

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 $0.012856\text{hm}^{-1}\text{cm}^{-1}$ 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 $126.45\text{ohm}^{-1}\text{cm}^2\text{mol}^{-1}$ 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:



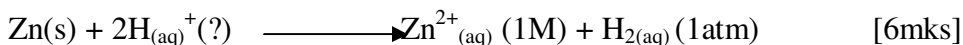
$$E^{\circ}\text{Ag}^{+}/\text{Ag} = 0.8 \quad [4\text{mks}]$$

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

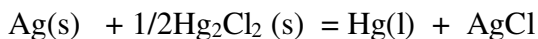
c) In a certain experiment the emf of the cell is found to be 0.54 V at 25 °C, suppose that $[\text{Zn}^{2+}] = 1\text{M}$ and $P_{\text{H}_2} = 1.0\text{atm}$.

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

The equilibrium constant at 25° C for the reaction



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



The emf of the cell is 0.0455V at 998K and the temperature coefficient $(\frac{\delta E}{\delta T})$ is $5.0 \times 10^{-5}\text{VK}^{-1}$. 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 $2.28 \times 10^{-6} \text{ ohm}^{-1}\text{cm}^{-1}$. If the ionic molar conductivities of Ag^+ and Cl^- are 62 and $76 \text{ Ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ respectively, calculate
- The solubility of silver chloride. [4mks]
 - The solubility product of silver chloride at 298K. [2mks]
- b) A conductivity cell has a resistance of 250 ohms when filled with $2 \times 10^{-2} \text{ mol/L}$ KCl at 298K and resistance of 10^5 ohms when filled with $6 \times 10^{-5} \text{ M}$ NH_4OH solution. The specific conductivity of $2 \times 10^{-2} \text{ M}$ KCl is $2.77 \times 10^{-3} \text{ ohm}^{-1}\text{cm}^{-1}$ and the ionic molar conductivities of NH_4^+ and OH^- are 73.4 and $198 \text{ ohm}^{-1}\text{cm}^2 \text{ mol}^{-1}$ respectively. Calculate
- The cell constant [3mks]
 - The dissociation/ ionization constant of NH_4OH [7mks]
 - 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 $\lambda_{\text{so}_4}^\infty = 159.6 \text{ Ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ [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). AgNO_3 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]