

2.5 hours

Total Marks:75

N.B.

1. All questions are **compulsory**.
2. **Figures** to the **right** indicate **full marks**.
3. Use of **log tables /non-programmable calculator** is **allowed**.

Physical constants:

$$N=6.023 \times 10^{23},$$

$$F=96500, C$$

$$R=8.314 \text{ J/K/mol},$$

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

$$c=3 \times 10^8 \text{ m/s},$$

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

$$\pi = 3.142$$

1. Attempt any three of the following:

- (A) Define dipole moment. How are cis and trans isomers identified on the basis of dipole moment? 5
- (B) What is zero point energy? The vibrational frequency of a molecule is $3 \times 10^5 \text{ m}^{-1}$. Calculate zero point energy. 5
- (C) Explain the IR spectra of water molecule. 5
- (D) Explain P and R branch lines in rotational – vibrational spectra. 5
- (E) What is Raman effect and Raman shift? Explain Stokes and anti-Stokes lines. 5
- (F) Derive an expression for frequency separation of lines in rotational spectrum of a diatomic molecule. 5

2. Attempt any three of the following:

- (A) Explain the different types of ion specific electrodes. 5
- (B) Derive an expression for emf of a concentration cell with transference reversible to cation. 5
- (C) Calculate the mean activity coefficient of KCl in a solution containing 0.1m KCl and 0.2m CaCl_2 . 5
- (D) Derive Nernst equation for a galvanic cell. 5
- (E) Derive an expression for emf of a concentration cell without transference reversible to anion. 5
- (F) The emf of the cell is 0.02 volt at 298K. Calculate t_+ and t_- in the given range of concentration. 5

Cu	CuSO ₄ m = 0.02 $\gamma = 0.32$	CuSO ₄ m = 0.2 $\gamma = 0.11$	Cu 0.02
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3. Attempt any three of the following:

- (A) Explain the application of phase rule to water system. 5
- (B) Explain the phase diagram of lead-silver system. 5
- (C) Explain the term reverse osmosis. 5
- (D) State the phase rule and explain the terms. 5
- (E) Derive the equation $\Delta T_b = K_b \cdot m$ 5
- (F) Derive Clapeyron equation. 5

4. Attempt any three of the following:

- (A) Explain Donnan Membrane equilibrium. 5
- (B) State BET equation and explain the terms involved. 5
- (C) Describe the characteristic features of catalysis. 5
- (D) Explains electrophoresis in details. 5
- (E) Write a note on origin of charge on colloids. 5
- (F) Explain Langmuir's adsorption isotherm and derive the equation. 5

5. (A) State true or false 4

- (a) Unit of dipole moment is Debye.
- (b) Water has non-linear structure.
- (c) CO_2 has 4 degrees of freedom.
- (d) Finger print region is $400\text{--}700\text{ cm}^{-1}$.

OR

(A) Match the following 4

- | | |
|------------------------|---------------------------|
| (p) Raman effect | (i) Tetrahedral |
| (q) CH_4 | (ii) Basic quantum theory |
| (r) Rotational spectra | (iii) $\Delta J = \pm 1$ |
| (s) Selection rule | (iv) Dipole moment |

5. (B) State true or false 4

- (a) Oxidation is gain of electrons
- (b) Amalgam electrode does not contain mercury.
- (c) Salt bridge contains KCl solution.
- (d) $a = m \cdot \gamma$

OR

(B) Match the following 4

- | | |
|-------------------------|-----------------------|
| (p) Electrode potential | (i) Pt electrode |
| (q) Gas electrode | (ii) Nernst theory |
| (r) Salt bridge | (iii) Lewis & Randall |
| (s) Ionic strength | (iv) U-tube |

5. (C) State true or false

4

- (a) Reverse osmosis is used to concentrate fruit juices.
- (b) K_f is molal depression constant.
- (c) Condensed phase rule is $F = C - P + 1$
- (d) Pb-Ag system is three component system.

OR

(C) Match the following

4

- | | |
|--------------------|----------------------------------|
| (p) Raoult's law | (i) Molal elevation constant |
| (q) K_b | (ii) Lowering of vapour pressure |
| (r) Osmosis | (iii) One components |
| (s) Sulphur system | (iv) Membrane |

5. (D) State true or false

3

- (a) Surfactants are used in food industry.
- (b) Charge on colloidal particles depend on medium.
- (c) Catalyst are selective

OR

(D) Match the following

3

- | | |
|-------------------------|---------------------|
| (p) Chemical adsorption | (i) Regenerated |
| (q) Catalyst | (ii) Same charge |
| (r) Colloidal particles | (iii) Chemical bond |