# Eastern University, Sri Lanka

## Third Year First Semester Examination in Science

## 2008/2009 (February 2010)

## CH 303 Electrochemistry

**(Proper)**

Answer all questions **Time : 01 hour**

**Useful constants: R = 8.134 J mol$^{-1}$ K$^{-1}$, F = 96485 C mol$^{-1}$, 2.303 RT/F = 0.0591 V**

(1) (a) Define the following terms which refer to the properties of ionic solutions

(i) Ionic strength
(ii) Molar conductivity
(iii) Ion mobility

(15 marks)

(b) Calculate the ionic strength and the mean activity coefficient of 0.001 M solution of $CaCl_2$ at 25 $^0$C

(20 marks)

(c) (i) Write the simplified form of the Debye – Huckel-Onsager equation and identify the terms in it.

(10 marks)

(ii) The dissociation constant of $ClCH_2COOH$ at 25 $^\circ$ C is 1.35 x 10$^{-3}$ mol dm$^{-3}$. The molar conductivity at 25 $^\circ$ C of a 0.04 M solution of this acid is 72.2 S cm$^2$ mol$^{-1}$. Calculate the molar conductivity at infinite dilution of $ClCH_2COOH$ at 25 $^\circ$ C.

(30 marks)

*Turn Over*

(d) The mobility of the $Rb^+$ ion in aqueous solution is $7.92 \times 10^{-8}$ $m^2 s^{-1} v^{-1}$ at 25 $^0$ C. The potential difference between two electrodes placed in the solution is 3.50 V. If the distance between electrodes is 8.00 mm, then what is the drift velocity of the $Rb^+$ ion.

(25 marks)

(2) (a) Define the following terms

(i) Electro motive force
(ii) Electrode potential

(10 marks)

(b) The following redox reaction occurs in a cell:

$$Al / Al^{3+} (aq) // Sn^{2+} (aq), Sn^{4+} (aq)/Pt$$

(i) Write the half cell reactions which occur at each electrode.

(ii) Write the balanced equation for all redox reaction (cell reaction) which occurs in the cell.

(iii) Calculate the electromotive force (e.m.f) of the cell when the activities of all the ions are 0.01. [ $E^{\theta}_{Sn^{4+}/Sn^{2+}} = 0.15$ V, $E^{\theta}_{Al^{3+}/Al} = -1.66$ V]

(iv) Calculate the value of $\Delta G^{\theta}$ and $\Delta G$.

(v) Calculate the equilibrium constant (k) for the reaction.

[ Hint: $\Delta G^{\theta} = RT \ln k$]

(50 marks)

(c) Calculate the standard electrode potential for the half cell reaction

$$Pd(OH)_2 (s) + 2e \longrightarrow Pd(s) + 2\ OH^- (aq)$$

Given that $K_{sp}$ for $Pd(OH)_2$ is $3 \times 10^{-28}$ and $E^{\theta}_{Pd^{2+}/Pd} = 0.915$ V.

(40 marks)

*End of paper*