

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 Z= number of atoms/unit cell M= molar mass 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

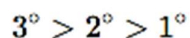
- Paramagnetic → unpaired electrons
- Diamagnetic → all electrons paired

Chapter 10: Haloalkanes and Haloarenes

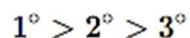
Key Concepts

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

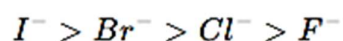
Order of Reactivity (SN1)



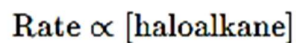
Order of Reactivity (SN2)



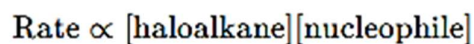
Leaving Group Ability



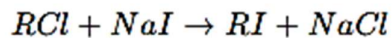
Rate of SN1 Reaction



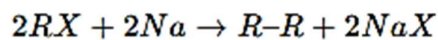
Rate of SN2 Reaction



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

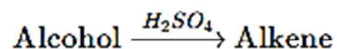


Electron-withdrawing group \uparrow \rightarrow acidity \uparrow

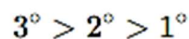
Lucas Test

- 3° alcohol \rightarrow immediate turbidity
- 2° alcohol \rightarrow slow turbidity
- 1° alcohol \rightarrow no turbidity

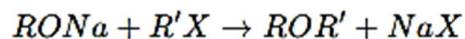
Dehydration of Alcohols



Order:

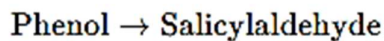


Williamson Ether Synthesis



(SN_2 mechanism \rightarrow 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

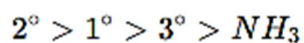
α -halogenation of carboxylic acids

Chapter 13: Amines

Key Concepts

- Classification
- Basicity
- Preparation
- Reactions
- Diazotisation

Basicity Order (Aqueous)



Hinsberg Test

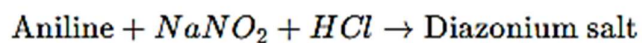
Used to distinguish:

- 1° , 2° , 3° amines

Gabriel Phthalimide Synthesis

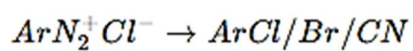
Preparation of primary amines only

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

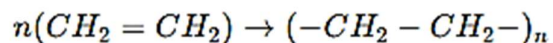
- DNA → double helix
- RNA → single strand

Chapter 15: Polymers

Key Concepts

- Addition & condensation polymers
- Natural & synthetic polymers

Addition Polymerisation



Condensation Polymerisation

Involves elimination of small molecule (H_2O , 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