Seat No. : 246

# E-735

**December-2010**

Sem-I

**Time : 3 Hours]** **[Max. Marks : 70**

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

(2) Necessary constants :

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

$k = 1.38 \times 10^{-27}$ ergs.sec $= 1.38 \times 10^{-23}$ 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 equation for the approximate calculation of the fugacity of a gas. 7

**OR**

Discuss the Nernst heat theorem and derive the equation giving relation between free energy, enthalpy and heat capacity. 7

(b) Derive Gibbs-Duham equation. 7

**OR**

(i) The activity of 3.0 moles of substance changes from 0.05 to 0.35. What would be the change in it's free energy at 27 °C. 3

(ii) Calculate change in entropy when two moles of ice are heated from –10 °C to 10 °C. $C_{p(ice)} = 37.7$ J mol$^{-1}$ K$^{-1}$, $C_{p(water)} = 75.3$ J mol$^{-1}$ K$^{-1}$, $\Delta H_f = 6.01$ kJ mol$^{-1}$. 4

2. (a) Explain the mechanism and kinetics of chain reaction between hydrogen and bromine. 7

**OR**

Derive the Michaelis Menten equation of enzyme catalyzed reaction. Give two examples of enzyme catalyzed reaction. 7

(b) (i) Write a note on explosion limits. 4

(ii) Calculate the entropy of activation ($\Delta S^*$) for a reaction. 3

$H_2 + I_2 \rightleftharpoons 2HI$ at 575 °K. The value of frequency factor (A) is $7.94 \times 10^{10}$ sec$^{-1}$.

**OR**

(i) Derive theory of absolute reaction rate. 4

(ii) Calculate the frequency factor (A) for the unimolecular decomposition of $(CH_3CO)_2$ at 285 °C. The value of entropy of activation ($\Delta S^*$) is 13.15 cal.mol$^{-1}$.deg$^{-1}$ (e.u.). 3

P.T.O.

3. (a) What are different types of defects in solid ? Derive equation to calculate number of Schottky defects in solids. 7

**OR**

Discuss super conductivity. 7

(b) Classify materials into conductors, semi conductors and insulators. Explain on what basis this classification is made. 7

**OR**

Estimate the mole fractions of Schottky and Frenkel defects in a NaCl crystal at 1000 °K. The energies of formation of these defects are 2 eV and 3 eV, respectively (1 eV = $1.602 \times 10^{-19}$ J, k = $1.38 \times 10^{-23}$ $JK^{-1}$). 7

4. (a) Derive Gibbs adsorption isotherm equation and explain positive and negative surface activity from it. 7

**OR**

Derive BET equation. 7

(b) (i) Write a note on detergents. 3

(ii) For $2 \times 10^{-4}$ M solution of organic acid $d\gamma/dc$ is $-0.08$ N $m^2$ $mol^{-1}$ at 25 °C. Calculate surface excess (Gibbs adsorption) of the acid. 4

**OR**

(i) Give difference between physical adsorption and chemical adsorption. 3

(ii) According to BET isotherm, the value of Vm for adsorption of nitrogen gas on silica gel at – 183 °C is 116.2 m*l* $gm^{-1}$. The surface area of the silica gel is 506.3 $metre^2$ $gm^{-1}$. Calculate the area covered by one molecule of nitrogen. 4

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

(1) State the third law of thermodynamic and its applications.
(2) What is Fugacity ?
(3) Define Ideal solution.
(4) Explain Unimolecular reaction.
(5) Define Chain Length.
(6) What is Chain reaction ?
(7) What is Unit cell ?
(8) What is Enzyme ?
(9) Chemical Potential.
(10) Define Surface Tension.
(11) Define Absorption.
(12) What is adsorbate and adsorbant ?
(13) Define Insulators.
(14) Define Semiconductors.