

Seat No. : \_\_\_\_\_

**ZQ-113**

**May-2014**

**M.Sc., Sem.-II**

**CHE-409 : Physical Chemistry**

**Time : 3 Hours]**

**[Max. Marks : 70**

**Instructions :** (1) **All** questions carry equal marks.

(2) Necessary Constants :

$$N = 6.022 \times 10^{23} \text{ mole}^{-1}$$

$$k = 1.38 \times 10^{-16} \text{ ergs. K}^{-1} = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

$$h = 6.626 \times 10^{-27} \text{ ergs.sec} = 6.626 \times 10^{-34} \text{ J.sec}$$

$$c = 2.998 \times 10^{10} \text{ cm.sec}^{-1} = 2.998 \times 10^8 \text{ m.sec}^{-1}$$

$$F = 96500 \text{ C}$$

$$R = 8.314 \times 10^7 \text{ ergs K}^{-1} \text{ M}^{-1} = 8.314 \text{ J K}^{-1} \text{ M}^{-1} = 1.987 \text{ cal.K}^{-1} \text{ M}^{-1}$$

1. (a) Derive an equation for Boltzmann's law of most probable distribution. 7

**OR**

- (a) (i) Derive an equation for translational partition function. 4

- (ii) Calculate the vibrational partition function for the oxygen at 300 K. Assuming it to be harmonic oscillator. The vibrational frequency is  $1580 \text{ cm}^{-1}$ .  $k = 1.38 \times 10^{-16} \text{ ergs.K}^{-1}$  and  $h = 6.626 \times 10^{-27} \text{ ergs.sec}$  3

- (b) Discuss permutations and combination. 7

**OR**

- (b) (i) Derive an equation for Rotational Partition function. 4

- (ii) Calculate the rotational partition function of the hydrogen gas at 0 C. The following data are given :

$$\text{Moment of inertia of molecular hydrogen} = 0.459 \times 10^{-40} \text{ gm. cm}^2,$$

$$k = 1.38 \times 10^{-16} \text{ ergs. K}^{-1}, h = 6.626 \times 10^{-27} \text{ ergs.sec and } \sigma = 2 \quad \text{3}$$

2. (a) Discuss the shell model of atomic nucleus and show how it explain the magic numbers. 7

**OR**

- Discuss the use of radio isotopes as tracers. 7

- (b) (i) Write a note on reaction cross section. 4  
 (ii) Write a note on linear accelerators. 3

**OR**

- (b) (i) Write a note on nuclear fission. 4  
 (ii) Calculate binding energy per nucleon for  $^{35}_{17}\text{Cl}$ , whose atomic mass is 34.980 amu. Mass of proton = 1.007825 amu, Mass of neutron = 1.008665 amu and 1 amu = 931.5 MeV 3

3. (a) Discuss kinetics of acid catalyzed poly condensation. 7

**OR**

Discuss kinetics of anionic polymerization. 7

- (b) (i) Discuss the Osmotic Pressure measurement method for the determination of number average molecular weight ( $\overline{M}_n$ ) of Polymer. 4  
 (ii) Calculate ( $\overline{X}_n$ ) and ( $\overline{X}_w$ ) for an equimolar mixture of a diacid and a glycol at the following extent of reaction :  
 P : 0.950, 0.980, 0.990 3

**OR**

- (b) (i) What are polymers ? Give the difference between simple molecules and Polymer molecules. 4  
 (ii) Intrinsic viscosity of poly isobutylene solution  $[\eta]$  at 20° C is 1.80 dl/gm.  
 Relation between Intrinsic viscosity  $[\eta]$  and molecular weight is given below :  

$$[\eta] = 3.60 \times 10^{-4} \cdot M^{0.64}$$
  
 Calculate molecular weight of polymer. 3

4. (a) Determine the dissociation constant of monobasic acid by Conductometry. 7

**OR**

Describe the American, European, and IUPAC conventions for expressing electrode potential. 7

- (b) Explain the origin and characteristic of various currents produced in Polarography. 7

**OR**

Derive an equation of Polarographic wave.

5. Answer in brief (**One** mark each) :

**14**

- (1) What is dimension of partition function ?
  - (2) Define : Thermodynamic probability.
  - (3) What is the value of symmetric factor ( $\sigma$ ) for symmetric diatomic molecules and asymmetric diatomic molecules ?
  - (4) Define : Spallation reaction.
  - (5) Define : Isotopes.
  - (6) Define : Nuclear reaction.
  - (7) What is co polymer ?
  - (8) Define : Kinetic chain length ( $\bar{v}$ ).
  - (9) What is unit of viscosity in C.G.S. ?
  - (10) What is unit of cell constant ?
  - (11) Define Conductance. What is unit of conductance ?
  - (12) Define : Over Voltage.
  - (13) Define Poly condensation.
  - (14) Define : Half wave potential.
-

