

West Bengal State University

B.A./B.Sc./B.Com. (Honours, Major, General) Examinations, 2012

PART-III

CHEMISTRY - Honours

Paper- V

Duration : 4 Hours

Full Marks : 100

*Candidates are required to give their answers in their own words as far as practicable.**The figures in the margin indicate full marks.*

GROUP - A

(Full Marks - 50)

Answer any three questions, taking one from each unit.

UNIT - I

1. a) (i) A system consists of three energy states — a ground state ($E_0 = 0$), a first excited state ($E_1 = 2kT$) and a second excited state ($E_2 = 6kT$). The degeneracies of the energy states are respectively 1, 3 and 2. Find out the molecular partition function.

- (ii) Show that the relation connecting entropy S of a system with the partition function Q is given by : $S = Nk_B \ln Q + \frac{E}{T}$

 E = internal energy of system k_B = Boltzmann constant N = Number of molecules in the system T = Temperature of the system.

2 + 4

- b) Mention the assumptions and approximations involved in studying colligative properties of a dilute solution. Derive thermodynamically, using chemical potentials, a relation between the elevation of boiling point of a dilute solution and the molal concentration of the solute.

2 + 4

- c) Write notes on any *two* of the following : 2 × 2
- (i) Critical solution temperature
 - (ii) Adiabatic demagnetization
 - (iii) Abnormal colligative properties
 - (iv) Eutectic mixtures.
2. a) (i) Derive the expressions for Pressure (P) and Enthalpy (H) in terms of partition function. 2 + 2
- (ii) Entropy is a function of thermodynamic probability. How can one conclude that the function is logarithmic ? 2
- b) Derive Duhem – Margules equation stating clearly the assumptions. Show that if Raoult's law is applicable to one of the constituents of a binary liquid mixture, at all compositions, it must be equally applicable to the other constituent. 4 + 2
- c) (i) Find out the osmotic pressure of a 0.001 M aqueous K_2SO_4 solution at $27^\circ C$.
- (ii) Boiling point of acetone is $56.5^\circ C$ and its latent heat of vaporization is 6920 cal/mole. Hence, calculate the molal boiling point elevation constant of acetone. 2 + 2
- UNIT - II**
3. a) Solid 'A' has a face centered cubic lattice with the length of the unit cube $a = 2.62 \text{ \AA}$. Another solid 'B' has a body centered cubic lattice with $a = 2.90 \text{ \AA}$. Calculate the ratio of the densities of the two solids. 4
- b) Explain the stability of colloid in the context of zeta potential. What do you mean by 'Gold number' and 'Tyndall effect' ? 2 + 1 + 1
- c) (i) Explain the action of surface active material from thermodynamic stand point.
- (ii) Describe the viscometric method of determination of molecular mass of a polymer. 2 + 2
- d) For $SO_2(g)$ at $0^\circ C$ and 1 atm pressure the dielectric constant is 1.00993. This gas has a permanent dipole moment of 1.63 debye. Assuming that SO_2 behaves as an ideal gas, calculate per mole the orientation and the induced polarization. 2 + 2

