

CHAPTER-WISE IMP. DEF. & FORMULAS

1. SOLUTIONS

- Molarity (M)** is the number of moles of the solute dissolved per litre of the solution.

$$M = \frac{w}{GMM} \times \frac{1000}{V(\text{mL})}$$

- Molality (m)** is the number of moles of the solute dissolved in one kilogram (Kg) of the solvent.

$$m = \frac{w}{GMM} \times \frac{1000}{W(\text{g})}$$

- Mole Fraction (χ)** is the ratio of the number of moles of one component to the total number of moles of all the components present in the solution.

$$\text{Mole fraction of A is } \chi_A = \frac{n_A}{n_A + n_B}$$

$$\text{Note: } \chi_A + \chi_B = 1 \text{ (or) } \chi_B = 1 - \chi_A$$

- Osmotic pressure** is the pressure required just to stop the Osmosis. **Formula:** $\Pi = CRT$
- Isotonic solutions** are the solutions with same osmotic pressure at a given temperature.

Ex: Blood is isotonic with 0.9% (w/v) NaCl.

- Henry's law:** $p = K_H \cdot x$.
- Relative lowering of vapour pressure**

$$\text{RLVP} = \frac{\Delta p_1}{p_1^0} = \frac{p_1^0 - p_1}{p_1^0}$$

- For a dilute solution $\text{RLVP} = \frac{p_1^0 - p_1}{p_1^0} = \frac{w_2}{M_2} \times \frac{M_1}{w_1}$

- Elevation of boiling point** $\Delta T_b = K_b m$
- Depression of freezing point**, $\Delta T_f = K_f m$

2. ELECTRO CHEMISTRY

- Faraday's first law:**

$$\text{Deposited mass } m = \frac{E \times C \times t}{96500}, \left(e = \frac{E}{96500} \right)$$

- Faraday's Second law:** $\frac{m_1}{m_2} = \frac{E_1}{E_2}$

- Kohlrausch's law :** $\Lambda_{m+}^0 = \Lambda_+^0 + \Lambda_-^0$

where Λ_+^0 = Molar conductivity of cation

Λ_-^0 = Molar conductivity of anion

- Nernst Equation:**

$$E = E^0 - \frac{2.303 RT}{nF} \log \frac{[\text{Products}]}{[\text{Reactants}]}$$

$$\text{Nernst Equation for Cation } E = E^0 + \frac{0.059}{n} \log C$$

$$\text{Nernst Equation for Anion } E = E^0 - \frac{0.059}{n} \log C$$

- $EMF = E_{\text{RHS}} - E_{\text{LHS}}$
- Representation of the Daniel Cell :**



- 1 Faraday = **96500** C mol⁻¹
- Charge of electron = **-1.602 × 10⁻¹⁹ C**
- Units of **molar conductivity:** **S m²mol⁻¹**

- Degree of dissociation $\alpha = \frac{\Lambda_m^c}{\Lambda_m^0}$

3. CHEMICAL KINETICS

- Zero order reaction:**

$$\text{Rate Constant : } k = \frac{[R]_0 - [R]}{t}$$

$$\text{Units: mol.L}^{-1}.\text{s}^{-1}$$

$$\text{Half life : } t_{1/2} = \frac{[R_0]}{2k}$$

- First order reaction:**

$$\text{Rate Constant : } k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

$$\text{Units: s}^{-1}$$

$$\text{Half life : } t_{1/2} = \frac{0.693}{k}$$

- Arrhenius equation:** $k = A e^{-E_a/RT}$
Where k = rate constant, A = Arrhenius factor, E_a = activation energy, R = Gas constant,

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

4. The d -and f- BLOCK ELEMENTS

- **Transition elements** are the elements with partially filled d-orbital either in their atoms or ions.
- Transition elements form coloured compounds, due to d-d transitions
- **Alloy** is a homogeneous mixture of a metal with other metals or metalloids or non-metals, having similar physical properties to that of the metal.
Ex: Brass: Cu (60% to 70%) and Zn (30% to 40%).
Bronze: Cu (75% to 90%) and Sn (10% to 25%).
- **Mischmetal** is an alloy of Lanthanoid metal.
- **Zeigler - Natta Catalyst** is used in the manufacture of **high-density polythene**.
- **Ferro Magnetic substances** are **very strong**.
- 'Spin only' magnetic moment(μ)

$$= \sqrt{n(n+2)} \text{ BM}$$
 where n= No. of unpaired electrons.

5. COORDINATION COMPOUNDS

- **Coordination compounds (complexes) :**
 $\text{CoCl}_3 \cdot 6\text{NH}_3 = [\text{Co}(\text{NH}_3)_6] \text{Cl}_3$
 $\text{K}_4[\text{Fe}(\text{CN})_6] \cdot \text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
- **Primary valence**= oxidation number
Secondary valence=coordination number
- **Ligand** is an atom (or) ion (or) molecule which gives lone pair of electrons to the central atom.
 (i) **Unidentate:** NH_3
 (ii) **Bidentate:** $\text{H}_2\text{N}-\text{CH}_2-\text{NH}_2$
 (iii) **Polydentate:** EDTA
- **Chelate ligand** is a ring-like structure obtained when a bidentate or a polydentate ligand uses its two or more donor atoms to bind a single metal ion.
- **Ambidentate ligand** is a ligand which contains two donor atoms but only one of them forms a coordinate bond at a time with central metal atom / ion.

6. HALOALKANES & HALOARENES

- **Haloalkanes** (R-X).
Ex: CH_3Cl , $\text{C}_2\text{H}_5\text{Br}$
- **Haloarenes** (Ar-X). **Ex:** $\text{C}_6\text{H}_5\text{Cl}$
- Outcome of S_N^1 is a **racemic mixture**.
- Outcome of S_N^2 is **inversion**. (Walden)
- **Enantiomers** are a pair of stereo isomers which are non-super imposable mirror images.
- **Ambident Nucleophile** are nucleophiles that have two different attacking atoms through which they can attack an electrophile, but only one atom attacks at a time.
- **Grignard Reagent** is alkyl magnesium halide.
 Its general formula is **RMgX**.

7. ALCOHOLS, PHENOLS & ETHERS

- **Alcohols** (R-OH)
Ex: CH_3OH (Methyl alcohol)
- **Phenols** **Ex:** $\text{C}_6\text{H}_5\text{OH}$ (Phenol)
- **Ethers** (R-O-R')
Ex: $\text{C}_2\text{H}_6\text{O}$ or $\text{CH}_3-\text{O}-\text{CH}_3$ (Simple ether)
- Isopropyl benzene is commonly called **cumene**.
- Alcohols and phenols react with carboxylic acids to form **esters**
- **Lucas reagent** is **Conc. HCl/ZnCl₂** (anhyd.)
- IUPAC name of glycerol is **Propane-1,2,3-triol**.
- Phenol on heating with zinc dust gives **Benzene** (C_6H_6).
- The byproduct in the preparation of phenol from cumene is **Acetone** (CH_3COCH_3)
- **Williamson synthesis:**
 Alkyl halide + sodium alkoxide $\rightarrow$ Ether

8. ALDEHYDES, KETONES & CARBOXYLIC ACIDS

- **Aldehydes** ($R-CHO$)
Ex: $HCHO$ (Formaldehyde/ Methanal)
- **Ketones** ($R-(C=O)-R'$)
Ex: $CH_3-(C=O)-CH_3$ (Acetone / 2-Propanone)
- **Carboxylic acids** ($R-COOH$)
Ex: $HCOOH$ (Formic acid/Methanoic acid),
- **Tollens' reagent is ammoniacal silver nitrate solution.** $[Ag(NH_3)_2]^+ OH^-$
- **Rochelle salt:** Sodium potassium tartarate ($KNaC_4H_4O_6 \cdot 4H_2O$)
- Aldehydes and ketones undergo **Nucleophilic addition reactions.**
- **Order of acidic strength:** Chloroacetic acid $>$ benzoic acid $>$ acetic acid $>$ phenol

9. AMINES

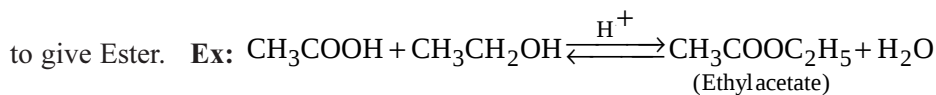
- **Amines** ($R-NH_2$)
Ex: CH_3NH_2 (Methanamine-)
- **Diazonium Salts** ($Ar-N_2^+ Cl^-$)
Ex: $C_6H_5N_2^+ Cl^-$ (Benzenediazonium chloride)
- **Cyanides** ($R-CN$)
Ex: CH_3CN (Ethanenitrile)
- **Isocyanides** ($R-NC$)
Ex: CH_3NC (Methylisocyanide)
- IUPAC name of ethyl methyl amine is **N-methyl ethanamine.**
- The shape of trimethyl amine is **pyramidal.**
- Carbylamine reaction or isocyanide test is used for the identification of **primary amines (1°).**
- **Zwitter ion** is the molecule that has both positive and negative regions of charge.
- **Decreasing order of pK_b :**
 $C_6H_5NH_2 > C_6H_5NHCH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$

10. BIOMOLECULES

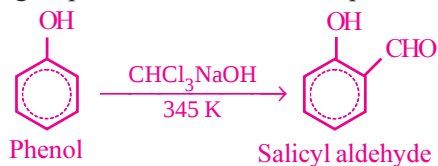
- **Carbohydrates** are Hydrates of carbon. They are optically active polyhydroxy aldehydes or ketones.
Ex: Sugars, Sucrose, Lactose
- **Types of carbohydrates:**
 - Monosaccharides
 - Disaccharides
 - Oligo saccharides
 - Polysaccharides
- **Amino acids** are biomolecules which contain **Amino** ($-NH_2$) group and a **carboxylic acid** group ($-COOH$) at α -carbon
Ex: Glycine
- **Proteins** are naturally occurring polypeptides that generally contain 100-300 amino acid units. Ex: Egg yolk
- **Enzymes** are bio catalysts which speed up reactions in biological reactions.
- **Vitamins** are essential dietary factors and are naturally occurring organic compounds.
Fat soluble vitamins : A, D, E, K
Water soluble vitamins : B, C
Scurvy (bleeding gums) occurs due to deficiency of ascorbic acid (**Vitamin C**).
Rickets disease is caused by the deficiency of vitamin **D**.
- **Hormones** carry biological information from one group of cells to distant tissues or organs.
Types of Hormones:
 - Steroid hormones
 - Protein hormones
 - Amino acid derivatives
- **Hormone - Biological function**
 - Insulin :** Maintains blood sugar level
 - Adrenaline:** Emergency reactions
 - Thyroxine:** Regulates metabolism
- Increased level of **Thyroxine** causes hyperthyroidism.
- **NUCLEIC ACIDS (DNA & RNA):**
Nucleic acids are long chain biopolymers of nucleotides with a polyphosphate ester chain.

TOP 7 NAMED REACTIONS

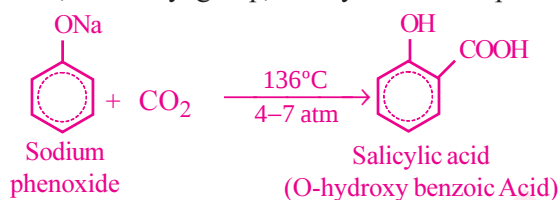
1. **Esterification:** Carboxylic acid reacts with alcohol in the presence of acidic medium (HCl , H_2SO_4)



2. **Riemer-Tiemann reaction:** Phenol on treating with CHCl_3 in the presence of sodium hydroxide, a $-\text{CHO}$ group is introduced at ortho position of benzene ring. [AP 17,18,19,22]



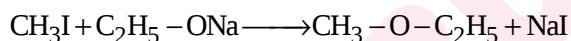
3. **Kolbe Reaction:** When sodium salt of phenol is heated with carbon dioxide at 135°C and under 4-7 atm pressure, a carboxyl group, mainly in the ortho position is introduced. [AP 17, 23]



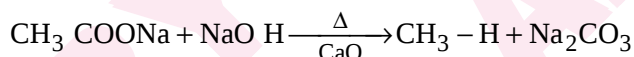
4. **Williamson's synthesis:** When Haloalkanes are heated with sodium (or) potassium alkoxide, they give ether.



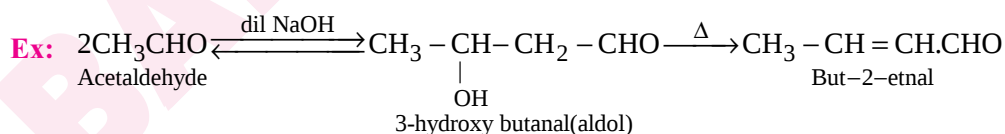
Ex: When methyl iodide reacts with sodium Ethoxide it forms methoxyethane.



5. **Decarboxylation:** Sodium salts of Carboxylic acids when heated with sodalime ($\text{CaO} + \text{NaOH}$) lose CO_2 to form hydrocarbons. [AP 15,16,19]



6. **Aldol Condensation:** Aldehydes and ketones having at least one α -hydrogen undergo a reaction in the presence of dilute alkali as catalyst to form β -hydroxy aldehyde. [AP 18,23,24,25]



7. **Carbylamine reaction:** Aniline when heated with alcoholic potash and chloroform, gives offensive smelling compound.

