Roll No. .... Total Pages : 04

GSQ/D-20   1064
CHEMISTRY
Physical Chemistry
Paper : XVI (CH-302)

Time : Three Hours] [Maximum Marks : 32

Note : Attempt *Five* questions in all, selecting *two* questions from each Section. Q. No. **1** is compulsory. Log table and/or non-programmable calculator are allowed.

1. (a) What do you mean by Black body ?   **1×8=8**

   (b) What is the significance of wave function Ψ ?

   (c) Define optical activity of a substance.

   (d) What is magnetic permeability ?

   (e) Out of the following, which will exhibit pure rotational spectra and why ?

   $$H_2, \; HCl, \; CO_2, \; H_2O$$

   (f) How does force constant 'k' is related to the fundamental frequency ?

   (g) What is Hermitian operator ?

   (h) Calculate the degrees of freedom of H_2O molecule.

(5)L-1064   1

Section A

2. (a) Derive an expression for Planck's Radiation law. How does it explain the spectral distribution of black body radiation ?

(b) What is photoelectric effect ? Explain the effect of frequency and intensity of incident radiation on photoelectric effect. **4,2**

3. (a) Derive an expression for energy of a particle in one dimentional box.

(b) Evaluate the following :

(i) $\left(x\dfrac{d}{dx}\right)^2$ (ii) $\left(\dfrac{d}{dx}+x\right)^2$. **3,3**

4. (a) What do you understand by electrical polarisation of molecules ? Discuss the effect of temperature on it.

(b) Calculate the specific rotation of a substance, the solution of which contains 5 g of the substance dissolved in 25 ml of water and shows a rotation of 5°, when introduced in 20 cm long polarimeter tube. **4,2**

5. (a) Explain any *one* method for the measurement of dipole moment.

(b) What is magnetic susceptibility ? Discuss its applications. **3,3**

Section B

6. (a) Derive an expression for energies of the rotational transitions in a pure rotational spectrum. Discuss the possible rotational transitions on the basis of selection rules for pure rotational spectra.

(b) What is Born-Oppenheimer approximation ? **4,2**

7. (a) What do you understand by intensity of spectral lines ? Explain the factors on which it depends.

(b) Calculate the force constant for the bond in HCl from the fact that the fundamental vibrational frequency is 8.667×10^{13} s^{-1}. **3,3**

8. (a) What is Raman Spectra ? Discuss the quantum theory of pure rotational Raman Spectra.

(b) What type of molecules exhibit IR spectra ? Out of the following, which are IR active :

H_2, HCl, CO_2, SF_4, H_2O, SF_6. **4,2**

9. (a) Discuss the effect of isotopic substitution on rotational spectra.

(b) Arrange the following groups in decreasing order of their absorption frequencies :

(i) CF, CBr, CCl, CH

(ii) $C = C, C - C, C \equiv C$.

(c) What are the advantages of Raman spectroscopy over IR spectroscopy ? **2,2,2**