

Class XII

Chemistry

One-page chapter summaries
Large print • CBSE 2026-27 syllabus

1. Solutions — page 2
2. Electrochemistry — page 3
3. Chemical Kinetics — page 4
4. The d- and f-Block Elements — page 5
5. Coordination Compounds — page 6
6. Haloalkanes and Haloarenes — page 7
7. Alcohols, Phenols and Ethers — page 8
8. Aldehydes, Ketones and Carboxylic Acids — page 9
9. Amines — page 10
10. Biomolecules — page 11

Chapter 1: Solutions

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Big idea: Colligative properties depend only on the NUMBER of solute particles.

Key points

- **Molality** (m) does not change with temperature; **molarity** (M) does.
- **Henry's law**: gas solubility $\propto$ partial pressure. Higher K_H = lower solubility; solubility falls as T rises.
- **Raoult's law**: partial vapour pressure $\propto$ mole fraction. Ideal solution: $\Delta H_{\text{mix}} = 0$, $\Delta V_{\text{mix}} = 0$.
- **Positive deviation**: weaker A-B forces, $\Delta V > 0$ (acetone + CS_2 , ethanol + acetone) $\rightarrow$ minimum-boiling azeotrope.
- **Negative deviation**: stronger A-B forces, $\Delta V < 0$ (acetone + chloroform, phenol + aniline) $\rightarrow$ maximum-boiling azeotrope (68% HNO_3).
- Osmotic pressure suits proteins/polymers. 0.9% NaCl is isotonic with blood.
- **van 't Hoff factor i**: > 1 for dissociation (KCl), < 1 for association (ethanoic acid in benzene).

Formulas, definitions & facts

- $p_{\text{total}} = x_1 p_1^\circ + x_2 p_2^\circ$; Henry: $p = K_H \cdot x$
- $(p_1^\circ - p_1)/p_1^\circ = x_2$
- $\Delta T_b = i \cdot K_b \cdot m$; $\Delta T_f = i \cdot K_f \cdot m$; $\pi = i \cdot CRT$
- $M_2 = K \times w_2 \times 1000 / (\Delta T \times w_1)$
- $i = 1 + \alpha(n - 1)$ for dissociation

Exam focus: how to score

- Molar mass numericals from ΔT_f , ΔT_b , π or VP lowering: formula, units, i.
- Deviations from Raoult's law with ΔV , ΔH and an example.
- Henry's law uses: soda fizz, divers (bends), altitude.

★ Important questions from CBSE sample papers

- 10 mL acetone + 10 mL CS_2 is not 20 mL. Comment. What if CS_2 is replaced by chloroform? (SQP 2026-27, 2 marks)
- 100 g of solute A in 1000 g water lowers vapour pressure by 50%. Find molar mass of A. (SQP 2026-27, 2 marks)
- Vapour pressure of 1 molal MgCl_2 , 70% dissociated ($p^\circ = 23.8$ mm Hg)? (SQP 2025-26, 3 marks)

Remember: Positive deviation pushes apart (volume up); Negative deviates closer (volume down).

Chapter 2: Electrochemistry

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Big idea: Redox makes electricity (galvanic cell) or is driven by it (electrolytic cell).

Key points

- Galvanic: anode (–) oxidation, cathode (+) reduction. Daniell cell $E^\circ = 1.10 \text{ V}$; salt bridge keeps neutrality.
- More negative E° = stronger reducing agent; SHE = 0 V.
- On dilution κ falls, but Λ_m rises. Strong electrolyte: $\Lambda_m = \Lambda^\circ_m - A\sqrt{c}$. Weak: use **Kohlrausch's law**.
- $1 \text{ F} = 96487 \text{ C mol}^{-1}$. Electrolysis products depend on E° and overpotential.
- Mercury cell gives constant 1.35 V. **Lead storage battery** is secondary; H_2SO_4 density falls on discharge.
- H_2 – O_2 **fuel cell**: ~70% efficient, pollution-free (Apollo).
- Rusting is electrochemical; protect by paint, galvanising, sacrificial Mg/Zn.

Formulas, definitions & facts

- $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$
- $E = E^\circ - (0.059/n) \log Q$ (298 K)
- $\Delta G^\circ = -nFE^\circ$; $\log K = nE^\circ/0.059$
- $\Lambda_m = \kappa \times 1000 / C$; $\alpha = \Lambda_m/\Lambda^\circ_m$
- $\text{Pb} + \text{PbO}_2 + 2\text{H}_2\text{SO}_4 \rightarrow 2\text{PbSO}_4 + 2\text{H}_2\text{O}$
- Fuel cell: $\text{O}_2 + 2\text{H}_2\text{O} + 4e^- \rightarrow 4\text{OH}^-$; $2\text{H}_2 + 4\text{OH}^- \rightarrow 4\text{H}_2\text{O} + 4e^-$

Exam focus: how to score

- Nernst numericals (E , K , ΔG°): the top 3–5 mark item; show n .
- Kohlrausch expressions; Λ_m vs $\sqrt{c}$ graphs.
- Electrolysis products and charge in faradays.

★ Important questions from CBSE sample papers

- Charge needed to get 1 mol of M from M_2O_3 ? (SQP 2026-27, 1 mark)
- Why connect iron pipes to Mg? Electrode reactions for electrolysis of molten MgCl_2 . (SQP 2026-27, 2 marks)
- $\Lambda_m(\text{NaCl}) = 123.9$ at 0.010 M and 120.7 at 0.040 M. Find Λ°_m and A . (SQP 2026-27, 3 marks)

Remember: AN OX, RED CAT: anode oxidation, reduction at cathode.

Chapter 3: Chemical Kinetics

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Big idea: How fast reactions go, and how concentration, temperature and catalysts change it.

Key points

- **Rate law** comes from experiment, not from the balanced equation.
- **Order**: sum of powers; can be 0 or fractional. **Molecularity**: elementary step only, never 0.
- **Zero order**: rate = k, constant throughout (NH_3 on hot Pt); $t_{1/2} \propto [\text{R}]_0$.
- **First order**: $t_{1/2} = 0.693/k$, independent of $[\text{R}]_0$.
- **Pseudo first order**: one reactant in excess (acid hydrolysis of ester, inversion of sucrose).
- Effective collisions need energy $\geq$ threshold AND proper orientation.
- **Catalyst** lowers E_a ; does not change ΔG or K .

Formulas, definitions & facts

- Zero: $k = ([\text{R}]_0 - [\text{R}])/t$; $t_{1/2} = [\text{R}]_0/2k$
- First: $k = (2.303/t) \log([\text{R}]_0/[\text{R}])$
- Units of k: $(\text{mol L}^{-1})^{1-n} \text{s}^{-1}$
- $k = A e^{(-E_a/RT)}$; slope of $\log k$ vs $1/T = -E_a/2.303R$
- $\log(k_2/k_1) = (E_a/2.303R)(1/T_1 - 1/T_2)$
- First order: $t_{75\%} = 2 t_{1/2}$

Exam focus: how to score

- First-order and Arrhenius numericals (3–5 marks).
- Order from units of k or from graphs.
- Order vs molecularity; catalyst on energy diagram.

★ Important questions from CBSE sample papers

- $t_{1/2}$ of a first-order reaction is 16 min. Time for 75% completion? (SQP 2026-27, 1 mark)
- 'Rate stays constant during the reaction.' Always true, or only under conditions? (SQP 2026-27, 2 marks)
- $\log k$ vs $1/T$ has slope -4250 K . Find E_a . (SQP 2026-27, 3 marks)

Remember: 0.693 over k: first-order half-life ignores how much you start with.

Chapter 4: The d- and f-Block Elements

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Big idea: Partly filled d orbitals give variable oxidation states, colour, magnetism and catalysis.

Key points

- Zn, Cd, Hg (d^{10}) are not regarded as transition elements.
- Many unpaired electrons $\rightarrow$ high melting point and enthalpy of atomisation.
- Mn shows most oxidation states (+2 to +7). Mn^{3+} oxidising ($\rightarrow d^5$); Cr^{2+} reducing ($\rightarrow d^3$). Cu^+ disproportionates.
- Colour from d-d transitions; d^0/d^{10} ions (Sc^{3+} , Zn^{2+}) colourless.
- Catalysts (Fe in Haber, V_2O_5), interstitial compounds, alloys.
- **Lanthanoid contraction** (poor 4f shielding): Zr and Hf almost same size.
- Lanthanoids mainly +3; actinoids show more states and are radioactive.

Formulas, definitions & facts

- $\mu = \sqrt{n(n+2)}$ BM
- $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$
- $2CrO_4^{2-} + 2H^+ \rightleftharpoons Cr_2O_7^{2-} + H_2O$
- $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$
- $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
- $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

Exam focus: how to score

- 'Account for' reasons: m.p., colour, E° trends, oxidation states.
- Compare μ by counting unpaired electrons.
- **Balanced ionic equations of $KMnO_4/K_2Cr_2O_7$.**

★ Important questions from CBSE sample papers

- Balance $SO_3^{2-} + MnO_4^- + H^+ \rightarrow$. Why does Ti melt lower than Cr? (SQP 2026-27, 2 marks)
- Highest magnetic moment: Ti^{2+} , Co^{2+} or Fe^{2+} ? Why is Fe a good Haber catalyst? (SQP 2026-27, 3 marks)
- Why: lowest oxide basic, highest acidic; Cr hard but Hg liquid. (SQP 2024-25, 3 marks)

Remember: More unpaired electrons: higher melting point, stronger magnetism.

Chapter 5: Coordination Compounds

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Big idea: A metal bonded to ligands by coordinate bonds; structure explains colour, magnetism, isomerism.

Key points

- **Werner:** primary valency = oxidation state (ionisable); secondary = coordination number.
- Ligands: di-/polydentate, **chelate**, **ambidentate** ($\text{NO}_2^-/\text{ONO}^-$, $\text{SCN}^-/\text{NCS}^-$).
- Isomers: ionisation, linkage, coordination, hydrate; geometrical (cis/trans, fac/mer), optical.
- **$[\text{Co}(\text{en})_3]^{3+}$ and cis- $[\text{PtCl}_2(\text{en})_2]^{2+}$ are optically active**; trans forms are not.
- **VBT:** $[\text{NiCl}_4]^{2-}$ sp^3 tetrahedral; $[\text{Ni}(\text{CN})_4]^{2-}$ dsp^2 square planar.
- **CFT:** strong-field ligands pair electrons when $\Delta_o > P$ (low spin).
- Anhydrous CuSO_4 white (no ligand field). Carbonyls: **synergic bonding**.

Formulas, definitions & facts

- Series: $\text{I}^- < \text{Br}^- < \text{Cl}^- < \text{F}^- < \text{OH}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$
- $\Delta_t = (4/9) \Delta_o$
- d^4 : $\Delta_o < P \rightarrow t_2g^3eg^1$; $\Delta_o > P \rightarrow t_2g^4eg^0$
- $[\text{Co}(\text{NH}_3)_6]^{3+}$: $d^2\text{sp}^3$, diamagnetic

Exam focus: how to score

- IUPAC name $\leftrightarrow$ formula (anionic ligands -o, metal in anion -ate).
- Hybridisation, geometry, magnetism; t_2g/eg filling.
- AgCl precipitate or conductivity $\rightarrow$ ionisable Cl^- .

★ Important questions from CBSE sample papers

- Which is tetrahedral: $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Cu}(\text{NH}_3)_4]^{2+}$, $[\text{NiCl}_4]^{2-}$, $[\text{Co}(\text{en})_3]^{3+}$? (SQP 2026-27, 1 mark)
- $\text{PdCl}_2 \cdot 4\text{NH}_3$ gives 2 mol AgCl . Primary and secondary valency of Pd? (SQP 2026-27, 1 mark)
- Formula of diaquasilver(I) dichloridoargentate(I). (SQP 2025-26, 1 mark)

Remember: Strong field: spins pair (low spin). Weak field: spread out (high spin).

Chapter 6: Haloalkanes and Haloarenes

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Big idea: The polar C-X bond makes haloalkanes ready for substitution and elimination.

Key points

- Alcohol + **SOCl₂ is best** (by-products SO₂, HCl are gases).
- HBr + alkene: Markovnikov; with peroxide, anti-Markovnikov.
- b.p.: RI > RBr > RCl; falls with branching.
- **SN2**: one step, **inversion**; 1° > 2° > 3°.
- **SN1**: carbocation, **racemisation**; 3° > 2° > 1°; allylic/benzylic fast.
- KCN → nitrile; AgCN → isocyanide. Alc. KOH → alkene (**Zaitsev**).
- Aryl halides resist substitution; o/p -NO₂ helps. CHCl₃ in dark bottles (phosgene); freons deplete ozone.

Formulas, definitions & facts

- Finkelstein: RCl + NaI → RI + NaCl (dry acetone)
- Swarts: CH₃Br + AgF → CH₃F + AgBr
- Sandmeyer: ArN₂⁺Cl⁻ + CuCl/HCl → ArCl + N₂
- Wurtz: 2RX + 2Na → R-R (dry ether)
- Wurtz-Fittig: ArX + RX + 2Na → Ar-R
- RX + Mg → RMgX (Grignard)

Exam focus: how to score

- SN1 vs SN2: steps, stereochemistry, reactivity order.
- Named reactions; 'explain why'.
- Major product: Markovnikov, Zaitsev, KCN vs AgCN.

★ Important questions from CBSE sample papers

- (–)-2-Bromohexane + NaOH gives (+)-hexan-2-ol. SN1 or SN2? Inversion or retention? (SQP 2026-27, 1 mark)
- Nitro or methoxy: which raises chlorobenzene's reactivity towards NaOH? Why? (SQP 2026-27, 2 marks)
- Explain: Finkelstein uses dry acetone; neopentyl chloride boils lower than isopentyl chloride. (SQP 2025-26, 2 marks)

Remember: SN2 flips like an umbrella; SN1 forms a carbocation and racemises.

Chapter 7: Alcohols, Phenols and Ethers

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Big idea: The -OH and -O- groups decide acidity, boiling point and reactions.

Key points

- **Hydroboration-oxidation** gives anti-Markovnikov alcohol.
- Grignard + HCHO $\rightarrow$ 1°; other aldehydes $\rightarrow$ 2°; ketones $\rightarrow$ 3° alcohol.
- Phenol from cumene (acetone by-product). H-bonding raises b.p.
- **Acidity: phenol > water > alcohol**. $-\text{NO}_2$ raises it; $-\text{CH}_3$ lowers it.
- Dehydration: $3^\circ > 2^\circ > 1^\circ$. Oxidation: $1^\circ \rightarrow$ aldehyde (PCC); $2^\circ \rightarrow$ ketone.
- Bromine water + phenol $\rightarrow$ 2,4,6-tribromophenol (white ppt).
- Ethers by **Williamson** (1° halide + alkoxide); anisole + HI $\rightarrow$ phenol + CH_3I .

Formulas, definitions & facts

- Kolbe: phenoxide + CO_2 , H^+ $\rightarrow$ salicylic acid
- Reimer-Tiemann: phenol + CHCl_3 + NaOH $\rightarrow$ salicylaldehyde
- $\text{R-X} + \text{R'ONa} \rightarrow \text{R-O-R'} + \text{NaX}$
- Ethanol + conc. H_2SO_4 : 413 K ether; 443 K ethene
- Phenol + Zn dust $\rightarrow$ benzene

Exam focus: how to score

- Acidity of substituted phenols with reasons (case-based).
- Conversions; Kolbe, Reimer-Tiemann, Williamson.
- Mechanism: acid dehydration of ethanol.

★ Important questions from CBSE sample papers

- From pKa data: pKa of 2,4,6-trinitrophenol? Acidity order of p-halophenols? (SQP 2026-27, 4 marks)
- Propanol dehydrated at 140 °C and 180 °C: major products? (SQP 2024-25, 3 marks)
- Convert: butan-2-one $\rightarrow$ 3-methylpentan-3-ol; phenol $\rightarrow$ benzene; chloroethane $\rightarrow$ ethoxyethane. (SQP 2025-26, 3 marks)

Remember: Pull electrons (NO_2): more acidic. Push (CH_3): less.

Chapter 8: Aldehydes, Ketones and Carboxylic Acids

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Big idea: The polar C=O invites nucleophilic addition; -COOH adds acidity.

Key points

- **Aldehydes more reactive than ketones** (less hindrance, fewer alkyl groups).
- Additions: HCN, NaHSO₃ (purifies aldehydes), Grignard, alcohols (dry HCl), NH₂-Z at pH ≈ 3.5.
- Tollens' and Fehling's: aldehydes. Iodoform: methyl ketones. 2,4-DNP: both.
- α-H → aldol; no α-H → Cannizzaro.
- Acidity rises with EWG: CF₃COOH > ClCH₂COOH > HCOOH > CH₃COOH.
- -COOH + NaHCO₃ → CO₂ (test). Acid chloride > anhydride > ester > amide.

Formulas, definitions & facts

- Rosenmund: RCOCl + H₂ (Pd-BaSO₄) → RCHO
- Etard: toluene + CrO₂Cl₂ → benzaldehyde
- Clemmensen (Zn-Hg/HCl), Wolff-Kishner (NH₂NH₂, KOH): C=O → CH₂
- Aldol: 2CH₃CHO → CH₃CH(OH)CH₂CHO
- Cannizzaro: 2HCHO + KOH → CH₃OH + HCOOK
- HVZ: RCH₂COOH + X₂/red P → RCHXCOOH

Exam focus: how to score

- **Named reactions with equations** (most asked).
- Tests to distinguish pairs; flowcharts.
- Order of acidity, reactivity, ease of oxidation.

★ Important questions from CBSE sample papers

- Name and complete: 2CH₃CHO → aldol; toluene → benzaldehyde (CrO₂Cl₂); >C=O → >CH₂. (SQP 2026-27, 3 marks)
- Why pH ~3.5 for NH₂-Z addition; why NaHSO₃ purifies aldehydes? (SQP 2026-27, 2 marks)
- Flowchart: identify methanol, acetaldehyde, acetic acid using NaHCO₃ and 2,4-DNP. (SQP 2026-27, 2 marks)

Remember: No α-H: Cannizzaro. α-H: Aldol. CH₃CO-: Iodoform.

Chapter 9: Amines

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Big idea: Nitrogen's lone pair makes amines bases; diazonium salts open many syntheses.

Key points

- **Gabriel phthalimide**: pure 1° aliphatic amines only, not aniline.
- **Hoffmann bromamide**: amide → amine with one carbon less.
- Basicity (water): $(\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N} > \text{C}_2\text{H}_5\text{NH}_2 > \text{NH}_3$.
- **Aniline is a weaker base** than NH_3 (lone pair in ring).
- **Hinsberg**: 1° → soluble in alkali; 2° → insoluble; 3° → no reaction.
- Nitration of aniline gives ~47% meta (anilinium). **Acetylate first** for mono-substitution.
- Diazotisation at 273–278 K; no Friedel–Crafts on aniline.

Formulas, definitions & facts

- $\text{RCONH}_2 + \text{Br}_2 + 4\text{NaOH} \rightarrow \text{RNH}_2 + \text{Na}_2\text{CO}_3 + 2\text{NaBr} + 2\text{H}_2\text{O}$
- Carbylamine: $\text{RNH}_2 + \text{CHCl}_3 + 3\text{KOH} \rightarrow \text{RNC}$ (foul) (1° only)
- $\text{ArNH}_2 + \text{NaNO}_2 + 2\text{HCl} \rightarrow \text{ArN}_2^+\text{Cl}^-$
- $\text{ArN}_2^+ + \text{CuCN} \rightarrow \text{ArCN}$; + HBF_4 , heat → ArF ; + $\text{H}_3\text{PO}_2 \rightarrow \text{ArH}$
- $\text{ArN}_2^+ + \text{phenol (alkaline)} \rightarrow \text{orange azo dye}$

Exam focus: how to score

- Basicity/pK_b order with reasons.
- Diazonium conversions step by step.
- Tests for 1°/2°/3° amines.

★ Important questions from CBSE sample papers

- X gives a foul smell with CHCl_3 and alc. KOH. Which reaction produces X? (SQP 2026-27, 1 mark)
- Convert: nitrobenzene → fluorobenzene; benzoic acid → benzylamine. (SQP 2026-27, 2 marks)
- Convert nitrobenzene → 4-bromobenzenamine. (SQP 2025-26, 1 mark)

Remember: Hinsberg: 1° dissolves in alkali, 2° stays solid, 3° stays out.

Chapter 10: Biomolecules

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Big idea: Carbohydrates, proteins, enzymes, vitamins, nucleic acids, hormones: the chemistry of life.

Key points

- **Reducing sugars** reduce Tollens'/Fehling's: glucose, maltose, lactose. **Sucrose is non-reducing.**
- Glucose gives no Schiff's test or NaHSO_3 adduct → **cyclic pyranose form** (α , β anomers).
- Starch = amylose (soluble) + amylopectin (80–85%); cellulose = β -D-glucose.
- Amino acids are **zwitter ions**; essential ones come from diet.
- Proteins: primary to quaternary; fibrous (keratin) vs globular (insulin).
- **Denaturation** destroys 2°/3° structure (curdling milk, boiled egg).
- Vitamins A, D, E, K fat-soluble; B, C water-soluble. DNA: $\text{A}=\text{T}$, $\text{G}\equiv\text{C}$; RNA has U.

Formulas, definitions & facts

- Glucose + HI → n-hexane ; + Br_2 water → gluconic acid
- Glucose + HNO_3 → saccharic acid
- Sucrose → glucose + fructose (invert sugar)
- Nucleotide = base + sugar + phosphate
- Deficiency: A night blindness; C scurvy; D rickets; K slow clotting

Exam focus: how to score

- Glucose reactions; evidence for cyclic structure.
- Reducing vs non-reducing; hydrolysis products.
- Protein structure, DNA vs RNA, vitamin diseases.

★ Important questions from CBSE sample papers

- $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}(\text{NH}_2)-\text{COOH}$, made in our body: acidic or neutral, essential or not? (SQP 2026-27, 1 mark)
- How does casein change when lemon juice is added to milk? (SQP 2026-27, 1 mark)
- Why does glucose, but not sucrose, reduce Fehling's reagent? (SQP 2025-26, 1 mark)

Remember: A, D, E, K are stored in fat; B and C wash out daily.