Exam. Code : 103206
Subject Code : 1335

B.A./B.Sc. 6th Semester

CHEMISTRY

(Physical Chemistry-B)

Time Allowed—2 Hours] [Maximum Marks—35

Note :— Attempt any **four** questions. All questions carry equal marks.

1. What are the postulates of Quantum Mechanics ? Explain any three of these postulates mathematically.

2. Derive Schrodinger wave equation for particle in 3-D box. How will you explain the degeneracy of particle in a 3-D box ?

3. (a) Set up and solve Schrodinger wave equation for particle of mass m moving in one dimensional potential with rigid walls, i.e.

$$V(x) = \begin{bmatrix} 0, & -a < x < a \\ \infty, & |x| > a \end{bmatrix}$$

(b) Show that for a particle in a 1-D box of width a,

(i) $\langle x \rangle = a/2$

(ii) $\langle P_x \rangle = 0$

(iii) $\langle x^2 \rangle = a^2\left[\frac{1}{3} - \frac{1}{2\pi^2 n^2}\right]$.

4. (a) Explain Simple Harmonic Oscillator model of vibrational motion. Derive Schrodinger wave equation for such a model. Also discuss the solution of wave equation.

(b) Show that the commutator :

$$[\hat{x}^n, \hat{p}_x] = i\hbar n x^{n-1}$$

5. Write Schrodinger wave equation for H-atom in terms of polar coordinates. Separate the resultant equation in three equations using technique of separation of variables.

6. Write a note on :

(i) Symmetry elements in crystals

(ii) Law of consistency of interfacial angles

(iii) Law of rationality of indices.

7. (a) Draw Jablonski diagram. With the help of Jablonski diagram, explain various processes occuring in the excited state.

(b) Differentiate between thermal and photochemical processes.

8. (a) What do you understand from Quantum yield ? How it is measured ?

(b) Explain the kinetics of photochemical reaction of Hydrogen and Chlorine.

(c) Photobromination of cinnamic acid to dibromocinnamic acid was carried out in blue light of wave length 440 nm at 35°C using light intensity of 1.5×10^{-3} J per second. An exposure of 20 minutes produced a decrease of 0.075 millimole of bromine. The solution absorbed 80% of light passing through it. Calculate the quantum yield of the reaction.