# KABARAK UNIVERSITY

## UNIVERSITY EXAMINATIONS

### 2009/2010 ACADEMIC YEAR

### FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION SCIENCE

**COURSE CODE:** CHEM 411

**COURSE TITLE:** ELECTROCHEMISTRY

**STREAM:** Y4S1

**DAY:** MONDAY

**TIME:** 2.00 – 4.00 P.M.

**DATE:** 07/12/2009

---

**INSTRUCTIONS:**

- F= 96500C/MOL
- Answer ALL QUESTIONS

**PLEASE TURN OVER**

Q1. a) Define the following terms:

| | | |
|---|---|---|
| i) | Specific conductance | [2mks] |
| ii) | solubility product | [2mks] |
| iii) | Molar conductivity | [2mks] |
| iv) | Transference number | [2mks] |

b) The measured resistance of a cell containing 0.1M KCl solution at 25°C was found to be 3468.9 ohms, the specific conductance was 0.012856hm$^{-1}$cm$^{-1}$ at 25°C. A 0.1M solution of another substance in the same cell had a resistance of 4573.5 ohms. Calculate the molar conductance of this electrolyte at the given concentration [5mks]

c) The molar conductance of sodium acetate, hydrochloric acid and sodium chloride at infinite dilution are 91.0, 426.16 and 126.45 ohm$^{-1}$ cm$^{2}$ mol$^{-1}$ respectively. Calculate the molar conductance at infinite dilution of acetic acid. [2mks]

Q2. a) (i) State Ohm's law [1mk]

(ii) Calculate the E M F of the cell:

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

E° $Ag^+/Ag$ = 0.8 [4mks

b) State the distinction between a galvanic cell and an electrolytic cell. [2mks]

c) In a certain experiment the emf of the cell is found to be 0.54 V at 25 °C, suppose that $[Zn^{2+}]$ =1M and $P_{H2}$ =1.0atm.

Calculate the molar concentration of $H^+$ given the standard emf of the cell as 0.76V.

The equilibrium constant at 25º C for the reaction

$$Zn(s) + 2H_{(aq)}^+(?) \longrightarrow Zn^{2+}_{(aq)}\ (1M) + H_{2(aq)}\ (1atm)$$ [6mks]

d) 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 $\left(\delta E / \delta T\right)$ is $5.0 \times 10^{-5}$ $VK^{-1}$. Calculate ΔG, ΔS and ΔH for the reaction. [6mks]

Q3. a) The specific conductivity of a saturated solution of silver chloride after subtracting the specific conductivity of water is 2.28 x $10^{-6}$ $ohm^{-1}cm^{-1}$. If the ionic molar conductivities of $Ag^+$ and $Cl^-$ 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]

b) A conductivity cell has a resistance of 250 ohms when filled with 2 x$10^{-2}$ 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 $ohm^{-1}cm^{-1}mol^{-1}$ respectively. Calculate

i) The cell constant [3mks]

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). In a moving boundary experiment with 0.1M KCl using 0.065M LiCl as indicator solution, a constant current of 0.05893 ampere was passed for 2180 s and the boundary was observed to move through 5.6 cm in a tube of 0.114258 $cm^2$ cross section calculate the transference number of the $K^+$ and $Cl^-$ ions [4mks]

c). AgNO3 solution containing 0.00739g of $AgNO_3$ per gm of $H_2O$ is electrolysed between silver electrodes. During the experiment 0.078gm of Ag is deposited at the cathode. At the end of the experiment the anode portion contains 23.14gm of $H_2O$ and 0.236gm of $AgNO_3$. What are the transport numbers of $Ag^+$ and $NO_3^-$ ions.

Atomic masses; N= 14, Cu =63.5, O= 16 and Ag =108 [7mks]