

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

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**PART I (40 marks)**

*Answer **all** questions.*

**Question 1.**

**(a)** *Correct the following statements.*

**[5]**

- (i) When a radioactive element loses an alpha and a beta particle, the element formed is its isotope.
- (ii) A trivalent element can have a bond order of one.
- (iii) 24 grams of magnesium can be deposited by one coulomb of electricity.
- (iv) Diethyl ether exhibits geometrical isomerism.
- (v) Column chromatography is based on the principle of absorption.

(b) *Each question below is followed by four possible choices of answers.*

*Choose the correct answer and write it in your answer booklet.*

- (i) The concentration unit independent of temperature is
- A percent.
  - B molality.
  - C molarity.
  - D normality.
- (ii) Radioactive iodine is used to diagnose the disease of
- A pituitary.
  - B kidneys.
  - C thyroid.
  - D bones.
- (iii) The catalyst in a chemical reaction changes the
- A equilibrium.
  - B heat of reaction.
  - C mass of product.
  - D activation energy.
- (iv) Which of the following cannot act as a buffer?
- A  $\text{HCl} + \text{NH}_4\text{Cl}$
  - B  $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$
  - C  $\text{H}_3\text{PO}_4 + \text{NaH}_2\text{PO}_4$
  - D  $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$
- (v) Entropy of the universe is
- A zero.
  - B constant.
  - C negative.
  - D increasing.

- (vi) Flux used in the extraction of copper is
- A limestone.
  - B magnesia.
  - C silica.
  - D coke.
- (vii) An isonitrile on reduction gives
- A 1° amine.
  - B 2° amine.
  - C 3° amine.
  - D quaternary salt.
- (viii) Aluminium chloride is an example of
- A free radicle.
  - B Lewis base.
  - C nucleophile.
  - D electrophile.
- (ix) Phenol gives violet colouration with
- A zinc chloride.
  - B ferric chloride.
  - C stannous chloride.
  - D aluminium chloride.
- (x) The type of polymer formed from ethylene glycol and terephthalic acid is
- A condensation.
  - B substitution.
  - C elimination.
  - D addition.

(c) **Fill in the blanks choosing appropriate word/s given in the brackets. Write the correct answers in your answer booklet.**

(esterification, structural, two, one, geometrical,  $T\Delta S$ , zero, saponification, glycine, ethyl alcohol)

- (i) A solution obtained by dissolving 342 gms of sucrose in 1000 gm of water is ..... molal.
- (ii) Normal propyl alcohol and isopropyl alcohol are examples of ..... isomerism.
- (iii) For a system to be in equilibrium,  $\Delta H$  should be equal to .....
- (iv) ..... forms zwitter ions in solution.
- (v) Reaction of fat with sodium hydroxide is called .....

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

[5]

Column A	Column B
(i) Graphite	(a) utropine
(ii) formaldehyde solution	(b) hardest substance
(iii) Aq. $\text{CH}_3\text{COOH}$	(c) $\text{sp}^2$ hybridized
(iv) Lactic acid	(d) triple point
(v) Water	(e) weak electrolyte
	(f) optically active
	(g) Tollens reagent
	(h) reduced phase rule

(e) *Answer the following questions.*

- (i) What type of bonding is present in sulphuric acid but not present in water? [1]
- (ii) The unit of rate constant of first order reaction is not the same as that of second order. Why? [1]
- (iii) Give the IUPAC name for  $K_3[Fe(CN)_6]$ . [1]
- (iv) In what physical states does fluorine exist at room temperature? [1]
- (v) What property of colloids is demonstrated by electrophoresis? [1]
- (vi) Free radicals are paramagnetic while carbocations are diamagnetic. Explain. [2]
- (vii) What is Cannizzaro's reaction? What type of compounds undergo this type of reaction? [2]
- (viii) Sucrose reduces ammoniacal silver nitrate only when preheated with dilute acids. Give reasons. [2]
- (ix) Arrange the following in increasing order of base strength.  
Phenol, aniline, ethylamine, methyl amine [2]
- (x) Give the balanced chemical equations for the preparation of polymer nylon 66. [2]

## PART II

### SECTION A (28 marks)

*Answer any four questions.*

#### Question 2.

- (a) The vapour pressure of pure benzene at a certain temperature is 200 mm Hg. At the same temperature the vapour pressure of a solution containing 2 gm of non-volatile electrolyte (solid) in 78 gm of benzene is 195 mm Hg. What is the molecular mass of the solid? [4]
- (b) Complete and balance the following nuclear equations. [3]
- (i)  ${}_3\text{Li}^7 + {}_1\text{H}^1 \rightarrow \dots + {}_4\text{Be}^7$
- (ii)  ${}_{13}\text{Al}^{27} + \dots \rightarrow {}_{15}\text{P}^{30} + {}_0\text{n}^1$
- (iii)  ${}_5\text{Be}^{10} + {}_2\text{H}^4 \rightarrow \dots + {}_0\text{n}^1$

**Question 3.**

- (a) Predict the hybridization, shape, bond angle and dipole moment of water molecule according to VSEPR. Support your answer with suitable reasons. [4]
- (b) At 298 K, an aqueous solution of iodine containing 0.0516 gm/lit is in equilibrium with  $\text{CCl}_4$  solution containing 4.413 gm/lit. What is the solubility of iodine in  $\text{CCl}_4$  at 298K, if its solubility in water is 0.34 gm? [3]

**Question 4.**

- (a) A certain first order reaction is 10% complete in 40 minutes. What percentage of the reactants would be consumed in 120 minutes? [3]
- (b) Draw a molecular orbital diagram for  $\text{O}_2^{+2}$  ion and calculate its bond order. [2]
- (c) Anthracene picrate gets separated into anthracene and picric acid when its solution is run down the column of alumina. Give reasons for this separation and name the principle involved. [2]

**Question 5.**

- (a) When a current of 11 amperes is passed through an aqueous solution of  $\text{CrCl}_3$ , 6.2 gm of Cr is deposited. For how long was the current passed? (Atomic weight: Cr = 52) [3]
- (b) Calculate the emf of the following cell at  $25^\circ\text{C}$ :  
 $\text{Zn} / \text{Zn}^{2+} (0.0004\text{M}) \parallel \text{Cd}^{2+} (0.2\text{M}) / \text{Cd}$ ,  
 $E^0$  for zinc and cadmium electrodes are -0.76 volts and 0.40 volts respectively. [3]
- (c) Draw a plot of rate vs. concentration for a first order reaction. [1]

**Question 6.**

- (a) The molecular weights of sodium chloride and glucose are determined by the depression of freezing point method. What will be their molecular weights as compared to their theoretical molecular weights? Justify your answer. [3]
- (b) 10 gms of a radioactive substance loses 2 gms of its weight in 50 seconds. Calculate its average life. [2]
- (c) How far can a mixture of water and ethanol be completely separated by fractional distillation? Explain with the help of a suitable plot. [2]

**Question 7.**

- (a) The solubility product of barium sulphate is  $1.0 \times 10^{-10}$  at  $25^\circ\text{C}$ . Will the precipitation occur, if equal volumes of  $4 \times 10^{-6}$  M sodium sulphate and barium chloride solution are mixed? Show with relevant calculations. [3]
- (b) Give *two* points of difference between Schottky and Frenkel defects. [2]
- (c) During analysis of mixture, zinc ion is not precipitated when  $\text{H}_2\text{S}$  is passed in group II while it is precipitated by the same reagent in group IV. Explain. [2]

**SECTION B (18 marks)**

Answer any **three** questions.

**Question 8.**

- (a) Name the chief ore of lead. Explain how it is extracted from it. [4]
- (b) What do you observe when  $\text{NH}_4\text{OH}$  is gradually added till excess to the solution of copper sulphate. Write relevant chemical equations. [2]

**Question 9.**

- (a) Give suitable reasons for the following: [4]
- Chloroacetic acid is stronger than acetic acid.
  - Chlorination of ethane is substitution reaction while chlorination of ethene is addition reaction.
  - Copper cannot be extracted as long as there are some iron impurities present in the ore.
  - Entropy of the universe tends to maximum.
- (b) What is observed when  $\text{H}_2\text{S}$  is passed through the following solutions? [2]
- copper sulphate
  - stannous chloride
  - zinc chloride
  - lead nitrate

**Question 10.**

- (a) Give the balanced chemical equations for the preparation of bromine in the laboratory. [2]
- (b) What are organometallic compounds? Give one important application. [1]
- (c) Calculate the work done in joules when 5 moles of an ideal gas at  $27^\circ\text{C}$  expand isothermally and reversibly from a volume of  $5 \text{ dm}^3$  to  $20 \text{ dm}^3$ . [3]

**Question 11.**

- (a) What are alums? How is potash alum prepared from alum stone?
- (b) How does sigma bonded organometallic compounds differ from pi bonded compounds? Explain with examples. [2]
- (c)  $\Delta H$  and  $\Delta S$  for vaporization of water at 1 atm pressure are  $40.625 \text{ KJ mole}^{-1}$  and  $108.8 \text{ Jmole}^{-1} \text{ K}^{-1}$  respectively. Calculate the equilibrium temperature. [2]

**SECTION C (14 marks)**  
Answer any **two** questions.

**Question 12.**

- (a) Give the formula and name of the reagents A, B, C and D to bring about the following conversions: [4]



- (b) Complete the following equations: [3]



**Question 13.**

- (a) A compound A having molecular formula  $C_2H_7N$  on treatment with nitrous acid gave a compound B having molecular formula  $C_2H_6O$ . The compound B on treatment with acetyl chloride gave a compound C with molecular formula  $C_4H_8O_2$ . [4]

- (i) Name the compounds A, B and C and write their structural formula.  
(ii) Write the balanced equation for the formation of B.

- (b) How will you convert the following? Give balanced equation. [3]

- (i) Nitrobenzene to aniline  
(ii) Benzene to benzoic acid  
(iii) Phenol to picric acid

**Question 14.**

- (a) Give the balanced chemical equation for the following. [4]

- (i) Benzaldehyde reacts with hydroxylamine  
(ii) Phenol reacts with bromine water  
(iii) Benzoic acid is treated with mixture of conc. sulphuric acid and conc. nitric acid  
(iv) Benzaldehyde is treated with Zn / HCl

- (b) Differentiate between the following with one example each:
- (i) thermosetting and thermoplastics
  - (ii) condensation and addition polymers
  - (iii) co-polymer and homopolymer