3. Answer any ***two*** questions 2×8 = 16

(a) IR and Raman spectroscopic data of CO_2 are given below.

Wavenumber (cm^{-1})	Infrared	Raman
1330	Inactive	Active
2349	Active (∥) PR	Inactive
667.3	Active (⊥) PQR	Inactive

(i) Predict geometry of CO_2 from the spectroscopic data.

(ii) Predict different modes of vibration corresponding to the wavenumber. 3 + 5

(b) (i) What do you mean Primary kinetic salt effect?

(ii) For the reaction

$$A^{z_A} + B^{z_B} \rightleftharpoons X^{(z_A+z_B)\ddagger} \rightarrow P$$

Prove that $\log k_r = \log k_r^0 + 2A(z_A z_B)\sqrt{I}$

(iii) Calculate the mean ionic activity coefficient ($\gamma\pm$) of 0.01(M) KCl solution at 298K using Debye-Huckel limiting law. [A = 0.51 for water at 298K] 2+4+2

(c) (i) Derive the BET equation for multilayer adsorption.

(ii) Calculate the vapour pressure of a spherical droplet of water of radius 20.0 nm at 35°C. The vapour pressure of bulk water at the temperature is 5.623 kPa and its density is 994.0 kg m^{-3}. Given γ(water) = 72 mN m^{-1}. 4 + 4

(d) (i) How will you calculate $v_{0,max}$ using Eadie Method? Why Eadie Method is more acceptable to obtain $v_{0,max}$ than *Lineweaver-Burk* method?

(iii) What is the product of uncertainty in velocity and position of an electron? (3+2) + 3

…….

Internal Assessment-10

2023

M.Sc.

2nd Semester Examination

CHEMISTRY

PAPER – CEM-201

Full Marks: 50

Time : 2 Hours

(CEM 201-Physical Chemistry-II)

1. Answer any ***four*** bits: 2×4 = 8

(a) Why the observed molar conductivity of an electrolyte at very high potential gradient (20000 V/cm) is equal to the molar conductivity at infinite dilution?

(b) Spectroscopically prove that N_2O molecule has no centre of symmetry.

(c) Frequently we use $\mu = \mu^0 + RT\ln(p/p^0)$. What is the value of p^0?

(d)Write Hamiltonian operator for Hydrogen-like system.

(e) What is the reason of deviation from ideality of ionic solution?

(f) For the reaction$\nu A \rightarrow P$, write rate expression equation in terms of reactant "A" for 1st order reaction.

2. Answer any ***four*** bits: 4×4 = 16

(a) Draw the curve for the mean activity coefficient versus concentration for HCl and explain the nature of the curve.

(b) Explain Q.M Picture of Raman Scattering.

(c) For bimolecular transition state theory, establish the *Eyring equation*

$$k_r = \frac{RT}{N_A h c^0} K^{\ddagger}$$

(d) Classify each of the operators as linear or nonlinear (*i*) d^2/dx^2 &(*ii*) $(\,)^2$.

(e) What do you mean by CMC? Plot Λ_m vs *c* for a solution and explain its nature at CMC.

(f) What would be the pressure inside a small air bubble of 0.1 mm radius is situated just below the surface of water. Surface tension of water = 72 dynes/cm, atmospheric pressure = 1.01×10^6 dynes/cm^2.