SESSIONAL EXAMINATION-2023

NORTH GAUHATI COLLEGE

B. Sc. SEMESTER-5 (CBCS)

SUB: CHEMISTRY (HC)

Paper-CHE-HC-5026

TOTAL MARKS: 30   TIME: 1 Hr

The figures in the margin indicate full marks for the questions

1. Answer the followings: (any ten) : $2 \times 10 = 20$

   (a) What is the significance of Ψ and $|\Psi|^2$?
   (b) What are normalized and orthogonal functions?
   (c) What are the conditions for a wave function to be acceptable?
   (d) Calculate the energy separation of electron between the levels of n=7 and n=6 in a box of length 1nm.
   (e) What is meant by spherical harmonics?
   (f) Draw energy level and wave function for the first four lowest state of 1-D harmonic oscillator.
   (g) Explain why s-orbital is spherically symmetric?
   (h) Calculate the average kinetic energy of the electron of ground state H-atom.
   (i) Write down the normalized VB wave functions and normalized MO wave functions for H_2 molecule.
   (j) What do you mean by Born-Oppenheimer approximation?
   (k) Why N_2 is Raman active but microwave and IR inactive?
   (l) Calculate the relative Boltzmann population of the v=1 and v=0 vibrational energy levels of a diatomic molecule, at 25 °C, if they are separated by 1000 cm^{-1}.
   (m) Which of the following molecule show vibrational spectra and why?
           H_2, O_2, H_2O, HCl
   (n) What is zero point energy? Is particle in a simple harmonic oscillator possesses   zero pint energy?

2. Consider a particle in a cubic box. What is the degeneracy of the level that has an energy 3 times of the lowest level.   3

3. For a harmonic oscillation of effective mass of 1.33×10^{-25} kg the difference in adjacent energy level is 4.82 J. Calculate the force constant of the oscillator.   3

4. What is classical mechanics? What are the factors that lead to the failure of classical mechanics? $2 + 2 = 4$

                                   Or,

   What do you mean by degrees of freedom? Calculate and explain diagrammatically the

   different normal modes of vibration of H_2O molecule. $1 + 3 = 4$

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