NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY

END OF SECOND SEMESTER EXAMINATIONS – MAY 2011

GENERAL CHEMISTRY: SCH 1217 FOR SBB & ESH

TIME : THREE (3) HOURS

INSTRUCTIONS TO CANDIDATES:

1. **ANSWER *ALL QUESTIONS* FROM *SECTION A* AND *ANY THREE* FROM *SECTION B.* SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS. MARKS ARE ALLOCATED AS INDICATED IN BRACKET.**

2. **START EACH QUESTION ON A NEW PAGE. (NOT EACH PART OF A QUESTION).**

3. **GRAPH PAPER WILL BE PROVIDED ON REQUEST.**

TOTAL MARKS = 100

THIS QUESTION PAPER CONSISTS OF *FIVE PRINTED PAGES* (ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.

SECTION A:

1. (a) What do you understand by
   (i) homogeneous catalyst
   (ii) heterogeneous catalyst

   (2x2 Marks)

   (b) With an appropriate example, describe the law of composition.

   (3 Marks)

   (c) How many protons, neutrons and electrons are in the following atoms?

   (i) $^{59}_{28}Ni$ (ii) $^{137}_{56}Ba$ (iii) $^{238}_{92}U$

   (6 Marks)

   (d) Explain briefly Pauli's exclusion principle.

   (2 Marks)

   (e) Define mole

   (2 Marks)

   (f) How many moles of glucose, $C_6H_{12}O_6$, are in 45.0g?

   (2 Marks)

   (g) Balance the following equation:

   (i) $C_4H_9OH + O_2 \longrightarrow CO_2 + H_2O$

   (2 Marks)

   (h) Define molarity.

   (2 Marks)

   (k) Calculate the molarity of a solution made by dissolving 10.00g of glucose $C_6H_{12}O_6$, in 100ml of solution.

   (3 Marks)

   (l) What do you understand by energy?

   (2 Marks)

   (m) Define (i) Lewis acid/base and
   (ii) Bronsted/Lowry acid/base theory
   Give one example each.

   (3x2 Marks)

   (n) Write electronic configurations for the following elements.
   Use sub-orbital with boxes for the answers.

   (i) $^{90}_{232}Th$ (ii) $^{56}_{137}Ba$

   (3x2 Marks)

SECTION B:

2. (a) Define isotope.

(2 Marks)

(b) The element sulphur has four isotopes distributed as follows in nature.

S(32) = 95.0%, S(33) = 0.76% S(34) = 4.22% and S(36) = 3.09%

Calculate average atomic mass of sulphur.

(5 Marks)

(c) Briefly explain entropy.

(3 Marks)

(d) Methanol, CH_3OH can be made by the reaction of CO and H_2 :

$$CO_{(g)} + H_{2(g)} \rightarrow CH_3OH_{(g)}$$

Calculate:

(i) ΔH^o and ΔS^o at 298K for the reaction and estimate ΔG^o at 298K.
Under the standard conditions is the reaction spontaneous at this temperature?

(ii) Calculate ΔG^o at 500K, assuming ΔH^o and ΔS^o do not change with temperature.
Is the reaction spontaneous under standard conditions at 500K?

ΔH^o for CO = - 110.5 kJ S^o for CO = +197.9 J/K

ΔH^o for CH_3OH = - 201.2 kJ S^o for CH_3OH = + 237.6 J/K

ΔH^o for H_2 = 0.00 S^o for H_2 = + 130.58 J/K

(10 Marks)

3. (a) The following data were collected for the rate of disappearance of $S_2O_8^{2-}$ varies with reactant concentrations in the following manner.

$$S_2O_8^{2-}(aq) + 3I^-(aq) \text{ ------> } 2SO_4^{2-}(aq) + I_3^{-1}(aq)$$

Exp. No	$[S_2O_8^{2-}]$ M	$[I^-]$ M	Initial rate (M/s)
1	0.023	0.048	6.8×10^{-6}
2	0.054	0.048	1.6×10^{-5}
3	0.054	0.019	6.3×10^{-6}

Determine:

(i) The rate law for the reaction.

(3Marks)

(ii) Calculate the rate constant K for the disappearance of $S_2O_8^{2-}$

(3 Marks)

(iii) Determine the overall order of the reaction from the results given. (Use rate Law).

(3 Marks)

(iv) What is the rate of disappearance of I^- when $[S_2O_8^{2-}] = 0.075$ M and $[I^-] = 0.060$ M?

(3 Marks)

(c) A popular bread from well known bakery contains 48.9g carbohydrate, 8.5g protein and 1.5g total fat per 100g.

(i) what is the fuel value in kilojoules in a 70g of bread which is equivalent to two slices of bread?

(ii) How many calories does it provide?

The average fuel value of carbohydrate is 17 kJ/g, protein is 17kL/g and fat is 38kJ/g. (1kJ = 1.18 cal).

(6 Marks)

(d) If pH = 6.3 What are the molar concentrations of H^+ and HO^- in the solution?

(2 Marks)

4. (a) State at least four factors that influence the rate of chemical reaction.

(4 Marks)

(b) Sucrose, $C_{12}H_{22}O_{11}$, which is commonly known as table sugar, reacts in dilute acid solutions to form two simple sugars, glucose and fructose, both of which have the formula $C_6H_{12}O_6$.

$$C_{12}H_{22}O_{11}\,(aq) + H_2O(l) \longrightarrow 2\,C_6H_{12}O_6\,(aq)$$

At 23^oC and in 0.5 M HCl. The following data was obtained for the rate of disappearance of sucrose.

Time (min)	0	39	80	140	210
$[C_{12}H_{22}O_{11}]$ M	0.316	0.274	0.238	0.190	0.146

(i) Draw the graphs of (a) ln $[C_{12}H_{22}O_{11}]$ versus time

(b) $1/[C_{12}H_{22}O_{11}]$ versus time.

(5x2 Marks)

(ii) From the graph deduce whether the reaction is first order or second order with respect to the concentration of sucrose.

(2 Marks)

(iii) Write the rate law for the reaction

(2 Marks)

(iv) From the graph, calculate the rate constant, k.

(2 Marks)

5. (a) What is the difference between 1.0g and 1.00g? Which one of these two is more precise?

(3 Marks)

(b) What do you understand by "common ion effect"?

(3 Marks)

(c) What do you understand by buffer or buffer solution?

(3 Marks)

(c) A buffer solution contains 0.3 mol of ethanoic acid, CH_3COOH and 0.3 mol of sodium ethanoate, CH_3COONa in 1.0 dm^3.

Ka for the ethanoic acid is 1.8×10^{-5}

(i) What is the pH of the buffer?

(ii) What is the pH of the buffer after addition of 0.02 mol of NaOH?

(iii) What is the pH of the buffer after addition of 0.02 mol of HCl?

(3+4+4 Marks)

**********END OF PAPER**********