

M.Sc. 2nd Semester Examination, 2011

CHEMISTRY

(Physical)

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. In a potential step problem with $E < V$. Show with derivation that both probability and probability current are conserved. 5 + 5

(Turn Over)

2. Derive an expression for $\Delta p \cdot \Delta q$ by operator technique for linear harmonic oscillator. 10

Or

Set up Schrödinger equation for a simple harmonic oscillator and solve it by the ladder operator method for the energy eigenvalue. 10

GROUP-B

Answer any *one* of the following

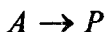
3. (a) What do you mean by enzyme inhibition? Show how the rate constant of an enzyme catalysis reaction changes in presence of an inhibitor. 5
- (b) Antibiotic-resistant bacteria have an enzyme, penicillinase, that catalyzes the decomposition of the antibiotic. The molecular mass of penicillinase is $30,000 \text{ g}\cdot\text{mol}^{-1}$. The turnover number of the enzyme at 28°C is 2000 s^{-1} . If $6.4 \mu\text{g}$ of penicillinase catalyzes the destruction of 3.11 mg of amoxicillin, an antibiotic with a

molecular mass of 364 g.mol^{-1} , in 20 seconds at 28°C , how many active sites does the enzyme have ? 4

(c) Give one example of heterogeneous catalysis reaction. 1

4. (a) What is the essential condition to occur a redox reaction by inner sphere mechanism ? 3

(b) What is Autocatalyse ? Find out the rate constant of the autocatalytic reaction 2 + 5



GROUP-C

Answer any *one* of the following

5. (a) What do you mean by asymmetry and electrophoretic effects ? Compute electrophoretic component of velocity of a moving ion. 2 + 2 + 2

(b) Write short note on dispersion of conductance. 4

6. (a) When does the concentration overpotential arise ? Derive an equation relating concentration overpotential and limiting current density. 2 + 5
- (b) How do you obtain equilibrium exchange current density using high field approximation of Butler Volmer equation ? 3

Or

- (a) What is Polarographic wave ? What do you mean by half-wave potential ? 2 + 2
- (b) How can the co-ordination number of a complex ion and the stability constant of a complex be determined by use of half wave potential ? 6

GROUP-D

Answer any *one* of the following

7. (a) Use free electron model to obtain the frequency of transition (HOMO \rightarrow LUMO) for a π -conjugated system having 'N' number of π -electrons. 3

(b) Depict the bonding (σ , π) and antibonding (σ , π^*) orbitals when (i) two p -orbital, (ii) two d -orbital are combined to form bond. 3

(c) State Franck-Condon principle. Explain the relative intensity of vibronic transitions when (i) $r_e'' < r_e'$, (ii) $r_e'' = r_e'$.
 r_e'' and r_e' are the minimum of potential curve of ground and excited state respectively. 4

8. (a) Show that the potential energy (V) of interaction between an n -pole and an m -pole can be written as,

$$V \propto \frac{1}{r^{n+m-1}}$$

where ' r ' is the distance (centre to centre) between the two poles. 7

(b) Write a short note on London dispersion interaction. 3