

NCERT CLASS XII CHEMISTRY

FORMULAS & CONCEPTS

Chapter 1: The Solid State

Key Concepts

- Crystalline vs Amorphous solids
- Unit cell, lattice parameters
- Packing efficiency
- Density of unit cell
- Voids and defects

Number of Atoms per Unit Cell

| Type | Atoms |
|--------------------------|-------|
| Simple cubic (SC) | 1 |
| Body-centred cubic (BCC) | 2 |
| Face-centred cubic (FCC) | 4 |

| | |
|--|--|
| Relation Between Edge Length (a) and Radius (r) | <ul style="list-style-type: none"> • SC: $a = 2r$ <ul style="list-style-type: none"> • BCC: $\sqrt{3} a = 4r$ <ul style="list-style-type: none"> • FCC: $\sqrt{2} a = 4r$ |
| Density of Unit Cell | $\rho = \frac{Z \times M}{N_A \times a^3}$ <p>Where</p> <p>Z= number of atoms/unit cell</p> <p>M= molar mass</p> <p>a= edge length</p> |
| Packing Efficiency | <ul style="list-style-type: none"> • SC → 52.4% • BCC → 68% • FCC → 74% |
| Voids | <ul style="list-style-type: none"> • Tetrahedral voids = $2N$ • Octahedral voids = N |
| Defects | <ul style="list-style-type: none"> • Schottky defect → decreases density • Frenkel defect → density unchanged |

Chapter 2: Solutions

Key Concepts

- Concentration terms
- Raoult's law
- Colligative properties
- Abnormal molar mass
- van't Hoff factor

| | |
|--|--|
| <i>Concentration Terms</i> • Mass % | |
| <i>Concentration Terms</i> • Mole fraction | $X_A = \frac{n_A}{n_A + n_B}$ |
| <i>Concentration Terms</i> • Molarity | $M = \frac{\text{moles of solute}}{\text{volume (L)}}$ |
| <i>Concentration Terms</i> • Molality | $m = \frac{\text{moles of solute}}{\text{mass of solvent (kg)}}$ |
| Raoult's Law | $P_A = X_A P_A^0$ |
| Relative Lowering of Vapour Pressure | $\frac{P^0 - P}{P^0} = X_{\text{solute}}$ |
| Elevation in Boiling Point | $\Delta T_b = K_b m$ |
| Depression in Freezing Point | $\Delta T_f = K_f m$ |
| Osmotic Pressure | $\pi = CRT$ |
| van't Hoff Factor <i>Used in association/dissociation problems</i> | $i = \frac{\text{observed colligative property}}{\text{calculated value}}$ |

Chapter 3: Electrochemistry

Key Concepts

- Electrochemical cells
- EMF and electrode potential
- Nernst equation
- Conductance
- Electrolysis

| | |
|-----------------------------|---|
| Cell EMF | $E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$ |
| Gibbs Free Energy | $\Delta G^{\circ} = -nFE_{\text{cell}}^{\circ}$ |
| Nernst Equation | $E = E^{\circ} - \frac{0.0591}{n} \log Q$ |
| Conductance | $G = \frac{1}{R}$ |
| Specific Conductance | $\kappa = \frac{G \times l}{A}$ |
| Molar Conductance | $\Lambda_m = \frac{\kappa \times 1000}{C}$ |
| Kohlrausch's Law | $\Lambda_m^{\circ} = \lambda^+ + \lambda^-$ |
| Faraday's Laws | $m = \frac{Q}{F} \times \frac{M}{n}$ |

Chapter 4: Chemical Kinetics

Key Concepts

- Rate of reaction
- Order and molecularity
- Rate law
- Integrated rate equations
- Activation energy

| | |
|-----------------------------|--|
| Rate Law | $\text{Rate} = k[A]^n$ |
| First Order Reaction | $k = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$ $t_{1/2} = \frac{0.693}{k}$ |
| Zero order reaction | $[A] = [A]_0 - kt$ $t_{1/2} = \frac{[A]_0}{2k}$ |
| Arrhenius Equation | $k = Ae^{-E_a/RT}$ |
| Activation Energy | $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$ |

Chapter 5: Surface Chemistry

Key Concepts

- Adsorption
- Colloids
- Emulsions
- Catalysis

| | |
|---------------------------------------|--|
| Adsorption | <ul style="list-style-type: none">• Physical adsorption → weak forces• Chemical adsorption → strong bonding |
| Freundlich Adsorption Isotherm | $\frac{x}{m} = kP^{1/n}$ |
| Langmuir Isotherm | $\theta = \frac{KP}{1 + KP}$ |
| Colloids | <ul style="list-style-type: none">• Lyophilic• Lyophobic |
| Tyndall Effect | Scattering of light by colloidal particles |
| Coagulation | Addition of electrolyte neutralizes charge |

Chapter 6: General Principles and Processes of Isolation of Elements

Key Concepts

- Ores and minerals
- Concentration of ores
- Extraction of metals
- Thermodynamics of metallurgy
- Ellingham diagram

Important Thermodynamic Relation

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

- Negative $\Delta G^\circ \rightarrow$ reaction feasible
- Ellingham diagram plots ΔG° vs T

Gibbs Energy and Equilibrium

$$\Delta G^\circ = -RT \ln K$$

Reducing Agent Selection

- Metal lower in Ellingham diagram reduces metal oxide above it
- Carbon, CO, Al commonly used reducing agents

Electrolytic Reduction

Used for:

- Na, K, Ca, Mg, Al

(No numericals; conceptual and reasoning-based)

Chapter 7: The p-Block Elements

Key Concepts

- Group 15–18 elements
- Trends in properties
- Oxides, hydrides, halides
- Anomalous behaviour

Oxidation States

- Group 15: -3 to $+5$
- Group 16: -2 to $+6$
- Group 17: -1 to $+7$
- Group 18: mostly 0

Acidic Strength of Oxoacids

Acidity \propto number of $= O$ bonds

Hydride Stability

Stability \downarrow down the group

Interhalogen Compounds

Types: XY , XY_3 , XY_5 , XY_7

Uses

- NH_3 (fertilizer)
- H_2SO_4 (industrial acid)
- Cl_2 (disinfectant)

(Mainly theory + reasoning, not numericals)



Chapter 8: d- and f-Block Elements

Key Concepts

- Transition elements
- Lanthanoids & actinoids
- Oxidation states
- Magnetic properties

Oxidation States

- Variable due to incomplete d-subshell
- Common: +2, +3

Magnetic Moment

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

Where

n = number of unpaired electrons

Colour of Transition Metal Ions

Due to d-d transitions

Lanthanoid Contraction

- Gradual decrease in atomic size
- Causes similarity in elements

Catalytic Activity

Due to:

- Variable oxidation states
- Formation of intermediates



Chapter 9: Coordination Compounds

Key Concepts

- Werner theory
- Coordination number
- Ligands
- Isomerism
- Bonding theories

Coordination Number

Number of ligand donor atoms attached

Oxidation Number Calculation

$$\text{Oxidation state} = \text{Charge on complex} - \sum \text{ligand charges}$$

IUPAC Naming Rules

- Ligands named first (alphabetical)
- Metal name later
- Oxidation state in Roman numerals

Isomerism

- Structural: ionisation, linkage
- Stereoisomerism:
 - Geometrical
 - Optical

Crystal Field Splitting Energy

$$\Delta_o < \Delta_t$$

Magnetic Behaviour

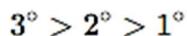
- Paramagnetic \rightarrow unpaired electrons
- Diamagnetic \rightarrow all electrons paired

Chapter 10: Haloalkanes and Haloarenes

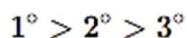
Key Concepts

- Nomenclature
- Physical properties
- Chemical reactions
- SN1 & SN2 mechanisms

Order of Reactivity (SN1)



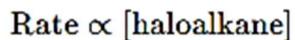
Order of Reactivity (SN2)



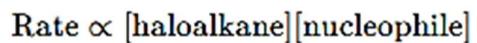
Leaving Group Ability



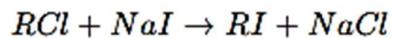
Rate of SN1 Reaction



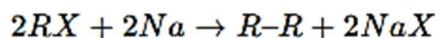
Rate of SN2 Reaction



Finkelstein Reaction



Wurtz Reaction



Chapter 11: Alcohols, Phenols and Ethers

Key Concepts

- Classification of alcohols
- Acidity of phenols
- Preparation methods
- Chemical reactions
- Mechanisms

Acidity Order

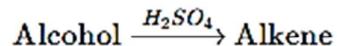


Electron-withdrawing group ↑ → acidity ↑

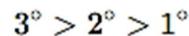
Lucas Test

- 3° alcohol → immediate turbidity
- 2° alcohol → slow turbidity
- 1° alcohol → no turbidity

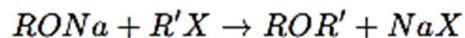
Dehydration of Alcohols



Order:

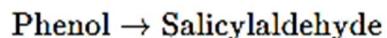


Williamson Ether Synthesis



(SN2 mechanism → primary halide preferred)

Reimer–Tiemann Reaction



Chapter 12: Aldehydes, Ketones and Carboxylic Acids

Key Concepts

- Nucleophilic addition
- Oxidation–reduction
- Aldol condensation
- Acidity of carboxylic acids

Tollens' Test

Aldehyde \rightarrow Silver mirror

Fehling's Test

- Aliphatic aldehydes \rightarrow positive
- Aromatic aldehydes \rightarrow negative

Aldol Condensation

2Aldehydes/Ketones \rightarrow β -hydroxy aldehyde

Acidity Order

Carboxylic acid > Phenol > Alcohol

Hell–Volhard–Zelinsky Reaction

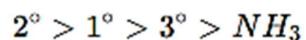
α -halogenation of carboxylic acids

Chapter 13: Amines

Key Concepts

- Classification
- Basicity
- Preparation
- Reactions
- Diazotisation

Basicity Order (Aqueous)



Hinsberg Test

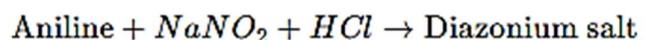
Used to distinguish:

- 1° , 2° , 3° amines

Gabriel Phthalimide Synthesis

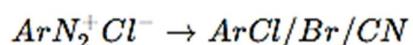
Preparation of primary amines only

Diazotisation Reaction



(0–5°C)

Sandmeyer Reaction



Chapter 14: Biomolecules

Key Concepts

- Carbohydrates
- Proteins
- Enzymes
- Vitamins
- Nucleic acids

Carbohydrates

- Monosaccharides: glucose, fructose
- Disaccharides: sucrose, maltose
- Polysaccharides: starch, cellulose

Reducing Sugars

- Glucose, fructose → reducing
- Sucrose → non-reducing

Proteins

- Amino acids linked by peptide bond
- Levels: primary → quaternary

Enzymes

- Biocatalysts
- Highly specific
- Optimal pH & temperature

Nucleic Acids

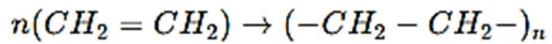
- DNA → double helix
- RNA → single strand

Chapter 15: Polymers

Key Concepts

- Addition & condensation polymers
- Natural & synthetic polymers

Addition Polymerisation



Condensation Polymerisation

Involves elimination of small molecule (H₂O, HCl)

Important Polymers

- Nylon-6,6
- Teflon
- PVC
- Bakelite

Biodegradable Polymers

- PHBV
- Nylon-2-nylon-6

Chapter 16: Chemistry in Everyday Life

Key Concepts

- Drugs
- Food additives
- Cleansing agents

Types of Drugs

- Antacids
- Antibiotics
- Analgesics
- Antihistamines

Antibiotics

- Penicillin
- Tetracycline

Food Preservatives

- Sodium benzoate
- Potassium metabisulphite

Cleansing Agents

- Soaps → basic salts
- Detergents → sulphonates