KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHEM 411**

COURSE TITLE: **ELECTROCHEMISTRY**

STREAM: **SESSION VIII**

DAY: **TUESDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **06/04/2010**

INSTRUCTIONS:

Attempt all questions

Data 2.303RT/F = 0.0592 at 25^{o}C, F = 96500Cmol^{-1}, 0^{o}C = 273K, R = 8.314Jmol^{-1}K^{-1}

PLEASE TURN OVER

QUESTION 1

a) Define the following

i) Molar conductivity **(1mk)**

ii) Strong electrolyte **(1mk)**

iii) Reference electrode **(1mk)**

iv) Liquid junction potential **(1mk)**

b) The molar conductivity of a strong electrolyte at 25^{o}C was to be 109.9 Scm^2mol^{-1} for a concentration of 6.2x 10^{-3} $molL^{-1}$ and 106.1 Scm^2mol^{-1} for a concentration of 1.5x10^{-2} $molL^{-1}$. Estimate the limiting molar conductivity of the electrolyte. **(5mks)**

c) i) State Kohlrausch law of independent ionic migration **(2mks)**

ii) The specific conductance of a 0.05M solution of ethanoic acid at 25^{o}C is 4.4 x10^{-4} $\Omega^{-1}cm^{-1}$. The limiting molar conductivities of hydrogen ions and ethanoate ions are 310 and 77 $\Omega^{-1}cm^2mol^{-1}$ respetively. Calculate dissociation constant of ethanoic acid. **(8mks)**

QUESTION 2

a) i) Write down an expression for ostwalds dilution law **(2mks)**

ii) The resistances of aqueous acetic acid solution were measured at 25^{o}C in a cell constant of 0.2063 cm^{-1}. The following results were obtained.

C (moll-1)	0.00049	0.00099	0.00198	0.0158	0.06323	0.2529
R (Ω)	6146	4210	2927	1004	497	253

Where C is the concentration of acetic acid and R is the resistance. Plot a graph of $1/\wedge_m$ versus $C\wedge_m$ and hence determine

I) Ka

II) The degree of ionization of acetic acid at resistance of 2927Ω. **(13mks)**

b) Given that the limiting molar conductivities of hydrochloric acid, sodium ethanoate and sodium chloride are 0.0426, 0.0091 and 0.01265 $\Omega^{-1}M^2Mol^{-1}$ respectively, determine the limiting molar conductivity of ethanoic acid. **(3mks)**

QUESTION 3

a) The emf and the derivative $(\delta E/\delta T)_P$ of the cell $Pb/PbBr_2(s)$, KBr(aq), Ag/Br (s)/Ag are 0.492V and $-0.000186VK^{-1}$ respectively.

i) Write down the cell reaction for the above cell **(1mk)**

ii) Calculate $\Delta G, \Delta H$ and ΔS at 27^oC. **(7mks)**

b) Briefly outline the principle underlying potentiometric titration and its applications. **(6mks)**

QUESTION 4

a) Define the term transport number of an ion **(1mk)**

b) State three factors that determine motion of an ion in a solution **(3mks)**

c) Briefly describe how transport number is determined experimentally by Hittorf method. **(3mks)**

d) The following cell was set up;

$Hg(l)|Hg_2Cl_2(s)|NaCl\ (0.001M): NaCl\ (0.01M)|Hg_2Cl_2(s)|Hg(l)$

i) Write an equation for all the processes taking place and net cell reaction. **(2mks)**

ii) Derive the equation for emf of this cell at 25^oC **(4mks)**

iii) Calculate the emf of this cell at 25^oC, if t_+ is 0.4 for NaCl solution and mean activity coefficient is 0.6 and 1 for 0.01 and 0.001M NaCl solution respectively. **(3mks)**

iv) Calculate what emf of this cell would be if there were no liquid junction potential. **(2mks)**

v) Determine the value of the liquid junction potential **(1mk)**