

M.Sc. (Chemistry) (CBCS Pattern) Sem-I
PSCCHT03 / CHE103 - Physical Chemistry Paper-III

P. Pages : 3

Time : Three Hours



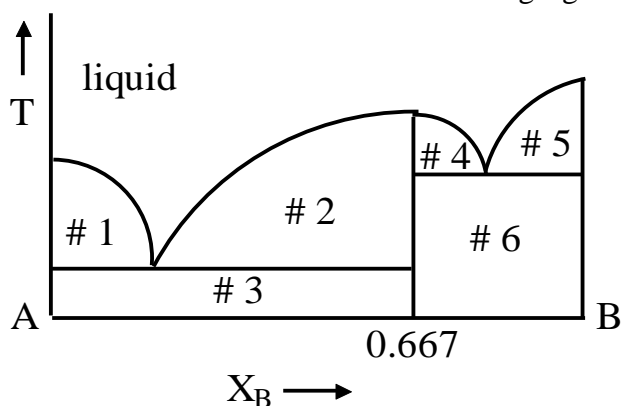
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Max. Marks : 80

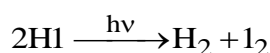
- Notes : 1. All questions are compulsory and carry equal marks.
2. Use of log table and calculators is permitted

1. a) Determine which of the following functions are the eigen functions of the operator $\frac{d^2}{dx^2}$ 8
- i) $\sin 3x$ ii) kx^2
iii) $\exp(-ax^2)$ iv) $\cos kx$
- b) Set up the Schrodinger wave equation for a simple harmonic oscillator and solve it for energy eigen values. 8
- OR**
- c) In the following equations $A\Psi_1 = \lambda_1\Psi_1$ and $A\Psi_2 = \lambda_2\Psi_2$ If A is a Hermitian operator then prove that λ_1 and λ_2 are real numbers and Ψ_1 and Ψ_2 are orthogonal to each other provided $\lambda_1 \neq \lambda_2$. 4
- d) What are the postulates of quantum mechanics? 4
- e) Explain the degeneracy of energy levels by using case of particle in three dimensional box. 4
- f) Derive the expression for the energy of rigid rotor by using Schrodinger wave equation. 4
2. a) Derive maxwell relations and give an application of one of them. 8
- b) What is meant by chemical potential? How does chemical potential vary with temperature and pressure? Derive the Gibbs Duhem equation. 8
- OR**
- c) Define partial molar quantities. How it is determined? 4
- d) What are the homogenous function of degree zero and one? Identify the extensive and intensive properties of the following enthalpy, density, chemical potential refractive index, volume. 4
- e) Derive any one thermodynamic equation of state. 4
- f) Introduce the concept of fugacity for non – ideal gas and derive its expression for a Vander – Waals gas. 4

3. a) Explain two component system in which the two components form a compounds with incongruent melting points. 8
- b) Discuss the first and second order phase transitions and lambda line observed in liquid helium. 8
- OR**
- c) Derive phase rule thermodynamically. 4
- d) Discuss the phase diagram of systems exhibiting formation of two pairs of partially miscible liquids. 4
- e) Explain phase diagram of one component system of carbon. 4
- f) Identify the phases present in the numbered areas of following figures. 4

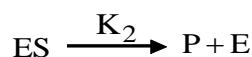
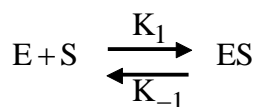


4. a) Discuss collision theory of bimolecular reaction. What are limitations of this theory? 8
- b) Discuss the kinetics of the following photochemical reaction. 8



OR

- c) The following mechanism has been proposed for enzyme catalysis. 4



Using Steady State approximation for [ES], show that the reaction rate is given by

$$r = \frac{\text{K}_2 [\text{E}]_0 [\text{S}]}{\text{K}_m + [\text{S}]}$$

where the symbols have their used meanings.

- d) Discuss in detail the transition state theory of reaction rates. 4
- e) Write short note on. 4
- i) Photosensitization.
- ii) Quenching
- f) Derive Michaelis – Menten equation: 4

5. a) Explain the term. 2
 i) Normalisation.
 ii) Orthogonality
- b) Show that $[AB] = -[BA]$ 2
- c) State and explain third law of thermodynamics. 2
- d) The N_2O molecule has two possible orientation. Calculate Residual entropy. 2
- e) Explain reduced phase rule. 2
- f) Calculate the number of degree of freedom. 2
 i) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
 where $P_{PCl_3} = P_{Cl_2}$
 ii) $H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$
- g) What are different types of catalysis? Give example of each type. 2
- h) Explain the effect of temperature on reaction rates. 2
