



**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:**

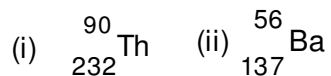
1. ANSWER ALL QUESTIONS FROM SECTION A AND ANY THREE FROM SECTION B. SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS. MARKS ARE ALLOCATED AS INDICATED IN BRACKET.
2. START EACH QUESTION ON A NEW PAGE. (NOT EACH PART OF A QUESTION).
3. GRAPH PAPER WILL BE PROVIDED ON REQUEST.

**TOTAL MARKS = 100**

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

**SECTION A:**

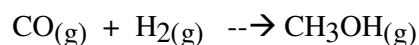
1. (a) What do you understand by  
(i) homogeneous catalyst  
(ii) heterogeneous catalyst  
(2x2 Marks)
- (b) With an appropriate example, describe the law of composition.  
(3 Marks)
- (c) How many protons, neutrons and electrons are in the following atoms?  
(i)  ${}_{28}^{59}\text{Ni}$  (ii)  ${}_{56}^{137}\text{Ba}$  (iii)  ${}_{92}^{238}\text{U}$   
(6 Marks)
- (d) Explain briefly Pauli's exclusion principle.  
(2 Marks)
- (e) Define mole  
(2 Marks)
- (f) How many moles of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ , are in 45.0g?  
(2 Marks)
- (g) Balance the following equation:  
(i)  $\text{C}_4\text{H}_9\text{OH} + \text{O}_2 \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$   
(2 Marks)
- (h) Define molarity.  
(2 Marks)
- (k) Calculate the molarity of a solution made by dissolving 10.00g of glucose  
 $\text{C}_6\text{H}_{12}\text{O}_6$ , 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.



(3x2 Marks)

**SECTION B:**

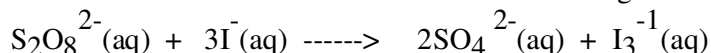
2. (a) Define isotope. (2 Marks)
- (b) The element sulphur has four isotopes distributed as follows in nature.  
 $S(32) = 95.0\%$ ,  $S(33) = 0.76\%$   $S(34) = 4.22\%$  and  $S(36) = 3.09\%$   
Calculate average atomic mass of sulphur. (5 Marks)
- (c) Briefly explain entropy. (3 Marks)
- (d) Methanol,  $CH_3OH$  can be made by the reaction of  $CO$  and  $H_2$  :



Calculate:

- (i)  $\Delta H^\circ$  and  $\Delta S^\circ$  at 298K for the reaction and estimate  $\Delta G^\circ$  at 298K.  
Under the standard conditions is the reaction spontaneous at this temperature?
- (ii) Calculate  $\Delta G^\circ$  at 500K, assuming  $\Delta H^\circ$  and  $\Delta S^\circ$  do not change with temperature.  
Is the reaction spontaneous under standard conditions at 500K?
- $\Delta H^\circ$  for  $CO = -110.5 \text{ kJ}$        $S^\circ$  for  $CO = +197.9 \text{ J/K}$   
 $\Delta H^\circ$  for  $CH_3OH = -201.2 \text{ kJ}$        $S^\circ$  for  $CH_3OH = +237.6 \text{ J/K}$   
 $\Delta H^\circ$  for  $H_2 = 0.00$        $S^\circ$  for  $H_2 = +130.58 \text{ J/K}$
- (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.



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

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)

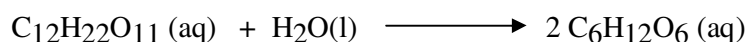
(iv) What is the rate of disappearance of  $\text{I}^-$  when  $[\text{S}_2\text{O}_8^{2-}] = 0.075 \text{ M}$  and  $[\text{I}^-] = 0.060 \text{ M}$ ?  
(3 Marks)

(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 17kJ/g and fat is 38kJ/g. (1kJ = 1.18 cal).  
(6 Marks)

(d) If pH = 6.3 What are the molar concentrations of  $\text{H}^+$  and  $\text{HO}^-$  in the solution?  
(2 Marks)

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

(b) Sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , 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  $\text{C}_6\text{H}_{12}\text{O}_6$ .



At  $23^\circ\text{C}$  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
$[\text{C}_{12}\text{H}_{22}\text{O}_{11}] \text{ M}$	0.316	0.274	0.238	0.190	0.146

(i) Draw the graphs of (a)  $\ln [\text{C}_{12}\text{H}_{22}\text{O}_{11}]$  versus time  
(b)  $1/[\text{C}_{12}\text{H}_{22}\text{O}_{11}]$  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,  $\text{CH}_3\text{COOH}$  and 0.3 mol of sodium ethanoate,  $\text{CH}_3\text{COONa}$  in  $1.0 \text{ dm}^3$ .

$K_a$  for the ethanoic acid is  $1.8 \times 10^{-5}$

- (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\*\*\*\*\*