TKN/KS/16/5888

Bachelor of Science (B.Sc.) Semester—V (C.B.S.)
Examination
CHEMISTRY
Paper—II (CH–502)
(Physical chemistry)

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) All **FIVE** questions are compulsory and carry equal marks.

(2) Draw diagrams wherever necessary.

1. (A) State and explain Heisenberg's uncertainty principle.

   A base ball weighing 0.1 kg is to be located within 1 nm. Calculate the uncertainty in its velocity. What conclusion is drawn from the result ? (h = 6.626×10^{-34} JS) 5

   (B) Derive Schrodinger wave equation. Explain physical significance of ψ and ψ^2. 5

   OR

   (C) Explain how classical mechanics failed when applied to photoelectric effect. 2½

   (D) Explain de-Broglie's hypothesis related to dual nature of matter. Derive the de-Broglie relation. 2½

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

(B) Explain the applications of magnetic susceptibility in :

   (i) Calculation of number of unpaired electrons in a molecule.

   (ii) The study of co-ordination compounds.   5

OR

(C) State Raoult's law. How is lowering of vapour pressure related to molecular weight of solute ?   2½

(D) A solution of sucrose (molecular weight = 342×10^{-3} kg) is prepared by dissolving 68.4×10^{-3} kg of it per 10^{-3} m^3 of the solution. What its osmotic pressure at 300 K ? (R = 0.0821×10^{-3} m^3 atm K^{-1} mol^{-1})   2½

(E) A 1.65 g of acetic acid when dissolved in 100 g of benzene raises the boiling point by 0.36 ℃. Calculate Van't Hoff factor. (K_b for benzene = 2.57 K kg mol^{-1})   2½

(F) Describe Gouy's method for determination of magnetic susceptibility.   2½

4. (A) What do you mean by singlet and triplet states ? Explain fluorescence and phosphorescence phenomenon using Jablonski diagram.   5

(B) Define quantum yield.

   A photobromination of cinnamic acid to dibromocinnamic acid was carried out in blue light of wavelength 440 nm at 35℃ using light intensity of 1.5×10^{-3} JS^{-1}. An exposure of 20 minutes produced a decrease of 0.075 millimole of bromine. The solution absorbed 80% of the light passing through it. Calculate the quantum yield of the reaction.

   (h = 6.626×10^{-34} JS, C = 3.0×10^8 mS^{-1}, N = 6.023×10^{23} mol^{-1}).   5

OR

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

(D) Explain the phenomenon of photosensitization. 2½

(E) Explain Rayleigh's lines, Stoke's lines and anti-Stoke's lines in Raman spectra.   2½

(F) On the basis of polarizability, explain which type of molecules will be rotationally Raman active and which will be inactive.   2½

5. Attempt any **TEN** questions of the following :

   (i) Define perfect blackbody.

   (ii) What is zero point energy ?

   (iii) What is an operator ?

(F) What is the ground state energy for an electron which is confined to a potential well having a width of $1 Å$?

($h = 6.626 \times 10^{-34}$ JS, mass of electron $= 9.11 \times 10^{-31}$ kg)

2½

2. (A) What are probability distribution curves ? Draw and discuss radial probability distribution curves for 2S and 2P orbitals. 5

(B) How does LCAO-MO treatment of H_2^+ ion lead to the concept of bonding and antibonding molecular orbitals ? Represent them diagrammatically. 5

OR

(C) Write Schrodinger wave equation for hydrogen atom in spherical polar co-ordinates. 2½

(D) Explain azimuthal and magnetic quantum numbers. 2½

(E) What are the conditions under which molecular orbitals are formed from atomic orbitals ? 2½

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

3. (A) Derive thermodynamically the relation, $\Delta T_f = K_f \times m$ (m = molality of the solution). 5

(iv) Write the expression for the energy for hydrogen like particles.

(v) What is an orbital ?

(vi) What is radial probability ?

(vii) Define the term molality.

(viii) Calculate the magnetic moment if the number of unpaired electrons are 4.

(ix) Define magnetic permeability.

(x) State first law of photochemistry.

(xi) State Beer's law.

(xii) What is Raman effect ? 10