Uva Wellassa University, Sri Lanka
End Semester Examination – August 2011
SCT 132-1 Chemistry II

Time: One (01) hour

Total three (03) questions.
Question No 1 is compulsory.
Answer only for two (02) questions.
Use of standalone scientific calculators is allowed.
All symbols carry standard meanings.

1. a. Define following terms
   i. Sublimation energy (ΔH_s)
   ii. Ionization energy (ΔH_E)
   iii. Dissociation energy (ΔH_d)
   iv. Electron affinity (ΔH_a)
   v. Lattice energy (ΔH_u)

(15 marks)

b. Write the balance equation for formation of $MgF_{2(S)}$

(02 marks)

c. Draw the Bohn-Haber cycle for formation of $MgF_{2(S)}$ from $Mg_{(S)}$ and $F_{2(g)}$

(10 marks)

d. Derive an equation for heat of formation (ΔH_f) of $MgF_{2(S)}$ in terms of ΔH_s, ΔH_E, ΔH_d, ΔH_a and ΔH_u

(08 marks)

e. Calculate the lattice energy (ΔH_u) of formation of $MgF_{2(S)}$ from following data and by using the equation derive in section (d)
Sublimation energy of Mg = 146.4 kJ mol^{-1}, First ionization energy of Mg = 737 kJ mol^{-1}, second ionization energy = 1449 kJ mol^{-1}, Dissociation energy of F_2 = 158.8 kJ mol^{-1}, Electron affinity = -328 kJ mol^{-1} and Formation energy = -1096.5 kJ mol^{-1} (ΔH_a)

(07 marks)

f. Calculate the distance between Na^+ and Cl^- ions in NaCl lattice, if crystallization energy of NaCl is -788 kJ mol^{-1}. Use following equation.

$$\Delta E_{crystanization} = -\frac{N}{4\pi\epsilon_0 r} Z^2 e^2 M \left(1 - \frac{1}{n}\right)$$

Avogadro number = $6.022X10^{23}$ mol^{-1}, number of charges of the ions in NaCl = 1, charge of electron = $1.6022X10^{-19}$ C, Madelung constant = 1.747558, permeability of space = $8.854\ X10^{-12}$ $C^2\ m^{-1}$, n= 9.1.

(08 marks)

2. a. Differentiate between the following: first order and pseudo-first order reactions. Explain why the H_2O in the following reaction does not affect the rate of the reaction, and reaction is pseudo-first order with respect to $C_{12}H_{22}O_{11}$ activity.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

(15 marks)

b. For a certain reaction, the value of the rate constant is 5.0×10^{-3} $dm^3.mol^{-1}.sec^{-1}$. Find the value of rate constant in $cm^3.molecule^{-1}.sec^{-1}$

(15 marks)

c. State the Arrehenius equation of a given reaction. Define all terms stated therein. The values of the rate constants for a reaction $H_2 + I_2 = 2HI$ were observed as 3.0×10^{-5} $dm^3.mol^{-1}.sec^{-1}$ and 2.5×10^{-3} $dm^3.mol^{-1}.sec^{-1}$ at 357 ^{0}C and 447 ^{0}C respectively. Calculate the activation energy, E_a for forward and reversed reaction of $\Delta H = 15.5$ kJ.mol^{-1}.

(20 marks)

3. a. What is meant by pseudo-steady state approximation (PSSA)?

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} (ES) \xrightarrow{k_2} E + P$$

For enzyme catalyzed reaction Prove that $\frac{d[P]}{dt} = \frac{k_2[E]_0[S]}{K_m + [S]}$ assuming PSSA.

Where

$K_M = \frac{k_{-1}+k_2}{k_1}$ and $[E]_0$ initial concentration of the enzyme.

(30 marks)

b. Deduce that at high substrate concentration, [S] >> K_M, the reaction rate, $\frac{d[P]}{dt}$ is 0^{th} order

(20 marks)