SAMPLE PAPER 9

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:
[Conc. HNO_3, sec^{-1}, octahedral, tetrahedral, nitrophenol, Conc. HCl, alkyl nitrites, L^2 mol^2 sec^{-1}, square planar, nitroalkanes, anhydrous $ZnCl_2$, L mol^{-1} sec^{-1}]

(i) Unit of rate constant for a second order reaction is _____and for first order reaction is _____.

(ii) The geometry of $[Fe(CN)_6]^{4-}$ is _____ and $[Cu(CN)_4]^{2-}$ is _____ respectively.

(iii) Haloalkanes react with $NaNO_2$ to form _____ main product while $AgNO_2$ form _____as the chief product.

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

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

(i) Standard solution of KNO_3 is used to make a salt bridge because

(a) Velocity of K^+ is greater than that of NO^-_3.
(b) Velocity of NO_3^- is greater than that of K^+.
(c) Velocity of both K^+ and NO^-_3 are nearly same
(d) KNO_3 is highly soluble in water.

(ii) IUPAC name of $[Pt(NH_3)_3(Br)(NO_2)Cl]Cl$ is

(a) Triamminebromochloronitroplatinum (IV) chloride
(b) Triamminebromonitrochloroplatinum (IV) chloride
(c) Triamminechlorobromonitroplatinum (IV) chloride
(d) Triamminenitrochlorobromoplatinum (1V) chloride

(iii) Across the lanthanide series, the basicity of lanthanide hydroxides

(a) Increases
(b) Decreases
(c) First increases and then decreases
(d) First decreases and then increases

(iv) Which of the following is not a final product of the reaction between propylamine and nitrous acid?

(a) $CH_3CH_2CH_2N_2Cl$
(b) $CH_3CH_2CH_2OH$
(c) N_2 gas
(d) HCI

(v) 12g of urea is dissolved in 1 L of water and 68.4 g sucrose is dissolved in 1 L of water. Relative lowering of vapour pressure of urea solution is

(a) Greater than sucrose solution
(b) Less than sucrose solution
(c) Double that of sucrose solution
(d) Equal to that of sucrose solution

(vi) **Assertion**: Electrolysis of aqueous NaCl produces Oxygen at the anode.

Reason: Oxidation potential of Oxygen is lower than chlorine
(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**: Anilinium chloride is more acidic than ammonium chloride.

Reason: Anilinium ion is resonance stabilized.

(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.

Colligative properties of a solution depend upon the number of moles of the solute dissolved and do not depend upon the nature of the solute. However, they are applicable only to dilute solutions in which the solutes do not undergo any association or dissociation. For solutes undergoing such changes, van't Hoff introduced a factor, called van't Hoff factor (i). This has helped not only to explain the abnormal molecular masses of such solutes in the solution but has also helped to calculate the degree of association or dissociation.

(i) The molar mass of sodium chloride determined by elevation of boiling point method is found to be abnormal. Why?

(ii) What is the elevation of boiling point of a solution of 13.44g of $CuCl_2$ in 1 kg of water? (K_b for water = 0.52 Kkg/mol^{-1}, molar mass of $CuCl_2$ = 134.4g/mol)

(iii) Equimolal solutions of NaCl and $BaCl_2$ are prepared in water. Freezing pint of NaCl is found to be -20 ^oC. What freezing point do you expect for $BaCl_2$ solution?

SECTION B – 20 MARKS

Question 2

Arrange the following in:

(i) increasing order of solubility in water

C_2H_5Cl, $C_2H_5NH_2$, C_2H_5OH

(ii) decreasing boiling point:

CH_3COOH, C_2H_5OH, CH_3NH_2, CH_3OCH_3

Question 3

Give a reason for each of the following:

(i) A transition metal exhibits highest oxidation state in oxides and fluorides.

(ii) Increasing oxidizing power in the series: $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

Question 4

Give balanced chemical equations to convert the following:

(i) Propa-2-ol to acetoxime

(ii) Ethanal to methylamine

Question 5

Give a reason for each of the following:

(i) In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.

(ii) Salts of cuprous (Cu^+) ion are diamagnetic whereas the salts of cupric (Cu^{2+}) ion are Paramagnetic.

Question 6

(i) Among all the isomers of molecular formula C_4H_9Br, identify the two isomers which give same product on dehydrohalogenation with alcoholic KOH.

(ii) Racemic mixture is optically inactive. Why?

Question 7

Explain the electrochemical behavior of chlorine and iodine in the context of their positions in the electrochemical series. Include the relevant half-reactions and describe the formation of a blue color when iodine is absorbed in starch.

Question 8

What happens when (write chemical reactions only)

(a) Salicylic acid is treated with $(CH_3CO)_2OO/H^+$?

(b) *t*–butyl bromide reacts with sodium methoxide?

Question 9

Jaggy is eager to understand the principles of colligative properties, conducted an experiment by dissolving 9.25 g of a non-volatile solute in 450 ml of water. The resulting solution exhibited an osmotic pressure of 350 mm Hg at 27 ºC. Can you help the student determine the molecular mass of the non-electrolyte solute based on the provided data? (Ideal gas constant (R = 0.0821 L atm K^{-1} mol^{-1}).

Question 10

(i) Why benzoic acid is stronger than acetic acid but weaker than formic acid?

(ii) Why do aldehydes and ketones have higher boiling points than hydrocarbons?

Question 11

Give a reason for each of the following:

(i) Copper, which is in first series of transition metal exhibits +1 oxidation state most frequently.

(ii) The actinoid metals are all silvery in appearance but display a variety of structures than lanthanoids.

SECTION C – 21 MARKS

Question 12

The following data were obtained for the reaction. A + 2B → C

Experiment	[A]/M	[B]/M	Initial rate of formation of C/M min^{-1}
1	0.2	0.3	4.2×10^{-2}
2	0.1	0.1	6.0×10^{-3}
3	0.4	0.3	1.68×10^{-1}
4	0.1	0.4	2.40×10^{-2}

(a) Find the order of reaction with respect to A and B.
(b) Write the rate law and overall order of reaction.
(c) Calculate the rate constant (*k*).

Question 13

Arrange the compounds $C_6H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$, and $C_2H_5NH_2$ in the following order:

(i) Increasing order of their water-based basic strength.

(ii) Decreasing order of their gas-phase basic strength.

Question 14

(i) When sucrose undergoes acid hydrolysis, what are the resulting products?

(ii) What makes Vitamin B and Vitamin C indispensable for our health?

(iii) What is the reason behind the solid and opaque transformation of egg white upon heating?

Question 15

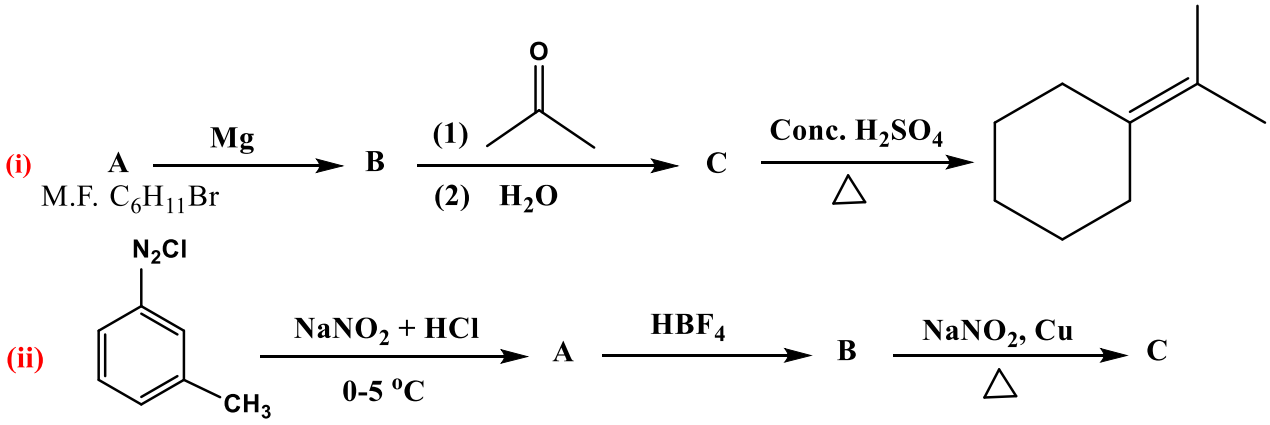
(a) What is the effect of temperature on the solubility of glucose in water?

(b) Ibrahim collected a 10mL each of fresh water and ocean water. He observed that one sample labeled "P" froze at 0 °C while the other "Q" at -1.3 °C. Ibrahim forgot which of the two, "P" or "Q" was ocean water. Help him identify which container contains ocean water, giving rationalization for your answer.

(c) Calculate Van't Hoff factor for an aqueous solution of $K_3[Fe(CN)_6]$ if the degree of dissociation (α) is 0.852. What will be boiling point of this solution if its concentration is 1 molal? (K_b=0.52 K kg/mol)

Question 16

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



Question 17

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

(a) Benzene to biphenyl

(b) Aniline to phenyl isocyanide

(c) *p*-Chloronitrobenzene to *p*-nitrophenol

Question 18

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) Write chemical equations to illustrate the following name reactions:

(a) Clemmensen's reduction

(b) Rosenmunds reduction

(c) HVZ reaction

(ii) You are given four organic compounds "A", "B" , "C" and "D". The compounds "A", "B" and "C" form an orange- red precipitate with 2,4 DNP reagent. Compounds "A" and "B" reduce Tollen's reagent while compounds "C" and "D" do not. Both "B" and "C" give a yellow precipitate when heated with iodine in the presence of NaOH. Compound "D" gives brisk effervescence with sodium bicarbonate solution. Identify "A", "B", "C" and "D" given the number of carbon atoms in three of these carbon compounds is three while one has two carbon atoms. Give an explanation for y our answer.

Question 20

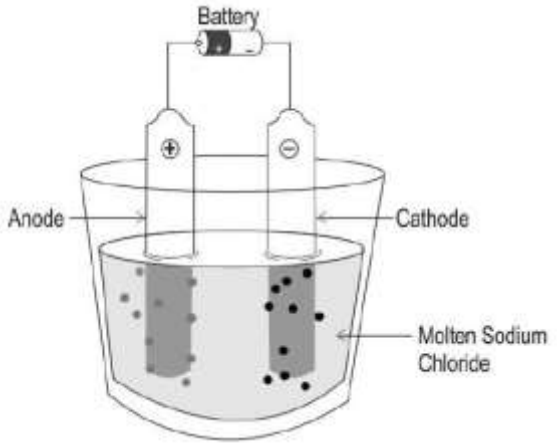
(a) Ammonia acts as a very good ligand but ammonium ion does not form complexes. Explain why.

(b) Stability of a coordination compound in solution", what do you understand by it? What are the factors responsible for the stability of a complex?

(c) Define crystal field splitting energy. In what way is the d-orbital configuration depending upon the magnitude of Δo?

Question 21

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



(a) Identify the ion(s) moving towards the cathode. Give a reason for your choice.

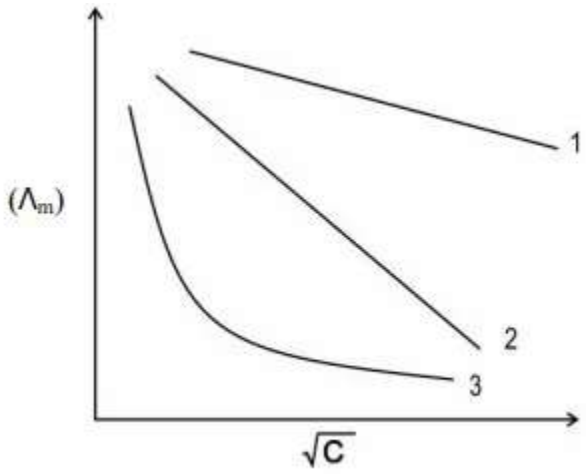
(b) What is the expected product at the anode? Write the reaction(s) occurring at the anode.

(c) Write the net reaction of the process seen in the above diagram.

(ii) A zinc rod is dipped in 0.1 M solution of $ZnSO_4$. The salt is 95% dissociated at this dilution at 298 K. Calculate the electrode potential.

OR

(ii) (a) Consider the diagram below and match the molar conductivity vs. √C curves with the respective substances Na_2SO_4, H_2SO_4, and NH_4OH, and provide a rationale for your selections based on the distinctive characteristics observed in each curve.



(b) The molar conductivity (Λ_m) of a dilute solution of methanoic acid is 34·1 S cm^2 /mol. Calculate its degree of dissociation. (Given λ^0 (H^+) = 349·6 S cm^2 /mol and λ^0 ($HCOO^-$) = 54·6 S cm^2 /mol).

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