AU–240

M.Sc.—I Semester—I (C.B.C.S. Scheme) Examination

CHEMISTRY (New)

(Physical Chemistry—I)

Paper—III

Time : Three Hours] [Maximum Marks : 80

Note :—(1) All questions are compulsory and carry equal marks.

(2) Use of log table and calculator is permitted.

1. (a) Calculate the probability, P, of locating a particle between x = 0 (left hand side of a box) and x = 0.25 nm in its lowest energy state in a box of length 1.0 nm. 4

(b) Determine the degree of degeneracy of the energy level $6h^2/8ma^2$ of a particle in a cubical box. 4

(c) Explain linear variation principle and its applications. 8

OR

(p) Discuss application of perturbation theorem to He atom. 8

(q) Deduce Eigen values and Eigen functions for angular momentum. 4

(r) Calculate the magnitude (in atomic units) of angular momentum of an electron that occupies the following atomic orbitals : 1s, 3s, 2p, 3p, 3d. 4

2. (a) Derive and discuss Gibbs adsorption equation. 8

(b) What is Critical Micellar Concentration (CMC) ? What are the factors affecting the CMC of surfactants ? How to determine Critical Micellar Concentration (CMC) ? 8

OR

(p) Give an account of micellization and explain hydrophobic interaction between micelles. 6

(q) Give the Freundlich adsorption isotherm. How it can be experimentally verified ? 6

(r) Explain :

(i) Microemulsion

(ii) Reverse emulsion. 4

3 (a) Show that if equation of state for a gas is

$$p(V_m - b) = RT$$

where b is a constant, the fugacity of the gas is given by

$$\ln\frac{f}{p} = \frac{bp}{RT}.$$ 4

(b) Explain partial molar volume with its significances. 4

(c) Explain entropy production and entropy flow for irreversible coupled reaction. 8

OR

(p) Give an account of Debey-Huckel theory for activity and activity coefficient of electrolyte solution. 8

(q) Give an account on the principle of microscopic reversibility and the Onsager reciprocal relation. 8

4. (a) ^{64}Cu decays with a half-life of 12.8 h as follows : 42% by EC, 19% by β^+, and rest by β^-. Find the partial decay constant and half-life for each mode of decay. 6

(b) Discuss in detail about critical size of a thermal reactor. 5

(c) What do you mean by parent and daughter nuclear substances ? Calculate number of α and β particles emitted from following nuclear reaction :

$$^{220}_{82}X \xrightarrow{\text{emitted } \alpha, \beta} {}^{212}_{86}Y.$$ 5

OR

(p) Discuss α-particle energy spectrum and Breeder reaction in brief. 5

(q) Give the decay schemes representing α, β^+, β^-, EC, IT and branched decay. 6

(r) What is Geiger Natta law ? Explain it. 5

5. (a) Discuss in detail transition state theory of reaction rates and its application to $H_2 + Br$ reaction. 10

(b) Give an account of Marcus extension of the RRK treatment in brief. 6

OR

(p) Give an account of Lindemann theory of unimolecular reactions. Discuss two main reasons for break down of Lindemann theory. 8

(q) Calculate ΔG^*, ΔH^* and ΔS^* for the second order reaction :

$$2NO_2(g) \rightarrow 2NO(g) + O_2(g)$$

At 500 K. Given $A = 2.1 \times 10^9$ sec^{-1} and the energy of activation = 121 kJ/mole. 8