THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
ACADEMIC YEAR 2022/23
TERM 1I
CHE 2615: Basic Physical Chemistry

ASSIGNMENT 3

Topics covered: **Chemical equilibrium, electrolytic cells and Thermodynamics of electrochemical cells**

Date: **11th September2023**

Answer all the problems and submit before 10:00 hrs on Monday, 31th October 2023

Question 1

The limiting molar conductance, Λ_m°, of NaI, $NaCH_3CH_2$, $MgCH_3CH_2$, are 12.69 mS m^2 mol^{-1}, 9.10 mS m^2 mol^{-1}, and 18.78 mS m^2 mol^{-1} respectively, all at 25 °C. Use Kohlraush's law of the independence of migration of ions to calculate the limiting molar conductance of MgI

Question 2

The mobility of the acetate ion.CH_3COO^-, in aqueous solution at 25 °C is 4.24 x10^{-8} $m^2s^{-1}V^{-1}$. Calculate the molar ionic conductance of the ions.

Question 3

A saturated solution of Ag_2CO_3 had an electrical resistance of 3529.6 Ω when measured in a conductance cell with a cell constant of 38.54 m^{-1} at 25 °C. The specific conductance of water was 0.00760 $\Omega^{-1}m^{-1}$. The limiting molar conductance, Λ_m°, of Ag_2CO_3 is 0.02624 $\Omega^{-1}m^2mol^{-1}$, at a temperature of 25 °C.

(i) Calculate the specific conductance of Ag_2CO_3 corrected for the specific conductance of water.
(ii) Determine the solubility of Ag_2CO_3.

Question 4

Consider a cell, below at a temperature of 25 °C,

$$Pt(s)|H_2(g,1\,bar)|HCl)(aq,0.0100 mol L^{-1})||AgCl(s)|Ag(s)$$

(i) Write the cell reaction
(ii) Use the Debye- Hūckell limiting law to calculate the mean ionic activity coefficient of HCl.
(iii) Apply the Nernst equation determine the emf of the cell.

Question 5

(a) The mobility, μ_+°, of K^+ ion is 7.6178×10^{-8} $m^2V^{-1}s^{-1}$ at 25°C. Calculate ionic molar conductance, Λ_+°, of K^+ ion. F = 96485 C mol^{-1}.

(b) An aqueous solution of 0.0200 M of KCl has conductance, L, of $1.923 \times 10^{-3}\,\Omega^{-1}$ in a conductance cell with a cell constant of 143.87 m^{-1}.

(i) Calculate specific conductance of the solution.
(ii) Find molar conductance of KCl solution.

(c) Kohlrausch's square root law is

$$\Lambda_m = \Lambda_m^\circ - k\sqrt{c}$$

Molar conductance of aqueous KCl solution at different concentrations is given below.

c (mol L^{-1})	Λ_m ($\Omega^{-1}m^2mol^{-1}$)
5.00×10^{-4}	0.014781
1.00×10^{-3}	0.014695
5.00×10^{-3}	0.014355
1.00×10^{-2}	0.014127

Use linear regression to determine molar conductance at infinity dilution of KCl.