JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL & PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF EDUCATION SCIENCE

1ST YEAR 2ND SEMESTER 2013/2014 ACADEMIC YEAR

MAIN SCHOOL BASED

COURSE CODE: SCH 311

COURSE TITLE: ELECTROCHEMISTRY

EXAM VENUE:LAB 3 **STREAM: (BEd. Science)**

DATE: 26/08/14 **EXAM SESSION: 9.00-11.00AM**

TIME: 2.00 HOURS

Instructions:

1. **Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

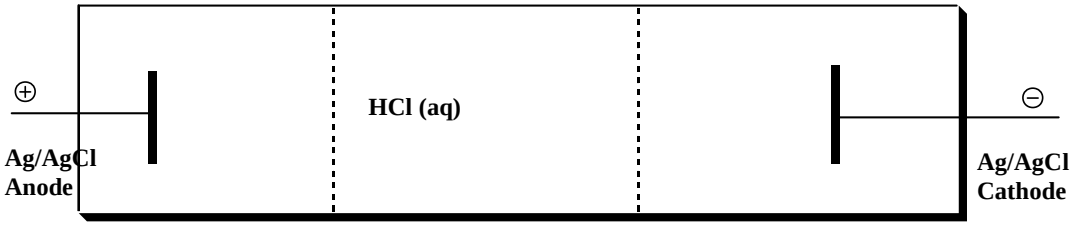
Question 1

a. Briefly explain each of the following terms: (8 marks)

i. Electromotive force
ii. Resistivity of a conductor
iii. Specific conductance
iv. Equivalent conductivity
v. Asymmetric effects
vi. electrophoretic effect
vii. mean activity

b. Outline the factors that influence conductivity in an electrolyte (5 marks)

c. The diagram shows a sketch of Hittorf's cell containing HCl concentration of 3.856 x10^{-4} g of HCl per gram of water.



Given after passing 2 mA of current through the cell for 3 hours, the following results were obtained:

Cathode solution	51.7436 g
Amount HCl in cathode compartment	0.267 g
Anode solution	52.0461 g
Amount HCl in anode compartment	0.0133 g

d. Determine the transport number of

i. H^+ ions. (8 marks)
ii. Cl^- ions (2 mark)

e. State the faradays laws of electrolysis (2 marks)

f. Calculate the *e.m.f.* at 25 ^oC for the $Cr^{3+}/Cr_2O_7^{2-}$ cell electrode at pH =1 and at pH = 3 in 0.01 M solution of $Cr^{3+}/Cr_2O_7^{2-}$. (6 marks)

Question 2

a. Draw a well labeled diagram to illustrate the complete Hittorf's apparatus for determination of transport numbers of ions. (3 marks)

b. Calculate the ionic strength for a 0.1 m acetic acid solution ,

i. Assuming complete dissociation (2 marks)
ii. Assuming the degree of dissociation, α is 0.01331 (2 marks)

iii. For the case in part (*b). ii.* above, calculate the activity coefficient of hydrogen ions (3 marks)

c. In a Weston cell *E* = -1.01832 V at 298 K. calculate:

i. ΔG (2 marks)

ii. ΔS (2 marks)

iii. ΔH (2 marks)

d. Calculate the $\gamma_{\pm}$ of a 1:2 electrolyte at a molality of 0.001 in an aqueous solution at 25 ^{o}C. (4 marks)

Question 3

a. Explain the factors that control conduction of electricity through a material. (4 marks)

b. State Ostwald dilution law (2 marks)

c. In an experiment to determine the transference number of Li^{+} ions by the moving boundary method 0.01 M LiCl was used and the following data obtained:

Cross section area	0.125 cm^2
Distance swept by boundary	7.3 cm
Time taken	1490 s
Current	1.8 x10^{-3} A

Calculate the t_{Li}+ . (7 marks)

d. Calculate the ionic strength of a solution containing 0.1 molal KCl and 0.1 molal K_2SO_4 (3 marks)

e. The *e.m.f.* of a cell consisting of copper electrodes dipped respectively in 0.5 M and 0.005 M CUSO4 solutions at 18 ^{o}C is 0.0391 V. Calculate the ratio of the activity of copper(II) ions in the two solutions assuming there is no *p.d.s* at the junction. (4 marks)

Question 4

a. State coulombs law (2 marks)

b. A piece of copper metal 0.2 m with cross-section area of 10 cm^2 has resistance of 3.45 x 10^{-5} Ω. Determine the resistivity of the copper wire. (3 marks)

c. Briefly discuss applications of Kahlrausch law (7 marks)

d. For the saturated solution of AgCl at 25 ^{o}C, the specific conductivity of water used to make the solution was 1.6 x 10^{-6} $\Omega^{-1}cm^{-1}$. Calculate the solubility of AgCl in water at 25 ^{o}C, given that:

a. $\lambda^0_{Ag^+} = 61.92\ \Omega^{-1}cm^2$ *and* $\lambda^0_{Cl^-} = 76.34\ \Omega^{-1}cm^2$. (4 marks)

e. Briefly outline advantages of dropping mercury electrode, DME, over the other cells (4 marks)

Question 5

a. Two solutions of 0.1 M KCl and 0.1 M HCl were found to have conductance of 2.17 x 10^{-3} Ω and 9.04 x10^{-3} Ω respectively, when measured in the same cell. Calculate the specific conductivity of

the 0.1 M HCl solution given that of 0.1 M KCl was found to be $1.167 \times 10^{-2}\ \Omega^{-1}cm^{-1}$.

(5 marks)

b. The equivalent conductance of sodium acetate, hydrochloric acid and sodium chloride at infinite dilution are 91.0, 426.16 and 126.45 $\Omega^{-1}cm^{-2}$, respectively at 25 ^{o}C. Calculate the equivalent conductance at infinite dilution for acetic acid. (5 marks)

c. Sketch a conductometric titration curve to show how the volume of the acid solution containing an equi-molar mixture of HCl and CH_3COOH varies with volume of base when the acid mixture is titrated against a strong base such as NaOH. (5 marks)

d. Briefly discuss classification of electrochemical cells (5 marks)

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