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Your JEE Guide

ISC Class XII · Chemistry Paper 1 (Theory)

Sample Question Paper 7 · Session 2026-27

Time allowed: 3 hours (plus 15 minutes reading time) **Maximum marks: 70**

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This is an original practice paper written to the CISCE 2027 specimen paper format; it is not issued by CISCE.

General instructions:

1. You are allowed an additional fifteen minutes for only reading the question paper. You must NOT start writing during the reading time.
2. The paper is divided into four sections and has twenty-one questions in all. Answer all questions.
3. Section A has fourteen subparts. Each subpart carries 1 mark.
4. While attempting Multiple Choice Questions in Section A, you are required to write only ONE option as the answer.
5. Section B has ten questions of 2 marks each. Section C has seven questions of 3 marks each. Section D has three questions of 5 marks each.
6. Internal choices have been provided in two questions each in Sections B, C and D.
7. The intended marks for questions are given in brackets [ ].
8. Balanced equations must be given wherever possible and diagrams where they are helpful. When solving numerical problems, all essential working must be shown.
9. Use: R = 1.987 cal K^{-1} mol^{-1} = 8.314 J K^{-1} mol^{-1} = 0.0821 dm^3 atm K^{-1} mol^{-1}; 1 L atm = 101.3 J; 1 faraday = 96500 C; Avogadro's number = 6.023×10^{23}.

Section A (14 marks)

1.	**(i)** *(A) Fill in the blanks by choosing the appropriate word(s) from those given in the brackets:* [Hell–Volhard–Zelinsky, Rosenmund, Sandmeyer, aldol, Cannizzaro, glycosidic, peptide, hydrogen, primary, secondary, tertiary, increases, decreases] Carboxylic acids with an α-hydrogen are halogenated at the α-carbon by chlorine and red phosphorus in the _____ reaction, while two molecules of ethanal join in dilute alkali in an _____ reaction.	1
	(ii) In carbohydrates the sugar units are joined by _____ linkages, while in proteins the amino acids are joined by _____ bonds.	1
	(iii) The sequence of amino acids in a protein is its _____ structure, while the α-helix is an example of its _____ structure.	1
	(iv) On dilution, the molar conductivity of an electrolyte _____, while its conductivity _____.	1

	(v) *(B) Select and write the correct alternative from the choices given below.* An aqueous solution of urea freezes at –0.186 °C. Its molality is (K_f = 1.86 K kg mol^{-1}): (a) 0.010 mol kg^{-1} (b) 0.10 mol kg^{-1} (c) 1.0 mol kg^{-1} (d) 0.186 mol kg^{-1}	1
	(vi) Which of these metals cannot be obtained by electrolysis of an aqueous solution of its salt? (a) sodium (b) silver (c) copper (d) nickel	1
	(vii) For most reactions, the ratio of rate constants for a 10 K rise in temperature (the temperature coefficient) lies between: (a) 5 and 10 (b) 10 and 20 (c) 2 and 3 (d) 0 and 1	1
	(viii) The coordination number of cobalt in $[Co(en)_2Cl_2]^+$ is: (a) 2 (b) 3 (c) 4 (d) 6	1
	(ix) Which of the following is the strongest acid? (a) CH_3COOH (b) $CHCl_2COOH$ (c) CCl_3COOH (d) $CH_2ClCOOH$	1
	(x) Given below are two statements marked Assertion and Reason. Select the correct option. **Assertion:** Acetylation of aniline reduces the activating effect of the $–NH_2$ group. **Reason:** In acetanilide the lone pair on nitrogen is also delocalised towards the carbonyl oxygen of the acetyl group. (a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion. (c) Assertion is true and Reason is false. (d) Both Assertion and Reason are false.	1
	(xi) Given below are two statements marked Assertion and Reason. Select the correct option. **Assertion:** The boiling point of a solvent rises when a non-volatile solute is dissolved in it. **Reason:** The solute increases the vapour pressure of the solvent. (a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion. (c) Assertion is true and Reason is false. (d) Both Assertion and Reason are false.	1

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	(xii) *(C) Read the passage carefully and answer the questions that follow.* Vitamins are organic compounds needed in small amounts for normal growth and health. Vitamins A, D, E and K are soluble in fats and oils; they are stored in the liver and in fatty tissue. The B-group vitamins and vitamin C dissolve in water. Any excess is passed out in urine and cannot be stored, so they must be taken regularly in the diet; vitamin B_{12} is an exception, as it can be stored in the liver. A shortage of a vitamin leads to a deficiency disease: for example, lack of vitamin B_1 (thiamine) causes beriberi, and lack of vitamin B_6 can cause convulsions. Why must water-soluble vitamins be taken regularly in the diet?	1
	(xiii) Which water-soluble vitamin can be stored in the liver?	1
	(xiv) Name the disease caused by a deficiency of vitamin B_1.	1

Section B (20 marks)

2.	Liquids A and B boil at 145 °C and 190 °C respectively. (i) Which has the higher vapour pressure at 80 °C? (ii) In the vapour above an ideal solution of A and B, which component is present in a larger proportion than in the liquid? **OR** 15 g of ethanol (C_2H_5OH) is dissolved in 60 g of water. Calculate the mass percentage and the mole fraction of ethanol.	2
3.	Can copper(II) sulphate solution be stored in a zinc vessel? Explain using standard electrode potentials. ($E°(Zn^{2+}/Zn) = -0.76$ V, $E°(Cu^{2+}/Cu) = +0.34$ V)	2
4.	Calculate the half-life of first-order reactions with rate constants (i) 0.0693 s^{-1}, (ii) 4.62×10^{-2} h^{-1}.	2
5.	Describe the colour changes when (i) acidified $KMnO_4$, (ii) acidified $K_2Cr_2O_7$ is used as an oxidising agent. Write the change in oxidation state of the metal in each.	2
6.	How many geometrical isomers does $[Co(NH_3)_4Cl_2]^+$ have? Describe them. Is either optically active?	2
7.	What is formed when bromoethane is treated with (i) $AgNO_2$, (ii) KNO_2? Why do the two products differ? **OR** Write the products of: (i) 1-bromopropane with NaI in dry acetone, (ii) benzenediazonium chloride with KI.	2
8.	Give reasons: (i) Ethanol dissolves in water, but chloroethane is only slightly soluble. (ii) Sodium metal can be used to distinguish ethanol from diethyl ether.	2
9.	Why are the α-hydrogens of aldehydes and ketones acidic? Give an example of a cross aldol condensation.	2

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10.	Write the IUPAC names of (i) $(CH_3)_2CHNH_2$, (ii) $C_6H_5NHCH_3$.	2
11.	Name the products of complete hydrolysis of (i) lactose, (ii) maltose.	2

Section C (21 marks)

12.	The freezing point of a 0.10 m aqueous solution of acetic acid is –0.19 °C. Calculate (a) the van't Hoff factor, (b) the degree of dissociation of acetic acid, (c) its dissociation constant. (K_f = 1.86 K kg mol^{-1}; take molality ≈ molarity)	3
13.	Silver nitrate and copper(II) sulphate solutions are connected in series and the same current is passed until 1.08 g of silver is deposited. Calculate (a) the charge passed, (b) the mass of copper deposited, (c) the time taken with a current of 0.50 A. (Ag = 108, Cu = 63.5)	3
14.	The gas-phase reaction A(g) → B(g) + C(g) is first order. In a closed vessel the initial pressure of A is 0.40 atm; after 10 minutes the total pressure is 0.60 atm. Calculate (a) the rate constant, (b) the total pressure after 20 minutes. **OR** State three differences between the rate of a reaction and its rate constant.	3
15.	(i) Give the oxidation states of manganese in MnO, MnO_2 and Mn_2O_7, and state how the acidic character of the oxides changes. (ii) CrO is basic, Cr_2O_3 is amphoteric and CrO_3 is acidic. Explain. (iii) Name a transition metal oxide used as a catalyst in the Contact process.	3
16.	Describe the bonding in $[Fe(CO)_5]$: the oxidation state of iron, its hybridisation, the shape of the molecule and its magnetic behaviour. **OR** How does a double salt differ from a coordination compound? Explain with Mohr's salt, $FeSO_4·(NH_4)_2SO_4·6H_2O$, and potassium ferrocyanide, $K_4[Fe(CN)_6]$, as examples.	3
17.	Give one chemical test each to distinguish: (i) ethanol from methanol, (ii) phenol from benzoic acid, (iii) aniline from ethanamine.	3
18.	(i) Which bases pair in the DNA double helix, and how many hydrogen bonds hold each pair? (ii) Why is DNA described as "deoxy"? (iii) What happens to the two strands during replication?	3

Section D (15 marks)

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19.	An aromatic compound A (C_7H_7Cl) is obtained from toluene. With aqueous KOH it gives B (C_7H_8O). Mild oxidation of B gives C (C_7H_6O), which with concentrated NaOH gives B together with D. C adds HCN to give E. (a) Identify A, B, C, D and E. *[2½]* (b) Write the equations for A → B and C → B + D. *[1½]* (c) How is A obtained from toluene? *[1]* **OR** (a) Write the equations for the preparation of benzoic acid from (i) toluene, (ii) phenylmagnesium bromide. *[2]* (b) Why does formic acid reduce Tollens' reagent? *[1]* (c) How is benzoic acid converted to m-nitrobenzoic acid? *[1]* (d) Why is p-nitrobenzoic acid a stronger acid than benzoic acid? *[1]*	5
20.	(a) Write the IUPAC name of $[Pt(NH_3)_4Cl_2][PtCl_4]$. *[1]* (b) Calculate the crystal field stabilisation energy, in terms of Δ_0, of a d^6 ion in (i) a strong octahedral field, (ii) a weak octahedral field, ignoring pairing energy. *[2]* (c) Write the formula of potassium hexacyanidoferrate(III) and its spin-only magnetic moment. *[1]* (d) Name the metal present in (i) chlorophyll, (ii) haemoglobin. *[1]*	5
21.	(a) Show that the relative lowering of vapour pressure of a dilute solution is related to the molar mass M_2 of the solute by $\frac{p^\circ - p}{p^\circ} = \frac{w_2 M_1}{M_2 w_1}$. *[2]* (b) 18 g of glucose (180 g mol^{-1}) is dissolved in 81 g of water at 298 K, where the vapour pressure of water is 3.17 kPa. Calculate the vapour pressure of the solution. *[2]* (c) Why is relative lowering of vapour pressure a colligative property? *[1]* **OR** (a) Show that for a first-order reaction $[R] = [R]_0 e^{-kt}$, and sketch the graph of ln[R] against t. *[2]* (b) A reaction is 50% complete in 20 minutes at 300 K and in 5 minutes at 320 K. Calculate its activation energy. (R = 8.314 J K^{-1} mol^{-1}) *[2]* (c) What would be the effect of temperature on the rate constant if the activation energy were zero? *[1]*	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 (14 marks)

Question 1

(i) Hell–Volhard–Zelinsky; aldol.

(ii) glycosidic; peptide.

(iii) primary; secondary.

(iv) increases; decreases.

(v) **(b)** 0.10 mol kg^{-1}. *Working:* $m = \Delta T_f / K_f = 0.186/1.86$.

(vi) **(a)** sodium. *Working:* Water is reduced in preference to Na^+, giving hydrogen at the cathode.

(vii) **(c)** 2 and 3. *Working:* The rate roughly doubles or triples for a 10 K rise.

(viii) **(d)** 6. *Working:* Each en binds through two N atoms (4) and there are two Cl^- ligands (2).

(ix) **(c)** CCl_3COOH. *Working:* Three electron-withdrawing Cl atoms stabilise the carboxylate ion most.

(x) **(a)** Both Assertion and Reason are true, and Reason is the correct explanation for Assertion. *Working:* Less of the lone pair is available to the ring, so the ring is less activated.

(xi) **(c)** Assertion is true and Reason is false. *Working:* The solute lowers the vapour pressure, so a higher temperature is needed for it to reach atmospheric pressure.

(xii) They are not stored in the body; any excess is passed out in urine.

(xiii) Vitamin B_{12}.

(xiv) Beriberi.

Section B (20 marks)

2. (i) A: the liquid with the lower boiling point is the more volatile (1). (ii) A, the more volatile component, is richer in the vapour (1).

OR Mass % = 15/75 × 100 = 20% (1). Moles: ethanol 15/46 = 0.326, water 60/18 = 3.33; x(ethanol) = 0.326/3.66 = 0.089 (1).

3. No (½). For $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, $E^\circ = 0.34 - (-0.76) = +1.10$ V; it is positive, so zinc would dissolve and copper be deposited (1½).

4. (i) $t_{½} = 0.693/0.0693 = 10$ s (1). (ii) $0.693/0.0462 = 15$ h (1).

5. (i) Purple to colourless; Mn from +7 to +2 (1). (ii) Orange to green; Cr from +6 to +3 (1).

6. Two: cis, with the two Cl^- ligands adjacent (90°), and trans, with them opposite (180°) (1½). Neither is optically active; both have planes of symmetry (½).

7. (i) Nitroethane, $C_2H_5NO_2$ (Ag–O bond is covalent, so nitrogen attacks) (½). (ii) Ethyl nitrite, C_2H_5–O–N=O (½). NO_2^- is ambident: the free ion from KNO_2 attacks through oxygen, while in

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$AgNO_2$ the oxygen is bonded to silver and the attack is through nitrogen (1).

OR (i) $CH_3CH_2CH_2I$ + NaBr (Finkelstein reaction) (1). (ii) $C_6H_5I + N_2 + KCl$ (1).

8. (i) Ethanol forms hydrogen bonds with water molecules; chloroethane cannot (1). (ii) Ethanol has an O–H group and gives off hydrogen with sodium; diethyl ether has none and does not react (1).

9. The carbanion (enolate) formed when an α-hydrogen is removed is stabilised by resonance with the carbonyl group (1). $C_6H_5CHO + CH_3CHO \rightarrow$ (dil. NaOH) $C_6H_5CH{=}CHCHO + H_2O$ (cinnamaldehyde) (1).

10. (i) Propan-2-amine (1). (ii) N-Methylbenzenamine (N-methylaniline) (1).

11. (i) D-glucose and D-galactose (1). (ii) Two molecules of D-glucose (1).

Section C (21 marks)

12. (a) $i = 0.19/(1.86 \times 0.10) = 1.02$ (1). (b) For $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$, $i = 1 + \alpha$, so $\alpha \approx 0.02$ (2%) (1). (c) $K_a = c\alpha^2/(1 - \alpha) = 0.10 \times (0.0215)^2/0.98 \approx 4.7 \times 10^{-5}$ (1).

13. (a) 1.08 g Ag = 0.010 mol, so 0.010 F = 965 C (1). (b) 0.010 F deposits 0.0050 mol Cu = 0.318 g (1). (c) $t = 965/0.50 = 1930$ s (1).

14. If A falls by x, the total is $0.40 + x = 0.60$, so $x = 0.20$ and $p_A = 0.20$ atm (1). This is one half-life, so $k = 0.693/10 = 0.0693\ min^{-1}$ (1). (b) After 20 min $p_A = 0.10$ atm, so $x = 0.30$ and the total is 0.70 atm (1).

OR The rate is the change in concentration per unit time, while k is the rate when all reactant concentrations are unity (1). The rate changes as the reaction proceeds; k is constant at a given temperature (1). The unit of rate is always $mol\ L^{-1}\ s^{-1}$; the unit of k depends on the order (1).

15. (i) +2, +4, +7; acidic character increases with oxidation state (1). (ii) In higher oxidation states the metal–oxygen bonds become more covalent and the oxides behave as acid anhydrides (1). (iii) Vanadium(V) oxide, V_2O_5 (1).

16. Iron is in the 0 oxidation state ($3d^6 4s^2$); the electrons are paired into four 3d orbitals by the strong ligand CO (1). One 3d, the 4s and three 4p orbitals give dsp^3 hybridisation: trigonal bipyramidal (1). No unpaired electrons, so it is diamagnetic (1).

OR A double salt dissociates completely into its simple ions in water; a coordination compound keeps its complex ion (1). Mohr's salt gives the tests of Fe^{2+}, NH_4^+ and SO_4^{2-} (1). $K_4[Fe(CN)_6]$ gives K^+ and $[Fe(CN)_6]^{4-}$ but no test for free Fe^{2+} or CN^- (1).

17. (i) Iodoform test: ethanol gives a yellow precipitate, methanol does not (1). (ii) Sodium hydrogencarbonate: benzoic acid gives brisk effervescence of CO_2, phenol does not (1). (iii) Treat with $NaNO_2$/HCl at 273–278 K and then alkaline β-naphthol: aniline gives an orange-red dye; ethanamine gives nitrogen gas and no dye (1).

18. (i) Adenine with thymine (two hydrogen bonds); guanine with cytosine (three) (1). (ii) Its sugar, 2-deoxyribose, lacks an oxygen at C2 compared with ribose (1). (iii) The strands separate and each acts as a template for a new complementary strand (1).

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Section D (15 marks)

19. (a) A: benzyl chloride, $C_6H_5CH_2Cl$; B: benzyl alcohol; C: benzaldehyde; D: sodium benzoate; E: $C_6H_5CH(OH)CN$, benzaldehyde cyanohydrin (½ each). (b) $C_6H_5CH_2Cl + KOH(aq) \rightarrow C_6H_5CH_2OH + KCl$ (½); $2C_6H_5CHO + NaOH \rightarrow C_6H_5CH_2OH + C_6H_5COONa$ (Cannizzaro) (1). (c) Chlorine is passed into boiling toluene in sunlight (side-chain substitution) (1).

OR (a) (i) $C_6H_5CH_3 \rightarrow$ (alkaline $KMnO_4$, then H^+) C_6H_5COOH (1). (ii) $C_6H_5MgBr + CO_2 \rightarrow C_6H_5COOMgBr \rightarrow (H_3O^+)\ C_6H_5COOH$ (1). (b) It contains an aldehyde (H–C=O) group as well as –COOH (1). (c) Nitration with concentrated HNO_3 and H_2SO_4; –COOH directs to the meta position (1). (d) The electron-withdrawing $–NO_2$ group stabilises the carboxylate ion (1).

20. (a) Tetraamminedichloridoplatinum(IV) tetrachloridoplatinate(II) (1). (b) (i) t_2g^6: $6 \times (–0.4\Delta_0) = –2.4\Delta_0$ (1). (ii) $t_2g^4e_g^2$: $4(–0.4\Delta_0) + 2(0.6\Delta_0) = –0.4\Delta_0$ (1). (c) $K_3[Fe(CN)_6]$; one unpaired electron, 1.73 BM (1). (d) Magnesium; iron (1).

21. (a) By Raoult's law $\frac{p^\circ - p}{p^\circ} = x_2 = \frac{n_2}{n_1 + n_2}$ (1); for a dilute solution $n_2 \ll n_1$, so $x_2 \approx \frac{n_2}{n_1} = \frac{w_2/M_2}{w_1/M_1}$ (1). (b) n(glucose) = 0.10, n(water) = 4.5; x(water) = 4.5/4.6 = 0.978 (1); p = 0.978 × 3.17 = 3.10 kPa (1). (c) It depends only on the mole fraction (number) of solute particles, not on their nature (1).

OR (a) $–d[R]/dt = k[R]$; integrating, $\ln[R] = \ln[R]_0 – kt$, so $[R] = [R]_0e^{–kt}$; the graph is a straight line of slope –k and intercept $\ln[R]_0$ (2). (b) The rate constant rises four times ($k \propto 1/t_{½}$) (½); $\log 4 = \frac{E_a}{2.303R} \cdot \frac{20}{300 \times 320}$ gives $E_a \approx 5.5 \times 10^4$ J mol^{-1} = 55 kJ mol^{-1} (1½). (c) None: k = A at all temperatures (1).

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