Seat No.: _____

B-873

May-2011

Time : [4 Hours] [Max. Marks : 70

Instructions : (1) All questions carry equal marks.

(2) Necessary constants :

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

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

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

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

$F = 96500$ C

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

$= 8.314$ JK^{-1}M^{-1}

$= 1.987$ cal. K^{-1}M^{-1}.

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

OR

(a) (1) Derive an equation for the vibrational partition function. 4

(2) Calculate vibrational partition function of molecular iodine at 300 °K, assuming it to be a harmonic oscillator. The vibrational frequency is 214 cm^{-1}. $k = 1.38 \times 10^{-16}$ erg.K^{-1}, $h = 6.624 \times 10^{-27}$ erg. sec. 3

(b) Discuss premutations and combinations. 7

OR

(b) (1) Derive an equation for translational partition function. 4

(2) Calculate the rotational partition function of hydrogen gas at 0 °C. The following data are given. 3

Moment of inertia of molecular hydrogen

$I_{H_2} = 0.459 \times 10^{-40}$ gm. cm^2.

$k = 1.38 \times 10^{-16}$ ergs. k^{-1}

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

$R = 82.06$ c.c. atm. K^{-1}. mole^{-1}

$\sigma = 2$

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

OR

Discuss the use of radio isotopes as tracers. 7

(b) (1) Write a note on nuclear binding energy. 4

(2) Assuming that $_8O^{16}$ is formed by bombarding $_6C^{12}$ with alpha particles. Calculate energy released in the process

$_8O^{16}$ = 16.00 a.m.u., $_6C^{12}$ = 12.00381 a.m.u.

$_2He^4$ = 4.00387 a.m.u., 1 a.m.u. = 931.5 MeV] 3

OR

(b) (1) Write a note on reaction cross section.

(2) Explain with the help of calculation that for Br^{80} and U^{238}, when the mass numbers increases approximately three folds, the nuclear radius increases approximately 1.5 folds.

$R_0 = 1.4f$ and $1f = 10^{-13}$ cm. 3

3 (a) What is poly condensation ? Discuss the kinetics of non-catalyzed polycondensation. 7

OR

What is Anionic polymerization ? Discuss the kinetics of Anionic polymerization. 7

(b) (1) Discuss any one method for determining molecular weights of polymers. 4

(2) A polydispersed sample of polystyrene is prepared by mixing three monodisperse samples in the following proportions : 3

1 gm of molecular weight 10,000;

1 gm of molecular weight 50,000;

0.5 gm of molecular weight 100,000;

Calculate the number-average molecular weight of the mixture.

OR

(b) (1) What are polymers ? Give difference between simple molecules and polymer molecules and give at least two names of natural polymers and synthetic polymers. 4

(2) Calculate $\bar{X}_n$ and $\bar{X}_w$ for an equimolar mixture of a diacid and a glycol at the following extent of reaction 3

P : 0.500, 0.750, 0.900

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

OR

Derive an equation of polarographic wave. 7

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

OR

Explain the origin and characteristics of various currents produced in polarography. 7

5. Answer in brief (one mark each) : 14

(1) Define Thermodynamic probability.

(2) Define Partition function.

(3) What is dimension of partition function ?

(4) Define nuclear fission.

(5) Define nuclear fusion.

(6) Define spallation reaction.

(7) Define Initiators.

(8) What is chain polymerization ?

(9) Define kinetic chain length (ν).

(10) Define conductance and what is unit of conductance.

(11) Define half wave potential.

(12) Define over voltage.

(13) Define statistical thermodynamics.

(14) Define intrinsic viscosity.