

Bachelor of Science (B.Sc.) Semester—V Examination
(Old and New)
CH-502 : PHYSICAL CHEMISTRY
Compulsory Paper—2
(Chemistry)
(New Course)

Time : Three Hours]

[Maximum Marks : 50

Note :— (1) All questions are compulsory.
 (2) Write chemical equations and draw diagrams wherever necessary.

- 1 (A) Derive the relationship between emf of the cell, enthalpy change and temperature coefficient of the emf.
 Calculate enthalpy change in the cell reaction, if the temperature coefficient of the emf is -4.02×10^{-4} volts deg⁻¹ for a cell and emf of the cell at 20°C is 1.015 V. (Given $n = 2$). 5
- (B) Give the application of emf measurement in the determination of pH of the solution using quinhydrone electrode. Find pH of the following cell at 25°C.
 Pt, Hg, Hg₂Cl₂(s) | KCl(sat.) || H⁺ | Q, QH₂, Pt
 (Given : $E_{cal}^{\circ} = 0.2415$ V, $E_{cell}^{\circ} = 0.301$ V, $E_{QH_2}^{\circ} = 0.6994$ V) 5
- OR
- (C) Derive Nernst equation for the reaction taking place in the Daniel cell. 2½
- (D) The cell emf of the following cell at 25°C is 0.0418 V :
 Ag(s) | AgNO₃(0.002 m) | AgNO₃(0.08 m) | Ag(s) 2½
 Calculate the transference numbers of Ag⁺ and NO₃⁻ ions *emf*
- (E) What is liquid junction potential? How can it be minimized? 2½
- (F) Explain how redox titrations are carried out potentiometrically. 2½
2. (A) What are quantum numbers? Give the significance of orbital and magnetic quantum numbers. 5
- (B) What are the conditions for the formation of molecular orbitals from the atomic orbitals? Discuss LCAO-MO treatment for the formation of H₂⁺ ion. 5
- OR
- (C) Write Schrodinger wave equation for hydrogen atom in polar co-ordinates. How it can be separated into three variable R(r), $\theta(\theta)$ and $\phi(\phi)$? 2½
- (D) What are orbitals? Discuss about the shapes of s-orbitals. 2½
- (E) What are probability distribution curves? Draw and discuss the radial distribution curve for 3-s orbital 2½
- (F) What are the differences between valence bond and molecular orbital models? 2½
3. (A) What are the reasons of high quantum yield of photochemical reactions?
 A substance absorbs 2.0×10^{16} quanta of radiations per second and 0.002 moles of it reacted in 1204 seconds. Calculate quantum efficiency of the reaction. 5
- (B) Give brief discussion of Raman spectra. What are the advantages of Raman spectra over Infrared spectra? 5

OR

- (C) State and explain Beer's Law. 2½
 (D) Differentiate between fluorescence and phosphorescence. 2½
 (E) Write a note on photosensitization. 2½
 (F) Discuss pure rotational Raman spectra of diatomic molecules. 2½
4. (A) State Raoult's law of relative lowering of vapour pressure. Derive the relationship between relative lowering of vapour pressure and molar mass of solute.

A solution has 0.0113 kg of a solute in 0.1 kg of ether, has a vapour pressure of $4.788 \times 10^4 \text{ Nm}^{-2}$. Vapour pressure of pure ether at the same temperature was $5.094 \times 10^4 \text{ Nm}^{-2}$. Calculate the molar mass of the solute.

(Molecular weight of ether = $0.074 \text{ kg mol}^{-1}$). 5

- (B) Discuss viscosity method for the determination of molecular weight of polymer.
 The intrinsic viscosity of a polyisobutene solution is $180 \times 10^{-3} \text{ m}^3/\text{kg}$. The constants k and a for the solvent are given as 3.60×10^{-5} and 0.64 respectively. Calculate the viscosity average molecular weight of the polymer. 5

OR

- (C) A solution of $1 \times 10^{-3} \text{ kg}$ of sodium chloride in 0.1 kg of water freezes at -0.604°C . The molal depression constant of water is 1.85°C . Calculate the percentage dissociation of sodium chloride. 2½
- (D) Derive the relationship between elevation in boiling point and molar mass of non-volatile solute. 2½
- (E) An equal number of protein mixture containing Haemoglobin 15.5 kg mol^{-1} , Ribonuclease 13.7 kg mol^{-1} and Myoglobin 17.2 kg mol^{-1} . Calculate number average and mass average molecular weight of the protein solution. <https://www.rtmnuonline.com> 2½
- (F) What are electrically conducting polymers? Discuss the conductance in polysulphur nitride. 2½

5. Attempt any TEN questions of the following :

- (i) Give an example of metal insoluble salt-salt anion electrode.
 (ii) Write two advantages of potentiometric titrations over simple titration.
 (iii) What is the effect of temperature on emf of the cell?
 (iv) Write two postulates of molecular orbital theory.
 (v) Draw the electronic probability density curve for anti-bonding molecular orbital.
 (vi) Draw radial distribution curve for 1s-orbital.
 (vii) State Grotthus-Draper law.
 (viii) What is an actinometer?
 (ix) What are isotropically polarizable molecules?
 (x) 36.5 g of HCl is dissolved in 90 g of water. Calculate molality of the solution.
 (xi) Define molal elevation constant.
 (xii) Give one example each of addition polymer and condensation polymer. 1×10=10