KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHEM 411

COURSE TITLE: ELECTROCHEMISTRY

STREAM: SESSION VII

DAY: FRIDAY

TIME: 2.00 – 4.00 P.M.

DATE: 13/08/2010

INSTRUCTIONS:
Attempt all questions

Data 2.303RT/F = 0.0592 at 25^{o}C, F = 96500Cmol^{-1}, 0^{o}C = 273K, R = 8.314Jmol^{-1}K^{-1}

PLEASE TURNOVER

QUESTION 1

a) Define the following terms:

i) Electrophoretic effect (1mk)

ii) Relaxation effect (1mk)

iii) Reversible electrode (1mk)

iv) Equivalence conductance (1mk)

b) Explain why the mobility of hydrogen ions is high yet the equilibrium of

$$H^+(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq)$$

lies far much to the right suggesting that few free protons are present in water. (4mks)

c) Write down the kohlrausch is law and define all symbols in the equation. (3mks)

d) A 0.2M aqueous solution of KCl has equivalent conductance of $138.35 Scm^2mol^{-1}$ and a resistance of 74.58Ω.

i) Find the cell constant. (2mks)

ii) The resistance of a 0.2M solution of acetic acid in the above cell was found to be 888Ω. Calculate the equivalence conductance. (3mks)

e) Briefly explain why molar conductivity of strong electrolyte decreases with increase in square root of concentration. (2mks)

QUESTION 2

a) Define the term transport number of an ion. (1mk)

b) State three factors that determine motion of an ion in a solution. (3mks)

c) Briefly describe how transport number is determined experimentally by Hittorf method. (3mks)

d) A solution of HBr was electrolysed in a transport cell between Pt electrodes. It was found that the cathode compartment had 0.253g and 0.208g of bromide ions before and after electrolysis respectively. In the same experiment, 0.185g of copper was deposited as measured by a coulometer. Calculate the transport numbers of H^+ and Br^- ions. [Br = 79.9, Cu = 63.54] (5mks)

e) An electrochemical cell has the following cell reaction equilibrium;

$$eA + fB \rightleftharpoons gC + hD$$

where A, B, C and D are reagents whose concentrations can be varied. Show from the first principles that for the overall cell reaction, the emf of the cell at 25°C is

$E = E^o - \frac{0.0592}{n} \log \frac{a^g_C a^h_D}{a^e_A a^f_B}$ define all the contants. (5mks)

QUESTION 3

a) Write down an expression for Ostwald's dilution law (2mks)

b) The resistances of aqueous acetic acid solutions were measured at 25°C in a cell constant of 0.2063 cm^{-1}. The following results were obtained.

C ($moll^{-1}$)	0.00049	0.00099	0.00198	0.0158	0.06323	0.2529
R (Ω)	6146	4210	2927	1004	497	253

where C is the concentration of acetic acid and R is the resistance. Plot a graph of $1/\wedge_m$ versus $C\wedge_m$ and hence determine

i) Ka

ii) The degree of ionization of acetic acid at resistance of 2927Ω. (13mks)

c) i) State the principle underlying conductometric titration. (1mk)

ii) Sketch conductometric titration curve showing the variation of conductance and volume of base on addition of sodium hydroxide solution to hydrochloric acid. Explain the shape of the curve. (3mks)

QUESTION 4

a) The standard emf of the cell $Pt|H_2(g)|HCl(aq)|Hg_2Cl_2(s)|Hg$ at 20°C is 0.2699V and 0.2669V at 30°C.

i) Write the equations for all the processes taking place and give the net cell reaction. (4mks)

ii) Determine the values of ΔG, ΔH and ΔS at 25°C. (8mks)

b) i) Explain what is meant by concentration cell. (1mk)

ii) State two types of concentration cells (2mks)