SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE CHEMISTRY/ GEOLOGY

SCH 204: INTRODUCTION TO REACTION KINETICS AND ELECTROCHEMISTRY

8TH DECEMBER, 2016 **TIME: 1.30-3.30 P.M**

INSTRUCTIONS TO CANDIDATES

(a) Answer question One and any other Two questions
(b) Question 1 carries 30 marks while the other questions carry 20 marks each
(c) Illustrate your answers with well labeled diagrams where appropriate

Some possibly useful information

1 amu =1.660565 x 10^{-27} Kg
Avogadro's number = 6.023 x 10^{23} atoms / mol
h = 6.626 x 10^{-34} J s
c = 2.998 x 10^{10} m/s
Gas constant R = 1.987 cal K^{-1} mol^{-1}
R_H = 2.179 x 10^{-18} J
R_H 1.0968 x 10^{7} m^{-1}
R_H = 10968 cm^{-1}

QUESTION ONE (30 MARKS)

(a) Define or explain the following terms: **[3 marks]**

(i) Order of a reaction

(ii) Molecularity of a reaction

(iii) Rate constant

(b) Hydrolysis of ethyl acetate by NaOH using equal concentration of the reactants was studied by titrating 25 mL of the reaction mixture at different time intervals against standard acid. From the data given below, show that this is a second order reaction. **[3marks]**

t (mins)	0	5	15	25
mL acid used	16.00	10.24	6.13	4.32

(c) Explain the following terms: [4 marks]

(i) Equivalent conductance

(ii) Molar concentration

(iii) Specific conductance

(iv) Faraday first law

(d) What is the importance of Faraday's first law of electrolysis? [**3 marks]**

(e) What current strength in amperes is required to liberate 10 g of iodine from potassium iodide in solution for one hour? **[3marks]**

(f) Calculate the equivalent conductance at 20^{o} C of NH_4OH at infinite dilution. Given:

λ_{∞} (NH_4Cl) = 130 λ_{∞} (OH^-) = 174 λ_{∞} (Cl^-) = 66

[**3 marks]**

(g) Explain **three** advantages of using conductometric titrations. **[3 marks]**

(h) Write the Nernst equation and define/explain the symbols used therein.

[3 marks]

(i) Calculate the emf of the cell

$Zn \mid Zn^{2+}$ (0.001M || Ag^{+} (0.1M) | Ag

The standard potential of Ag/Ag^{+} half-cell is +0.80 V and Zn/Zn^{2+} is -0.76 V.

[5 marks]

QUESTION 2 (20 MARKS)

(a) Explain the components of chemical kinetics. **[3 marks]**

(b) Explain why high molecularity reactions are rare. **[3 marks]**

(c) Define half-life period of a reaction **[2 marks]**

(d) For the reaction

$2N_2O_{5(g)} \rightarrow 4\ NO_{2(g)} + O_{2(g)}$

the rate is directly proportional to $[N_2O_5]$. At 45^{o} C, 90 % of the N_2O_5 reacts in 3600 seconds. Find the value of the rate constant *k.* **[5 marks]**

(e) (i) What is activation energy? **[2 marks]**

(ii) The rate constant for a reaction at 20^{o} C is half of the rate constant at 30^{o} C. Calculate the energy of activation of the reaction. [R = 1.987 cal K^{-1} mol^{-1}]

[5 marks]

QUESTION 3 (20 MARKS)

(a) In a tabular form, distinguish between conductometric and volumetric titrations. **[5 marks]**

(b) 0.1978 g of copper is deposited by a current of 0.2 amperes in 50 minutes. What is the electrochemical equivalent of copper? **[5 marks]**

(c) Explain the factors that determine the conductance of an electrolyte.

[4 marks]

(d) A conductance cell when filled with 0.05M solution of KCl records a resistance of 410.5 ohm at 25^{o} C. When filled with calcium chloride solution (11 g $CaCl_2$ in 500 ml) it records 990 ohms. If the specific conductance of 0.05M KCl solution is 0.00189 ohm cm^{-1}. Calculate

(i) the cell constant **[2 marks]**

(ii) specific conductance **[2 marks]**

(iii) molecular conductance **[2 marks]**

QUESTION 4 (20 MARKS)

(a) Explain the following terms: **[3 marks]**

(i)Transport number

(ii)Kohlrausch's law

(iii)Degree of dissociation

(b) The speed ratio of silver and nitrate ions in a solution of silver nitrate electrolysed between silver electrodes is 0.916. Find the transport number of the two ions. **[4 marks]**

(c) Explain the factors that determine the conductance of an electrolyte [**5 marks]**

(d) The specific conductance of saturated solution of silver chloride at 18^{o} C is 1.24×10^{-6} ohms after subtracting that of water. The mobilities of Ag^{+} and Cl^{-} ions at this temperature are 53.8 and 65.3, respectively. Calculate the solubility of silver chloride in grams per litre. **[4 marks]**

(e) Draw the titration curves for: **[4 marks]**

I. Weak acid with a strong base

II. Na_2SO_4 solution with $BaCl_2$ solution

QUESTION 5 (20 MARKS)

(a) Explain the following: **[3 marks]**

(i)Redox reaction

(ii)Reversible cell

(iii)Concentration cells

(b) What is the potential of a half cell consisting of zinc electrode in 0.01M $ZnSO_4$ solution at 25^oC, $E^0 = 0.763$ V **[4 marks]**

(c) Explain why the hydrogen electrode is not convenient for routine measurement of pH. [**4 marks]**

(d) The emf of the following cell at 25^oC 0.445V.

Pt, H_2 (1 atm) | H^+ (test solution) || KCl (sat solution) | Hg_2Cl_2 | Hg

Calculate the pH of the unknown solution, $E_{cell} = 0.2415$ [5 marks]

(e) Explain reasons why the glass electrode is universally used [4marks]