Your Roll No. . . . .

5173

B.Sc. Prog./III   J

CH-303 – PHYSICAL CHEMISTRY

(NC – Admissions of 2008 & onwards)

Time : 2 Hours   **Maximum Marks : 50**

(*Write your Roll No on the top immediately on receipt of this question paper*)

Log table/simple calculator may be used

Answer **four** questions in all

Q No **1** is compulsory

1   Answer any **three** of the following

    (i)   Define Unit Cell and Crystal Lattice How many crystal systems exist ? How many Bravais Lattices exist in all ?   4½

    (ii)   Which of the following are expected to be microwave-active i e exhibit Rotation spectrum   NO, CO, H_2, Cl_2, NH_3 Briefly explain. Give the nature of interaction with electromagnetic radiation   5

(iii) Briefly describe the major factor which accounts for the fact that rates of many chemical reactions become 2 to 3 times as fast when the temperature is raised from 25 °C to 35 °C   4½

(iv) Give two differences between Physical absorption and Chemisorption Briefly explain these   4½

(v) What are Addition Polymers and condensation polymers ? Give one example of each Briefly describe the determination of molar mass of a polymer using osmotic pressure measurements.   3 + 1½

2   (i) Derive the integrated rate equation for a zero-order reaction. Give the relation between half-life, initial concentration of reactant and the rate constant for such a reaction   3 + 1 = 4

(ii) The rate of a reaction becomes 10 times as fast when the temperature is raised from 27 °C to 37 °C Calculate the energy of activation for the reaction

(R = 8 314 J/mol k)   4

(iii) Define Quantum yield of a photochemical reaction In a reaction 1×10^{20} molecules decomposed when 2×10^{20} quanta of radiation was absorbed Calculate the Quantum yield Why is the quantum yield quite high in certain reactions ?   1 + 2 + 1 = 4

3. (i) Explain why the extent of adsorption increases upto a temperature after which it decreases in the case of chemisorption   **3**

   (ii) Give two applications of adsorption   **2**

   (iii) In chemisorption show graphically the fraction of the surface sites occupied as a function of pressure Briefly explain this behaviour   **3**

   (iv) What are Elastomers and Fibres. What kind of forces exist between the chains in these ?   **2**

   (v) Define, mathematically, the number-average molar mass of a polymer. Indicate what do the symbols stand for in this expression.   **2**

4. (i) In the case of a cubic system, a plane intersects at $1a$, ∞b and ∞c on the respective axes Assign the Miller indices of this plane Show a neat diagram and mark out this plane.   **2 + 1 = 3**

   (ii) Calculate the wavelength of X-rays (in pm) if the first-order reflections from planes, 405 pm apart, are observed at a sin θ value of 0 20.   **3**

   (iii) Ionic crystals do not conduct electricity in the solid state but do so in the molten state. Explain.   **2**

   (iv) In the cubic system which of the Bravais lattices has the highest packing efficiency ? What is the packing efficiency in such a case ? What is the relation between the edge length and radius of the atom in such a case Give the basis for your answers.

   1 + 1 + 1 + 1 = 4

5. (i) Calculate the bond length in a covalent molecule, PQ, if the frequency separation in its microwave spectrum is 4190 m^{-1} Its reduced mass is $1\,5 \times 10^{-27}$ kg. Calculate the moment of inertia and give its units.

[$h = 6.63 \times 10^{34}$ Js; $C = 3 \times 10^8$ m/s, $\pi = 3\,14$] $4 + 1 = 5$

(ii) Which of the molecules can exhibit infrared spectrum Cl_2 F_2, NH_3, CO ? Briefly explain $2 + 1 = 3$

(iii) Calculate the degeneracy of a particle in a three-dimensional cubical box of width l having energies equal to $(6h^2/8ml^2)$ 2

(iv) What is a Quantum Mechanical Operator ? Illustrate with an example   2