

**M.Sc. 1st Semester Examination, 2010**

**CHEMISTRY**

*( Physical )*

PAPER—CEM-101

*Full Marks : 40*

*Time : 2 hours*

Answer any **four** questions taking **one** from each Group

*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. What is meant by stationary states in quantum mechanics? Show with derivation in details. 2 + 4 + 4

*( Turn Over )*

( 2 )

2. Derive the exact uncertainty relation for any arbitrary operators and for hermitian operators. 5 + 5

GROUP - B

Answer any *one* of the following

3. (a) Define phase-space and grand canonical ensemble.
- (b) What do you understand by the term 'microstate'?
- (c) Derive the expression which shows the rotational contribution to the molar entropy. (2 + 2) + 2 + 4
4. (a) What do you understand by identical distinguishable and identical indistinguishable particle?
- (b) Give one example each of a Boson and a Fermion.
- (c) Using Boltzmann distribution formula calculate the ratio of population of particles in two non-degenerate levels with energies 10 and 20 kcal/mole at 27 °C. At what temperature will the inversion of population occur?

- (d) Under what condition Fermi-Dirac distribution reduces to the Boltzmann distribution? 2 + 2 + 4 + 2

### GROUP - C

Answer any *one* of the following

5. (a) What are the advantages of the relaxation method over flow method?

- (b) Relaxation time for the fast reaction  $P \xrightleftharpoons[K_{-1}]{K_1} Q$  is  $15 \mu\text{s}$  and equilibrium constant is  $1.5 \times 10^{-3}$ . Calculate  $K_1$  and  $K_{-1}$ .

- (c) State the basic principle for studying very fast reaction by Flash photolysis technique.

- (d) Why the transition state theory is better than collision theory to describe a kinetic reaction?

2 + 4 + 2 + 2

6. (a) Solutions of strong electrolytes exhibit marked deviation from ideal behavior even at low concentrations at which solutions of non-electrolytes would behave ideally.

- (b) Why is it necessary to define mean activity co-efficient when dealing with ionic solution? 5 + 5

### GROUP - D

Answer any *one* of the following

7. (a) What do you mean by spherical top and symmetric top class of molecules? Give one example for each.
- (b) Show that for a rigid diatomic molecule, the quantum number of rotational energy level having maximum population is

$$J_{\max} = \sqrt{\frac{KT}{2B hc}} - \frac{1}{2}$$

where symbols have their usual significance. 3 + 7

8. (a) It is the fluctuation of dipole moment during vibration and not the permanent dipole moment which is responsible for infrared activity of molecule. Explain.

(b) What do you mean by Raman Scattering? How do you account for the appearance of Stokes and antistokes Raman lines using classical mechanics. What is the major drawback of classical mechanics to explain Raman spectra.

5 + 5

