

- N.B.**(1) All questions are **compulsory**.
 (2) **Figures** to the **right** indicate **full** marks
 (3) Use of **logarithmic tables** or **nonprogrammable** calculator is **allowed**

Physical constants:

$$N = 6.022 \times 10^{23}$$

$$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$$

$$F = 96500 \text{ Coulombs}$$

$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$h = 6.626 \times 10^{-34} \text{ J s}$$

$$c = 3.0 \times 10^8 \text{ m s}^{-1}$$

$$m_e = 9.109 \times 10^{-31} \text{ kg}$$

$$1 \text{ a m u} = 931 \text{ MeV} = 1.66 \times 10^{-27} \text{ kg}$$

$$\pi = 3.142$$

1. Attempt **any three** of the following :
 - A. Derive an expression to show that elevation in boiling point is directly proportional to mole fraction of the solute. 5
 - B. Define osmotic pressure. Explain what is meant by abnormal molar mass. 5
 - C. Define and explain the term phase with suitable examples of one, two and three phase systems using two components. 5
 - D. Draw and explain the phase diagram for lead silver system. 5
 - E. Draw and explain the phase diagram for three component system having one pair of partially miscible liquids. 5
 - F. When 1.84 g of carbon tetrachloride was dissolved in 100 g of benzene, the freezing point depression was found to be 0.613 K. Calculate the molecular weight of carbon tetrachloride if $K_f = 5.12 \text{ K mol}^{-1} \text{ kg}$. 5

2. Attempt **any three** of the following:
 - A. Give any five characteristics features of catalyst. 5
 - B. Derive Michaelis-Menten equation for enzyme catalysis. 5
 - C. With respect to BET equation answer the following: 5
 - (i) State the equation.
 - (ii) identify the terms involved in the equation.
 - (iii) test the validity of the equation.
 - D. Differentiate between physical and chemical adsorption. 5
 - E. What are surfactants? Give the application of surfactants in detergents and food industry. 5
 - F. Describe any two methods to explain the charge on a colloidal particle. 5

3. Attempt **any three** of the following:

- A. Explain the terms (i) chemical cell (ii) concentration cell .Give one example of each. 5
- B. Explain how quinhydrone electrode is used to determine pH of a solution 5
- C. Derive an expression for emf of an electrolyte concentration cell with transference reversible to cation. 5
- D. A solution is 0.01m w.r.t NaCl and Na₂SO₄ each.Calculate the activity coefficient of NaCl in this solution.(A = 0.509 for water at 298 K) 5
- E. Derive an expression for a emf of the following cell: 5



- F. Define the ionic strength of a solution. Calculate the ionic strength of a solution containing 0.1 m KCl and 0.01 m CaCl₂ 5

4. Attempt **any three** of the following:

- A. Differentiate between thermoplastic and thermosetting polymer. 5
- B. The intrinsic viscosity of a solution is 0.36 dl g⁻¹. The constants K and α in Mark-Houwink equation are 3.6x 10⁻⁴ and 0.64 respectively. Calculate the molecular weight of the polymer. 5
- C. Explain the Schottky and Frenkel defect in solids. 5
- D. Prove: 5
- (i) There are four molecules of NaCl per unit cell of the crystal.
- (ii) There are four atoms per unit cell of face centred cubic lattice of an element.
- E. Derive Bragg's equation. 5
- F. The first order reflection maxima from (100),(110) and (111) planes of a given cubic crystal occurs at 7.2°, 10.2° and 12.5° respectively. What type cubic lattice does the crystal possess? 5

5.A. Say **true** or **false** for the following statement: 4

- (a) The reaction $\text{N}_{2(g)} + 3\text{H}_{2(g)} = 2\text{NH}_{3(g)}$ has three degrees of freedom.
- (b). The Gibbs phase rule is given by : $F = C + P - 2$.
- (c) The addition of nonvolatile solute to the solvent increases the vapour pressure of the solution.
- (d) A system with zero degree of freedom is known as invariant system.

OR

5.A. Match the following:

4

Column A**Column B**

(p) $p/p^0 = 1 - x_2$

(i) phase rule for three component system.

(q) $F = 3 - P$

(ii) van't Hoff equation

(r) $\pi V = nRT$

(iii) condensed phase rule

(s) $F = 5 - P$.

(iv) Raoult's Law

(v) phase rule for one component system.

5.B. Say **true** or **false** for the following:

4

- (a) Langmuir's isotherm holds good at low pressure but fails at high pressure.
 (b) Adsorption of hydrogen on charcoal is physical adsorption.
 (c) Potential developed at the fixed layer in a colloidal solution is known as Nernst potential.
 (d) The inhibitors accelerate the rate of reaction.

OR

5.B. Match the following:

4

Column A**Column B**

(p) Adsorption is multilayer in thickness

(i) heterogeneous in nature

(q) colloidal solution

(ii) BET

(r) Soap

(iii) catalyst

(s) Invertase

(iv) colloidal electrolyte

(v) inhibitor

5.C. Say **true** or **false** for the following:

4

- (a) The expression for activity of HCl and NaCl will be same.
 (b) The value for E^0_{cell} is 0.0 V in chemical cell.
 (c) Chemical energy is converted into electrical energy in galvanic cells.
 (d) Quinhydrone electrode functions satisfactorily from pH range 1 to 14.

OR**Turn Over**

5.C. Match the following:

4

Column A**Column B**

- | | |
|---|--------------------------------|
| (p) Glass electrode | (i) amalgam electrode |
| (q) Quinhydrone electrode | (ii) concentration cell |
| (r) $^{-}\text{Ag} \text{AgNO}_3 \text{AgNO}_3 \text{Ag}^{+}$
a_1 a_2 | (iii) ion selective electrode. |
| (s) Cd (Hg) | (iv) redox electrode. |
| | (v) chemical cell |

5.D. Say **true** or **false** for the following.

3

- (a) Number of atoms per unit cell of body centred cubic crystal is 4.
 (b) Weight average molecular weight depends only on number of polymer molecules.
 (c) There are six Cl^{-} surrounding one Na^{+} in NaCl unit cell.

OR

5.D. Match the following:

3

Column A**Column B**

- | | |
|-------------------|---------------------|
| (p) NaCl | (i) natural polymer |
| (q) starch | (ii) BCC lattice |
| (r) epoxy polymer | (iii) FCC lattice |
| | (iv) liquid polymer |
