

Seat No. : _____

AT-128

May-2016

M.Sc., Sem.-II

**409 : Chemistry
(Physical Chemistry)**

Time : 3 Hours

[Max. Marks : 70]

Instructions : (1) All questions carry equal marks.

(2) Necessary constants :

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

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

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

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

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

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

$$= 8.314 \text{ J K}^{-1} \text{ M}^{-1}$$

$$= 1.987 \text{ cal K}^{-1} \text{ M}^{-1}$$

1. (a) Define thermodynamic probability. Derive an expression for Boltzmann's distribution law. 7

OR

Discuss Permutations and Combinations.

- ✓ (b) Derive an equation for translational partition function. 7

OR

- ✓ (i) Derive an equation for vibrational partition function. 4

- (ii) Calculate the rotational partition function of hydrogen gas at 273 °K. The following data are given.

Moment of inertia of molecular hydrogen = 0.459×10^{-40} gm.cm².

$k = 1.38 \times 10^{-16}$ erg / degree / molecule

$h = 6.624 \times 10^{-27}$ erg.sec.

$R = 82.06 \text{ c.c. atm} / \text{degree} / \text{mole}$

$\sigma = 2$

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

OR

What is Isotopes ? Discuss the use of radio-isotopes as tracers.

- (b) (i) Write a note on nuclear binding energy.

- (ii) Assuming that $_8\text{O}^{16}$ is formed by bombarding $_6\text{C}^{12}$ with alpha particles, calculate energy released in the process.

$$_8\text{O}^{16} = 16.00 \text{ a.m.u.}, _6\text{C}^{12} = 12.00381 \text{ a.m.u.}$$

$$_2\text{He}^4 = 4.00387 \text{ a.m.u.}$$

$$1 \text{ a.m.u.} = 931.5 \text{ MeV.}$$

OR

- (i) Write a note on reaction cross section.

- (ii) Write a note on nuclear fusion reaction.

7

4

3

4

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3. (a) What is Anionic Polymerization ? Discuss the kinetics of Anionic Polymerization.

OR

What is poly condensation ? Discuss the kinetics of acid catalyzed poly condensation.

- (b) (i) Discuss the Osmotic Pressure measurement method for the determination of number average molecular weight (\bar{M}_n) of polymer.

- (ii) Intrinsic viscosity of polymer solution (η) at 30°C is 2.20 dl/gm . Relation between intrinsic viscosity (η) and molecular weight is given below.

$$(\eta) = 8.63 \times 10^{-5} \cdot M^{0.70}$$

Calculate molecular weight.

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- (i) Discuss thermodynamics of polymer solution.

- (ii) Calculate (\bar{X}_n) and (\bar{X}_w) for an equimolar mixture of a diacid and a glycol at the following extent of reaction :

$$P : 0.750, 0.900, 0.950$$

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4. (a) How will you determine the dissociation constant of monobasic acid by potentiometric method ? 7

OR

✓ Derive an equation of polarographic wave.

- (b) Describe the American, European and IUPAC conventions for expressing electrode potentials. 7

OR

✓ Determine dissociation constant of monobasic acid by conductometry.

5. Answer in brief (one mark each) :

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- (1) At which temperature the value of partition function is one.
- (2) What is the value of symmetric factor (σ) for symmetric diatomic molecules ? $\sigma = 2$
- (3) Define Partition function.
- (4) Define spallation reaction.
- (5) Define Nuclear fission reaction.
- (6) Define Nuclear reaction.
- (7) What is Osmosis ?
- (8) What is C.G.S. unit of viscosity ?
- (9) For the synthesis of commercial stereo regular polymer which catalyst is used ? 9
- (10) What is Electrolyte ?
- (11) Define Degree of dissociation.
- (12) Define half-wave potential.
- (13) What is Co-polymer ?
- (14) Define Reduced Viscosity.