KNT/KW/16/5173

Bachelor of Science (B.Sc.) Semester–V (C.B.S.) Examination

CH-502 : PHYSICAL CHEMISTRY

Paper–2

(Chemistry)

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) All **FIVE** questions are compulsory.

(2) Write chemical equations and draw diagrams wherever necessary.

1. (A) State and explain Heisenberg's uncertainty principle. The uncertainty in position and uncertainty in velocity of a particle are 1×10^{-10} m and 5.27×10^{24} ms^{-1} respectively. Calculate the mass of a particle. 5

(B) Derive an expression of energy for a particle moving in one dimensional box. What is zero point energy ? 5

OR

(C) Explain how classical mechanics fails when applied to heat capacity of solids. 2½

(D) Calculate de-Broglie wavelength of a body of mass 0.1 kg moving with a velocity of 2000 ms^{-1}. 2½

(E) What is an operator ? When is it said to be linear and commute ? 2½

(F) What are normalized and orthogonal wave functions ? 2½

2. (A) What are probability distribution functions ? Draw and discuss radial distribution curves for 2p and 3d orbitals. 5

(B) Using LCAO-MO treatment of H_2^+ ion, derive expressions for molecular orbital wave functions. Discuss graphically the variation of electron probability density for antibonding molecular orbitals along the internuclear axis. 5

OR

(C) What are quantum numbers ? Discuss the significance of principal quantum number. 2½

(D) Write the radial and angular parts of the wave functions obtained by the separation of variables for H-atom. 2½

(E) Explain Molecular Orbital theory for H_2 molecule. 2½

(F) Explain physical picture of bonding and antibonding wave functions. 2½

3. (A) Derive the relationship between depression in freezing point of the solvent and molar mass of a non-volatile solute. 5

(B) How do the magnetic susceptibility measurement can be used :

(i) to decide the structure of co-ordination compounds and

(ii) in confirming the structure of a given molecule ? 5

OR

(C) Define osmotic pressure. How can it be determined by Berkeley-Hartly method ? 2½

(D) A 1% solution of KCl was found to freeze at – 0.46 ºC. Calculate Van't Hoff factor and degree of dissociation of a solute at this concentration. (K_f for water = 1.86 K kg mol^{-1}) 2½

(E) Explain the terms magnetic permeability and magnetic susceptibility. How are they used to decide diamagnetic and paramagnetic substances ? 2½

(F) Derive the relationship between relative lowering of vapour pressure of the solution and molar mass of a non-volatile solute. 2½

4. (A) What is quantum yield of photochemical reactions ? For a photochemical reaction A $\rightarrow$ B, 1.0×10^{-5} moles of B were formed on absorption of 6.0 Joules at 3600×10^{-10} m. Calculate the quantum yield. (N = 6.023×10^{23} mol^{-1}, h = 6.626×10^{-34} JS, C = 3.0×10^{8} ms^{-1}). 5

(B) Discuss briefly pure rotational Raman Spectra of diatomic molecules. What are the advantages of Raman spectroscopy over infrared spectroscopy ? 5

OR

(C) Give the difference between thermal and photochemical processes. 2½

(D) What are the reasons for low quantum yield of photochemical reactions ? 2½

(E) Explain stokes and anti-stokes lines in Raman spectra. 2½

(F) Explain photosensitized reactions by giving examples. 2½

5. (I) Write Wien's radiation law equation.

(II) What is photoelectric effect ?

(III) Give the physical significance of ψ^2.

(IV) What is the concept of atomic orbitals ?

(V) Draw probability density curve for bonding molecular orbitals.

(VI) Write the expression of the energy for hydrogen like particles.

(VII) Define the term normality of solution.

(VIII) Calculate mole fraction of NaCl when 5.84×10^{-3} kg of it is dissolved in 1.8×10^{-2} kg of water.

(IX) Write the relation between magnetic moment and number of unpaired electrons.

(X) State Lambert's law.

(XI) What are isotropically polarizable and anisotropically polarizable molecules ?

(XII) Define molar extinction coefficient. 1×10=10