



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

(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  $\text{CaCl}_2$  at  $25^\circ \text{C}$

(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  $\text{ClCH}_2\text{COOH}$  at  $25^\circ \text{C}$  is  $1.35 \times 10^{-3} \text{ mol dm}^{-3}$ . The molar conductivity at  $25^\circ \text{C}$  of a 0.04 M solution of this acid is  $72.2 \text{ S cm}^2 \text{ mol}^{-1}$ . Calculate the molar conductivity at infinite dilution of  $\text{ClCH}_2\text{COOH}$  at  $25^\circ \text{C}$ .

(30 marks)

**Turn Over**

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

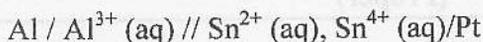
(25 marks)

- (2) (a) Define the following terms

- (i) Electro motive force
- (ii) Electrode potential

(10 marks)

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



- (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  $0.01$ . [ $E_{\text{Sn}^{4+}/\text{Sn}^{2+}}^\theta = 0.15 \text{ V}$ ,  $E_{\text{Al}^{3+}/\text{Al}}^\theta = -1.66 \text{ V}$ ]
- (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



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

(40 marks)

*End of paper*