CBSE Class 12 Chemistry

Important Questions and Answers for Board Exams

A printable solved question bank · Aligned to the CBSE 2026-27 syllabus (Board Exam 2027)

Inside: Part A – 29 important questions, unit by unit · Part B – case-based and assertion-reason questions · Part C – model practice questions. Every question comes with its solution right below it.

Part A: Important Questions and Answers

Solutions

Q1 What is Raoult's law? Why do solutions of ethanol and acetone show positive deviation?

Ans. For a solution of volatile liquids, the partial vapour pressure of each component is directly proportional to its mole fraction: $p_A = x_A \cdot p_A^\circ$. In ethanol-acetone, ethanol molecules are held together by hydrogen bonds. Adding acetone breaks some of these bonds, and the new ethanol-acetone attractions are weaker than the ones lost. Molecules therefore escape more easily, the vapour pressure is higher than Raoult's law predicts, and we see positive deviation ($\Delta mixH > 0$ and $\Delta mixV > 0$).

Q2 Why is osmotic pressure preferred over other colligative properties for finding the molar mass of polymers and proteins?

Ans. Polymers have very large molar masses and low solubility, so a solution of reasonable mass concentration has an extremely small mole fraction of solute. Changes in boiling point or freezing point would be too tiny to measure. Osmotic pressure, on the other hand, is measurable even for very dilute solutions, and it is usually measured at room temperature, which protects heat-sensitive biomolecules.

Q3 Define the van't Hoff factor. What is its value for an associating and a dissociating solute?

Ans. i = (observed colligative property) ÷ (calculated colligative property assuming no association or dissociation) = (normal molar mass) ÷ (observed molar mass). For association (e.g. ethanoic acid in benzene) $i < 1$. For dissociation (e.g. KCl in water) $i > 1$. For a solute that does neither, $i = 1$.

Q4 Calculate the boiling point of a solution of 18 g of glucose (M = 180 g/mol) in 1 kg of water. (K_b = 0.52 K kg/mol)

Ans. Molality = 18/180 = 0.1 m. $\Delta T_b = K_b \times m = 0.52 \times 0.1 = 0.052$ K. Boiling point = 373.15 + 0.052 ≈ 373.20 K (100.05 °C).

Q5 State Henry's law. Why do scuba divers use air diluted with helium?

Ans. Henry's law: the partial pressure of a gas in the vapour phase is proportional to its mole fraction in the solution ($p = K_H \cdot x$). At depth, the high pressure dissolves more nitrogen in the blood. When the diver surfaces, the dissolved gas comes out as bubbles and blocks capillaries (the bends). Helium is much less soluble in blood than nitrogen, so helium-oxygen mixtures greatly reduce this risk.

Electrochemistry

Q6 Write the Nernst equation for the Daniell cell and find its E° given $E°(Zn^{2+}/Zn) = -0.76$ V and $E°(Cu^{2+}/Cu) = +0.34$ V.

Ans. Cell: Zn | Zn^{2+} || Cu^{2+} | Cu. $E°cell = 0.34 - (-0.76) = 1.10$ V. $E_{cell} = E°cell - (0.0591/2)\ \log([Zn^{2+}]/[Cu^{2+}])$ at 298 K.

Q7 State Kohlrausch's law. How is Λ°m of ethanoic acid calculated?

Ans. At infinite dilution, the limiting molar conductivity of an electrolyte equals the sum of the limiting molar conductivities of its cation and anion, since each ion migrates independently. A weak electrolyte cannot be extrapolated to infinite dilution directly, so: $Λ°m(CH_3COOH) = Λ°m(CH_3COONa) + Λ°m(HCl) - Λ°m(NaCl)$.

Q8 How much copper is deposited when a current of 2 A passes through $CuSO_4$ solution for 30 minutes? (Molar mass of Cu = 63.5 g/mol; 1 F = 96500 C)

Ans. $Q = I \times t = 2 \times 1800 = 3600$ C. $Cu^{2+} + 2e^- \rightarrow Cu$, so 2 × 96500 C deposits 63.5 g. Mass = $(63.5 \times 3600)/(2 \times 96500) \approx 1.18$ g.

Q9 Why does the conductivity of an electrolyte decrease on dilution while its molar conductivity increases?

Ans. Conductivity (κ) depends on the number of ions per unit volume, and dilution reduces that number. Molar conductivity ($Λm = κ \times 1000/M$) is conductivity per unit concentration. On dilution the ions are further apart (less inter-ionic attraction), and for weak electrolytes the degree of dissociation also rises. Therefore Λm increases.

Q10 Explain the electrochemical theory of rusting.

Ans. A drop of water containing dissolved CO_2 and O_2 acts as an electrolyte. Anode: $Fe \rightarrow Fe^{2+} + 2e^-$. Cathode: $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$. Fe^{2+} is further oxidised by atmospheric oxygen to Fe^{3+}, which forms hydrated iron(III) oxide ($Fe_2O_3 \cdot xH_2O$), i.e. rust.

Chemical Kinetics

Q11 A first-order reaction is 75% complete in 32 minutes. Find its half-life and rate constant.

Ans. 75% complete means 25% = $(1/2)^2$ remains, so two half-lives have passed. $t½ = 32/2 = 16$ min. $k = 0.693/16 = 0.0433\ min^{-1}$.

Q12 Differentiate between molecularity and order of a reaction.

Ans. Molecularity is the number of reacting species colliding in an elementary step. It is always a whole number (1, 2, 3) and applies only to elementary steps. Order is the sum of the powers of concentration terms in the experimentally determined rate law. It can be zero, fractional or whole, and applies to the overall reaction.

Q13 What is activation energy? How can it be found graphically?

Ans. Activation energy (E_a) is the minimum extra energy that reacting molecules must have to form the activated complex. From the Arrhenius equation, $\ln k = \ln A - E_a/RT$, so a plot of log k against 1/T is a straight line with slope = $-E_a/(2.303\ R)$. A catalyst lowers E_a and thus increases the rate without changing ΔH.

d- and f-Block Elements

Q14 Why do transition elements show variable oxidation states and form coloured compounds?

Ans. The (n−1)d and ns electrons have very similar energies, so different numbers of electrons can be lost, and successive oxidation states usually differ by one unit. Colour comes from d-d transitions: in a complex, the d orbitals split, and electrons absorb visible light to jump to a higher d level. Ions with d^0 or d^{10} configurations (e.g. Sc^{3+}, Zn^{2+}) have no d-d transition and are colourless.

Q15 What is lanthanoid contraction? State two consequences.

Ans. The steady decrease in atomic and ionic radii from La to Lu, caused by poor shielding of the nuclear charge by 4f electrons. Consequences:
(i) the second and third transition series have almost identical radii (Zr ≈ Hf), making their separation difficult;
(ii) the basic strength of the hydroxides decreases from $La(OH)_3$ to $Lu(OH)_3$.

Q16 Write the ionic equations for the oxidising action of acidified $K_2Cr_2O_7$ and $KMnO_4$ on Fe^{2+}.

Ans. $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$
$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

Coordination Compounds

Q17 Write the IUPAC names of
(i) $[Co(NH_3)_5Cl]Cl_2$ and
(ii) $K_3[Fe(CN)_6]$.

Ans. (i) Pentaamminechloridocobalt(III) chloride.
(ii) Potassium hexacyanidoferrate(III).

Q18 Explain why $[Fe(CN)_6]^{4-}$ is diamagnetic while $[CoF_6]^{3-}$ is paramagnetic, using Crystal Field Theory.

Ans. In $[Fe(CN)_6]^{4-}$ the metal is Fe^{2+} (d^6). CN^- is a strong-field ligand, so Δo > pairing energy and the electrons pair up: $t_{2g}^6\ e_g^0$ (low spin, 0 unpaired electrons, diamagnetic). In $[CoF_6]^{3-}$ the metal is Co^{3+} (d^6). F^- is a weak-field ligand, so Δo < pairing energy and the electrons occupy all orbitals singly first: $t_{2g}^4\ e_g^2$ (high spin, 4 unpaired electrons, paramagnetic).

Q19 What is linkage isomerism? Give an example.

Ans. It arises with ambidentate ligands, which can bind through two different donor atoms. Example: $[Co(NH_3)_5(NO_2)]^{2+}$ (bonded through N) and $[Co(NH_3)_5(ONO)]^{2+}$ (bonded through O).

Haloalkanes and Haloarenes

Q20 Distinguish between SN1 and SN2 mechanisms.

Ans. SN1 is a two-step reaction through a planar carbocation, shows first-order kinetics, gives racemisation, is favoured by tertiary substrates and polar protic solvents. SN2 is a single-step concerted reaction through a pentacoordinate transition state, shows second-order kinetics, gives inversion of configuration (Walden inversion), and is favoured by primary substrates and polar aprotic solvents.

Q21 Why is chlorobenzene less reactive than chloroethane towards nucleophilic substitution?

Ans. The lone pair on chlorine is in resonance with the benzene ring, giving the C–Cl bond partial double-bond character, so it is harder to break. In addition, the carbon is sp^2 hybridised (more electronegative than sp^3), which also shortens and strengthens the bond, and the incoming nucleophile is repelled by the electron-rich ring.

Alcohols, Phenols and Ethers

Q22 How can you distinguish primary, secondary and tertiary alcohols with the Lucas test? Why is phenol more acidic than ethanol?

Ans. Lucas reagent is anhydrous $ZnCl_2$ in conc. HCl. Tertiary alcohols give turbidity immediately, secondary alcohols in about 5 minutes, and primary alcohols show no turbidity at room temperature. Phenol is more acidic because the phenoxide ion is stabilised by resonance (the negative charge is delocalised over the ring), while the ethoxide ion is destabilised by the electron-donating ethyl group.

Q23 Why can't tert-butyl ethyl ether be made well by reacting sodium ethoxide with tert-butyl bromide? What should be used instead?

Ans. A tertiary alkyl halide undergoes elimination (E2) with the strongly basic ethoxide, giving isobutene rather than the ether. The correct pair is sodium *tert*-butoxide + bromoethane (a primary halide that undergoes SN2).

Aldehydes, Ketones and Carboxylic Acids

Q24 Distinguish between aldol condensation and Cannizzaro reaction.

Ans. Aldol condensation occurs with aldehydes and ketones that have at least one α-hydrogen, in the presence of dilute alkali; it gives β-hydroxy carbonyl compounds that dehydrate to α,β-unsaturated carbonyl compounds. The Cannizzaro reaction occurs with aldehydes that have **no** α-hydrogen (e.g. HCHO, C_6H_5CHO) in concentrated alkali: one molecule is oxidised to the carboxylate and another is reduced to the alcohol.

Q25 Give one chemical test each to distinguish
(i) propanal and propanone,
(ii) ethanal and propanal.

Ans. (i) Tollens' test: propanal gives a silver mirror; propanone does not.
(ii) Iodoform test: ethanal (a methyl ketone-type CH_3CO- group) gives a yellow precipitate of CHI_3 with I_2/NaOH; propanal does not.

Amines

Q26 Arrange ethylamine, diethylamine, triethylamine and ammonia in decreasing order of basic strength in aqueous solution and explain.

Ans. $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2 > NH_3$. The ethyl groups push electrons (+I effect) and make the lone pair more available. But in water, the stability of the conjugate acid depends on solvation through hydrogen bonding, and this decreases from primary to tertiary. The balance of +I effect and solvation puts the secondary amine on top.

Q27 Why does aniline not undergo Friedel–Crafts reaction? How is it distinguished from N-methylaniline?

Ans. Aniline is basic and forms a salt with the $AlCl_3$ catalyst, which puts a positive charge on nitrogen and strongly deactivates the ring. Use the Hinsberg test: aniline (primary) forms a sulphonamide soluble in alkali; *N*-methylaniline (secondary) forms one that is insoluble in alkali.

Biomolecules

Q28 What are reducing and non-reducing sugars? Give examples.

Ans. Sugars with a free aldehydic or ketonic (hemiacetal/hemiketal) group that can reduce Tollens' and Fehling's reagents are reducing (glucose, fructose, maltose, lactose). In sucrose, the glycosidic bond joins the anomeric carbons of glucose and fructose, so there is no free anomeric -OH, and sucrose is non-reducing.

Q29 What is denaturation of proteins? Compare DNA and RNA briefly.

Ans. Denaturation is the loss of the secondary and tertiary structure (and biological activity) of a protein on heating or a change of pH, with the primary structure intact (e.g. coagulation of egg white). DNA has deoxyribose and the bases A, G, C, T and is double-stranded. RNA has ribose and the bases A, G, C, U and is generally single-stranded.

Part B: Competency-Based Questions with Solutions

Case-Based Question 1 (4 marks)

Q1 (i) Why does galvanised iron remain protected even when scratched? (1)
(ii) Calculate E°cell for the cell formed by Zn and Fe. (1)
(iii) Why does tin-plated iron corrode faster when the tin layer is damaged? (2)

Ans. (i) Zinc is more reactive than iron (more negative E°), so in the scratched area zinc acts as the anode and corrodes in preference to iron. This is **sacrificial protection**.
(ii) $E°_{cell} = E°_{cathode} - E°_{anode} = (-0.44) - (-0.76) = \mathbf{0.32\ V}$.
(iii) Tin is less reactive than iron ($E°$ of −0.14 V is less negative than −0.44 V). When the coating is broken, iron becomes the anode and tin the cathode, so iron oxidises *faster* than it would alone.

Case-Based Question 2 (4 marks)

Q2 (i) Identify A, B, C and D. (2)
(ii) Name the reaction by which D is obtained from C. (1)
(iii) Why must the diazotisation be carried out at 273–278 K? (1)

Ans. (i) A = nitrobenzene ($C_6H_5NO_2$); B = aniline ($C_6H_5NH_2$), formed by reduction; C = benzenediazonium chloride ($C_6H_5N_2^+Cl^-$); D = benzonitrile (C_6H_5CN, formula C_7H_5N). The foul-smelling product is phenyl isocyanide, which confirms B as a primary amine (carbylamine test).
(ii) **Sandmeyer reaction** (using CuCN).
(iii) Benzenediazonium salts are unstable above about 278 K and decompose to phenol and N_2. A low temperature keeps the diazonium ion intact.

Assertion–Reason Questions (1 mark each)

Choose from:
(a) both A and R are true and R explains A;
(b) both are true but R does not explain A;
(c) A is true, R is false;
(d) A is false, R is true.

AR 1 **Assertion: Molar conductivity of a weak electrolyte rises sharply at high dilution.**
Reason: The degree of dissociation increases on dilution.

Ans. **Correct option: (a).** Both statements are true; the greater dissociation at high dilution explains the sharp rise in Λm.

AR 2 **Assertion: Phenol is more acidic than ethanol.**
Reason: The phenoxide ion is less resonance-stabilised than the ethoxide ion.

Ans. **Correct option: (c).** Assertion is true. Reason is false because it is the phenoxide ion that is stabilised by resonance, not the ethoxide ion.

AR 3 **Assertion: Zn, Cd and Hg are not considered typical transition elements.**
Reason: They have completely filled d^{10} configuration in the ground state and in their common oxidation states.

Ans. **Correct option: (a).** Both are true, and the d^{10} configuration explains why they do not behave as typical transition metals.

Part C: Model Questions (Practice Only)

These are practice questions written in the style of board papers. They are not predicted or guaranteed board questions.

M1 **[1 mark] The unit of the rate constant of a second-order reaction is:**
(a) s^{-1}
(b) mol L^{-1} s^{-1}
(c) L mol^{-1} s^{-1}
(d) L^2 mol^{-2} s^{-1}

Ans. **Correct option: (c).** For an nth-order reaction the unit is (mol L^{-1})^(1−n) s^{-1}. For n = 2: L mol^{-1} s^{-1}.

M2 **[1 mark] The number of unpaired electrons in $[Mn(H_2O)_6]^{2+}$ is:**
(a) 1
(b) 3
(c) 5
(d) 0

Ans. **Correct option: (c).** Mn^{2+} is d^5. H_2O is a weak-field ligand, so the complex is high spin, with all five electrons unpaired.

M3 **[2 marks] Calculate the emf of the cell Zn | Zn^{2+} (0.1 M) || Cu^{2+} (0.01 M) | Cu at 298 K. $E°_{cell}$ = 1.10 V.**

Ans. $E = E° - (0.0591/2)\ \log([Zn^{2+}]/[Cu^{2+}]) = 1.10 - 0.02955 \times \log(0.1/0.01) = 1.10 - 0.02955 \times \log 10 = 1.10 - 0.02955 \approx$ **1.07 V.**

M4 [2 marks] Give a chemical test to distinguish pentan-2-one from pentan-3-one.

Ans. Iodoform test. Pentan-2-one has a CH_3CO- group and gives a yellow precipitate of iodoform with I_2/NaOH. Pentan-3-one does not.

M5 [3 marks] The rate constant of a first-order reaction is $3.0 \times 10^{-3}\ s^{-1}$. How long will it take for 90% of the reactant to be consumed?

Ans. $t = (2.303/k)\ \log([R]_0/[R])$. For 90% consumption, $[R] = 0.1[R]_0$, so $\log 10 = 1$. $t = 2.303/(3.0 \times 10^{-3}) = 767.7\ s \approx$ **768 s** (about 12.8 minutes).

M6 [3 marks] Convert:
(a) benzoic acid to aniline;
(b) ethanenitrile to ethanamine;
(c) ethanol to ethanal.

Ans. (a) $C_6H_5COOH \rightarrow (SOCl_2)\ C_6H_5COCl \rightarrow (NH_3)\ C_6H_5CONH_2 \rightarrow (Br_2 + NaOH;$ Hofmann bromamide degradation) $C_6H_5NH_2$.
(b) $CH_3CN \rightarrow (H_2/Ni$ or $LiAlH_4)\ CH_3CH_2NH_2$.
(c) $CH_3CH_2OH \rightarrow$ (PCC, or Cu at 573 K) CH_3CHO.

M7 [3 marks] 2 g of a non-volatile solute dissolved in 100 g of benzene lowers the freezing point by 0.40 K. Calculate the molar mass of the solute. (K_f for benzene = 5.12 K kg/mol)

Ans. $\Delta T_f = K_f \times w_2 \times 1000 / (M_2 \times w_1)$, so $M_2 = (5.12 \times 2 \times 1000)/(0.40 \times 100) = 10240/40 =$ **256 g/mol**.

M8 [5 marks] (a) Why is Mn^{2+} more stable than Mn^{3+}, whereas Cr^{2+} is a strong reducing agent? (3)
(b) Draw the crystal-field splitting diagram for a d^4 ion in a weak-field octahedral field and state the number of unpaired electrons. (2)

Ans. (a) Mn^{2+} is d^5, a half-filled and exceptionally stable configuration, so Mn^{3+} (d^4) readily gains an electron ($E°\ Mn^{3+}/Mn^{2+}$ is about +1.57 V). Cr^{2+} is d^4 and readily loses an electron to become Cr^{3+} (d^3, t_2g^3, very stable), so it is a strong reducing agent ($E°\ Cr^{3+}/Cr^{2+}$ is about −0.41 V).
(b) With weak-field ligands, Δo is small, so the four electrons go $t_2g^3\ eg^1$ (high spin). Number of unpaired electrons = **4**.

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