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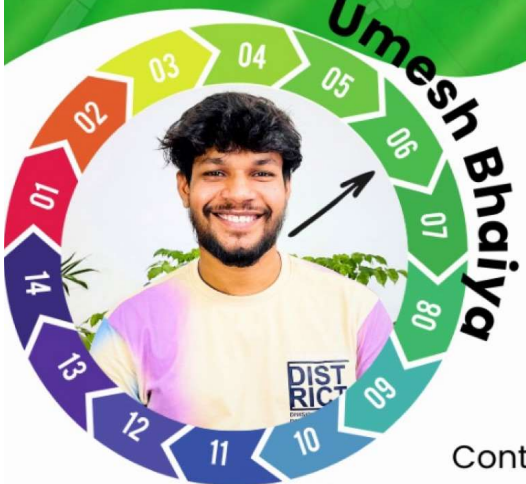
2025
2026

CHEMISTRY
FORMULA SHEET

CLASS - 12



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Class XII (2025 - 2026)

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UNIT - 1 Solutions

Mass Percentage (w/w)

$$\text{Mass \% of the component} = \frac{\text{Mass of Solute}}{\text{Total Mass of the solution}} \times 100$$

(solute = component)

Volume Percentage (V/V)

$$\text{Volume \% of the component} = \frac{\text{Volume of Solute}}{\text{Total Volume of the solution}} \times 100$$

Mass by Volume percentage (w/V)

$$\text{Mass by Volume \%} = \frac{\text{Mass of Solute}}{\text{Volume of Solution}} \times 100$$

Parts Per Million (ppm)

$$\text{ppm} = \frac{\text{Number of parts of the component}}{\text{Total no. of parts of all components of the solution}} \times 10^6$$

Mole fraction

$$\text{Mole fraction of the component} = \frac{\text{no. of moles of the component}}{\text{Total no. of moles of all the component}}$$

Mole fraction of the solvent in the solution

$$x_A = \frac{n_A}{n_A + n_B}$$

Mole fraction of the solute in the solution

$$x_B = \frac{n_B}{n_A + n_B}$$

sum of the mole fraction of the component is unity $x_A + x_B = 1$

Molarity (M)

$$\text{Molarity (M)} = \frac{\text{Moles of Solute}}{\text{Volume of Solution (in litre)}}$$

Molality (m)

$$\text{Molality (m)} = \frac{\text{Moles of Solute}}{\text{Mass of Solution (in Kg)}} = \frac{\text{Number of mass of Solute}}{\text{Mass of Solvent (in grams)}} \times 1000$$

Henry's law

$p = K_H x$

p = Partial Pressure
K_H = Henry's law constant
x = mole fraction of the gas

Raoult's law

$p_1 \propto x_1$ OR $p_1 = x_1 p_1^\circ$

Raoult's law for a volatile liquid

$P_1 = P_1^\circ x_1$, $P_2 = P_2^\circ x_2$

Total pressure $P = P_1 + P_2 = P_1^\circ x_1 + P_2^\circ x_2$

P_1 = partial vapour pressure of 1
P_2 = partial vapour pressure of 2
P_1° = vapour pressure of pure 1
P_2° = vapour pressure of pure 2

Ideal Solution

1.) Raoults law is obeyed
2.) $\Delta_{mix} H = 0$
3.) $\Delta_{mix} V = 0$

Relative lowering of vapour pressure

$$\frac{P_1^\circ - P}{P_1^\circ} = \frac{W_2}{M_2} \times \frac{M_1}{W_1}$$

Elevation of boiling point

$$\Delta T_b = K_b m$$

K_b = ebulliscopic constant

$$\Delta T_b = \frac{K_b \times W_2 \times 1000}{M_2 \times W_1}$$

Depression of freezing point

$$\Delta T_f = K_f m$$

K_f = cryoscopic constant

$$\Delta T_f = \frac{K_f \times W_2 \times 1000}{M_2 \times W_1}$$

Osmotic pressure (π)

$$\pi = CRT$$

$$\pi = \frac{n_2}{V} RT$$

$$\pi = \frac{W_2 \times R \times T}{M_2 \times V}$$

W_1 = Mass of Solvent
W_2 = Mass of Solute
M_1 = Molar mass of solvent
M_2 = Molar mass of solute
C = Molarity
T = Temperature

Van't Hoff factor (i)

$$i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$$

$$i = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$$

$$i = \frac{\text{Total no. of moles of particles after association / dissassociation}}{\text{no. of moles of particles before association / dissassociation}}$$

Degree of Disassociation

$$\alpha = \frac{i-1}{n-1}$$

n = number of ions

Modified form of Colligative properties

1.) $\frac{P_1^\circ - P_1}{P_1^\circ} = i \frac{n_2}{n_1}$
2.) $\Delta T_b = i K_b m$
3.) $\Delta T_f = i K_f m$
4.) $\pi = i n_2 RT/V$

UNIT - 2

Electrochemistry

- **EMF of a cell (cell potential)**

$$E_{cell} = E_{Cathode} - E_{Anode}$$

- **Nernst Equations for a general electrode reaction**

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

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

$$E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{0.059}{n} \log \frac{1}{[M^{n+}]}$$ At 298 K

- **Nernst Equations for a general electrochemical reaction**

$$E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{RT}{nF} \ln \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$$E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{2.303\ RT}{nF} \log \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$$E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{0.059}{n} \log \frac{[C]^c[D]^d}{[A]^a[B]^b}$$ At 298 K

- **Gibb's Free Energy** $\Delta_r G^{\circ} = -RT \ln K_c$ OR $\Delta_r G^{\circ} = -2.303\ RT \log K_c$

- **Ohm's law** $V = IR$

V = Potential difference
I = Current

- **Specific Resistance (Resistivity)** $R = \rho \frac{l}{A}$

R = Resistance
A = Area
l = length

- **Conductance** $G = \frac{1}{R} = \frac{A}{\rho l} = K\frac{A}{l}$

- **Conductivity** $K = \frac{1}{\rho} = \frac{1}{R} \times \frac{l}{A} = G \times \frac{l}{A}$

- **Wheatstone bridge** $\frac{R_1}{R_2} = \frac{R_3}{R_4}$

- **Molar Conductivity** $\Lambda_m = K \times V$ OR $\Lambda_m = \frac{K \times 1000}{C}$

C = Molar Concentration
V = Volume
Λ°_m = Limiting Molar Conductivity

- **Limiting Molar Conductivity** $\Lambda_m = \Lambda^{\circ}_m - A c^{1/2}$

- **Kohlrausch's law** $\Lambda^\circ_m = \nu_+ \lambda^\circ_+ + \nu_- \lambda^\circ_-$

  λ°_+ = limiting molar conductivity of Cation
  λ°_- = limiting molar conductivity of Anion

- **Calculation of Molar conductivities of a weak electrolyte at infinite dilution**

$$\Lambda^\circ_{m(CH_3COOH)} = \Lambda^\circ_{m(CH_3COONa)} + \Lambda^\circ_{m(HCl)} - \Lambda^\circ_{m(NaCl)}$$

- **Degree of Dissociation** $\alpha = \frac{\Lambda_m}{\Lambda^\circ_m}$

- **Dissociation constant** $K = \frac{c(\Lambda_m)^2}{\Lambda^\circ_m(\Lambda^\circ_m - \Lambda_m)}$

- **Solubility of sparingly soluble salts** $\text{Solubility} = \frac{K \times 1000}{\Lambda^\circ_m}$

- **Concentration cells** $E_{cell} = \frac{0.0591}{n} \log \frac{c_2}{c_1}$ where $c_2 > c_1$

- **Faraday's law**

  First law $W = Z \times I \times t$ $[\because Q = I \times t]$ Z = Propationality

  Second law $\frac{W_1}{W_2} = \frac{E_1}{E_2}$

UNIT-3 Chemical Kinetics

Rate of Reaction = $\frac{\text{Decrease in concentration of R}}{\text{Time taken}}$

OR

Rate of Reaction = $\frac{\text{Increase in concentration of R}}{\text{Time taken}}$

OR

Rate of Reaction = $-\frac{\Delta[R]}{\Delta t} = \frac{\Delta[P]}{\Delta t}$

Differential Rate Equation

K = Rate Constant

Reaction $A + B \rightarrow$ Products

Rate = $K[A]^x[B]^y$ OR $\frac{-dR}{dt} = K[A]^x[B]^y$

Reaction $A + B \rightarrow$ Products Rate = $K[A]^x[B]^y$

Order of Reaction = $x + y$

x = order of Reaction with respect to A
y = order of Reaction with respect to B

Integrated Rate Equation for Zero order Reactions

$$k = \frac{[R]_0 - [R]}{t}$$

Integrated Rate Equation for First order Reactions

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

Half life of a zero order Reaction

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

Half life of a first order Reaction

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

Integrated Rate Equation for a gaseous state

$$k = \frac{2.303}{t} \log \frac{P_i}{(2P_i - P_t)}$$

P_i = initial Pressure P_t = total Pressure

Arrhenius Equation

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

A = Arrhenius factor or frequency factor
E_a = Activation Energy
R = Gas constant at T_1
T = Temperature in kelvin

K_2 = Rate constant at T_1
K_1 = Rate constant at T_2

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

E_a = - 2.303 X R X slope (in a plot of log k vs $\frac{1}{T}$)

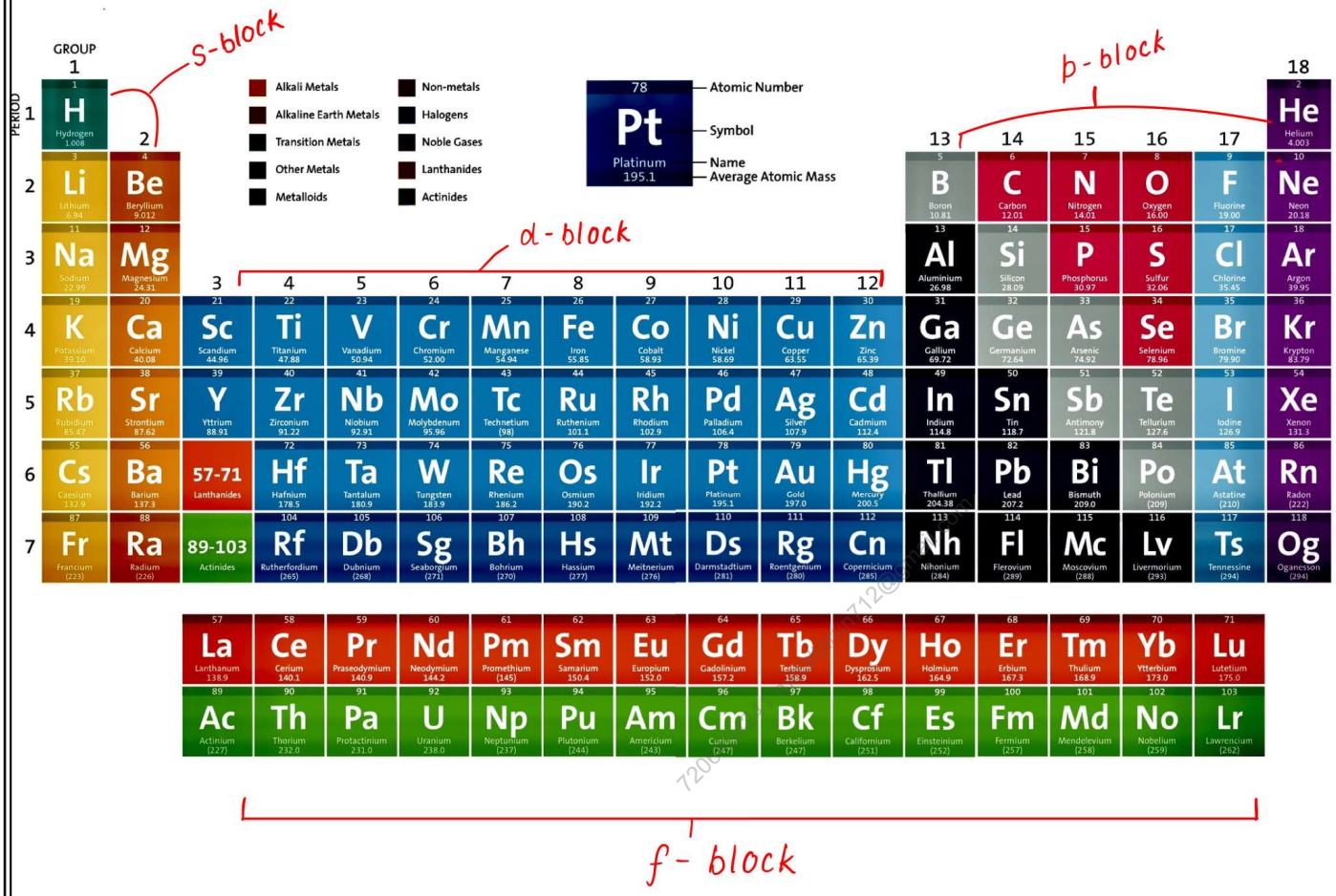
Collision theory of Chemical Reactions

Rate = $PZ_{AB}e^{-E_a/RT}$

Z_{AB} = The collision frequency of reactants A and B
P = Probability factor
$e^{-E_a/RT}$ = Fraction of molecules with energies equal to or greater than E_a

UNIT-4

The d- and f- block Elements



- $_{21}Sc$ to $_{30}Zn$ — First transition series OR 3d-series
- $_{39}Y$ to $_{48}Cd$ — Second transition series OR 4d-series
- $_{57}La$ and $_{72}Hf$ to $_{80}Hg$ ($_{58}Ce$ to $_{71}Lu$) — Third transition series OR 5d-series
- Begins with $_{89}Ac$ is still incomplete — Fourth transition series OR 6d-series

Note : d-block elements known as Transition Elements

General Electronic configuration $(n-1)d^{1-10}ns^{1-2}$

f- block Elements OR Inner transition metals

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

n = number of unpaired electrons

μ = Magnetic moment

Difference between Lanthanoids and Actinoids

	Lanthanoids	Actinoids
1.	4f-orbital is progressively filled	5f-orbital is progressively filled
2.	+3 oxidation state is most common along with +2 and +4	show +3, +4, +5, +6, +7 oxidation states
3.	Only promethium (Pm) is radioactive	All are radioactive.
4.	They are less reactive than actinoids	They are more reactive.
5.	Magnetic properties are less complex	Magnetic properties are more complex

UNIT-5

Coordination Compounds

Number of orbitals and Types of Hybridizations

Coordination no.	Type of hybridization	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

Relationship between the wavelength of light absorbed and the colour observed in some condition Entities

Coordination entity	Wavelength of light absorbed (nm)	Colour of light absorbed	Colour of coordination entity
$[Co(NH_3)_5Cl]^{2+}$	535	Yellow	Violet
$[Co(NH_3)_5(H_2O)]^{3+}$	500	Blue green	Red
$[Co(NH_3)_6]^{3+}$	475	Blue	Yellow orange
$[Co(CN)_6]^{3-}$	310	Ultraviolet	Pale yellow
$[Cu(H_2O)_4]^{2+}$	600	Red	Blue
$[Ti(H_2O)_6]^{3+}$	498	Blue green	Violet

Nomenclature of some coordination compounds

S.No.	Formula	Name
1	$[Pt(NH_3)_2ClNO_2]$	diaamminechloridonitro-N-platinum(II)
2	$[CoCl_2(en)_2]Cl$	diachlorobis(ethane-1,2-diamine) cobalt(III) chloride
3	$K_3[Fe(C_2O_4)_3]$	potassium trioxalatoferrate(III)
4	$[Ag(NH_3)_2][Ag(CN)_2]$	diamminesilver(I) dicyanoargentate(I)

Mohr's salt $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

Potash alum $K_2SO_4 \cdot Al_2SO_4 \cdot 24H_2O$

Carnallite $KCl \cdot MgCl_2 \cdot 6H_2O$

$\Delta_t = \frac{4}{9}\Delta_o$ (Δ_t: distance; Δ_o: crystal field stabilization energy)

Stepwise and overall stability constant

$$\beta_n = K_1 \times K_2 \times K_3 \times K_4 \ldots K_n$$

UNIT-6

Haloalkanes and Haloarenes

R-X — An alkyl Halide (Haloalkane) — X = F, Cl, Br, I — Alkyl on substituted alkyl

Ar-X — An aryl Halide (Haloarene) — X = F, Cl, Br, I — Phenyl on substituted Phenyl

$$\text{Specific rotation } (\alpha) = \frac{\text{Observed rotation } (\alpha_{obs})}{\text{Length of tube (dm)} \times \text{Concentration of solution (gmL}^{-1})}$$

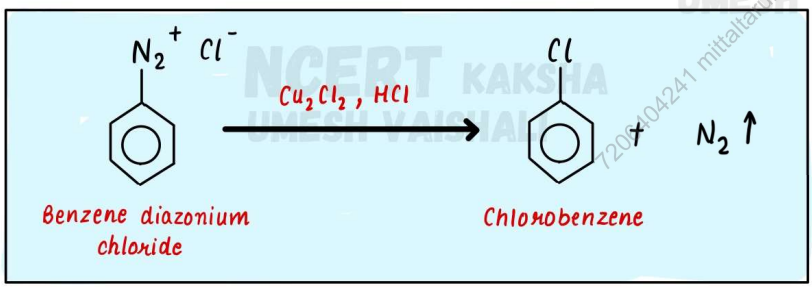
Naming Reactions —

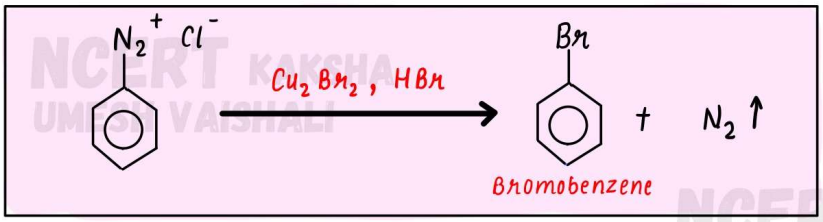
Swarts Reaction

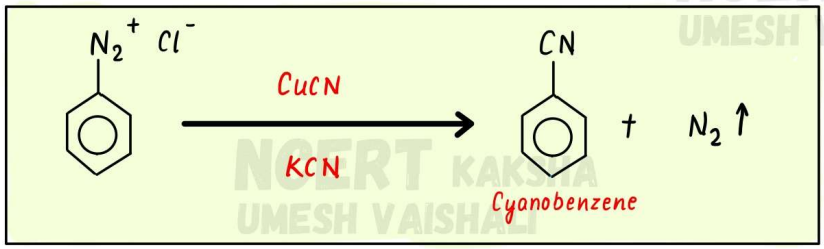
$$3CCl_4 + 2SbF_3 \xrightarrow[SbCl_5]{\text{Heat}} 3CCl_2F_2 + 2SbCl_3$$

Freon - 12

Sandmeyer's Reaction







Finkelstein Reaction

$$CH_3CH_2Cl + NaI \xrightarrow{\text{Dry Acetone}} CH_3CH_2I + NaCl$$

Ethyl Chloride — Ethyl Iodide

$$CH_3CH_2Br + NaI \xrightarrow{\text{Dry Acetone}} CH_3CH_2I + NaBr$$

Ethyl bromide — Ethyl Iodide

Wurtz Reaction

$$CH_3Br + 2Na + Br-CH_3 \xrightarrow{\text{Dry Ether}} CH_3CH_3 + 2NaBr$$

Methyl Bromide — Ethane

$$CH_3-\underset{CH_3}{\underset{|}{CH}}-Br + 2Na + Br-\underset{CH_3}{\underset{|}{CH}}-CH_3 \xrightarrow{\text{Dry Ether}} CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{CH_3}{\underset{|}{CH}}-CH_3 + 2NaBr$$

Isopropyl Bromide — 2,3 - Dimethylbutane

Wurtz - Fittig Reaction

$$C_6H_5-Cl + 2Na + Cl-CH_3 \xrightarrow{\text{Dry Ether}} C_6H_5-CH_3 + 2NaCl$$

$$C_6H_5-Cl + 2Na + Cl-C_2H_5 \xrightarrow{\text{Dry Ether}} C_6H_5-C_2H_5 + 2NaCl$$

Fittig's Reaction

$$C_6H_5-Cl + 2Na + Cl-C_6H_5 \xrightarrow{\text{Dry Ether}} C_6H_5-C_6H_5 + 2NaCl$$

Diphenyl OR biphenyl

Friedel - Crafts Alkylation

$$C_6H_6 + CH_3Cl \xrightarrow{\text{Anhyd. } AlCl_3} C_6H_5CH_3 + HCl$$

Benzene — Toluene

$$C_6H_5CH_3 \xrightarrow[\text{Anhyd. } AlCl_3]{CH_3Cl} C_6H_4(CH_3)_2 + C_6H_4(CH_3)_2$$

Toluene — O - Xylene + p - Xylene

Dow's Process

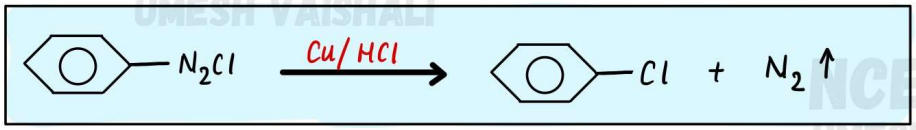
$$C_6H_5Cl + 2NaOH\,(aq) \xrightarrow[(-NaCl,\ -H_2O)]{623\,K,\ 300\ atm} C_6H_5ONa \xrightarrow{H^+} C_6H_5OH$$

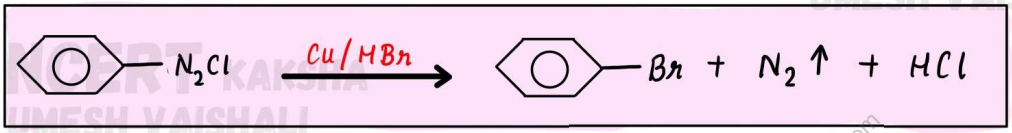
Hunsdiecker's Reaction

$$R\text{-}COOAg + Br_2 \xrightarrow[\text{Reflux}]{CCl_4} R\text{-}Br + AgBr + CO_2\uparrow$$

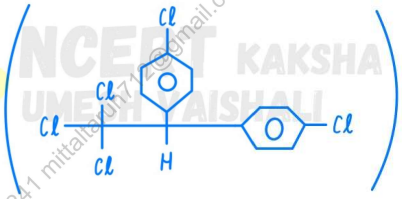
$$CH_3CH_2COOAg + Br_2 \xrightarrow[\text{Reflux}]{CCl_4} CH_3CH_2\text{-}Br + AgBr + CO_2\uparrow$$

Gattermann's Reaction





Note : DDT (p, p' - Dichlorodiphenyl trichloroethane)

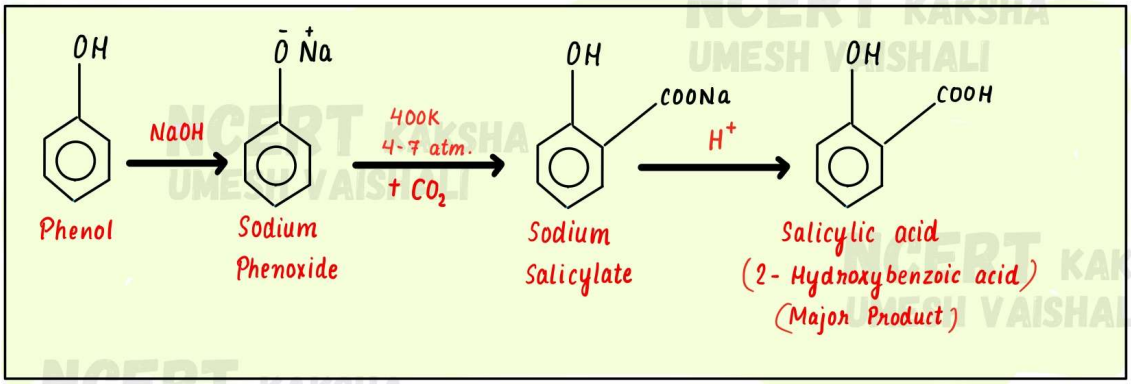


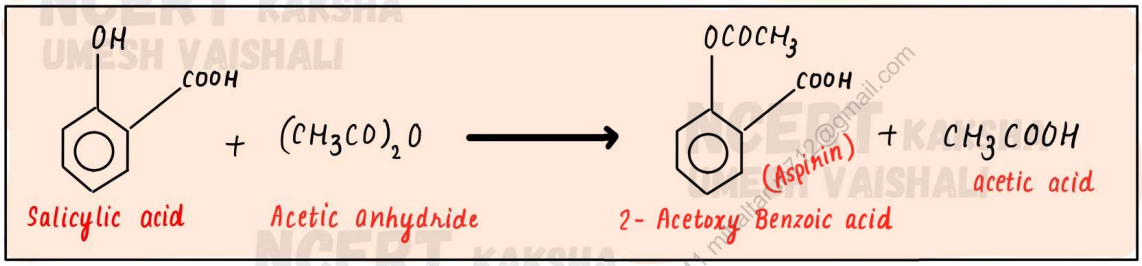
UNIT-7

Alcohols, Phenols and Ether

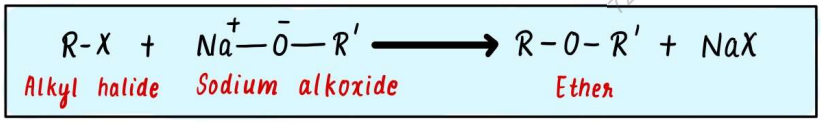
Naming Reactions —

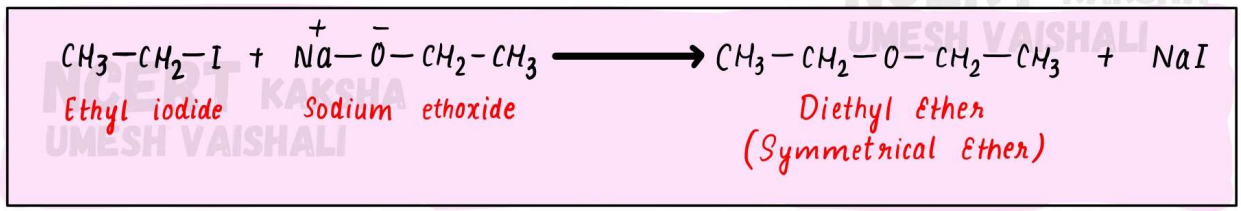
Kolbe's Reaction

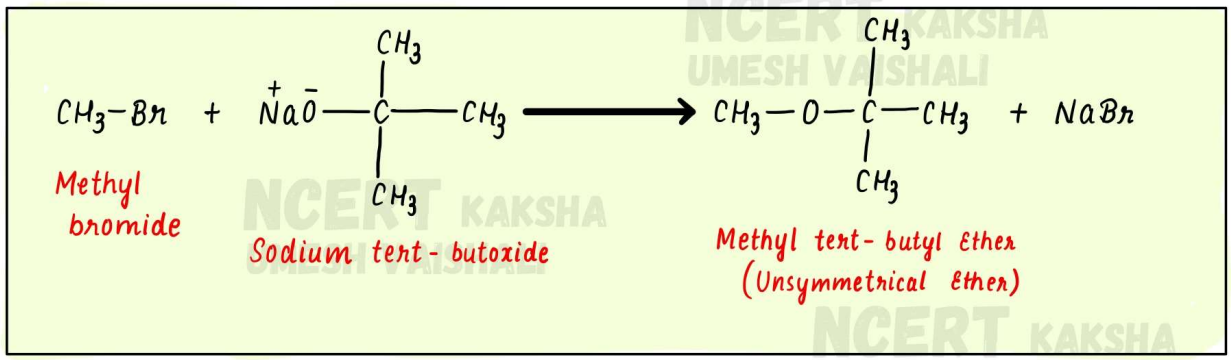


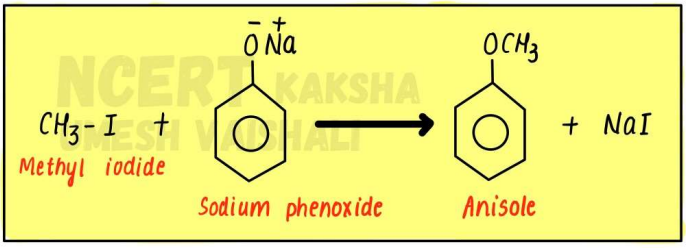


William Synthesis

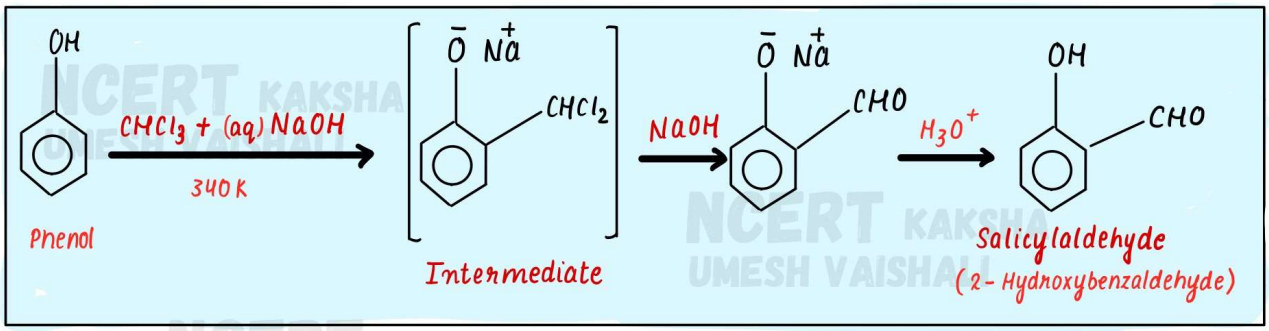








Riemann - Tiemann Reaction



your only limit is your Mind

UNIT - 8

Aldehydes, Ketons and Carboxylic Acid

Naming Reactions —

Rosenmund Reaction

$$R-\overset{\overset{O}{\|}}{C}-Cl + H_2 \xrightarrow{Pd/BaSO_4} R-\overset{\overset{O}{\|}}{C}-H + HCl$$

Acyl chloride → Aldehyde

$$CH_3-\overset{\overset{O}{\|}}{C}-Cl + H_2 \xrightarrow{Pd/BaSO_4} CH_3-\overset{\overset{O}{\|}}{C}-H + HCl$$

Acetyl chloride → Acetaldehyde

$R-\overset{\overset{O}{\|}}{C}-H$ Aldehyde (where R may be H or any alkyl, anyl or analkyl group)

$R-\overset{\overset{O}{\|}}{C}-R'$ Ketone (where R and R' may be same or diffenent alkyl, anyl or analkyl group)

$R-\overset{\overset{O}{\|}}{C}-OH$ Carboxylic Acid (where R may be H or any alkyl, anyl or analkyl group)

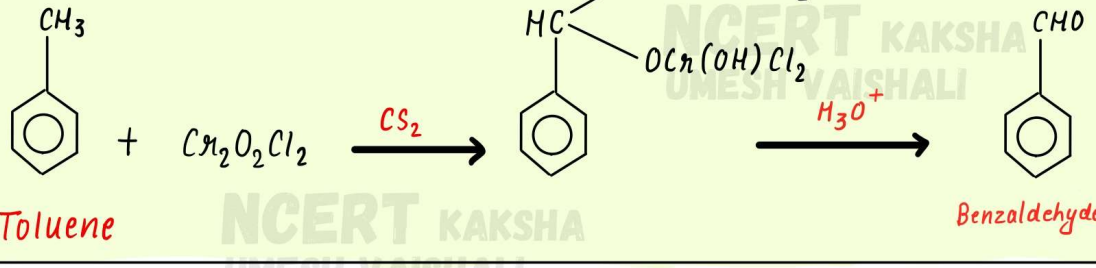
Stephen Reaction

$$SnCl_2 + 2HCl \longrightarrow SnCl_4 + 2[H]$$

$$CH_3-C\equiv N + 2[H] + HCl \longrightarrow CH_3-CH=NH.HCl \xrightarrow{H_2O\ (boil)} CH_3-CHO + NH_4Cl$$

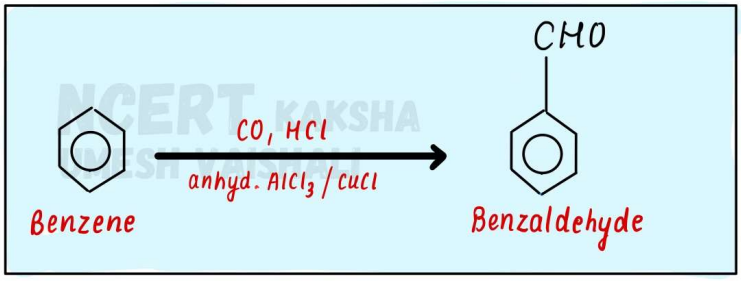
Ethanenitrile → Acetaldoxime hydrochloride → Acetaldehyde

Etard Reaction



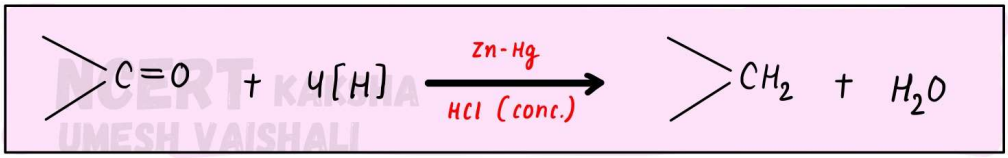
Toluene → Benzaldehyde

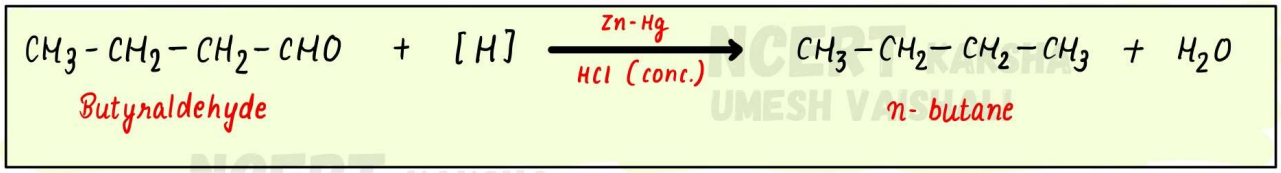
Gatterman - Koch Reaction



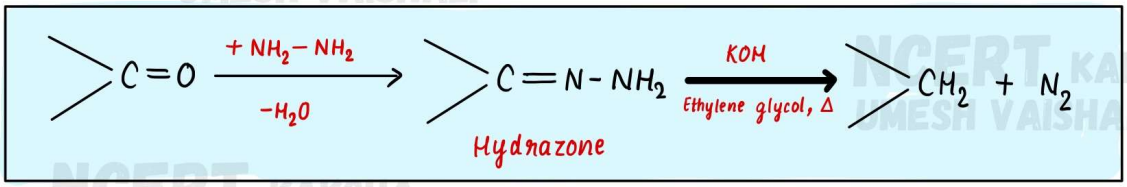
Benzene → Benzaldehyde

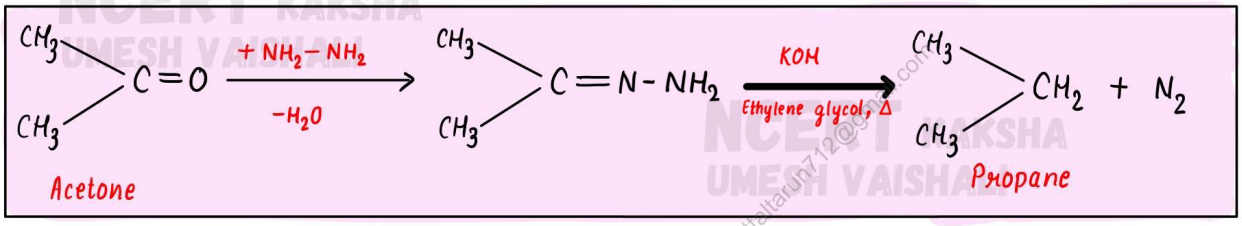
Clemmensen Reduction



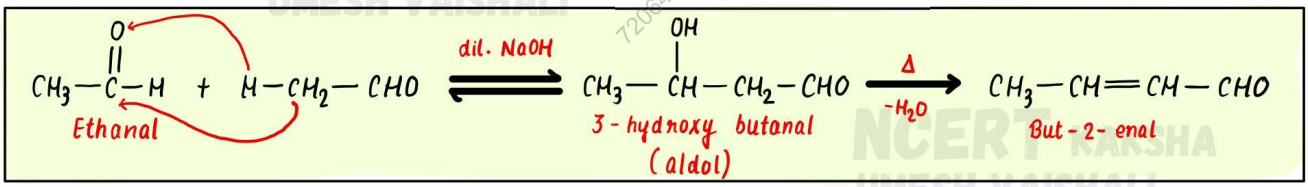


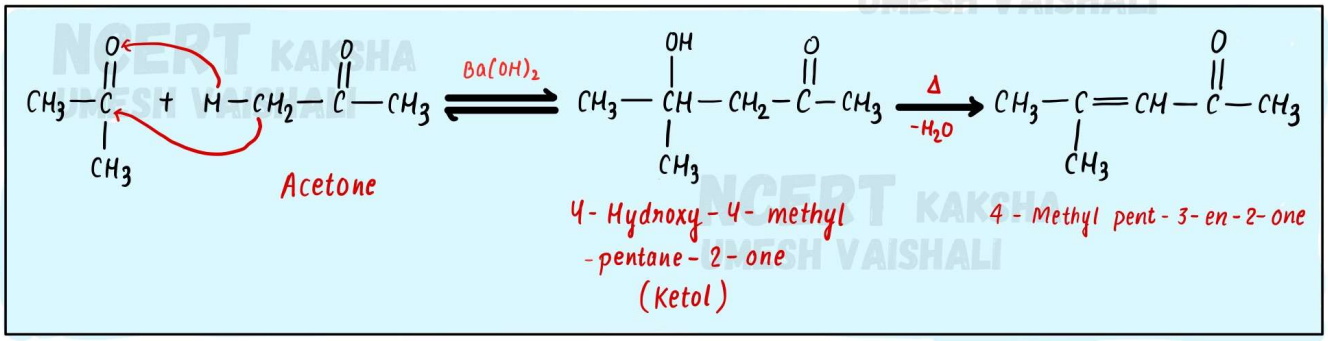
Wolff - Kishner Reduction



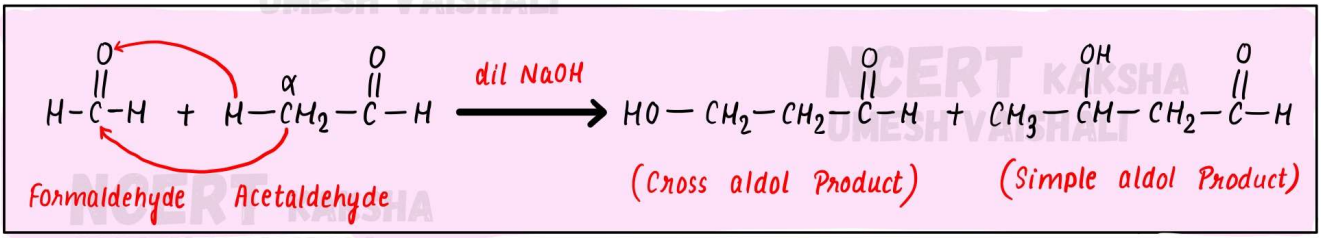


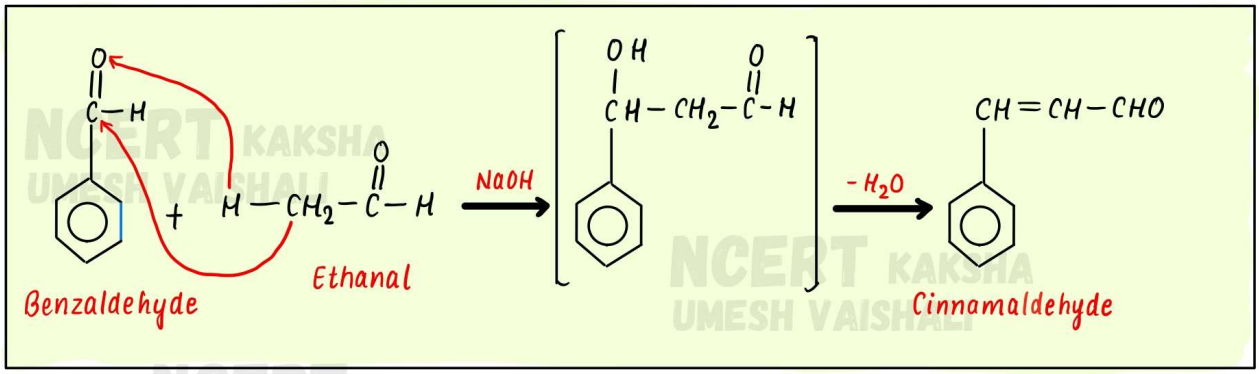
Aldol condensation

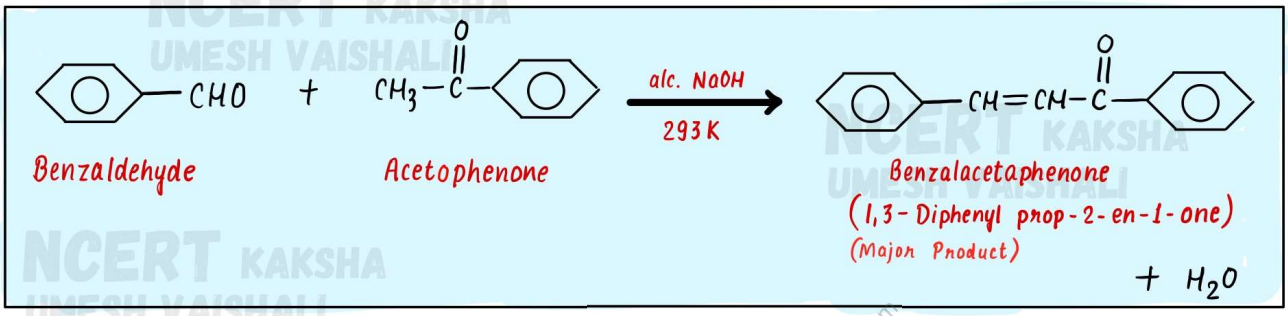




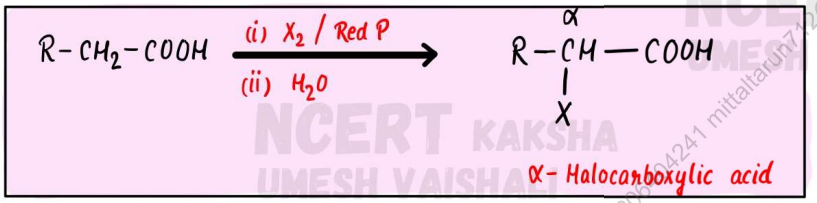
Cross aldol Condensation



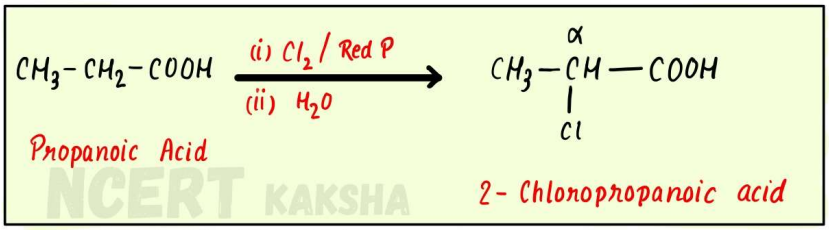




Hell - Volhard - Zelinsky Reaction

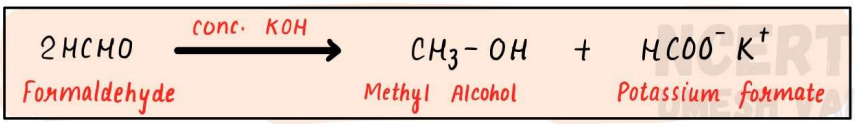


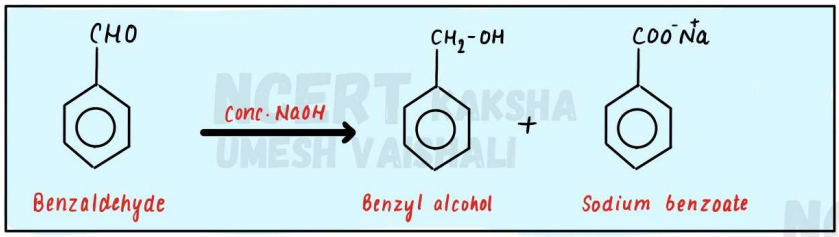
$X = Cl, Br$

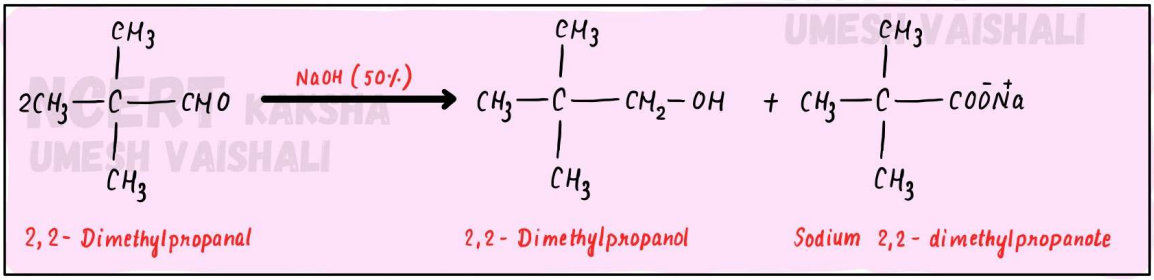


Focus

Cannizzaro Reaction

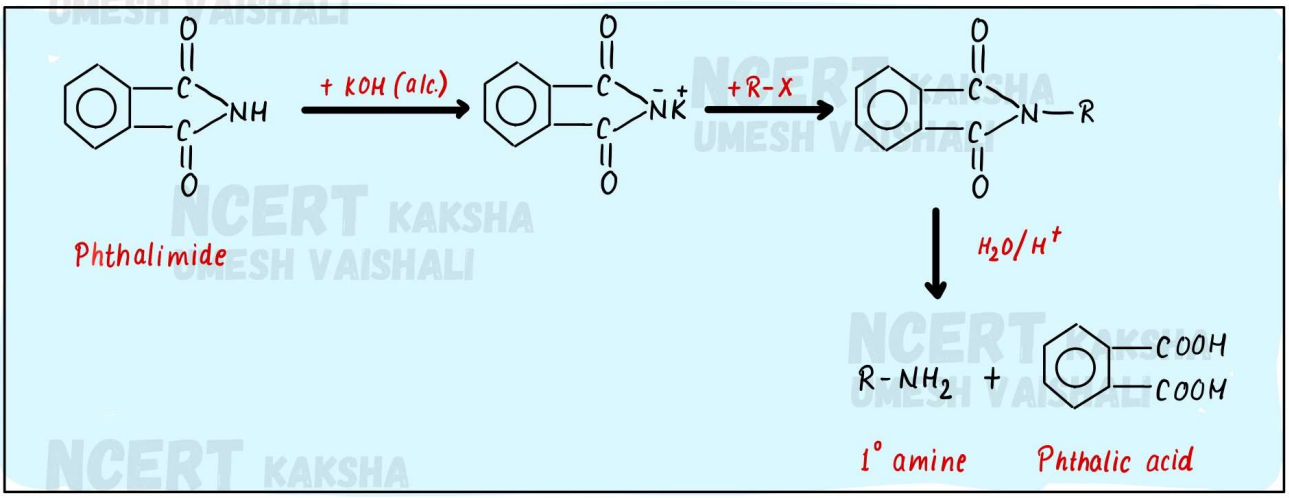






UNIT - 9 Amines

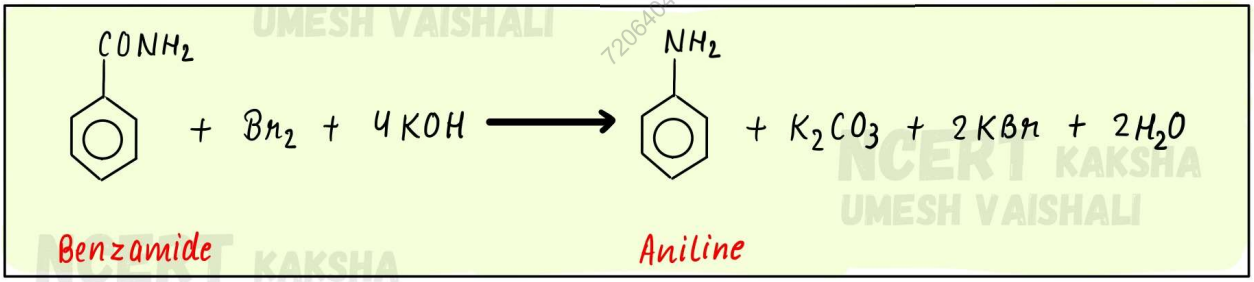
Gabriel phthalimide Synthesis



Hoffmann bromamide reaction

$$R-CONH_2 + Br_2 + 4NaOH \longrightarrow R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

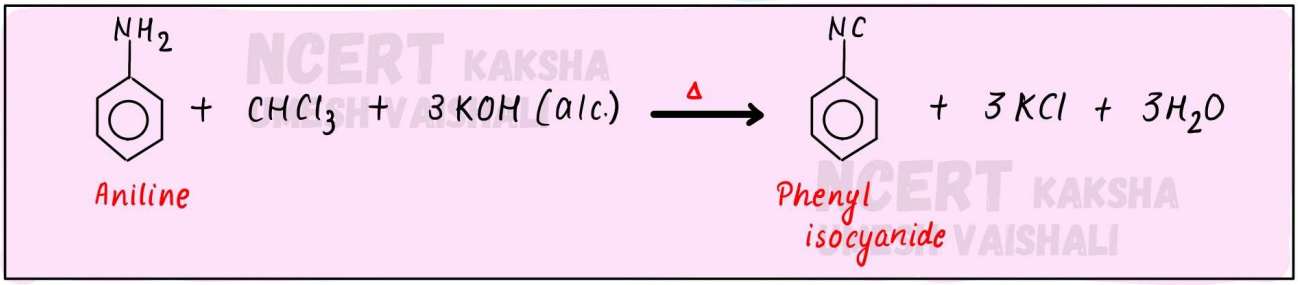
Acid amide — 1° amine



Carbylamine Reaction (Isocynaide test)

$$R-NH_2 + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} R-NC + 3KCl + 3H_2O$$

1° amine — Alkyl isocyanide



Basic character of Amines in terms of K_b and pK_b $\quad pK_b = -\log K_b$

Longer the value of K_b or smaller the value of pK_b stronger is the base.

UNIT - 10 Biomolecules

Carbohydrates
- Monosaccharides
- Oligosaccharides
- Polysaccharides

Important Rxn :-

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 2832\ KJ$$

Preparation of Glucose

From sucrose

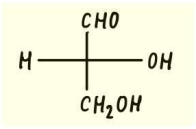
$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

From starch

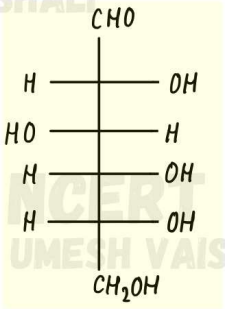
$$\underset{\text{Starch OR cellulose}}{C_6H_{10}O_5} + nH_2O \xrightarrow[393\ K,\ 2-3\ atm.]{H^+} \underset{\text{Glucose}}{nC_6H_{12}O_6}$$

Note :- DNA (Deoxyribonucleic acid)
RNA (Ribonucleic acid)

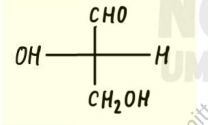
Structure of Glucose



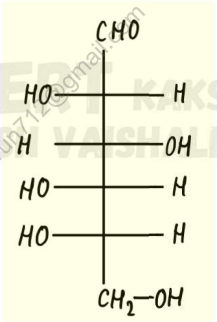
D (+) Glycenaldehyde



D (+) Glucose



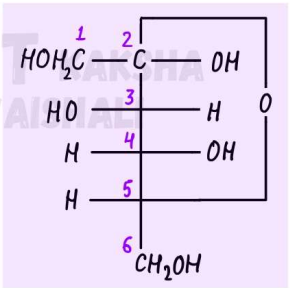
L (−) Glycenaldehyde



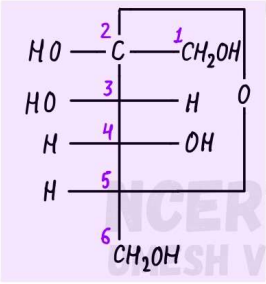
L (−) Glucose

Structure of Fructose

Furan

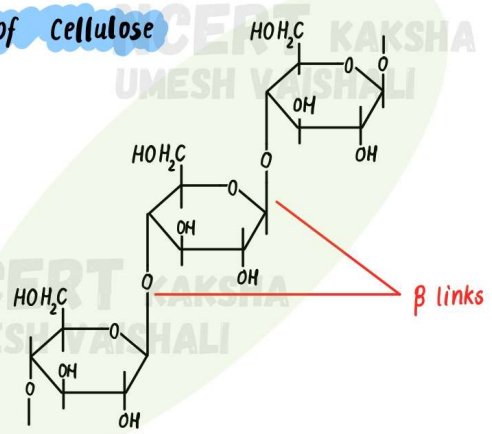


α - D (−) fructofunanose



β - D (−) fructofunanose

Structure of Cellulose



Never Give up

Some Chemical compounds names & Molecular Formulas

Compound Name	Molecular Formula	Compound Name	Molecular Formula
Acetic acid	CH_3COOH	Potassium Nitrate	KNO_3
Hydrochloric acid	HCl	Ammonium chloride	NH_4Cl
Sulfuric acid	H_2SO_4	Ammonium hydroxide	NH_4OH
Acetate	CH_3COO^-	Calcium nitrate	$Ca(NO_3)_2$
Ammonia	NH_3	Hydrogen Peroxide	H_2O_2
Nitric acid	HNO_3	Silver Chloride	$AgCl$
Phosphoric acid	H_3PO_4	Barium Sulphate	$BaSO_4$
Sodium Phosphate	Na_3PO_4	Magnesium Sulphate	$MgSO_4$
Calcium carbonate	$CaCO_3$	Sodium Sulphite	Na_2SO_3
Sodium Bicarbonate	$NaHCO_3$	Oxalic acid	$H_2C_2O_4$
Sodium Hydroxide	$NaOH$	Potassium dichromate	$K_2Cr_2O_7$
Calcium Hydroxide	$Ca(OH)_2$	Zinc Chloride	$ZnCl_2$
Ethanol	C_2H_5OH	Zinc hydroxide	$Zn(OH)_2$
Nitrous Acid	HNO_2	Zinc Sulphate	$ZnSO_4$
Potassium Hydroxide	KOH	Phosphorus Pentachloride	PCl_5
Silver nitrate	$AgNO_3$	Sodium nitrite	$NaNO_2$
Sodium Carbonate	Na_2CO_3	Potassium Permagnate	$KMnO_4$
Magnesium Hydroxide	$Mg(OH)_2$	Boric acid	H_3BO_3
Methane	CH_4	Potassium nitrite	KNO_2
Sodium chloride	$NaCl$	Tartaric acid	$C_4H_6O_6$
Carbon tetra chloride	CCl_4	Aluminium Hydroxide	$Al(OH)_3$
Sodium Sulphate	Na_2SO_4	Iron oxide	Fe_2O_3