Chemical Reactions and Equations

Chemical Reaction: The transformation of chemical substance into another chemical substance. e.g. Rusting of iron, the setting of milk into curd.

Chemical Equation: Representation of chemical reaction using symbols and formulae of the substances.

Reactant ⟵ $\boxed{A + B} \rightarrow \boxed{C + D}$ ⟶ Product

Reactant ⟵ $\boxed{Mg + O_2} \rightarrow \boxed{MgO}$ ⟶ Product

Characteristic	Example Reaction
Change in Colour	$Fe + CuSO_4$(Blue) → $FeSO_4$(Blue-green) + Cu
Change in Temperature	$CaO + H_2O \rightarrow Ca(OH)_2$ + Heat (heat is generated)
Change in State	$H_2(g) + O_2(g) \rightarrow H_2O(l)$ (i.e., gas to liquid)
Evolution of Gas	$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$
Formation of Precipitate	$Pb(NO_3)_2(aq) + KI(aq) \rightarrow PbI_2(s) + KNO_3(aq)$
Endothermic Reaction	$CaCO_3$ + Heat → $CaO + CO_2$ (photosynthesis also)
Exothermic Reaction	$CaO + H_2O \rightarrow Ca(OH)_2$ + Heat (digestion and respiration also)

Kuch important terms:

→**Precipitate**: Insoluble solid formed after a chemical reaction.

→**Exothermic Reaction**: Reaction releasing heat energy.

→**Endothermic Reaction**: Reaction absorbing heat energy.

→**Catalyst**: Speeds up a reaction without being consumed.

Balanced Chemical Equation: Number of atoms of each element in reactants = number of atoms of each element in products. **Law of Conservation of Mass**: Mass of reactants = Mass of products

Balance these: $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

- Draw boxes around formulas.
- Count atoms on both sides.
- Start with the biggest compound.
- Balance elements one by one.
- Use smallest whole numbers.
- Recheck for balance.

Types of Chemical Reactions:

1. Combination Reaction: Two or more reactants combine to form single products.

A + B → AB

$CaO + H_2O \rightarrow Ca(OH)_2$

$2H_2 + O_2 \rightarrow 2H_2O$

The most effective way to test for CO_2 is to bubble the gas through lime water, which is a diluted solution of calcium hydroxide.

2. Decomposition Reaction: A single reactant decomposes to form two or more products.

AB → A + B

$CaCO_3(s) \rightarrow CaO(s) + CO_2$

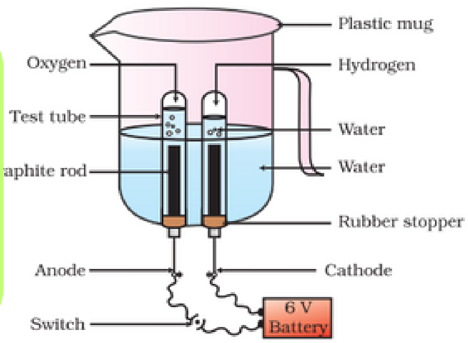
$FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$

→ **Thermal Decomposition** (thermal energy) $CaCO_3 \rightarrow CaO + CO_2$

→ **Photolytic Decomposition** (energy from sunlight) $2AgBr \rightarrow 2Ag + Br_2$ *black & white photography*

→ **Electrolytic Decomposition** electrical energy) $2H_2O \rightarrow 2H_2 + O_2$

Hydrogen (cathode) will produce a popping sound when a burning candle is brought close.
Oxygen (anode) will make the flame of the candle burn brighter.



3. Displacement Reaction: a more reactive element displaces a less reactive element from its compound.

Single Displacement **A + BC → AC + B**

$Zn + CuSO_4 \rightarrow Cu + ZnSO_4$

Double Displacement **AB + CD → AD + CB**

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

Reaction	Observation
$Mg + O_2 \rightarrow MgO$	Magnesium ribbon burns with a dazzling white flame and forms a white powder (magnesium oxide).
$Pb(NO_3)_2 + KI \rightarrow PbI_2$	Yellow precipitate of lead iodide forms, and the solution changes from colorless to yellow.
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$	Bubbles of hydrogen gas form around the zinc metal. Heat is released during the reaction.
$CaO + H_2O \rightarrow Ca(OH)_2$	Calcium oxide reacts vigorously with water to produce slaked lime, releasing a large amount of heat.
$2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$	Initially green; turns white, then brown (ferric oxide) with the smell of burning sulfur.

Reaction	Observation
$2AgCl \rightarrow 2Ag + Cl_2$ (in sunlight)	White silver chloride turns grey in sunlight.
$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$	The deep blue solution fades to light green, and the iron nail becomes covered with a red-brown layer of copper.
$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$	A white precipitate of barium sulfate forms.
$2Cu + O_2 \rightarrow 2CuO$	Black copper oxide (CuO) forms. Hydrogen gas can reduce CuO back to copper during a reverse reaction.

4. Redox Reactions: **Oxidation**: + oxygen or - hydrogen
Reduction: - oxygen or + hydrogen

Oxidizing agent: An oxidizing agent is a substance that causes oxidation by accepting electrons; therefore, it gets reduced.

Reducing agent: A reducing agent is a substance that causes reduction by losing electrons; therefore it gets oxidized.

Issme batao:

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

Oxidised (+O)

$ZnO + C \rightarrow Zn + CO$

Reduced (-O)

K
Na
Ca
Mg
Al
Zn
Fe
Pb
H
Cu
Hg
Ag
Au

Rancidity: the spoilage of fats and oils in food, leading to unpleasant taste and smell. Examples: Spoiled butter, Old cooking oil, Stale chips

Prevention: Adding antioxidants, storing foods in airtight containers, and refrigerating can help slow down or prevent the oxidation process and, consequently, rancidity

Effects of oxidation in daily life:

Corrosion: metals are gradually destroyed by chemical reactions with substances in their environment, such as moisture and acids. Examples: Rusting of iron, Tarnishing of silver, Green coating on copper

Prevention: Coating metals with protective layers (e.g., paint or galvanization) helps prevent direct exposure to oxygen and moisture, reducing the risk of corrosion.

- *Silver develops a black coating after some time.*
- *Copper develops a green coating after some time.*

Chapter ka KAZAANA:

- *Balancing (MCQs)*
- *Type of Reaction and Example (Specially Decomposition and Redox)*
- *Color Change Activities*

Acids , Bases And Salts

PRASHANT KIRAD

ACID	BASES
Usually sour in taste.	Bitter in taste and soapy to touch.
Turns blue litmus paper red.	Turns red litmus paper blue.
Gives hydrogen ions in solution pH < 7	Gives hydroxyl ions in solution pH > 7
e.g. Hydrochloric Acid (HCl), Acetic Acid (CH_3COOH)	eg. Sodium Hydroxide (NaOH)

Important

Natural Source	Acid	Natural Source	Acid
Vinegar	Acetic acid	Sour milk (Curd)	Lactic acid
Orange	Citric acid	Lemon	Citric acid
Tamarind	Tartaric acid	Ant sting	Methanoic acid
Tomato	Oxalic acid	Nettle sting	Methanoic acid

INDICATORS: A chemical compound that changes its colour in presence of an acid or a base.

OLFACTORY: substances whose odour changes in acidic or basic medium are called Olfactory indicators. eg- Vanilla, Onion. clove oil. base (no smell), acid (smell remains)

Natural: (found in nature)

Indicator	Neutral solution	Reac. with Acid	Reac. with Base
Litmus	Pale purple (Mauve)	Red	Blue
Hydrangea flowers	Blue	Blue	pink
Turmeric	yellow	yellow	Red

Synthetic: (from chemical proesses)

Indicator	Reac. with Acid	Reac. with Base
Phenolphthalein	Colourless	pink
Methyl Orange	Red	yellow

Litmus solution is a purple dye from lichen, used as an indicator

Chemical Properties of Acid:

Base with Metal Metal + Base → Salt + Hydrogen Gas

eg; $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$ {Hydrogen gas evolved; indicates a reaction with the base}

Base with Non-Metal Oxide Non-Metallic Oxide + Base → Salt + Water

eg; $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$ {Neutralization reaction; forms salt and water, indicating acidic nature of non-metal oxide}.

Base + Acid → Salt + Water $NaOH + HCl \rightarrow NaCl + H_2O$

Chemical Properties of Acids:

Acid with Metal eg: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
{Hydrogen gas evolved; bubbles in soap solution ignite with a popping sound when a burning candle is brought near.}

Metal Carbonate eg: $Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$
{Carbon dioxide turns lime water milky, indicating its presence}

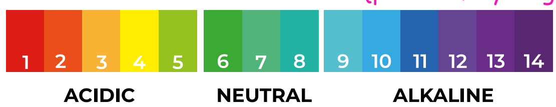
Metal Hydrogencarbonate eg: $NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$
{Carbon dioxide turns lime water milky, indicating its presence.}

Metallic Oxide eg: $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
{The solution turns blue-green, indicating the formation of copper(II) chloride.}

Strength of Acids and bases:

- Strength of Acid and Base can be estimated using universal indicator.
- It shows different colours at different concentrations of H+ ions in the solution.

P(potenz)H: pH is a measure of the concentration of hydrogen ions in solution. {power of hydrogen}



pH<7 { Acidic }
ph = 7 { neutral }
pH>7 { Basic }

- **Strong acids release more H^+ ions, while weak acids release fewer H^+ ions. The same applies to bases.**

Dilution occurs when an acid or base is mixed with water, reducing the concentration of H_3O^+ or OH^- ions per unit volume, making the acid or base less concentrated.

diluted acid - small amount of acid (solute) dissolved in a large amount of water (solvent)

Concentrated acid - large amount of acid dissolved in a small amount of water.

Importance of pH in daily life:

- Digestion: The stomach uses hydrochloric acid with a pH of 1 to 3 to break down food.
- Soil: Plants thrive in soil with a pH of 6.3 to 7.3. If soil is too acidic, adding lime helps; if too basic, gypsum is added.
- Tooth Decay: Bacteria in the mouth make it acidic, leading to tooth decay. Toothpaste, being basic, balances the mouth's pH.
- Blood: Blood functions best with a pH between 7.0 to 7.8.
- Plants and Animals: They prefer specific pH levels, with most plants growing best in soil around pH 7.
- Bee Stings: Baking soda neutralizes the acidity caused by bee stings.
- Acid Rain: Pollution can cause rain to become acidic, harming fish and other animals.

Salts

alts are ionic compounds composed of positively charged ions (cations) and negatively charged ions (anions), These ions are held together by ionic bond

H: strong acid + strong base are neutral (pH 7).
strong acid + weak base are acidic (pH < 7),
strong base + weak acid are basic (pH > 7).

Sodium Chloride (NaCl) $HCl + NaOH \rightarrow NaCl + H_2O$ (Neutral)

- Found in seawater and rock salt deposits
- Used in food seasoning, raw material for chemicals like NaOH,.

Sodium Hydroxide (NaOH) (Basic) $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$ (Chlor-alkali process)

- Produced by electrolysis of brine
- At anode: Cl_2 (uses Water treatment, PVC, disinfectants)
- At cathode: H_2 gas (uses Fuels, margarine.)
- Near cathode: NaOH solution is formed (Soap, paper, textiles.)

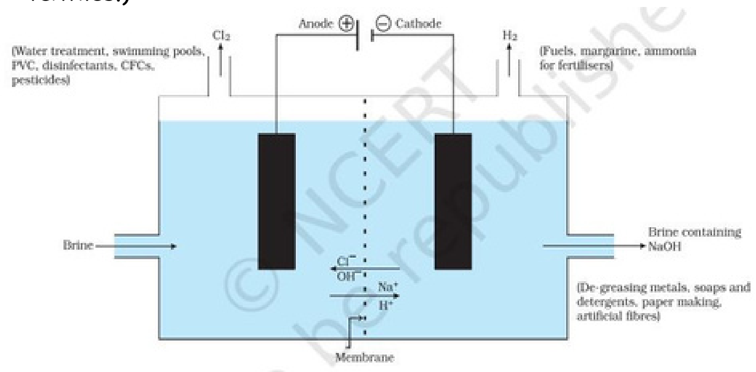


Figure 2.8 Important products from the chlor-alkali process

Sodium Hydrogen Carbonate ($NaHCO_3$) $NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$ (Basic)

- Produced using sodium chloride, water, and carbon dioxide
- Used in bakng powder, antacids, soda-acid fire extinguisher.

Sodium Carbonate (Na_2CO_3)

$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ **Baking Soda** (Basic)

- Obtained by heating sodium hydrogen carbonate and recrystallization
- Used in glass, soap, and paper industries, and to remove water hardness.

Calcium Oxychloride ($CaOCl_2$)

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

Bleaching powder

- Produced by reacting chlorine with slaked lime
- Used for bleaching in textile and paper industries,

Calcium Sulphate Hemihydrate ($CaSO_4 \cdot \frac{1}{2}H_2O$)

$CaSO_4 \cdot 2H_2O$ (gypsum) $\rightarrow CaSO_4 \cdot \frac{1}{2}H_2O$ (Plaster of Paris) $+ 1\frac{1}{2}H_2O$ (Neutral)

- Found as gypsum in natural deposits
- Used for removing permanent hardness of water.

Sodium Carbonate Decahydrate ($Na_2CO_3 \cdot 10H_2O$) (Basic)

$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3 \cdot 10H_2O$

Washing Soda

- Produced by recrystallization of sodium carbonate
- Used as washing soda, in glass, soap, and paper industries, and for removing permanent hardness of water.

Copper(II) Sulphate ($CuSO_4 \cdot 5H_2O$)

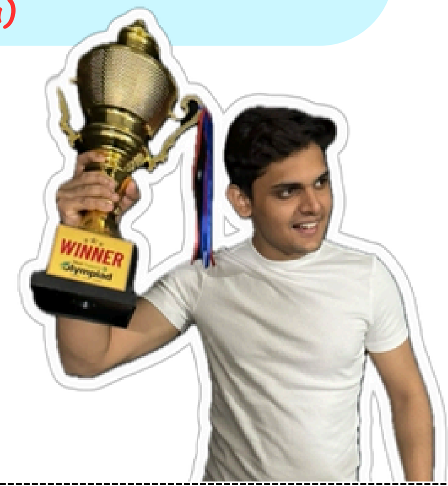
$CuSO_4 \cdot 5H_2O$ (blue) $\rightarrow CuSO_4$ (white) $+ 5H_2O$ (Acidic)

Are the Crystals of Salts really Dry?

- Copper sulphate, contain water molecules in their crystal structure, known as water of crystallisation.
- When copper sulphate crystals are heated, they lose their water of crystallisation and turn from blue to white.
- Rehydration: Adding water back to the white, anhydrous copper sulphate restores its blue color.
- Chemical Formula: The hydrated form of copper sulphate is represented as $CuSO_4 \cdot 5H_2O$, indicating it has five water molecules per formula unit..

Chapter ka KAZAANA:

- ***Indicators + pH scale***
- ***Chlor - Alkali Process***
- ***POP, Washing, Baking Soda (Specially Baking Soda)***



Metals and Non Metals

Property	Metals	Non-Metals
State	Solid at room temperature (except Mercury - liquid)	Can exist in all three states: solids (e.g., Sulfur, Phosphorus), liquid (Bromine - only liquid), gases (e.g., Oxygen, Nitrogen)
Lustre	Shiny (metallic lustre)	Dull (except Iodine - lustrous)
Hardness	Generally hard (except Sodium, Potassium - soft)	Generally soft (Diamond - exception, hardest natural substance)
Malleability	Can be beaten into sheets	Brittle, cannot be beaten into sheets
Ductility	Can be drawn into wires	Non-ductile, cannot be drawn into wires
Conductivity (Heat & Electricity)	Good conductors (except Lead, Mercury - poor conductors of heat)	Poor conductors (except Graphite - conducts electricity but not heat efficiently)
Melting & Boiling Point	Generally high (except Gallium, Caesium - low melting points)	Generally low (Diamond - exception, extremely high melting point)
Sonority	Produces sound when struck	Does not produce sound

Reactions of Metals and Non Metals

Oxygen - Non - metals

Non-Metal + Oxygen → Non-Metal Oxide (Acidic/Neutral)

Example: $C + O_2 \rightarrow CO_2$

$S + O_2 \rightarrow SO_2$

Oxygen - Metals

Metal + Oxygen → Metal Oxide (Basic)

Example: $2Mg + O_2 \rightarrow 2MgO$

Amphoteric Metals: Beryllium (Be), Zinc (Zn), Tin (Sn), Lead (Pb), Aluminium (Al), (Antimony (Sb)

Aluminium with Oxygen: $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

Zinc with Oxygen: $2Zn(s) + O_2(g) \rightarrow 2ZnO(s)$

Aluminium Oxide Reactions:

- $Al_2O_3(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2O(l)$
- $Al_2O_3(s) + 2NaOH(aq) \rightarrow 2NaAlO_2(aq) + H_2O(l)$

Water- Non - metals

Non metals don't react with water

Non-Metal Oxide + Water → Acid

- $SO_2 + H_2O \rightarrow H_2SO_3$
- $SO_3 + H_2O \rightarrow H_2SO_4$
- $CO_2 + H_2O \rightarrow H_2CO_3$
- $NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

Water- Metal

Metal + Water → Metal Hydroxide + H_2

Na_2O, K_2O, CaO, and MgO dissolve in water to form metal hydroxides

Example: $2Na + 2H_2O \rightarrow 2NaOH + H_2$

K, Na react violently with water; Ca reacts mildly; Ca+2H2O→Ca(OH)2+H2

Mg reacts with hot water. Al, Fe, Zn react with steam; 2Al+3H2O (steam)→Al2O3+3H2

3Fe+4H2O (steam)→Fe3O4+4H2

Pb, Cu, Ag, Au do not react with water.

Acids- Non - metals No Reaction

Acids- Metal

Metal + dil. Acid → Salt + H_2

Example: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

Hydrogen gas isn't produced when metals react with HNO_3 because it oxidizes H_2 to water and reduces to nitrogen oxides.

Only Mg and Mn with very dilute HNO_3 release H_2 gas.

Metal (Mg and Mn) + Dilute nitric acid → Salt + Hydrogen gas

- $2Mg + 4HNO_3 \rightarrow 2Mg(NO_3)_2 + H_2$
- $Mn + 2HNO_3 \rightarrow Mn(NO_3)_2 + H_2$

Other Metals + Dilute nitric acid → Salt + Water + $NO_2/N_2O/NO$

Aqua regia is a mix of concentrated hydrochloric and nitric acids in a 3:1 ratio. It's highly corrosive and can dissolve gold and platinum.

Metal Salts Non - metals

No Reaction

Metal Salts Metal

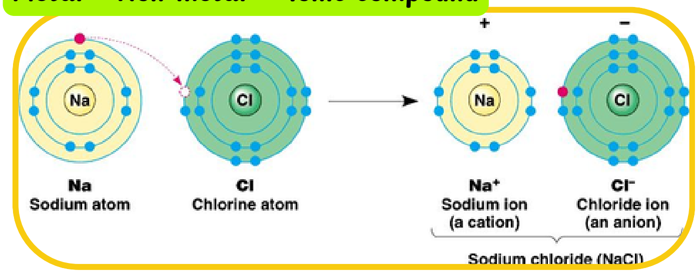
More reactive metals displace less reactive metals from their salt solutions (displacement reaction).

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

Example: $Pb + CuCl_2 \rightarrow PbCl_2 + Cu$

When metals react with non-metals, electrons transfer from metals to non-metals, forming ions. The compound formed is ionic.

Metal + Non-metal → Ionic compound PROPERTIES?



Property	Description
Physical nature	Solid, hard, brittle due to strong ionic bonds.
Melting & Boiling points	High, due to strong inter-ionic attractions requiring more energy to break.
Solubility	Soluble in water, insoluble in organic solvents like kerosene and petrol.
Electrical conductivity	Conducts in molten and aqueous states, not in solid due to immobile ions.

Metallurgy: Science & tech of metals' properties, production, purification

↓

Minerals: Naturally occurring elements/compounds in Earth's crust

↓

Ores: Minerals from which metals can be extracted economically and conveniently

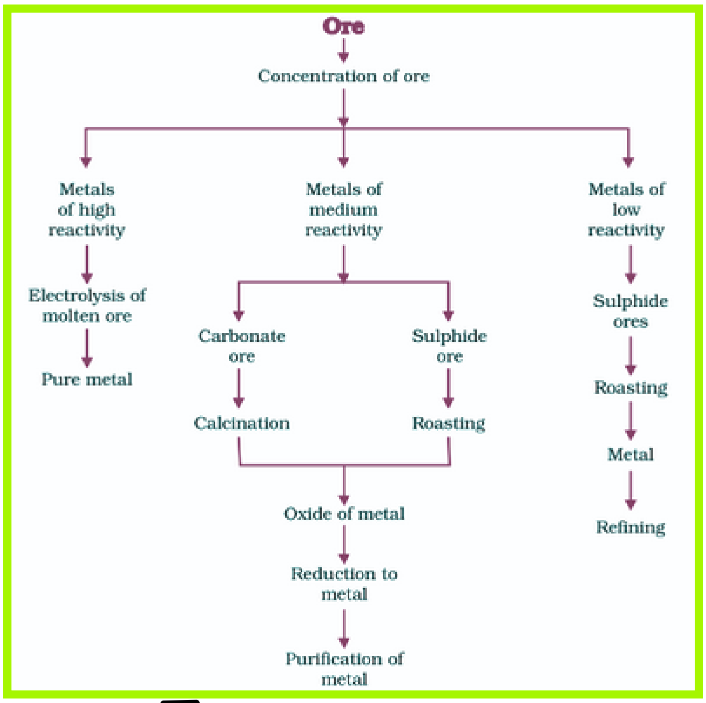
↓

Gangue Particles: Impurities in ores (sand, oil, etc.)

↓

Enrichment of Ore/Concentration: Process of removing gangue particles from ore

Zinc (Zn) - Zinc Blende (Sphalerite) : ZnS
- Calamine : $ZnCO_3$
Mercury (Hg) - Cinnabar : HgS
Copper (Cu) - Copper Glance : Cu_2S
Aluminium (Al)- Bauxite : $Al_2O_3 \cdot xH_2O$



K (Potassium)
Na (Sodium)
Ca (Calcium)
Mg (Magnesium)
Al (Aluminum)
— *Electrolysis* — Highly reactive metals (K, Na, Ca, Mg, Al) are extracted using electrolysis.

Zn (Zinc)
Fe (Iron)
Pb (Lead)
— *Reduction using carbon* — Moderately reactive metals (Zn, Fe, Pb) are usually extracted through carbon reduction.

Cu (Copper)
Ag (Silver)
Au (Gold)
— *Found in native state* — Metals like gold and silver are found in a free state due to low reactivity.

Roasting	***Calcination***
Heating of a metal ore in the presence of excess air or oxygen.	Heating of a metal ore in the presence of limited air or oxygen.
Requires an excess amount of air or oxygen.	Done with limited air or oxygen.
Mainly done for sulphide ores.	Done for carbonate ores.
Releases toxic gases and substances (e.g., SO_2).	Releases volatile compounds, often less toxic than in roasting.

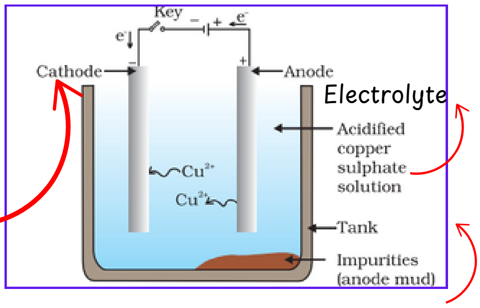
Electrolysis Highly reactive metals (K, Na, Ca, Mg, Al) are extracted using electrolysis.

Reduction using carbon Moderately reactive metals (Zn, Fe, Pb) are usually extracted through carbon reduction.

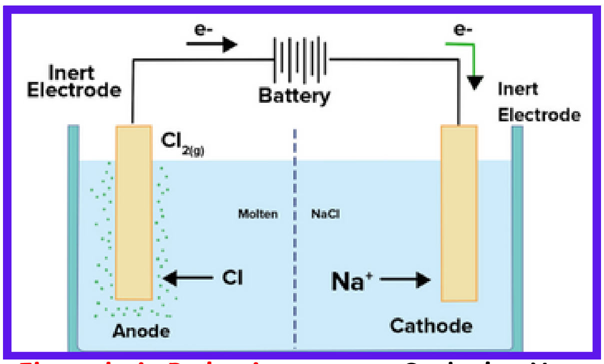
Found in native state Metals like gold and silver are found in a free state due to low reactivity.

Refining of Metals

Electrolytic refining is widely used for purification.
Metals like copper, zinc, tin, nickel, silver, gold are refined using this method



Insoluble impurities form anode mud, while soluble ones stay in the solution.



Electrolytic Reduction

Cathode : $Na^+ + e^- \rightarrow Na$
Anode : $2Cl^- \rightarrow Cl_2 + 2e^-$

Alloying

- An alloy is a mixture of metals or a metal with a non-metal, altering properties like conductivity and melting point.
  Examples :
- Brass (Copper + Zinc) and Bronze (Copper + Tin) are poor conductors, unlike Copper, which powers electrical circuits.
- Solder (Lead + Tin) melts easily, making it perfect for welding electrical wires.
- Pure gold is soft, so it is alloyed with silver or copper to make jewelry, typically in 22 carat form in India.
- The Iron Pillar near Qutub Minar in Delhi, over 1600 years old, resists rust due to ancient Indian metallurgy techniques

Chapter ka KAZAANA:

- **Chemical Properties of Metal**
- **Reactivity Series (Give reasons type of questions)**
- **Exceptional Cases (HNO_3 reaction with metals)**
- **Metallurgy**
- **Calcination/Roasting**
- **Electrolytic Refining**

Carbon And Its Compound

Carbon: Carbon is the 15th most abundant in the earth's crust.

Atomic mass :12u.

Atomic number : 6.
no. of protons = no. of neutrons = 6

Valency : 4

shell - K L
No. of electrons- 2 4 → elctronic arrangment

Covalent bond

chemical bond that involves the sharing of electrons to form electron pairs between atoms.

Three types of covalent bonding

Single Covalent Bond **Double Covalent Bond** **Triple Covalent Bond**

Properties of Covalent Compounds:

Low melting/boiling points due to weaker intermolecular forces compared to ionic compounds.
- Physical state can be solid, liquid, or gas.
- Poor conductors of electricity as they lack charged particles.
- Generally soluble in organic solvents, insoluble in water (exception: sugar in water).

Catenation: Carbon forms strong covalent bonds with itself, creating chains, branches, or rings.

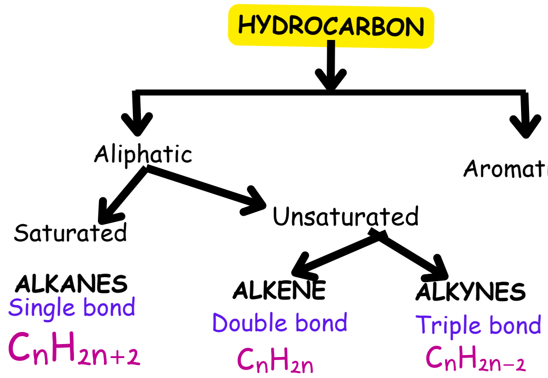
Polymerisation: Small molecules (monomers) join to form large molecules (polymers).

Isomerism: Compounds with the same molecular formula but different structures.

Tetravalency of Carbon: Carbon has four valence electrons, forming four covalent bonds instead of gaining or losing electrons, ensuring stability and diverse organic compounds.

Allotropes: the various physical forms in which an element can exist.

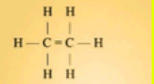
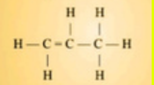
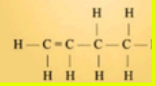
DIAMOND	GRAPHITE	FULLURENCE
3D network, each carbon bonds with four others; very hard.	Layers of hexagons held by weak forces soft and slippery	Hollow, cage-like with 60 carbons; soccer ball shape.
Four strong covalent bonds per carbon; highly stable.	Three covalent bonds per carbon, with delocalized electrons.	Strong covalent bonds in hexagons and pentagons.
Hard, transparent, high refractive index; jewelry, abrasives.	Soft, used in pencils and lubricants.	Unique electronic properties; used in nanotech, drugs.

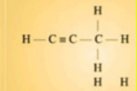
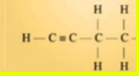


ALKANES

Name	Molecular Formula	Condensed Formula	Structural Formula
Methane	CH_4	CH_4	
Ethane	C_2H_6	H_3CCH_3	
Propane	C_3H_8	$H_3CCH_2CH_3$	
Butane	C_4H_{10}	$H_3C(CH_2)_2CH_3$	
Pentane	C_5H_{12}	$H_3C(CH_2)_3CH_3$	
Hexane	C_6H_{14}	$H_3C(CH_2)_4CH_3$	
Heptane	C_7H_{16}	$H_3C(CH_2)_5CH_3$	

ALKENE

ame of Hydrocarbon	Mileculas formula	Structural Formula
lkenes :		
. Ethene	C_2H_4	
. Propene	C_3H_6	
. Butane	C_4H_8	

lkynes :		
1. Ethyne	C_2H_2	
2. Propyne	C_3H_4	
3. Butyne	C_4H_6	

ALKYNES

Three types of Hydrocarbons

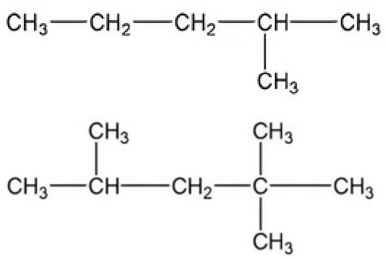
Straight chain : Each carbon atom is bonded to either one or two other carbon atom

Branched chain: Each carbon atom is bonded to one, two, or more than two other carbon atoms

Cyclic Hydrocarbon: Carbon atoms form a closed ring structure. e.g. Cyclohexane (C_6H_{12}), Benzene (C_6H_6).

COMMON NOMENCLATURE: They are named after their sources of isolation. Formic acid derives from "Formectus," meaning red ant, and acetic acid from "Acetum," meaning vinegar.

International Union of Pure and Applied Chemistry (IUPAC), founded in 1919, establishes standardized naming rules in chemistry



NAME THESE

Functional groups:

In hydrocarbons, hydrogen atoms can be replaced by heteroatoms (e.g., Cl, S, N, O), forming functional groups that determine the compound's reactivity and properties.

Rules for Naming Compounds with Functional Groups

Common Functional Groups & Their Formulae:

- Alcohol (-OH) → Ends in -ol (e.g., Ethanol)
- Aldehyde (-CHO) → Ends in -al (e.g., Ethanal)
- Ketone (-CO-) → Ends in -one (e.g., Propanone)
- Carboxylic Acid (-COOH) → Ends in -oic acid (e.g., Ethanoic acid)
- Amine ($-NH_2$) → Ends in -amine or starts with Amino-

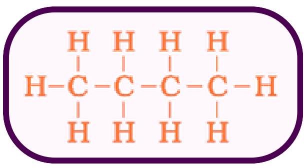
Naming Rules:

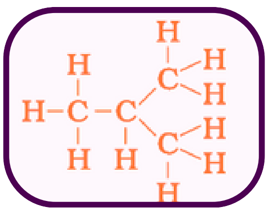
- Identify the longest carbon chain.
- Number the chain to give the functional group the lowest possible number.
- Functional groups have priority over alkanes, alkenes, and alkynes.
- Use suffix or prefix based on the functional group.
- If multiple groups are present, the most important one gets the suffix.
- Priority Order (Highest to Lowest):
- -COOH > -CHO > -CO- > -OH > $-NH_2$

Homologous series:

a collection of compounds with the same general formula that differ only in the carbon chain length.
-Homologues share the same general formula.
- Differ by a $-CH_2$ group; molecular mass difference is 14 μ.
- Similar chemical properties.
- Gradual change in physical properties.
- Functional group influences properties.

Isomerism Compounds with identical molecular formula but different structures.





Chemical properties of carbon Compounds

Combustion (Burning)

Carbon compounds burn in oxygen (O_2) to form CO_2, H_2O, and heat.Example: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat

Oxidation

Alcohols are oxidized to acids using $KMnO_4$ or $K_2Cr_2O_7$.
Example: $CH_3CH_2OH + [O] \rightarrow CH_3COOH$

Addition Reaction

Unsaturated hydrocarbons (alkenes, alkynes) add H_2 in the presence of Ni/Pd catalyst.
Example: $CH_2{=}CH_2 + H_2 \rightarrow CH_3{-}CH_3$

Substitution Reaction

Alkanes react with halogens (Cl_2, Br_2) in the presence of sunlight.
Example: $CH_4 + Cl_2 \rightarrow$ (Sunlight) $\rightarrow CH_3Cl + HCl$

Chemical properties of Ethanol and Ethanoic Acid

Ethanol (C_2H_5OH):

Physical Properties of Ethanol:

- Ethanol is a liquid at room temperature.
- It is soluble in water in all proportions.
- Commonly known as alcohol, it is the active ingredient in alcoholic drinks.
- It is a good solvent, used in medicines like tincture iodine, cough syrups, and tonics.

Reactions of Ethanol:

Reaction with Sodium: Ethanol reacts with sodium, producing hydrogen gas and sodium ethoxide.

- Equation: $2Na + 2C_2H_5OH \rightarrow 2C_2H_5O^-Na^+ + H_2$

Dehydration of Ethanol to Ethene:

- Ethanol is heated with excess concentrated sulphuric acid at 443 K, leading to the removal of water (dehydration) and formation of ethene.
- Equation: $C_2H_5OH \rightarrow CH_2{=}CH_2 + H_2O$ **(In presence of hot conc. H_2SO_4)**
- Sulphuric acid acts as a dehydrating agent.

Denatured alcohol is ethanol mixed with chemicals to make it unfit for drinking. It is used in industries for cleaning, fuel, and as a solvent. The added substances, like methanol, make it poisonous and undrinkable to avoid misuse. Denatured alcohol is cheaper than pure ethanol due to tax exemptions.

Ethanoic Acid (CH_3COOH):

Commonly known as **acetic acid**, belongs to the carboxylic acid group. 5-8% solution in water is called vinegar, used as a preservative in pickles. Melting point: 290 K; freezes in winter, hence called glacial acetic acid. Weak acid compared to mineral acids like HCl (does not fully ionize in water).

Reactions of Ethanoic Acid:

1. Esterification Reaction: Reacts with ethanol in the presence of concentrated H_2SO_4 to form ester (sweet-smelling, used in perfumes & flavoring agents).

$$\underset{\text{(Ethanoic acid)}}{CH_3-COOH} + \underset{\text{(Ethanol)}}{CH_3-CH_2OH} \xrightleftharpoons{\text{Acid}} \underset{\text{(Ester)}}{CH_3-\overset{\overset{\large O}{\|}}{C}-O-CH_2-CH_3} + H_2O$$

2. Saponification reaction: Process of converting esters into salts of carboxylic acids and ethanol by treating them with a base.

$$\underset{\substack{\text{Ethyl ethanoate}\\\text{(Ethyl acetate)}}}{CH_3COOC_2H_5} + \underset{\text{Sodium hydroxide}}{NaOH} \xrightarrow{\text{Heat}} \underset{\substack{\text{Sodium ethanoate}\\\text{(Sodium acetate)}}}{CH_3COONa} + \underset{\substack{\text{Ethanol}\\\text{(Ethyl alcohol)}}}{C_2H_5OH}$$

3. Reaction with Bases: Reacts with sodium hydroxide to form sodium ethanoate (sodium acetate) and water.

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

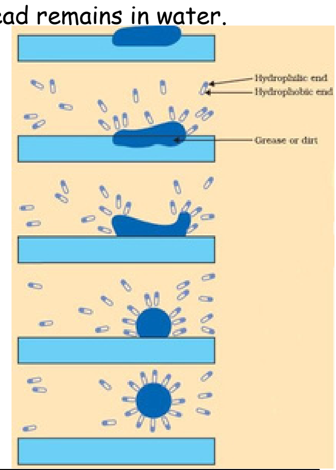
4. Reaction with Carbonates and Hydrogencarbonates: Reacts with Na_2CO_3 or $NaHCO_3$, producing carbon dioxide, water, and sodium acetate.

$$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$$
$$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

Structure of Soap/Detergent Molecule

- Soap/Detergent molecules have two ends:
  - Hydrophilic head (Water-attracting, polar)
  - Hydrophobic tail (Oil-attracting, non-polar)
- Cleansing Process (Micelle Formation)
- Oil and dirt do not mix with water.
- When soap/detergent is added, the hydrophobic tail attaches to grease/dirt, while the hydrophilic head remains in water.
- The molecules arrange themselves in a micelle structure, surrounding the dirt.
- The dirt gets trapped inside micelles and is lifted off the surface.
- When rinsed with water, the micelles are washed away, removing dirt

Soap molecule



Soap	Detergents
Molecules of soap are sodium or potassium salts of long-chain carboxylic acids.	Detergents are sodium salts of sulphonic acids or ammonium salts with chloride or bromide ions.
Not so effective in hard water.	Effective even in hard water.
Relatively weak cleansing action.	Strong cleansing action.
Soaps are biodegradable.	Most of them are non-biodegradable.

Hard Water	Soft Water
Contains high mineral content, mainly calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions.	Contains low mineral content, mainly sodium (Na^+) or potassium (K^+) ions.
Does not lather easily with soap.	Lathers easily with soap.
Forms scum and scale in pipes, boilers, and appliances.	Does not form scum or scale.
Can cause roughness in hair and skin.	Feels smooth on skin and hair.
Example: Groundwater, well water.	Example: Rainwater, distilled water.

Chapter ka KAZAANA:

- *IUPAC Naming*
- *Electron Dot Structure (Ethanol, Amine)*
- *Homologous Series (MCQs)*
- *Important Reactions: Esterification, Saponification, Dehydration of Ethanol*
- *Working of Soap (diagram)*

Electricity

Electric Charge

physical property of matter that causes it to experience a force when placed in an electromagnetic field. S.I. Unit: Coulomb (C)

- Positive charge : Loss of electron
- Negative charge : Gain of electron

$Q = ne.$

Properties:

1. Additivity of Charge :Total charge=sum of all charges on the body.
2. Charge is Conserved : Charge cannot be created or destroyed.
3. Charge is Invariant : Charge value remains the same, regardless of speed.
4. Quantization of Charge : Charge is a multiple of electron charge:

Conductors	Semiconductors	Insulators
Allow Current to pass	Medium Conductivity	Don't allow Current to pass

Electric Current

Flow of electric charge through a conductor.
Unit: Ampere (A) → 1 A = 1 C/s.

$I = \frac{Q}{t}$

I = current, Q = charge, t = time.

1 Ampere: When 1C of charge flows in 1 second then current is said to be 1A.

Potential Difference

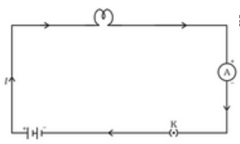
The work done to move a unit positive charge between two points.
Unit: Volt (V) → 1 V = 1 J/C.

1 Volt :1 Joule of work done to move 1 unit positive charge between two points

$V = W/Q$

Electric Circuit

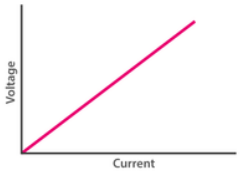
A continuous path for current flow, consisting of a ...er source, conductor, and load.



Sl. 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	or
8	A resistor of resistance R	
9	Variable resistance or rheostat	or
10	Ammeter	
11	Voltmeter	

Ohm's Law

Current through a conductor is directly proportional to the potential difference across its ends, at a constant temperature



$V \propto I$

$V = IR$

$R = \rho L/A$

$\rho = RA/L$

$\rho = \Omega m$

Resistance:

Property of a conductor that resists the flow of charges. Unit: Ohm (Ω).

Factors Affecting Resistance:

- Length (l): R∝l
- Area (A): R∝1/A
- Material: Different materials have different resistivities (ρ)

Question Asked

***Step 1** : Firstly check what question is asking and write given, to find from question . Out of V,I,R two quantities will be given and you'll have to find third one. Other information might also be provided to find other two values.*

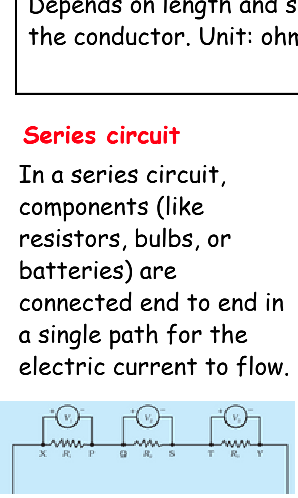
Step 2 : Then finally use Ohm's Law:
V = IR
Don't forget to write units

Resistance and Resistivity ka diffrence yaad rkhna

Resistance	Resistivity
Opposition to the flow of electric current in a substance. Depends on length and size of the conductor. Unit: ohm (Ω).	Resistance of a material with unit length and unit cross-sectional area. Independent of length or size of the conductor.Unit: ohm-meter (Ω·m).

Series circuit

In a series circuit, components (like resistors, bulbs, or batteries) are connected end to end in a single path for the electric current to flow.



Series Circuit

Voltage: Total voltage (V) is the sum of the voltages across each resistor:
$V = V_1 + V_2 + V_3$

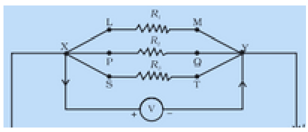
Current: Current (I) is the same through each resistor.

Ohm's Law for Each Resistor:
$V_1 = IR_1, V_2 = IR_2, V_3 = IR_3$

Equivalent Resistance:
$V = IR$
Substituting:
$IR = IR_1 + IR_2 + IR_3$
Cancelling I:
$R_s = R_1 + R_2 + R_3$

Parallel Circuit

In a parallel circuit, components are connected in separate branches, and each component gets its own direct path to the power source



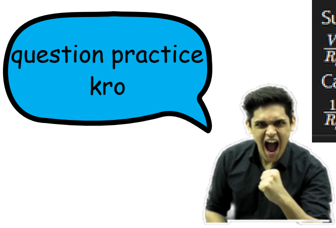
Parallel Circuit

Current: Total current (I) is the sum of the currents through each resistor:
$I = I_1 + I_2 + I_3$

Voltage: Voltage (V) is the same across each resistor.

Ohm's Law for Each Resistor:
$I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2}, I_3 = \frac{V}{R_3}$

Equivalent Resistance:
$I = \frac{V}{R_p}$
Substituting:
$\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$
Cancelling V:
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$



Heating effect of electric current

Joules Law oh Heating ; Heat is proportional to the square of the current, resistance, and time.

For a current I flowing through a resistor of resistance R with a potential difference V, the work done to move a charge Q across the resistor is VQ. The power input to the circuit is:

$$P = \frac{VQ}{t} = VI$$

The energy supplied by the source in time t is VIt. This energy is dissipated as heat in the resistor, so the heat produced is:

$$H = VIt$$

Using Ohm's law, V=IR, the heat can also be expressed as:

$$H = I^2Rt$$

Applications:

- Electric Bulb-has a tungsten filament inside a neutral gas or vaccum. When current passes through, the filament heats up and emits light, with most energy lost as heat.
- Electric fuse- is a low melting point wire in a circuit. If current rises suddenly, the wire melts, breaking the circuit and preventing damages.
- Electric heater- Use a nichrome coil with high resistance to generate heat when current flows

Electric Power : Power (P): Rate of energy consumption.
Unit: Watt (W) → 1 W = 1 J/s.

$$P = VI$$
$$P = I^2R = V^2/R$$

1 watt is the power consumed by a device carrying 1A of current at 1V. In practice, a larger unit, the kilowatt (1000 watts), is used.

Electric Energy : energy used by a circuit to allow current flow. It is the product of power and time, measured in watt-hours (Wh).

Commercial Unit of Energy:
One watt-hour is the energy used when 1 watt of power is consumed for 1 hour. The commercial unit of electric energy is the kilowatt-hour (kWh), also called a "unit."

1 kWh = 1000 watts × 3600 seconds
= 3.6 × 10^6 watt-seconds
= 3.6 × 10^6 joules (J)

Question Based

Step 1: Read the question carefully. Identify the given values (V, I, R) and determine what needs to be found.

- Out of voltage (V), current (I), and resistance (R), two values will be given, and you'll have to find the third.
- Other information might be provided to calculate remaining values like power or heat.

Step 2: Use Ohm's Law: V=IR

- Ensure all units are correct before proceeding.

Step 3: For heat produced:

$$H = I^2Rt$$ or $$H = VIt$$

Step 4:

- For power calculation:

$$P = VI \quad \text{or} \quad P = I^2R \quad \text{or} \quad P = \frac{V^2}{R}$$

Step 5:

- Substitute the values into the appropriate formulas and calculate the required quantity. Always check your units at the end.

Chapter ka KAZAANA:

- **Numerical**
- **Series and Parallel Resistance**
- **R =ρ (l/A)**
- **Power/ Heating effect**
- **Ohm's Law Graph**
- **Calculating cost of Electricity of Appliance**

Magnetic Effect of Electric Current

PRASHANT KIRAD

Magnet: is any substance that attracts iron or iron like substances.

Properties of Bar Magnet:

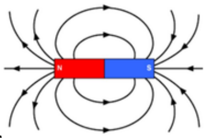
- A freely suspended bar magnet aligns in the Earth's north-south direction.
- Attractive and Repulsive Forces: Like poles repel, opposite poles attract.
- Dipole Nature: Always has two poles (north and south); cutting the magnet creates smaller magnets, each with two poles.
- Creates a magnetic field around it where its effect can be felt.
- It retains its magnetic properties over time.

Magnetic Field: is the area around a magnet in which the effect of magnetism is felt.

Magnetic field lines are imaginary lines that show the strength and direction of a magnetic field.

Properties of Magnetic Filed Lines:

- Magnetic field lines start at the north pole and end at the south pole.
- Closer lines mean a stronger magnetic field (near poles).
- Field lines never cross each other.
- They form closed continuous curves.
- They show the direction of magnetic force.

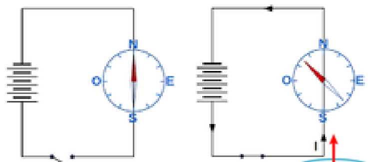


Horseshoe shaped

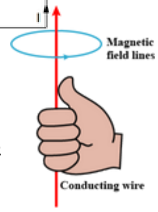
Bar magnet

Hans Christian Oersted (1820): Discovered that electric current deflects a compass needle, proving the link between electricity and magnetism.

Hans Christian Oersted



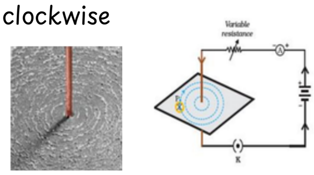
Maxwell's Right Hand Thumb Rule



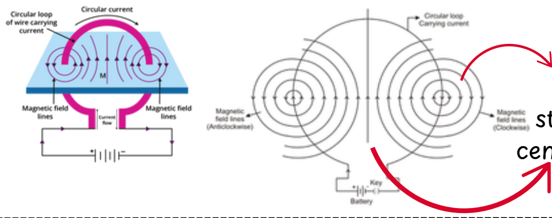
The rule states that if a straight conductor carrying current is held in the right hand such that the thumb is pointed in the direction of the current, then the direction in which your fingers encircle the wire gives the direction of the magnetic lines of force around the wire

Thumb = upwards, curled fingers = magnetic field (clockwise), the field direction = anticlockwise.
Thumb = downwards, curled fingers = magnetic field (anticlockwise), the field direction = clockwise

Magnetic field lines due to Straight conductor



Magnetic field lines due to current carrying loop

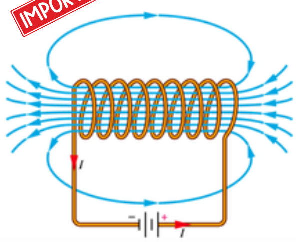


circular pattern around the arms

straight at the center of the loop

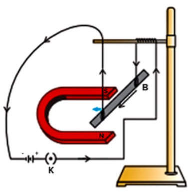
Magnetic field lines due to Solenoid electromagnet.

IMPORTANT



A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder.
Outside the solenoid: North to South
Inside the solenoid: South to North
Factors: number of turns in the coil, amount of current flowing through it, radius of coil, Material of core of the solenoid.

Force on a current carrying conductor in a magnetic field



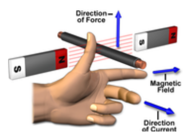
- Andre Marie Ampere's Suggestion (Magnet exerts equal and opposite force)
- Force on a current-carrying conductor in a magnetic field
- Maximum displacement (When current is at a right angle to the magnetic field)
- Reversing current direction → Force direction is reversed

Electromagnet	Permanent Magnet
Works only when current flows.	Always magnetic once magnetized.
Strength changes with current.	Strength depends on material.
Loses magnetism when current stops.	Loses magnetism permanently if demagnetized.
Needs electricity to stay magnetic.	No electricity required.
Made of soft materials.	Made of hard materials.
Poles can switch with current.	Poles stay the same.

Fleming's Left Hand Rule

When a current-carrying conductor is placed in an external magnetic field, the conductor experiences a force which is mutually perpendicular to both the Magnetic field and to the direction of the current flow.
Stretch the thumb, forefinger, and middle finger of your left hand perpendicular to each other.

IMPORTANT



- Forefinger = Magnetic field direction, Middle finger = Current direction, Thumb = Force/motion direction.

Domestic Circuit

1/100 second in India, i.e. the frequency of A.C in India is 50 Hz.

Potential Difference in India: 220V at 50Hz.

Alternating Current (AC)	Direct Current (DC)
AC can travel safely over long distances, even between cities.	DC cannot travel long distances; it loses power.
Frequency is 50 or 60 Hz, depending on the country.	DC has zero frequency.
Current direction reverses periodically.	Current flows steadily in one direction.
Cheaper then DC generation	Expensive then AC generation

Wire in Domestic Circuit

Earth Wire

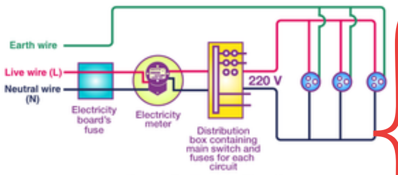
- Generally green in color, connected to a metal plate in the earth as a safety measure.
- Grounds gadgets with metallic bodies, preventing shocks by grounding leaked charges.

Live Wire

Positive, usually red, carries current in the circuit.

Neutral Wire

Negative, usually black, returns electricity to the power source



Power sockets (15A): For high-power appliances (geyser, fridge, AC).

Normal sockets (5A): For low-power appliances (TV, bulbs, fans).

Ekdum simple chapter!

Short Circuit : occurs when a live wire and a neutral wire come into direct contact, causing a sudden and large amount of current to flow in the circuit.
Reasons: damage of insulation in power lines, fault in an electrical appliance.
Overloading: If the total current drawn through a wire by the appliances connected to it exceeds the safety limit for that wire, it gets overheated.
Electrical fuse: is a low melting point copper or other metal wire that breaks due
to heat caused by overvoltage or high load to avoid short circuit or failure to the
device.

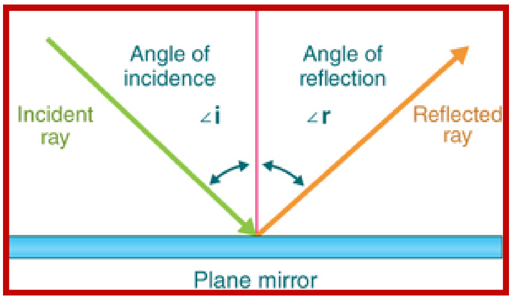
Chapter ka KAZAANA:

- **Fleming's left hand rule (Numerical)**
- **Solenoid (Diagram)**
- **Properties of Magnetic field lines**
- **Live wire, Neutral and earth wire.**

Light

- Rectilinear propagation of light - light travels in a straight line.
- Speed of Light = c = 3 x 10^8 m/s

Reflection: The bouncing back of light from any shiny surface e.g. mirror or water.



The Laws of reflection states that:
1. The **Incident ray**, the **Reflected ray** and **Normal** all lie in the **same plane**.
2. Angle of incidence (∠i) = The angle of reflection (∠r).

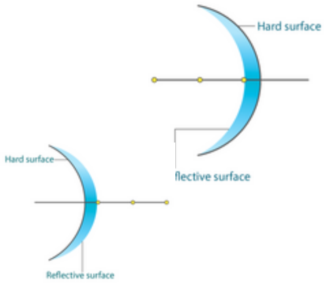
Plane mirror: A smooth and polished surface that reflects light uniformly.

The image formed by a plane mirror is :
- always virtual and erect.
- size of the image is equal to that of the object.
- image formed is as far behind the mirror as the object is in front of it.
- image is **laterally inverted.**

Spherical mirror: a mirror whose reflecting surface is part of a hollow sphere of glass.

CONCAVE MIRROR
reflecting surface is curved inwards, towards the center of the sphere

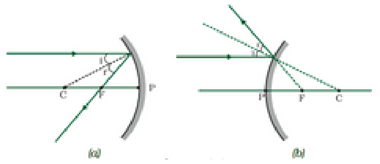
CONVEX MIRROR
reflecting surface is curved outwards.



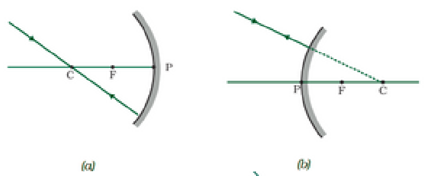
- **Pole (P):** The center point of the reflecting surface of a spherical mirror.
- **Centre of Curvature (C)**: The center of the sphere of which the mirror's reflecting surface forms a part.
- **Radius of Curvature (R)**: The radius of the sphere of which the mirror's reflecting surface forms a part. **R=2f**
- **Principal Axis:** The straight line passing through the pole and the center of curvature of the mirror.
- **Principal Focus (F)**: The point where parallel rays of light either converge or appear to diverge after reflecting from the mirror.
- **Focal Length (f)**: The distance between the pole and the principal focus.
- **Aperture:** The diameter of the reflecting surface of the spherical mirror.

Ray Diagrams

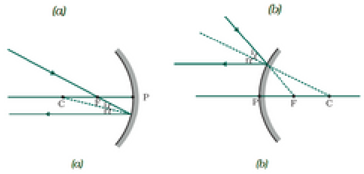
(i) A ray parallel to principal axis will pass through focus after reflection.



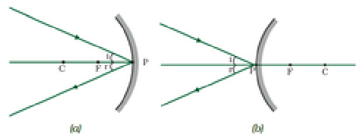
(iii) A ray passing through center of curvature will follow the same path back after reflection.



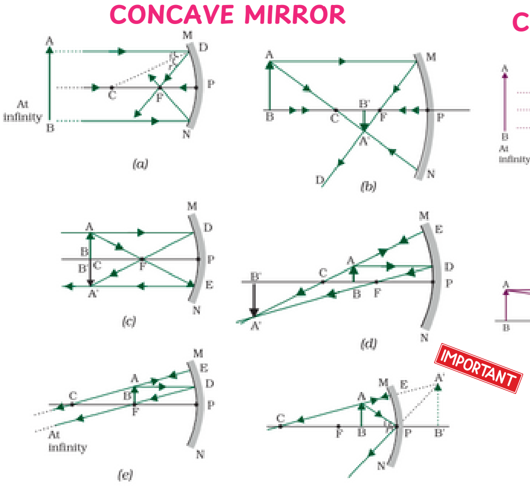
(ii) A ray passing through the principal focus will become parallel to principal axis after reflection



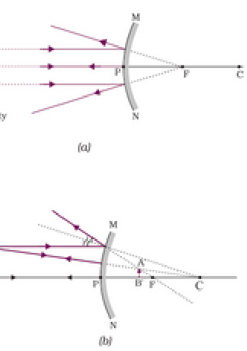
(iv) Ray incident at pole is reflected back making same angle with principal axis.



CONCAVE MIRROR



CONVEX MIRROR



Position of the object	Position of the image	Size of the image	Nature of the 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

Position of the object	Position of the image	Size of the image	Nature of the 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

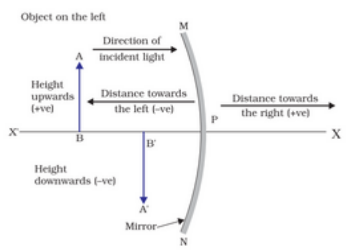
Uses of Concave Mirrors:
- Torches, Search-lights, and Vehicle Headlights:
- Shaving Mirrors
- Dentist's Mirrors
- Solar Furnaces

Uses of Convex Mirrors:
- Rear-view Mirrors in Vehicles:

Preferred in Vehicles:
- Provide erect, though diminished, images.
- Have a wider field of view due to their outward curve.
- Allow drivers to view a larger area compared to plane mirrors.

Sign Conventions for Spherical Mirrors:

- The object is always placed to the left of the mirror.
- Distances are measured from the pole of the mirror.
- Distances along the incident ray (+X-axis) are positive, and those against it (-X-axis) are negative.
- Distances above the principal axis are positive.
- Distances below the principal axis are negative.



Object distance = always +ve
Focal length of concave mirror = -ve
Focal length of convex mirror = +ve

Important Formulas:

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

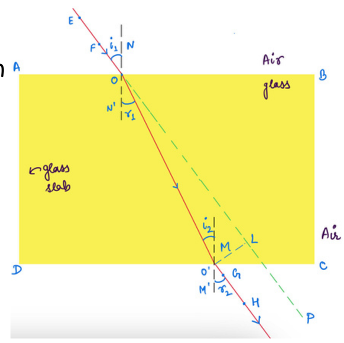
$$m=\frac{Height\ of\ image(h')}{Height\ of\ object(h)}=-\frac{v}{u}$$

h' = positive (virtual images)
h' = negative (real images)
m = negative (real)
m = positive (virtual)

Magnification **refers to the ratio of the height of an image to the height of an object**

Refraction of Light

Phenomenon of change in the direction of light when it passes from one transparent medium to another.



Laws of refraction of light.

(i) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.

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

Snell's law of refraction.

Refractive index:

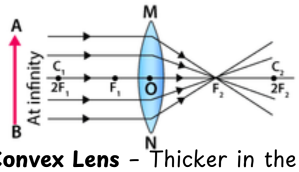
$$n_m=\frac{\text{Speed of light in air}}{\text{Speed of light in medium}}=\frac{c}{v}$$

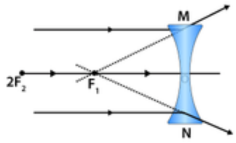
measurement of how much a light ray bends when it passes from one medium to another.

Lenses:

A transparent material bound by two surfaces, of which one or both surfaces are spherical.

CONVEX LENS | **CONCAVE LENS**

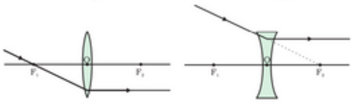




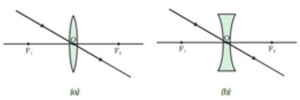
Convex Lens – Thicker in the middle, converges light.
Concave Lens – Thicker at edges, diverges light.
Centre of Curvature (C_1, C_2) – Center of the sphere forming the lens surface.
Principal Axis – Straight line through both curvature centers.
Optical Centre (O) – Central point where light passes undeviated.
Aperture – Effective diameter of the lens.
Principal Focus (F_1, F_2) – Point where parallel rays converge (convex) or diverge (concave).
Focal Length (f) – Distance between the principal focus and optical center.

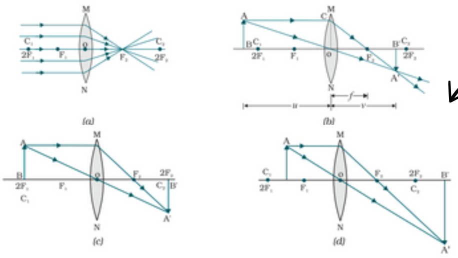
(i) A ray of light from the object, parallel to the principal axis

(ii) A ray of light passing through a principal focus

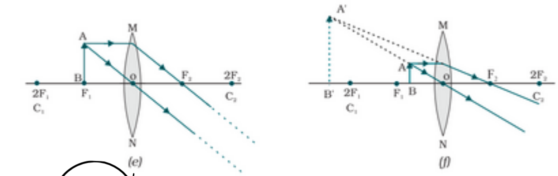


(iii) A ray of light passing through the optical centre of a lens

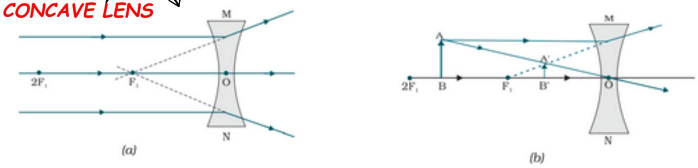




CONVEX LENS



CONCAVE LENS



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 O	On the same side of the lens as the object	Enlarged	Virtual and erect

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

Uses of Concave Lens:

- spy holes in the doors
- glasses
- some telescopes

Uses of Convex Lens:

- overhead projector
- camera
- focus sunlight
- simple telescope
- projector microscope
- magnifying glasses

Lens formula:

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

$$m = \frac{Height\ of\ image(h')}{Height\ of\ object(h)} = -\frac{v}{u}$$

Power of Lens: The ability of a lens to converge or diverge the ray of light after refraction through it is called the power of the lens. It is defined as the reciprocal of focal length. ‘
SI unit = Dioptre (D)

1 dioptre is the power of a lens whose focal length is 1 metre. 1D = 1m.

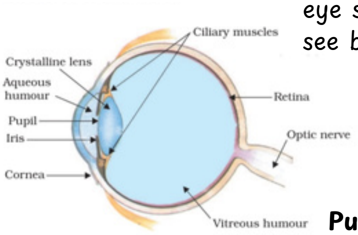
power of a convex lens = positive
power of concave lens = negative.

$$P = \frac{1}{f}$$

Chapter ka KAZAANA:

- **Numerical**
  - **Mirror Formula**
  - **Lens Formula**
  - **Power of Lens**
- **All Ray Diagrams**
- **Snell’s Law**

Human eye And The Colorful World



Sense organ for vision, located in the eye sockets of the skull; it helps us see by detecting light and colors.

Aqueous Humor: Clear fluid between cornea and lens; maintains eye pressure and nourishes cornea and lens.

Pupil: Small opening in the iris; controls light entry into the eye

Iris: Ring-like, muscular tissue behind the cornea; determines eye color and adjusts pupil size.

Lens: Fibrous, jelly-like, convex; focuses light on the retina, creating a real, inverted image.

Cornea: Outermost transparent part; provides most light refraction

Ciliary Muscles: Hold and adjust the lens curvature for focus.

Retina: Delicate membrane with light-sensitive cells.

- Rods: Detect light intensity.
- Cones: Detect primary colors

Vitreous Humor: Provides nutrients and maintains eye shape.

Optic Nerve: Transmits visual information from the retina to the brain.

Sclera: Tough, white outer covering of the eye; provides protection.

Power of Accommodation

The ability of the human eye to focus on objects at different distances by changing the focal length of the eye lens, controlled by ciliary muscles.

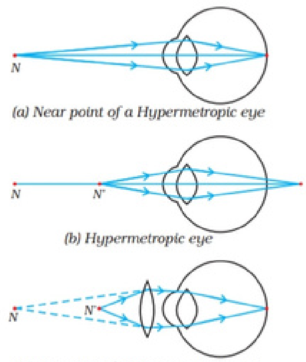
Near point: Minimum distance for clear vision without strain, typically 25 cm for a normal eye.

When looking at a nearby object, the ciliary muscles contract, making the lens thicker and decreasing its focal length.

Far point: Maximum distance seen clearly, normally at infinity.

When looking at a distant object, the ciliary muscles relax, making the lens thin and increasing its focal length.

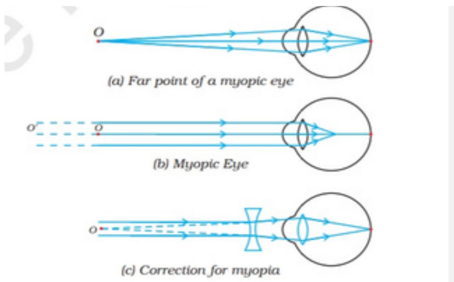
Defects of Vision & their Correlation



(a) Near point of a Hypermetropic eye

(b) Hypermetropic eye

(c) Correction for Hypermetropic eye



(a) Far point of a myopic eye

(b) Myopic Eye

(c) Correction for myopia

cataract

↓

cloudy or blurry vision

↓

Causes: age related condition, weakening of eye muscles

↓

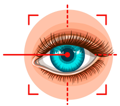
treatment: surgery.

Defects of Vision & their Corrections IMPORTANT

1. Myopia (Nearsightedness)
   - Cause: The eyeball is too long or the cornea is too curved, causing light to focus in front of the retina.
   - Effect: Distant objects appear blurry, while close objects are clear.
   - Correction: Concave (diverging) lenses spread out light rays so they focus on the retina.
2. Hyperopia (Farsightedness)
   - Cause: The eyeball is too short or the cornea is too flat, causing light to focus behind the retina.
   - Effect: Close objects appear blurry, while distant objects are clear.
   - Correction: Convex (converging) lenses bend light to focus it correctly on the retina.
3. Astigmatism
   - Cause: The cornea or lens has an irregular shape, leading to multiple focus points.
   - Effect: Blurred or distorted vision at all distances.
   - Correction: Cylindrical lenses or toric contact lenses adjust for the uneven curvature.
4. Presbyopia
   - Cause: Aging causes the lens to lose flexibility, making it harder to focus on close objects.
   - Effect: Difficulty reading or seeing nearby objects.
   - Correction: Bifocal or progressive lenses, and reading glasses.

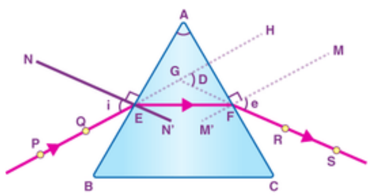
Advantages of having eyes in front of the face...

- Gives a wider field of view.
- Enhances the ability to detect faint objects.
- Provides three dimensional view.



Refraction through a glass prism

- Prism: Transparent refracting medium. Structure: Two triangular bases, three rectangular lateral surfaces.
- Angle of Prism: Angle between two lateral faces.
- Angle of Deviation: Angle between incident and emergent rays.



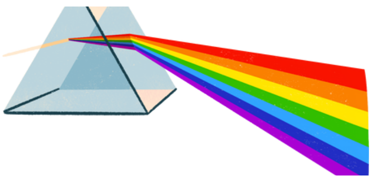
Dispersion of White Light: Splitting of white light into seven colors when passing through a prism.

Spectrum: The band of seven colors formed.

- Color Sequence: VIBGYOR (Violet, Indigo, Blue, Green, Yellow, Orange, Red).

Causes:

- Varying refraction indices of different colours.
- wavelength of light when passing through transparent medium like prism.
- **Newton's Experiment:** Used a second inverted prism to recombine the spectrum into white light, proving sunlight is made up of seven colors.
- **White Light:** Any light producing a similar spectrum to sunlight is called white light.



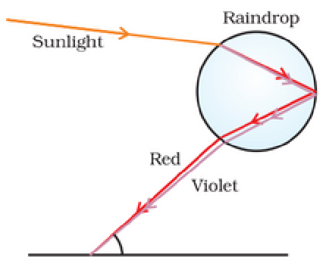
Red is the least deviated colour as it has largest/longest wavelength.
Violet is the most deviated colour as it has smallest wavelength in visible spectrum.

Natural spectrum: Rainbow :

Refraction of Sunlight -- Dispersion into Colors -- Internal Reflection -- Refraction Again

IMPORTANT

Rainbow: A natural spectrum appearing in the sky after a rain shower, caused by the dispersion of sunlight by tiny water droplets in the atmosphere.



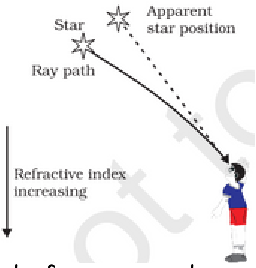
Mechanism: Water droplets act like prisms, refracting and dispersing sunlight, reflecting it internally, and refracting it again.
Color Sequence: Red at the top, violet at the bottom.
Formation Direction: Always opposite to the sun.

Atmospheric Refraction

The refraction of light caused by the Earth's atmosphere (having air layers of varying optical densities)

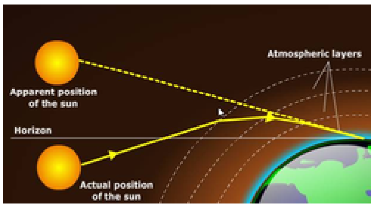
Stars Twinkle

Caused by atmospheric refraction; starlight bends as it enters Earth's atmosphere, causing stars to appear to change position and flicker.



Advanced Sunrise & Delayed Sunset:

Sun appears ~2 minutes before sunrise and after sunset due to atmospheric refraction. The Sun's disc also appears flattened at these times.



Why Planets Don't Twinkle

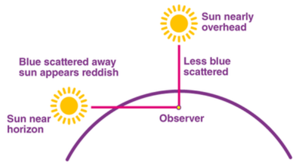
Planets are closer and seen as extended sources, averaging out the light variations and reducing the twinkling effect.

Scattering of Light

Scattering of light occurs when light is absorbed by particles and then re-emitted in different directions.

Red Sun at Sunrise/Sunset

During sunrise and sunset, sunlight travels a longer distance through the atmosphere. Blue light is scattered away, while red light, with a longer wavelength, reaches the observer's eyes, making the sun appear red.



Blue Sky

due to the scattering of sunlight by small air molecules and fine particles. Blue light, having a shorter wavelength, scatters more than red light, making the sky appear blue.

Tyndall Effect:

- Light scatters when it strikes particles in a colloid, making the light path visible.
- Seen in sunlight passing through mist or a dense forest canopy.
- Smaller particles scatter blue light, while larger particles scatter red light.

Chapter ka KAZAANA:
- **Human Eye (Diagram)**
- **Defects (Myopia and Hypermetropia)**
- **Prism (Diagram + Concept)**