KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHEM 411**

COURSE TITLE: **ELECTROCHEMISTRY**

STREAM: **Y4S1**

DAY: **MONDAY**

TIME: **9.00 -11.00 A.M.**

DATE: **23/03/2009**

INSTRUCTIONS:

F= 96500C

Answer ALL QUESTIONS

PLEASE TURN OVER

Q1. a) Explain the following terms:

i) Specific conductance [2mks]

ii) Ionic mobility [2mks]

iii) Equivalent conductivity [2mks]

iv) Transference number [2mks]

b) A cell with electrodes that are 2 x $10^{-4}m^2$ in area and 0.01 m apart was filled with 0.1x10^3 g equiv/m^3 solution of NaCl. Given that the equivalent conductance is 106.7 x10^{-4} ohm^{-1} g $equiv^{-1}$ m^2 and if the applied potential across the electrodes was 50V, calculate the current in amperes passing through the circuit. [5mks]

c) Calculate the E M F of the cell

Zn /zn^{2+} (1M) // Ag+ (1M)/Ag given E° zn^{2+}/zn =-0.762V

E° Ag^{+}/Ag = 0.8V [3mks]

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 [2mks]

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

Zn(s) + Cu^{2+} (1M) = Cu(s) + Zn^{2+}(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 cadmium chloride as an indicator electrolyte.

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.

[6mks]

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

i) Cell constant [2mks]

ii) The dissociation/ ionization constant of NH_4OH [7mks]

iii) The pH of the base [3mks]

Q4. a) What is the ionic mobility of SO_4^{2-} ions in solution at infinite dilution given the ionic conductivity of the ions as $\lambda^{\infty}_{so4} = 159.6$ Ohm^{-1} cm^2 mol^{-1} [4mks]

b) The specific conductivity of a saturated solution of silver chloride after subtracting the specific conductivity of water is 2.28×10^{-6} If the ionic molar conductivities of Ag^+ and Cl^{-1} are 62 and 76 Ohm^{-1} cm^2 mol^{-1} respectively, calculate

i) The solubility of silver chloride. [4mks]

ii) The solubility product of silver chloride at 298K. [2mks]

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) Give a suitable explanation as to why the resistance of a metal increases and that of an electrolyte solution decreases on raising the temperature. [2mks]