63/2 (SEM-1) CHM 101

2021

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(held in 2022)

CHEMISTRY

(Theory Paper)

Paper : CHM-101

(Physical Chemistry – I)

Full Marks – 80

Time – Three hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer :   1×6=6

(i) Which pair is not considered as thermoelectric effects ?

(a) Seebeck, Peltier

(b) Thomson, Peltier

(c) Thomson, Seebeck

(d) Joule, Thomson

[Turn over

(ii) The partition function for a system of k identical noninteracting indistinguishable particles is

(a) $Q = q^k$

(b) $Q = q^N$

(c) $Q = \dfrac{q^k}{k!}$

(d) $Q = \dfrac{q^n}{N!}$

(iii) Which one is not correct about Debye and Hückel theory ?

(a) Interionic forces are assumed to be Coulombic

(b) Dielectric saturation effect is neglected

(c) Thermal energy is much smaller than potential energy

(d) Ions, size are ignored

(iv) Debye-Huckel-Onsager equation is

(a) $\Lambda_m = \Lambda_m^0 - (B_1 \Lambda_m^0 + B_2)\sqrt{C}$

(b) $\Lambda_m = \Lambda_m^0 - (B_1 \Lambda_m^0 + B_2)C$

(c) $\Lambda_m = \Lambda_m^0 - (B_1 \Lambda_m^0) + B_2 \sqrt{C}$

(d) $\Lambda_m = \Lambda_m^0 - (B_1 \Lambda_m^0)\sqrt{C} + B_2$

(v) The polymers, those occur naturally are

(a) Silk, Collagen

(b) PP, PMMA

(c) PP, Collagen

(d) Silk, PMMA

(vi) Polymer formation from monomers starts by

(a) Coordination reaction between monomers

(b) Condensation reaction between monomers

(c) Hydrolysis of monomers

(d) Condensation reaction between monomers and initiators.

2. Answer the following questions :   2×5=10

(a) Define residual entropy and the weight of configuration.

(b) Name the methods used to determine solvation number of electrolytes

(c) What is degree of polymerization ? How it is linked to the molecular weight in addition polymer ?

(d) What is Flux ? How it is related to the force ?

(e) What is thermal wavelength ? How it varies with volume ?

3. Answer any *six* of the following questions :

$$5 \times 6 = 30$$

(a) Find an expression for mean translational energy using statistical thermodynamics.

(b) Derive the expression : $A = -KT \ln Q$.

(c) Deduce an expression for Born's free energy change when the ion is introduced from vacuum into a medium of dielectric constant ε.

(d) Discuss the structure of water in presence of a cation.

(e) For a monoatomic ideal gas with no internal degree of freedom, show that

$$G_t = -NKT \ln \left[\frac{KT}{P\Lambda^3} \right]$$

(f) Derive the Gibb's-Duhem equation.

(g) Find an expression for Ion-dipole interaction energy when the dipole is oriented at an angle $45°$ to the line joining the centre of the ion and the dipole.

(h) Discuss the vibrational contribution of partition function to the chemical potential.

(i) Show that proper phenomenological coefficients are positive.

4. Answer any *two* of the following questions :

$$10 \times 2 = 20$$

(a) Using the random-walking model of ions, establish a relation between the mean square distance and the coefficient of macroscopic Fick's law.

(b) Define fugacity. Describe a method for determination of fugacity.

(c) Discuss about the various classifications of polymers with examples.

5. Answer any *one* of the following questions :

14×1=14

(a) Discuss about the approximation laid down to establish the Debye-Huckel equation for ion-solvent interaction. Comment on the applicability and validity of this form of equation w.r.t. electrolytic solution.

(b) Draw and discuss the three component systems with triangular plots using water-acetic acid-chloroform or ammonium chloride-ammonium sulphate-water system as model.