KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION

SCIENCE

COURSE CODE: **CHEM 411**

COURSE TITLE: **ELECTROCHEMISTRY**

STREAM: **SESSION VI & VII**

DAY: **WEDNESDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **12/08/2009**

INSTRUCTIONS TO CANDIDATES:

F= 96500 C
Answer ALL QUESTIONS

PLEASE TURN OVER

Q1. a) Define the following terms:

i) An electrochemical cell (2mks)

ii) Ionic mobility (2mks)

i) Molar conductivity. (2mks)

b) A conductivity cell has a resistance of 250 ohms when filled with 2 $x10^{-2}$ mol/L KCl solutionat 298K and resistance of 10^5 ohms when filled with 6 x 10^{-5}M NH_4OH solution. The specific conductivity of 2 x 10^{-2} M KCl is 2.77x 10^{-3} $ohm^{-1}cm^{-1}$and the ionic molar conductivities of NH_4^+ and $OH^{-1}$are 73.4 and 198 $ohm^{-1}cm^2mol^{-1}$ respectively. Calculate

i) the cell constant [2mks]

ii) the dissociation constant (Kb) of NH_4OH [7mks]

c) The specific conductivity of a saturated solution of silver chloride (AgCl) is 3.6 x 10^{-6} ohm^{-1} cm^{-1} and that of water used in preparing the solution is 0.6 x 10^{-6} ohm^{-1} $cm^{-1.}$ If the molar conductivities at infinite dilution of Ag^+ and Cl^- are 61.92 and 76 ohm^{-1} cm^2 mol^{-1}

Calculate,

i) The solubility of AgCl

ii) The solubility product, Ksp, of AgCl. [6mks]

Q2. a) Give the differences between electronic and electrolytic conductors [4mks]

b) State

(i) Kohlrausch's law of ionic mobility at infinite dilution [2mks]

(ii) Ohm's law [2mks]

c) State the distinction between a galvanic cell and an electrolytic cell [4mks]

d) Calculate the equilibrium constant at 25° for the reaction

$Zn(s) + Cu^{2+}_{(aq)}(1M) = Cu(s) + Zn^{2+}_{(aq)}(1M)$ $E° = 1.1V$ [4mks]

e) Calculate the transport number of H^+ ions and Cl^- ions from the following data obtained by a moving boundary method using silver chloride as an indicator electrolyte. Atomic weight Ag=108

- Concentration of HCl= 0.1M
- Weight of Ag deposited in the coulometer = 0.13g
- Boundary movement = 4.5 cm
- Cross-section area = 1.25 sq. cm [4mks]

Q3 a) When a silver- silver chloride and calomel electrode are incorporated in the same cell the reaction taking place as the cell supplies current is

$Ag(s) + 1/2Hg_2Cl_2(s) = Hg(l) + AgCl$

The EMF of the cell is 0.0455V at 998K and the temperature coefficient $(\delta E/\delta T)$ is 5.0×10^{-5} VK^{-1}. Calculate ΔG, ΔS and ΔH for the reaction. [7mks]

b) Give a suitable explanation as to why the resistance of a metal increases and that of an electrolyte solution decreases on raising the temperature. [3mks]

4 a) The respective standard electrode potentials and the reaction taking place in the electrochemical cell is given as follows;

$Cu/Cu^{2+}//Cl^-/Cl_2/Pt$ $\quad E°Cl/Cl^- = 1.36V$

$E°Cu^{2+}/Cu = 0.337V$

Write down the cathode, anode and the net cell reaction of the cell and predict whether the reaction is spontaneous. [5mks]

b) In a Hittorf experiment a student electrolyzed aqueous $AgNO_3$ using silver electrodes. The amount of $AgNO_3$ in the anode compartment before electrolysis was 0.228 g and after electrolysis it was 0.282 g. During electrolysis it was found that 0.019 g of Cu was deposited on copper coulometer connected in series to hittorf cell. Calculate the transport number of Ag^+ and NO^-_3 Atomic masses; N= 14, Cu = 63.5, O= 16 and Ag =108 [6mks]

c) Explain briefly three factors that affect ionic mobility [6mks]

d) Write brief notes on electrophoretic effect [2 mks]