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CBSE Class XII · Chemistry (043)

Sample Question Paper 4 · Session 2026-27

Time allowed: 3 hours **Maximum marks: 70**

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This is an original practice paper written to the official CBSE 2026-27 design; it is not issued by CBSE.

General instructions:

1. There are 33 questions in this question paper with internal choice.
2. Section A consists of 16 multiple-choice questions carrying 1 mark each.
3. Section B consists of 5 very short answer questions carrying 2 marks each.
4. Section C consists of 7 short answer questions carrying 3 marks each.
5. Section D consists of 2 case-based questions carrying 4 marks each.
6. Section E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

Section A

1.	Which 0.1 m aqueous solution has the lowest freezing point? (A) sugar (B) NaCl (C) urea (D) $CaCl_2$	1
2.	Which colligative property is most suitable for finding the molar mass of a protein? (A) elevation of boiling point (B) relative lowering of vapour pressure (C) osmotic pressure (D) depression of freezing point	1
3.	The relation between ΔG° and E°_{cell} is: (A) $\Delta G^\circ = nFE^\circ_{cell}$ (B) $\Delta G^\circ = -nFE^\circ_{cell}$ (C) $\Delta G^\circ = -E^\circ_{cell}/nF$ (D) $\Delta G^\circ = RT \ln E^\circ_{cell}$	1
4.	The rate constant of a reaction generally increases with: (A) an increase in temperature (B) an increase in concentration (C) time (D) a decrease in temperature	1
5.	Which of the following reactions is first order? (A) photochemical $H_2 + Cl_2 \rightarrow 2HCl$ (B) $2NO + O_2 \rightarrow 2NO_2$ (C) decomposition of N_2O_5 (D) $H_2 + I_2 \rightarrow 2HI$	1
6.	Which ion has the largest spin-only magnetic moment? (A) Zn^{2+} (B) Mn^{2+} (C) Cu^{2+} (D) Fe^{2+}	1

7.	The shape of $[Ni(CO)_4]$ is: (A) octahedral (B) linear (C) square planar (D) tetrahedral	1
8.	The oxidation state of iron in $K_4[Fe(CN)_6]$ is: (A) +2 (B) +3 (C) 0 (D) +4	1
9.	Which of these undergoes SN1 reaction most readily? (A) CH_3CH_2Cl (B) $C_6H_5CH_2Cl$ (C) $CH_2=CHCl$ (D) C_6H_5Cl	1
10.	Which of the following is the weakest acid? (A) phenol (B) water (C) ethanol (D) p-nitrophenol	1
11.	Aldehydes reduce Fehling's solution, giving a red precipitate of: (A) Cu_2O (B) CuO (C) $CuSO_4$ (D) Cu	1
12.	Which base is not present in RNA? (A) adenine (B) cytosine (C) uracil (D) thymine	1
13.	**Assertion (A):** The boiling point of 0.1 M NaCl solution is higher than that of 0.1 M glucose solution. **Reason (R):** NaCl dissociates into two ions in water. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1
14.	**Assertion (A):** Transition metals and their compounds are good catalysts. **Reason (R):** Transition metals have high melting points. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1
15.	**Assertion (A):** Phenol is less acidic than ethanol. **Reason (R):** The phenoxide ion is stabilised by resonance. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1

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16.	**Assertion (A):** Insulin is a protein hormone. **Reason (R):** All hormones are proteins. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1

Section B

17.	Find the molarity of a solution containing 5 g of NaOH in 450 mL of solution. **OR** Concentrated nitric acid is 68% HNO_3 by mass and has a density of 1.504 g mL^{-1}. Find its molarity.	2
18.	Define limiting molar conductivity. Why can it not be found by extrapolation for a weak electrolyte?	2
19.	Show that for a first-order reaction, the time required for 99.9% completion is about ten times the half-life.	2
20.	Find the spin-only magnetic moment of Fe^{2+} (Z = 26). Would its compounds be coloured?	2
21.	Write the IUPAC names of (i) $CH_3CH(Cl)CH(Br)CH_3$, (ii) $(CH_3)_3CCH_2Br$.	2

Section C

22.	The vapour pressure of benzene is 640 mm Hg. A non-volatile, non-electrolyte solute weighing 2.175 g is added to 39.0 g of benzene, and the vapour pressure becomes 600 mm Hg. Find the molar mass of the solute.	3
23.	How much charge, in faradays and coulombs, is needed for (i) 1 mol of $H_2O \rightarrow O_2$, (ii) 1 mol of $FeO \rightarrow Fe_2O_3$, (iii) 1 mol of $MnO_4^- \rightarrow Mn^{2+}$? **OR** Write the relation between conductivity, cell constant and resistance. A cell filled with 0.1 M KCl (κ = 1.29 S m^{-1}) has a resistance of 100 Ω. Find its cell constant.	3
24.	Derive the integrated rate equation for a zero-order reaction and sketch the graph of [R] against time. What is its slope?	3
25.	Explain: (i) Mn^{2+} is more stable than Fe^{2+} towards oxidation; (ii) Cu^{2+}(aq) is more stable than Cu^{+}(aq); (iii) Ce^{4+} is a good oxidising agent.	3
26.	Write the IUPAC names of (i) $[Co(en)_2Cl_2]^+$, (ii) $K_3[Fe(C_2O_4)_3]$, (iii) $[Pt(NH_3)_2Cl(NO_2)]$.	3
27.	Give reasons: (i) chlorobenzene has a smaller dipole moment than cyclohexyl chloride; (ii) haloalkanes give alkyl cyanides with KCN but isocyanides with AgCN; (iii) a racemic mixture is optically inactive.	3

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28.	Why does the Williamson synthesis of an ether fail with a tertiary alkyl halide? Give the best method to prepare 2-ethoxy-2-methylpropane (tert-butyl ethyl ether).	3

Section D

29.	**Case study.** According to Kohlrausch's law, the limiting molar conductivity of an electrolyte is the sum of the limiting ionic conductivities of its ions. At 298 K: $\lambda^\circ(H^+) = 349.6$, $\lambda^\circ(Na^+) = 50.1$, $\lambda^\circ(Cl^-) = 76.3$ and $\lambda^\circ(CH_3COO^-) = 40.9$ S cm² mol⁻¹. (i) Which ion has the highest limiting ionic conductivity? (A) Na^+ (B) Cl^- (C) H^+ (D) CH_3COO^- *[1]* (ii) Find Λ°_m for NaCl. *[1]* (iii) Λ°_m for CH_3COOH is 390.5 S cm² mol⁻¹. A 0.001 M solution has $\Lambda_m = 39.05$ S cm² mol⁻¹. Find its degree of dissociation. *[2]* **OR** (iii) Using the same data, find the dissociation constant of the acid. *[2]*	4
30.	**Case study.** A compound X (C_3H_6O) gives a silver mirror with Tollens' reagent but does not give the iodoform test. Its isomer Y gives the iodoform test but does not react with Tollens' reagent. (i) X is: (A) propanone (B) propanal (C) propan-1-ol (D) prop-2-en-1-ol *[1]* (ii) Identify Y. *[1]* (iii) Write the reaction of X with Tollens' reagent. *[2]* **OR** (iii) Write the iodoform reaction of Y. *[2]*	4

Section E

31.	(a) Write the Nernst equation for the electrode $Cu^{2+}(aq)/Cu(s)$ and find its potential when $[Cu^{2+}] = 0.01$ M ($E^\circ = 0.34$ V). (b) How is the sign of E°_{cell} related to the spontaneity of a reaction? (c) Explain two methods of preventing corrosion of iron. **OR** (a) State Kohlrausch's law of independent migration of ions and give two applications. (b) The molar conductivities at infinite dilution of NH_4Cl, NaOH and NaCl are 129.8, 217.4 and 108.9 S cm² mol⁻¹. Find Λ°_m for NH_4OH.	5

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32.	(a) State two postulates of Werner's theory of coordination compounds. (b) What is the spectrochemical series? (c) $[CoF_6]^{3-}$ is a high-spin complex. Give its IUPAC name, hybridisation and number of unpaired electrons. **OR** (a) Why does the carbonyl group of carboxylic acids not show the typical reactions of aldehydes and ketones? (b) How will you convert (i) toluene to benzoic acid, (ii) benzoic acid to benzaldehyde, (iii) ethanoic acid to methanamine?	5
33.	(a) Explain Gabriel phthalimide synthesis with equations. Why is it unsuitable for aromatic primary amines? (b) How does the Hinsberg test distinguish primary, secondary and tertiary amines? **OR** (a) Describe the primary, secondary, tertiary and quaternary structures of proteins. (b) What are essential amino acids? Name two.	5

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Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

Section A

1. **(D)** $CaCl_2$. *Working:* $CaCl_2$ gives the most particles (i = 3).

2. **(C)** osmotic pressure. *Working:* It is large enough to measure at room temperature, where proteins are stable.

3. **(B)** ΔG° = −nFE°cell. *Working:* A positive E° gives a negative ΔG°.

4. **(A)** an increase in temperature. *Working:* Arrhenius equation.

5. **(C)** decomposition of N_2O_5. *Working:* Rate = k[N_2O_5].

6. **(B)** Mn^{2+}. *Working:* Mn^{2+} ($3d^5$) has five unpaired electrons.

7. **(D)** tetrahedral. *Working:* sp^3 hybridisation.

8. **(A)** +2. *Working:* 4(+1) + x + 6(−1) = 0.

9. **(B)** $C_6H_5CH_2Cl$. *Working:* The benzyl carbocation is resonance-stabilised.

10. **(C)** ethanol. *Working:* Ethoxide is destabilised by the electron-releasing ethyl group.

11. **(A)** Cu_2O. *Working:* Cu^{2+} is reduced to copper(I) oxide.

12. **(D)** thymine. *Working:* RNA has uracil in place of thymine.

13. **(A)** Both A and R are true, and R is the correct explanation of A. *Working:* More particles give a larger elevation of boiling point.

14. **(B)** Both A and R are true, and R is not the correct explanation of A. *Working:* Both are true, but catalytic activity is due to variable oxidation states and surface adsorption.

15. **(D)** A is false but R is true. *Working:* A is false: phenol is more acidic, and R explains why.

16. **(C)** A is true but R is false. *Working:* A is true. R is false: steroid hormones such as testosterone are not proteins.

Section B

17. Moles = 5/40 = 0.125 (1). Molarity = 0.125/0.450 ≈ 0.278 M (1).

OR 1 L has mass 1504 g, of which 0.68 × 1504 = 1022.7 g is HNO_3 (1). Molarity = 1022.7/63 ≈ 16.2 M (1).

18. The molar conductivity when the concentration approaches zero (infinite dilution) (1). For a weak electrolyte Λ_m rises very steeply at low concentration, so the graph cannot be extrapolated reliably to c = 0 (1).

19. $t_{99.9\%} = \frac{2.303}{k}\log\frac{100}{0.1} = \frac{6.909}{k}$ (1). $t_{1/2} = \frac{0.693}{k}$, so the ratio is ≈ 10 (1).

20. Fe^{2+} is $3d^6$ with 4 unpaired electrons: $\mu = \sqrt{4 \times 6} \approx 4.90$ BM (1). Yes; partly filled d orbitals allow d–d transitions (1).

21. (i) 2-Bromo-3-chlorobutane (1). (ii) 1-Bromo-2,2-dimethylpropane (1).

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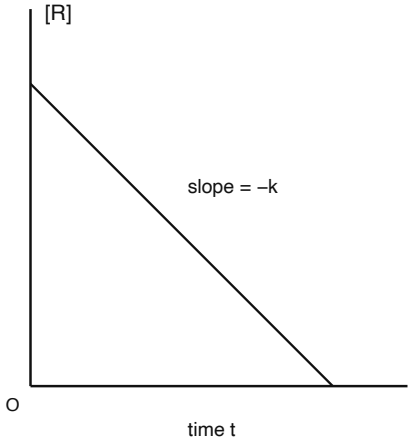
Section C

22. $\frac{p^\circ - p}{p^\circ} = \frac{n_2}{n_1}$ for dilute solutions (1). $\frac{40}{640} = \frac{2.175/M}{39/78}$ (1). M ≈ 69.6 g mol^{-1} (1).

23. (i) $H_2O \rightarrow ½O_2 + 2H^+ + 2e^-$: 2F = 1.93 × 10^5 C (1). (ii) $Fe^{2+} \rightarrow Fe^{3+}$: 1F = 96 500 C (1). (iii) Mn(+7) → Mn(+2): 5F = 4.825 × 10^5 C (1).

OR κ = G*/R, where G* = l/A is the cell constant (1). G* = κR (1) = 1.29 × 100 = 129 m^{-1} (1).

24. $-\frac{d[R]}{dt} = k$, so [R] = −kt + [R]$_0$ (1½). Graph (1):



A straight line with slope −k and intercept [R]$_0$ (½).

25. (i) Mn^{2+} has the stable half-filled 3d^5 configuration; Fe^{2+} (3d^6) becomes 3d^5 on oxidation (1). (ii) The much higher hydration enthalpy of Cu^{2+} more than makes up for the second ionisation enthalpy (1). (iii) The common, most stable oxidation state of lanthanoids is +3, so Ce^{4+} readily gains an electron (1).

26. (i) Dichloridobis(ethane-1,2-diamine)cobalt(III) ion (1). (ii) Potassium trioxalatoferrate(III) (1). (iii) Diamminechloridonitrito-N-platinum(II) (1).

27. (i) In chlorobenzene the C–Cl bond is shorter and less polar because of resonance, and the sp^2 carbon is more electronegative (1). (ii) KCN is ionic and the C end of CN^- attacks; AgCN is covalent, so the N lone pair attacks (1). (iii) It has equal amounts of the two enantiomers, whose rotations cancel (1).

28. The alkoxide is a strong base, so a tertiary halide undergoes elimination to an alkene instead of substitution (1½). Use sodium tert-butoxide and ethyl bromide: $(CH_3)_3CONa + C_2H_5Br \rightarrow (CH_3)_3COC_2H_5 + NaBr$ (1½).

Section D

29. (i) (C) H^+.
(ii) 50.1 + 76.3 = 126.4 S cm^2 mol^{-1}.
(iii) α = $\Lambda_m/\Lambda^\circ_m$ = 39.05/390.5 = 0.1. **OR** $K_a = \frac{c\alpha^2}{1-\alpha} = \frac{0.001 \times 0.01}{0.9} \approx 1.1 \times 10^{-5}$.

30. (i) (B) propanal, CH_3CH_2CHO.
(ii) Propanone, CH_3COCH_3.
(iii) $CH_3CH_2CHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow CH_3CH_2COO^- + 2Ag + 4NH_3 + 2H_2O$. **OR** $CH_3COCH_3 + 3I_2 + 4NaOH \rightarrow CHI_3$ (yellow) + $CH_3COONa + 3NaI + 3H_2O$.

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Section E

31. (a) $E = E^\circ - \frac{0.059}{2}\log\frac{1}{[Cu^{2+}]}$ (1) = 0.34 − 0.059 = 0.281 V (1). (b) ΔG° = −nFE°; a positive E° gives a negative ΔG°, so the reaction is spontaneous (1). (c) Any two: galvanising with zinc (sacrificial protection); painting or oiling to keep out air and moisture; connecting to a more reactive metal such as magnesium (2).

OR (a) The limiting molar conductivity of an electrolyte is the sum of the contributions of its anion and cation (1). Uses: finding Λ°_m of weak electrolytes; finding their degree of dissociation and dissociation constant (2). (b) $\Lambda^\circ(NH_4OH) = 129.8 + 217.4 - 108.9 = 238.3$ S cm² mol⁻¹ (2).

32. (a) Metals show primary (ionisable) and secondary (non-ionisable) valencies; secondary valencies are directed in space, giving definite geometry (2). (b) Ligands arranged in increasing order of crystal field splitting: $I^- < Br^- < Cl^- < F^- < OH^- < H_2O < NH_3 <$ en $< CN^- <$ CO (1). (c) Hexafluoridocobaltate(III) ion; sp^3d^2, outer orbital; 4 unpaired electrons (2).

OR (a) The carbonyl carbon is less electrophilic because the lone pair of –OH is delocalised onto it by resonance (2). (b) (i) Alkaline $KMnO_4$, then acid (1). (ii) $SOCl_2$ to benzoyl chloride, then Rosenmund reduction (1). (iii) Convert to ethanamide (via acid chloride + NH_3), then Hoffmann bromamide degradation (1).

33. (a) Phthalimide + ethanolic KOH gives potassium phthalimide, which with an alkyl halide gives N-alkylphthalimide; alkaline hydrolysis releases the primary amine (1½). Aryl halides do not undergo nucleophilic substitution with the phthalimide anion (½). (b) With benzenesulphonyl chloride: a primary amine gives a sulphonamide soluble in alkali; a secondary amine gives one insoluble in alkali; a tertiary amine does not react (3).

OR (a) Primary: sequence of amino acids; secondary: α-helix or β-pleated sheet held by hydrogen bonds; tertiary: overall folding of the chain; quaternary: arrangement of two or more polypeptide subunits (4). (b) Amino acids the body cannot make and must get from food, e.g. valine, leucine (1).

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