LMDQ/D-23   6536

PHYSICAL CHEMISTRY (Special-I)
CHEM-304 (CBCS-LOCF)

Time : Three Hours]   [Maximum Marks : 60

Note : Attempt *Five* questions in all selecting at least *one* question from each Section. All questions carry equal marks.

Section A

1. (a) Describe the general procedure to obtain the energy and the eigenfunction of a system up to first order correction by perturbation method.   **8**

   (b) What is Born-Oppenheimer approximation ? Under what condition is this approximation applicable ? **3**

   (c) The trial function, $\varphi(x) = x(a - x)$. At the boundaries, $\varphi(0) = 0$ and $\varphi(a) = x(a - a) = 0$. Thus, φ satisfies these boundary conditions. Justify.   **1**

2. (a) What are symmetric and antisymmetric solution of hydrogen molecule ion (H_2^+) ?   **7**

(b) Write a note on "spin-orbit coupling". **2**

(c) Write the term symbol for the electronic configuration :

(i) $1s^2 2s^2 2p^4$

(ii) Term symbol for the ground state of nitrogen atom. **3**

Section B

3. (a) Compare the molecular orbital and valence bond treatments of hydrogen molecule in the ground state. **6**

(b) Discuss the molecular orbital treatment of heteronuclear diatomic molecules with examples. **6**

4. (a) What are hybrid orbitals ? Describe the quantum mechanical treatment for bond formation in ethylene molecule. **6**

(b) With the help of Hückel's rule, show that cyclopropenyl cation is more stable than its anion or radical. **6**

Section C

5. (a) Neatly draw Jablonsky diagram and label it with its various transitions that can occur after a molecule has been excited photochemically. With the diagram, explain why phosphorescence life time is much longer than fluorescence. **8**

(b) How do you correlate selection rules and transition moment integral ? Explain. **4**

6. (a) What is oscillator strength in spectroscopy ? How is absorption intensity related to oscillator strength ? **4**

(b) Discuss about Einstein's coefficient of absorption and emission phenomenon. **5**

(c) Write a note on " Probability of Induced Emission and its Application to Lasers". **3**

Section D

7. (a) What is a surface active agents ? Discuss the different types of surface active agents with examples. **6**

(b) Explain the terms 'Micellization' and 'Critical micellar concentration'. How the mass action model can be used to discuss micellization ? **6**

8. (a) Discuss briefly the different types of intermolecular forces in liquids. **5**

(b) What is the physical interpretation of internal pressure ? Discuss the significance of internal pressure in liquids. **4**

(c) Give a brief account about 'Liquids as disordered solids'. **3**