SAMPLE PAPER 8

CHEMISTRY PAPER 1
(THEORY)

Maximum Marks: 70

Time Allowed: Three Hours

*(Candidates are allowed **additional 15 minutes** for **only** reading the paper.*

*They must **NOT** start writing during this time.)*

This paper is divided into four sections – A, B, C and D.
*Answer **all** questions.*
***Section – A** consists of **one** question **having sub-parts** of **one** mark each.*
***Section – B** consists of **ten** questions of **two** marks each.*
***Section – C** consists of **seven** questions of **three** marks each, and*
***Section – D** consists of **three** questions of **five** marks each.*
Internal choices have been provided in one question each in Section B,
Section C and Section D.
All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
The intended marks for questions or parts of questions are given in brackets [ ].
Balanced equations must be given wherever possible and diagrams where they are helpful.
When solving numerical problems, all essential working must be shown.
In working out problems, use the following data:
Gas constant $R = 1.987$ cal deg^{-1} mol^{-1} = 8.314 JK^{-1} mol^{-1} = 0.0821 dm^3 atm K^{-1}mol^{-1}
1 L atm = 1 dm^3 atm = 101.3 J, 1 Faraday = 96500 coulombs,   Avogadro's number = 6.023 x 10^{23}

SECTION A – 14 MARKS

Question 1

(A) Fill in the blanks by choosing the appropriate word(s) from those given in the brackets:
[S$_N$1, S$_N$2, Anhydrous ZnCl$_2$, H$_2$SO$_4$, HCl, tetrahedral, octahedral, Square planar, can, cannot, rate, molecularity*]*

 (i) A catalyst _____ start a reaction but it can increase the _____ of the reaction.

(ii) The geometry of [Ni(CN)$_4$]$^{2-}$ and [NiCl$_4$]$^{2-}$ are _____ and _____ respectively.

(iii) Lucas reagent is a mixture of _____ and _____.

(iv) *Tert*-butyl bromide reacts with aq. NaOH by _____ mechanism while *n*-butyl bromide reacts with _____mechanism.

(B) **Select and write the correct alternative from the choices given below:**

(i) The term infinite dilution refers for:

P) $\alpha \rightarrow 1$ for weak electrolytes.

Q) All inter-ionic effects disappear.

R) When specific conductance of an electrolyte increases.

S) An electrolyte is 100% dissociated.

    a) Only P and Q

    b) Only Q and R

    c) P, Q and R

    d) P, Q and S

(ii) Which one of the following has an optical isomer?

    a) $[Co(H_2O)_4(en)]^{3+}$

    b) $[Zn(en)_2]^{2+}$

    c) $[Zn(en)(NH_3)_2]^{2+}$

    d) $[Co(en)_3]^{3+}$

(iii) When MnO_2 is fused with KOH, a coloured compound is formed. The product is:

    a) $KMnO_4$

    b) K_2MnO_4

    c) Mn_2O_3

    d) Mn_2O_4

(iv) Benzene diazonium chloride on reaction with hypophosphorus acid yields:

    a) chlorobenzene

    b) aniline

    c) benzene

    d) phenol

(v) If the vapor pressure of pure benzene and toluene at 350K are 100 mm and 50 mm respectively, then the mole fraction of benzene in vapor phase in contact with equimolar solution of benzene and toluene is:

    a) 0.75

    b) 0.33

    c) 0.67

    d) 0.50

(vi) **Assertion**: Specific conductance of all electrolytes decreases on dilution.

Reason: On dilution, the number of ions per unit volume decreases.

    a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

    b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

    c) Assertion is true but Reason is false.

    d) Assertion is false but Reason is true.

(vii) Assertion: The order of boiling points of isomeric amines is Primary > Secondary > Tertiary
Reason: Intermolecular association is more in primary, then in secondary and least in tertiary amines.

a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
c) Assertion is true but Reason is false.
d) Assertion is false but Reason is true.

(C) Read the passage given below carefully and answer the questions that follow.

Freezing point is the temperature at which the liquid and the solid phase of a substance are in equilibrium. The freezing point of solution is always less than that of pure solvent as the vapour pressure of solution is lowered. Depression in freezing point is the difference between the freezing point of solvent and the solution. It is a colligative property. Molal cryoscopic constant is a constant value for a given solvent. It does not depend upon the nature of solute dissolved in it. Addition of glycol to water acts as anti-freezing compound.

(i) Mixture of ethylene glycol and water is used in car radiators in cold countries, why?

(ii) What will be the value of molal depression constant (K_f) if the molality of dilute solution is doubled?

(iii) What will be freezing point of an aqueous solution of 0.1 molal concentration of sucrose? Given, $K_f=1.86$ K mol^{-1} kg

SECTION B – 20 MARKS

Question 2

(i) Arrange the following compounds in the decreasing order of their boiling points
Pentan-1-ol, 2-methylbutan-2-ol, 3-methylbutan-2-ol.

(ii) Ethanol gives iodoform reaction but methanol does not.

Question 3

Give reason for the following:
(i) Chemistry of lanthanoids is identical.
(ii) The paramagnetic character in 3d transition series elements increases upto Mn and then decreases.

Question 4:
Give balanced chemical equations to convert the following:
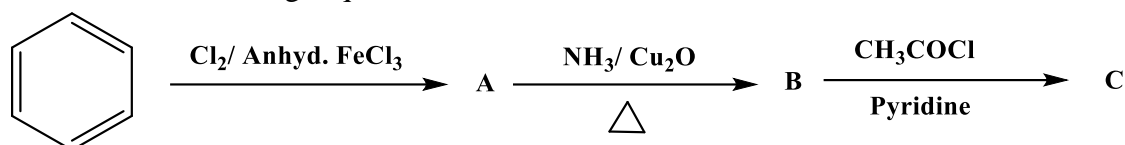**(i)** Chlorobenzene to *p*-nitrophenol
(ii) Propane nitrile to ethanal

Question 5:

Give a reason for each of the following:

(i) Zn has high value for M^{3+}/M^{2+} Standard Electrode Potentials.

(ii) Transition metals, despite high $E°$ oxidation, are poor reducing agents.
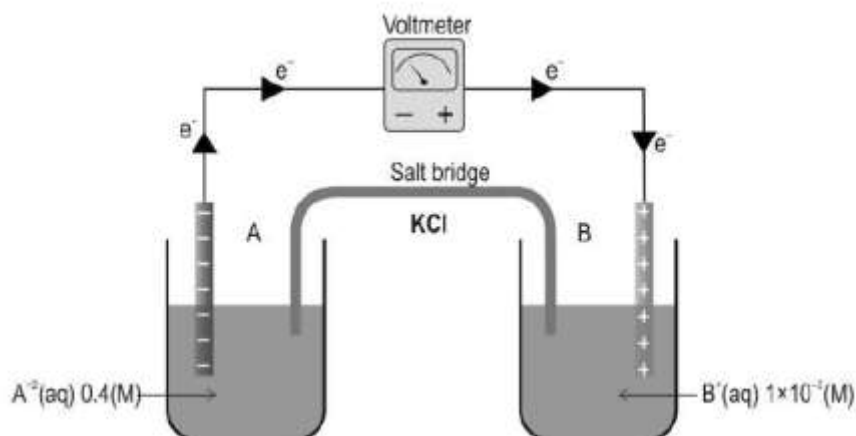
Question 6:

Consider the following sequence of reactions:

(i) Identify the product B.
(ii) Does the product B react with isopropyl chloride in presence of $AlCl_3$?

Question 7:

Calculate the emf of the cell given below at STP:-

Given that $E^o_{B^+/B} = 0.80$ V; $E^o_{A^{2+}/A} = -2.37$ V

Question 8

(i) What happens when (write chemical reactions) only
(a) Tert-butyl alcohol is heated with Cu at 573 K?
(b) The vapours of ethyl alcohol are passed over anhydrous alumina at 523 K?

<center>**OR**</center>

(ii) A and B are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formula of A and B.

Question 9:

An antifreeze solution is prepared from 222.6 g of ethylene glycol ($C_2H_6O_2$) and 200 g of water. Calculate the molality of the solution. If the density of the solution is 1.072 g mL^{-1}, then what shall be the molarity of the solution?

Question 10:

Write chemical equations only for the following conversions:
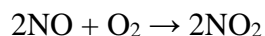**(a)** Ethanol to 1-Butanol
(b) Aniline to Chlorobenzene

Question 11:

Answer the following:
(i) Which element in 3d series has lowest enthalpy of atomisation and why?

(ii) Iron has higher enthalpy of atomisation than that of copper. Why?

SECTION C – 21 MARKS

Question 12:

The following data were obtained for the reaction:

$2NO + O_2 \rightarrow 2NO_2$

S. No.	[NO] mol/L	[O$_2$] mol/L	Initial rate of formation of NO$_2$/mol/L/sec
1.	0.3	0.2	7.2 x 10^{-2}
2.	0.1	0.1	6.0 x 10^{-3}
3.	0.3	0.4	2.88 x 10^{-1}
4.	0.4	0.1	2.40 x 10^{-2}

(i) Find the order of reaction with respect to NO and O$_2$.
(ii) Write the rate law and overall order of reaction.
(iii) Calculate the rate constant (*k*).

Question 13:

Arrange the following compounds in increasing order of basic strengths in their aqueous solution.

(i) NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$

(ii) NH_3, $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$

Question 14:

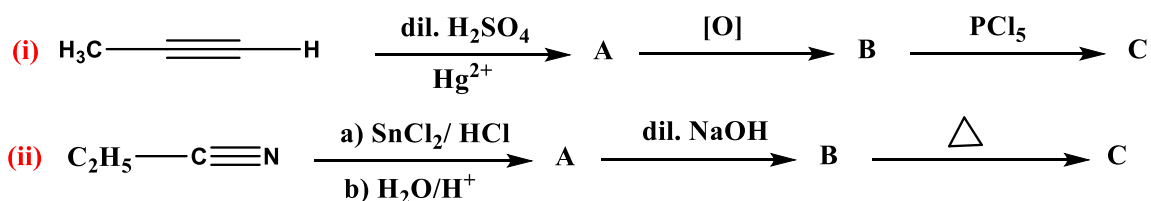Define the following as related to protein:

(a) Primary structure
(b) Peptide linkage
(c) glycosidic linkage

Question 15:

(i) Calculate the osmotic pressure of a solution prepared by dissolving 0.025 g of K_2SO_4 in 2.0 litres of water at 25 °C assuming that K_2SO_4 is completely dissociated. [Mol.Wt. of K_2SO_4 =174g/mol]

(ii) Why the freezing point depression ΔT_f of 0.4 M NaCl solution is nearly twice than that of 0.4 M glucose solution?

Question 16

Identify the compounds [A], [B] and [C].

(i) H_3C———≡———H $\xrightarrow[\text{Hg}^{2+}]{\text{dil. H}_2\text{SO}_4}$ **A** $\xrightarrow{\text{[O]}}$ **B** $\xrightarrow{\text{PCl}_5}$ **C**

(ii) C_2H_5—C≡N $\xrightarrow[\text{b) H}_2\text{O/H}^+]{\text{a) SnCl}_2\text{/ HCl}}$ **A** $\xrightarrow{\text{dil. NaOH}}$ **B** $\xrightarrow{\triangle}$ **C**

Question 17

(i) How will the following be obtained? (Give chemical equations only)

   (a) Salicylic acid from phenol

   (b) Tertiary butyl alcohol from Grignard's reagent

   (c) Picric acid from phenol

OR

18. (i) Determine the age of an archaeological sample containing wood by considering the radioactive decay of ^{14}C, given that the sample has only 80% of the ^{14}C content found in a living tree, and the half-life of ^{14}C is 5730 years.

(ii) What is the activation energy for a reaction that exhibits a two-fold increase in its rate when the temperature rises from 298 K to 308 K?

SECTION D – 15 MARKS

Question 19:

(i) Give a reason for each of the following:

(a) There are two – NH_2 groups in semicorbazide but only one is involved in the formation of semicorbozones.

(b) During the preparation of an ester from a carboxylic acid and an alcohol in the presence of an acid catalyst, ester is removed as fast as it is formed.

(c) Cyclohexanone forms cyanohydrin in good yield but 2,2,6-trimethyl cyclohexanone does not.

(ii) Give simple chemical tests to distinguish between the following pairs of compounds.

(a) Ethanal and Propanal

(b) Pent-2-one and Pent-3-one

Question 20:

(i) $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are of different colours in dilute solutions. Why?

(ii) $FeSO_4$ solution mixed with $(NH_4)_2SO_4$ solution in 1 : 1 molar ratio gives the test of Fe^{2+} ion but $CuSO_4$ solution mixed with aqueous ammonia in 1 : 4 molar ratio does not give the test of Cu^{2+} ion. Explain why?

(iii) What is the coordination entity formed when excess of aqueous KCN is added to an aqueous solution of copper sulphate? Why is it that no precipitate of copper sulphide is obtained when $H_2S(g)$ is passed through this solution?

Question 21:

(i) Look at the diagram and answer the questions that follow:
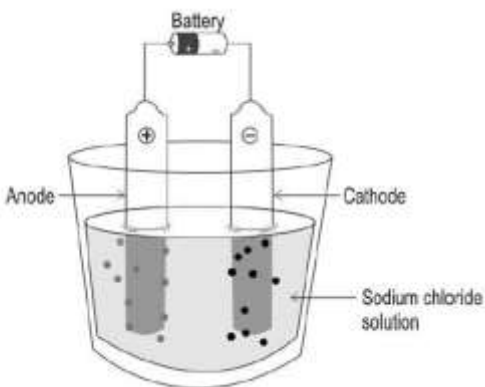

The electrodes used in the cell are made up of platinum.

(a) What is(are) the product(s) formed at the cathode for the given setup? What factors did you consider to determine the products of electrolysis in the cell given above?

(b) What is the nature and function of the electrodes seen here?

(c) Write the electrode reactions if the electrolyte is changed to molten sodium chloride.

(**OR**)

(ii) (a) The limiting molar conductivities of KCl, NaCl and KNO_3 are 152, 128 and 111 Scm^2mol^{-1} respectively. What is the limiting molar conductivity of $NaNO_3$?

(b) Calculate E_{cell} for the following reaction at 298 K

$2Cr(s) + 3Fe^{2+}$ (0.01 M) $\rightarrow 2Cr^{3+}$ (0.01 M) + 3Fe(s) Given: $E^o_{cell} = 0.261$ V
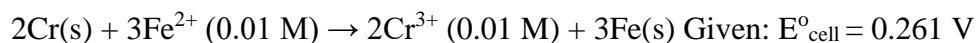
(c) How much electricity in terms of Faraday is required to produce 20·0 g of Ca from molten $CaCl_2$?

************************** The End **************************