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1

SOLUTIONS

Solutions

Important Concentration terms

$$\text{Mass \%} = \frac{\text{Mass of a component}}{\text{Total mass of all component}} \times 100$$

$$\text{Mole fraction} = \frac{\text{No. of moles of a component}}{\text{Total No. of moles of all component}}$$

$$\text{Molarity} = \frac{W_2 \times 1000}{M_2 \times V \text{ in ml}} \qquad \text{Molality} = \frac{W_2 \times 1000}{M_2 \times w_1 \text{ in g}}$$

W_1 = Mass of Solvent

W_2 = Mass of Solute

M_2 = Molar Mass of Solute

Henry's Law

Vapour pressure of a gas is proportional to its mole fraction in solution.

$$P \propto x \quad P = K_H x$$

Applications of henry's law

1. Carbonated water (soft drinks)
   - Sealed at high pressure
2. Bend
3. Anoxia

Raoult's law

Partial V.P of a component is directly proportional to its mole fraction in Solution

$$P_A = P_A^\circ x_A \quad ; \quad P_B = P_B^\circ x_B$$

$$P_A = P_A^\circ x_A + P_B^\circ x_B$$

Ideal solution (obeys Rault's law)	Non-Ideal solution (Does not obeys Rault's law)	
	+ve deviation	−ve deviation
$\Delta V = 0$; $\Delta H = 0$	$\Delta V = +ve$; $\Delta H = +ve$	$\Delta V = -ve$; $\Delta H = -ve$
A−B = A−A & B−B	A−B < A−A & B−B	A−B > A−A & B−B
Eg: Hexane + Heptane	Ethanol + H_2O	$H_2O + HNO_3$
Chlorobenzene + Bromo benzene	Ethanol + Acetone	$H_2O + HCl$

Colligative properties

1. Relative lowering of V.P $= \dfrac{P_1^\circ - P_1}{P_1^\circ} = x_2$

2. Elevation of Boiling point $(\Delta T_b) = k_b \cdot m$

3. Depression of freezing point $(\Delta T_f) = k_f \cdot m$

4. Osmotic pressure $(\pi) = CRT$

Isotonic : Same osmotic pressure
Hypertonic : Higher osmotic pressure
Hypotonic : Lower osmotic pressure

- 0.9 % Nacl Solution $\longrightarrow$ Used as IV Injection
  $\Rightarrow$ Isotonic with blood (RBC).
- Application of Reverse osmosis $\longrightarrow$ Desalination of sea water

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Electrochemistry

Electrochemistry

Electrochemistry is the branch of chemistry which deals with chemical energy, electrical energy and their interconversions.

Galvanic cell

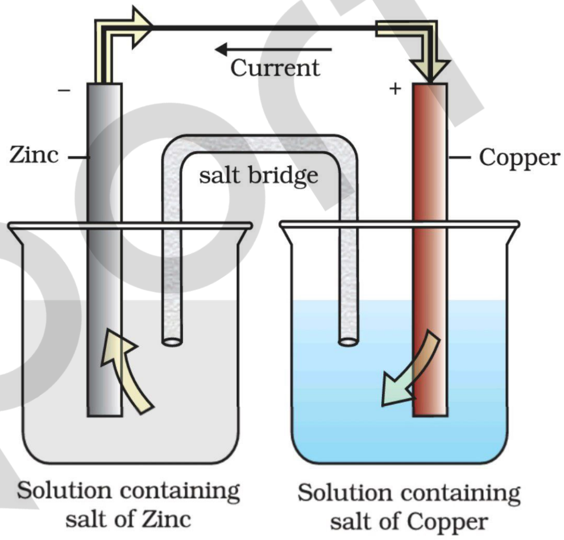
converts chemical energy to electrical energy

Anode : oxidation half cell : $M \longrightarrow M^{n+} + n\bar{e}$

Cathode : Reduction half cell : $M^{n+} + n\bar{e} \longrightarrow M$

Daniel Cell

Galvanic cell in which anode is zinc and cathode is copper.



overall reaction

$Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$

Representation

$Zn/Zn^{2+}//Cu^{2+}/Cu$

Direction of $\bar{e}$ flow

Anode $\longrightarrow$ Cathode

Left $\longrightarrow$ Right

−ve $\longrightarrow$ +ve

High reactive $\longrightarrow$ Less Reactive

In Daniel cell

$Zn \longrightarrow Cu$

Electrode potential

Tendency to lose or gain electrons.

Reduction potential is taken as electrode potential.

Reduction potential $\longrightarrow E_{M^{n+}/M}$

Standard Reduction potential $\longrightarrow E^{\circ}_{M^{n+}/M}$

Cell potential

$$E^\circ_{cell} = E^\circ_c - E^\circ_a$$

E°_c : Reduction potential of cathode

E°_a : Reduction potential of anode

$emf = E^\circ_c - E^\circ_a$

For Daniel cell, $E^\circ_{cell} = E_{Cu^{2+}/Cu} - E^\circ_{Zn^{2+}/Zn}$

$E^\circ_{cell} = 1.1\ V$

Nernst Equation

Equation representing relation between electrode potential or cell potential with electrolytic concentration.

For an anode,

$$E_{M^{n+}/M} = E^\circ_{M^{n+}/M} - \frac{2.303RT}{nF} \log \frac{1}{[M^{n+}]}$$

For a Daniel cell,

$$E_{cell} = E^\circ_{cell} - \frac{2.303RT}{2F} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

For Galvanic cell,

$$mx + ny^{n+} \longrightarrow mx^{n+} + ny$$

$$E_{cell} = E^\circ_{cell} - \frac{2.303RT}{nF} \log \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Nernst equation & K_c

$$E^\circ_{cell} = \frac{2.303RT}{nF} \log K_c$$

Gibb's Energy & E°_{cell}

$$\Delta G^\circ = -nFE^\circ_{cell}$$

Resistance (R)

$$R \propto \frac{\rho l}{A}$$

Unit = Ω or ohm

Conductance (G)

$$G = \frac{1}{R}, \quad G = \frac{KA}{l}$$

unit = Ω^{-1} or siemens (S)

Resistivity

$$\rho = \frac{RA}{l}$$

Unit = Ωm

Conductivity (K)

$$K = \frac{Gl}{A} = \frac{1}{R}\frac{l}{A}$$

$$K = GG^*$$

Unit = $\Omega^{-1} m^{-1}$

G^* = Cell constant

$$G^* = \frac{l}{A}$$

Unit = m^{-1}

Molar conductivity

$\lambda_m = \frac{1000 \times K}{M}$ $\quad$ $K \Rightarrow$ conductivity $\quad$ $M \Rightarrow$ Molarity

Unit : $S\,cm^2\,mol^{-1}$

$\Omega^{-1}\,cm^2\,mol^{-1}$

Variation conductivity on dilution

On dilution conductivity decreases due to decrease in number ions per unit volume.

Variation of Molar conductivity on Dilution (λ_m)

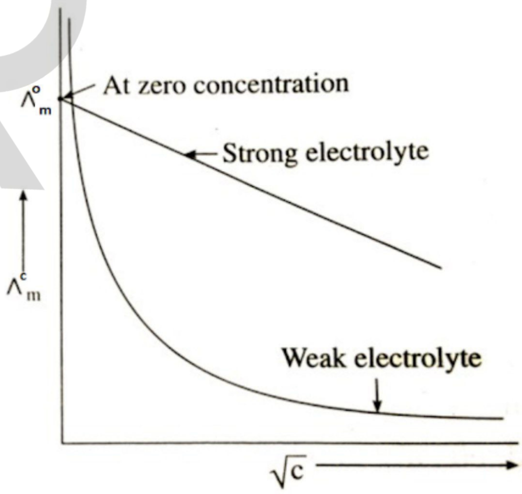
λ_m increases on dilution for both strong & weak electrolyte.

For strong electrolyte, force of attraction between opposite ion decreases, ionic mobility increases, λ_m increases.

For weak electrolyte, degree of dissociation increases, no. of ions increases and λ_m increases.

Debye-Huckel-Onsugar equation

$$\boxed{\begin{aligned} \lambda_m &= \lambda_m^\circ - A\sqrt{c} \\ y &= c + mx \end{aligned}}$$



Kohlrausch's law

Limiting molar conductivity of any electrolyte can be represented as the sum of individual contributions of anions & cations of the electrolyte

$$\lambda_{m\,AB}^\circ = \lambda_m^\circ(A^+) + \lambda_m^\circ(B^-)$$

Applications

Calculation of λ_m° of weak electrolyte

Eg: $\lambda_m^\circ\, CH_3COOH = \lambda_m^\circ\, CH_3COONa + \lambda_m HCl - \lambda_m^\circ\, NaCl$

Calculation of Degree of dissociation

$$\alpha = \frac{\lambda_m^c}{\lambda_m^\circ}$$

Electrolytic Cell

Convert Electrical energy into chemical energy.

Electrolysis of Molten Nacl	Electrolysis of aqeous Nacl
Anode : Cl_2 gas $2Cl^- \rightarrow Cl_2 + 2\bar{e}$ Cathode : Na. Metal $Na^+ + \bar{e} \rightarrow Na$	Anode : Cl_2 gas $2Cl^- \rightarrow Cl_2 + 2\bar{e}$ Cathode : H_2 gas $2H^+ + 2\bar{e} \rightarrow H_2$

Faraday's First law of electrolysis

Amount substance deposited/ Liberated directly proportional current passing through the electrolyte.

$m = ZIt$ — $m \rightarrow$ Mass of substance

$Z = \frac{E}{96500}$ — $Z \rightarrow$ Electro chemical equivalence

$I \rightarrow$ Current

$E = \frac{\text{Molar Mass}}{\text{Valency}}$ — $t \rightarrow$ Time in seconds

1 Faraday $\rightarrow$ Total charge of one mole of electrons Or Amount of electricity required to deposit one gram equivalent of a substance.

$$1 F = 96500 \, C$$

→ Faraday's 2nd law of Electrolysis

$$\frac{\text{Mass of A}}{\text{Mass of B}} = \frac{\text{Equivalent mass of A}}{\text{Equivalent mass of B}}$$

→ Batteries : A galvanic cell which convert chemical energy to electrical energy.

Primary cell : cell can't be rechargable

Secondary cell : cell can be rechargable

Cell potential of

Dry cell : 1.5 V

Mercury cell : 1.35 V

Lead storage cell

Anode : Pb

Cathode : A grid of Pb packed with PbO_2

Electrolyte : 38 % H_2SO_4

Chemical reactions

Anode : $Pb + SO_4^{2-} \longrightarrow PbSO_4 + 2\bar{e}$

Cathode : $PbO_2 + 4H^+ + SO_4^{2-} + 2\bar{e} \longrightarrow PbSO_4 + 2H_2O$

Overall : $Pb + PbO_2 + 2H_2SO_4 \longrightarrow 2PbSO_4 + 2H_2O$

H_2O_2 Fuel cell

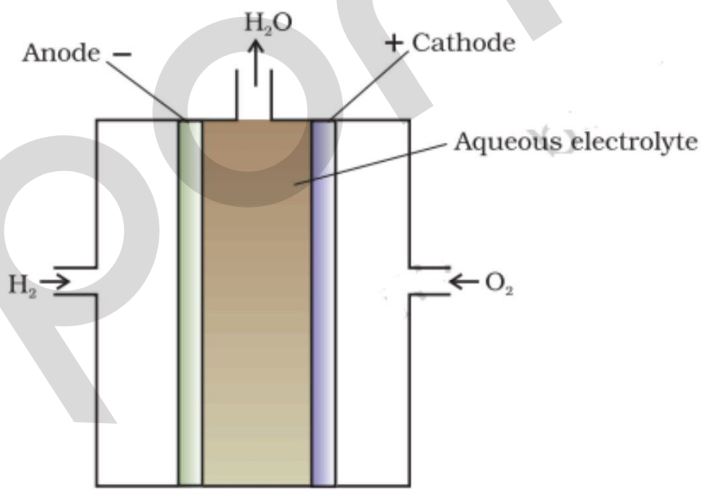
: A galvanic cell which convert energy of combustion of H_2 fuel into electrical energy.

Chemical Reactions

Anode : $2H_2 + 4OH^- \longrightarrow 4H_2O + 4\bar{e}$

Cathode : $O_2 + 2H_2O + 4\bar{e} \longrightarrow 4OH^-$

overall : $2H_2 + O_2 \longrightarrow 2H_2O$



Rusting of Iron

Anode : $Fe \rightarrow Fe^{2+} + 2\bar{e}$

Cathode : $O_2 + 4H^+ + 4\bar{e} \rightarrow 2H_2O$

Overall : $2Fe^{2+} + 2H_2O + \frac{1}{2}O_2 \longrightarrow Fe_2O_3 + 4H^+$

Prevention Methods

Painting or varnishing

Galvanisation

Sacrifical prevention

4

The d- and f-Block elements

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Chemical kinetics

Chemical Kinetics

Consider a reaction

$R \longrightarrow P$

$$\text{Rate} = \frac{-d[R]}{dt} = \frac{+d[P]}{dt}$$

$aA + bB \longrightarrow \text{Products}$

$\text{Rate} = k[A]^x[B]^y$

$\text{Order} = x + y$

$\text{Molecularity} = a + b$

Order: Sum of Powers of concentration terms in the rate law.

Molecularity: The no. of reacting species of colloids simultaneously in a reaction.

Order	Molecularity
Can be zero, Fractional	Cannot be zero, Fractional
Experimental	Theoretical
Applicable for both Elementary & complex reactions.	Applicable for Elementary reactions only.

I^{st} Order Reactions

$$k = \frac{2.303}{t} \log \frac{R_0}{R_t}$$

$$T_{1/2} = \frac{0.693}{k}$$

Eg: $2N_2O_5 \longrightarrow 2N_2O_4 + O_2$

Pseudo I^{st} Order reaction

$\text{Ester} + H_2O \longrightarrow \text{Alcohol} + \text{c. acid}$

$\text{Rate} = k[\text{Ester}]^1[H_2O]^0$

Zero Order Reaction

$$k = \frac{R_0 - R_t}{t} \qquad T_{1/2} = \frac{R_0}{2k}$$

Eg: $2NH_3 \longrightarrow N_2 + 3H_2$

Arrhenius equation

$$k = Ae^{-E_A/RT}$$

Activation Energy, E_a : Extra amount of energy required by reactant molecule to get converted in to product.

$$\log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

Temperature $\longrightarrow$ Increases Rate

Catalyst $\longrightarrow$ Increases Rate

The d And f block Elements

Transition elements

$(n-1)d^{1-10}\,ns^{0-2}$

Pseudo transition elements

Zn, Cd, Hg

Coinage elements

Lu, Ag, Au

Classification

Series	Elements
First transition or 3-d series	Sc (z=21) to Zn (z=30)
Second transition or 4-d series	Y (z=39) to Cd (z= 48)
Third transition or 5-d series	La (z=57), Hf (z=72) to Hg (z=80)
Fourth transition or 6-d series	Ac (z=89), Rf (z=104) to Cn (z=112)

General Characteristics

Atomic size

Along period : First decreases, then become same. Finally increases.

Down in a group : Decreases or become comparable due to lanthanoid contraction.

Melting point & Boiling point

Along period : First increases upto the middle & then decreases.

M.P & B.P $\propto$ No.of unpaired electrons

Down in a group : Decreases due to low heat of atomisation

M.P & B.P $\propto$ Heat of Atomization

Oxidation state

Paramagnetism due to the presence of unpaired $\bar{e}$s.

Diamagnetism due to the absence of unpaired $\bar{e}$s.

spin only Magnetic Moments,

$\mu = \sqrt{n(n+2)}$ BM , $n \rightarrow$ No.of unpaired $\bar{e}$s.

No. of unpaired $\bar{e}s$ (n)	Magnetic Moment (M)
1	$\sqrt{3}$: 1.73
2	$\sqrt{8}$: 2.82
3	$\sqrt{15}$: 3.87
4	$\sqrt{24}$: 4.89
5	$\sqrt{35}$: 5.92

Colour of compounds

If it due to the presence of partially filled d $\bar{e}s$.
It is also due to d-d transition
d^0 & d^{10} configurations are colourless.

Catalyst properties

Due to ⇒ Large surface area
⇒ Ability to exhibit variable oxidation state.

Complex formation

smaller size
High charge to radius ratio
Variable oxidation state
Presence of d-orbitals.

Alloy formation

Bronze : Cu, Sn
Brass : Cu, Zn

Important compounds of Transition Elements

Potassium dichromate ($K_2Cr_2O_7$)

Prepared from chromate ore ($FeCr_2O_4$)

① Chromate ore → Sodium chromate

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

[Sodium chromate - Yellow]

② Sodium chromate → Sodium dichromate

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

[Sodium dichromate - Yellow]

③ Sodium chromate → Sodium dichromate

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

[Potassium dichromate - Orange]

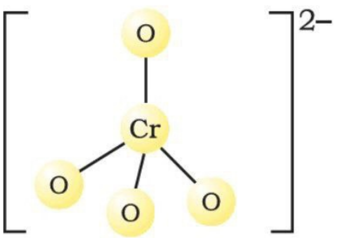
Properties

- Orange crystalline solid, melting point = 669 K
- Moderately soluble in cold water but freely in hot water.
- Powerful oxidising agent

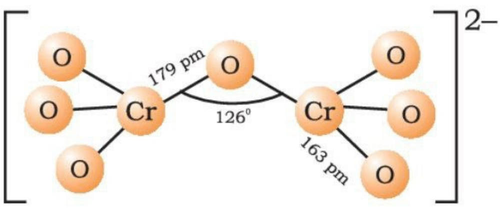
Uses

- In chrome tanning in leather industry.
- In calico printing & dyeing
- In photography and in hardening gelatin film.

Structure of chromate and dichromate



Chromate ion



Dichromate ion

Potassium permanganate ($KMnO_4$)

Prepared from pyrolusite ore (MnO_2)

1. Pyrolusite ore ⟶ Potassium manganate

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

[Potassium manganate – Green]

2. Potassium manganate ⟶ Potassium permanganate

$$3K_2MnO_4 + 4HCl \longrightarrow 2KMnO_4 + MnO_2 + 4KCl + 2H_2O$$

[Potassium per manganate – Purple]

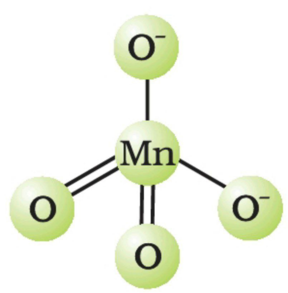
Properties

- Deep purple, melting point = 513 K
- Moderately soluble in water at room temperature & more soluble in hot water
- Powerful oxidising agent.

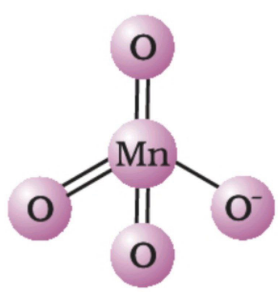
Uses

- Baeyer's agent to test unsaturation in organic compounds.
- As a disinfectant & germicide
- For bleaching of wool, cotton, silk and other textile fibres and also for decolourisation of oils.

Structure of Manganate and permanganate



Tetrahedral manganate ion (green)



Tetrahedral permanganate ion (purple)

The f block elements

Inner transition elements

$(n-2)f^{1-14}(n-1)d^{0-1}ns^2$

Classification

Series	Elements
Lanthanides or 4f - series	Ce (Z = 58) to Lu (Z = 71)
Actinides or 5f - Series	Th (Z = 90) to Lr (Z = 103)

Lanthanoid contraction

The regular decrease in the atomic radii of lanthanides due to the poor shielding of 4f ēs.

Consequences

Isolation Lanthanoids become difficult.

The size of 2^{nd} & 3^{rd} row transition elements become comparable.

Basic character of $Ln(OH)_3$ decreases from La to Lu.

Trends and Characteristics of Lanthanides

Show common stable oxidation state +3.

Low I.E and high boiling point & melting point.

Form coloured compounds.

Misch Metal

Alloy of lanthanoid metals Contain 95% Lanthanoid, 5% Iron and traces of S, Ca, C & Al.

Trends and characteristics of Actinides

All actinides show +3 oxidation State

They are highly reactive metals

Radioactive

Generally coloured [except $Ac^{3+}(5f^0)$, $Cm^{3-}(5f^7)$ and $Lr^{3+}(5f^{14})$]

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5

COORDINATION COMPOUNDS

Coordination Compounds

• Werner's Theory

Primary Valency	Secondary Valency
Ionisable	Non Ionisable
Directional	Non Directional
Equal to Oxidation number	Equal to coordination number

Double Salt	Complex
Complete Ionisation	Partial Ionisation
Loses properties in aqous phase	Retains properties in aqous phase

Coordination Number

Total no. of bonds made by ligands into central metal atom.

Homoleptic : Complexes which contains same type ligand

Heteroleptic : Complexes which contains different type ligand

IUPAC Name

✓ For cationic / Neutral

Name = Ligands + Central Metal atom + Oxidation Number + Non complex part

✓ For anionic

Name = Non-complex part + ligands + CM atom + ate + Oxidation Number

Strong ligands

NH_3

CN^-

NO_2^-

en

Bidentate ligand

en

ox^{2-}

gly^-

Ambidentate ligand

CN^- & NC^-

SCN^- & NCS^-

NO_2^- & ONO^-

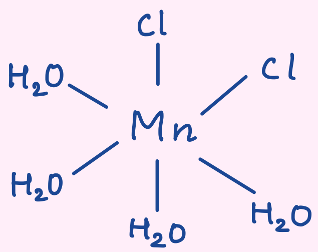
Isomerism

1. Ionisation [Different ions]
2. Hydrate [Different no. of water molecules]
3. Linkage [Ambidentate ligand]
4. Coordination

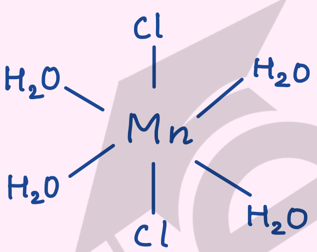
1. Geometrical
2. Optical

$Mn(H_2O)_4Cl_2$

Cis



Trans



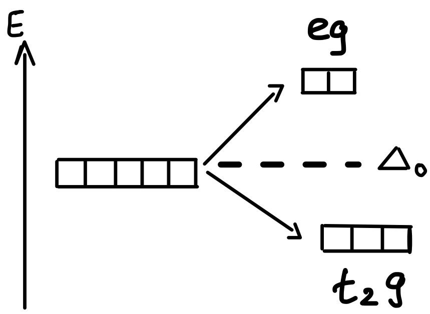
Valence bond theory

Coordination number	Type of hybridisation	Distribution of hybrid orbitals in space
4	sp^3	Tetrahedral
4	dsp^2	Square planar
5	sp^3d	Trigonal bipyramidal
6	sp^3d^2	Octahedral
6	d^2sp^3	Octahedral

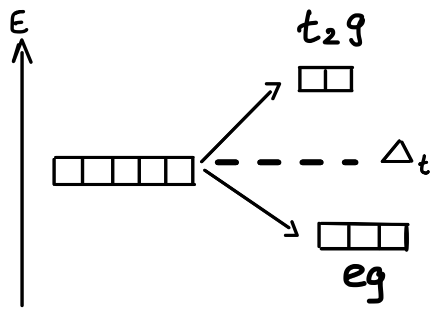
Magnetic moment $= \sqrt{n(n+2)}$ BM

Crystal Field Theory

CN = 6



CN = 4



$$\Delta_t = \frac{4}{9}\Delta_o$$

6

HALOARENES & HALOARENES

Haloalkanes and Haloarenes

Preparation

1. From alcohol

$R-OH \xrightarrow{A} R-X$

$A \Rightarrow HCl, PX_3, PCl_5,$ Red P/X_2, $SOCl_2$

2. Markovnikov's addition of HX in alkene

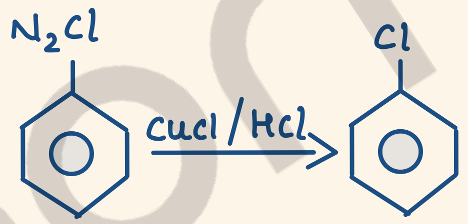
$CH_3-CH=CH_2 + HBr \longrightarrow CH_3-CH(Br)-CH_3$ (Major)

3. Halogen exchange NaI

$R-X \xrightarrow{NaI} R-I$ [Finkelstein]

$R-X \xrightarrow{AgF} R-F$ [Swarts]

4. Sandmeyer's Reaction



Chemical reactions

1. Nucleophilic Substitution

Eg:

$R-X \xrightarrow{NaOH} R-OH$

$R-X \xrightarrow{KCN} R-CN$

$R-X \xrightarrow{AgCN} R-NC$

$R-X \xrightarrow{LiAlH_4} R-H$

SN^1	SN^2
Order = 1	Order = 2
No. of step = 2	No. of step = 1
Intermediate = Carbo-cation	No Intermediate
Order = $3° > 2° > 1°$	Order = $1° > 2° > 3°$
Stereochemistry ⇒ both Inversion & Retention	Stereochemistry ⇒ Inversion only

2. Elimination Reaction / dehydro halogenation

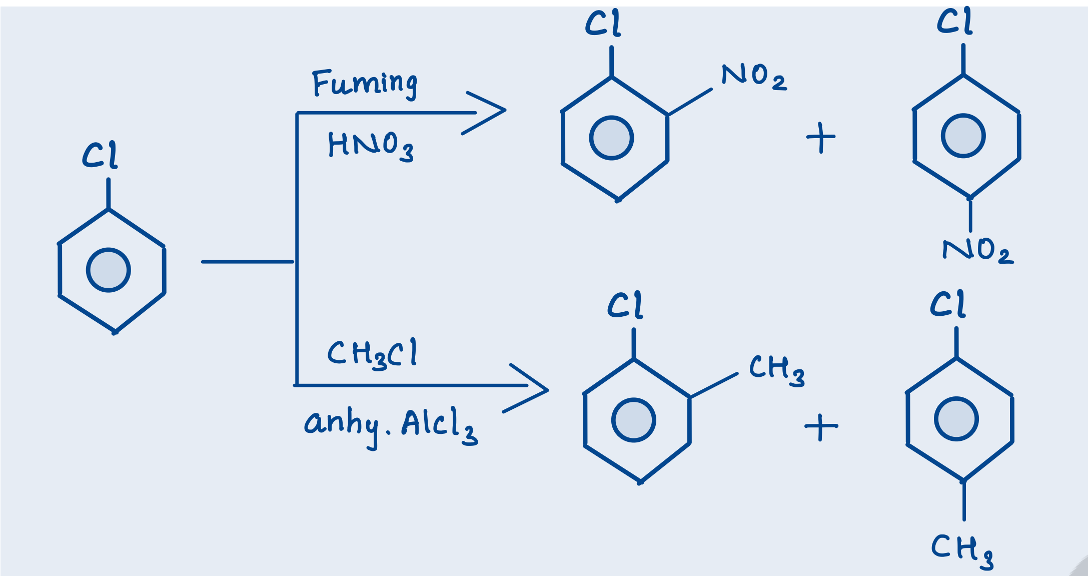
$CH_3-CH-Cl \xrightarrow{alc.KOH} CH_2=CH_2$

[Recall Saytzeff Rule]

3. Preparation of Grignard Reagent

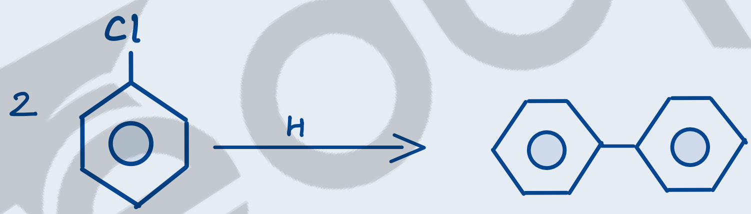
$R-X \xrightarrow[\text{Dry Ether}]{Mg} R-MgX$

4. Electrophilic Substitution

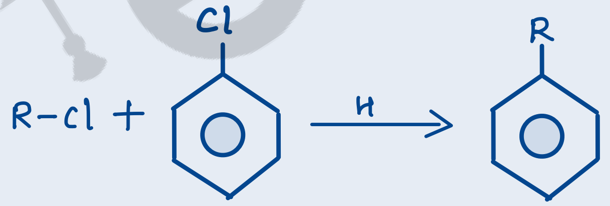


Halogens are ortho para directing

5. $2R-Cl \xrightarrow[DE]{Na} R-R$; Wurtz reaction



; Fitting reaction



; Wurtz- fitting reaction

- chlorine containing insecticide → DDT
- Freon- chloro fluorocarbons
- chloroform → stored in dark bottles to prevent
  $CHCl_3 \xrightarrow{(O)} COCl_2$ (Phosgene)

7

AICOHOLS PHENOLS & ETHERS

Alcohols, Phenols and Ethers

Preparation of Alcohol

1. Hydration & Hydroboration of Alkene.

$$CH_3-CH=CH_2 \begin{cases} \xrightarrow[H^+]{H_2O} CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3 \\ \xrightarrow[H_2O_2]{B_2H_6} CH_3-CH_2-CH_2-OH \end{cases}$$

2. Reduction of Aldehyde, ketone & C.acid

$$R-CHO \xrightarrow{LiAlH_4} R-CH_2OH$$

$$R-CO-R \xrightarrow{NaBH_4} R-\underset{\displaystyle OH}{\underset{|}{CH}}-R$$

$$R-COOH \xrightarrow{LiAlH_4} R-CH_2OH$$

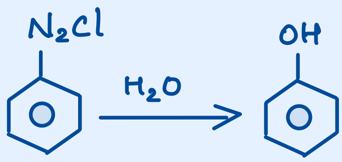
3. From Grignard reagent

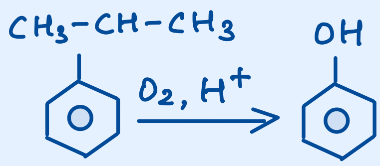
Formaldehyde + RMgX $\longrightarrow$ 1° Alcohol

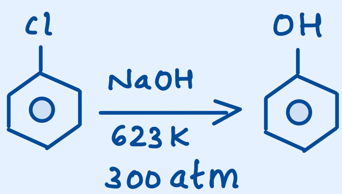
other aldehyde + RMgX $\longrightarrow$ 2° Alcohol

ketone + RMgX $\longrightarrow$ 3° Alcohol

Preparation of Phenol

1. 

2. 

3. 

Chemical reaction of alcohol

1. Acidity

$Ar-OH > H_2O > R-OH$, $1° > 2° > 3°$

2. Esterification

$$R-OH \xrightarrow[R-COCl]{R-COOH} R-COOR$$

3. Oxidation

1° alcohol $\xrightarrow{OA}$ Aldehyde
2° alcohol $\xrightarrow{OA}$ Ketone
3° alcohol $\xrightarrow{OA}$ No oxidation

OA = oxidising agent
OA $\Rightarrow$ PCC, CrO_3, Cu/573

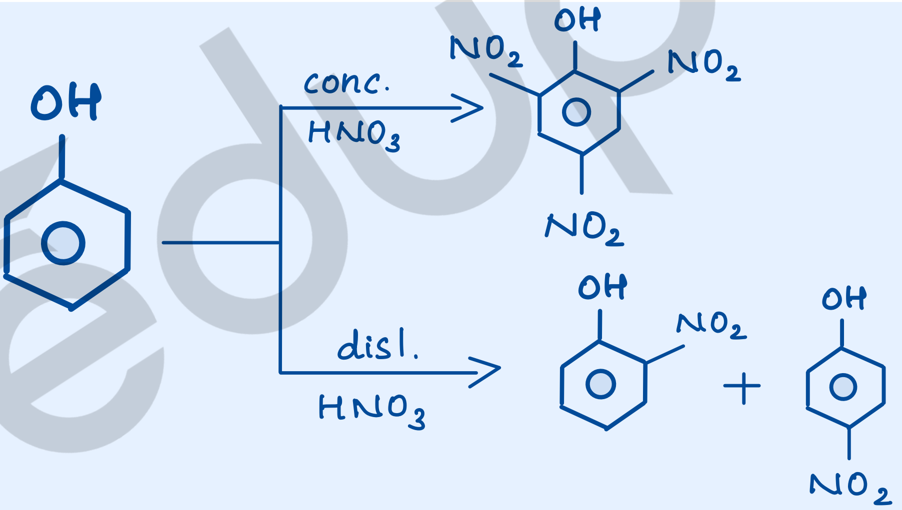
Lucas test

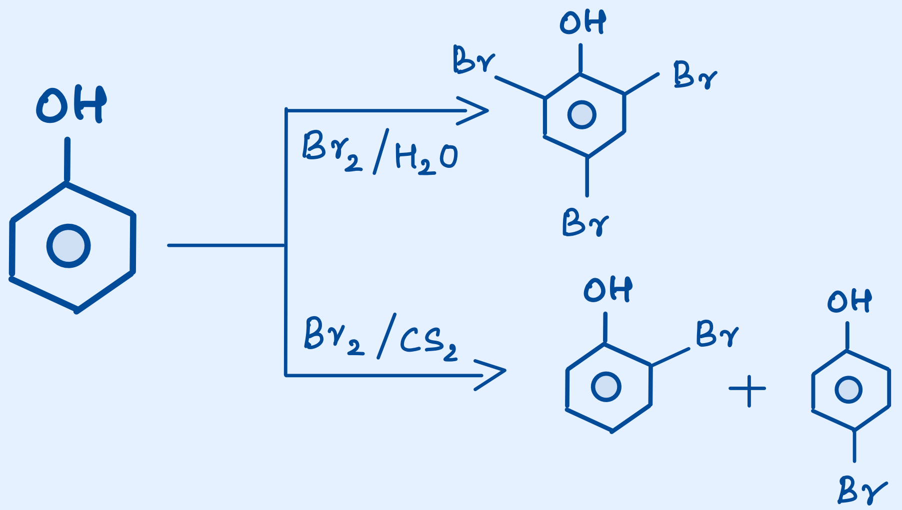
LR (Lucas reagent)
$\Rightarrow$ anhydous $ZnCl_2/HCl$

1° alcohol $\rightarrow$ No turbidity
2° alcohol $\rightarrow$ Turbidity after 5 min
3° alcohol $\rightarrow$ Immediate turbidity

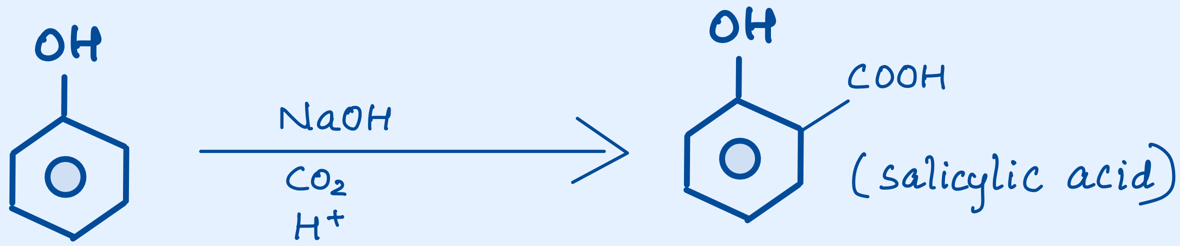
Chemical reactions of Phenol

1. Electrophilic substitution

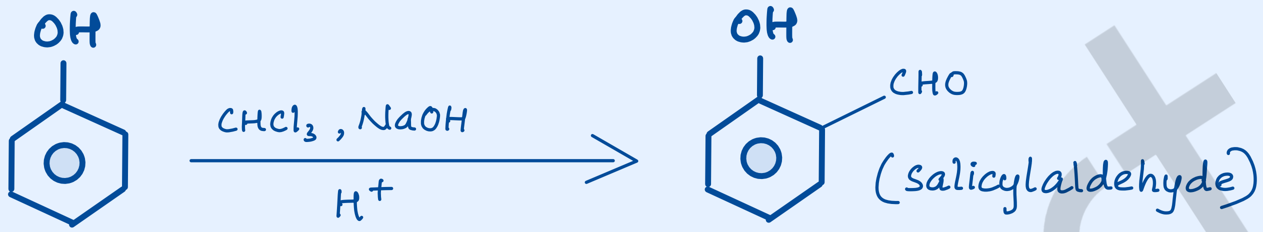




2. Kolbe's Reaction



3. Reimer – Tiemann Reaction



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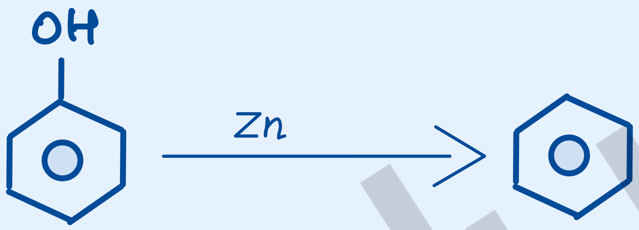

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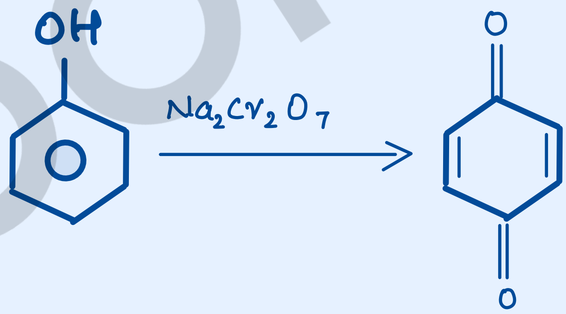

Preparation of Ether

- Willimson's Synthesis

$$R-ONa + R'-X \longrightarrow R-O-R'$$

- $2R-OH \xrightarrow[413\,K]{conc.\,H_2SO_4} R-O-R$

- Reaction of Ether with HX

$$R-O-R \xrightarrow{HX} R-OH + R-X$$

eduport

നല്ല കാര്യങ്ങൾക്ക് മാത്രം ഉപയോഗിക്കുക

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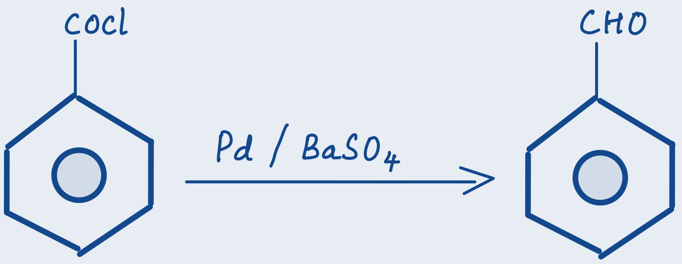
8

AlDEHYDES,KETONES &CARBOXYLIC ACID

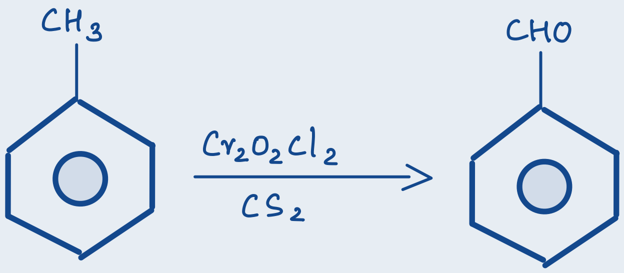
Aldehydes , Ketones and Carboxylic acids

Preparation of Aldehydes and ketones

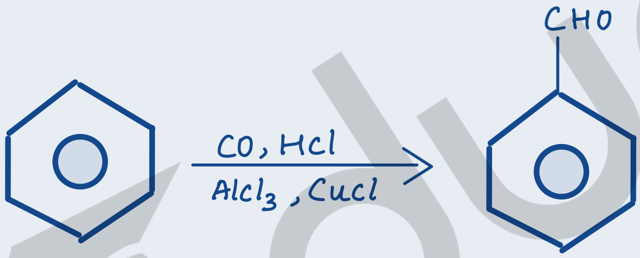


; Rosenmund's reaction

$R-CN \xrightarrow{SnCl_2/HCl} R-CHO$; stephen reaction



; Etard's reaction



; Gattermann - koch reaction

Chemical reactions of aldehydes and ketones

Reduction

Aldehyde $\xrightarrow{RA}$ 1° Alcohol

ketones $\xrightarrow{RA}$ 2° Alcohol

RA ⇒ Reducing agent

RA ⇒ $LiAlH_4$, $NaBH_4$ etc

$\left.\begin{array}{l} R-CHO \\ R-CO-R \end{array}\right\} \xrightarrow[HCl]{ZnHg} \begin{array}{l} R-CH_3 \\ R-CH_2-R \end{array}$; clemmensen reduction

$\begin{array}{l} R-CHO \\ R-CO \end{array} \xrightarrow[KOH]{NH_2NH_2} \begin{array}{l} R-CH_3 \\ R-CH_2-R \end{array}$; wolff -Kishner reduction

Test to distinguish between aldehyde and ketone

1. Tollen's test

Aldehyde $\longrightarrow$ silver mirror formation

ketone $\longrightarrow$ No Reaction

2. Fehling's test

Aldehyde $\longrightarrow$ Reddish brown precipitate

ketone $\longrightarrow$ No Reaction

Haloform test

To detect presence of $-\overset{O}{\overset{\|}{C}}-CH_3$ group

$$R-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{NaOX} R-\overset{O}{\overset{\|}{C}}-ONa + CHX_3$$

Aldol condensation $\longrightarrow$ ($\alpha - H_2$ present)

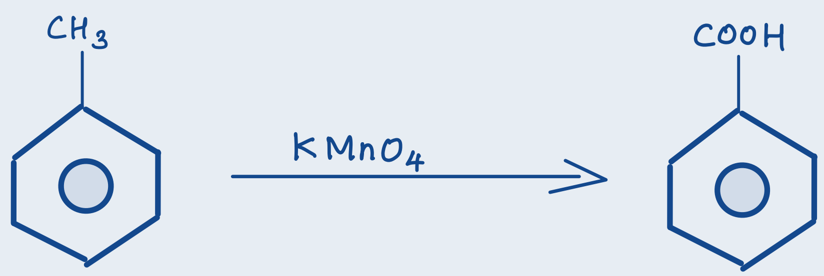
Eg :

$$H-CHO \xrightarrow{NaOH} CH_3-CH=CH-CHO$$

Cannizzaro reaction $\longrightarrow$ ($\alpha - H_2$ Absent)

$$H-CHO \xrightarrow{NaOH} A-COONa + CH_3-OH$$

Preparation of Carboxylic acids



Hydrolysis of amide, nitrile and ester

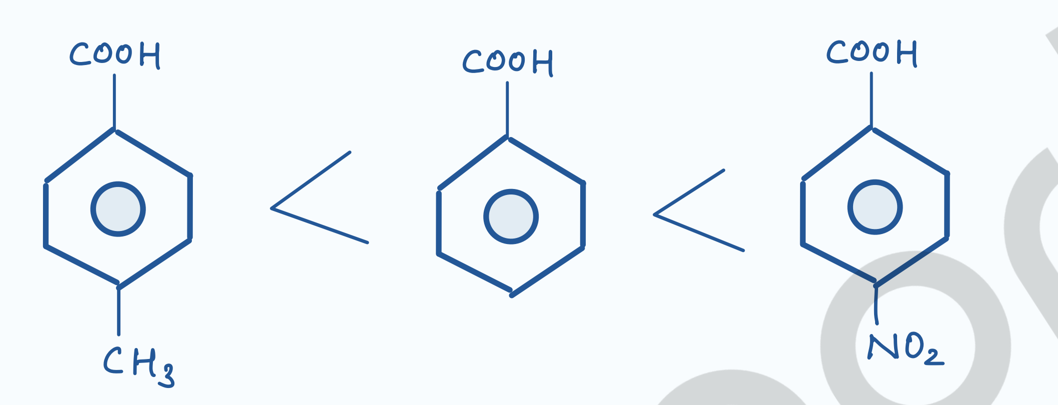
$$R-CO-NH_2 \xrightarrow{H_2O/H^+} R-COOH$$

Grignard reagent + CO_2

$$R-MgX + CO_2 \xrightarrow{H_2O/H^+} R-COOH$$

Chemical reactions of Carboxylic acids

1. Acidity



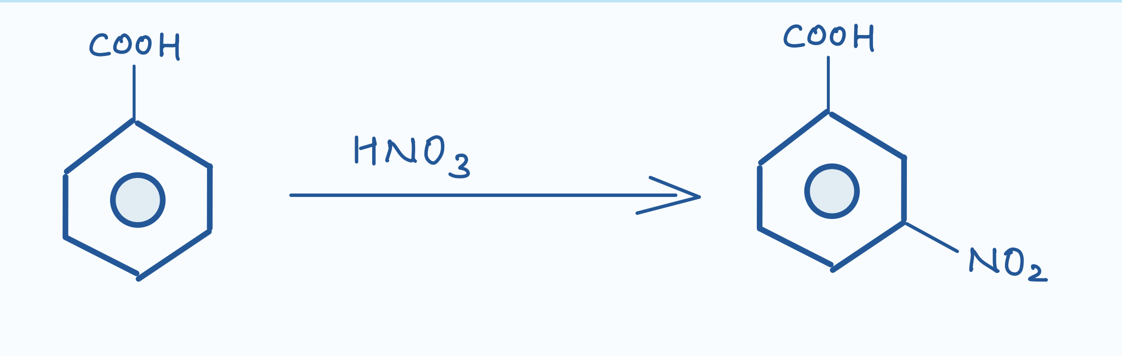
2. Reduction

$$R-COOH \xrightarrow{LiAlH_4} R-CH_2OH$$

3. HVZ Reaction

$$R-CH_2-COOH \xrightarrow{Red\ P/X_2} R-\underset{\displaystyle X}{\underset{|}{CH}}-COOH$$

4. Ring Substitution



AMINES

$R-NH_2$	R_2NH	R_3N
1° Amine	2° Amine	3° Amine

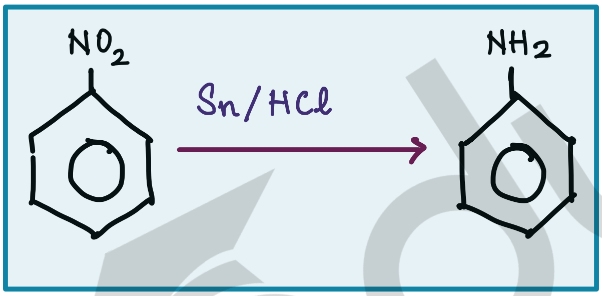
PREPARATION

Reduction of Amide

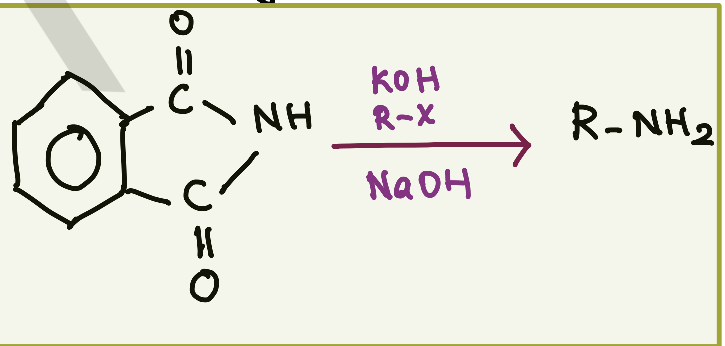
$$R-CO-NH_2 \xrightarrow{LiAlH_4} R-CH_2-NH_2$$

Reduction of Nitrile

$$R-CN \xrightarrow{Ni} R-CH_2NH_2$$



Gabriel phthalimide Synthesis

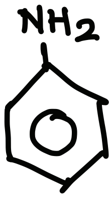


Hoffmann Bromamide Degradation Reaction.

$$R-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow[NaOH]{Br_2} R-NH_2$$

REACTIONS OF AMINES

1. **Basicity**

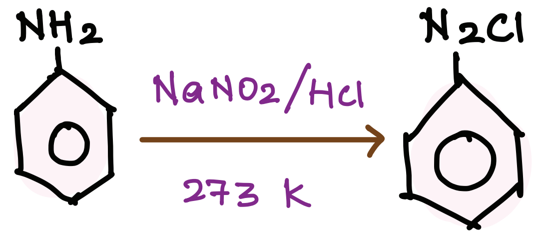
$R-NH_2 > NH_3 >$ 

- If $R = -CH_3$:
  Basicity: 2° > 1° > 3°
- If $R = -CH_2-CH_3$:
  Basicity: 2° > 3° > 1°

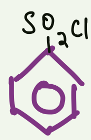
2. CARBYLAMINE REACTION

$$R-NH_2 \xrightarrow[KOH]{CHCl_3} R-NC$$

3. DIAZOTISATION



Hinsberg Test



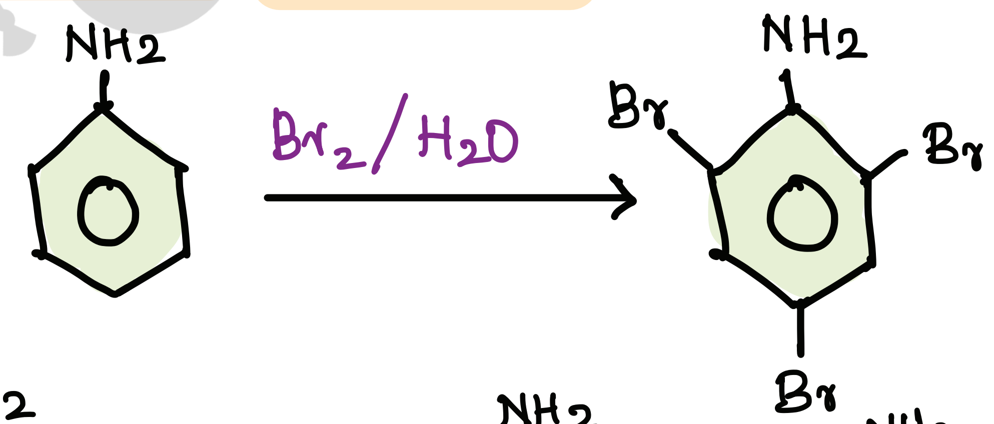
– Hinsberg Reagent

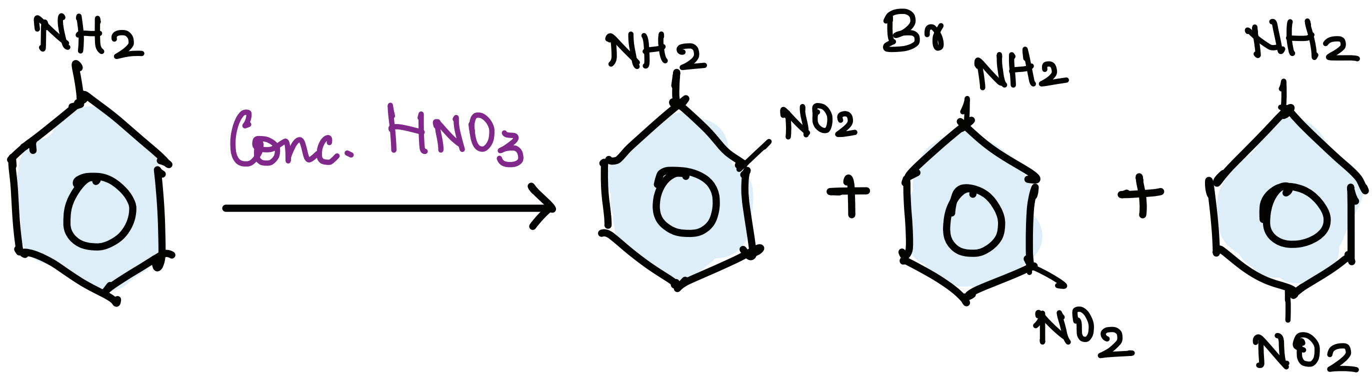
1° amine $\xrightarrow[\text{Reagent}]{\text{Hinsberg}}$ a precipitate which is Soluble in alkali

2° amine $\xrightarrow[\text{Reagent}]{\text{Hinsberg}}$ a precipitate which is insoluble in alkali

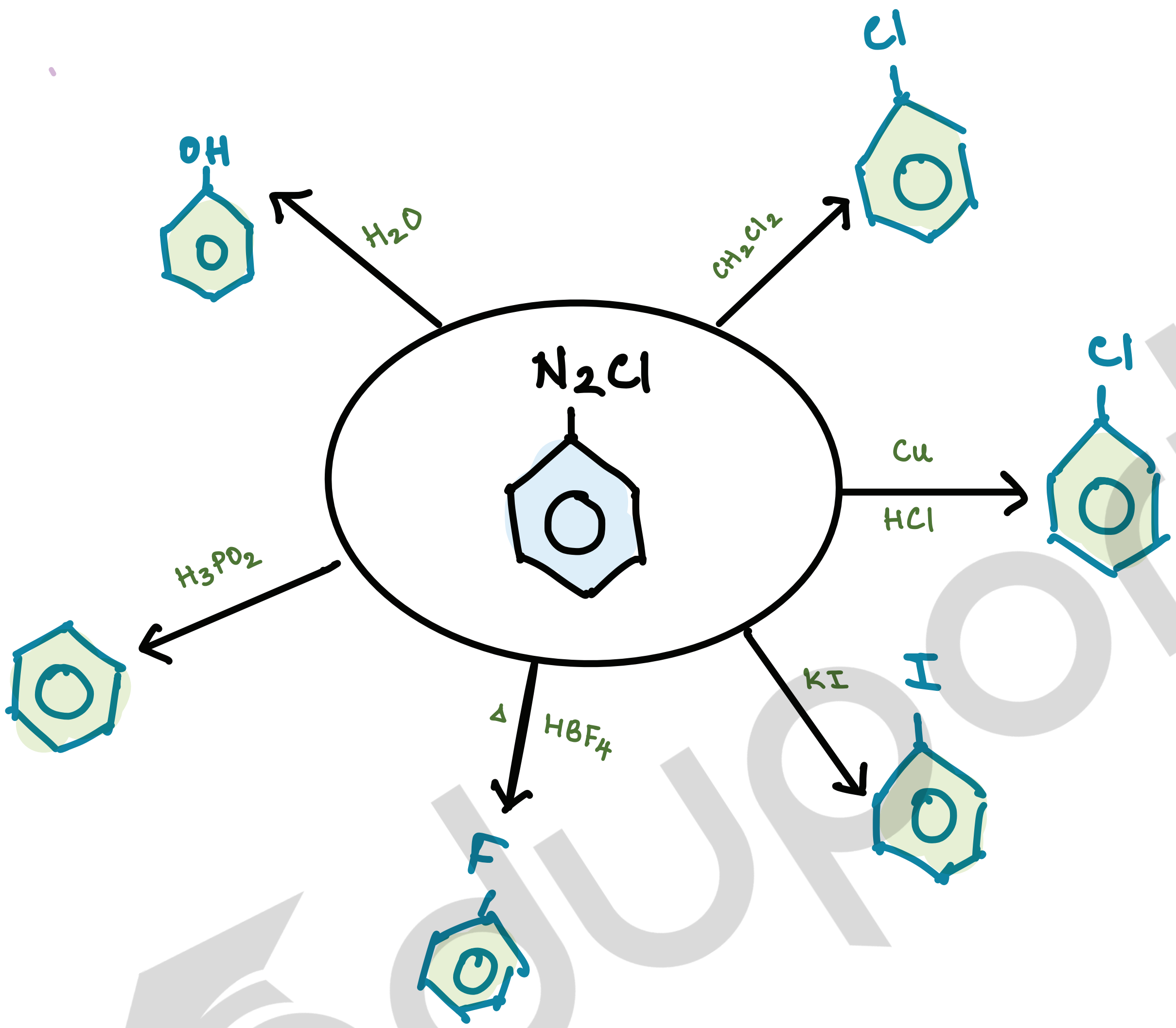
3° amine $\xrightarrow[\text{Reagent}]{\text{Hinsberg}}$ will not give a precipitate

4) ELECTROPHILIC SUBSTITUTION





REACTIONS OF DIAZONIUM SALT



Biomolecules

Carbohydrates

Monosaccharides ⟶ Glucose, Fructose, Ribose
Disaccharides ⟶ Maltose, Sucrose, Lactose
Polysaccharides ⟶ cellulose, Glycogen, cellulose

Preparation of Glucose

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$
sucrose

$$(C_{12}H_{10}O_5)_n + nH_2O \longrightarrow nC_6H_{12}O_6$$
Starch — Glucose

Important reactants of Glucose

Glucose
- $\xrightarrow{HCN}$ Cyanohydrin
- $\xrightarrow{HI}$ Hexane
- $\xrightarrow{HNO_3}$ Glucaric acid
- $\xrightarrow{Br_2/H_2O}$ Gluconic acid

Disaccharides

Maltose = Glucose + Glucose
Sucrose = Glucose + Fructose
Lactose = Glucose + Galactose

Proteins

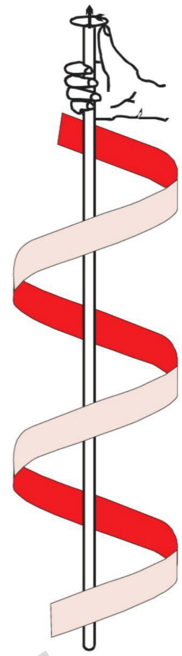
Monomer = Amino acids ⟶ (20)
- ⟶ Acidic ⟶ (2)
- ⟶ Basic ⟶ (3)
- ⟶ Neutral ⟶ (15)

Structure of Amino acids

⟶ 1°, 2°, 3° & 4° structures

1° structure ⟶ Amino acid sequence
2° structure ⟶ Stabilised by H_2 bonding
3° structure ⟶ 2 types ⟶ Globular & Fibrous

Globular	Fibrous
Soluble in water Having biological activity Eg : Albumin , Insulin	Insoluble in water No biological activity Eg : Keratin , Myosin



4° structure ⟶ Give spatial arrangement of Polypeptide chain

Denaturation

→ By altering pH or temperature
→ Biological activity loses
→ Eg : Boiling of Egg

Nucleic acid

Monomer = Nucleotide
Nucleotide = Sugar + N_2 base + Phosphate group

DNA (Deoxy Ribo nucleic acid)	RNA (Ribo nucleic acid)
Double stranded More stable , Less reactive Function : RNA synthesis Adinine , Guanine , Thymine , Cytosine	Single stranded Less stable , More reactive Function : Protein synthesis Adinine , Guanine , Uracil , Cytosine

Vitamin	Deficiency
Vitamin A	Night Blindness
Vitamin B_1	Beri – Beri
Vitamin B_6	Convulsions
Vitamin B_{12}	Pernicious Anaemia
Vitamin C	Scurvy
Vitamin D	Rickets
Vitamin K	Increased blood clotting time

Linkages

Carbohydrate	Glycosidic
Protein	Peptide bond
Nucleic acid	Phosphodiester bond