KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2007/2008

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE

SCH 401: ELECTROCHEMISTRY

DATE: Wednesday 11th June, 2008 **TIME:** 8.00 – 10.00 a.m.

INSTRUCTIONS:

Instructions: Answer all questions

F = 96500 C, Atomic mass of Cu = 64, Ag = 107, N = 14, O = 16

Cu^{+2}/Cu, E^0 = +0.337 V, Ag^+/Ag E^0 = +0.7991 V

1. a) Define the following terms

i) Electrophoretic effect

ii) Asymmetric effect

iii) Electrolysis

(6 marks)

b) I) Find how long it will takes to deposit 5 g of copper when a current of 0.120A flows through a solution of copper(II) sulphate using copper electrodes (**3 mark)**

II) A silver coulometer is connected in series with a cell for electrolysis of water. One gram of silver is deposited on the cathode of the coulometer.

i) How many grams of oxygen are evolved at the anode of the water electrolysis cell (**3 marks)**

ii) How many grams of hydrogen are evolved at the cathode of the water electrolysis cell? (**3 marks)**

iii) What is the average current passed during the electrolysis if the experiment is run for one hour? **(2 marks)**

c) The variation of molar conductivities with concentration of an aqueous solution of a given salt is as shown in table 1 below

Concentration/mol dm^{-3}	0.0005	0.001	0.005	0.01	0.02	0.05	0.1
Molar conductivity/ $\Omega^{-1}cm^2mol^{-1}$	131.4	130.5	127.2	124.8	121.4	115.2	109.1

i) By plotting a graph, determine the molar conductance at infinite dilution of the solution (**8 marks)**

ii) Calculate the apparent degree of dissociation for the solution at a concentration of 0.015 mol dm^{-3} (**2 marks)**

iii) Based on information from above (Q1c part ii), classify the above solution **(1 mark)**

2. a) In a moving boundary experiment a current of 1.6 mA was applied to a 0.02 M NaCl solution at 25 ^oC using $CdCl_2$ as the following solution. It was found out that the boundary had moved 10 cm in 3453 seconds in a tube of cross sectional area 0.1115 cm^2. The conductivity of this sodium chloride solution at 25 ^oC is 2.313 x 10^{-3} Ω^{-1} cm^2mol^{-1}. Calculate

i) The mobility of Na^+ (**3 marks)**

ii) The transport number of Na^+ (**3 marks)**

b) In a HIttorf cell experiment, a solution of silver nitrate was electrolysed between silver electrodes. The amount of silver nitrate in the anode compartment was 0.227 g before electrolysis and 0.2819 g after electrolysis. During electrolysis, 0.0194 g of copper were deposited on the cathode of copper coulometer in series with the Hittorf cell.

i) Calculate the transport number of Ag^+ and NO_3^- ions (**4 marks**)

ii) Which of the ions (between Ag^+ and NO_3^-) carry majority of the current (**1mark)**

3. a) Given the metals silver and copper and solutions of silver nitrate and copper nitrate at 25 ^oC

i) Construct a cell which will operate spontaneously (**1 mark)**

ii) Write the equation for the reaction (**2 marks)**

iii) Calculate the equilibrium constant for the reaction (**2 marks)**

b) The emf of the cell with transport viz

Pt/H_2(1 atm)/HCl(a±0.009048)/HCl(a±0.01751)/H_2 (1 atm)/Pt is 0.02802 V at 25 ^oC. The emf of the corresponding cell without transport is 0.01969 V

(I) Write the overall cell reaction for the cell

i)Without transport (**2 marks)**

ii) With transport (**2marks)**

(II) Calculate

(i) The liquid junction potential (**2 marks)**

(ii) The transport numbers of the H^+ ions (**2 marks)**

4. Give the electrochemistry principles of nickel cadmium battery, showing the reactions at the cathode, anode and overall reaction, the electrolyte used and current collector and give two applications (**8 marks)**

5. Give two advantages and two disadvantages of using the following techniques in corrosion monitoring

i) Linear polarisation resistance technique

ii) Corrosion potential measurement technique (**8 marks)**