

13E-111

May-2015

M.Sc., Sem.-II

409 : Chemistry**(Physical Chemistry)****Time : 3 Hours]****[Max. Marks : 70****Instructions :** (1) All questions carry equal marks.

(2) Necessary constants :

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

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

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

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

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

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

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

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

1. (a) Define thermodynamic probability. Derive an equation for Boltzmann's most probable distribution. 7

OR

What is partition function ? Derive an equation for rotational partition function.

- (b) Discuss permutation and combination. 7

OR

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

- (ii) Calculate the translational partition function for 1 mole of nitrogen at 2 atmosphere pressure at 300 °K, assuming the gas to behave ideally. The following data's are given : 3

Atomic weight of Nitrogen = 14.008

$$N = 6.022 \times 10^{23}$$

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

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

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

2. (a) Discuss the Fermi gas model of atomic nucleus. 7
- OR**
- Discuss the use of radio isotope as tracers.
- (b) (i) Write a note on reaction cross section. 4
- (ii) Write a note on nuclear binding energy. 3
- OR**
- (i) Write a note on linear accelerators. 4
- (ii) Calculate binding energy per nucleon for ${}^4_2\text{He}$. whose atomic mass is 4.0026 a.m.u.
- Mass of proton = 1.00783 a.m.u.
- Mass of neutron = 1.00870 a.m.u.
- 1 a.m.u. = 931.4 MeV 3
3. (a) What is Cationic Polymerization ? Discuss Kinetics of Cationic Polymerization. 7
- OR**
- Discuss the kinetics of free radical chain polymerization.
- (b) (i) Discuss any one method for the determination of molecular weights of polymers. 4
- (ii) Intrinsic viscosity of a polymer in chloroform at 25 °C $[\eta] = 4.1686$ dl/gm. Relation between intrinsic viscosity and molecular weight is given below.
- $$[\eta] = 2.3 \times 10^{-3} \cdot M^{0.65}$$
- Calculate molecular weight of polymer. 3
- OR**
- (i) Write a note on polycondensation. 4
- (ii) There are 100 polymer molecules of molecular weight 1000, 200 molecules of molecular weight 10000 and 200 molecules of molecular weight 100000.
- Calculate \bar{M}_n . 3
4. (a) Determine dissociation constant of monobasic acid by conductometry. 7
- OR**
- How will you determine dissociation constant of dibasic acid by potentiometric method ?
- (b) Derive an equation of polarographic wave. 7
- OR**
- Explain the origin and characteristics of various current produced in polarography.

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

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- (1) What is dimension of partition function ?
 - (2) At absolute zero temperature, what is the value of partition function.
 - (3) Define Statistical Thermodynamics.
 - (4) Define Nuclear Reaction.
 - (5) Define Half-life period of radioactive an element.
 - (6) Define Nuclear fission.
 - (7) What is relation between viscosity and fluidity ?
 - (8) What is Polydispersity Index (P.D.I.) ?
 - (9) Define Initiators.
 - (10) Define Zeta potential.
 - (11) Define Over Voltage.
 - (12) What is unit of cell constant ?
 - (13) Ostwald dilution law is applicable for which type of electrolyte solution ?
 - (14) What is SI unit of viscosity ?
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