

## 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 and carry equal marks.

(2) Draw diagrams and give chemical equations wherever necessary.

1. (A) Briefly explain de-Broglie hypothesis related to dual nature of matter. Derive de-Broglie relation.

Calculate the de-Broglie wavelength of a ball of mass 100 g moving with a speed of  $60 \text{ ms}^{-1}$ . 5

- (B) Write postulates of quantum mechanics. Derive Schrodinger Wave Equation based on the postulates of quantum mechanics. 5

**OR**

(C) How does the classical mechanics fail to explain heat capacity of solids ? 2½

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

(E) Find the energy of an electron in one dimensional box having width  $1 \text{ \AA}$  moving in L-shell. (Given : Mass of electron =  $9.1 \times 10^{-31} \text{ kg}$ ) 2½

(F) State and explain Heisenberg's Uncertainty Principle. 2½

2. (A) Give the basic ideas of molecular orbital theory. Explain the formation of  $\text{H}_2^+$  ion by LCAO method. 5

(B) What are radial probability distribution curves ? Explain probability distribution curves for 3s and 3p orbitals. 5

**OR**

(C) What are quantum numbers ? Give the significance of magnetic quantum number. 2½

(D) Give the physical picture of bonding and anti-bonding wave functions. 2½

(E) What are the criteria for forming molecular orbitals from atomic orbitals ? 2½

(F) Write the equations of angular wave functions  $\theta(\theta)$ ,  $\phi(\phi)$  and Radial wave functions  $R(r)$ . 2½

3. (A) What are colligative properties ? Derive the relationship between depression in freezing point and molar mass of a non-volatile solute. 5

(B) Give the applications of magnetic susceptibility measurement :

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

(ii) in confirming the structure of a molecule. 5

**OR**

(C) A solution of 1g of sodium chloride in 100 g of water freezes at  $0.604^\circ\text{C}$ . The molal depression constant of water is  $1.86 \text{ K m}^{-1}$ . Calculate the degree of dissociation of sodium chloride. 2½

(D) What is relative lowering of vapour pressure ? Derive the relationship between relative lowering of vapour pressure and molar mass of a non-volatile solute. 2½

(E) Discuss Gouy's method for determination of magnetic susceptibility. 2½

(F) Discuss Berkeley-Hartley method for determination of osmotic pressure. 2½

4. (A) What are radiative and non-radiative transitions ? Explain with the help of Jablonski diagram. 5
- (B) What is Raman Effect ? Give the brief discussion of formation of Rayleigh lines and Raman lines. What is the relationship between polarizability of molecules and Raman spectra ? 5

**OR**

- (C) What is photosensitization ? Give suitable examples. 2½
- (D) Give the reasons of low quantum yield. 2½
- (E) Give the advantages of Raman spectra over IR spectra. 2½
- (F) State and explain Einstein's law of photochemical equivalence. 2½
5. Solve any **TEN** :
- (i) What is an operator ?
- (ii) Give physical significance of  $\psi^2$ .
- (iii) What is photoelectric effect ?
- (iv) What are atomic orbitals ?
- (v) Write Schrodinger wave equation for H-atom.
- (vi) Give two points of differences between VBT and MOT.
- (vii) What is ebullioscopic constant ?
- (viii) What is magnetic permeability of a substance ?
- (ix) Calculate the molarity of a solution containing 20% by weight of HCl. (Given : Density of solution = 1.18 g cm<sup>-3</sup>)
- (x) What are thermochemical reactions ?
- (xi) State Lambert Law.
- (xii) What are isotropically polarizable molecules ? 1×10=10