CHEMISTRY

Paper – 1

(THEORY)

Three hours and a quarter

(The first 15 minutes of the examination are for reading the paper only.

Candidates must NOT start writing during this time).

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*Answer **all** questions in Part I. From Part II, answer any four questions from Section A, any three questions from Section B and any two questions from Section C.*

All workings, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for 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}

PART I (40 marks)

Answer **all** *questions.*

Question 1.

(a) Correct the following statements. **[4]**

(i) Depression in freezing point is proportional to the molarity of the solution.

(ii) Stronger the base, lower is its dissociation constant.

(ii) Specific conductance is the conductance of a solution containing specific number of ions.

(iv) Sulphonation of benzene is nucleophillic addition reaction.

(b) Read the following questions carefully. For each question there are four alternatives A, B, C and D. Choose the correct alternative and write it in your answer sheet.

(i) The compound COOH-CH=CH-COOH can exhibit **[1]**

A chain isomerism.

B optical isomerism.

C geometrical isomerism.

D optical and chain isomerism.

(ii) The property where magnitude does not depend upon the number of moles present in the system is called **[1]**

A colligitive property.

B extensive property.

C intensive property.

D optical property.

(iii) The principle ore of copper is **[1]**

A cuprites.

B malachite.

C copper glance.

D copper pyrites

(iv) When acetaldehyde reacts with ammonia, the product formed is **[1]**

A acetaldoxime.

B acetaldehyde ammonia.

C acetaldehyde hydrazone.

D acetaldehyde cynohydrin.

(v) In a nuclear reactor, the function of moderator is to **[1]**

A produce more neutron.

B stop the nuclear reaction.

C increase the speed of neutron.

D slow down the speed of neutron.

(vi) The forces present among the carbon atoms of diamond are

A ionic bond.

B metallic bond.

C covalent bond.

D Vanderwaal's force.

(vii) Rate constant of reaction depend upon **[1]**

A time.

B pressure.

C temperature.

D initial concentration.

(viii) When H_2S is passed through acidified $KMnO_4$, the product formed is **[1]**

A $KHSO_4$.

B MnO_2.

C K_2S.

D S.

(ix) Which of the following is an electrophile? **[1]**

A NH_3

B BCl_3

C $AlCl_4^-$

D CH_3OH

(x) In a reversible reaction, the catalyst **[1]**

A decreases the activation energy of both forward and backward reaction.

B increases the activation energy of the backward reaction.

C decreases the activation energy of the backward reaction.

D increases the activation energy of the forward reaction.

(c) ***Fill in the blanks by choosing appropriate words given in brackets below. Write the correct answers only in your answer booklet. Donot copy the whole sentence.*** **[6]**

(hydration, tetrahedral, alkyl halide, fusion, isotropy, inversion, anisotropy, alkoxide, fission, trigonal planar)

(i) ${}_1H^2 + {}_1H^3 \rightarrow {}_2H^4 + {}_0n^1$ is a nuclear ……. reaction

(ii) Amorphous solids show …….

(iii) In Williamson's synthesis, ethers are prepared by the reaction of an …….. with ……..

(iv) Hydrolysis of sucrose is called ……..

(v) The shape of BF_3 is ……..

(d) ***Match the items of column A with the items in column B. Rewrite the correct pairs in your answer booklet.*** **[4]**

Column A	**Column B**
(i) Cryoscopy	(a) Vanderwaal's forces
(ii) Nylon 66	(b) poison catalyst
(iii) Hydrogen fluoride	(c) Cottrell's method
(iv) Electron gas theory	(d) metallic bond
(v) Starch	(e) positive catalyst
(vi) Ebullioscopy	(f) co-polymer
(vii) Molybdenum	(g) Beckman's method
(viii)Manganese dioxide	(h) promoter
	(i) glucose
	(j) inter-molecular hydrogen bond

(e) Answer the following questions.

(i) Complete the following reaction:

$_{13}Al^{27} + \ldots\ldots\ldots\ldots \rightarrow {}_{15}P^{30} + {}_{0}n^{1}$ **[1]**

(ii) Why is glycerol more viscous than ethanol? **[1]**

(iii) State the *two* basic principles of chromatography. **[2]**

(iv) Give the structural formula of Tetra ethyl lead and Ethyl magnesium bromide. **[2]**

(v) Under what conditions does silicon react with carbon? What is the product formed? **[2]**

(vi) Categorize the following into electrophile and nucleophile:

NO_2^+, NH_3, CN^-, BF_3 **[2]**

(vii) How is iodoform prepared from acetone? **[1]**

(viii) Name a α amino acid. **[1]**

(ix) What are detergents? **[1]**

(x) How will you prepare benzene from phenol? **[1]**

(xi) Write the chemical equation for the synthesis of Teflon. **[1]**

(xii) How will you detect primary amine? **[1]**

PART II

SECTION A (28 marks)

Answer any **four** *questions.*

Question 2.

(a) The boiling point of pure benzene is 56.2°C. A solution of 0.81g of non-volatile solute in 10g of acetone is boiled at 58.5°C. What is the molecular weight of the solute if the ebullioscopic constant for acetone is 1.71 K mol^{-1} Kg $^{-1}$? **[2]**

(b) At 300K, 36g of glucose present per litre in its solution has an osmotic pressure of 4.58 bar. If the osmotic pressure of solution is 1.52 bar at the same temperature, what would be its concentration? **[2]**

(c) Draw the molecular orbital energy level diagrams for H_2^-, H_2, H_2^+ and calculate their bond order. **[3]**

Question 3.

(a) Complete the following nuclear equations: **[2]**

(i) $_{96}Cm^{246} + _{6}C^{12} \rightarrow _{102}No^{254} + \ldots\ldots\ldots\ldots$

(ii) $_{94}Pu^{239} + \ldots\ldots\ldots\ldots\ldots \rightarrow _{96}Cm^{242} + _{0}n^{1}$

(b) The partition coefficient between ether and water is 3. Calculate the amount of an organic compound *x* from 1000 cm^3 of water containing 10g of *x* using 500 cm of ether. **[4]**

(i) One extraction

(ii) In two extractions using 250cm^3 each time

(c) Name *two* emulsion type of colloids. **[1]**

Question 4.

(a) The cell reaction of a galvanic cell is given as follows: **[3**

$Zn_{(s)} + 2Ag^{+}{}_{(aq)} \rightarrow Zn^{2+}{}_{(aq)} + 2Ag_{(s)}$

(i) Which of the electrode is negatively charged?

(ii) Show the direction of the flow of current.

(iii) Write the reactions at the anode and cathode.

(b) The half life for radioactivity decay of C^{14} is 5730 years. An archeological artifact was found to have only 80% of the C^{14} activity as found in a living tree. Estimate the age of the artifact. **[2]**

(c) (i) Write the Arrhenius equation. **[1]**

(ii) How many atoms are present in the face centered cubic unit cell? **[1]**

Question 5.

(a) Name *two* factors that influence the rate of chemical reaction. **[1]**

(b) A first order reaction is 50% complete in 30 minutes at 27°C. Calculate the rate constant of the reaction at 27°C. **[3]**

(c) What is hydrolysis? Why is a solution of CH_3COONa alkaline and NH_4Cl acidic? **[3]**

Question 6.

(a) Classify the following as Bronsted acid and Bronsted base. **[2]**

H_3O^{+}, NH_4^{+}, Cl^{-}, OH^{-}

(b) The solubility product of $Mg(OH)_2$ at 298K is 1.4×10^{-11}. Find the solubility of $Mg(OH)_2$? [At. Wt. Mg = 24, O = 16, H = 1] **[3]**

(c) What type of hybridization is shown by the following structures: **[2]**

(i) linear

(ii) trigonal

(iii) tetrahedral

(iv) pyramidal

Question 7.

(a) What is cell constant? **[1]**

(b) 0.1M of $AgNO_3$ solution has a resistance of 35 ohms in a conductivity cell at 298K. Calculate the molecular conductivity of the solution. The cell constant is 0.375 Cm^{-1}. **[3]**

(c) (i) How is the colloidal solution of As_2S_3 (Arsenous sulphide) prepared? **[2]**

(ii) Give *two* methods by which colloidal solution can be purified? **[1]**

SECTION B (18 marks)

Answer any **three** *questions.*

Question 8.

(a) What are the steps involved in the extraction of silver from its sulphide ore by the cyanide process. Write appropriate balanced chemical equations. **[4]**

(b) Calculate the free energy change when one mole of an ideal gas at 27°C is reduced from 5.0 atm to 0.5 atm. **[2]**

Question 9.

(a) Complete the following reactions and name the type of reaction. **[3]**

(i) $CH_3Br + KOH_{(aq)} \rightarrow$

(ii) $H_2C{=}CH_2 + HCl \rightarrow$

(iii) $C_2H_5OH \xrightarrow[443\ K]{Conc.H_2SO_4}$

(b) Write the balanced chemical equation for each of the following reactions:

(i) Sodium thiosulphate with aqueous silver nitrate

(ii) Copper sulphate with aqueous potassium iodide

(iii) Hydrogen peroxide with acidified ferrous sulphate solution

Question 10.

(a) Give *two* uses of silicones and their corresponding properties. **[2]**

(b) Explain SN^1 reaction with relevant chemical reactions and its mechanism. **[4]**

Question 11.

(a) Give an account of the manufacture of iodine from sea weeds. **[3]**

(b) Calculate the work done in Joules when 3 moles of an ideal gas at 27°C expand isothermally and reversibly from 10 atm to 1 atm ($1atm = 1.013 \times 105\ Nm^{-2}$). **[3]**

SECTION C (14 marks)

Answer any **two** *questions.*

Question 12.

(a) Perform the following conversions: **[4]**

(i) acetaldehyde to chloroform

(ii) hydrogen cyanide to formic acid

(b) Give the balanced equation for the preparation of methyl amine from acetamide. **[2]**

(c) Give the balanced chemical equation for the preparation of soap. **[1]**

Question 13.

(a) An organic compound (A) has a characteristic odour. When compound (A) is treated with NaOH it forms two compounds (B) and (C). Compound (B) has a molecular formula C_7H_8O which on oxidation gives

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back compound (A). Compound (C) is a sodium salt of an acid. When compound (C)is heated with soda lime it yields an aromatic hydrocarbon (D). Identify the compounds (A), (B), (C) and (D). **[4]**

(b) Differentiate between thermoplastics and thermosetting plastics on the basis of their structures and properties. **[3]**

Question 14.

(a) Write the balanced equations for the following reactions. What do you observe in each case? **[4]**

(i) Glucose is warmed with Tollen's reagent.

(ii) Fructose is treated with excess of phenylhydrazine

(b) Write the name of the product formed by the reaction of formaldehyde and ammonia. Write *one* of its uses. **[2]**

(c) Draw the structure of nitroethane. **[1]**
