

**EMBU UNIVERSITY COLLEGE**  
**(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)**

**FIRST SEMESTER EXAMINATIONS 2014/2015**

**SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE**

**SCH 204: INTRODUCTION TO REACTION KINETICS AND ELECTROCHEMISTRY**

**DATE: DECEMBER 11, 2014**

**TIME: 10:30AM – 12:30PM**

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**INSTRUCTIONS:**

**Answer Question ONE and ANY Other TWO Questions**

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**QUESTION ONE**

- a) Define the following concepts
- i) Molecularity
  - ii) Transference number
  - iii) Order of reaction
  - iv) Solubility product
  - v) Opposing reactions (5 marks)
- b) Give rate law expressions for first and second order kinetics. In each case, give an integrated rate law (5 marks)
- c) Calculate the emf of the following cell. Write the reaction involved (5 marks)
- $Zn/Zn(0.1M)//Cu^{2+}(0.2M)/Cu$
- $(E_{Zn/Zn^{2+}}^{\circ} = -0.76V \text{ and } E_{Cu/Cu^{2+}}^{\circ} = +0.34V)$
- d) Calculate the pre-exponential factor and the activation energy given that the rate constant for  $N_2O_5 \rightarrow N_2O_4 + \frac{1}{2}O_2$  is  $3.46 \times 10^{-5}$  at 298K and  $4.87 \times 10^{-3}$  at 335K. (5 marks)

e) Explain why  $H^+$  and  $OH^-$  have very high ionic mobilities compared to other ions. Use appropriate diagrams. (5 marks)

f) Derive the equation for half-life of a first order reaction:



### QUESTION TWO

a) Draw suitable sketches and explain how one would be able to determine the end-point of titrimetric analysis of the following

i) Strong acid against a strong base (4 marks)

ii) Weak acid against a strong base (4 marks)

iii) Weak acid against a weak acid (6 marks)

b) Given the following information

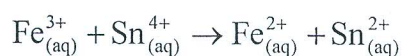
Salt	$\Lambda$
NaCl	126.4
KNO <sub>3</sub>	144.9
KCl	149.8

and  $t^+$  for  $Na^+$  in NaCl = 0.39

Calculate  $\Lambda$  for  $NaNO_3$  solution (Neglect the change in mobility of these ions with concentration). (5 marks)

### QUESTION THREE

a) Given the following electrochemical cell reaction :



i) Calculate the standard cell potential (3marks)

ii) Under standard conditions, will this reaction occur spontaneously as written? Justify your answer (4 marks)

iii) Calculate the equilibrium constant,  $K_{eq}$ . (3 marks)

(Standard reduction potentials are:  $E_{\text{Fe}^{2+}/\text{Fe}}^{\circ} = -0.44\text{V}$  and  $E_{\text{Sn}^{4+}/\text{Sn}^{2+}}^{\circ} = +0.15\text{V}$ )

b) A Hittorf cell is used mostly for determination of transference numbers of ions of interest in an electrolyte

i) Give a labelled schematic representation of Hittorf cell. (3 marks)

ii) Explain the steps, with relevant chemical and mathematical equations, used to determine transference numbers of  $\text{Ag}^+$  and  $\text{Cl}^-$  using the Hittorf apparatus (7 marks)

#### QUESTION FOUR

Identify the various steps in the following chain reaction and derive the rate law equation the reaction mechanism given below for the reaction



The mechanism is:



(20 marks)

#### QUESTION FIVE

a) Using Nernst equation, derive the equation for

i) Determining the solubility product of an insoluble salt using  $\text{Ag}/\text{Cl}^-$ ,  $\text{Ag}^+/\text{AgCl}$ .

(7 marks)

ii) Determining the equilibrium of an opposing reaction of your choice.

(6 marks)

iii) Obtaining pH of a solution using a suitable half cell(s)

(7 marks)

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