SS4
PREBOARD EXAM (2023-24)
SUBJECT: CHEMISTRY
(SET II)

TIME DURATION: 3 hours

M.M: 70

General Instructions:
- This question paper comprises five Sections - A, B, C, D and E.
- There are 33 questions in the question paper on 6 printed pages.
- All questions are compulsory.
- Section A contains sixteen questions, twelve multiple choice-based questions and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.
- There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You need to attempt only one of the choices in such questions.
- Use of calculators and log tables is not allowed.

	SECTION-A	
1.	Iodide ions in faintly alkaline medium reduces $KMnO_4$ to: (a) Mn^{2+} (b) K_2MnO_4 (c) MnO_2 (d) Mn^{3+}	1
2.	The test used to distinguish aniline from ethylamine is: (a) Carbylamine Test (b) Sodium bicarbonate Test (c) Bromine water Test (d) Grignard's reagent Test	1
3.	The number of Faradays of charge needed to liberate 1 mol of oxygen gas from water is: (a) 2 (b) 4 (c) 1 (d) 8	1
4.	What fraction of reactant remains after 40 minutes for a first order reaction if its half life is 10 minutes? (a) ½ (b) ¼ (c) $^1/_{16}$ (d) no reactant left	1
5.	Which of the following complex of Ni will absorb highest wavelength in visible region? (a) $[Ni(H_2O)_6]^{2+}$ (b) $[Ni(NH_3)_6]^{2+}$ (c) $[Ni(NO_2)_6]^{4-}$ (d) $[NiCl_4]^{2-}$	1
6.	NO_2 (benzene ring with NO_2) $\xrightarrow{Fe/HCl}$ A $\xrightarrow[273\ K]{HNO_2}$ B $\xrightarrow{C_2H_5OH}$ C Compound C will be: (a) Phenol (b) Benzene (c) Azo dye (d) Aniline	1

7.	Toluene when refluxed with Br_2 in the presence of light mainly gives: (a) p-bromotoluene (b) m-bromotoluene (c) mixture of o & p bromotoluene (d) benzyl bromide	1
8.	For the system having configuration $t_{2g}^6 e_g^2$, the value of magnetic moment will be: (a) 2.83 BM (b) 1.73 BM (c) 3.87 BM (d) 4.92 BM	1
9.	In a second order reaction, first order in each reactant A and B, which one of the following reactant mixtures will provide the highest initial rate: (a) 0.1 mol of A and 0.1 mol of B in 0.1 L solution (b) 0.2 mol of A and 0.2 mol of B in 0.1 L solution (c) 0.1 mol of A and 0.1 mol of B in 1 L solution (d) 0.1 mol of A and 0.1 mol of B in 0.2 L solution	1
10.	The deficiency of Vitamin B_{12} causes: (a) beri beri (b) convulsions (c) pernicious anaemia (d) cheilosis	1
11.	A half-cell containing aqueous $CuSO_4$ solution with Cu rod is diluted to 10 times, the reduction electrode potential (a) increases by 0.030 V (b) decreases by 0.030 V (c) increases by 0.059 V (d) decreases by 0.059 V	1
12.	Phenol has a higher pK_a than: (a) picric acid (b) p-cresol (c) methanol (d) cyclohexanol	1

For Questions 13 to 16, two statements are given—one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
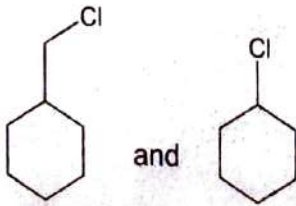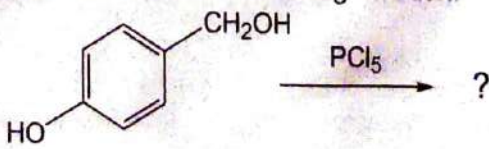
a. Both Assertion and Reason are true and Reason is correct explanation of Assertion.
b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c. Assertion is true but Reason is false.
d. Assertion is false but Reason is true.

13.	Assertion: As temperature decreases, activation energy increases. Reason: $k = Ae^{\left(\frac{-E_a}{RT}\right)}$	1
14.	Assertion: Upon nitration of aniline, m-nitroaniline gets formed in substantial amounts. Reason: Aniline is meta directing in nature.	1
15.	Assertion: A first order reaction never goes to completion. Reason: The half-life for a first order reaction remains constant throughout.	1
16.	Assertion: Transition metals are known to form alloys. Reason: Transition metals have an ability to show multiple oxidation states.	1

SECTION-B

17.	Write a short note on each of the following named reactions giving a suitable example: (a) Finkelstein reaction (b) Sandmeyer reaction	2
18.	Write the equation involved in the following steps of preparation: (a) potassium manganate from pyrolusite ore (b) sodium dichromate from sodium chromate	2
19.	How is 1-propoxypropane synthesised from propan-1-ol? Write the mechanism of this reaction.	2
20.	(a) What are the expected products of hydrolysis of lactose? (b) What is the basic structural difference between starch and cellulose? OR (a) What happens when D-glucose is treated with bromine water? Support your answer with a suitable equation. (b) The two strands of DNA are not identical but complementary. Explain.	2
21.	Some urea is dissolved in 500 g water. If the boiling point of the solution is 100.45°C, then calculate the freezing point of this solution. (K_b = 0.52 K/molal; K_f = 1.86 K/molal)	2

SECTION-C

22.	Arrange the following in the decreasing order of property mentioned: (a) Benzoic acid, 4-nitrobenzoic acid, 3, 4-dinitrobenzoic acid, 4-methoxybenzoic acid {acidic strength} (b) Acetaldehyde, acetone, di-tert-butyl ketone, methyl tert-butyl ketone {reactivity towards HCN} (c) ethanal, benzaldehyde, butan-2-one, formaldehyde {solubility in water}	3
23.	(a) In the following pairs of halogen compounds, which would undergo S_N^1 reaction faster and why? and (b) Amongst the isomeric dihalobenzenes which isomer has the highest melting point and why? (c) Write the major product formed in the following reaction: 	3

24.	(a) For an elementary reaction $2A + B \rightarrow 3C$ the rate of appearance of C at time t is 1.3×10^{-4} mol L^{-1} s^{-1}. Calculate (i) rate of the reaction (ii) rate of disappearance of A. (b) A first order reaction takes 90 minutes for 90% completion. Calculate the time required for 99% completion of this reaction. (log 2 = 0.3)	3
25.	The emf of a cell corresponding to the reaction: Zn (s) + 2 H^+ (aq) $\rightarrow$ Zn^{2+} (0.1 M) + H_2 (g, 1 bar) is 0.28 V at 25°C. Write the cell representation and calculate the log $[H]^+$. {$E°$ (Zn/Zn^{2+}) = 0.76 V and $E°$ (H_2/H^+) = 0.00 V} OR Calculate the emf and the obtainable work done by the following cell at 298 K: Mg(s)	Mg^{2+} (0.01 M) || Ag^+ (0.0001 M)	Ag (s) {$E°$ (Mg/Mg^{2+}) = 2.37 V and $E°$ (Ag^+/Ag) = 0.80 V}	3
26.	Carry out the following conversions: (a) Nitromethane into dimethylamine (b) Aniline into 1,3,5-tribromobenzene (c) Ethanenitrile to propanenitrile	3
27.	(a) Draw the structures of compounds A to D: (b) Draw the structures of products formed when ethoxybenzene is treated with HI.	3
28.	Give reasons: (a) Ce(IV) is oxidising whereas Eu(II) is reducing in nature. (b) The lowest oxidation state of transition metal is basic, the highest is amphoteric/acidic. (c) Actinoid contraction is greater from element to element than lanthanoid contraction.	3

SECTION-D
CASE STUDY BASED QUESTIONS

29.	You have already read that proteins are the polymers of α-amino acids and they are connected to each other by peptide bond or peptide linkage. Chemically, peptide linkage is an amide linkage formed between -COOH group and $-NH_2$ group. The reaction between two molecules of similar and different amino acids, proceeds through the combination of the amino group of one molecule with the carboxyl group of the other.	4

Protein found in biological system with a unique three-dimensional structure and biological activity is called a native protein. When a protein in its native form is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein.

a.	Which structure of protein remains intact after denaturation?	1
b.	Give two differences between fibrous and globular proteins.	1
c.	(i) What are essential amino acids? Give an example. (ii) Name an optically inactive amino acid. OR (i) Name the forces of attraction which stabilise tertiary structure of proteins. (ii) Why do amino acids have a higher melting point than the corresponding halo acids?	2
30.	Weak electrolytes like acetic acid have a lower degree of dissociation at higher concentrations and hence for such electrolytes change in Λ_m with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains 1 mol of electrolyte. In such cases Λ_m increases steeply on dilution, especially near lower concentrations. Therefore Λ_m° cannot be obtained by extrapolation of Λ_m to zero concentration. At infinite dilution, electrolyte dissociates completely but at such concentration, the conductivity of solution is so low that it cannot be measured accurately.	4
a.	Λ_m° for $Ba(OH)_2$, $BaCl_2$ and NH_4Cl are 457.6, 240.6 and 129.8 Scm^2mol^{-1} respectively. Calculate Λ_m° for NH_4OH.	1
b.	Plot Λ_m versus $\sqrt{C}$ for CH_3COOH.	1
c.	0.2 M solution of an electrolyte has conductivity 3.2×10^{-3} S cm^{-1}. If limiting molar conductivity of electrolyte is 200.0 S cm^2 mol^{-1}, calculate its degree of dissociation. OR The molar conductivity of a 1.5 M solution of an electrolyte is found to be 140 Scm^2mol^{-1}. Calculate the conductivity and cell constant for the cell if resistance offered by it is 100 ohms.	2

SECTION-E

31.	(a) The molar freezing point depression constant for benzene is 4.90 K kg mol^{-1}. An element Z exists as polymer Z_x. When 3.26 g of it is dissolved in 226 g of benzene, the observed freezing point is 0.112°C lower than the pure benzene. Determine the value of x. (Atomic mass of Z = 78.8 amu) (b) Which type of deviation is shown by a solution made by dissolving cyclohexanol and water. Justify your answer. (c) Preservation of meat is done by salting it. Why?	5

31.	(a) 0.6 g of acetic acid (molar mass = 60 g/mol) is dissolved in 1 litre of water (molar mass = 18 g/mol). The depression in freezing point observed for this strength of acid was 0.0205°C. Calculate the van't Hoff factor and degree of dissociation of the acid. (K_f = 1.86 K kg mol^{-1}) (b) What are minimum boiling azeotropes? Give an example. (c) Tanks of scuba divers are diluted with Helium gas. Why?	
32.	$CoSO_4Cl.5NH_3$ exists in two isomeric forms P and Q. Isomer P reacts with $AgNO_3$ to give white precipitate, but does not react with $BaCl_2$. Isomer Q forms a white ppt with $BaCl_2$ but does not react with $AgNO_3$. (a) Write the IUPAC names of P and Q. (b) Name the type of isomerism involved. (c) Identify the geometry and coordination number of complex P. (d) Will complex Q be coloured? Justify your answer.	5

32.	(a) $[Co(NH_3)_6]^{3+}$ is diamagnetic whereas $[Cr(NH_3)_6]^{3+}$ is paramagnetic. Explain on the basis of Valence Bond Theory. (Atomic numbers:- Cr – 24, Co – 27)
	
	(b) Give an example to explain the role of coordination compounds in analytical chemistry.
	
	(c) Give reasons:
	    (i) $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are of different colours in dilute solutions.
	    (ii) CO can stabilise metals even in zero or low oxidation states.	

33.	(a) Give a suitable test to distinguish between ethanal and acetone. (b) Draw the structure of oxime of acetophenone. (c) There are two $-NH_2$ groups in semicarbazide, then why only one is involved in the formation of semicarbazones? (d) Complete the following reaction: $$C_6H_5CHO + CH_3CH_2CHO \xrightarrow[\text{(ii) heat}]{\text{(i) dil NaOH}} \ ?$$ (e) Write a short note on Etard reaction giving a suitable example.	5

	(a) Why is ethanoic acid a stronger acid than phenol? (b) Would you expect benzaldehyde to be more reactive or less reactive in nucleophilic addition reactions than propanal? Explain your answer. (c) Draw the structure of ethylene ketal of hexan-3-one. (d) How will you convert ethanal into but-2-enoic acid? (e) Write a short note on Hell-Volhard-Zelinsky reaction giving a suitable example.