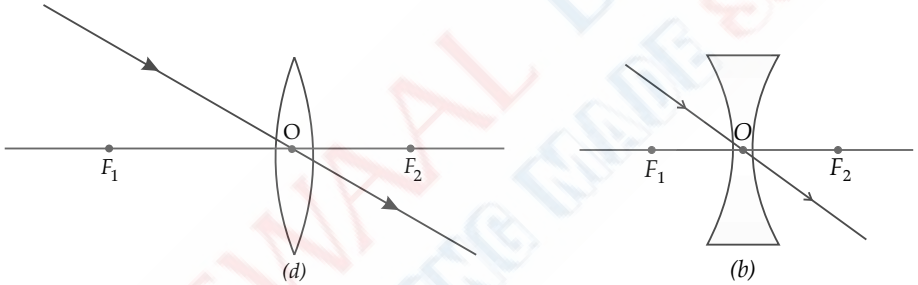
(i) A ray of light from the object parallel to the principal axis passes through the focus after refraction.



(ii) A ray of light passing through a principal focus becomes parallel to the principal axis after refraction.



(iii) A ray of light passing through the optical centre travels undeuiated even after refraction.



➢ **Nature, position and relative size of the image formed by a convex lens for various positions of the object:**

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_2	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_2$	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At focus F_1	At infinity	Infinitely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre	On the same side of the lens as the object	Enlarged	Virtual and erect

➢ **Nature, position and relative size of the image formed by a concave lens for various positions of the object:**

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_1	Highly diminished, point-sized	Virtual and erect
Between infinity and optical centre O of the lens	Between focus F_1 and optical centre O	Diminished	Virtual and erect

Mnemonics

Concept: Image formation by concave mirror

Mnemonics: Mnemonics:54321 to be converted in 12345

At F	1
Between C and F	2
At C	3
Beyond C	4
Infinity	5
Between F and P	Exception

Object	1	2	3	4	5
Image	5	4	3	2	1

Interpretation:
If object is at infinity (5) , image will be formed at F (1)
If object is at beyond C (4), image will be formed at between C and F (2)
And so on.

Know the Terms

- **Ray and beam:** Rectilinear propagation light travels in a straight line. The straight line indicating the path of the light (arrow–direction) is called a ray. A bundle of rays originating from the same source of light in a particular direction is called a beam of light.
- **Parallel beam:** When the rays which constitute the beam are parallel to one another, then it is called a parallel beam of light.
- **Convergent beam:** When the rays actually meet or appear to meet at a point, then the beam is called convergent beam and rays are called convergent rays.
- **Divergent beam:** When the rays actually diverge or appear to diverge from a point, then the beam is called divergent beam and rays are called divergent rays.
- **Image:** The point of convergence or the point from where the light appears to diverge after reflection or refraction is called an image.
- **Aperture:** The width of the reflecting refractions surface from which reflection refraction takes place is called aperture.
- **Pole: The central point** of the reflecting spherical surface is called pole (P). It lies on the surface of the mirror.
- **Centre of curvature:** The centre of the hollow sphere of which the spherical mirror lens is a part, is called centre of curvature (C).
- **Radius of curvature:** The separation between the pole optical centre and the centre of the hollow sphere, of which the mirror lens is a part, is called radius of curvature (R).
- **Principal axis:** The straight line joining the pole optical centre and the centre of curvature is called principal axis.
- **Focus:** The point F on the principal axis, where a beam of light parallel to the principal axis actually meet after reflection refraction or appear to come from it is called its principal focus.
- **Focal length:** The distance between the pole optical centre and the focus is called focal length.

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Chapter - 6 : Human Eye and Colourful World

Revision Notes

Refraction of Light through prism, Dispersion of Light and Scattering of Light

- The phenomenon of splitting of white light into its constituent colours on passing through a glass prism is called **dispersion of light**.
  Concept Name: Spectrum
- Different colours undergo different deviations on passing through prism.
- If a second identical prism is placed in an inverted position with respect to the first prism, all the colours recombine to form white light.
- **Atmospheric refraction** is the phenomenon of bending of light on passing through earth's atmosphere.
- As we move above the surface of earth, density of air goes on decreasing.
- Light travelling from rarer to denser layers always bends towards the normal.
- Stars twinkle on account of atmospheric refraction.
- Sun appears to rise 2 minutes earlier and set 2 minutes later due to atmospheric refraction.
- The phenomenon in which a part of the light incident on a particle is redirected in different directions is called **scattering of light.**
- Very small particles scatter light of shorter wavelengths better than longer wavelengths.
- The scattering of longer wavelengths of light increases as the size of the particle increases.
- Larger particles scatter light of all wavelengths equally well.

Mnemonics

Concept: Complete Phenomenon of light	
Mnemonics: **VIBGYOR**	
Interpretation: **V - V**iolet **I - I**ndigo **B - B**lue **G - G**reen **Y - Y**ellow **O - O**range **R - R**ed	A prism causes dispersion, Stars twinkle due to refraction, Scattering causes redirection, All have their own attraction.

Know the Terms

- **Prism:** Prism is a homogenous, transparent, refracting material, such as glass, enclosed by two inclined plane refracting surfaces, at some fixed angle, called refracting angle or angle of prism. It has two triangular bases and three rectangular lateral surfaces which are inclined to each other.
- **Angle of Refraction:** The angle between the refracted ray and the normal is called angle of refraction ($\angle r$).
- **Angle of Emergence:** The angle between the emergent ray and normal at the second refracting face of the prism is called angle of emergence ($\angle e$).
- **Angle of Deviation:** The angle formed between the incident ray produced in the forward direction and emergent ray produced in the backward direction in the refraction through the prism is called angle of deviation ($\angle \delta$).
- **Tyndall effect:** The phenomenon of scattering of light by the colloidal particles is known as tyndall effect.

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