

M.Sc. 2nd Semester Examination, 2015

CHEMISTRY

PAPER – CEM- 201

Full Marks : 40

Time : 2 hours

The figures in the right hand margin indicate marks

GROUP –A

Answer any **one** of the following

1. In a potential step problem for $E > V$ show that there is conservation of probability (i.e. $R + P = 1$) as well as probability current (i.e. $S_I = S_{II}$). The terms have their usual meaning. 4 + 4
2. For a linear Harmonic Oscillator derive Δq . Δp with the help of step up and step down operator. 8

(Turn Over)

GROUP -B

Answer any one of the following

3. (a) Distinguish between identical distinguishable and identical indistinguishable particles. 2
- (b) Define ensemble. 2
- (c) Obtain the expression for rotational contribution to the molar entropy of a rigid rotor. 4
4. (a) Derive the distribution law for the particles having asymmetric wave function. 6
- (b) Calculate the relative population of two energy levels separated by 10 kJ/mol. at 27°C. 2

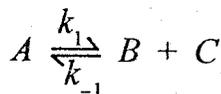
GROUP -C

Answer any one of the following

5. (a) Find out the rate constant of a kinetic reaction whose enzymatic activity is inhibited by an inhibitor. 4

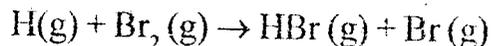
- (b) The enzyme carbonic anhydrase catalyzes both the forward and the reverse reactions for the hydration of CO_2 according to
- $$\text{H}_2\text{O}(l) + \text{CO}_2(aq) \rightleftharpoons \text{HCO}_3^-(aq) + \text{H}^+(aq)$$
- CO_2 is produced in tissue as one of the final products of respiration. It then diffuses into the blood system, where it is converted to the bicarbonate ion by carbonic anhydrase. The reverse reaction occurs in the lungs, where $\text{CO}_2(g)$ is expelled. Carbonic anhydrase has a single active site, and its molecular mass is $30,000 \text{ g mol}^{-1}$. If $8.0 \mu\text{g}$ of carbonic anhydrase catalyze the hydration of 0.146 g of CO_2 in 30 secs at 30°C , what is the turnover number of the enzyme (in units S^{-1})? 4

6. (a) Derive the expression of relaxation time of the kinetic reaction



where k_1 and k_{-1} are the forward and backward rate constants. 5

- (b) The Arrhenius activation energy and pre-exponential factor for the reaction



are 15.5 kJ/mole and $1.09 \times 10^{11} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$, respectively. What are the values of $\Delta^\ddagger H^\circ$ and $\Delta^\ddagger S^\circ$ at 1000 K based on a standard state of $1.00 \text{ mol. dm}^{-3}$? Assume ideal gas behavior.

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GROUP -D

Answer any **one** of the following

7. (a) What do you mean by asymmetry and electrophoretic effects? Compute electrophoretic component of velocity of a moving ion. 2 + 2
- (b) How are the co-ordination number of a complex ion and the stability constant of the complex determined by use of change of half wave potential? 4

8. (a) When does the concentration overpotential arise? Derive an equation relating concentration overpotential and limiting current density. 1 + 4
- (b) How do you obtain equilibrium exchange current density using high field approximation of Butler Volmer equation? 3

GROUP -E

Answer any **one** of the following

9. (a) Show that Pure rotational Raman Shift is twice as that of rotational frequency. 4
- (b) What is Hyper Raman Scattering? Depict the energy level diagram to explain the appearance of Hyper Rayleigh, Hyper Stokes and anti stokes Raman Scattering. 4
10. (a) Low temperature (77K) is generally required to observe phosphorescence — Explain. Give one example where phosphorescence occurs even at room temperature. 2 + 1

(b) Write down the MO electronic configuration of B_2 . Deduce the MO term symbols of B_2 and hence the ground state MO term symbol of B_2 .

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