



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2007/2008
INSTITUTE OF OPEN LEARNING
SPECIAL EXAMINATION FOR THE DEGREE OF
BACHELOR OF EDUCATION AND BACHELOR OF SCIENCE

SCH 401: ELECTROCHEMISTRY

DATE: Thursday 7th October 2008

TIME: 10.00am – 12.00pm

INSTRUCTIONS: Answer ALL questions.

F = 96500 C, Atomic mass Cu = 64, Ag = 107, N = 14, O=16
Cu⁺² /Cu' E⁰ = +0.337V, Ag E⁰ = +0.7991V

- Q1. (a) Define the following electrochemical terms and show how they are related to each other.
- (i) Conductance
 - (ii) Conductivity
 - (iii) Molar conductivity [6 marks]
- (b) (i) Discuss quantitatively the way in which conductivity and molar conductivity changes with increase in dilution for strong intermediate and weak electrolyte. [6 marks]
- (ii) Account for asymmetric and electrophonetic effects in the same. [6 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/ $\Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$	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 $0.015 \text{ mol dm}^{-3}$ [2 marks]
- (iii) Based on information from above (Q1c part ii), classify the above solution. [1 mark]

- Q2. (a) In a moving boundary experiment a current of 1.6 mA was applied to a 0.02 M NaCl solution at 25°C 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 solution chloride solution at 25°C is $2.313 \times 10^{-3} \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$. 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. [1 mark]

- Q3. (a) Given the metals silver and copper and solutions of silver nitrate and copper nitrate at 25°C .
- (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
 $\text{Pt}/\text{H}_2 (1 \text{ atm})/\text{HCl} (a_{\pm}0.009048)/\text{HCl} (a_{\pm}0.01751)/\text{H}_2 (1 \text{ atm})/\text{Pt}$ is 0.02802 V at 25°C . 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 [2 marks]
- (II) Calculate
- (i) The liquid junction potential [2 marks]
 - (ii) The transport numbers of the H^+ ions [2 marks]

Q4. 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]

Q5. Give two advantages and two disadvantages of using the following techniques in corrosion monitoring

- (a) Linear polarization resistance technique
- (b) Corrosion potential measurement technique [8 marks]

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