KABARAK 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: **MONDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **06/04/2009**

INSTRUCTIONS:
F= 96500C/mol

Answer ALL QUESTIONS

PLEASE TURN OVER

Q1. a) Define the following terms:

i) An electrochemical cell (2mks)

ii) Ionic mobility (2mks)

iii) Molar conductivity (2mks)

b) A cell containing 0.1mol dm^{-3} aqueous NaCl has a conductivity of 125 ohm^{-1} cm^2 mol^{-1}. The measured resistance was 28 ohms.

When the same cell was filled with 0.05 mol dm^{-3} KOH aqueous solution, the resistance was 37.6 ohms. Find molar conductivity of aqueous KOH at that concentration. (6mks)

c) Give the Debye-Huckel equation and define each term in the equation. (3mks)

d) Write brief notes on asymmetric effect. (5mks)

e) Sketch a diagram and explain how molar conductivity of Methanoic acid varies with dilution. (4mks)

Q2. a) A conductivity cell has a resistance of 250 ohms when filled with 2 $x10^{-2}$ mol/L KCl at 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) Cell constant (2mks)

ii) The dissociation constant of NH_4OH (Kb) (6mks)

b) The specific conductivity of a saturated solution of silver chloride 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 conductivity at infinite dilution of Ag^+ and Cl^- are 61.92 and 76 ohm^{-1} cm^2 mol^{-1} respectively, calculate

i) The solubility of AgCl

ii) The solubility product Ksp of AgCl. (5mks)

Q3. a) What is the ionic mobility of the ions H^+ and Cl^- in aqueous solution at infinite dilution? The conductivities at infinite dilution of H^+ and Cl^- are λ^{∞}_{H+}= 348 ohm^{-1} cm^2 mol^{-1} and λ^{∞}_{Cl}= 76.34 ohm^{-1} cm^2 mol^- and 1 (3mks)

F= 96500C/mol.

b) The EMF of the cadmium cell is 1.0183Vat 298K. The temperature coefficient is $-5.0x10^{-5}$ VK^{-1}. Calculate ΔG and ΔH when 2 faradays are passed through the circuit. (4mks)

c) 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 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)

d) State the three factors that affect ionic mobility. (3 mks)

Q4 a) Calculate the transport number of K^+ and Cl^- ions from the following data obtained by a moving boundary method using cadmium chloride as an indicator electrolyte.

Concentration of HCl= 0.1M

Quantity of electricity passed = 12.55C

Boundary movement = 5.6 cm

Cross-section area = 0.114 sq. cm (4mks)

b) Calculate the solubility product Ksp of AgCl by forming a proper cell given that

$E° Cl^- / AgCl(s) /Ag(s) = 0.168V$

$E° Ag^+ / Ag(s) = 0.779V$ (4mks)

c) Write down the cathode, anode and the net cell reaction of the cell and predict whether the reaction is spontaneous.

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

$E°Cu^{2+}/Cu = 0.337V$ (4mks)

d) Define the term a reversible electrode and give any two examples (5mks)