NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

PHYSICAL CHEMISTRY II FOR SCH AND TTE

SCH2204

Supplementary Examination Paper

July 2016

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Dr. S Majoni

Useful information: $R = 8.314 JK^{-1} mol^{-1}$; 1 atm = 101 325 Pa; 1 bar = 100000 Pa

INSTRUCTIONS

1. Answer ALL questions
2. Each question carries 25 marks

MARK ALLOCATION

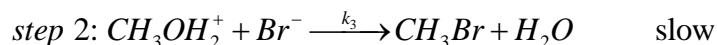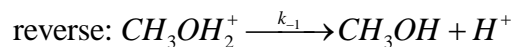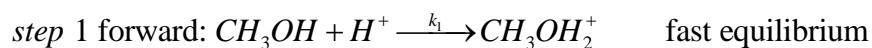| QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
TOTAL	100

1. a) Given an equation in the form shown below:

$$\Lambda_M = \Lambda_M^\circ - \beta\sqrt{\frac{c}{c_o}}$$

What information are you are able to obtain from the equation? Sketch the plot that you need to obtain the information. [10 marks]

b) A solution of A is mixed with a solution of B containing the same number of moles, and the reaction $A + B \rightarrow C$ occurs. At the end of one hour, 50% of A has reacted. How much of A will remain unreacted after 2 hours if the reaction is:

i) Zeroth order with respect to both A and B. [5 marks]
ii) First order with respect to A and zeroth order with respect to B. [5 marks]
iii) Second order with respect to A. [5 marks]

2. Consider the following cell: $Cu(s)|CuSO_4(aq, 0.5\ M)\ ||Ag+(aq, 0.15\ M|Ag(s)$

a) Draw a well labelled diagram representing the above cell and calculate the cell potential at 25^oC. [10 marks]

b) What does the double line in the above line diagram represent and discuss its importance for the cell? [8 marks]

c) Calculate the equilibrium constant at $25\ ^o$C and the work done under standard conditions. [7 marks]

3. The proposed mechanism for the reaction between CH_3OH and HBr is as follows

step 1 forward: $CH_3OH + H^+ \xrightarrow{\ k_1\ } CH_3OH_2^+$ fast equilibrium

reverse: $CH_3OH_2^+ \xrightarrow{\ k_{-1}\ } CH_3OH + H^+$

step 2: $CH_3OH_2^+ + Br^- \xrightarrow{\ k_3\ } CH_3Br + H_2O$ slow

a) Write the overall reaction and comment on the validity of the mechanism with respect to that aspect of testing validity of mechanisms. [8 marks]

b) Determine the rate law from the mechanism above. [6 marks]

c) The data below shows the temperature dependence of the rate of decomposition of N_2O_5 (g) into NO_2 (g) and O_2 (g).

T/K	$k \ (s^{-1})$
338	4.87×10^{-3}
328	1.50×10^{-3}
318	4.98×10^{-4}
308	1.35×10^{-4}
298	3.46×10^{-5}
273	7.87×10^{-7}

    i.   What is the order of the reaction?   [1 mark]

    ii.   Determine the activation energy for the reaction.   [10 marks]

4.

  a) Distinguish between chemical adsorption and physical adsorption. [10 marks]

  b) Discuss why heterogeneous catalysis is more common in industrial processes, include the importance of the adsorption process in your answer.   [8 marks]

  c) Calculate the ionic strength and the mean ionic activity coefficient of 0.001mol kg^{-1} CaCl$_{2(aq)}$ at 25°C.

$$\log \gamma_{\pm} = -|Z^{+}Z^{-}| A I^{1/2}; A = 0.509; I = \frac{1}{2}\sum Z_i^2 m_i \qquad \text{[7 marks]}$$

END OF QUESTION PAPER!!!