

2023

M.Sc.

2ndSemester Examination

CHEMISTRY

PAPER – CEM-201

Full Marks: 50

Time : 2 Hours

(CEM 201-Physical Chemistry-II)

(a) IR and Raman spectroscopic data of CO₂ are given below.

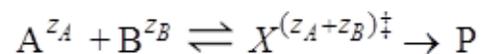
Wavenumber (cm ⁻¹)	Infrared	Raman
1330	Inactive	Active
2349	Active () PR	Inactive
667.3	Active (⊥) PQR	Inactive

(i) Predict geometry of CO₂ 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

Prove that $\log k_r = \log k_r^0 + 2A(z_A z_B)\sqrt{I}$ (iii) Calculate the mean ionic activity coefficient (γ_{\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 $\gamma(\text{water}) = 72 \text{ mN m}^{-1}$. 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

1. Answer any *four* bits:

2×4 = 8

- 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?
- Spectroscopically prove that N₂O molecule has no centre of symmetry.
- Frequently we use $\mu = \mu^0 + RT \ln(p/p^0)$. What is the value of p^0 ?
- Write Hamiltonian operator for Hydrogen-like system.
- What is the reason of deviation from ideality of ionic solution?
- For the reaction $nA \rightarrow P$, write rate expression equation in terms of reactant "A" for 1st order reaction.

2. Answer any *four* bits:

4×4 = 16

- Draw the curve for the mean activity coefficient versus concentration for HCl and explain the nature of the curve.
- Explain Q.M Picture of Raman Scattering.
- For bimolecular transition state theory, establish the *Eyring equation*

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

- Classify each of the operators as linear or nonlinear (i) d^2/dx^2 & (ii) $()^2$.
- What do you mean by CMC? Plot Λ_m vs c for a solution and explain its nature at CMC.
- 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/cm².

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