Directorate of Education, GNCT of Delhi
Questions From CBSE Question Papers
Session 2025-2026
CLASS – XII
Chemistry (CODE :043)

Chapter 1
Solutions

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	In case of association, abnormal molar mass of solute will (A) Increase (B) decrease (C) remain same (D) first increase and then decrease	CBSE 2025
Value points	(A)	1
2	An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because ____ (A) it gains water due to osmosis (B) it loses water due to reverse osmosis (C) it gains water due to reverse osmosis (D) it loses water due to osmosis	CBSE 2025
Value points	(D)	1
3	The value of KH at 298 K for Ar(g), CO_2(g), HCHO(g) and CH_4(g) are 40.32, 1.68, 1.84 x 10^{-5} and 0 416 kbar respectively. When these gases are arranged in increasing order of solubility, the correct order is : (A) HCHO < CH_4 < CO_2 < Ar (B) HCHO < CO_2 < CH_4 < Ar (C) Ar < CO_2 < CH_4 < HCHO (D) Ar < CH_4 < CO_2 < HCHO	CBSE COMPTT. 2025
Value points	(C)	1
4	A compound $CaCl_2$. $6H_2O$ undergoes complete dissociation in water. The Van't Hoff factor (i) is : (A) 9 (B) 6 (C) 4 (D) 3	CBSE COMPTT. 2025
Value points	(D)	1
5	An azeotropic mixture of two liquids has a boiling point higher than that of either of the two liquids when it (A) obeys Raoult's law. (B) shows positive deviation from Raoult's law. (C) shows negative deviation from Raoult's law.	CBSE 2025 (Visually impaired students)

	(D) obeys Henry's law.	
Value points	(C)	**1**
6	Solubility of gases in liquid decreases with increase in (A) pressure (B) volume (C) number of solute particles (D) temperature	**CBSE 2025 (Visually impaired students)**
Value points	(D)	**1**
7	Isotonic solutions have the same (A) density (B) refractive index (C) osmotic pressure (D) volume	**CBSE 2024**
Value points	(C)	**1**
8	Van't Hoff factor for $Na_2SO_4.10H_2O$ solution, assuming complete ionization is (A) 1 (B) 3 (C) 13 (D) 2	**CBSE 2024**
Value points	(B)	**1**
9	Low concentration of oxygen in the blood and tissues of people living at high altitudes is due to : (A) Low temperature (B) Low atmospheric pressure (C) High atmospheric pressure (D) High temperature	**CBSE 2024 (Visually impaired students)**
Value points	(B)	**1**
	For following question, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
1	**Assertion (A) :** When NaCl is added to water, a depression in freezing point is observed. **Reason (R) :** The lowering of vapour pressure of a solution causes depression in the freezing point.	**CBSE 2024 (Visually impaired students)**
Value points	(A)	**1**

	Short answers type questions with Value Points (2 marks)	
1	Give reasons: (a) Cooking is faster in pressure cooker than in an open pan. (b) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution ? What change in temperature would you observe after mixing liquids X and Y?	**CBSE 2025**
Value points	(a) Due to high pressure inside the pressure cooker, higher is the boiling point and faster is the cooking. (b) Negative deviation, Temperature increases.	**1** **1**
2	Define Azeotrope. What type of Azeotrope is formed by negative deviation from Raoult's law? Give an example.	**CBSE 2025**
Value points	Same composition in liquid and in vapour phase and boil at a constant temperature. Maximum Boiling Azeotrope 68% HNO_3 + 32% H_2O	**1** **½+ ½**
	Short answers type questions with Value Points (3 marks)	
1	A solution of glucose (molar mass = 180 g mol^{-1}) in water has a boiling point of 100.20 ^{O}C. Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are 1.86 K kg mol^{-1} and 0.512 K kg mol^{-1} respectively.	**CBSE 2025**
Value points	T_b of glucose solution = 100.20°C $\Delta Tb = Tb - T^ob$ $= 100.20\ ^oC - 100\ ^oC = 0.20\ ^oC$ or 0.20 K $\triangle Tb = Kb.m$ $m = \frac{0.20}{0.512} = 0.390$ mol/kg $\Delta T_f = K_f . m$ $\Delta T_f = 1.86$ K kg/mol × 0.390 mol/kg $\Delta T_f = 0.725$ K Freezing point of solution = 273.15 – 0.725 = 272.425 K	**1** **1** **½** **½**
2	Calculate elevation of the boiling point of the solution when 4 g of $MgSO_4$ (molar mass = 120 g/mol) was dissolved in 100 g of water, assuming $MgSO_4$ undergoes complete ionisation. (K_b for water = 0.52 K kg mol^{-1})	**CBSE COMPTT. 2024**
Value points	a)i=2 $\Delta T_b = \frac{i \times K_b \times w_B \times 1000}{M_B \times w_A}$ $= \frac{2 \times 0.52 \times 4 \times 1000}{120 \times 100}$ = 0.34K $\Delta T_b = T_b - T^o_b$ $0.34 = T_b - 373.15$ $T_b = 373.49$ K	**½** **½** **½** **½** **1**

	Case based questions with Value Points (4 marks)	
1	The cause for deviation from Raoult's law in the colligative properties of non-ideal solutions lie in the nature of interactions at the molecular level. These properties show deviations from Raoult's law due to difference in interactions between solute – solvent, solute – solute and solvent – solvent. Some liquids on mixing, form azeotropes which are binary mixtures having the same composition in liquid and vapour phase and boil at a constant temperature. In such cases, it is not possible to separate the components by fractional distillation. There are two types of azeotropes called minimum boiling azeotrope and maximum boiling azeotrope. Answer the following questions : (a) Pure ethanol cannot be prepared by fractional distillation of ethanol – water mixture. Comment. (b) Why does a mixture of chloroform and acetone show deviation from ideal behaviour ? (c) (i) The vapour pressure of pure benzene at a certain temperature is 1.25 atm. When 1.2 g of non-volatile, non-electrolyte solute is added to 60 g of benzene (M = 78 g mol–1), the vapour pressure of the solution becomes 1.237 atm. Calculate the molar mass of the non-volatile solute. **OR** (c) (ii) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is 2.53 K kg mol^{-1}.	**CBSE COMPTT. 2024**
Value points	(a) Ethanol-water forms azeotropic mixture. (b) Due to the formation of hydrogen bond between chloroform and acetone. (c) (i) $\frac{P^0-P}{P^0} = x_2 = \frac{w_2}{M_2} \times \frac{M_1}{w_1}$ $\frac{1.25-1.237}{1.25} = \frac{1.2}{M_2} \times \frac{78}{60}$ $M_2 = \frac{1.2}{M_2} \times \frac{78}{60} \times \frac{1.25}{0.013}$ $M_2 = 150 \text{ g mol}^{-1}$ (c) (ii) The elevation (ΔT_b) in the boiling point = 354.11 K – 353. 23 K = 0.88 K $M_2 = \frac{2.53 \text{ K kg mol}^{-1} \times 1.8 \text{ g} \times 1000 \text{ g kg}^{-1}}{0.88 \text{ K} \times 90 \text{ g}}$ M_2 = 57.5 g mol-1≈ 58 g mol^{-1}	**1** **1** ½ ½ ½ ½ **1** **1**
	Long answer type questions with Value Points (5 marks)	
1	(i) Define osmotic pressure. Why is it considered as a colligative property ? (ii) The vapour pressure of two pure liquids A and B at 400 K are 450 and 700 mmHg respectively. Find out the composition of liquid mixture if the total vapour pressure of mixture is 600 mmHg.	**CBSE COMPTT. 2025**
Value points	(i) The extra pressure applied on the solution side, which just stops the flow of solvent across the semipermeable membrane.	**1**

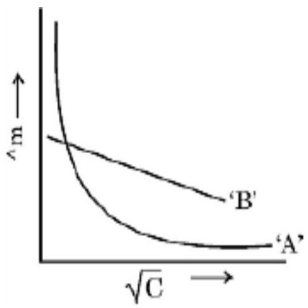
	Because it depends on concentration or the number of moles of solute particles. (ii) $P_t = P_A^\circ x_A + P_B^\circ x_B$ $P_t = P_A^\circ (1 - x_B) + P_B^\circ x_B$ $600 = 450 (1 - x_B) + 700 x_B$ $x_B = 0.6$ $x_A = 1 - x_B$ $x_A = 0.4$	**1** **1** **1** **1**
2	(i) What type of deviation from Raoult's law is expected when phenol and aniline are mixed with each other ? What change in the net volume of the mixture and enthalpy is expected ? (ii) Boiling point of water at 750 mmHg is 99.48◦C. How much sucrose (M = 342 g mol $^{-1}$ is to be added to 500 g of water such that it boils at 100◦C ? [Kb for water = 0 52 K kg mol–1]	**CBSE COMPTT. 2025**
Value points	(i) Negative deviation Volume of the mixture decreases ΔH = -ve. (ii) $\Delta T_b = 100 - 99.48 = 0.52$ $\Delta T_b = K_b \cdot m$ $0.52 = 0.52\ X \frac{W_B}{M_B} \times \frac{1000}{W_A}$ $W_B = \frac{342}{1000} \times \frac{500}{1}$ $= 171$ g.	**1** **½+½** **1** **1** **1**
3	(a) Calculate the boiling point of solution when 6 g of $MgSO_4$ (Molar mass = 120 g mol^{-1}) was dissolved in 200 g of water, assuming the complete dissociation of $MgSO_4$. (K_b for water = 0.52 K kg mol^{-1}). (b) State Raoult's law for a solution containing volatile components. How Raoult's law is a special case of Henry's law ?	**CBSE 2025 (Visually impaired students)**
Value points	a)i=2 $\Delta T_b = \frac{i \times K_b \times w_B \times 1000}{M_B \times w_A}$ $= \frac{2 \times 0.52 \times 6 \times 1000}{120 \times 200}$ $= 0.26K$ $\Delta T_b = T_b - T^o_b$ $0.26 = T_b - 373.15$ $T_b = 373.41$ K **OR** $0.26 = T_b - 100^oC$ $T_b = 100.26$ oC b)	**½** **½** **1** **1**

	• For a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. • $p = p^0 x$; $p = K_H x$ When $p^0 = K_H$ p α c for both.	**1** **1**
4	(a) The freezing point of a solution containing 5 g of benzoic acid (Molar mass = 122 g mol^{-1}) in 35 g of benzene is depressed by 2.94 K. Calculate the percentage association of benzoic acid if forms a dimer in solution. (K_f for benzene = 4.9 K kg mol^{-1}) (b) Define the following terms : (i) Ideal Solution (ii) Osmotic Pressure	**CBSE 2025 (Visually impaired students)**
Value points	a) $\Delta T_f = \frac{i \times K_f \times w_B \times 1000}{M_B \times w_A}$ $2.94 = \frac{i \times 4.9 \times 5 \times 1000}{122 \times 35}$ $i = \frac{2.94 \times 122 \times 35}{4.9 \times 5 \times 1000}$ i= 0.512 $\alpha = \frac{i-1}{1/n - 1}$ $= \frac{0.512-1}{½ - 1}$ = 0.976 α (%) = 97.6% b)i) The solutions which obey Raoult's law over the entire range of concentration. ii) Extra(excess) pressure which needs to be applied to a solution to stop the flow of solvent across a semipermeable membrane.	½ ½ ½ ½ **1** **1** **1**
5	**(i)** Ishan's automobile radiator is filled with 1.0 kg of water. How many grams of ethylene glycol (Molar mass = 62 g mol^{-1})must Ishan add to get the freezing point of the solution lowered to – 2.8 °C. (K_f for water is 1.86 K $kg.mol^{-1}$). **(ii)** What type of deviation from Raoult's law is shown by ethanol and acetone mixture? Give reason.	**CBSE 2024**
Value points	(i) ΔT_f=2.8◦C $\Delta T_f = K_f x\ w_B / M_B x\ W_A$ (kg) $2.8 = 1.86 x\ w_B / 62 x\ 1$ w_B= (2.8x62)/1.86 w_B= 93.33 g (ii) Positive deviation Interaction between ethanol-ethanol is stronger than ethanol- acetone	 **1** **1** **1** **1** **1**
6	**(i)** Boiling point of water at 750 mm Hg pressure is 99.68 °C. How much sucrose (Molar mass = 342 g mol^{-1}) is to be added to 500 g of water such that it boils at 100 °C ? (K_b for water = 0.52 K kg mol^{-1}). **(ii)** State Henry's law and write its any one application.	**CBSE 2024**

Value points	(i) ΔT_b =100-99.68◦C = 0.32◦C $\Delta T_b = K_b \times w_B / M_B \times W_A$ (kg) $0.32 = 0.52 \times w_B \times 1000 / 342 \times 500$ $w_B = 0.32 \times 342 / 0.52 \times 2 = 105.23$ g (ii) At a constant temperature, the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas present above the surface of liquid or solution/ The partial pressure of the gas in vapour phas (p) is proportional to the mole fraction of the gas (c) in the solution. **Application:** To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.	 **1** **1** **1** **1** **1**

Chapter 2
Electrochemistry

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	Standard electrode potential for Sn^{4+}/Sn^{2+} couple is +0.15 V and that for the Cr^{3+}/Cr couple is —0.74 V. The two couples in their standard states are connected to make a cell. The cell potential will be (A) +1.19 V (B) +0.89 V (C) +0.18 V (D) +1.83 V	**CBSE 2025**
Value points	(B)	**1**
2	A conductivity cell contains electrodes made up of : (A) Silver (B) Copper (C) Platinum (D) Zinc	**CBSE COMPTT. 2025**
Value points	(C)	**1**
3	The standard electrode potential of 'A', 'B' and 'C' are + 0 68 V, – 2 54 V and – 0 50 V respectively. The order of their reducing power is : (A) A > B > C (B) A > C > B (C) B > C > A (D) C > B > A	**CBSE COMPTT. 2025**
Value points	(C)	**1**
4	Kohlrausch gave the following relation for strong electrolytes at low concentration : $\Lambda_m = \Lambda^0_m - A$ ÖC Which of the following equality holds true ? (A) $\Lambda_m = \Lambda^0_m$ – as C → ÖA (B) $\Lambda_m = \Lambda^0_m$ – as C → 0 (C) $\Lambda_m = \Lambda^0_m$ – as C → ∞ (D) $\Lambda_m = \Lambda^0_m$ – as C → 1	**CBSE 2025 (Visually impaired students)**
Value points	(B)	**1**
5	$\Delta_r G^0$ and E^0_{cell} for a spontaneous reaction will respectively be (A) positive and positive (B) positive and negative (C) negative and positive (D) negative and negative	**CBSE 2025 (Visually impaired students)**
Value points	(C)	**1**

6	Which of the following cell was used in Apollo space programme ? (A) Mercury cell (B) $H_2 - O_2$ fuel cell (C) Dry cell (D) Ni-Cd cell	**CBSE 2024**
Value points	(B)	**1**
7	Dilution affects both conductivity as well as molar conductivity. Effect of dilution on both is as follows: (A) both increase with dilution. (B) both decrease with dilution. (C) conductivity increases whereas molar conductivity decreases on dilution. (D) conductivity decreases whereas molar conductivity increases on dilution.	**CBSE 2024**
Value points	(D)	**1**
8	The quantity of charge required to obtain one mole of Al from Al_2O_3 is : (A) 1 F (B) 6 F (C) 3 F (D) 2 F	**CBSE 2024 (Visually impaired students)**
Value points	(C)	**1**
	Short answers type questions with Value Points (2 marks)	
1	Visha diluted the solutions of two electrolytes 'A' and 'B'. She observed that Λm of 'A' increased 28 times whereas Λm of 'B' increased 1.8 times. Which of the two is a strong electrolyte ? Justify your answer by graphically explaining the behaviour of 'A' and 'B'.	**CBSE COMPTT. 2025**
Value points	'B' On dilution, there is a slight increase in the number of ions of strong electrolytes whereas in weak electrolytes, the number of ions increases to a greater extent. 	**1** **½+½**
2	Define Fuel cell. Write two advantages of fuel cell over ordinary cell.	**CBSE COMPTT. 2025**
Value points	A Galvanic cell which converts the energy of combustion of fuel directly into electrical energy. High efficiency, pollution free.	**1** **½+½**
3	Predict the products of electrolysis in each of the following : (i) A dilute solution of H_2SO_4 with platinum electrodes (ii) An aqueous solution of $CuCl_2$ with platinum electrodes	**CBSE COMPTT. 2025**
Value points	(i) H_2 at cathode, O_2 at anode (ii) Cu at cathode, Cl_2 at anode	**1** **1**

4	(a) Why does the cell potential of mercury cell remains constant throughout its life ? (b) Calculate the degree of dissociation (α) of CH_3COOH if Λ_m and Λ_m° of CH_3COOH are 50 S cm^2 mol^{-1} and 400 S cm^2 mol^{-1} respectively.	**CBSE 2025 (Visually impaired students)**
Value points	a) Because overall reaction does not involve any ion in solution whose concentration can change during its life time. b) $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$ $\alpha = \frac{50}{400}$ $= 0.125$	**1** **½** **½**
5	Using the E^0 values of P and Q, predict which one is better for coating the surface of iron [E^0 (Fe^{2+} / Fe) = –0.44 V] to prevent corrosion and why ? E^0 (P^{2+} / P) = –2.37 V, E^0(Q^{2+} /Q) = – 0.14 V	**CBSE 2025 (Visually impaired students)**
Value points	• P is the better choice for coating iron to prevent corrosion • Because it will oxidize first, protecting the iron from corrosion/ The more negative the E° value, the stronger the reducing agent./ P has a more negative E° (-2.37 V) as compared to iron (-0.44 V), which means P is a stronger reducing agent than iron.	**1** **1**
6	State: (a) Kohlrausch law of independent migration of ions. (b) Faraday's first law of electrolysis.	**CBSE 2024**
Value points	a) Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte and anion respectively. b) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte .	**1** **1**
7	Resistance of a conductivity cell filled with 0.2 mol L^{-1} KCl solution is 200 W. If the resistance of the same cell when filled with 0.05 mol L^{-1} KCl solution is 620, calculate the conductivity and molar conductivity of 0.05 mol L^{-1} KCl solution. The conductivity of 0.2 mol L^{-1} KCl solution is 0.0248 S cm^{-1}.	**CBSE 2024**
Value points	Cell constant = G* = conductivity × resistance= 0.0248 S/cm × 200 ohm = 4.96 cm^{-1} Conductivity of 0.05 mol L^{-1}KCl solution = cell constant / resistance =* G/R=4.96/620= 0.008 S cm^{-1} Molar conductivity = $\Lambda m = \frac{k \times 1000}{c}$ = 0.008 x 1000 /0.05 = 160 S cm^{-1}	1 1 1

	Short answers type questions with Value Points (3 marks)	
1	(a) State the following : (i) Kohlrausch law of independent migration of ions and (ii) Faraday's first law of electrolysis. (b) Using E°_{Values} of X and Y given below, predict which is better for coating the surface of iron to prevent corrosion and why ? $E^\circ_{y2+/y}$ = —0.14 V, $E^\circ_{z2+/z}$ =-0'44 V	**CBSE 2025**
Value points	(a) (i) The limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. (ii) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte. (b) 'X' is better, as X has more negative electrode potential than Fe / X has more oxidation potential than Fe.	**1** **1** **1**
2	Calculate emf of the following cell at 298 K : $Mg(s)\|Mg^{2+}$ (0 001 M)yCu^{2+} (0 0001 M)$\|Cu(s)$ Given : E◦ cell = 2.71 V, log 10 = 1	**CBSE COMPTT. 2025**
Value points	$E_{cell} = E^0_{cell} - \frac{0.059}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$ $E_{cell} = 2.71 - \frac{0.059}{2} \log \frac{[0.001]}{[0.0001]}$ $E_{cell} = 2.71 - \frac{0.059}{2} \log 10$ $E_{cell} = 2.71 - 0.0295$ $E_{cell} = 2.68\ V$	**1** **1** **1**
3	Calculate D_rG° and log K_C for the following cell at 25◦C : $Zn(s) \mid Zn^{2+} \parallel Cd^{2+} \mid Cd(s)$ Given that : $E^\circ_{Zn2+/Zn}$ = –0.76 V, $E^\circ_{Cd2+/Cd}$ = 0.40 V 1 F = 96500 C mol–1.	**CBSE 2025 (Visually impaired students)**
Value points	E^ocell = E^ocathode -E^oanode = 0.40-(-0.76)V = 1.16 V ΔG^0= - n F E^ocell = -2 × 96500 × 1.16 = - 223880 J mol-1 or - 223.880 kJ mol^{-1} log Kc=$\frac{n\ E°cell}{0.059}$ = $\frac{2 \times 1.16}{0.059}$ = 39.322	½ **1** ½ **1**
4	Calculate the emf of the following cell: $Ni(s) + 2Ag^+$ (0.01 M) → Ni^{2+} (0.1 M) + 2Ag(s) Given that E°cell = 1.05 V, log 10 = 1	**CBSE 2024**

Value points	$E^{\circ}_{cell}=1.05$ V $E_{cell}=1.05-\frac{0.059}{2}\log\frac{[Ni]^{2+}}{[Ag+]^2}$ $=1.05-0.059/2\log\frac{(0.1)}{(0.01)^2}$ $=1.05-0.0825$ = 0.9615 V	**1** **1** **1**
5	The electrical resistance of a column of 0.05 M NaOH solution of cell constant 50 cm^{-1} is 4.5x 10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.	**CBSE COMPTT. 2024**
Value points	**Resistivity:** $\rho = \frac{RA}{l}$ $\rho = \frac{4.5\ X\ 10^3}{50}$ ρ=0.09 x 10^3 Ω cm or 90 Ω cm **Conductivity:** $k = 1/\rho$ = 1/ 90 k= 0.011 Ω^{-1} cm^{-1} or 0.011 S cm^{-1} **Molar Conductivity** $\Lambda_m = \frac{k\ X\ 1000}{c}$ S cm^2 mol^{-1} $= \frac{0.0110\ X\ 1000}{0.05}$ = 220 $\Omega^{-1}cm^2mol^{-1}$or 220 Scm^2mol^{-1}	**1** **1** **1**
	Long answer type questions with Value Points (5 marks)	
1	(a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K Sn(s) | Sn^{2+}(0.004 M) || H^+ (0.02 M) I H_2(g) (1 Bar) | Pt (s) (Given : $E_{Sn\ 2+/Sn.}$ =—0.14 V, $E^{\circ}_{H^+/H2(a),\ pt}$ =0.00V) (b) Account for the following ; (i) On the basis of E° values, 0_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl. (ii) Conductivity of CH_3COOH decreases on dilution.	**CBSE 2025**
Value points	(a) The cell reaction is $Sn(s) + 2H^+(aq) \rightarrow Sn^{2+}(aq) + H_2(g)$ $E_{Cell} = (E^{o}_{c} - E^{o}_{a}) - \frac{0.059}{2}\log\frac{[Sn^{2+}]}{[H^+].^2}$ $= [(0) - (-0 \cdot 14)] - \frac{0.059}{2} log\frac{0.004}{(0.02).^2}$ = 0.14 - 0.0295 log 10 = 0.1105 V (b) (i) overpotential of O_2 (ii) Number of ions carrying current per unit volume decreases on dilution	½ ½ **1** **1** **1** **1**

2	(a) Write the anode and cathode reactions and the overall cell reaction occurring in a lead storage battery during its use. (b) Calculate the potential for half-cell containing 0.01 M $K_2Cr_2O_7$ (aq), 0.01 M Cr^{3}+ (aq) and 1.0 x 10 M H+(aq). The half cell reaction is $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \text{—+ } 2Cr^{3+}(aq) + 7H_2O(l)$ and the standard electrode potential is given as E° = 1.33 V. [Given:log l0 = l]	**CBSE 2025**
Value points	a) At Anode: $Pb+SO_4^{-2} \rightarrow PbSO_4+2e-$ At cathode: $PbO_2+ SO_4^{-2}+4H^++2e- \rightarrow PbSO_4+2H_2O$ Overall reaction: $Pb+PbO_2+2\ SO_4^{-2}+4H^+ \rightarrow 2PbSO_4+2H_2O$ b) $E_{Cell} = E°_{Cell} - \frac{0.059}{n} log \left[\frac{[Cr^{3+}]^2}{[Cr2O7^{2-}]\,[H+]^{14}}\right]$ $Ecell = 1.33 - \frac{0.059}{6} \log (10^{-2})^2 / (10^{-2})(\ 1\ X10^{-4}\ )^{14}$ $= 1.33 - \frac{0.059}{6} (54) \log 10$ $= 1.33 - 0.059 \times 9$ $= 1.33 - 0.531$ $= 0.799$ V	**1+1** **1** **1** **1**
3	(i) What type of battery is the lead storage battery ? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it. (ii) Calculate the time to deposit 1.5 g of silver at cathode when a current of 1.5 A was passed through the solution of $AgNO_3$. [Molar mass of Ag = 108 g mol^{-1}, 1 F = 96500 C mol^{-1}]	**CBSE COMPTT. 2024**
Value points	(i) Secondary cell /Battery At anode: $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$ At cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$ overall reaction $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$ (ii) Reaction at Cathode: Ag+ (aq) + e- Ag (s) 108 g of Ag required = 96500 C 1.5 g of Ag required=96500108 x 1.51 = 1340. 27 C Time = Q/I = 1340.27/1.5 = 893.51 s or 14.85 min.	**1+1** **1** **1** **1**
4	(i) State Kohlrausch's law of independent migration of ions. Molar conductivity at infinite dilution for NH_4Cl, NaOH and NaCl solution at 298 K are 110, 100 and 105 S cm^2 mol^{-1} respectively. Calculate the molar conductivity of NH_4OH solution. (ii) Calulate DG° of the following cell at 25°C : Zn (s) | Zn^{2+}(aq) || Cu^{2+} (aq) | Cu (s) Given : $E°_{Zn2+/Zn}$ = – 0.76 V $E°_{Cu2+/Cu}$ = + 0.34 V 1 F = 96500 C mol–1	**CBSE COMPTT. 2024**

Value points	(i) Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. $\Lambda^{\circ}_{NH_4OH} = \Lambda^{\circ}_{NH_4Cl} + \Lambda^{\circ}_{NaOH} - \Lambda^{\circ}_{NaCl}$ = 110 + 100 -105 S cm2 mol-1 = 105 S cm^2 mol^{-1} (ii) Ecell= E^0cathode-E^0anode =0.34 – (– 0.76 V) = 1.10 V $\Delta rG^{o}=-nFEcell^{o}$ = −2 x 96500 x 1.10 = −212,300 J mol-1or –212. 3 kJ mol-1	**1** **1** **1** ½ ½ **1**

Chapter 3
Chemical Kinetics

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	If the half-life period of a first order reaction is 1386 s, then the rate constant of this reaction is (A) 0.5×10^{-2} s^{-1} (B) 0.5×10^{-3} s^{-1} (C) 5×10^{-2} s^{-1} (D) 5×10^{-3} s^{-1}	**CBSE COMPTT. 2025**
Value points	(B)	**1**
2	The rate of reaction X + Y → products, is given by the equation Rate = k[X] [Y]. If Y is taken in large excess, the order of the reaction would be (A) 0 (B) 1 (C) 2 (D) 1/2	**CBSE 2025 (Visually impaired students)**
Value points	(B)	**1**
3	The rate of a reaction increases sixteen times when the concentration of the reactant increases four times. The order of the reaction is (A) 2.5 (B) 2.0 (C) 1.5 (D) 0.5	**CBSE 2024**
Value points	(B)	**1**
4	For a chemical reaction, A → B, it was observed that the rate of reaction doubles when the concentration of A is increased four times. The order of the reaction is : (A) 2 (B) 1 (C) 1/2 (D) Zero	**CBSE COMPTT. 2024**
Value points	(C)	**1**
	For following question, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (C) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	

1	**Assertion (A) :** The molecularity of the reaction $H_2 + Br_2 \rightarrow 2HBr$ appears to be 2. **Reason (R) :** Two molecules of the reactants are involved in the given elementary reaction.	**CBSE COMPTT. 2025**
Value points	(A)	**1**
2	**Assertion (A) :** In a first order reaction, if the concentration of the reactant is doubled, its half-life is also doubled. **Reason (R) :** The half-life of a reaction does not depend upon the initial concentration of the reactant in a first order reaction.	**CBSE 2025 (Visually impaired students)**
Value points	(D)	**1**
3	**Assertion (A):** The units of rate constant of a zero order reaction and rate of reaction are the same. **Reason (R):** In zero order reaction, the rate of reaction is independent of the concentration of reactants.	**CBSE 2024**
Value points	(A) Or (B)	**1**
4	**Assertion (A) :** Rate constant increases with increase in temperature. **Reason (R) :** Increasing the temperature of the substance increases the fraction of molecules, which collide with energies greater than activation energy.	**CBSE COMPTT. 2024**
Value points	(A)	**1**
	Short answers type questions with Value Points (2 marks)	
1	By giving reasons, explain how the rate of the reaction for a given reaction will be affected when : (a) the temperature at which the reaction was taking place is decreased. (b) a catalyst is added.	**CBSE COMPTT. 2025**
Value points	(a) • Rate of reaction decreases on decreasing temperature. • Effective collisions decrease / Decrease in fraction of molecules having energy equal to or greater than Ea. (b) • Rate of reaction increases on adding a catalyst. • Due to lowering of activation energy.	**1** **1**
2	(a) A reaction is second order in 'A' and first order in 'B'. How is the rate affected when the concentrations of both 'A' and 'B' are doubled ? (b) Write the unit of 'k' for zero order reaction.	**CBSE 2025 (Visually impaired students)**
Value points	a) Rate = $k [A]^2 [B]$ $= k [2A]^2 [2B]$ =8 times b) mol L^{-1} s^{-1} / mol L^{-1} $time^{-1}$	**1** **1**
3	Show that in case of a first order reaction, the time taken for completion of 99% reaction is twice the time required for 90% completion of the reaction.(log10 = 1)	**CBSE 2024**

Value points	$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$ Time required for the completion of 99% reaction $t_{99\%} = \frac{2.303}{k} \log \frac{100}{1}$ $t_{99\%} = \frac{2.303}{k} \times 2$ Time required for the completion of 90% reaction $t_{90\%} = \frac{2.303}{k} \log \frac{100}{10}$ $t_{90\%} = \frac{2.303}{k} \log 10$ $t_{90\%} = \frac{2.303}{k}$ $\frac{t_{99\%}}{t_{90\%}} = \frac{\left(\frac{2.303}{k}\right) \times 2}{\frac{2.303}{k}}$ $\frac{t_{99\%}}{t_{90\%}} = 2$ $t_{99\%} = 2 \times t_{90\%}$	½ ½ ½ ½
4	The thermal decomposition of an acid is a first order reaction with a rate constant of 2.3 x 10^{-3} s^{-1} at a certain temperature. Calculate how long it will take for three-fourths of the initial quantity of acid to decompose. (log 4 = 0.6021, log 2 = 0.301)	**CBSE COMPTT. 2024**
Value points	$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$ $t = \frac{2.303}{k} \log \frac{[R]_0}{[R]_0/4}$ $t = \frac{2.303}{2.3 X 10^{-3}} \log 4$ $t = \frac{2.303}{2.3 X 10^{-3}} \log 0.6021$ $t = 602$ s	½ ½ **1**
	Short answers type questions with Value Points (3 marks)	
1	A certain reaction is 50% complete in 20 minutes at 300 K and the same reaction is 50% complete in 5 minutes at 350 K. Calculate the activation energy if it is a first order reaction. [R = 8.314 I K^{-1} mol^{-1}; log 4 = 0.602]	**CBSE 2025**
Value points		½

	$t_{1/2} = \frac{0.693}{k}$ $k_1 = \frac{0.693}{20} = 0.03465 / 3.465 \times 10^{-2}\ min^{-1}$ $k_2 = \frac{0.693}{5} = 0.1386 / 1.386 \times 10^{-1}\ min^{-1}$ $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$ $\log \frac{0.1386}{0.03465} = \frac{Ea}{2.303 \times 8.314} \frac{[350-300]}{[350 \times 300]}$ $\log 4 = \frac{Ea}{19.15} \frac{[50]}{[350 \times 300]}$ $Ea = 24209\ J\ mol^{-1}$ or $24.209\ kJ\ mol^{-1}$	**1** **½** **½**
2	The following data were obtained during the kinetic studies of the reaction A +2B → C+2D Determine the order of reaction with respect to each reactant and the overall order of the reaction. Write the rate law expression for the reaction.	**CBSE COMPTT. 2025**

Experiment	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial rate of formation of C (M min–1)
1	0.10	0.10	3.0×10^{-4}
2	0.30	0.30	9.0×10^{-4}
3	0.10	0.30	3.0×10^{-4}
4	0.20	0.40	6.0×10^{-4}

Value points	Let the order w.r.t to A be x and y w.r.t to B Rate = $k [A]^x [B]^y$ $3.0 \times 10^{-4} = k [0.10]^x [0.10]^y$ ----------(1) $9.0 \times 10^{-4} = k [0.30]^x [0.30]^y$ ----------(2) $3.0 \times 10^{-4} = k [0.10]^x [0.30]^y$ ----------(3) $6.0 \times 10^{-4} = k [0.20]^x [0.40]^y$ ----------(4) Dividing Exp. (1) by (3) y = 0, the order w.r.t B is 0. Dividing Exp. (2) by (3) $3 = 3^x$ i.e., x =1, order w.r.t A is 1. Overall order of the reaction = 1 Rate = $k [A]^1 [B]^0$ / Rate = k [A]	**1** **1** **1**
3	The rate constant of a first order reaction increases from 0.04 s^{-1} to 0.08 s^{-1} when the temperature increases from 27◦C to 37◦C. Calculate the energy of activation (E_a). [Given : 2.303R = 19.15 $JK^{-1}mol^{-1}$] [log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021]	**CBSE 2025 (Visually impaired students)**

Value points	$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$ $\log \frac{0.08}{0.04} = \frac{Ea}{19.15} \frac{[310-300]}{[310 \times 300]}$ $\log 2 = \frac{Ea}{19.15} \frac{[10]}{[310 \times 300]}$ $Ea = \frac{0.3010 \times 19.15 \times 310 \times 300}{10}$ $= 53606 \text{ J mol}^{-1} = 53.606 \text{ kJ mol}^{-1}$	**1** **1** **1**
4	The rate constant of a reaction quadruples when the temperature changes from 300 K to 320 K. Calculate the activation energy for this reaction. [log 2 = 0.30, log 4 = 0.60, 2.303 R = 19.15 J $K^{-1}mol^{-1}$]	**CBSE 2024**
Value points	$\log \frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$ It is given that, $k_2 = 4k_1$ Therefore, $\log \frac{4k_1}{k_1} = \frac{E_a}{2.303 \times R}\left(\frac{320-300}{320 \times 300}\right)$ $0.60 = \frac{20 \times E_a}{19.15 \times 320 \times 300}$ $E_a = \frac{0.60 \times 19.15 \times 320 \times 300}{20}$ $= 55152 \text{ J mol}^{-1}$ **or** $= 55.152 \text{ kJ mol}^{-1}$	**1** **1** **1**
5	Hydrolysis of sucrose takes place by the chemical reaction : $C_{12}H_{22}O_{11} + H_2O \text{ (excess)} \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$ Based on the above reaction, write : (a) Rate law equation (b) Molecularity and order of reaction (c) What do you call such reactions ?	**CBSE COMPTT. 2024**
Value points	(a) Rate = k $[C_{12}H_{22}O_{11}]$ (b) Molecularity = 2 and order = 1 (c) Pseudo first order reaction.	**1** **1** **1**
	Case based questions with Value Points (4 marks)	
1	The rate of a chemical reaction is expressed either in terms of decrease in the concentration of reactants or increase in the concentration of a product per unit time. Rate of the reaction depends upon the nature of reactants, concentration of reactants, temperature, presence of catalyst, surface area of the reactants and presence of light. Rate of reaction is directly related to the concentration of reactant. Rate law states that the rate of reaction depends upon the concentration terms on which the rate of reaction actually depends, as observed experimentally.	**CBSE 2025**

	The sum of powers of the concentration of the reactants in the Rate law expression is called order of reaction while the number of reacting species taking part in an elementary reaction which must collide simultaneously in order to bring about a chemical reaction is called molecularity of the reaction. Answer the following questions : (a) (i) What is a rate determining step ? (ii) Define complex reaction. (b) What is the effect of temperature on the rate constant of a reaction ? **OR** (b) Why is molecularity applicable only for elementary (c) The conversion of molecule X to Y follows second order kinetics. If concentration of X is increased 3 times, how will it affect the rate of formation of Y ?	
Value points	(a) (i) Slowest step. (ii) Series of elementary reactions / Reactions involving two or more steps. (b) Increases with increase in temperature. **OR** (b) Molecularity is defined only for elementary reactions whereas order is experimentally determined hence applicable for both / Because molecularity of each elementary reaction in complex reaction may be different and hence meaningless for overall complex reaction whereas order of a complex reaction is experimentally determined by the slowest step in its mechanism and is therefore applicable for both. (c) 9 times	**1** **1** **1** **1** **1**
2	Rate of reaction depends upon the experimental conditions such as concentration of reactants, temperature and catalyst. Mathematical representation of rate of a reaction is given by rate law : $Rate = k [A]^p [B]^q$ A balanced chemical equation never gives us a true picture of how a reaction takes place since rarely does a reaction get completed in one step. The reactions taking place in one step are called elementary reactions. When a sequence of elementary reactions give us the products, the reactions are called complex reactions. Order and molecularity of elementary reaction are same. (a) For a reaction A + B Product, the rate law is given by $Rate = k [A]^1 [B]^{1/2}$ What is the overall order of the reaction ? (b) How are order and molecularity different for complex reactions ? (c) For a first order reaction, show that the time required for 99% completion is twice the time required for the completion of 90% of reaction. [Given : log 10 = 1] **OR** (c) What is meant by zero order reaction ? Give any one example of zero order reaction.	**CBSE 2024 (Visually impaired students)**
Value points	a)3/ 2 b)Order is applicable to elementary as well as complex reactions whereas molecularity is applicable only for elementary reactions.For complex reaction molecularity has no meaning. c)	**1** **1**

$$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$

Time required for the completion of 99% reaction

$$t_{99\%} = \frac{2.303}{k} \log \frac{100}{1}$$

$$t_{99\%} = \frac{2.303}{k} \times 2$$

Time required for the completion of 90% reaction

$$t_{90\%} = \frac{2.303}{k} \log \frac{100}{10}$$

$$t_{90\%} = \frac{2.303}{k} \log 10$$

$$t_{90\%} = \frac{2.303}{k}$$

$$\frac{t_{99\%}}{t_{90\%}} = \frac{\left(\frac{2.303}{k}\right) \times 2}{\frac{2.303}{k}}$$

$$\frac{t_{99\%}}{t_{90\%}} = 2$$ **1**

$t_{99\%} = 2 \times t_{90\%}$

OR

c) Zero-order reaction means that the rate of the reaction is independent of initial concentration of reactants. Example : Decomposition of gaseous ammonia on hot platinum surface **1**

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	The magnetic moment is associated with its spin angular momentum and orbital angular momentum. Spin only magnetic moment value of Cr^{3+} ion (Atomic no. : Cr = 24) is _____ (A) 2.87 BM (B) 3.87 BM (C) 3.47 BM (D) 3.57 BM	CBSE 2025
Value points	(B)	1
2	Acidified $KMnO_4$ oxidises sulphite to (A) $S_2O_3^{2-}$ (B) $S_2O_8^{2-}$ (C) $SO_2(g)$ (D) SO_4^{2-}	CBSE 2025
Value points	(D)	1
3	The transition element which shows both +1 and +2 oxidation states is (A) Sc (B) Mn (C) Cu (D) Zn	CBSE 2025
Value points	(C)	1
4	Which of the following transition metals does not show variable oxidation states? (A) Cu (B) Sc (C) Ti (D) Fe	CBSE 2025 (Visually impaired students)
Value points	(B)	1
5	Transition metals are known to make interstitial compounds. Formation of interstitial compounds makes the transition metal (A) more hard (B) more soft (C) more ductile (D) more metallic	CBSE 2024
Value points	(A)	1
6	Out of Fe^{2+}, Co^{2+}, Cr^{3+}, Ni^{2+}, the one which shows highest magnetic moment is :	CBSE

	(A) Fe^{2+} (B) Co^{2+} (C) Cr^{3+} (D) Ni^{2+} [Atomic number : Cr = 24, Fe = 26, Co = 27, Ni = 28]	**COMPTT. 2024**
Value points	(A)	**1**
7	Which of the following oxidation state is common for all lanthanoids ? (A) + 2 (B) + 4 (C) + 6 (D) + 3	**CBSE 2024 (Visually impaired students)**
Value points	(D)	**1**
8	Which of the following ions has the electronic configuration $3d^3$? [Atomic number : Cr = 24, Mn = 25, Fe = 26, Co = 27] (A) Cr^{3+} (B) Mn^{3+} (C) Fe^{3+} (D) Co^{3+}	**CBSE 202 (Visually impaired students)**
Value points	(A)	**1**
	For questions number 1 to 4 below, two statements are given —one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A) :** Actinoids show a wide range of oxidation states. **Reason (R) :** Actinoids are radioactive in nature.	**CBSE COMPTT. 2025**
Value points	(B)	**1**
2	**Assertion (A) :** Zinc is not regarded as a transition element. **Reason (R) :** Zinc has completely filled 3d orbitals in its ground state as well as in its oxidised state.	**CBSE 2025 (Visually impaired students)**
Value points	(A)	**1**
3	**Assertion (A):** Zr and Hf are of almost similar atomic radii. **Reason (R):** This is due to lanthanoid contraction.	**CBSE 2024**
Value points	(A)	**1**
4	**Assertion (A) :** Cu^{2+} iodide is not known.	**CBSE**

	Reason (R) : Cu^{2+} has strong tendency to oxidise I^- to iodine.	**COMPTT. 2024**
Value points	(A)	**1**
	Short answers type questions with Value Points (2 marks)	
1	Complete and balance the following chemical equations : (a) $2MnO_4^-(aq) + 10\ I^-(aq) + 16H^+(aq) \rightarrow$ (b) $Cr_2O_7^-(aq) + 6Fe^{2+}(aq) + 14H^+(aq) \rightarrow$	**CBSE 2025**
Value points	(a) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$ (b) $Cr_2O_7^{2-} + 14\ H^+ + 6\ Fe^{2+} \rightarrow 2\ Cr^{3+} + 6\ Fe^{3+} + 7\ H_2O$	**1+1**
	Short answers type questions with Value Points (3 marks)	
1	The elements of 3d transition series are given as : Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn Answer the following : (a) Copper has exceptionally positive $E^\circ_{M2+/M}$ value, why ? (b) Which element is a strong reducing agent in +2 oxidation state and why ? (c) Zn^{2+} salts are colourless. Why ?	**CBSE 2025**
Value points	(a) Its high D_aH° and low $D_{hyd}H^\circ$. (b) Cr Cr^{3+} (d^4 to d^3) / stable half-filled t_{2g} level (c) Fully-filled d-orbitals hence no d-d transition / due to the absence of unpaired electron.	**1** **½** **½** **1**
	Long answer type questions with Value Points (5 marks)	
1	(i) Write the chemical equations involved in the preparation of potassium permanganate from pyrolusite ore (MnO2). (ii) Give reasons for the following : (I) Sc (Atomic No. 21) salts are white. (II) $E^\circ_{Cu2+/Cu}$ is positive whereas $E^\circ_{Mn2+/}$ is negative. (III) Transition metals have high enthalpies of atomisation.	**CBSE COMPTT. 2025**
Value points	(i) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$ $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$ (ii) (I) Due to the absence of unpaired electrons in d-orbitals. / no d-d transition. (II) Due to the low $D_{hyd}H^\circ$ and high D_aH° of Cu^{2+}, whereas Mn^{2+} has lower D_aH° as well as lower $D_{hyd}H^\circ$ (III) Due to the presence of a greater number of unpaired electrons, resulting in strong interatomic interactions / metallic bonding.	**1+1** **1** **1** **1**
2	(i) Complete and balance the following chemical equations :	**CBSE**

	(I) $Cr_2O_7^{-2}(aq) + H_2S\ (g) + H^+(aq) \rightarrow$ (II) $Cu^{2+}(aq) + I^-\ (aq) \longrightarrow$ (ii) Give reasons : (I) Separation of mixture of lanthanoids is difficult. (II) Chromium has higher melting point than manganese. (III) It is difficult to obtain oxidation state greater than two for Zn	**COMPTT. 2025**
Value points	(i) (I) $Cr_2O_7^{2-} + 8H^+ + 3H_2S \rightarrow 2Cr^{3+} + 7H_2O + 3S$ (II) $2Cu^{2+} + 4I^- \rightarrow Cu_2I_{2(s)} + I_2$ (ii) (I) Due to lanthanoid contraction. (II) Due to more number of unpaired electrons from ns and (n-1)d in chromium as compared to manganese. (III) Due to the higher value of the third ionisation enthalpy of zinc.	**1+1** **1** **1** **1**
3	(a) Account for the following : (i) Transition metals and their compounds show catalytic activities. (ii) Mn^{3+} is a strong oxidising agent. (iii) Cu^+ is not stable in aqueous solution. (b) Write the preparation of $KMnO_4$ from Pyrolusite ore (MnO_2).	**CBSE 2025 (Visually impaired students)**
Value points	(a) i) They have the ability to exhibit variable oxidation states/ tendency to form complex compounds/ provide large surface area. ii)Because Mn^{+2} is more stable in +2 due to stable $3d^5$ configuration. iii)Because it undergoes disproportionation reaction (b) $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$ $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$	**1** **1** **1** **1+1**
4	(i) Write the preparation of $Na_2Cr_2O_7$, from $FeCr_2O_4$. (ii) What is Lanthanoid contraction ? Write its two consequences. (iii) Name two elements of 3d series which show anomalous electronic configuration.	**CBSE 2025 (Visually impaired students)**
Value points	i) Dichromates are generally prepared from chromate, which in turn are obtained by the fusion of chromite ore ($FeCr_2O_4$) with sodium or potassium carbonate in free access of air $4\ FeCr_2O_4 + 8\ Na_2CO_3 + 7\ O_2 \rightarrow 8\ Na_2CrO_4 + 2\ Fe_2O_3 + 8\ CO_2$ $2Na_2CrO_4 + 2\ H^+ \rightarrow Na_2Cr_2O_7 + 2\ Na^+ + H_2O$ ii) The steady decrease in atomic radii in lanthanoid series. / steady decrease in ionic radii or atomic radii across the 4f series **Consequence :** 4d and 5d elements have similar radii and similar properties. iii)Cr and Cu	**1+1** **1+1** **1**
5	Attempt any **five** of the following:	**CBSE**

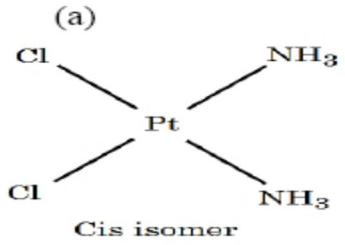
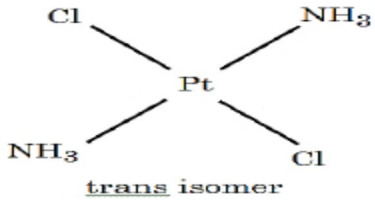
	(a) Ce(III) is easily oxidised to Ce(IV). Comment. (b) $E°(Mn^{2+}/Mn)$ is –1.18 V. Why is this value highly negative in comparison to neighbouring *d* block elements? (c) Which element of 3*d* series has lowest enthalpy of atomisation and why? (d) What happens when sodium chromate is acidified? (e) Zn, Cd and Hg are soft metals. Why? (f) Why is permanganate titration not carried out in the presence of HCl? (g) The lower oxides of transition metals are basic whereas the highest are amphoteric/acidic. Give reason.	**2024**
Value points	a) Ce(IV) ion has more stable configuration ($4f^0$) than Ce(III)ion. b) Due to extra stability of half filled (d^5) orbitals in Mn^{2+} c) Zinc, due to completely filled d orbitals/ weak metallic bonding. d) It gets converted to sodium dichromate e) Due to completely filled d-orbitals/ weak metallic bonding. f) HCl is oxidized by $KMnO_4$ to Cl_2 g) Lower oxides of transition metals are ionic & ionic character decreases or covalent character increases with increase in oxidation state.	**1x5=5**
6	Attempt any five of the following : (a) Cu^+ is not stable in aqueous solution. Comment. (b) Out of Cr^{2+} and Fe^{2+}, which one is a stronger reducing agent and why ? (c) Actinoid contraction is greater from element to element than lanthanoid contraction. Why ? (d) KMnO4 acts as an oxidising agent in acidic medium. Write the ionic equation to support this. (e) Name the metal in the first transition series which exhibits +1 oxidation state most frequently. (f) Transition metals and their compounds are good catalysts. Justify. (g) Scandium forms no coloured ions, yet it is regarded as a transition element. Why ?	**CBSE COMPTT. 2024**
Value points	(a) Cu^+ in aqueous solution undergoes disproportionation to Cu and Cu^{2+}. (b) Cr^{2+}; due to greater stability of t^2g^3 in aqueous state. (c) Due to relatively poor shielding effect of 5f electrons in actinoids than 4f electrons in lanthanoids. (d) $$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$ (e) Copper / Cu (f) Due to variable oxidation state / provide greater surface area / complex formation. (g) Due to incompletely filled d orbital in its ground state.	**1x5=5**
7	The elements of 3d transition series are given as : Sc Ti V Cr Mn Fe Co Ni Cu Zn Answer the following : (i) Which element shows +1 oxidation state ? (ii) Which element is a strong reducing agent in +2 oxidation state and why ? (iii) Write the element which shows maximum number of oxidation states. Give reason.	**CBSE 2024 (Visually impaired students)**

	(iv) Which element has the lowest value of enthalpy of atomization and why ? (v) Which element shows only +3 oxidation state ?	
Value points	(i) Cu (ii) Cr, because Cr is more stable in + 3 oxidation state (iii) Mn, because of the participation of both 3d and 4s electrons (iv) Zn, because of absence of unpaired electrons. (v) Sc	**1** **1** **1** **1** **1**

Chapter 5
Coordination compounds

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	The correct IUPAC name of $[Pt(NH_3)_2Cl_2]^{2+}$. (A) Diamminedichloridoplatinum (II) (B) Diamminedichloridoplatinum (IV) (C) Diamminedichloridoplatinum (O) (D) Diamminedichloridoplatinate (IV)	**CBSE 2025**
Value points	(B)	**1**
2	The most stable complex among the following is : (A) $[Pt(NH_3)_2Cl_2]$ (B) $[Ag(NH_3)_2]Cl$ (C) $[Pt(en)_2Cl_2]^{2+}$ (D) $K_4[Fe(CN)_6]$	**CBSE COMPTT. 2024**
Value points	(C)	**1**
3	The geometry of diamagnetic nickel complex $[Ni(CN)_4]^{2-}$ is : (A) Tetrahedral (B) Octahedral (C) Square planar (D) Distorted octahedral	**CBSE COMPTT. 2024**
Value points	(C)	**1**
4	Considering the strength of the ligand, the highest excitation energy will be observed in : (A) $[Co(H_2O)_6]^{3+}$ (B) $[Co(NH_3)_6]^{3+}$ (C) $[Co(CN)_6]^{3-}$ (D) $[CoCl_6]^{3-}$	**CBSE COMPTT. 2024**
Value points	(C)	**1**
5	The IUPAC name of the complex $[Co(NH_3)_5(NO_2)]Cl_2$ is : (A) Pentaamminenitrito-O-cobalt(III) chloride (B) Pentaamminenitrito-N-cobalt(III) chloride (C) Pentaamminenitro-cobalt(III) chloride (D) Pentaaminenitrito-cobalt(II) chloride	**CBSE COMPTT. 2024**
Value points	(B)	**1**
6	When 1 mole of $CoCl_3 . 5NH_3$ is treated with excess of $AgNO_3$, 2 moles of AgCl are obtained. The secondary valency of Co will be : (A) 6 (B) 4 (C) 3 (D) 5	**CBSE 2024 (Visually impaired students)**

Value points	(A)	**1**
	For questions number 1 to 4 below, two statements are given —one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A)** : $[Cr(H_2O)_6]Cl_2$ and $[Fe(H_2O)_6]$ Cl_2 are examples of homoleptic complexes. **Reason (R)** All the ligands attached to the metal are the same.	**CBSE 2025**
Value points	(A)	**1**
2	**Assertion (A) :** Linkage isomerism arises in coordination compounds containing ambidentate ligand. **Reason (R) :** Ambidentate ligand has two same donor atoms.	**CBSE 2024 (Visually impaired students)**
Value points	(C)	**1**
	Short answers type questions with Value Points (3 marks)	
1	(a) Write IUPAC name of the complex $[Co(NH_3)_5(ONO)]^{2+}$ (b) Write the hybridization of $[Ni(CN)_4]^{2-}$ and predict its magnetic behaviour. [Atomic number : Ni = 28] (c) What type of isomerism is shown by the given complex : $[Co(NH_3)_6][Cr(CN)_6)]$?	**CBSE COMPTT. 2025**
Value points	(a) pentaamminenitrito-O-cobalt(III) ion (b) dsp^2, diamagnetic (c) Coordination isomerism	**1** **1** **1**
2	When a co-ordination compound $CoCl_3.6NH_3$ is mixed with excess of $AgNO_3$ solution, 3 moles of AgCl are precipitated per mole of the compound. Write (i) Structural formula of the complex (ii) IUPAC name of the complex (iii) Hybridization of the complex using valence bond theory [Atomic number: Co = 27]	**CBSE 2025 (Visually impaired students)**
Value points	i) $[Co(NH_3)_6]$ Cl_3 ii) Hexaamminecobalt(III) chloride iii)d^2sp^3	**1** **1** **1**
3	(i) Write IUPAC name of $[Pt(NH_3)_2$ Cl(ONO)]. (ii) Why $[Co(en)_3]^{3+}$ is more stable complex than $[Co(NH_3)_6]^{3+}$? (iii) Predict the hybridization of $[Ni(CO)_4]$ on the basis of valence bond theory. [Atomic number : Ni = 28]	**CBSE 2025 (Visually impaired students)**
Value points	i)Diamminechloridonitrito-O-platinum(II) ii)$[Co(en)_3]^{3+}$ contains a didentate ligand showing chelate effect / Because of chelate formation. iii)sp^3	**1** **1** **1**

4	Write the IUPAC names of the following coordination compounds **(any three):** (a) $[Co(NH_3)_4Cl(NO_2)]Cl$ (b) $[Ni(NH_3)_6]Cl_2$ (c) $K_3[Cr(C_2O_4)_3]$ (d) $[Co(en)_2Br_2]^+$	**CBSE 2024**
Value points	a) Tetraamminechloridonitrito-N-cobalt (III) chloride b) Hexaamminenickel(II) chloride c) Potassium trioxalatochromate (III) d) Dibromidobis(ethane-1,2-diamine)cobalt (III) ion	**1x3=3**
5	(a) Draw the geometrical isomers of the complex $[Pt(NH_3)_2Cl_2]$. (b) Give the electronic configuration of d^4 ion when Do > P. (c) Solution of $[Ni(H_2O)_6]^{2+}$ is green in colour whereas $[Ni(CN)_4]^{2-}$ is colourless. Give reason. [Atomic number : Ni = 28]	**CBSE COMPTT. 2024**
Value points	(a)  Cis isomer  trans isomer (b) $t_{2g}^4 e_g^0$ (c) In $[Ni(H_2O)_6]^{2+}$ due to the presence of two unpaired electrons that undergoes d-d transition whereas in $[Ni(CN)_4]^{2-}$there is no unpaired electrons.	½ +½ 1 1
	Case based questions with Value Points (4 marks)	
1	One of the most distinctive properties of transition metal complexes is their wide range of colours. This means that some of the visible spectrum is being removed from white light as it passes through the sample, so the light that emerges is no longer white. The colour of the complex is complementary to that which is absorbed. The complementary colour is the colour generated from the wavelength left over. If green light is absorbed by the complex, it appears red. Table given below, gives the relationship between different wavelengths of the light absorbed and the colour observed.	**CBSE COMPTT 2025**

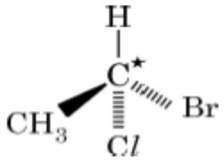
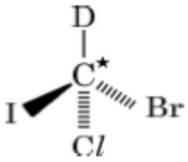
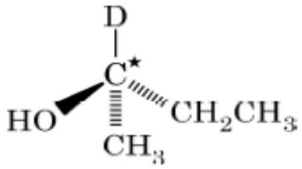
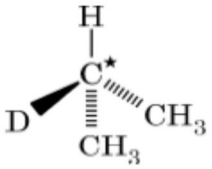
Coordination Entity	Wavelength of light absorbed (nm)	Colour of light absorbed	Colour of coordination entity
$[CoCl(NH_3)_5]^{2+}$	535	Yellow	Violet
$[Co(NH_3)_5(H_2O)]^{3+}$	500	Blue-green	Red
$[Co(NH_3)_6]^{3+}$	475	Blue	Yellow-orange
$[Co(CN)_6]^{3-}$	310	Ultra-Violet (U.V.)	Pale Yellow
$[Cu(H_2O)_4]^{2+}$	600	Red	Blue
$[Ti(H_2O)_6]^{3+}$	498	Blue-green	Violet

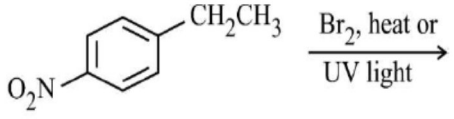
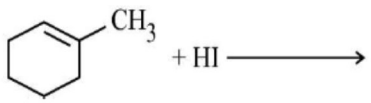
	(a) What is spectrochemical series ? Write the relationship between Δ_t and Δ_o. (b) (i) Arrange $[Co(CN)_6]^{3-}$, $[Co(NH_3)_6]^{3+}$ and $[Cu(H_2O)_4]^{2+}$ in increasing order of wavelength of light absorbed. **OR** (b) (ii) On the basis of crystal field theory, write the electronic configuration of d^5 ion if $\Delta o < P$. (c) Define crystal field splitting energy.	
Value points	(a) Spectrochemical series: Arrangement of ligands in the increasing order of their field strength. $\Delta_t = 4/9\ \Delta_o$ (b)(i) $[Co(CN)_6]^{3-} < [Co(NH_3)_6]^{3+} < [Cu(H_2O)_4]^{2+}$ (b) (ii) $t_{2g}^3 e_g^2$ (c) The energy required to separate the degenerate d-orbitals into t_{2g} and e_g sets, when ligands approach the central metal atom/ion.	**1+1** **1** **1** **1**
2	Werner proposed the concept of a primary valence and a secondary valence for a metal ion. The primary valences are normally ionisable and are satisfied by negative ions. The secondary valences are non-ionisable. These are satisfied by neutral molecules or negative ions. The secondary valency is equal to the co-ordination number and is normally fixed for a metal. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometrical shapes of co-ordination compounds whereas the Crystal Field Theory (CFT) is based on the effect of different crystal fields on the degeneracy of dorbitals energies of the central metal atom / ion. (a) $[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why ? [Atomic number : Cr = 24, Ni = 28] (b) Write one difference between a primary valence and a secondary Valence. (c) What is crystal field splitting energy ? **OR** (c) On the basis of CFT, write the electronic configuration of d^4 orbitals when $\Delta_0 > P$.	**CBSE 2025 (Visually impaired students)**
Value points	a) Because in $[Cr(NH_3)_6]^{3+}$, there are 3 unpaired electrons in the d-orbitals of the chromium ion ,while in $[Ni(CN)_4]^{2-}$, cyanide is a strong field ligand causing the d-electrons to pair up resulting in no unpaired electrons. b) The primary valences are normally ionisable while secondary valences are non-ionisable. c) The difference of energy between the two sets of d-orbitals t_{2g} and e_g due to the presence of ligands in a definitegeometry. **OR** c) $t_{2g}^4 e_g^0$	**1+1** **1** **1** **1**
3	The oxidation number of the central atom in a complex is defined as the charge it would carry if all the ligands are removed along with the electron pairs that are shared with the central atom. Similarly the charge on the complex is the sum of the charges of the constituent parts i.e. the sum of the charges on the central metal ion and its surrounding ligands. Based on this, the complex is called neutral if the sum of the charges of the constituents is equal to zero. However, for an anion or cationic complex, the sum of the charges of the constituents is equal to the charge on the coordination sphere. Answer the following questions:	**CBSE 2024**

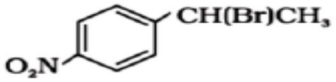
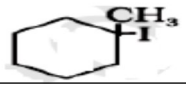
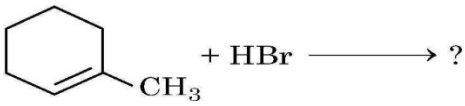
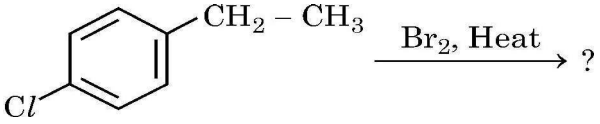
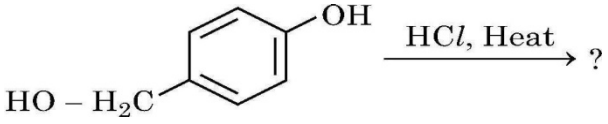
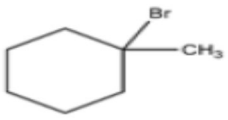
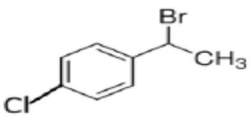
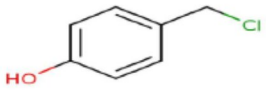
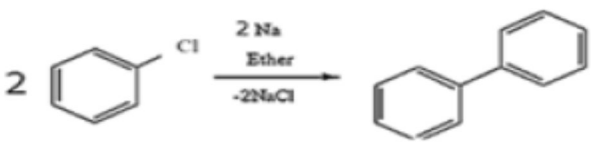
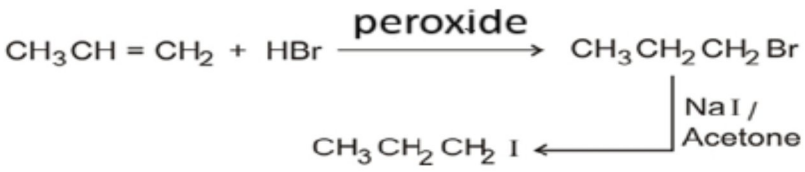
	(a) Define ambidentate ligand with an example. (b) What type of isomerism is shown by $[Co(NH_3)_5Cl]\ SO_4$ and $[Co(NH_3)_5SO_4]Cl$? (c) Define chelate effect. How it affects the stability of complex? **OR** (c) Find the coordination number and oxidation state of chromium in $Na_3[Cr(C_2O_4)_3]$.	
Value points	a) Ligand which has two different donor atoms and either of the two ligates in the complex Examples :- NO^{2-} / SCN^- / CN^-(any one) b) Ionization isomerism c) When a bi-dentate or polydentate ligand ligates to the metal atom or ion that forms ring More is the chelation more is the more is the stability. **OR** c)Coordination number: 6 , Oxidation State = +3	**½ +½** **1** **1+1** **1+1**
	Long answer type questions with Value Points (5 marks)	
1	Answer the following : (a) Low spin tetrahedral complexes are not known. (b) Co^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand [At. No. of Co = 27] (c) What type of isomerism is shown by the complex $[Co(NH_3)_6]\ [Cr(CN)_6)]$ (d) Why a solution of $[Ni(H_2O)_6]^{2+}$ is green while a solution of $[Ni(CN)_4]^{2-}$ is colourless. (At. No. of Ni = 28) (e) Write the IUPAC name of the following complex : $[Co(NH_3)_5(CO_3)]Cl$	**CBSE 2025**
Value points	(a) The orbital splitting energies are not sufficiently large for forcing paring of electrons. (b) In the presence of strong field ligand, d^7 is converted into more stable d^6 (c) Co-ordination isomerism. (d) $[Ni(H_2O)_6]^{2+}$ has unpaired electrons whereas $[Ni(CN)_4]^{2-}$ has no unpaired electron. (e) Pentaamminecarbonatocobalt(III) chloride	**1** **1** **1** **1** **1**
2	(a) What is meant by 'Chelate effect' ? Give an example. (b)Write the hybridization and magnetic behaviour of $[Fe(CN)_6]^{4-}$. (Atomic number : Fe = 26) (c) If $PtCl_2.2NH_3$ does not react with $AgNO_3$, what will be its formula ?	**CBSE 2025**
Value points	(a) The higher stability of complexes involving chelating ligands as compare to complexes having non-chelating ligand. Example: $[Co(en)_3]^{3+}$ (or any other correct example) (b) d^2sp^3 , diamagnetic (c) $[Pt\ (NH_3)_2\ Cl_2]$	**1+1** **1+1** **1**

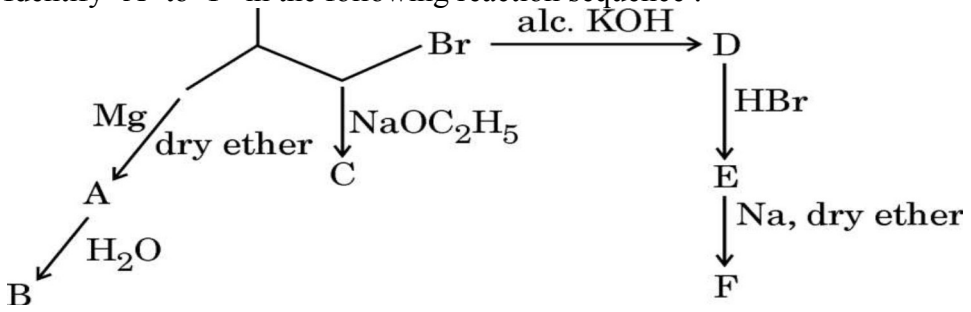
Chapter 6
Haloalkanes and Haloarenes

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	Alkyl halides undergoing nucleophilic bimolecular substitution reaction involve (A) retention of configuration (B) formation of racemic mixture (C) inversion of configuration (D) formation of carbocation	**CBSE 2025**
Value points	(C)	**1**
2	Arrange the following compounds in increasing order of their boiling point (i) $(CH_3)_2CH$ — CH_2Br (ii) $CH_3CH_2CH_2CH_2B$ (iii) $(CH_3)_3C$ — Br The correct order is (A) (ii) < (i) < (iii) (B) (i) < (ii) < (iii) (C) (iii) < (i) < (ii) (D) (iii) < (ii) < (i)	**CBSE 2025**
Value points	(C)	**1**
3	Identify the Freon from the following compounds : (A) CCl_2F_2 (B) CCl_2Br_2 (C) $CH_2Cl – CHCl_2$ (D) $CHCl_2 – CHCl_2$	**CBSE COMPTT 2025**
Value points	(A)	**1**
4	Which one of the following halides contains following halides contains $Csp^2 – X$ b (A) Alkyl halide (B) Allyl halide (C) Benzyl halide (D) Vinyl halide	**CBSE COMPTT 2025**
Value points	(D)	**1**
5	The conversion of an alkyl halide into an alcohol by aqueous NaOH is classified as (A) an addition reaction (B) a substitution reaction (C) a dehydrohalogenation reaction (D) a dehydration reaction	**CBSE 2025 (Visually impaired students)**
Value points	(B)	**1**

6	The synthesis of alkyl fluoride is best accomplished by (A) Sandmeyer reaction (B) Finkelstein reaction (C) Wurtz reaction (D) Swarts reaction	**CBSE 2025 (Visually impaired students)**
Value points	(D)	**1**
7	Auto-oxidation of chloroform in air and light produces a poisonous gas known as (A) Phosphine (B) Mustard gas (C) Phosgene (D) Tear gas	**CBSE 2024**
Value points	(C)	**1**
8	In which of the following molecules, C atom marked with asterisk is chiral? (I)  (II)  (III)  (IV)  (A) I, II, III (B) I, II, III, IV (C) II, III, IV (D) I, III, IV	**CBSE 2024**
Value points	(A)	**1**
9	The correct IUPAC name of $(CH_3)_3$ C – CH_2Br is : (A) 2,2-Dimethyl-2-bromopropane (B) 1-Bromo-2,2,2-trimethylethane (C) 2-Bromo-1,1,1-trimethylethane (D) 1-Bromo-2,2-dimethylpropane	**CBSE COMPTT. 2024**
Value points	(D)	**1**
10	A primary alkyl halide would prefer to undergo _____. (A) S_N2 reaction (B) S_N1 reaction (C) Electrophilic substitution reaction (D) Racemisation	**CBSE 2024 (Visually impaired students)**
Value points	(A)	**1**

	For questions number 1 to 4 below, two statements are given —one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (C) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A)** : The boiling points of alkyl halides decrease in the order : RI > RBr > RCf > RF. **Reason (R) :** The boiling points of alkyl chlorides, bromides and iodides are considerably higher than that of the hydrocarbon of comparable molecular mass	**CBSE 2025**
Value points	(B)	**1**
2	**Assertion (A) :** Presence of $-NO_2$ group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution reactions. **Reason (R) :** Nitro group decreases the electron density over the benzene ring.	**CBSE COMPTT. 2025**
Value points	(A)	**1**
3	**Assertion (A) :** Nucleophilic substitution reaction of chlorobenzene is easier than that of chloroethane. **Reason (R) :** C – C*l* bond in chlorobenzene has partial double bond character due to resonance.	**CBSE 2025 (Visually impaired students)**
Value points	(D)	**1**
4	**Assertion (A):** Inversion of configuration is observed in SN^2 reaction. **Reason (R):** The reaction proceeds with the formation of carbocation.	**CBSE 2024**
Value points	(C)	**1**
	Short answers type questions with Value Points (2 marks)	
1	Draw the structures of major monohalo products in each of the following reactions : (a)  (b) 	**CBSE COMPTT. 2024**

Value points	(a)  (b) 	**1** **1**
	Short answers type questions (3 marks)	
1	Draw the structure of the major monohalo product for each of the following reaction : (a)  (b)  (c) 	**CBSE 2025**
Value points	(a)  (b)  (c) 	**1x3=3**
2	How do you convert : a. Chlorobenzene to biphenyl b. Propene to l-Iodopropane c. 2-bromobutane to but-2-ene.	**CBSE 2025**
Value points	**(a)**  **(b)**  **(c)** 	**1x3=3**

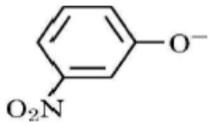
3	Identify 'A' to 'F' in the following reaction sequence :  	**CBSE COMPTT. 2025**
Value points	A = $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2MgBr$ B = $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3$ C = $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-OC_2H_5$ D = $CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2$ E = $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{Br}{|}}{C}}-CH_3$ F = $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$	½ + ½ ½ + ½ ½ + ½
4.	What happens when : (i) methyl chloride is treated with KCN ? (ii) methyl bromide is treated with NaI in dry acetone ? (iii) methyl bromide is treated with silver fluoride ?	**CBSE COMPTT. 2025**
Value points	(i) CH_3CN / Methyl cyanide / Ethanenitrile is formed. (ii) CH_3I / Iodomethane / Methyl iodide is formed. (iii) CH_3F / Fluoromethane / Methyl fluoride is formed.	**1** **1** **1**
5	Define Racemization. Out of S_N1 and S_N2 reactions, which is accompanied by racemization ? Give reason in support of your answer.	**CBSE 2025 (Visually impaired students)**
Value points	• The process of conversion of an enantiomer into a racemic mixture is known as racemisation. • S_N1 • In S_N1 the carbocation formed is sp^2 hybridised and planar.	**1** **1** **1**
6	Account for the following: (a) Haloalkanes react with AgCN to form isocyanide as main product. (b) Allyl chloride shows high reactivity towards SN1 reaction. (c) Haloarenes are extremely less reactive towards nucleophilic substitution reactions.	**CBSE 2024**
Value points	a) AgCN is mainly covalent in nature and only nitrogen is free to donate electron pair forming isocyanide as the main product. b) Allyl carbocation formed is resonance stabilized. 	**1** **1**

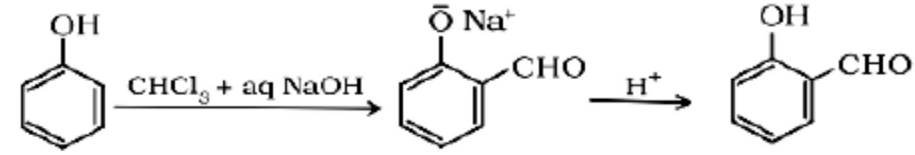
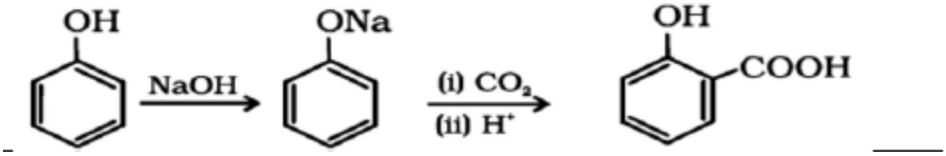
	c) Due to Resonance, a partial double bond is formed between C atom in C—X bond / Instability of phenyl cation/ sp^2 hybridization of carbon atom in C-X bond	**1**
7	Account for the following : (a) The dipole moment of chlorobenzene is lower than that of cyclohexylchloride. (b) Alkyl halides are immiscible in water. (c) t-butyl bromide has lower boiling point than n-butyl bromide.	**CBSE COMPTT. 2024**
Value points	(a) Due to –I and +R effect in chlorobenzene net dipole moment is lower than that of cyclohexyl chloride in which net dipole moment is due to –I effect only / sp^2 hybridized carbon in chlorobenzene is more electronegative and C-Cl bond length is shorter as compared to sp^3 hybridized carbon in cyclohexyl chloride. (b) Less energy is released when new attractions are set up between the alkyl halide and the water molecules as these are not as strong as the original hydrogen bonds in water / Alkyl halides are unable to form hydrogen bond with water. (c) Due to branching t-butyl bromide has weaker van der Waal forces than n-butyl bromide.	**1½** **1½**

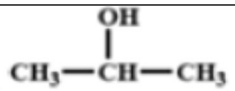
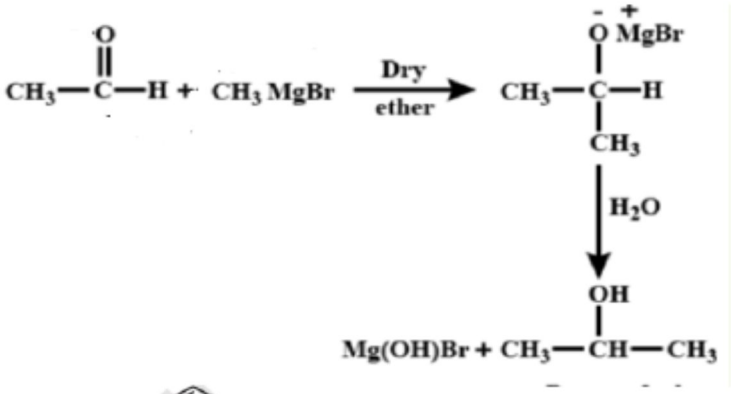
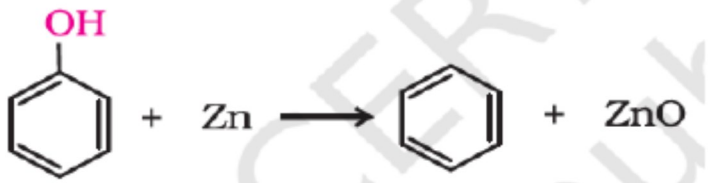
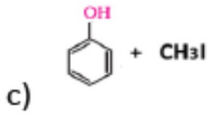
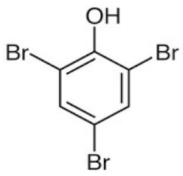
Chapter 7
Alcohol , Phenol & Ethers

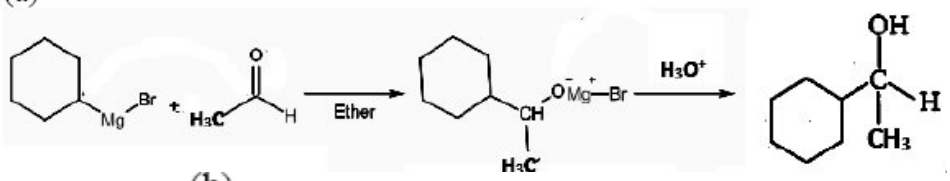
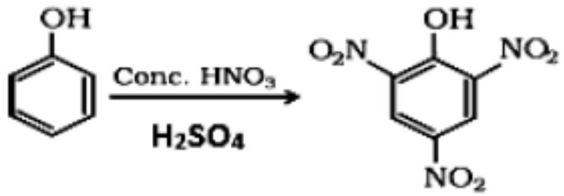
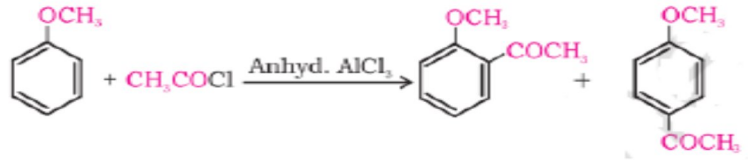
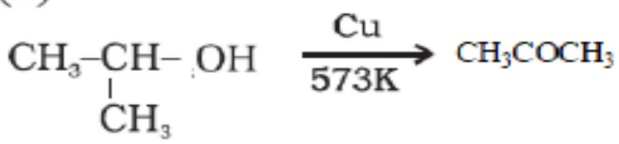
Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	Which is the correct order of acid strength from the following ? (A) $C_6H_5OH > H_2O > ROH$ (B) $C_6H_5OH > ROH > H_2O$ (C) $ROH > C_6H_5OH > H_2O$ (D) $H_2O > C_6H_5OH > ROH$	**CBSE 2025**
Value points	(A)	**1**
2	Out of the following organic compounds, the one which will react with Lucas	**CBSE**

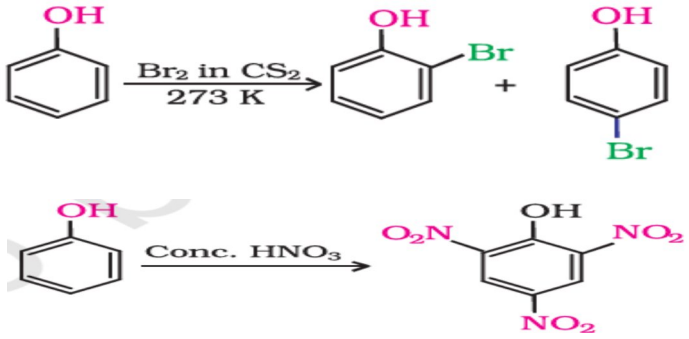
	reagent at room temperature is : (A) $CH_2 = CH - CH_2OH$ (B) $CH_3CH_2CH_2OH$ (C) $C_6H_5CH_2OH$ (D) $(CH_3)_3COH$	**COMPTT. 2025**
Value points	(D)	**1**
3	When phenyl methyl ether is heated with HI, it produces : (A) Methyl chloride and Iodobenzene (B) Benzene and Methanol (C) Iodobenzene and Methanol (D) Phenol and Methyl iodide	**CBSE COMPTT. 2025**
Value points	(D)	**1**
4	The compound which undergoes dehydration most easily is (A) 2-Methylpropan –2– ol (B) Ethanol (C) 2-Methylbutan –2– ol (D) Propan –1– ol	**CBSE 2025 (Visually impaired students)**
Value points	(C)	**1**
5	Benzene diazonium chloride on hydrolysis gives (A) Chlorobenzene (B) Phenol (C) Anisole (D) Aniline	**CBSE 2025 (Visually impaired students)**
Value points	(B)	**1**
6	Out of the following alkenes, the one which will produce tertiary butyl alcohol on acid catalysed hydration is (A) $CH_3CH_2CH = CH_2$ (B) $CH_3CH = CH_2$ (C) $CH_3 - CH = CH - CH_3$ (D) $(CH_3)_2C = CH_2$	**CBSE 2024**
Value points	(D)	**1**
7	Which of the following species can act as the strongest base ? (A) OH– (B) C_6H_5O– (C) RO^- (D)	**CBSE 2024**

		
Value points	(C)	**1**
8	Williamson's synthesis of preparing dimethyl ether is a/an (A) electrophilic substitution (B) S_N1 reaction (C) electrophilic addition (D) S_N2 reaction	**CBSE COMPTT. 2024**
Value points	(D)	**1**
9	Phenol is less acidic than : (A) Ethanol (B) o-cresol (C) p-cresol (D) o-nitrophenol	**CBSE 2024 (Visually impaired students)**
Value points	(D)	**1**
	For questions number 1 to 4 below, two statements are given —one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A) :** The boiling point of ethanol is higher than that of methoxymethane. **Reason (R) :** There is intramolecular hydrogen bonding in ethanol.	**CBSE 2025**
Value points	(C)	**1**
2	**Assertion (A) :** p-methoxyphenol is a stronger acid than p- nitrophenol. **Reason (R) :** Methoxy group is electron-donating group whereas nitro group is electron- withdrawing.	**CBSE COMPTT. 2025**
Value points	(D)	**1**
3	**Assertion (A) :** $(CH_3)_3C–O–CH_3$ gives $(CH_3)_3C–I$ and CH_3OH on treatment with HI. **Reason (R) :** The reaction occurs by SN^1 mechanism.	**CBSE 2025 (Visually impaired**

		students)
Value points	(A)	**1**
4	**Assertion (A):***p*-methoxyphenol is a stronger acid than *p*-nitrophenol. **Reason (R):** Methoxy group shows +I effect whereas nitro group shows -I effect.	**CBSE 2024**
Value points	(D)	**1**
	Short answers type questions with Value Points (2 marks)	
1	Write the reaction involved in the following : (a) Reimer-Tiemann reaction (b) Kolbe's reaction	**CBSE COMPTT. 2024**
Value points	(a)  (b)  	**1** **1**
2	A and B are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer B forms a precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae of A and B.	**CBSE 2024 (Visually impaired students)**
Value points	**A** = CH_3CH_2CHO **B** =CH_3COCH_3	**1+1**
	Short answers type questions with Value Points (3 marks)	
1	Give reasons for the following : 3 (a) t-butyl bromide on reaction with sodium methoxide gives alkene as main product and not ether. (b) o-nitrophenol is steam volatile while p-nitrophenol is not. (c) Alcohol is less acidic than phenol.	**CBSE COMPTT. 2025**
Value points	(a) Beside being a nucleophile, methoxide acts as a strong base. Thus, elimination reaction predominates over substitution to give alkene as the main product and not ether. (b) Due to intramolecular H-bonding in o-nitrophenol, whereas intermolecular H-bonding in p- nitrophenol. (c) Alkoxide ion is less stable than the phenoxide ion, which is resonance stabilised.	**1** **1** **1**
2	What happens when (a) Ethanal is treated with CH_3MgBr followed by hydrolysis ? (b) Phenol is treated with Zinc dust ?	**CBSE 2025 (Visually**

	(c) Anisole is treated with HI ?	**impaired students)**
Value points	a)  / Propan-2-ol is formed/  b) Benzene () is formed /   c) / Phenol and methyl iodide are formed / 	**1x3=3**
3	Give the structure of the major product expected from the following reactions: (a) Reaction of ethanal with methyl-magnesium bromide followed by hydrolysis. (b) Hydration of But-1-ene in the presence of dilute sulphuric acid. (c) Reaction of phenol with bromine water.	**CBSE 2024**
Value points	a)$CH_3CH(OH)CH_3$ b) $CH_3CH(OH)CH_2CH_3$ c) 	**1x3=3**
4	What happens when : (any three) (a) MgBr is treated with CH_3CHO followed by hydrolysis.	**CBSE COMPTT.**

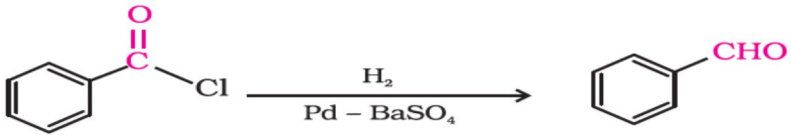
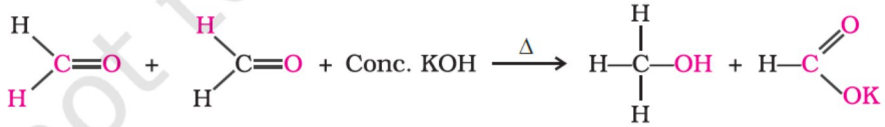
	(b) Phenol is treated with conc. ($HNO_3 + H_2SO_4$). (c) Anisole is treated with CH_3COCl in the presence of anhydrous $AlCl_3$. (d) Propan-2-ol is heated with Cu at 573 K.	**2024**
Value points	(a)  (b)  (c)  (d)  	**1x3=3**
	Case based questions with Value Points (4 marks)	
1	Phenols undergo electrophilic substitution reactions readily due to the strong activating effect of OH group attached to the benzene ring. Since, the OH group increases the electron density more to o— and p— positions therefore OH group is ortho, para-directing. Reimer-Tiemann reaction is one of the examples of aldehyde group being introduced on the aromatic ring of phenol, ortho to the hydroxyl group. This is a general method used for the ortho-formylation of phenols. Answer the following questions : (a) What happens when phenol reacts with (i) Br_2/CS_2 (ii) Cone. HNO_3 (b) Why phenol does not undergo protonation readily ? (c) Which is a stronger acid — phenol or cresol ? Give reason. **OR** (c) Write the IUPAC name of the product formed in the Reimer-Tiemann reaction	**CBSE 2025**
Value	(a)(i)	**1+1**

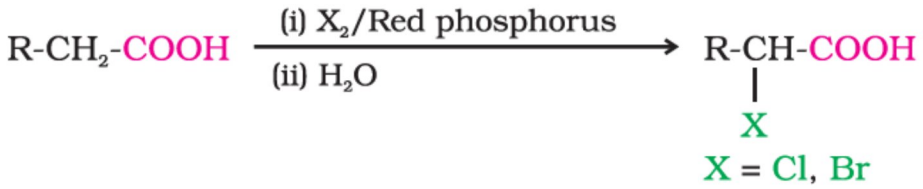
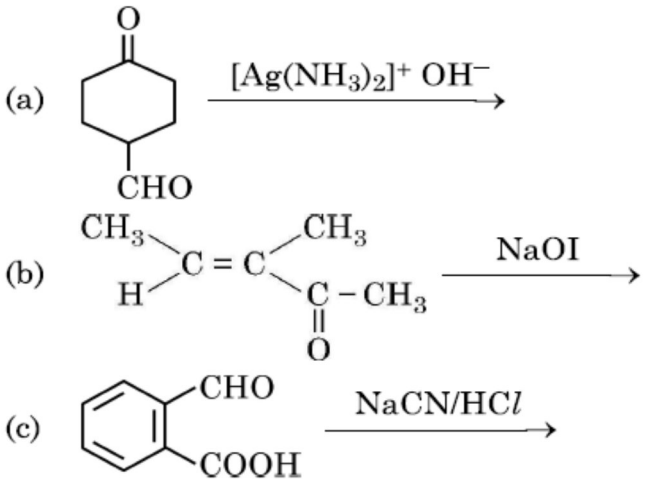
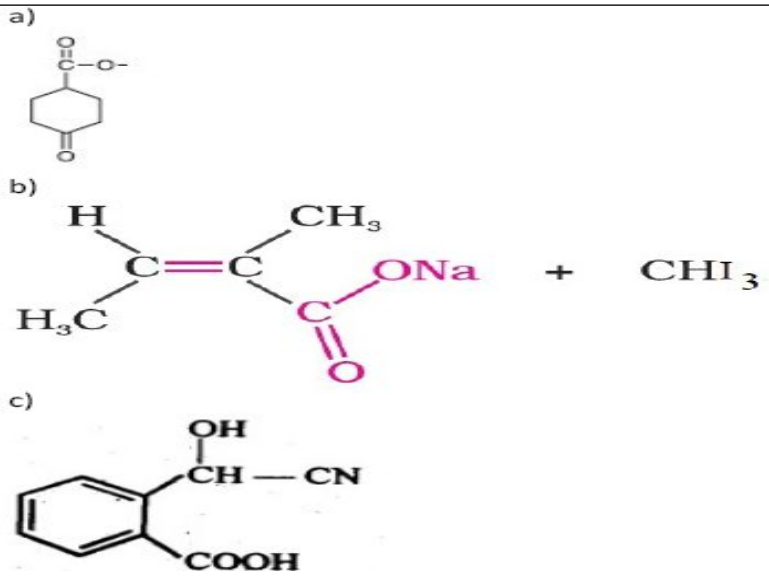
points	(ii)  (b) Due to resonance, the lone pair of electrons on oxygen is not easily available for protonation. (c) Phenol Due to electron releasing effect (+I effect) of methyl group/ phenoxide ion formed is less stable in cresol. **OR** (c) 2-Hydroxybenzaldehyde	**1** **½ + ½** **1**

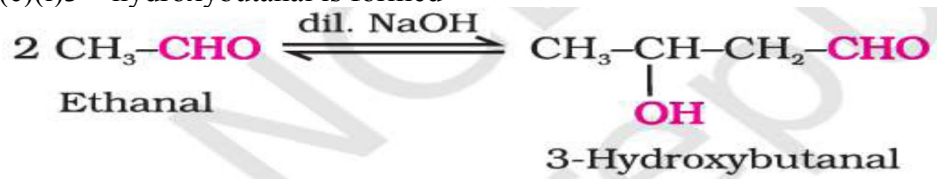
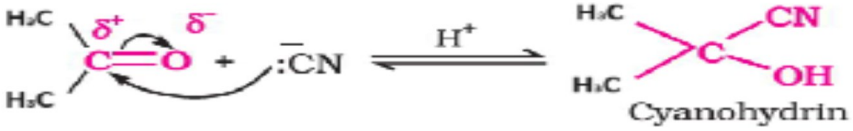
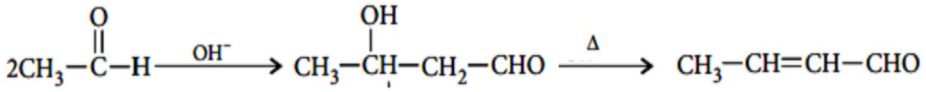
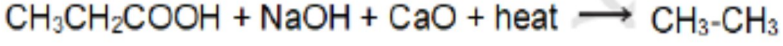
Chapter 8
Aldehydes , Ketones & Carboxylic Acids

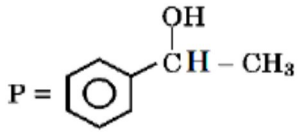
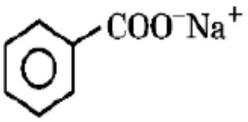
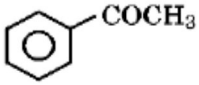
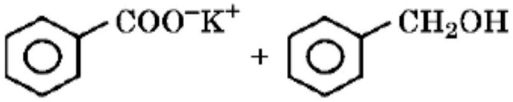
Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	The acid formed when propyl magnesium bromide is treated with CO_2 followed by acid hydrolysis is: (A) C_3H_7COOH (B) C_2H_5COOH	**CBSE 2025**

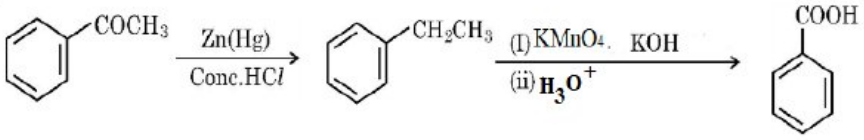
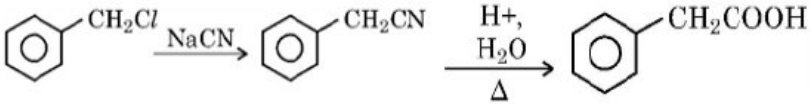
	(C) CH_3COOH (D) C_3H_7OH	
Value points	(A)	**1**
2	Which of the following does not undergo Aldol condensation ? (A) CH_3CHO (B) CH_3COCH_3 (C) CH_3CH_2CHO (D) C_6H_5CHO	**CBSE COMPTT. 2024**
Value points	(D)	**1**
3	Which of the following compounds is most reactive towards nucleophilic addition reactions ? (A) CH_3CHO (B) CH_3 CO CH_3 (C) C_6H_5CHO (D) C_6H_5 CO CH_3	**CBSE 2024 (Visually impaired students)**
Value points	(A)	**1**
	For questions number 1 below, two statements are given —one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A) :** Bromination of benzoic acid gives m-bromobenzoic acid. **Reason (R) :** Carboxyl group acts as a deactivating and meta-directing group.`	**CBSE 2024 (Visually impaired students)**
Value points	(A)	**1**
	Short answers type questions with Value Points (2 marks)	
1	Would you expect benzaldehyde to be more reactive or less reactive in nucleophilic addition reactions than propanal ? Justify your answer.	**CBSE 2025**
Value points	• Less reactive, • The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in propanal.	**1** **1**
2	Account for the following : (i) CH_3CHO is more reactive than CH_3COCH_3 towards reaction withHCN. (ii) Carboxylic acids are higher boiling liquids than aldehydes and ketones.	**CBSE COMPTT. 2024**

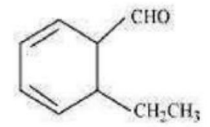
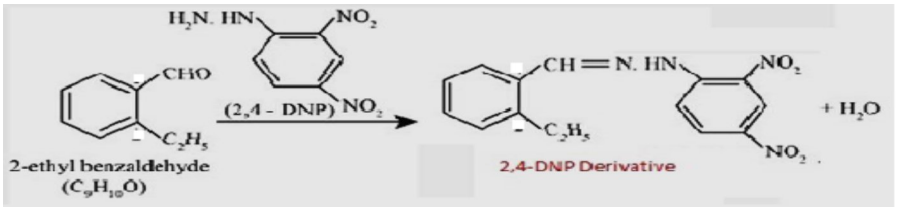
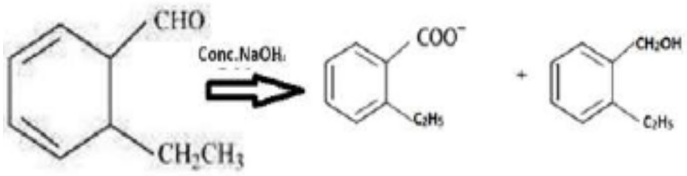
Value points	(i) In CH_3CHO carbonyl carbon is more electrophilic and has less steric hinderance than CH_3COCH_3. (ii) Due to intermolecular hydrogen bonding in carboxylic acids / due to dimer formation.	**1** **1**
3	Give chemical tests to distinguish between the following pair of compounds : (i) Propanal and Propanone (ii) Benzaldehyde and Benzoic acid	**CBSE COMPTT. 2024**
Value points	(i) Add NaOH + I_2 to both the compounds separately and heat.Propanone will form yellow precipitate of CHI_3 whereas propanal will not. (ii) Add $NaHCO_3$ to both the compounds separately. Benzoic acid will give the brisk effervescence of CO_2 while benzaldehyde does not.	**1** **1**
	Short answers type questions with Value Points (3 marks)	
1	Give plausible explanation for each of the following : (a) Sodium hydrogen sulphite is used for separation and purification of aldehydes. (b) 2,2,6-trimethylcyclohexanone does not form cyanohydrin. (c) Only one – NH_2 group of semicarbazide is involved in the formation of semicarbazone.	**CBSE COMPTT. 2025**
Value points	(a) Because aldehydes form water soluble hydrogensulphite addition compounds which can be converted back to the aldehydes on treating it with dilute mineral acid or alkali. (b) Due to steric hindrance created by three methyl groups / Due to steric hindrance. (c) The other -NH_2 group is in resonance with the carbonyl group.	**1** **1** **1**
2	Explain the following reactions : (a) Rosenmund's Reduction (b) Cannizzaro's reaction (c) Hell-Volhard Zelinsky reaction	**CBSE 2025 (Visually impaired students)**
Value points	a)When an acid chloride is treated with H_2 , Pd-$BaSO_4$ an aldehyde is formed.  b)When aldehyde with no α-hydrogen atom is treated with conc.KOH, it undergoesdisproportionation to form alcohol and carboxylate ion.  c)When carboxylic acids having an α-hydrogen are halogenated with Cl_2/Br_2 in presence of red phosphorous, α-hhalogen acids are formed	**1x3=3**

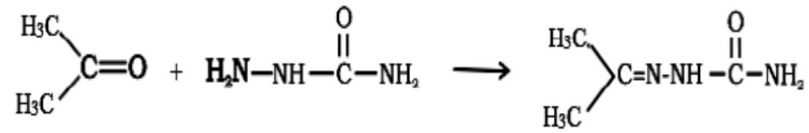
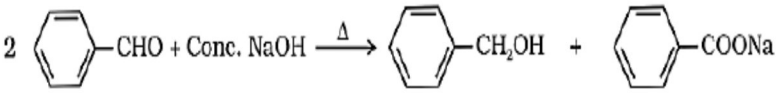
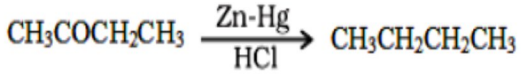
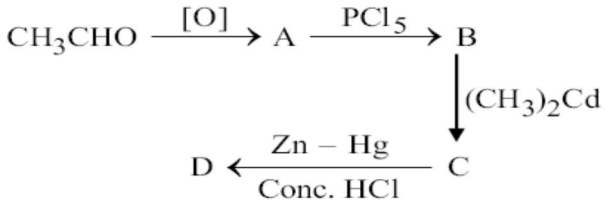
		
3	Draw the structures of major product(s) in each of the following reactions: 	**CBSE 2024**
Value points		**1x3=3**
	Case based questions with Value Points (4 marks)	
1	Aldehydes and ketones undergo nucleophilic addition reactions on to the carbonyl group but carboxylic acids do not undergo nucleophilic addition reaction. The alpha (α)-hydrogens of aldehydes and ketones are acidic in nature. Therefore aldehydes and ketones having at least one α-hydrogen undergo Aldol condensation. Aldehydes are easily oxidized by mild oxidizing agents such as Tollen's reagent and Fehling reagent. (a) Why does methanal not undergo Aldol condensation ? (b) Why are -hydrogens of aldehydes and ketones acidic in nature ? (c) (i) Why are aldehydes easily oxidised as compared to ketones ? (ii) Why is addition of sodium hydrogen sulphite to aldehydes used for separation and purification of aldehydes ?	**CBSE 2024 (Visually impaired students)**

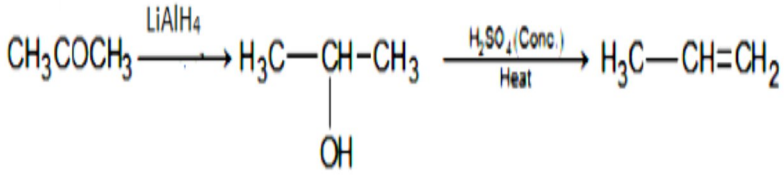
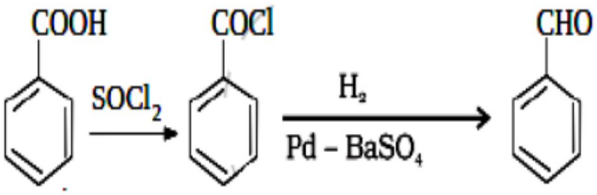
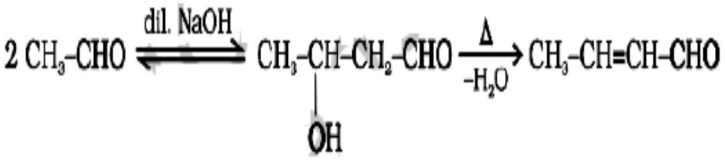
	OR (c) What happens when : (i) ethanal is treated with dilute NaOH ? (ii) propanone is treated with HCN ?	
Value points	(a)Due to the absence of α – hydrogen atom (b)Due to resonance stabilized conjugate base. (c)(i)Because oxidation of aldehydes involve cleavage of C-H bond which is easier than C-C bond. (ii)Because the addition compounds are water soluble and can be converted back to original carbonyl compounds by treating them with dilute mineral acid or alkali. (c)(i)3 – hydroxybutanal is formed  (ii)Propanone cyanohydrin is formed  	**1** **1** **1+1** **1+1**
	Long answer type questions with Value Points (5 marks)	
1	(a) Carry out the following conversions : (i) Ethanal to But-2-enal (ii) Propanoic acid to ethane (b) An alkene A with molecular formula C_5H_{10} on ozonolysis gives a mixture of two compounds B and C. Compound B gives positive Fehling test and also reacts with iodine and NaOH solution. Compound C does not give Fehling solution test but forms iodoform. Identify the compounds A, B and C.	**CBSE 2025**
Value points	(a) (i)  (ii) (b) A = $(CH_3)_2CH=CHCH_3$ / 2-Methylbut-2-ene  B = CH_3CHO / Ethanal C = CH_3COCH_3/ Acetone/ Propanone	**1+1** **1** **1** **1**
2	An organic compound (A) (molecular formula $C_8H_{16}O_2$) was hydrolysed with dilute sulphuric acid to get a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives But-l-ene. Identify (A), (B) and (C) and write chemical equations for the reactions involved.	**CBSE 2025**
Value points	A= $C_3H_7COOC_4H_9$ / Butyl butanoate B= C_3H_7COOH / Butanoic acid	**1** **1**

	C= C_4H_9OH / Butan-1-ol $C_3H_7COOC_4H_9$+ dil.H_2SO_4 → C_3H_7COOH + C_4H_9OH C_4H_9OH + Conc. Sulphuric acid + Heat→$CH_3CH_2CH=CH_2$ $C_4H_9OH \xrightarrow{CrO_3 / CH_3COOH} C_3H_7COOH$	**1** **1** **1**
3	(i) An organic compound 'P' (C8H10O) on oxidation gave compound 'Q'. The compound 'Q' can also be obtained from a reaction of benzene with acetyl chloride in the presence of anhydrous AlCl3. 'Q' on treatment with I2 in aq. NaOH gave 'R' and a yellow compound 'S'. Identify 'P', 'Q', 'R' and 'S'. (ii) Give the structure(s) of the product(s) when benzaldehyde is heated in the presence of conc. KOH.	**CBSE COMPTT. 2025**
Value points	(i) P =  R =  Q =  S = CHI_3 (ii) 	**1x4=4** **1**
4	(i) Carry out the following conversions : (I) Propanone to Propane (II) Acetophenone to Benzoic acid (III) Benzyl chloride to Phenylethanoic acid (ii) Give a simple chemical test to distinguish between the following pairs of compounds : (I) Benzaldehyde and Phenol (II) Butanal and Butan-2-one	**CBSE COMPTT. 2025**
Value points		**1x3=3**

	(i) (I) $CH_3COCH_3 \xrightarrow[\text{Conc. } HCl]{Zn-Hg} CH_3CH_2CH_3$ (II)  (ii)(I) Benzaldehyde will form a silver mirror on warming it with Tollens' reagent, whereas Phenol will not. (II) Butan-2-one on heating with NaOH & I_2 will give yellow ppt of CHI_3,whereas butanal will not. (III) 	1 1
5	(a) 'A' and 'B' are two functional isomers of compound C_4H_8O. On heating with NaOH and I_2, isomer 'B' forms yellow precipitate of iodoform whereas isomer 'A' does not form any precipitate. (i) Identify 'A' and 'B'. (ii) What happens when isomer 'A' is treated with Zn(Hg) in the presence of Conc. HCl ? (iii) Write the reaction of isomer 'B' with NaOH and I_2. (b) Arrange the following in the increasing order of their property as indicated : (i) Ethanol, Ethanoic acid, Ethanal (boiling point). (ii) Ethanal, Methanal, acetone (reactivity towards addition of HCN).	**CBSE 2025 (Visually impaired students)**
Value points	a)i)A: $CH_3CH_2CH_2CHO$, B: $CH_3COCH_2CH_3$ ii)n-Butane is formed / Chemical equation iii) $CH_3\text{-}CO\text{-}CH_2\text{-}CH_2\text{-}CH_3 \xrightarrow{NaOH\,/\,I_2} CHI_3 + CH_3CH_2CH_2COONa$ b)i)ethanal < ethanol < ethanoic acid ii)acetone < ethanal < methanol	**1x3=3** **1** **1**
6	(a) Explain Aldol Condensation with an example. Why alpha (α) hydrogen of aldehydes and ketones are acidic in nature ? (b) Give simple chemical test to distinguish between the following compounds : (i) Benzoic acid and Benzaldehyde (ii) Ethanal and Propanal	**CBSE 2025 (Visually impaired students)**
Value points	a) Aldehydes and ketones having at least one α-hydrogen undergo a reaction in the presence of dilute alkali to form β-hydroxy aldehydes (aldol) or β-hydroxy ketones (ketol), respectively. $2\ CH_3\text{–}CHO \underset{}{\overset{\text{dil. NaOH}}{\rightleftharpoons}} CH_3\text{–}\underset{OH}{CH}\text{–}CH_2\text{–}CHO$ Ethanal • Due to the strong electron withdrawing effect of the carbonyl group and	**1+1** **1**

	resonance stabilisation of the conjugate base. b)i)Add NaHCO3 to both the compounds, benzoic acid gives brisk effervescence while benzaldehyde does not. ii)Add NaOH and I2 to both the compounds and heat, ethanal forms yellow precipitate of iodoform while propanal does not.	**1** **1**
7	An organic compound (A) with the molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Fehling solution and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1, 2-benzene dicarboxylic acid. (i) Identify the compound (A) and write its IUPAC name. (ii) Write the reaction of compound (A) with (1) 2,4-Dinitrophenyl hydrazine and (2) Fehling solution (iii) Write the equation of compound (A) when it undergoes Cannizzaro reaction.	**CBSE 2024**
Value points	(i)  2 – Ethylbenzaldehyde (A) (ii) (1)  (2) Aromatic aldehydes do not give fehling's test (iii)  	**1+1** **1+1** **1**
8	(i) Account for the following: (1) The alpha (a)-hydrogens of aldehydes and ketones are acidic in nature. (2) Oxidation of aldehydes is easier than ketones. (ii) Arrange the following in: (1) Decreasing reactivity towards nucleophilic addition reaction propanal, acetone, benzaldehyde. (2) Increasing order of boiling point: Propane, Ethanol, Dimethylether, Propanal (iii) Give simple chemical test to distinguish between Benzoic acid and Benzaldehyde.	**CBSE 2024**

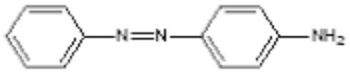
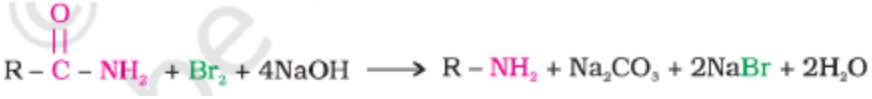
Value points	(i) (1) Electron withdrawing nature of carbonyl group/ Due to resonance stabilization of the conjugate base. (2) Due to cleavage of C-H bond in aldehydes is easier than C-C bond in Ketones (ii) (1) propanal> benzaldehyde > Acetone (2) Propane < dimethyl ether <propanal< ethanol (iii) Benzoic acid will give brisk effervescence on reacting with $NaHCO_3$ whereas inn benzaldehyde does not.	**1+1** **1+1** **1**
9	(i) Explain with the help of chemical reaction when : (I) Acetone is treated with semicarbazide. (II) Two molecules of benzaldehyde are treated with conc. NaOH. (III) Butan-2-one is treated with Zn/Hg and conc. HCl. (ii) Arrange the following in the increasing order of their acidic strength : (I) $CH_3CH_2CH_2COOH$, $BrCH_2CH_2CH_2COOH$, $CH_3CHBrCH_2COOH$, $CH_3CH_2CHBrCOOH$ (II) Benzoic acid, 4-Methoxybenzoic acid, 4-Nitrobenzoic acid 3,4-Dinitrobenzoic acid	**CBSE COMPTT. 2024**
Value points	(i) (I)  (II)  (III)  (ii) (I) $CH_3CH_2CH_2COOH < BrCH_2CH_2CH_2COOH < CH_3CH(Br)CH_2COOH < CH_3CH_2CH(Br)COOH$ (II) 4-Methoxybenzoic acid < Benzoic acid<4-Nitrobenzoic acid <3,4-Dinitrobenzoic acid	**1x3=3** **1x2=2**
10	(i) Identify the products A, B, C and D in the following sequence of reactions :  (ii) How will you bring about the following conversions ? 3´1=3 (I) Propanone to Propene (II) Benzoic acid to Benzaldehyde (III) Ethanal to But-2-enal	**CBSE COMPTT. 2024**

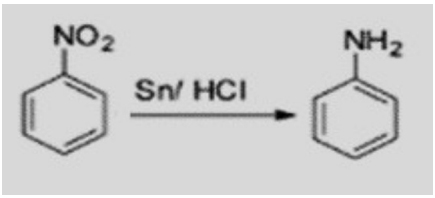
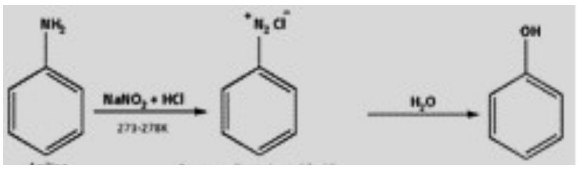
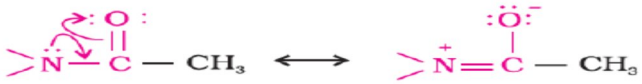
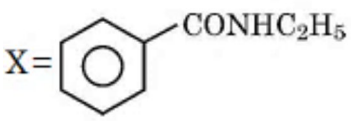
Value points	(i) A = CH_3COOH/ Ethanoic acid/ Acetic acid B = CH_3COCl / Ethanoyl chloride / Acetyl chloride C = CH_3COCH_3/ Propanone / Acetone D = $CH_3\ CH_2CH_3$ / Propane (ii) (I)  (II)  (III) 	**½ x4=2** **1x3=3**

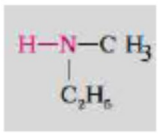
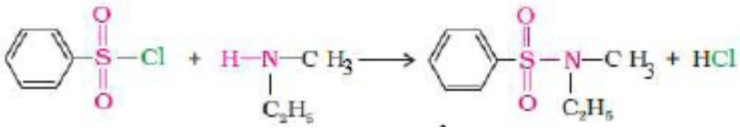
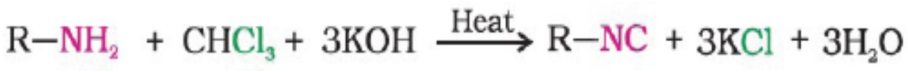
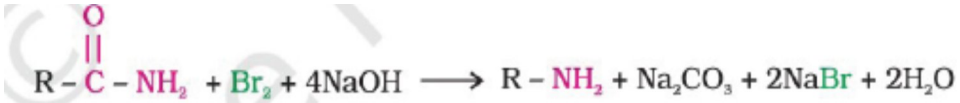
Chapter 9
Amines

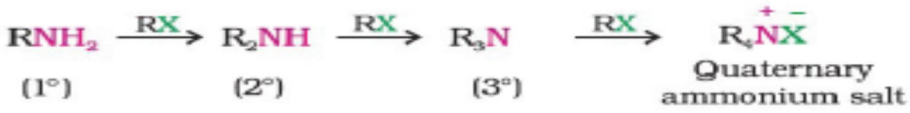
Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	The best reagent for converting propanamide into propanamine is (A) excess H_2 (B) Br_2 in aqueous NaOH (C) iodine in the presence of red phosphorus (D) $LiAlH_4$ in ether	CBSE 2025
Value points	(D)	1
2	Which of the following amines has the highest boiling point ? (A) 2,2-Dimethyl propanamine (B) 3-Methylbutanamine (C) 2-Methylbutanamine (D) Pentanamine	CBSE COMPTT. 2025
Value points	(D)	1
3	The Gabriel Phthalimide Synthesis is used for the preparation of (A) Secondary amines (B) Primary aromatic amines (C) Tertiary amines (D) Primary aliphatic amines	CBSE 2025 (Visually impaired students)
Value points	(D)	1
4	The correct name of the given reaction is $Ar-N_2^+X^- \xrightarrow{Cu\ CN/KCN} Ar-CN + N_2$ (A) Sandmeyer's reaction (B) Gabriel Phthalimide synthesis (C) Carbyl amine reaction (D) Hoffmann bromamide degradation reaction	CBSE 2024
Value points	(A)	1
5	If amines are arranged in increasing order of their basic strength in gaseous phase, then the correct order will be : (A) $NH_3 < CH_3NH_2 < (CH_3)_3N < (CH_3)_2NH$ (B) $NH_3 < (CH_3)_2NH < (CH_3)_3N < CH_3NH_2$ (C) $(CH_3)_3N < (CH_3)_2NH < CH_3NH_2 < NH_3$ (D) $NH_3 < CH_3NH_2 < (CH_3)_2NH < (CH_3)_3N$	CBSE COMPTT. 2024
Value points	(D)	1

6	The chemical test which can be used to distinguish between ethanamine and aniline is : (A) Haloform test (B) Tollens' test (C) Azo dye test (D) Hinsberg test	**CBSE COMPTT. 2024**
Value points	(C)	**1**
7	Reduction of aromatic nitro compounds using Sn and HCl gives : (A) Aromatic amide (B) Aromatic oxime (C) Aromatic primary amine (D) Aromatic hydrocarbon	**CBSE 2024 (Visually impaired students)**
Value points	(C)	**1**
8	Methylamine reacts with HNO_2 to form : (A) CH_3 O N = O (B) CH_3 O CH_3 (C) CH_3 OH (D) CH_3 CHO	**CBSE 2024 (Visually impaired students)**
Value points	(C)	**1**
9	Which one of the following has the lowest pK_b value ? (A) Ammonia (B) Aniline (C) Methylamine (D) Dimethylamine	**CBSE 2024 (Visually impaired students)**
Value points	(D)	**1**
	For questions number 1 below, two statements are given —one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A) :** Acetanilide is less basic than aniline. **Reason (R) :** Acetylation of aniline results in decrease of electron density on nitrogen.	**CBSE COMPTT. 2024**
Value points	(A)	**1**

	Short answers type questions with Value Points (2 marks)	
1	Identify A and B in each of the following reaction sequence : (a) $CH_3CH_2Cl \xrightarrow{NaCN} A \xrightarrow{H_2/Ni} B$ (b) $C_6H_5NH_2 \xrightarrow[0-5\,^\circ C]{NaNO_2/HCl} A \xrightarrow[H^+]{C_6H_5NH_2} B$	**CBSE 2025**
Value points	(a) A = CH_3CH_2CN ; B= $CH_3CH_2\ CH_2NH_2$ (b) A = $C_6H_5N_2^+Cl^-$; B = 	**½ +½** **½ +½**
2	(a) Name the reaction which can be used to distinguish chemically between aniline and N,N-dimethylaniline. (b) Why can aniline not be prepared by the ammonolysis of chlorobenzene under normal conditions ?	**CBSE COMPTT. 2025**
Value points	(a) Carbylamine reaction (b) C – Cl bond is not cleaved easily by NH_3 due to partial double bond character of C – Cl bond.	**1** **1**
3	How do you convert the following ? (i) Ethanenitrile to Ethanamine (ii) Benzenediazonium chloride to benzonitrile	**CBSE 2025 (Visually impaired students)**
Value points	(i)  ii) 	**1+1**
4	(i) Write a simple chemical test to distinguish between ethanamine and dimethylamine. (ii) What happens when CH_3CONH_2 is heated with Br_2 and an aqueous solution of NaOH ?	**CBSE 2025 (Visually impaired students)**
Value points	i)Add chloroform with alc. KOH to both the compounds and heat, ethanamine will give foul smell of isocyanide while dimethylamine does not. ii) CH_3NH_2 methanamine is formed 	**1+1**
5	Carry out the following conversions: **(i)** Nitrobenzene to Aniline **(ii)** Aniline to Phenol	**CBSE 2024**

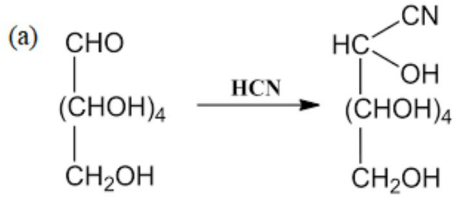
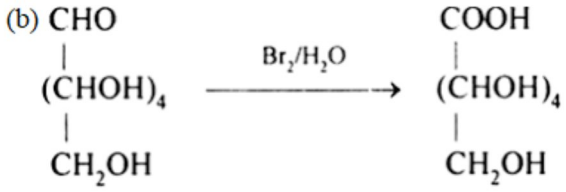
Value points	(i)  (ii)  	**1+1**
6	**(i)** Write a chemical test to distinguish between Dimethyl amine and Ethanamine. **(ii)** Write the product formed when benzene diazonium chloride is treated with KI.	**CBSE 2024**
Value points	(i) On reaction with alc. KOH and chloroform, ethanamine gives foul smelling isocyanide whereas dimethylamine does not. (ii) iodobenzene	**1+1**
	Short answers type questions with Value Points (3 marks)	
1	(a) Arrange the following compounds in increasing order of their boiling poi $(CH_3)_2NH$, $CH_3CH_2NH_2$, CH_3CH_2OH. (b)Give plausible explanation for each of the following : (i) Aromatic primary amines cannot be prepared by Gabriel Phthalimide synthesis. (ii) Amides are less basic than amines.	**CBSE 2025**
Value points	(a) $(CH_3)_2NH < CH_3CH_2NH_2 < CH_3CH_2OH$. (b) (i) aromatic halides do not undergo nucleophilic substitution with the anion formed by phthalimide. (ii) Due to resonance the lone pair on nitrogen is less available for donation 	**1** **1** **1**
2	Ethanamine reacts with benzoyl chloride to form a product 'X'. Give the structure and IUPAC name of 'X'. Can 'X' undergo Hoffmann bromamide degradation reaction ? If yes, then give the structure of the product. If no, then give reason.	**CBSE COMPTT. 2025**
Value points	 • Name: N-Ethylbenzamide. • No, 'X' will not undergo the Hoffmann bromamide degradation reaction. • As it is a N-substituted amide	**½ + ½** **1** **1**
3	Give reactions for the following :	**CBSE**

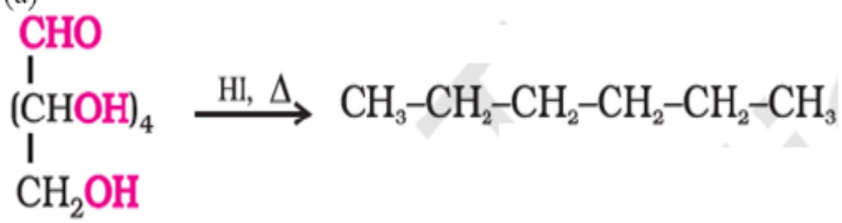
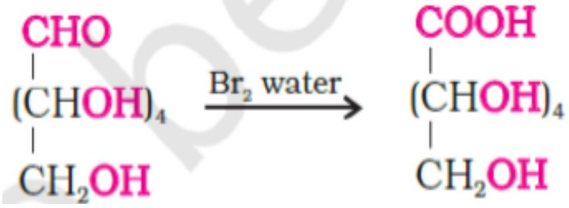
	(i) Aniline does not undergo Friedel – Crafts reaction. (ii) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution. (iii) Ethyl amine is soluble in water whereas aniline is insoluble.	**2025 (Visually impaired students)**
Value points	i) Due to salt formation with aluminium chloride, the Lewis acid. ii) Due to more hydration and less steric hinderance. iii) Because it can form hydrogen bonds with water molecules, while aniline does not form due to bulky benzene molecule.	**1** **1** **1**
4	A compound 'X' with molecular formula C_3H_9N reacts with $C_6H_5SO_2Cl$ to give a solid, insoluble in alkali. Identify 'X' and give the IUPAC name of the product. Write the reaction involved.	**CBSE 2024**
Value points	X=  IUPAC name of the product- **N-Ethyl-N-methylbenzene sulphonamide** 	**1+1** **1**
5	Give plausible explanation for the following : (a) Diazonium salts of aromatic amines are stable. (b) Aniline does not undergo Friedel-Crafts reaction. (c) Aniline on nitration gives a substantial amount of meta product.	**CBSE COMPTT. 2024**
Value points	(a) Due to resonance stabilisation of diazonium salts of aromatic amines. (b) Aniline forms salt with Lewis acid anhydrous $AlCl_3$. (c) Due to the formation of anilinium ion which is deactivating.	**1** **1** **1**
6	Explain the following : (a) Carbylamine reaction (b) Hoffmann bromamide degradation reaction (c) Ammonolysis	**CBSE 2024 (Visually impaired students)**
Value points	a)**Carbylamine Reaction:** Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines which are foul smelling substances.  b)**Hoffmann Bromamide reaction:** It is a method for preparation of primary amines by treating an amide with bromine in an aqueous or ethanolic solution of sodium hydroxide. The amine so formed contains one carbon less than that present in the amide.  c)**Ammonolysis:** An alkyl or benzyl halide on reaction with an	**1x3=3**

	ethanolic solution of ammonia undergoes nucleophilic substitution reaction in which the halogen atom is replaced by an amino (NH_2) group. This process of cleavage of the C–X bond by ammonia molecule is known as ammonolysis.  	

Biomolecules

Q. No.	MCQ (multiple-choice questions) with Value Points (1 Mark each)	Main / Comptt With marks
1	Which of the following statements is not true about glucose ? (A) It is an aldohexose. (B) On heating with HI it forms n-hexane. (C) It exists in furanose form. (D) It does not give Schiff's test.	CBSE 2025
Value points	(C)	1
2	Glucose on reaction with Br_2 water gives : (A) Gluconic acid (B) Hexanoic acid (C) Saccharic acid (D) Glycolic acid	CBSE COMPTT. 2025
Value points	(A)	1
3	Which of the following is a polysaccharide ? (A) Maltose (B) Glucose (C) Cellulose (D) Sucrose	CBSE 2025 (Visually impaired students)
Value points	(C)	1
4	The specific sequence in which amino acids are arranged in a protein is called its (A) Primary structure (B) Secondary structure (C) Tertiary structure (D) Quaternary structure	CBSE 2024
Value points	(A)	1
5	Nucleic acids are the polymers of : (A) Nucleotides (B) Nucleosides (C) Bases (D) Sugars	CBSE 2024 (Visually impaired students)
Value points	(A)	1
	For questions number 1 to 3 below, two statements are given —one	

	labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true	
1	**Assertion (A)** : All naturally occurring o-amino acids except glycine are optically active. **Reason (R) :** Most naturally occurring amino acids have L-configuration.	**CBSE 2025**
Value points	(B)	**1**
2	**Assertion (A) :** Maltose is a reducing sugar. **Reason (R) :** Maltose is composed of two glucose units in which C-1 of one glucose unit is linked to C-4 of another glucose unit.	**CBSE COMPTT. 2024**
Value points	(B)	**1**
3	**Assertion (A) :** Vitamin C cannot be stored in our body. **Reason (R) :** Vitamin C is fat soluble and is excreted from the body in urine.	**CBSE 2024 (Visually impaired students)**
Value points	(C)	**1**
	Short answers type questions with Value Points (2 marks)	
1	Write the reactions involved when D-glucose is treated with the following reagents : (a) HCN (b) Br_2 water	**CBSE 2025**
Value points	(a)  (b)  	**1+1**
2	Give one point of difference between the following : (a) Starch and Cellulose (b) Primary and Secondary structure of protein	**CBSE COMPTT. 2025**
Value	(a) Starch is made up of α-D glucose units while cellulose is made up of	**1**

points	β-D glucose units. (b) Amino acids linked with each other in a specific sequence is a primary structure while secondary structure refers to the shape in which a long polypeptide chain can exist.	**1**
3	What is the effect of denaturation on the structures of protein ? Give one example each of fibrous protein and globular protein.	**CBSE 2025 (Visually impaired students)**
Value points	The hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity Fibrous protein- keratin/ Myosin Globular protein- Insulin / Albumin	**1** **½ +½**
4	Classify the following sugars into monosaccharides and disaccharides: Galactose, Glucose, Lactose and Maltose	**CBSE 2024**
Value points	Monosaccharides: Galactose, Glucose Disaccharides : Lactose, Maltose	**½ +½** **½ +½**
5	Write the reaction of glucose with : (a) HI (b) Br_2 water	**CBSE COMPTT. 2024**
Value points	(a)  (b) 	**1+1**
	Short answers type questions with Value Points (3 marks)	
1	(a) What is the difference between native protein and denatured protein (b) Which one of the following is a disaccharide ? Glucose, Lactose, Amylose, Fructose (c) Which vitamin is responsible for the coagulation of blood ?	**CBSE 2025**
Value points	(a) **Native protein** / **Denatured protein** Three-dimensional structure is intact. / Three-dimensional structure is destroyed. Biologically active / Biologically inactive (b) Lactose (c) Vitamin K	**1** **1** **1**
	Case based questions with Value Points (4 marks)	

<table>
<tr><td>1</td><td>Reduce carbohydrates, increase protein to check diabetes, older people may need greater carbohydrates reduction. An average Indian derives 61 – 64% of energy from consumption of food rich in carbohydrates. A study published in the Journal of Diabetes Care has recommended reducing this to 49 – 56% for remission or prevention of Type 2 diabetes, one of the leading cause of death worldwide. Along with reducing carbohydrate intake, the study suggests that one should also increase protein intake up to 14 – 20% of the total energy consumption. Fat should contribute not more than 21 – 27% of the total energy consumption. In simple words, 50% of the plate should consist of fruits and green vegetables, 25% carbohydrates, 25% food rich in protein. Type 1 diabetes is due to deficiency of insulin.
Answer the following questions :
(a) Write any two functions of carbohydrates.
(b) What are monosaccharides ?
(c) (i) Write the name of the deficiency diseases caused due to the lack of Vitamin D.
OR
(c) (ii) Name the hormone which maintains the glucose level within narrow limit in the blood.</td><td>CBSE COMPTT. 2025</td></tr>
<tr><td>Value points</td><td>(a) Biofuel, provide energy, an instant source of energy, energy storage, cell wall formation
(b) A carbohydrate that cannot be hydrolysed further to give a simpler unit of polyhydroxy aldehyde or ketone.
(c) (i) Rickets (in children) / Osteomalacia (in adults).
OR
(c) (ii) Insulin.</td><td>1+1
1
1
1</td></tr>
<tr><td>2</td><td>Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups – monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkage to form disaccharides like sucrose, maltose. Another biomolecule : proteins are polymers of α-amino acids which are linked by peptide bonds. On the basis of number of amino group and carboxyl group, amino acids are classified as acidic, basic or neutral amino acids. Amino acids are amphoteric in nature.
(a) What is difference between glycosidic linkage and peptide linkage ?
The pentacetate of glucose does not react with Hydroxyl amine.
What does it indicate ?
(b) Define Oligosaccharides with an example.
OR
(b) Why amino acids are amphoteric in nature ?
(c) Define Acidic amino acids.</td><td>CBSE 2025 (Visually impaired students)</td></tr>
<tr><td>Value points</td><td><table><tr><th>Glycosidic linkage</th><th>Peptide linkage</th></tr><tr><td>A glycosidic linkage is an oxide(-O-) linkage that joins two monosaccharides.</td><td>A peptide linkage is an amide (-CONH-) linkage that forms between two amino acids.</td></tr></table>
• Due to absence of free —CHO group.
b) Carbohydrates that yield two to ten monosaccharide units, on hydrolysis. For example- maltose/ sucrose
OR</td><td>1
1
1
1</td></tr>
</table>

	b) Because it exists in zwitter ionic form which reacts with both acids and bases. c) Amino acids which contain more carboxyl groups as compared to amino groups.	**1**
3	Certain organic compounds are required in small amounts in our diet but their deficiency causes specific disease. These compounds are called vitamins. Most of the vitamins cannot be synthesized in our body but plants can synthesize almost all of them. So they are considered as essential food factors. However, the bacteria of the gut can produce some of the vitamins required by us. All the vitamins are generally available in our diet. The term 'vitamin' was coined from the words vital + amine, since the earlier identified compounds had amino group. Vitamins are classified into two groups depending upon their solubility in water or fat namely-fat soluble vitamins and water soluble vitamins. Answer the following questions: (a) What is the other name of vitamin B_6? (b) Name the vitamin whose deficiency causes increased blood clotting time. (c) Xerophthalmia is caused by the deficiency of which vitamin? Give two sources of this vitamin. OR (c) Why can't vitamin C be stored in our body? Name the disease caused by the deficiency of this vitamin.	**CBSE 2024**
Value points	a) Pyridoxine b) Vitamin K c) Vitamin A Sources-Fish liver oil, carrots. **OR** c) Water soluble and are readily excreted in urine Scurvy	**1** **1** **1+1** **1+1**
4	The particles in the nucleus of the cell, responsible for heredity, are called chromosomes which are made up of proteins and another type of biomolecules called nucleic acids. These are mainly of two types, DNA and RNA. Nucleic acids on hydrolysis yield a pentose sugar, phosphoric acid and nitrogen containing heterocyclic compound. Nucleic acids have a very diverse set of functions, such as cell creation, the storage and processing of genetic information, protein synthesis and the generation of energy cells. Although their functions may differ, the structure of DNA and RNA are very similar, with only a few fundamental differences in their molecular make-up. Based on the above information, answer the following questions : (a) Write two functions of DNA. (b) What products will be formed when a nucleotide from DNA containing Adenine is hydrolyzed ? (c) (i) What are nucleic acids ? What is the difference between nucleotide and nucleoside ? **OR** (c) (ii) Give one similarity and one difference between DNA and RNA.	**CBSE COMPTT. 2024**
Value points	(a) To store information and to transfer traits from one generation to another. (b) Deoxyribose sugar, Adenine and phosphoric acid. (c) (i) The polymer of nucleotides which are responsible for heredity. Nucleosideis made up of nitrogenous bases and sugar whereas nucleotide is made up of nitrogenous bases, sugar and phosphoric acid. **OR**	**½ ½** **1** **1+1**

	(c) (ii) **Similarity:** Both are nucleic acids and are found in the nucleus of the cell. **Difference:** DNA has a double strand while RNA is single stranded	**1+1**
	Long answer type questions with Value Points (5 marks)	
1	Do any five of the following : (a) Pentaacetate of glucose does not react with hydroxylamine. Give reason. (b) Why do amino acids behave like salts ? (c) Why must water soluble vitamins be taken regularly in diet ? (d) Why are the two strands in DNA complementary to each other ? (e) What happens when D-glucose is heated with HI ? (f) What is meant by glyosidic linkage ? (g) What are enzymes ?	**CBSE 2024 (Visually impaired students)**
Value points	(a)Because − CHO group of pentaacaetate of glucose is not free (b)Because of zwitterion formation (c)Because they are easily excreted in urine (d)Because of the hydrogen bond formation between specific base pair i.e. A=T and C≡G (e)n − hexane is formed (f)A linkage joining two monosaccharides through oxygen (g) Enzymes are biocatalysts that increases the rate of metabolism.	**1x5=5**