

M.Sc. 2nd Semester Examination, 2013

CHEMISTRY

PAPER—CEM - 201

Full Marks : 40

Time : 2 hours

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

GROUP – A

Answer any *one* of the following

1. (a) What is the difference between potential step and potential barrier problem? 2
- (b) In case of potential step problem when $E < V$, show that $R + P = 1$, terms have their usual meaning. 6

(Turn Over)

(2)

2. Derive Δx , Δp_x for a particle in one dimensional box and comment on the result. 6 + 2

GROUP – B

Answer any *one* of the following

3. (a) Derive the line Weaver-Burk plot for a enzyme catalysis reaction? 6
(b) With a suitable example define an autocatalytic reaction. 1 + 1
4. (a) Explain the mechanism of activated bridge complex formation with a suitable example. 5
(b) The turnover number for acetylcholinesterase, an enzyme with a single active site that metabolizes acetylcholine, is $1.4 \times 10^4 \text{ S}^{-1}$. How many grams of acetylcholine can $2.16 \times 10^{-6} \text{ g}$ of acetylcholinesterase metabolize in one hour? (Take the molecular mass of the enzyme to be $4.2 \times 10^4 \text{ g mol}^{-1}$; acetylcholine has the molecular formula $\text{C}_7\text{NO}_2\text{H}_{16}^+$). 3

GROUP – C

Answer any *one* of the following

5. (a) Define equilibrium exchange current density and activation overpotential. 2 + 2
- (b) Write down Butler-Volmer equation on electrode kinetics, specifying significance of all the terms. How do you obtain the symmetry factor and equilibrium exchange current density using high field approximation of Butler-Volmer equation? 4
6. (a) What is polarogram? Mention two uses of polarography. 1 + 2
- (b) How do you determine polarographically the co-ordination number of metal atom in a complex and the instability constant of the complex? 5

GROUP – D

Answer any *one* of the following

7. Show that, average potential energy of interaction

between two permanent dipoles is a function of temperature (T), but that of dipole-induced dipole is independent of temperature (T). Give reason in favour of your result. 7 + 1

8. Derive Gibbs' adsorption equation and discuss with the help of this equation, why the surface tension of a solvent is decreased with increasing concentration of a surface active agent. 8

Or

Use Maxwell distribution of molecular speed to derive the expression for the average kinetic energy and hence state the principle of equipartition of energy. 8

GROUP – E

Answer any *one* of the following

9. (a) Describe the steps for the determination of molecular term symbols for linear molecules. Write down the MO electronic configuration for N_2 and O_2 and hence obtain their ground state term symbol. 2 + 1 + 3

(b) What do you understand by the ' L_a ' and ' L_b ' electronic state of molecule? Give one such example. 1 + 1

10. (a) State Franck-Condon principle for vibronic transitions. Give an expression of transition moment integral for vibronic transition and state its significance. Depict the relative intensities of vibronic transitions where (i) $r_e'' < r_e'$ and $r_e'' = r_e'$. (r_e'' and r_e' are the position of minima of the ground and the excited state potential energy curves) 1 + 2 + 3

(b) "Generally low temperature is required to observe phosphorescence" – Explain. Give one example, where phosphorescence occurs even at room temperature. 1 + 1