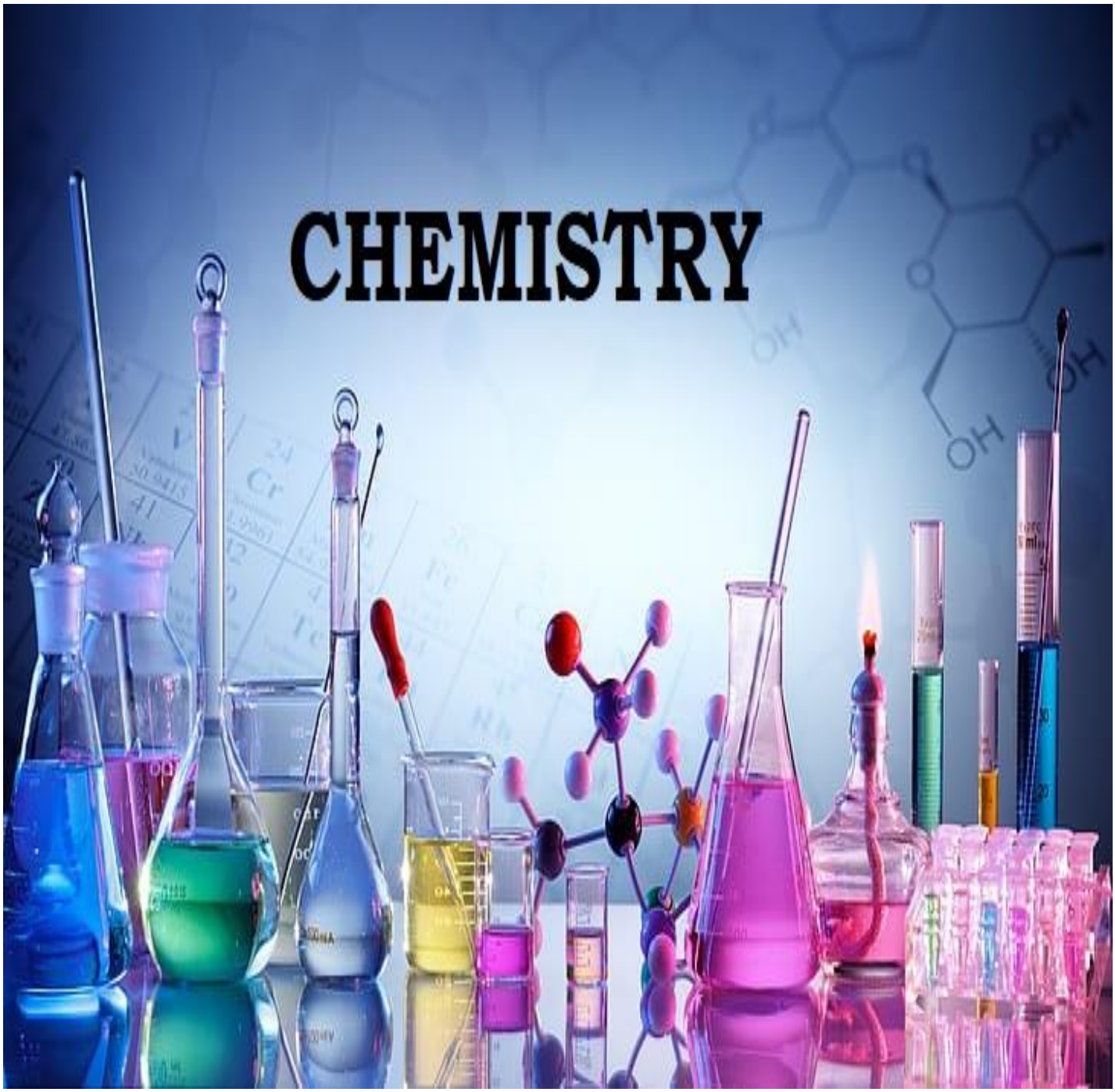

II PUC

PASSING PACKAGE

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CONTENT

Unit No.	CHAPTERS	Page No.
1	**THE SOLID STATE**	1– 3
2	**SOLUTIONS**	4
3	**ELECTROCHEMISTRY**	5 – 6
4	**CHEMICAL KINETICS**	7 – 9
5	**SURFACE CHEMISTRY**	10
6	**GENERAL PRINCIPLES AND PROCESS OF ISOLATION OFELEMENTS**	11 – 12
7	**THE p-BLOCK ELEMENTS**	13 – 14
8	**THE d AND f-BLOCK ELEMENTS**	15
9	**COORDINATION COMPOUNDS**	16 – 18
10	**HALOALKANES AND HALOARENES**	19 – 20
11	**ALCOHOLS, PHENOLS AND ETHERS**	21 – 22
12	**ALDEHYDES, KETONES AND CARBOXYLIC ACIDS**	23 – 24
13	**ORGANIC COMPOUNDS CONTAINING NITROGEN**	24
14	**BIOMOLECULES**	25 – 26
15	**POLYMERS**	26 – 27
16	**CHEMISTRY IN EVERYDAY LIFE**	28

II PUC Chemistry (34)

Time : 3 Hrs. 15min. **Blue Print for Model Question Papers** Max. Marks: 70

Group	Unit	Title	Hours	Marks	Part-A I 10x1 mark	Part B II 8x2 mark	Part C III 8x3 mark	Part D IV & V 11x5 mark	Total
Group-I Physical	1	The Solid state	8	7		✓		✓	7
	2	Solution	9	8	✓✓			✓	7
	3	Electrochemistry	9	8	✓	✓		✓	8
	4	Chemical kinetics	9	8	✓	✓		✓	8
	5	Surface chemistry	6	5	✓			✓	6
		Total of Group-I	**41**	**36**					**36**
Group-II Inorganic	6	General principles and processes of isolation of elements	5	4	✓		✓		4
	7	The p-block elements	11	10	✓		✓✓✓		10
	8	The d and f-block elements	9	8		✓	✓✓		8
	9	Coordination compounds	7	6			✓✓		6
		Total of Group-II	**32**	**28**					**28**
Group-III Organic	10	Haloalkanes and haloarenes	7	6	✓			✓	6
	11	Alcohols, phenols and ethers	8	7		✓		✓	7
	12	Aldehydes, ketones and carboxylic acids	9	8	✓	✓		✓	8
	13	Amines	6	5				✓	5
	14	Biomolecules	7	6	✓			✓	6
	15	Polymers	5	5				✓	5
	16	Chemistry in everyday life	5	4		✓✓			4
		Total of Group-III	**47**	**41**					**41**
		TOTAL	**120**	**105**	**10**	**10**	**15**	**35**	**105**

Chapter-1: The Solid State

1. **Give any two differences between Crystalline and Amorphous solids.**

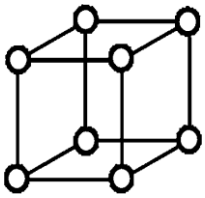
Crystalline solids	Amorphous solids
Definite geometrical shape	Irregular shape
Sharp melting points	Range of melting points
Anisotropic in nature	Isotropic in nature

2. **Calculate the number of particles per unit cell of simple cubic.**

The particles are present only at eight corners of the cube.

From each corner, contribution per unit cell is $\frac{1}{8}$ x 8 = 1

Therefore, number of particles per unit cell = 1



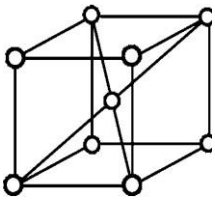
3. **Calculate the number of particles per unit cell of Body-Centred Cubic (BCC).**

The particles are present at eight corners and at body centre.

From each corner, contribution per unit cell is $\frac{1}{8}$ x 8 = 1

The particle present at body centre of the cube = $\frac{1}{1}$ = 1

Therefore, number of particles per unit cell = 1 + 1 = 2



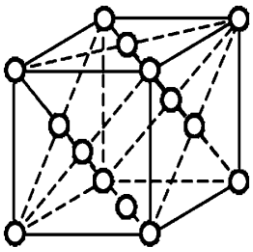
4. **Calculate the number of particles per unit cell of Face-Centred Cubic (FCC).**

The particles are present at eight corners and at the centre of six faces.

From each corner, contribution per unit cell is $\frac{1}{8}$ x 8 = 1

From each face, contribution per unit cell is $\frac{1}{2}$ x 6 = 3

Therefore, number of particles per unit cell = 1 + 3 = 4



5. **Calculate the packing efficiency in simple cubic (sc) lattice**

Let the edge length of the unit cell be 'a' and radius of particle be 'r'.

Then, a = 2r

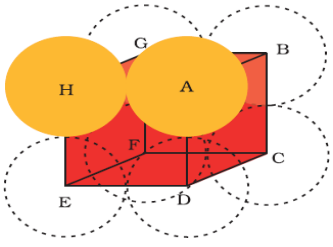
Volume of particle = $\frac{4}{3}\pi r^3$

Volume of the unit cell = $a^3 = (2r)^3 = 8r^3$

Packing efficiency = $\frac{Volume\ occupied\ by\ the\ particles}{volume\ of\ the\ unit\ cell}$ x 100

$= \frac{\frac{4}{3}\pi r^3}{8r3}$ x 100

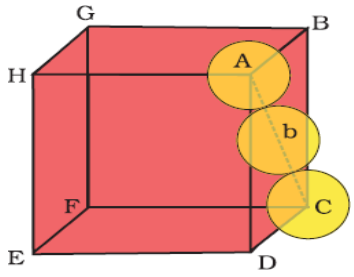
Packing efficiency = 52 %



6. Calculate the packing efficiency in cubic close packed (ccp) / face-centred cubic (fcc)

Let the edge length of the unit cell be 'a' and radius of particle be 'r'.

From Δ ABC



$AC^2 = AB^2 + BC^2$

$b^2 = a^2 + a^2 = 2a^2$

$b = \sqrt{2}a$ But, b = 4r

Therefore, $4r = \sqrt{2}\,a$

$a = \frac{4r}{\sqrt{2}} = 2\sqrt{2}r$

Volume of the unit cell = $a^3 = (2\sqrt{2}r)^3$

Volume of particles = $4 \times \frac{4}{3}\pi r^3 = \frac{16}{3}\pi r^3$

Packing efficiency = $\frac{\textit{Volume occupied by the particles}}{\textit{volume of the unit cell}} \times 100\ \%$

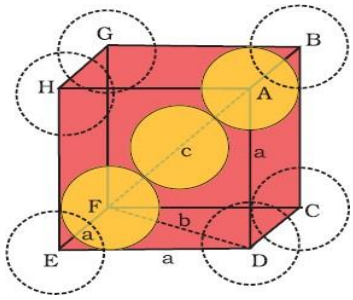
$= \frac{\frac{16}{3}\pi r^3}{(2\sqrt{2}r)^3} \times 100\ \%$

Packing efficiency = 74 %

7. Calculate the packing efficiency in body-centred cubic (bcc)

Let the edge length of the unit cell be 'a' and radius of particle be 'r'.

From Δ EFD



$FD^2 = EF^2 + ED^2$

$b^2 = a^2 + a^2 = 2a^2$

Now in Δ AFD

$AF^2 = AD^2 + FD^2$

$c^2 = a^2 + b^2 = a^2 + 2a^2 = 3a^2$

$c = \sqrt{3}\,a$, But c = 4r

Therefore, $4r = \sqrt{3}a$ then $a = \frac{4r}{\sqrt{3}}$

Volume of the unit cell = $a^3 = (4r/\sqrt{3})^3$

Volume of particles = $2 \times \frac{4}{3}\pi r^3 = \frac{8}{3}\pi r^3$

Packing efficiency = $\frac{\text{Volume occupied by the particles}}{\text{Volume of the unit cell}} \times 100\ \%$

$= \frac{\frac{8}{3}\pi r^3}{(4r/\sqrt{3})^3} \times 100\ \%$

Packing efficiency = 68 %

8. Give any two differences between Schottky and Frenkel defect

Schottky defects	Frenkel defect
Missing of equal number of cations and anions from their lattice sites is called Schottky defect.	Displacement of cation from their lattice sites into the interstitial site is called Frenkel defect.
It decreases density of the crystal	No change in the density of crystal
Ex **:** AgBr	Ex **:** AgBr

Note : AgBr shows both Schottky and Frenkel defects**.**

9. Sodium metal crystallises in a BCC structure. Its unit cell edge length is 420 pm. Calculate its density. (Atomic mass of sodium = 23 μ, N_A = 6.022x10^{23} mol^{-1})

$$d = \frac{Z \times M}{N_A \times a^3}$$

$$= \frac{2 \; X \; 23}{6.022 \; X \; 10^{23} \; X \; (420)^3}$$

$$= \frac{46}{6.022 \; X \; 10^{23} \; (4.20)^3 \; X \; 10^{-24}}$$

$$d = 1.031 \text{ g } cm^{-3}$$

10. What are paramagnetic substances? Give an example.

Substances which are weakly attracted by a magnetic field are called paramagnetic substances.

Ex **:** O_2

11. What are ferromagnetic substances? Give an example.

Substances which are strongly attracted by a magnetic field and they can be permanently magnetized are called ferromagnetic substances.

Ex **:** Iron

Chapter–2: Solutions

1. **State Henry's law. Write its mathematical form.**

'At constant temperature, the solubility of a gas in liquid is directly proportional to the partial pressure of the gas present above the surface of the solution'.

$P = K_H X_g$

Where; K_H Henry's constant

X_g Mole fraction of the gas in solution.

2. **What is the effect of temperature and pressure on the solubility of gases in liquids?**

Solubility of gases in liquids,

- ✓ Decreases with temperature
- ✓ Increases with pressure.

3. **State Raoult's law for liquid mixtures.**

'For a solution of volatile liquids, the partial vapour pressure of a component at a given temperature is directly proportional to mole fraction of that component in the solution.'

4. **Give any two differences between Ideal and Non – Ideal solutions.**

Ideal Solutions	Non – Ideal Solutions
Solutions which obey Raoult's law are called ideal solutions. Ex : n-hexane and n-heptane	Solutions which does not obey Raoult's law are called non – ideal solutions. Ex : Phenol and Aniline
$\Delta V = 0$	$\Delta V \neq 0$
$\Delta H = 0$	$\Delta H \neq 0$

5. **What is reverse osmosis? Mention its one practical utility(use).**

The process of reversing the direction of osmosis by applying the pressure higher than the osmatic pressure to the solution of higher concentration is called reverse osmosis.

Used in desalination of sea water.

Chapter–3: Electrochemistry

1. **State Faraday's first law and Faraday's second law of electrolysis.**

First law :

It states that 'The amount of substance deposited on cathode is directly proportional to quantity of electric current supplied'.

$W = Z \times I \times t$

Where**;** Z is called Electro-chemical equivalent

Second law :

It states that the 'The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights'.

2. **Explain the construction and working of Standard Hydrogen Electrode (SHE).**

Construction :

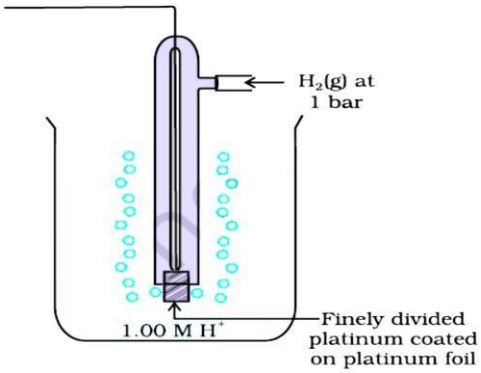
It consists of a platinum foil fitted into a glass tube containing mercury.

The inner glass tube is enclosed in an outer jar that contains an inlet at the top to pass hydrogen gas.

The whole apparatus is placed in 1M HCl solution.

Working:

Hydrogen gas passed is adsorbed on platinum surface.



At Anode **:**

$$\frac{1}{2} H_{2(g)} \rightarrow H^+_{(aq)} + e^-$$

At Cathode **:**

$$H^+_{(aq)} + e^- \rightarrow \frac{1}{2} H_{2(g)}$$

Representation of SHE is $Pt_{(s)} / H_{2(g,\ 1\ bar)} \| H^+_{(aq,\ 1M)}$

Emf of SHE is 0.0 V

3. **What is a Primary and Secondary cell? Give an example.**

A primary cell is one where the reaction occurs only once and after use over a period of time battery becomes dead.

Ex **:** Dry cell

A secondary cell is one where after use it can be recharged by passing current through it in the opposite direction.

Ex **:** Lead storage cell

4. State Kohlrausch law.

It states that 'Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the cation and anion of the electrolyte'.

5. Write Nernst equation for Daniel cell. Explain the terms?

$E_{Mn+/M} = E^0_{Mn+/M} - \frac{RT}{nF} \ln \frac{[M]}{[M^{n+}]}$

Where**;** $E^0_{Mn+/M}$ standard electrode potential

n number of electrons transferred during the reaction.

R gas constant

T Temperature in kelvin

F Faraday's constant

$[M^{n+}]$ concentration of species

6. Write the equations of anodic and cathodic reactions occur during rusting of iron.

At Anode **:**

$2Fe_{(s)} \rightarrow 2Fe^{2+}_{(aq)} + 4e^-$

At Cathode **:**

$O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightarrow 2H_2O_{(l)}$

7. Write the equations of anodic and cathodic reactions of Hydrogen-Oxygen fuel cell.

At Anode **:**

$2H_{2(g)} + 4OH^-_{(aq)} \rightarrow 4H_2O_{(l)} + 4e^-$

At Cathode**:**

$O_{2(g)} + 2H_2O_{(l)} + 4e^- \rightarrow 4OH^-_{(aq)}$

Chapter–4: Chemical Kinetics

1. What is a Pseudo first order reaction? Give an example.

The reaction where order is one but molecularity is two or more is called pseudo first order reaction.

Ex **:** Acid hydrolysis of methyl acetate

2. Give any two differences between order and molecularity

Order	Molecularity
It is the sum of the powers of the concentration terms in the rate law expression.	It is the number of reacting species involved in an elementary reaction.
Experimental quantity	Theoretical quantity

3. Derive an integrated rate equation for the rate constant of a zero order reaction.

Consider a zero order reaction

$R \rightarrow P$

$-\frac{d[R]}{dt} = K[R]^0$

$d[R] = -K\,dt \qquad (\because [R]^0 = 1)$

On integration we get,

$[R] = -Kt + I$----------(1)

Where 'I' is integration constant.

When, $t = 0$ then $[R] = [R]_0$

Therefore $[R]_0 = -K \times 0 + I$

Then $I = [R]_0$

equation (1) becomes

$[R] = -Kt + [R]_o$

$Kt = [R]_o - [R]$

$$K = \frac{[R]o - [R]}{t}$$

4. Derive an integrated rate equation for the rate constant of a first order reaction.

Consider a first order reaction

$R \rightarrow\longrightarrow P$

$-\frac{d[R]}{dt} = K\,[R]^1$

$\frac{d[R]}{[R]} = -\,K\,dt$

On integration we get,

$\ln [R] = -\,Kt + I$ ----------(1)

When $t = 0$ then, $[R] = [R]_0$

$\ln[R]_0 = -K \times 0 + I$

Then $I = -\ln[R]_0$

equation (1) becomes

$\ln [R] = -\,Kt + \ln[R]_0$

$Kt = \ln[R]_0 - \ln[R]$

Then, $Kt = \ln \frac{[R]0}{[R]}$

$$K = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

5. Show that for a zero order reaction half -life period is directly proportional to initial concentration of the reactant.

We know that, $K = \frac{[R]o - [R]}{t}$

When, $t = t_{1/2}$ then $[R] = \frac{1}{2}[R]_0$

$K = \frac{[R]_0 - \frac{1}{2}[R]_0}{t_{1/2}} = \frac{\frac{1}{2}[R]_0}{t_{1/2}}$

$K = \frac{[R]_0}{2\,t_{1/2}}$ OR

$$t_{1/2} = \frac{[R]_0}{2K}$$

Therefore, for a zero order reaction $t_{1/2} \alpha [R]_0$

6. **Show that for a first order reaction half- life is independent of the initial concentration of the reactant.**

We know that, $K = \frac{2.303}{t} \log\frac{[R]_0}{[R]}$

When, $t = t_{1/2}$ then $[R] = \frac{1}{2}[R]_0$

$$K = \frac{2.303}{t_{1/2}} \log\frac{[R]_0}{[R]_0/2}$$

$$K = \frac{2.303}{t_{1/2}} \log 2$$

$$K = \frac{2.303 \times 0.3010}{t_{1/2}} = \frac{0.693}{t_{1/2}}$$

$$t_{1/2} = \frac{0.693}{K}$$

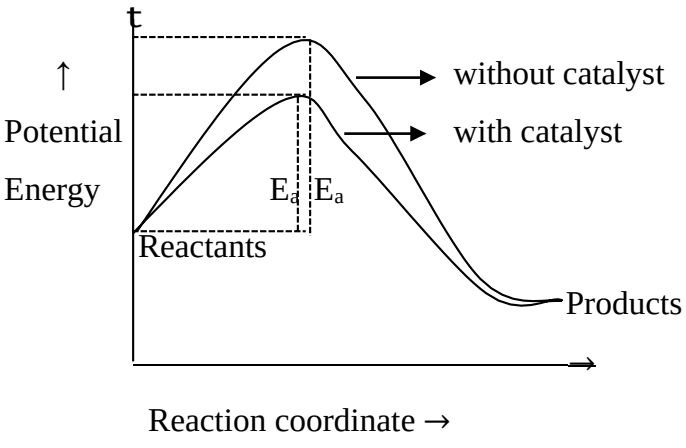
Therefore, for a first order reaction $t_{1/2}$ is independent of initial concentration.

7. **Explain the effect of catalyst on the activation energy of a reaction with graph.**

The effect is explained by intermediate complex formation theory.

According to this theory, a catalyst combines with the reactants to form an intermediate complex which is decomposes to products.

A positive catalyst increases the rate of reaction by providing an alternative pathway with lower activation energy.



Chapter-5: Surface Chemistry

1. **Write the differences between Physisorption and Chemisorption**.

Physical adsorption (Physisorption)	**Chemical adsorption (Chemisorption)**
Low heat of adsorption	High heat of adsorption
Reversible	Irreversible
Multi molecular layers	Mono molecular layer

2. **What are Homogeneous and Heterogeneous catalysis? Give an example for each.**

Homogeneous catalysis :

The process in which both reactants and the catalyst are present in the same phase.

Ex **:** $CH_3COOCH_{3(l)} + H_2O_{(l)} \xrightarrow{HCl_{(l)}} CH_3COOH_{(aq)} + CH_3OH_{(aq)}$

Heterogeneous catalysis :

The process in which the reactants and the catalyst are in different phases.

Ex **:** $N_{2(g)} + 3H_{2(g)} \xrightarrow{Fe_{(s)}} 2NH_{3(g)}$

3. **Write the differences between Lyophilic and Lyophobic colloids.**

Lyophilic colloids	**Lyophobic colloids**
The colloids in which there is a strong affinity between dispersed phase and dispersion medium is called lyophilic colloids. Ex **:** Starch sol	The colloids in which there is no affinity between dispersed phase and dispersion medium is called lyophobic colloids. Ex **:** Gold sol
More stable	Less stable
Reversible in nature	Irreversible in nature

4. **What is Brownian movement? Give reason for that.**

The zig-zag movement of colloidal particles in the colloidal solution is called Brownian movement. It is due to bombardment of particles by the molecules of dispersion medium.

5. **State Hardy-Schulze rule.**

It states that 'Greater the value of the flocculating ion added, the greater is its power to cause precipitation'.

Chapter–6: General principles and process of isolation of elements

1. How is pure alumina is obtained from bauxite by leaching process?

Al_2O_3 is treated with NaOH gives sodium aluminate leaving the impurities behind.

$$Al_2O_{3(s)} + 2NaOH_{(aq)} + 3H_2O_{(l)} \rightarrow\!\!-\!\!-\!\!-\!\!\rightarrow 2Na[Al(OH)_4]_{(aq)}$$

The solution is neutralized by passing CO_2 gas

$$2Na[Al(OH)_4]_{(aq)} + 2CO_{2(g)} \rightarrow\!\!-\!\!-\!\!-\!\!\rightarrow Al_2O_3.xH_2O_{(s)} + 2NaHCO_{3(aq)}$$

Hydrated alumina is filtered, dried to give back pure Al_2O_3.

$$Al_2O_3.xH_2O_{(s)} \rightarrow\!\!-\!\!-\!\!\rightarrow Al_2O_{3(s)} + xH_2O_{(g)}$$

2. Explain Zone refining.

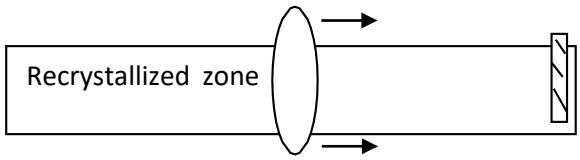
Principle **:** Impurities are more soluble in the molten state than in the solid state.

A moving electrical coil is fixed at one end of a impure metal rod.

On heating, pure metal solidifies while impurities pass into the molten zone.

The process is repeated for several times.

This method is used to get ultra-pure metals for producing semiconductors like germanium and silicon.



Electric Coil Impurities

3. Explain Mond's process for refining of nickel.

The crude metal is heated with carbon monoxide gives tetra carbonyl.

On heating tetra carbonyl gives metal.

$$Ni + 4CO \xrightarrow{350\,K} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450\,K} Ni + 4CO$$

4. Explain Van Arkel method for refining of Zirconium or Titanium.

The crude metal is heated with iodine, gives tetra iodides.

On heating tetra iodides gives metal.

$$Zr + 2I_2 \xrightarrow{850\,K} ZrI_4$$

$$ZrI_4 \xrightarrow{200\,K} Zr + 2I_2$$

Metals used in space technology purified by this method.

5. **Write down the reactions taking place in different zones in the Blast furnace during the extraction of iron.**

Combustion zone :

At the bottom of the furnace carbon burns with hot air gives CO_2.

CO_2 moves upwards meets more carbon gives carbon monoxide.

$$C + O_2 \rightarrow\!\!\!\!\longrightarrow CO_2$$

$$C + CO_2 \rightarrow\!\!\!\longrightarrow 2CO$$

Reduction zone :

At the top of the furnace CO reduces iron oxide to iron

$$Fe_2O_3 + 3CO \rightarrow\!\!\!\!\longrightarrow 2Fe + 3CO_2$$

Slag zone :

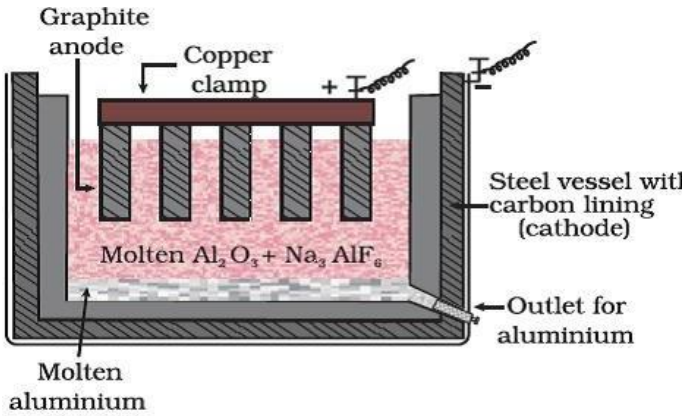
Limestone decomposed to CaO, which is combined with SiO_2 form a slag.

$$CaCO_3 \rightarrow\!\!\!\longrightarrow CaO + CO_2$$

$$CaO + SiO_2 \rightarrow\!\!\!\!\longrightarrow CaSiO_3$$

6. **Draw labelled diagram of Hall – Heroult Electrolytic cell for the extraction of aluminium. Write anode and cathode reactions.**

Purified Al_2O_3 (bauxite) is mixed with Na_3AlF_6, which lowers the melting point and increases the conductivity of the melt.



Anode :

Graphite rod

$$C_{(s)} + O^{2-}_{(melt)} \rightarrow\!\!\!\longrightarrow CO_{(g)} + 2e^-$$

$$C_{(s)} + 2O^{2-}_{(melt)} \rightarrow\!\!\longrightarrow CO_{2(g)} + 4e^-$$

Cathode :

Steel vessel with carbon lining

$$Al^{3+}_{(melt)} + 3e^- \rightarrow\!\!\!\longrightarrow Al$$

Overall reaction is

$$2Al_2O_3 + 3C \rightarrow\!\!\!\!\longrightarrow 4Al + 3CO_2$$

7. **Write the composition of copper matte.**

$Cu_2S + FeS$

Chapter–7: The p – block elements

1. **For the manufacture of Ammonia by Haber's process, write the flow chart and chemical equations with optimum conditions.**

N_2 and H_2 combined in the ratio of 1:3, gives ammonia

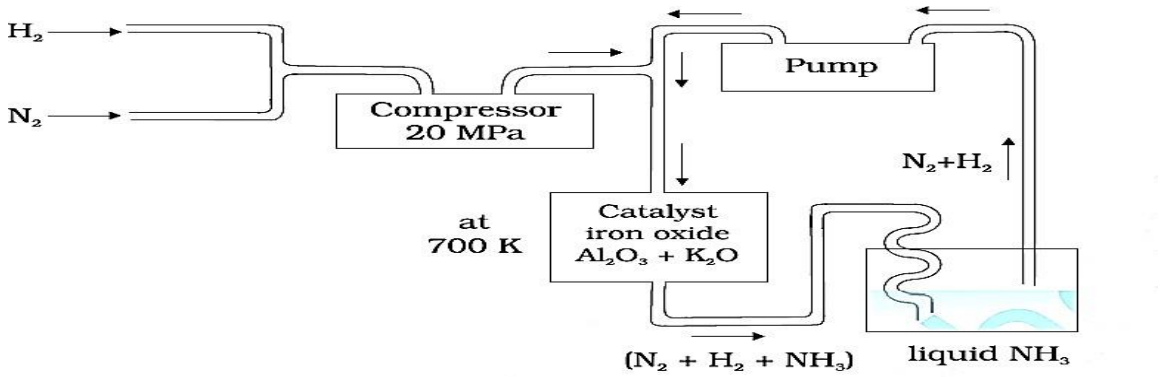
$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

According to Le Chatelier's principle, the optimum conditions to get a good yield of ammonia are,

Optimum temperature of 700 K

High pressure of 200 atm

In presence of iron oxide as catalyst



2. **Write the balanced chemical equations with conditions involved in the manufacture of Nitric acid by Ostwald's process.**

Ammonia is oxidized by air in the presence of Pt – Rh gauze catalyst at 500 K, gives nitric oxide.

$$4NH_{3\,(g)} + 5O_{2\,(g)} \xrightarrow{Pt-Rh\ Catalyst} 4NO_{(g)} + 6H_2O_{(g)}$$

The nitric oxide is oxidised by air, it gives nitrogen dioxide

$$2NO_{(g)} + O_{2\,(g)} \longrightarrow 2NO_{2\,(g)}$$

Nitrogen dioxide so formed, dissolves in water it gives nitric acid.

$$3NO_{2\,(g)} + H_2O_{(l)} \longrightarrow 2HNO_{3\,(aq)} + NO_{(g)}$$

NO thus formed is recycled.

3. **In the manufacture of sulphuric acid by contact process write reactions and optimum conditions?**

- Burning of sulphur in air gives sulphur dioxide

  $S + O_2 \longrightarrow SO_2$

- Sulphur dioxide oxidised to sulphur trioxide with air

  $$2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3$$

According to Le Chatelier's principle, the optimum conditions to get a good yield of SO_3 are,

Optimum temperature of 720 K

High pressure of 2 bar

In presence of V_2O_5 as catalyst.

- Absorption of SO_3 in H_2SO_4 gives oleum. (Fuming sulphuric acid is called oleum)

  $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$

- Oleum with water gives sulphuric acid.

  $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

4. For Noble gases

(a) Name the noble gas obtained as decay product of ^{226}Ra.

(b) Name the noble gas used in the treatment of cancer.

(c) Which noble gas is most abundant in atmospheric dry air?

(d) Mention the main commercial source of helium.

(e) Give reason for chemical inertness

(a) Radon

(b) Radon

(c) Argon

(d) Natural gas

(e) It is due to octet configuration and high ionisation energy.

5. What are inter halogen compounds? Give an example.

The compounds obtained when two different halogens react with each other are called inter halogen compounds.

Ex **:** ClF

6. Give reason : Inter halogen compounds are more reactive than halogens (except fluorine).

This is because $X - X^1$ bond in inter halogens is weaker than X – X bond in halogens except F – F bond.

Chapter–8: d and f- block Elements

1. **Give reason : The electronic configuration of chromium is [Ar] $3d^5\ 4s^1$ but not [Ar] $3d^4\ 4s^2$, similarly for copper is [Ar] $3d^{10}\ 4s^1$ but not [Ar] $3d^9\ 4s^2$.**

This is because, half -filled and completely filled orbitals are more stable.

2. **Transition metals and many of their compounds acts as good catalyst. Explain**

Most of the transition elements and their compounds are acts as good catalysts.

The catalytic properties is due to,

- ✓ Variable oxidation states.
- ✓ Large surface area in the finely divided state.

Ex **:** Iron is used as a catalyst in Haber's process.

3. **What are interstitial compounds?**

The compounds obtained, when small atoms like H or C are trapped inside the crystal lattices of metals are called interstitial compounds.

4. **Explain the manufacture of potassium dichromate ($K_2Cr_2O_7$) from chromite ore ($FeCr_2O_4$)**

Chromite ore is mixed with soda ash and burnt in excess of air gives sodium chromate.

$$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$

Sodium chromate is treated with acid gives sodium dichromate.

$$2Na_2CrO_4 + 2H^+ \longrightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$$

Sodium dichromate is treated with potassium chloride gives potassium dichromate.

$$Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$$

5. **How is Potassium permanganate ($KMnO_4$) is prepared from MnO_2. Write equations.**

When MnO_2 is fused with KOH gives potassium manganite.

$$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

Potassium manganite in acidic medium gives potassium permanganate.

$$3K_2MnO_4 + 4H^+ \longrightarrow 2KMnO_4 + MnO_2 + 2H_2O + 4K^+$$

6. **What is Lanthanide contraction? Mention one of its consequence and cause for it.**

The gradual decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanide contraction.

Consequence **:** Almost identical radii of Zr and Hf.

Cause**:** It is due to imperfect shielding of 4f electrons.

Chapter–9: Coordination Compounds

1. Write the postulates of Werner's theory.

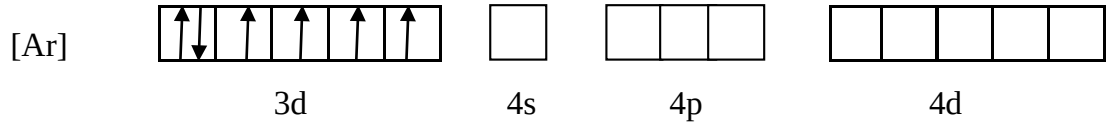
Postulates

- ❖ The central metal show two types of valences, namely primary and secondary valency.
- ❖ Primary valences are ionisable and are satisfied by negative ions.
- ❖ Secondary valences are non-ionisable and are satisfied by neutral molecules or negative ions.

2. Using Valence bond theory account for the geometry and magnetic property of $[CoF_6]^{3-}$.

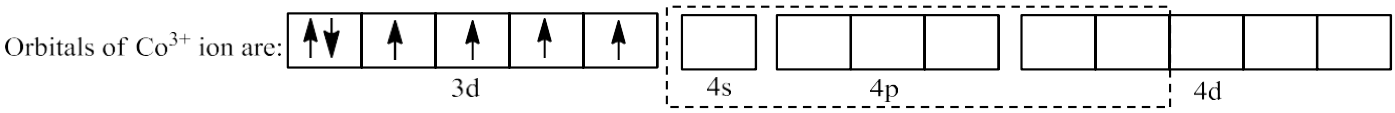
In $[CoF_6]^{3-}$ the cobalt ion is in +3 oxidation state.

For Co^{3+} the electronic configuration is [Ar] $3d^6\,4s^0$

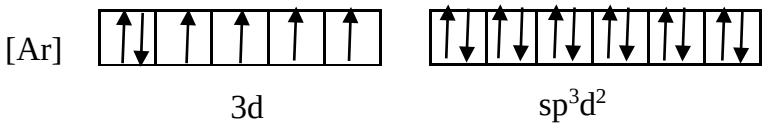


Fluoride is a weak ligand, hence no pairing of electrons takes place in d-orbitals.

Hybridization takes place gives six vacant sp^3d^2 hybridized orbitals.



Six pairs of electrons, from six fluoride ligands occupy hybrid orbitals.



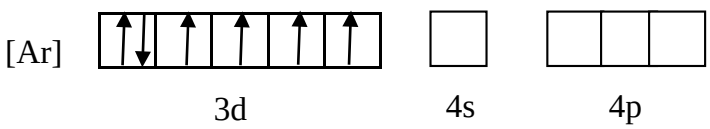
Due to presence of unpaired electrons, the complex is paramagnetic.

It has octahedral geometry.

3. Using Valence bond theory account for the geometry and magnetic property of $[Co(NH_3)_6]^{3+}$.

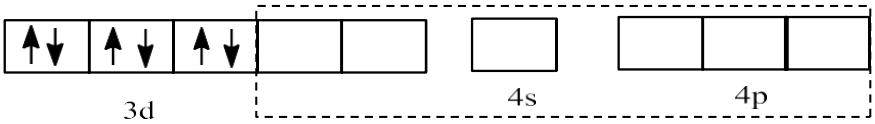
In $[Co(NH_3)_6]^{3+}$ the cobalt ion is in +3 oxidation state.

For Co^{3+} the electronic configuration is [Ar] $3d^6\,4s^0$

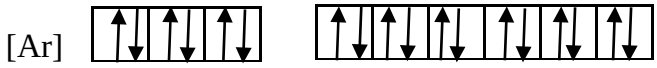


NH_3 is a strong ligand, hence pairing of electrons takes place in d-orbitals.

Hybridization takes place gives six vacant d^2sp^3 hybridized orbitals.



Six pairs of electrons from six NH_3 ligands, occupy hybrid orbitals.



3d d^2sp^3

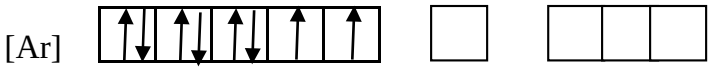
Due to absence of unpaired electrons, the complex is diamagnetic.

It has octahedral geometry.

4. Using Valence bond theory account for the geometry and magnetic property of $[NiCl_4]^{2-}$.

In $[NiCl_4]^{2-}$ the nickel ion is in +2 oxidation state.

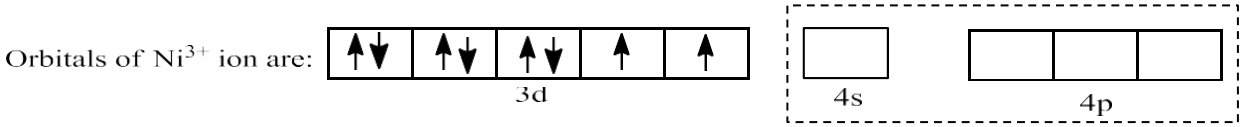
For Ni^{2+} the electronic configuration is [Ar] $3d^8\,4s^0$



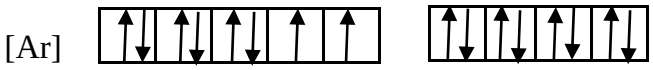
3d 4s 4p

Chloride is a weak ligand, hence no pairing of electrons takes place in d-orbitals.

Hybridization takes place gives four vacant sp^3 hybridized orbitals.



Four pairs of electrons, from four chloride ligands occupy hybrid orbitals.



3d sp^3

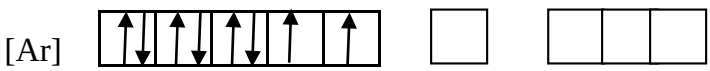
Due to presence of unpaired electrons, the complex is paramagnetic.

It has tetrahedral geometry.

5. Using Valence bond theory account for the geometry and magnetic property of $[Ni(CN)_4]^{2-}$.

In $[Ni(CN)_4]^{2-}$ the nickel ion is in +2 oxidation state

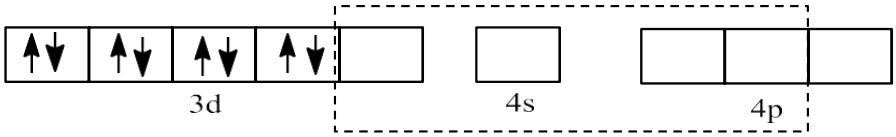
For Ni^{2+} the electronic configuration is [Ar] $3d^8\,4s^0$



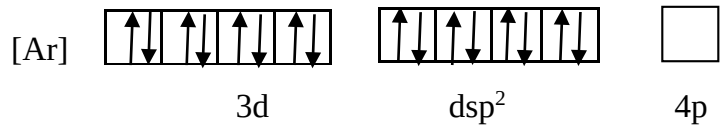
3d 4s 4p

Cyanide is a strong ligand, hence pairing of electrons takes place in d-orbitals.

Hybridization takes place gives four vacant dsp^2 hybridized orbitals.



Four pairs of electrons, from four cyanide ligands occupy hybrid orbitals.



Due to absence of unpaired electrons, the complex is diamagnetic.

It has square planar geometry.

6. What are Homoleptic and Heteroleptic complexes? Give an example.

Complexes in which a metal is bound to only one kind of ligands are called homoleptic complexes.

Ex **:** $Ni(CO)_4$

Complexes in which a metal is bound to more than one kind of ligands are called heteroleptic complexes.

Ex **:** $[CoCl_3(NH_3)_3]$

7. What are linkage and ionization isomerism? Give an example.

Linkage isomers have same molecular formula but the same ligand linked to central metal with different donor atom.

Ex **:** $[Co(NH_3)_5(NO_2)]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$

Ionization isomers have same molecular formula but give different ions on ionization in solution.

Ex **:** $[Co(NH_3)_5(SO_4)]Br$ and $[Co(NH_3)_5Br]\ SO_4$

Chapter-10: Haloalkanes and haloarenes

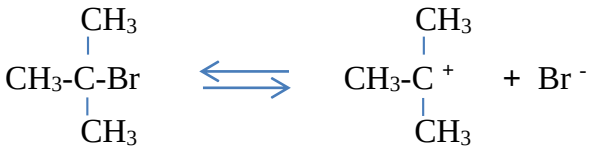
1. **Explain SN^1 mechanism for the conversion of tertiary butyl bromide to tertiary butyl alcohol.**

When tertiary butyl bromide is heated with aqueous potassium hydroxide, tertiary butyl alcohol is formed.

$$(CH_3)_3C\text{-}Br + KOH \longrightarrow (CH_3)_3C\text{-}OH + KBr$$

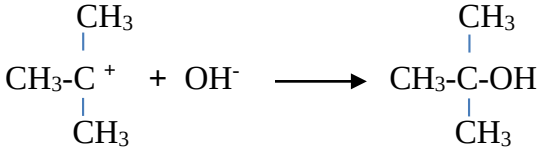
Mechanism :

Step **1:** Tertiary butyl bromide undergoes slow ionization gives carbocation.



This is a slow step and hence it is a rate determining step.

Step **2:** The nucleophile OH^- attack carbocation and gives tertiary butyl alcohol.



Rate of reaction depends only on concentration of alkyl halide, hence it is a 1st order reaction.

2. **Explain SN^2 mechanism for the conversion of methyl chloride to methyl alcohol.**

When methyl chloride is heated with aqueous potassium hydroxide methyl alcohol is formed.

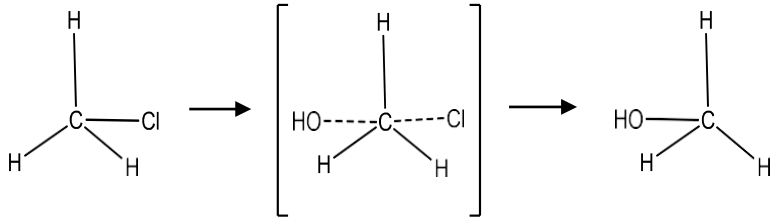
$$CH_3\text{-}Cl + KOH \longrightarrow CH_3\text{-}OH + KCl$$

Mechanism :

The nucleophile OH^- attacks the carbon atom from the side opposite to the chlorine.

The formation of C-OH and the cleavage of C-Cl bond takes place simultaneously.

Finally Cl^- gets detached to give methyl alcohol.



It involves only one step hence this is the rate determining step.

Rate depends on both concentration of nucleophile and alkyl halide, hence it is a second order reaction.

3. **What are Freon's? Give an example.**

The chlorofluoro compounds of methane and ethane are called Freon's.

Ex **:** Freon 12

4. Explain Finkelstein and Swart's reactions with equation.

When alkyl chlorides are heated with sodium iodide in acetone, gives alkyl iodides. This reaction is called Finkelstein reaction.

$$CH_3Cl + NaI \xrightarrow{Acetone} CH_3I + NaI$$

Methyl chloride	Methyl iodide

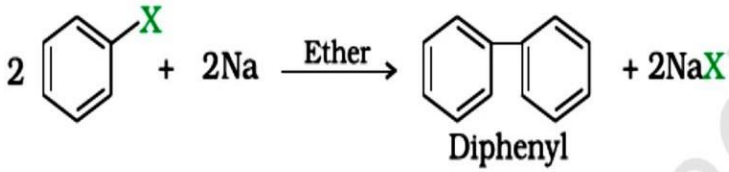
When alkyl chlorides are heated with silver fluorides, gives alkyl fluorides. This reaction is called Swarts reaction.

$$CH_3Cl + AgF \longrightarrow CH_3F + AgCl$$

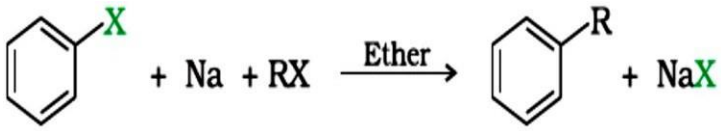
Methyl chloride	Methyl fluoride

5. Explain Fittig and Wurtz-Fittig reaction with equation.

When two molecules of aryl halides are coupled in presence of sodium metal in dry ether, gives biphenyl. This reaction is called Fittig reaction.



When aryl halide coupling with alkyl halide in presence of sodium metal in dry ether, gives alkylarene. This reaction is called Wurtz-Fittig reaction.

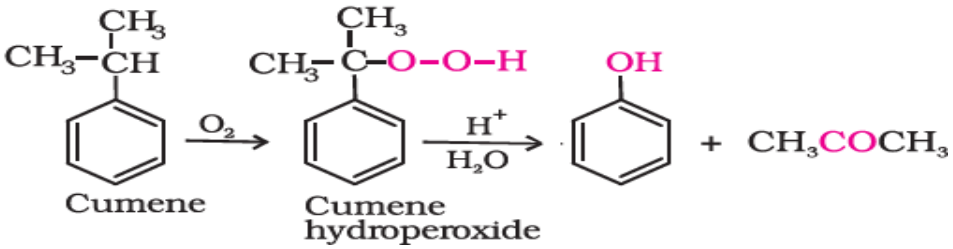


Chapter-11: Alcohols, Phenols and Ethers

1. Explain the preparation of phenol from Cumene.

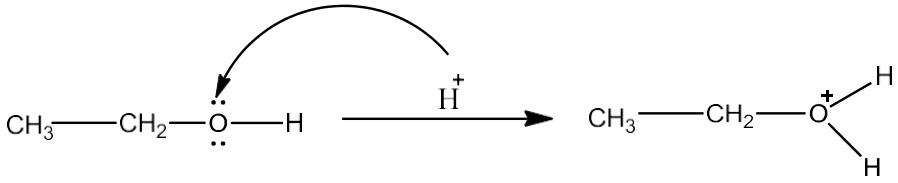
When Cumene is oxidised in presence of air gives Cumene hydroperoxide.

Cumene hydroperoxide on acidification gives phenol and acetone.

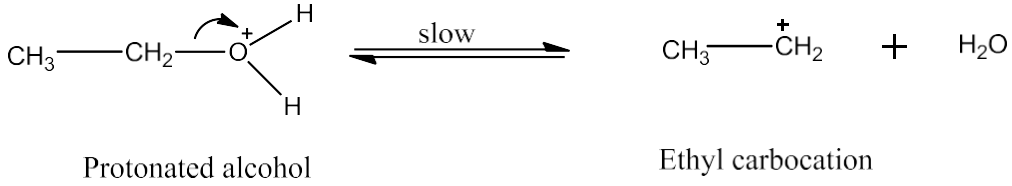


2. Write the mechanism of acid catalysed dehydration of ethanol to ethene.

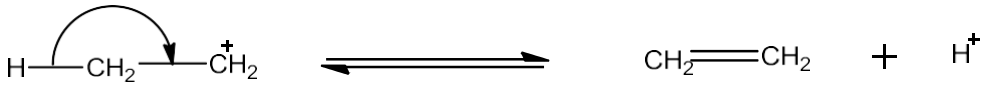
Step1: Protonation of alcohol yields protonated alcohol.



Step2: Protonated alcohol loses water molecule to form ethyl carbocation.

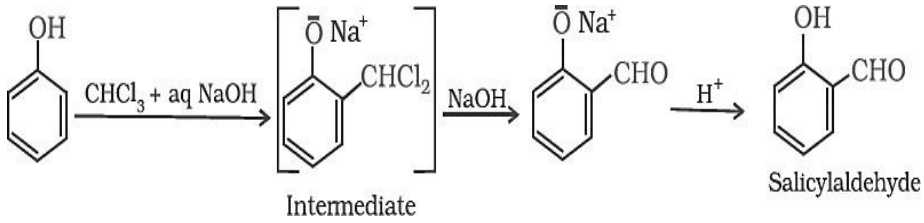


Step3: Ethyl carbocation loses a proton to form ethene.



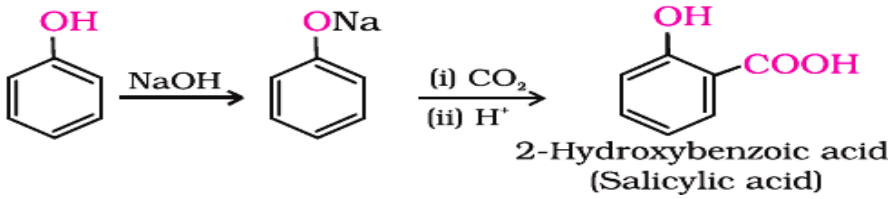
3. Explain Reimer-Tieman reaction.

When phenol is heated with sodium hydroxide and $CHCl_3$, sodium salt of Salicylaldehyde is obtained, which on acidified with HCl gives Salicylaldehyde.



4. **Explain Kolbe's reaction.**

When phenol is heated with NaOH gives sodium phenate and then CO_2 is passed through it and followed by acidification gives salicylic acid.



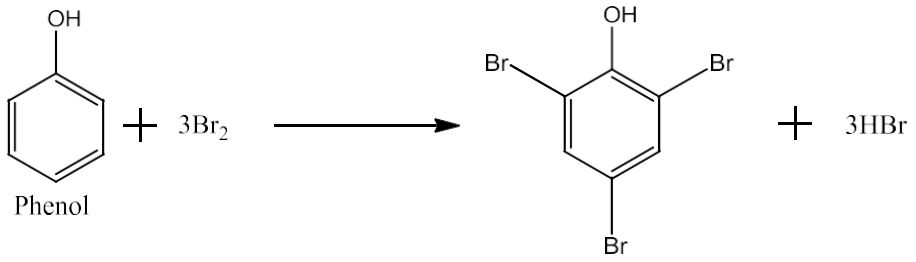
2-Hydroxybenzoic acid
(Salicylic acid)

5. **What is Lucas reagent?**

A solution of anhydrous zinc chloride in concentrated HCl is called Lucas reagent.

6. **How is phenol reacts with bromine water. Write equation.**

When phenol is treated with bromine water, a white precipitate of 2, 4, 6-tribromophenol is formed.



2,4,6-Tribromo phenol

7. **Explain Williamson's ether synthesis.**

When alkyl halide is heated with sodium alkoxides, gives ether. This reaction is called Williamson's ether synthesis.

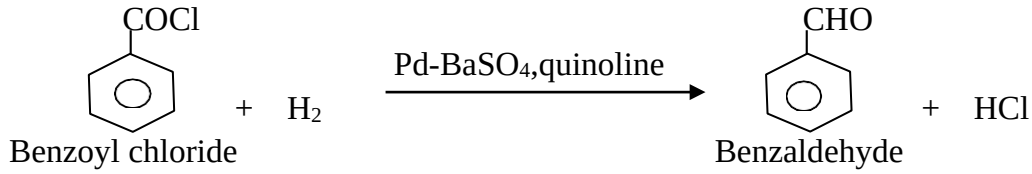
Ex : CH_3Br + $NaOC_2H_5$ ⟶ CH_3-O-CH_2-CH_3 + NaBr

Methyl bromide — Sodium ethoxide — Ethyl methyl ether

Chapter-12: Aldehydes, Ketones and Carboxylic acids

1. Explain Rosenmund's reduction in the preparations of aldehydes.

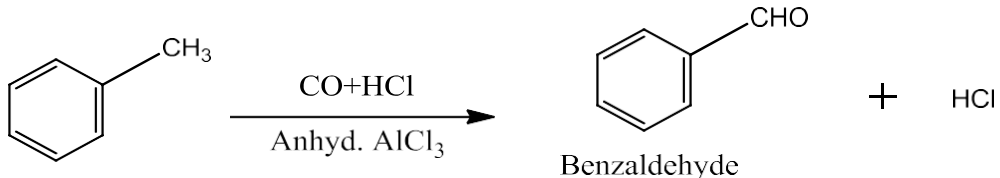
When acid chlorides heated with H_2 in the presence of palladium catalyst gives aldehydes. This reaction is called Rosenmund reduction.



Benzoyl chloride Benzaldehyde

2. Explain Gatterman-Koch reaction in the preparations of aldehydes.

When toluene is heated with a mixture of carbon monoxide and hydrogen chloride in presence of anhydrous $AlCl_3$ catalyst, gives benzaldehyde. This reaction is called Gatterman-Koch reaction.



Toulene Benzaldehyde

3. Explain Clemmensen reduction with an example.

The reduction of aldehydes with zinc amalgam and concentrated HCl to corresponding hydrocarbon is called Clemmensen reduction.

$$CH_3CHO + 4[H] \xrightarrow{Zn-Hg} CH_4 + H_2O$$

4. What is a Cannizzaro's reaction explain with an example.

Aldehydes do not containing α-hydrogen atoms are reacted with strong alkali gives alcohol and salt of carboxylic acid. This reaction is called Cannizzaro's reaction.

$$2HCHO + NaOH \longrightarrow HCOONa + CH_3OH$$

Formaldehyde Sodium formate Methanol

5. Explain Decarboxylation reaction with an example.

The process of removal of CO_2 from sodium salt of carboxylic acids using dry soda lime (NaOH + CaO) is called decarboxylation.

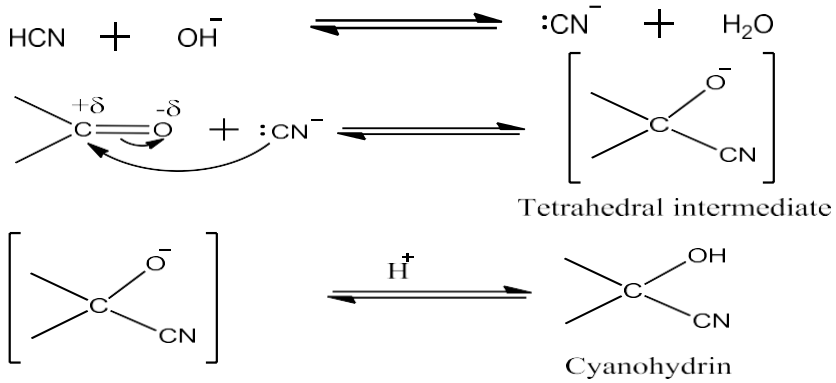
$$CH_3COONa \xrightarrow{NaOH + CaO} CH_4 + Na_2CO_3$$

Sodium acetate Methane

6. **Explain the mechanism of addition of HCN to a carbonyl group in presence of a base.**

Aldehydes and ketones react with hydrogen cyanide to give cyanohydrine.

This reaction is very slow. Therefore, it is catalysed by a base and the generated cyanide ions (CN^-) is a stronger nucleophile which readily adds to carbonyl compounds to yield corresponding cyanohydrin.



Chapter-13: Organic Compounds Containing Nitrogen

1. **How is primary amine is prepared by Hoffmann bromamide degradation reaction? Write equation.**

The acid amides on reaction with Br_2 in presence of NaOH, gives primary amine is called Hoffmann bromamide reaction.

$C_6H_5CONH_2 + Br_2 + 4NaOH \longrightarrow C_6H_5NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

Benzamide — Aniline

2. **Explain Carbylamine reaction.**

When primary amines are heated with chloroform and KOH carbylamines are formed. This reaction is called Carbylamine reaction.

This is used as a test for primary amines.

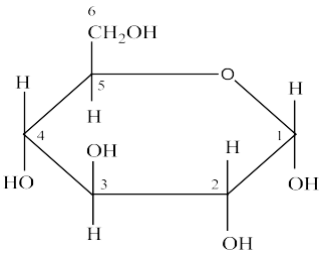
$CH_3NH_2 + CHCl_3 + 3KOH \longrightarrow CH_3NC + 3KCl + 3H_2O$

Methyl amine — Methyl isocyanide

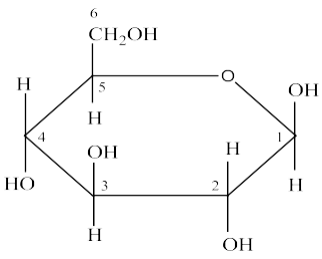
Chapter-14: Biomolecules

1. **Write Haworth structure of glucose and maltose.**

Glucose

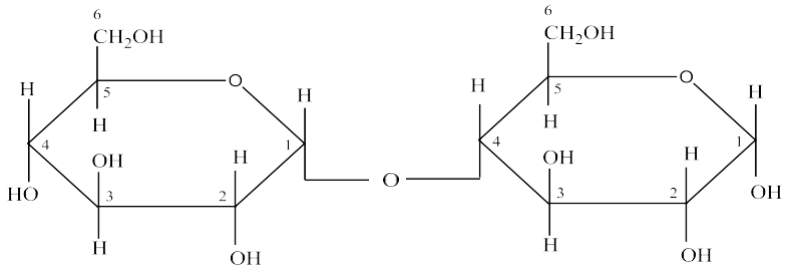


α–D(+)-Glucopyranose



β–D(+)-Glucopyranose

Maltose



(α-D-Glucose) (Maltose) (α-D-Glucose)

2. **What are essential and non-essential amino acids? Give an example.**

Amino acids that are not synthesised in the body and must be supplied through diet are called essential amino acids.

Ex **:** Lysine

Amino acids that are synthesised in the body are called non-essential amino acids.

Ex **:** Glycine

3. **Answer the following questions.**

Reducing sugar	Glucose
Non-reducing sugar	Sucrose
Nitrogen base present only in DNA	Thymine
Nitrogen base present only in RNA	Uracil
Water soluble component of starch	Amylose
Water insoluble component of starch	Amylopectin
Water soluble vitamin	Vitamin C

Fat soluble vitamin	Vitamin D
Deficiency of vitamin A	Night blindness
Deficiency of vitamin C (Ascorbic acid)	Scurvy
Deficiency of vitamin D	Rickets
Deficiency of vitamin B_{12}	Pernicious anaemia
Hormone maintains blood sugar level	Insulin

4. What are fibrous and globular proteins? Give an example.

Long polypeptide chains arranged parallel to each other and held together by disulphide and hydrogen bonds are called fibrous proteins.

Ex **:** Keratin (present in hair)

In globular proteins polypeptide chains are coiled around, giving a spherical shape.

Ex **:** Egg albumin

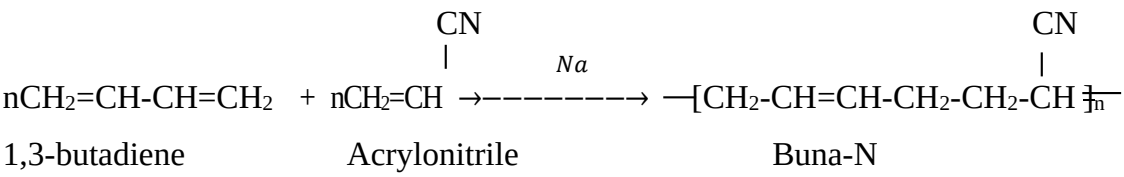
Chapter-15: Polymers

1. Name the monomer present in the following polymer

Polymer	Monomer unit
Poly vinyl chloride (PVC)	Vinyl chloride
Polythene	Ethene
Nylon 6,6	Hexamethylene diamine + adipic acid
Nylon-6	Caprolactum
Neoprene	Chloroprene
Natural rubber	Cis-isoprene (IUPAC Name is 2-methyl buta-1,3-diene)

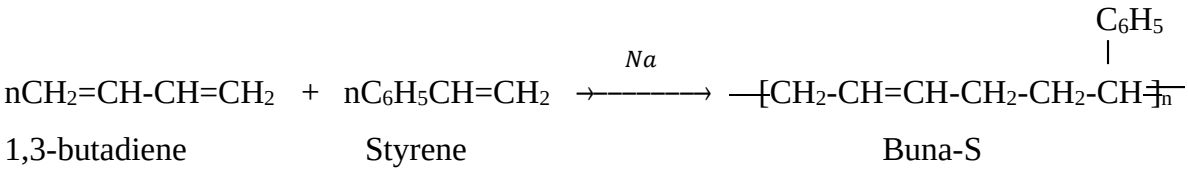
2. Explain the preparation of Buna-N.

Buna-N is obtained by the copolymerisation of 1,3-butadiene and acrylonitrile in the presence of a peroxide catalyst .



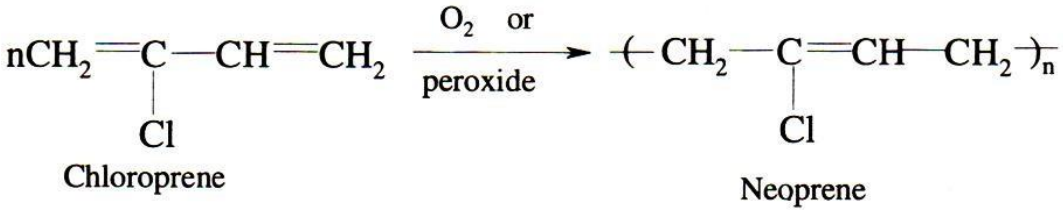
3. Explain the preparation of Buna-S:

Buna-S is obtained by the co-polymerisation of 1,3-butadine and styrene.



4. Explain preparation of Neoprene.

Neoprene are Polychloroprene is formed by the free radical polymerisation of chloroprene.



5. Explain Vulcanisation of rubber.

The process of heating natural rubber with sulphur, to improve the physical properties rubber is called vulcanisation of rubber.

- ✓ During vulcanisation, sulphur forms bridges between different chains.
- ✓ Vulcanized rubber is hard, non-sticky and has high tensile strength.
- ✓ It is used for making rubber bands, gloves and tyres.

6. What are biodegradable and non-biodegradable polymers? Give an example for each.

Polymers which undergo natural break down into raw materials of nature and disappear into nature are called biodegradable polymers.

Ex **:** PHBV

Polymers which cannot undergo natural break down or break down over a long period of time are called non-biodegradable polymers.

Ex **:** Polythene

7. What are addition and condensation polymers? Give an example.

The polymers formed by repeated addition of monomer molecules possessing double or triple bonds are called addition polymers.

Ex **:** Polythene

The polymers formed by repeated condensation reaction between two different bi-functional monomeric units are called condensation polymers.

Ex **:** Nylon 6,6

Chapter-16: Chemistry in everyday life

1. **What are food preservatives? Give an example.**

Food preservatives are chemicals that prevents food from spoilage due to microbial growth.

Ex **:** Table salt

2. **What are antioxidants? Give an example.**

The chemical substances which prevent oxidation and subsequent spoilage of the food are called antioxidants.

Ex **:** Butylated hydroxyl toluene (BHT)

3. **What are antifertility drugs? Give an example.**

The chemical compounds which prevents the pregnancy in women are called antifertility drugs.

Ex **:** Norethindrone

4. **What are tranquilizers? Give an example.**

Tranquilizers are drugs used for the treatment of stress and mental disorders.

Ex **:** Equanil

5. **What are anionic detergents? Give an example.**

Sodium salts of sulphonated long chain hydrocarbons are called anionic detergents.

Ex **:** Sodium lauryl sulphate

6. **Give an example for each of the following.**

Artificial sweetening agent **:** Saccharin

Antiseptic **:** Dettol

Non-narcotic analgesic **:** Aspirin