Seat No. : _____

FC-140

February-2025

M.Sc., Sem.-I

403 : Chemistry

(Physical Chemistry)

Time : 2:30 Hours] **[Max. Marks : 70**

Necessary Constants :

$N = 6.022 \times 10^{23}\ mol^{-1}$

$k = 1.38 \times 10^{-16}\ ergs\ K^{-1} = 1.38 \times 10^{-23}\ J \cdot K^{-1}$

$h = 6.626 \times 10^{-27}\ erg \cdot sec = 6.626 \times 10^{-34}\ J \cdot sec$

$c = 2.998 \times 10^{10}\ cm \cdot sec^{-1} = 2.998 \times 10^{8}\ m \cdot sec^{-1}$

$F = 96500\ C$

$R = 8.314 \times 10^{7}\ ergs\ K^{-1}M^{-1} = 8.314\ J \cdot K^{-1}\ M^{-1} = 1.987\ cal\ K^{-1}\ M^{-1}$

1. (A) What are partial molar properties ? Show how partial molar volume can be determined by density measurements. **7**

OR

(A) Explain in brief a chemical affinity. Explain various methods to determine the chemical affinity. **7**

(B) Discuss the Nernst heat theorem and derive the equation giving relations between heat capacity, free energy and enthalpy. **7**

OR

(B) What is meant by chemical potential ? Derive the Gibbs-Duhem equation. **7**

2. (A) Explain the Collision theory of bimolecular reactions. **7**

OR

(A) Explain the influence of solvent properties on rate of reaction. **7**

(B) Discuss activated complex theory of bimolecular reactions. **7**

OR

(B) Discuss the kinetics of diffusion control reaction in solutions. **7**

3. (A) Define 'Heat of Adsorption'. Write 10 points of differences between Physical and Chemical Adsorption. **7**

OR

(A) What is the importance of surface area ? Explain how the surface area of solids is determined using B.E.T. method. **7**

(B) Derive Gibbs adsorption isotherm equation and its significance in terms of positive and negative adsorption. **7**

OR

(B) Explain the gravimetric and the volumetric methods to determine the gas adsorption. **7**

4. (A) Explain in detail about the defects in solids. Derive an equation to calculate number of Frenkel defects in crystals. **7**

OR

(A) Explain the determination of particle size of crystallite with the help of X-ray powder method. **7**

(B) Discuss semiconductors, insulators and conductors with illustration using band theory. **7**

OR

(B) What is super-conductivity ? Explain about low temperature and high temperature super-conductivity. **7**

5. Answer the following : (Any **Seven**) **14**

(1) Give any two applications of third law of thermodynamics.

(2) Define Heat capacity.

(3) Calculate K for a reaction which has ΔG^{o} value –20.0 k·cal at 25 ºC.

(4) Define Energy of activation.

(5) Give two limitations of the Collision theory.

(6) Calculate the activation energy of a reaction whose reaction rate at 27 ºC gets doubled for 10 ºC rise in temperature, R = 8.314 $J \cdot k^{-1} M^{-1}$.

(7) What are Adsorption Isotherms ?

(8) What is the effect of temperature and pressure on the adsorption of a gas on a solid ?

(9) Adsorption of N_2 on TiO_2 was carried out at 75 K. The B.E.T. plot gives a straight line with an intercept 4.0×10^{-6} mm^{-3} and slope 1.0×10^{-3} mm^{-3}. What is the volume (round off) corresponding to monolayer coverage ?

(10) Define Lattice energy of an Ionic Crystal.

(11) Frenkel defect is not seen in pure alkali metal halids. Why ?

(12) Calculate the distance between III Planes in a crystal of Ca. Repeat the calculation for the 222 planes. Which planes are closer ? (a = 0.556 n.m)