



EASTERN UNIVERSITY, SRI LANKA

FIRST YEAR FIRST SEMESTER EXAMINATION IN SCIENCE-2010/2011

(NOVEMBER 2012)

CH 102 INTRODUCTION TO ELECTROCHEMISTRY AND
THERMODYNAMICS

Answer all questions

Time: 01 hour

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}, \quad 2.303 RT/F = 0.5091 \text{ V}$$

- 1) (a) What do you mean by extensive and intensive properties and give three examples for each. [10 marks]
- (b) (i) Write the mathematical expression for the first and second laws of thermodynamics. [10 marks]
- (ii) A piston filled with 0.04 mole of an ideal gas expand reversibly from 50.0 ml to 375.0 ml at a constant temperature of 37.0 °C. During the process it absorbs 208 J of heat. Calculate q , W , ΔU and ΔH . [30 marks]
- (c) (i) Using the combination of first and second laws of thermodynamics show that the entropy change (ΔS) on heating of the 'n' moles of substance reversibly from temperature T_1 to T_2 at constant volume is

$$\Delta S = C_v \ln \left(\frac{T_2}{T_1} \right)$$

(Assume C_v is independent of temperature)

[15 marks]

Contd...



(ii) The heat capacity of oxygen at constant volume is given by the empirical equation

$$C_v = \alpha + \beta T + \gamma T^2$$

Where α , β and γ are constants. Show that the entropy change (ΔS) of oxygen is heated from T_1 to T_2 is

$$\Delta S = \alpha \ln \frac{T_2}{T_1} + \beta(T_2 - T_1) + \frac{\gamma}{2}(T_2^2 - T_1^2)$$

[20 marks]

(iii) Determine entropy change (ΔS) - when the oxygen is heated from 300 K to 500 K. Where $\alpha = 25.503 \text{ J K}^{-1} \text{ mol}^{-1}$, $\beta = 13.612 \times 10^{-3} \text{ J K}^{-2} \text{ mol}^{-1}$ and $\gamma = -42.553 \times 10^{-7} \text{ J K}^{-3} \text{ mol}^{-1}$.

[15 marks]

2) (a) (i) Show that the Maxwell relation as $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

[15 marks]

(ii) For a gas follows a van der Waals equation of state show that

$$\left(\frac{\partial S}{\partial V}\right)_T = \frac{nR}{V-nb}$$

[15 marks]

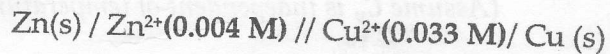
(b) Assume the following reaction occurs in an electrochemical cell



- (i) What is the cell representation for the cell
- (ii) What is standard electrode potential (E_{cell}^θ) of the cell at 25 °C
- (iii) Determine standard change in Gibb's free energy (ΔG^θ) and equilibrium constant K of the cell at 25 °C

[40 marks]

(c) Calculate the electrode potential (E_{cell}) of the following cell by using the Nernst equation



[30 marks]

$$[E_{\text{Cu}^{2+}, \text{Cu}}^\theta = 0.3394 \text{ V}, E_{\text{Cd}^{2+}, \text{Cd}}^\theta = -0.40224 \text{ V}, E_{\text{Zn}^{2+}, \text{Zn}}^\theta = -0.7618 \text{ V}]$$

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