Summary

Chapter 1. Chemical Reactions and Equations

- A chemical equation is a statement or representation that describes a chemical reaction in terms of symbol and formulae.
- A chemical reaction is the transformation of chemical substance called reactants into another chemical substance called products. In a chemical reaction, only rearrangement of atoms takes place.
- The substances which take part in a chemical reaction are called reactants. The reactants are written on the left hand side. The new substances produced as a result of chemical reaction are called products. The products are written on the right hand side.
- **Some of the symbols used in a chemical Equation are :**
  (a) Solids (s)
  (b) Liquids (l)
  (c) Gases (g)
  (d) Aqueous solutions (aq)
  (e) Gas released as a product (↑)
  (f) Precipitate formed in the reaction (↓)
  (g) Direction of reaction (→)
- **Steps to balance a chemical equation :**
  (a) Write word equation.
  (b) Then write skeletal chemical equation.
  (c) Enclose the formula in the boxes.
  (d) List the number of atoms of different elements present in the unbalanced equation.
  (e) Start balancing with the compound that contains the maximum number of atoms.
  (f) Start balancing other atoms.
  (g) Check the correctness of the balanced equation.
- **Types of chemical equations :**

CHEMICAL REACTION

Exothermic Reactions
[accompanied by evolution of heat]
Example :
$CH_4 + O_2 \rightarrow CO_2 + H_2O + Heat$

Endothermic Reactions
[accompanied by absorption of heat]
Example :
$2Pb(NO_3)_2 \xrightarrow{Heat} 2PbO + 4NO_2 + O_2$

DECOMPOSITION REACTION

Thermal decomposition
[takes place by heat]
Examples :
$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

Electrolytic decomposition
[takes place by electricity]
Example :
$2H_2O(v) \xrightarrow{Electrolysis} 2H_2(g) + O_2(g)$

Photolysis
[takes place by light]
Example :
$2AgCl \longrightarrow 2Ag + Cl_2$

DOUBLE DISPLACEMENT REACTION

Neutralization
[Acid and base react to form salt.]
Example : $NaOH + HCl \longrightarrow NaCl + H_2O$

Precipitation
[Precipitate is formed as a result of chemical equation.]
Example : $Na_2SO_4 + BaCl_2 \longrightarrow 2NaCl + BaSO_4 \downarrow$

REDOX REACTION

Oxidation
[Addition of O_2 or removal of H_2]
Example : $Cu + O_2 \rightarrow 2CuO$

Reduction
[Addition of H_2 or removal of O_2]
Example : $2Na + H_2 \longrightarrow 2NaH$

➢ **Characteristics of a chemical equation: (Flow Chart).**

CHARACTERISTICS OF A CHEMICAL EQUATION

Change in state

Example :

1. Solid wax on heating changes to gas

2. Petrol (liquid) burns to form gas.

Change in colour

Example :

1. Iron (grey colour) Changes to rust (brown colour) on reaction with air or moisture

2. $PbNO_3 + KI \rightarrow PbI_2 + KNO_3$
   [colourless] [Yellow]

Evolution of gas

Example :

1. $Zn + dil.\ H_2SO_4 \rightarrow ZnSO_4 + H_2 \uparrow$
2. $CaCO_3 \longrightarrow CaO + CO_2 \uparrow$

Change in temperature

Example :

1. $CaO + H_2O \rightarrow Ca(OH)_2 + Heat$

Formation of Precipitate

Example :

1. $AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl (\downarrow)$ ppt.
2. $CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2 \downarrow$

TYPES OF CHEMICAL REACTIONS

Combination reaction

[Single product is formed from two or more reactants]

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

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

Decomposition reaction

[Two or more products are formed by a single reactant]

- Thermal decomposition
- Electrolytic decomposition
- Photolysis

Displacement reaction

[More reactive metal displaces a less reactive metal]

- Cation displacement
- Anion displacement

Example : (Cation)

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Example : (Anion)

$Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$

Double displacement reaction

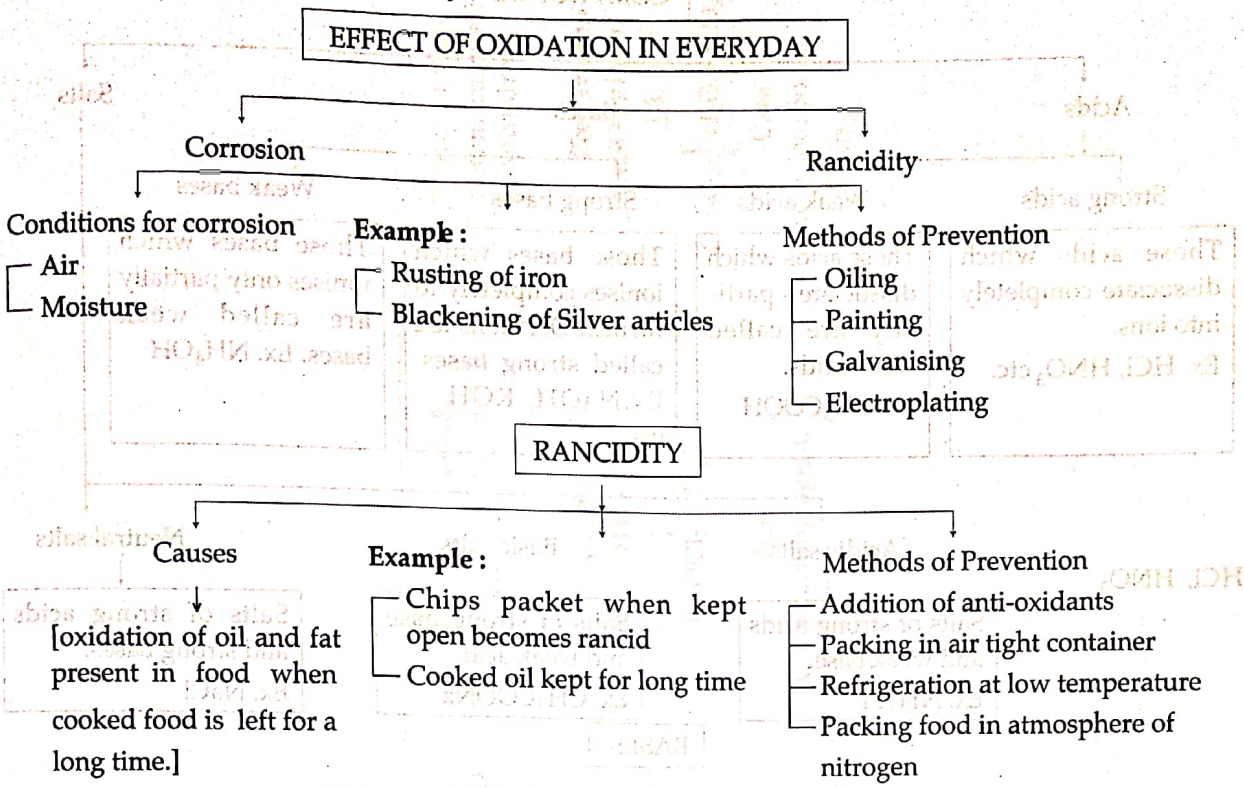
[Exchange of ions between the reactants]

- Neutralization
- Precipitation

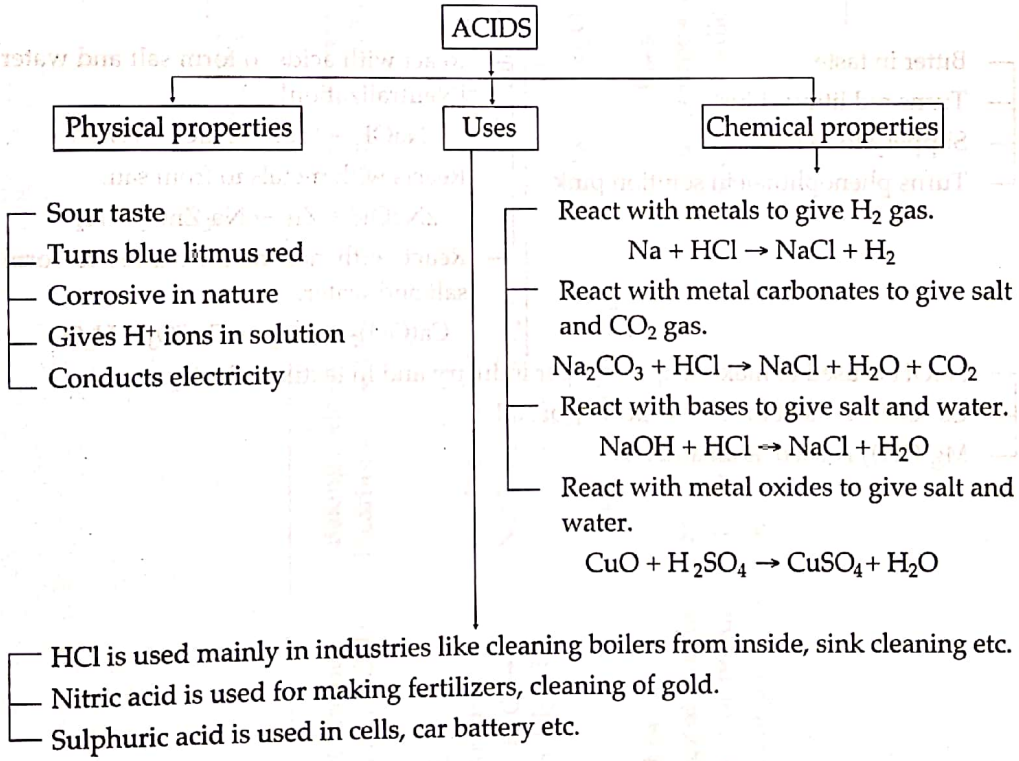
Redox reaction

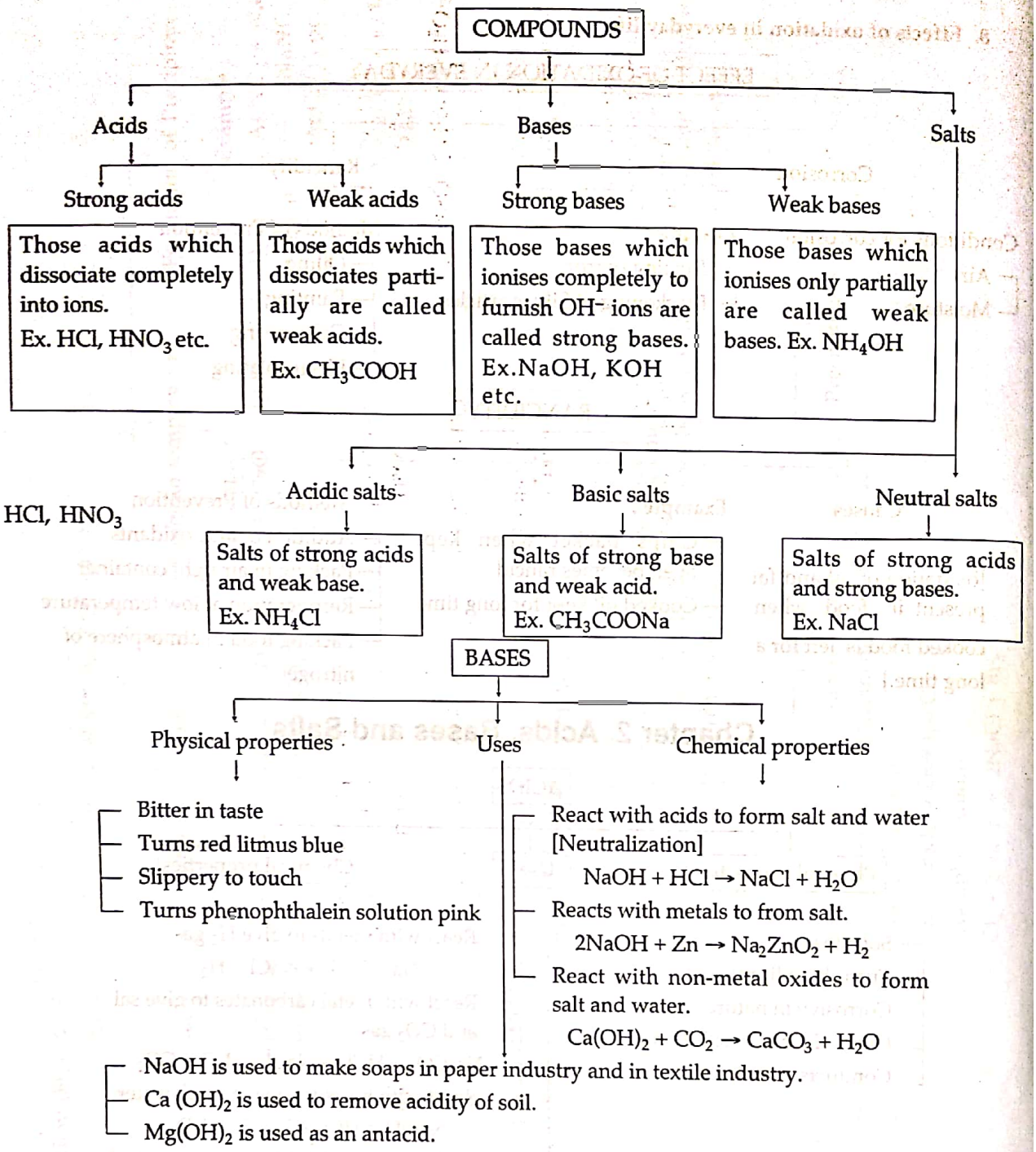
[Oxidation and reduction occurs simultaneous]

8. Effects of oxidation in everyday life.



Chapter 2. Acids, Bases and Salts





SALTS

Sodium Hydroxide caustic soda (NaOH)

Preparation

$NaCl + H_2O \rightarrow 2NaOH + Cl_2 + H_2$

Uses

- Metallurgy of bauxite
- Distillation of petrol
- Formation of soil

Baking soda sodium bicarbonate $NaHCO_3$

Preparation

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

Uses

- Food industry
- Bakery
- Antacid

Washing soda sodium carbonate $Na_2CO_3.10H_2O$

Preparation

$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

Uses

- Washing purposes
- Paper and textile industry

Calcium oxychloride Bleaching powder $CaOCl_2$

Preparation

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

Uses

- As a bleaching agent

Plaster of paris Calcium sulphate hemihydrate

Preparation

$CaSO_4 \cdot 2H_2O \xrightarrow{\Delta} CaSO_4 \cdot \frac{1}{2} H_2O + \frac{3}{2} H_2O$

Uses

- Used to join bones
- 1In dentistry

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Families of Salts

Sodium Salts	—	$NaCl$, $NaNO_3$, Na_2SO_4, Na_2CO_3, CH_3COONa etc.
Potassium Salts	—	KCl, KNO_3, K_2SO_4, KBr, K_2CO_3
Ammonium Salts	—	NH_4Cl, NH_4NO_3, NH_4Br
Magnesium Salts	—	$MgCl_2$, $MgSO_4$, $MgCO_3$
Calcium Salts	—	$CaCl_2$, $Ca(COO)_2$, etc.

Chloride Salts

Formula	Name of Salt	Base involved
$NaCl$	Sodium chloride	$NaOH$
KCl	Potassium chloride	KOH
NH_4Cl	Ammonium chloride	NH_4OH
$BaCl_2$	Barium chloride	$Ba(OH)_2$
$MgCl_2$	Magnesium chloride	$Mg(OH)_2$

Nitrate Salts

Formula	Name of Salt	Base involved
$NaNO_3$	Sodium nitrate	$NaOH$
KNO_4	Potassium nitrate	KOH
$Ca(NO_3)_2$	Calcium nitrate	$Ca(OH)_2$

Sulphate Salts

Na_2SO_4	Sodium sulphate	$NaOH$
K_2SO_4	Potassium sulphate	KOH
$MgSO_4$	Magnesium sulphate	$Mg(OH)_2$

Carbonate Salts

Na_2CO_3	Sodium Carbonate	$NaOH$
K_2CO_3	Potassium Carbonate	KOH
$CaCO_3$	Calcium Carbonate	$Ca(OH)_2$

Chapter 3. Metals and Non-Metals

Elements are classified into Metals, Non-metals and Metalloids

PHYSICAL PROPERTIES

Metals
- Solid at room temperature.
- Hard, have high M.P. and B.P.
- Malleable and ductile.
- Good conductors of heat and electricity.
- High density.
- Lustrous and sonorous.

Exceptions
- Mercury, liquid at room temperature.
- Sodium and potassium are soft and have low M.P. and B.P.
- Zinc is neither malleable nor ductile.
- Mercury and Tungsten are poor conductors.

Non-metals
- Soft, solid or in gaseous state.
- Neither malleable nor ductile.
- Poor conductor of heat and electricity.
- Low density.
- Non-lustrous and non-sonorous.

Exceptions
- Bromine, liquid at room temperature.
- Diamond is hardest substance. High density.
- Graphite is good conductor of heat and electricity.
- Iodine crystals and graphite shiny.

CHEMICAL PROPERTIES

Metals

With Oxygen

$M + O_2 \rightarrow M_2O$ (basic)

$4Na + O_2 \rightarrow 2Na_2O$

With Water

$M + H_2O \rightarrow MOH$

$Mg + H_2O \rightarrow Mg(OH)_2$

With Acids

$M + Acid \rightarrow Salt + H_2$

$2Na + 2HCl \rightarrow 2NaCl + H_2$

With Bases

$M + Base \rightarrow Salt + H_2$

$2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$

Non-metals

With Oxygen

$E + O_2 \rightarrow O_2$ (acidic)

$C + O_2 \rightarrow CO_2$

With Water

$E + H_2O \rightarrow$ No reaction

With Acids

No reaction

With Salt Solution

$2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

Note :

(1) Copper oxide is black in colour.

(2) Aluminium oxide is amphoteric oxide.

(3) Sodium and potassium react violently with water.

(4) Magnesium do not react with cold water.

(5) Some metals like aluminium, iron and zinc do not react either with cold or hot water.

IONIC COMPOUNDS

Formation

Formed by losing or gaining of electron or by transfer of electrons between a metal a non-metal.

Examples

$NaCl$, $MgCl_2$, CaF_2, MgO etc.

Properties

- Solid and hard
- High M.P. and B.P.
- Good conductors of electricity
- Soluble in water.

EXTRACTION OF METALS

Crushing

Huge lumps of ore are broken into small pieces.

Concentration of ore

- Gravity Separation
- Froth Floatation Process
- Magnetic Separation
- Leaching or chemical separation

Preliminary Treatment of ore

- Calcination: Ore is heated in limited supply of oxygen
- Roasting: Ore is heated in excess supply of oxygen

Reduction

Purification

Purification is done by distillation, liquidation or by electrolytic refining

REDUCTION

Metals at top of activity series	Na, K, Ca Mg, Al	By electrolysis
Metals at the middle of reactivity series	Zn, Fe, Pb	Reduction using carbon or some reducing agent
Metal in the lower region of reactivity series	Cu, Hg, Ag	Reduction by heating alone
Metals found at the bottom of activity series	Pt, Au	Found in native state

Chapter 4. Carbon and Its Compounds

1. The study of carbon compounds is called organic chemistry.
2. Carbon is a non-metal having atomic number 6.
3. Bonding in carbon : Covalent bonding is present in carbon.

COVALENT BONDING

Formation	Examples	Properties
Covalent bond is formed by sharing of electrons	H_2, O_2, N_2, HCl, CCl_4	Generally soft. Low melting and boiling point. Bad conductors of electricity. Insoluble in polar solvents. Shows molecular reactions.

ALLOTROPES OF CARBON

Diamond	Graphite	Fullerene
Structure	**Structure**	**Structure**
Each carbon is bonded to four other carbon atoms.	Each carbon is joined to three carbon atoms.	60 carbon atoms are linked to form a stable structure.
Properties	**Properties**	**Properties**
Bad conductor of electricity. Hardest substance known.	Soft and slippery to touch, good conductor of electricity.	Atoms are arranged in shape of football.
Uses	**Uses**	
Used in jewellery, cutting glasses and as an abrasive.	Used in pencil and electrodes.	

CHEMICAL PROPERTIES OF CARBON COMPOUNDS

Oxidation reaction	Addition reaction	Substitution reaction
Heating in the presence of oxygen.	Reaction which involves addition of two reactants to form a single product.	The reaction in which a reagent substitutes an atom or a group of atoms.
$C + O_2 \rightarrow CO_2$	$CH_2 = CH_2 + H_2 \rightarrow CH_3—CH_3$	$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

IMPORTANT CARBON COMPOUNDS

Ethanoic acid or Acetic acid [CH_3COOH]

Properties

- Colourless pungent smelling liquid.
- Reacts with ethanol to give ester.

$$CH_3COOH + C_2H_5OH \downarrow CH_3COOC_2H_5 + H_2O$$

- React with base to give salt.

$$CH_3COOH + NaOH \rightarrow CH_3COONa$$

- React with carbonates to give CO_2 gas.

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

Uses

- For making vinegar.
- Making pickles.
- Ester preparation.

Ethanol [C_2H_5OH]

Properties

- Liquid, colourless and have distinct smell.
- Soluble in water.
- Reacts with sodium to form sodium ethoxide and H_2 gas.

$$C_2H_5OH + Na \rightarrow C_2H_5ONa + H_2$$

- It reacts with conc. H_2SO_4 to give ethene.

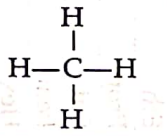
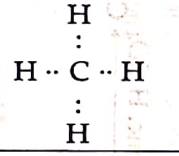
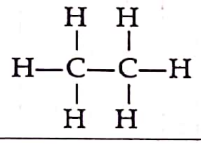
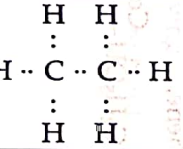
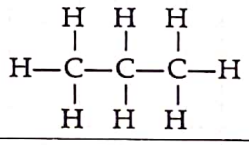
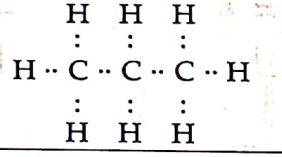
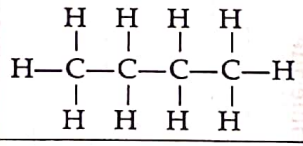
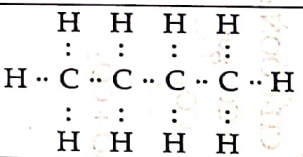
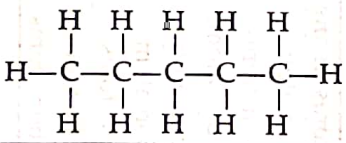
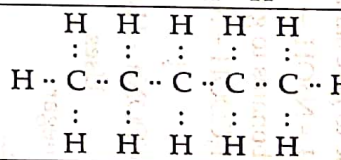
$$C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} CH_2 = CH_2$$

Uses

- Used in all alcoholic drinks.
- As an antiseptic.
- In medicines like tincture of iodine, cough syrup, tonic etc.
- As hypnotic.

Number of carbon atoms in one molecule	Greek name (Alk)
One carbon atom	Meth
Two carbon atoms	Eth
Three carbon atoms	Prop
Four carbon atoms	But
Five carbon atoms	Pent
Six carbon atoms	Hex
Seven carbon atoms	Hept
Eight carbon atoms	Oct

Formulae of the First Five Members of Alkanes

Number of carbon atoms	IUPAC Name	Molecular formula	Structural formula	Electronic formula	Condensed formula
One	**Meth**-ane	CH_4			CH_4
Two	**Eth**-ane	C_2H_6			$CH_3—CH_3$
Three	**Prop**-ane	C_3H_8			$CH_3—CH_2—CH_3$
Four	n-**But**-ane	C_4H_{10}			$CH_3—CH_2—CH_2—CH_3$
Five	n-**Pent**-ane	C_5H_{12}			$CH_3—CH_2—CH_2—CH_2—CH_3$

Chapter 5. Periodic Classification of Elements

CLASSIFICATION OF ELEMENTS

- Dobereiner's Triad
- Newland's Law of Octaves
- Mendeleev's Periodic Table
- Modern Periodic Table

DOBEREINER'S TRIAD

Law

When elements are arranged in order of increasing atomic mass, mass of middle element is arithmetic mean of other two.

Example

Li(7), Na(23), K39)

$$= \frac{7 + 39}{2}$$

$$= \frac{46}{2}$$

$$= 23 \text{ (Na)}$$

Limitations

All known elements could not be arranged in Dobereiner's triad.

NEWLAND LAW OF OCTAVES

Law

The property of eight element was repetition of first element.

Example

H and F

F and Cl

Limitations

Applicable to elements upto calcium only.

MENDELEEV'S PERIODIC TABLE

Characteristics

- Horizontal Columns—Periods
- Vertical Columns—groups
- 7 periods and nine groups.

Merits

- Systematic study of elements.
- Correction of atomic masses of elements.
- Prediction of new elements.

Demerits

- Position of hydrogen.
- Anomalous pair.
- Position of isotopes.
- Uncertainity in prediction of new elements.

MODERN PERIODIC TABLE

Law

"Physical and chemical properties of elements are periodic function of atomic number."

Characteristics

- Vertical columns are called groups. There are 18 groups.
- Horizaontal columns are called periods. There are 7 periods.

Merits

- Position of isotopes.
- Anomalous position of some elements.
- Easy to remember and reproduce.

Demerits

- Position of hydrogen is not certain.

TRENDS IN MODERN PERIODIC TABLE

Valency	Atomic Size	Ionisation enthalpy	Electron Affinity	Electronegativity
Combining capacity of an element.	Distance between nucleus and outermost shell.	Energy required to remove loosely bonded electron.	Energy released when an electron is added to an isolated atom.	Tendency to accept electron pair.
Valency is same in a group.	Increases down the group and decreases in a period.	Increases in a period, decreases down a group.	Increases in a period and decreases in a group.	Increases in a period and decreases down the group.

❐❐