

NKT/KS/17/5173

Bachelor of Science B.Sc. Semester—V (C.B.S.) Examination**CH-502 : PHYSICAL CHEMISTRY****(Chemistry)****Paper—2**

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) Explain how classical mechanics fails when applied to :
- (i) Photoelectric effect and
- (ii) Heat capacity of solids. 5
- (B) Derive Schrodinger wave equation by considering wave as a vibration of stretched string. 5
- OR**
- (C) State and explain Heisenberg's uncertainty principle. 2½
- (D) What are normalized and orthogonal wave functions ? 2½
- (E) State postulates of quantum mechanics. 2½
- (F) Calculate lowest energy and spacing between first two energy levels for an electron when placed in a box of length 1Å . 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 the formation of molecular orbitals from atomic orbitals ? Discuss the physical picture of bonding and antibonding wave functions. 5

OR

- (C) Explain azimuthal and magnetic quantum numbers. 2½
- (D) Write Schrodinger wave equation for hydrogen like particles in terms of Cartesian co-ordinates. 2½

- (E) Discuss graphically the variation of electron probability density for bonding molecular orbitals along the internuclear axis. 2½
- (F) Explain valence bond theory for H₂ molecule. 2½
3. (A) Derive thermodynamically the relation, $\Delta T_b = K_b \times m$ (m = molality of the solution). 5
- (B) Define :
- (i) Magnetic permeability and
- (ii) Molar magnetic susceptibility.
- Describe Gouy's method for the determination of magnetic susceptibility. 5

OR

- (C) The vapour pressure of a 5% aqueous solution of non-volatile organic substance at 373 K is 745 mm. Calculate the molecular mass of solute. 2½
- (D) Discuss Berkeley- Hartley method for determination of osmotic pressure. 2½
- (E) What is van't Hoff factor ? How is it used for the determination of degree of association of a solute in the solution ? 2½
- (F) How magnetic susceptibility of a substance can be used to decide the structure of co-ordination compounds ? 2½
4. (A) State Grotthus-Draper law and Stark-Einstein's law of photochemical equivalence.
- Calculate the energy of one photon of light of wavelength 2450 Å°. Will it be able to dissociate a bond in diatomic molecule which absorbs this photon and has a bond energy equal to 95 Kcal mol⁻¹ ($h = 6.626 \times 10^{-34}$ JS mol⁻¹, $C = 3 \times 10^8$ ms⁻¹ and $N = 6.023 \times 10^{23}$ mol⁻¹). 5
- (B) Define quantum yield of photochemical reactions. How can it be experimentally determined ? What are the reasons for high quantum yield of photochemical reactions ? 5

OR

- (C) Explain Rayleigh's lines, Stokes' lines and anti-Stokes' lines in Raman spectra. 2½
- (D) What are the advantages of Raman spectroscopy over infrared spectroscopy ? 2½
- (E) Explain the phenomenon of radiative and non-radiative transitions using Jablonski diagram. 2½
- (F) Write a short note on photosensitization. 2½

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

- (i) Define perfect blackbody.
- (ii) State de-Broglie's hypothesis.
- (iii) What is an operator ?
- (iv) Write the expression for the energy for hydrogen like particles.
- (v) What is an orbital ?
- (vi) Draw potential energy curve for H_2^+ ion.
- (vii) State Raoult's law.
- (viii) Define cryoscopic constant.
- (ix) Calculate the magnetic moment of a molecule having four unpaired electrons.
- (x) State Beer's law.
- (xi) What do you mean by singlet ground state ?
- (xii) What is selection rule for pure rotational Raman spectra ?

1×10=10