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**GSQ/D-21** **1072**

PHYSICAL CHEMSITRY
Paper–XVI CH-302

Time : Three Hours] [Maximum Marks : 32

**Note :** Attempt *five* questions, selecting at least *two* questions from each section Question no. 1 is compulsory.

**Compulsory Ouestion**

**1.** (a) What happens to the energy of the particle in one dimensional box if the length of the box is made large? 2

(b) How does measurement of magnetic susceptibility confirm that the formula of hypo phosphoric acid is $H_4P_2O_6$ and not $H_2PO_3$? 2

(c) Why $CO_2$ molecule can't give pure rotational spectra but give vibrational spectra? 2

(d) What is the selection rule for pure rotational spectroscopy and pure rotational Raman spectroscopy? 2

**SECTION–A**

**2.** (a) Derive Planck's radiation law. 3

(b) Explain the photoelectric effect, why it was not explained on the basis of Classical mechanics. 2

(c) Write a note on Eigen values. 1

**3.** (a) Evaluate the commutator

$[x^2, d^2/dx^2]$. 2½

(b) Write results of a particle moving in one dimensional box. 2

(c) To prove the Eigen values of a Hermitian Operator are all real values. 1.5

**4.** (a) Prove that

$\Delta x.\Delta p_x > h/4\pi$ with the help of a wave function which represents a particle moving in one dimensional box. 3

(b) Write a note on Optical activity, its origin and acts as constitutive property. 3

**5.** (a) Derive Clausius-Mosotti equation. 2

(b) The dipole moment of HBr is 0.78D and the bond distance is 1.40 Å. Calculate the percentage ionic character of the H-Br bond. 1½

(c) Explain the applications of magnetic susceptibility. 2½

## SECTION–B

**6.** (a) Why band spectrum is observed in electronic spectrum of a molecule while single line spectrum is observed in atomic spectra. 2

(b) Calculate vibrational degree of freedom in following molecules (i) $CO_2$ (ii) $C_2H_2$ (iii) Benzene (iv) He. 2

(c) Define signal to noise ratio. 2

**7.** (a) Explain Isotopic effect on pure rotational spectra by taking an example of $^{1}HC1$ & $^{2}HC1$. 3

(b) Which are rotational active molecules among the following :

(i) CO

(ii) $H_2$

(iii) $CH_4$

(iv) $H_2O$. 2

(c) Which region of electromagnetic spectrum belongs to rotational spectrum? 1

**8.** (a) Calculate the force constant for the bond in HC1 from the fact that fundamental vibration frequency is $8.667 \times 10^{13}\ S^{-1}$. 3

(b) Write a note on the elementary idea of vibrational frequencies of fundamental transition due to some functional groups in organic molecules. 3

**9.** (a) Explain O, Q & S-branches of lines in Raman spectra. 3

(b) Write a note on the Raman effect in terms of polarizability. 3