

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).

*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 working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer in the answer booklet.

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 $R = 1.987 \text{ cal deg}^{-1} \text{ mol}^{-1} = 8.314 \text{ JK}^{-1} \text{ mol}^{-1} = 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$

PART I (40 marks)

*Answer **all** questions.*

Question 1.

(a) *Correct the following statements.*

[5]

- (i) The observed colligative property of an electrolyte which associates in solution is more than its normal value.
- (ii) In ethyne molecule, two carbon atoms are linked together by two sigma bonds and one pi-bond.
- (iii) The degree of ionization decreases with dilution.

- (iv) Maleic and fumaric acids are a pair of optical isomers.
- (v) Acetic acid undergoes saponification on treatment with ethyl alcohol in presence of a strong dehydrating agent.

(b) *Each question is followed by four possible choices of answers. Choose the correct answer and write it in your answer booklet.*

[10]

- (i) Elevation in boiling point is maximum for
- A 1M acetic acid.
- B 1M glucose.
- C 1M KCl.
- D 1M urea.
- (ii) Radioactive $^{14}_7\text{C}$ used in carbon dating can be made by (n, p) reaction. For this reaction, the target nucleus is
- A $^{15}_8\text{O}$.
- B $^{14}_7\text{N}$.
- C $^{13}_7\text{N}$.
- D $^{10}_5\text{B}$.
- (iii) The number of atoms of an element in a body centered and face centered unit cell respectively are
- A 1, 2.
- B 1, 4.
- C 2, 3.
- D 2, 4.

- (iv) Which of the following solution cannot act as a buffer?
- A $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$.
 - B $\text{H}_3\text{PO}_4 + \text{NaH}_2\text{PO}_4$.
 - C $\text{NaHPO}_4 + \text{H}_3\text{PO}_4$.
 - D $\text{HCl} + \text{NH}_4\text{Cl}$.
- (v) All of the following are the alloys of copper, *except*
- A silver-amalgam.
 - B german silver.
 - C bronze.
 - D brass.
- (vi) Halogenation of benzene in the dark is an example of
- A nucleophilic substitution reaction.
 - B electrophilic substitution reaction.
 - C free radical substitution reaction.
 - D electrophilic addition reaction.
- (vii) The product formed when glycine is treated with dilute HCl is
- A $[\text{H}_3\text{NCH}_2\text{COOH}]^+ \text{Cl}^-$.
 - B $\text{H}_2\text{N CH}_2 \text{COOHCl}$.
 - C $\text{H}_2\text{N CH}_2\text{COOH}$.
 - D $\text{H}_3\text{N}^+\text{CH}_2 \text{COO}^-$.
- (viii) Chlorobenzene is treated with alkyl halide and sodium in the presence of ether in
- A Perkin reaction.
 - B Rosenmund reaction.
 - C Wurtz Fittig reaction.
 - D Benzoin condensation.

- (ix) Which of the following pairs is the monomers of Terylene?
 A hexamethylene diamine and terephthalic acid
 B ethylene glycol and terephthalic acid
 C adipic acid and ethylene glycol
 D ethylene glycol and ethylene
- (x) When temperature is increased, the rate of reaction also increases because of the
 A lowering of activation energy.
 B increase in the number of collisions.
 C decrease in the number of collisions.
 D decrease in the number of activated molecules.

(c) **Fill in the blanks by choosing the appropriate word/s given in the brackets.**

Write the correct answers in your answer sheet.

[5]

[AlCl₃, LiAlH₄, oximes, phenylhydrazine, osazone, increases, decreases, sodium iodate, sodium iodide]

- (i) When iodine reacts with cold and dil. NaOH solution, the products formed are hypoiodous acid and
- (ii) The compound used as a catalyst in Friedal Craft reaction is
- (iii) Both glucose and fructose form when they are treated with hydroxylamine while both form when they are treated with excess of phenylhydrazine.
- (iv) Molar conductivity of a weak electrolytic solution on dilution.

(d) **Match the items in Column A with the items in Column B.**

Rewrite the correct pairs in your answer sheet.

[5]

Column A	Column B
(i) Ostwald's dilution law	(a) coordination compounds
(ii) Henry's law	(b) reaction rate
(iii) Law of mass action	(c) conservation of energy
(iv) First law of thermodynamics	(d) dissociation of weak electrolyte
(v) Werner's theory	(e) solubility
	(f) solution
	(g) Gibb's free energy

(e) *Answer the following questions.*

- (i) How will you convert oxalic acid to formic acid using glycerol? [1]
- (ii) Calculate the bond order of nitrogen molecule. [1]
- (iii) Give *two* functions of a salt bridge. [1]
- (iv) Write *two* differences between reversible and irreversible processes. [2]
- (v) Explain the following terms with examples. [2]
1. homo polymer
 2. co-polymer
- (vi) Give *one* use of Wilkinson's catalyst. [1]
- (vii) Give *two* advantages of detergent over soap. [1]
- (viii) What do you understand by asymmetric carbon atom? Explain with an example. [1]
- (ix) Benzene cannot be represented by a single structure. Support the statement. [1]
- (x) Give the balanced reaction when methyl isocyanide reacts with dil. acids and name the products formed. [2]
- (xi) Name the aromatic compound which undergoes Cannizzaro's reaction. [1]

PART II

*Answer **nine** questions choosing **four** from Section A, **three** from Section B and **two** from Section C*

SECTION A (28 marks)

*Answer any **four** questions.*

Question 2.

- (a) 2.5 gm of a non-volatile solute dissolved in 50 gm of benzene depresses the freezing point by 1.2K. If the normal molecular mass is 122, calculate the observed molecular mass and the Vant Hoff factor. (K_f for benzene is $5.12 \text{ K kg mol}^{-1}$) [3]
- (b) Write the molecular orbital configuration of O_2^+ molecule and predict its magnetic property with a reason. [2]
- (c) What are the conditions necessary for a chemical reaction to occur? [2]

Question 3.

- (a) What do you understand by the following terms?
- (i) Semi-conductor
 - (ii) Pyroelectricity
- (b) The rate constant of a reaction with respect to reactant x is 9 min^{-1} . If the initial concentration of x is 0.12 mol L^{-1} , calculate the time taken for the final concentration to be $0.012 \text{ mol}^{-1} \text{ L}^{-1}$. [2]
- (c) (i) When an aqueous solution of ammonium chloride was tested with blue litmus paper it changed to red. Give a reason for the observation. [1]
- (ii) Mn is not precipitated as MnS when H_2S gas is passed through manganese carbonate solution in presence of dil.HCl. Give a reason. [1]
- (iii) The pH value of a solution of carbonic acid and sodium carbonate does not change on adding a small amount of acid. Explain. [1]

Question 4.

- (a) The pH of lemon juice is 3.5 at 25°C . Calculate the H^+ ion and OH^- ion concentration. [3]
- (b) Explain the intermediate compound formation theory of catalyst with the help of an appropriate example. [2]
- (c) Why is molality preferred over molarity for expressing the concentration of a dilute solution? [2]

Question 5.

- (a) For the cell $\text{Cd}|\text{Cd}^{2+}_{(1\text{M})}||\text{Ag}^+_{(1\text{M})}|\text{Ag}$,
- $\text{Cd}^{2+}|\text{Cd} = -0.04\text{V}$
- $\text{Ag}^+|\text{Ag} = 0.08\text{V}$
- (i) Write the reactions at the anode and the cathode. [1]
 - (ii) Calculate the standard e.m.f. of the cell. [1]
 - (iii) Is the cell reaction spontaneous? Why? [1]

- (b) Fission reaction is carried out in a special device to harvest energy.
Name at least **four** parts of the device and state their functions.
- (c) Indicate the type of hybridization of the central atom in the following compounds: [2]
 NH_3 , C_2H_4 , H_2O , BeCl_2

Question 6.

- (a) The solubility of a solid x in water and ether are 5 gm L^{-1} and 25 gm L^{-1} respectively.
If 10 gm of the solid is shaken with a mixture of 1000ml water and 50ml ether,
how many grams of x goes into the ether layer? [3]
- (b) Explain with illustrations the Frenkel defect and Schottky defect. [2]
- (c) What are the difficulties of using standard hydrogen electrode as a reference electrode? [2]

Question 7.

- (a) Why is the smoke coming out from the chimney of factories passed through charged plates? [2]
- (b) How many α and β particles are emitted when ${}_{93}\text{Np}^{237}$ changes to ${}_{83}\text{Bi}^{209}$? [2]
- (c) (i) What are the phases in equilibrium at the triple point of the water system? [1]
(ii) A carbon dioxide molecule has two polar bonds, yet it has zero dipole moment.
Explain. [1]
(iii) Distinguish between artificial transmutation and artificial radioactivity. [1]

SECTION B (18 marks)

Answer any **three** questions.

Question 8.

- (a) For the reaction: $\text{NH}_4\text{Cl}(\text{g}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$ at 27°C , calculate the ΔS
(entropy change). [$\Delta\text{H} = 177 \text{ KJ}$, $\Delta\text{G} = 92 \text{ KJ}$] [2]
- (b) Name the following coordination compounds. [2]
(i) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$
(ii) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$
- (c) Explain SN^1 mechanism with an example. [2]

Question 9.

- (a) Outline the steps in the cyanide process for the extraction of silver from its ore.
Give balanced equations for the important chemical reactions. [3]
- (b) What will be the internal energy change (ΔE) in: [1]
- (i) isothermal process?
- (ii) adiabatic process?
- (c) Describe and write the balanced equation for the preparation of potash alum. [2]

Question 10.

- (a) Write the steps involved in the manufacture of bromine from sea-water. [3]
- (b) Distinguish between state and path functions with an example each. [2]
- (c) What do you understand by the term bidentate ligand? [1]

Question 11.

- (a) (i) Give *two* examples each of neutral electrophile and neutral nucleophile. [2]
- (ii) From the reaction given below, identify the reagent and the type of reaction.
$$\text{CH}_3\text{CH}_2\text{Cl} + \text{alc. KOH} \rightarrow \text{CH}_2 = \text{CH}_2 + \text{H}_2\text{O} + \text{KCl}$$
 [2]
- (b) Name the chief ore of lead. [½]
- (c) Define Joule Thomson effect. [1]
- (d) What property is shown by H_2O_2 in the reaction given below? [½]
- $$\text{H}_2\text{O}_2 + \text{O}_3 \rightarrow \text{H}_2\text{O} + 2\text{O}_2$$

SECTION C (14 marks)

Answer any **two** questions.

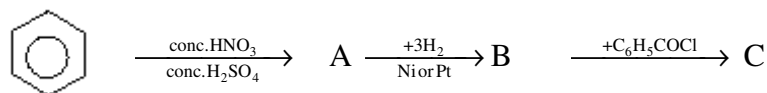
Question 12.

- (a) What is the structural formula of triolein? [1]
- (b) Give the balanced equation for the following conversions: [4]
- (i) Ethyl alcohol to diethyl ether
- (ii) Dimethyl ketone to iodoform
- (iii) Phenol to benzene
- (iv) Aniline to acetanilide

- (c) Name the products formed when sucrose undergoes acid hydrolysis.
What change is observed in the optical activity?

Question 13.

- (a) What type of isomerism is exhibited by lactic acid? Draw all the possible isomers. [2]
- (b) Acetaldehyde undergoes aldol condensation but formaldehyde does not.
Justify the statement. [2]
- (c) Identify A, B and C in the following reaction. [3]



Question 14.

- (a) Complete and balance the following reactions. [2]
- (i) $\text{CH}_3\text{CONH}_2 + \text{Br}_2 + \text{NaOH} \rightarrow$
- (ii) $\text{KCNO} + (\text{NH}_4)_2\text{SO}_4 \rightarrow$
- (b) Give **one** chemical test to distinguish between primary and secondary amines.
Support your answer by giving balanced equations. [2]
- (c) (i) The compound $\text{C}_4\text{H}_{10}\text{O}$ exhibits position isomerism. Justify by writing **two** isomers of the above compound. [1]
- (ii) Name the monomers of Nylon 66. [1]
- (iii) Name the product formed when glycine is heated. [1]