NRT/KS/19/2140

Bachelor of Science (B.Sc.) Semester—V Examination

CH–502 PHYSICAL CHEMISTRY

Compulsory Paper—2 (Chemistry)

Time : Three Hours] [Maximum Marks : 50

Note :— (1) All questions are compulsory.

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

1. (A) Explain how classical mechanics fails when applied to :—

(i) Black body radiation and

(ii) Heat capacity of solids. 5

(B) State postulates of quantum mechanics. Derive Schrodinger wave equation from postulates of quantum mechanics. 5

OR

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

(D) A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Å. What is the uncertainty involved in the measurement of its velocity ?

($m_e = 9.1 \times 10^{-31}$ kg and $h = 6.626 \times 10^{-34}$ Js). 2½

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

(F) An electron is confined to an infinite one dimensional box of width 4Å. Calculate its energy in eV in the fourth energy level ($1\ eV = 1.60 \times 10^{-19}$ J). 2½

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

(B) What are the conditions for formation of molecular orbitals from atomic orbitals ? Discuss the physical picture of bonding and antibonding wave functions. 5

OR

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

(D) Write Schrodinger wave equation for hydrogen like particles in terms of polar co-ordinates. 2½

(E) Discuss graphically the variation of electron probability density for bonding molecular orbitals along the internuclear axis. 2½

(F) Explain molecular orbital theory for H_2 molecule. 2½

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

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

(i) In the study of co-ordination compounds and

(ii) In calculation of the number of unpaired electrons in a molecule. 5

OR

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

(D) A 0.3015 g of silver nitrate when dissolved in 28.40 g of water depressed the freezing point by 0.212 ºC. To what extent is silver nitrate dissociated ?

(K_f for water = 1.85 ºC mol^{-1}). 2½

(E) Define molarity of solution. A 0.212 g of Na_2CO_3 with molecular mass 106 is dissolved in 250 ml of solution. Caculate the molarity of Na_2CO_3 in the solution. 2½

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

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

(B) Explain Rayleighs' line, Stokes' lines and anti-Stokes' lines in Raman spectra ? Give experimental setup of Raman spectroscopy. 5

OR

(C) Calculate the transmittance, absorbance and absorption coefficient of a solution which absorbs 90% of a certain wavelength of light beam passed through a 1 cm cell containing 0.25 M solution. 2½

(D) Define quantum yield of photochemical reactions. How can it be experimentally determined ? 2½

(E) Write a short note on energy transfer processes. 2½

(F) Represent diagramatically the separation between the different lines obtained for pure rotational Raman spectrum of diatomic molecules. 2½

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

(i) What is Photoelectric effect ?

(ii) Give the physical significance of Ψ^2.

(iii) When is an operator said to be linear ?

(iv) What is the concept of atomic orbitals ?

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

(vi) Draw potential energy curve of H_2^+ ion.

(vii) State Raoult's law.

(viii) Define molal elevation constant.

(ix) Calculate the magnetic moment of a molecule having two unpaired electrons.

(x) State Grotthus–Drawper law.

(xi) What are the limitations of Beer's law ?

(xii) What is the selection rule for pure rotational Raman spectra ? 1×10=10