



Eastern University, Sri Lanka

First Year First Semester Examination in Science-2009/2010

(May/July 2012)

External Degree

EXTCH 102 Introduction to Electrochemistry and Thermodynamics

(Repeat)

Answer all questions

Time: 01 hour

1. (a) Define extensive and intensive properties with suitable examples.

(15 Marks)

- (b) i) Derive the expression for the work done when 'n' moles of an ideal gas expand isothermally and reversibly from volume V_1 to V_2 .

(15 Marks)

- ii) Five moles of an ideal gas at the initial pressure of 1.5 atm at 10°C were expanded reversibly under isothermal conditions to a final pressure of 0.5 atm. Calculate the work done by the gas and change in internal energy. ($R=8.314\text{ J mol}^{-1}\text{ K}^{-1}$)

(25 Marks)

- (c) i) Define the term heat capacity and from the basic thermodynamic relations show

that the isobaric heat capacity (C_p) is given by $C_p = \left(\frac{\partial H}{\partial T}\right)_p$

(20 Marks)

- ii) The molar isobaric heat capacity C_p for NH_3 gas over the temperature range T_1 to T_2 is given by $C_p = a + bT + cT^2$, where T is a temperature (in Kelvin) and a , b and c are constants. Show that the change in enthalpy (ΔH) when the temperature of one mole of NH_3 gas increased from T_1 to T_2 is given by

$$\Delta H = a(T_2 - T_1) + \frac{b}{2}(T_2^2 - T_1^2) + \frac{c}{3}(T_2^3 - T_1^3)$$

(25 Marks)

Contd...

2. (a) i) Write the mathematical expression for the second law of thermodynamics.

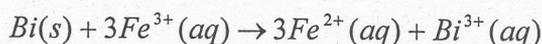
(10 Marks)

ii) Show that the entropy change (ΔS) for one mol of an ideal gas expand from volume V_1 to V_2 and temperature T_1 to T_2 is given by

$$\Delta S = C_V \ln\left(\frac{T_2}{T_1}\right) + R \ln\left(\frac{V_2}{V_1}\right)$$

(20 Marks)

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

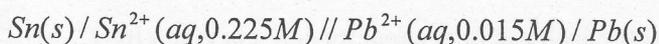


- (i) Write down the half cell reaction and identify the oxidizing agent.
- (ii) How many electrons are transferred in the redox reaction
- (iii) Represent the electrochemical cell for the cell reaction
- (iv) Calculate the standard cell potential (E_{cell}^θ) for this cell.

$$[E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^\theta = 0.771\text{V}, E_{\text{Bi}^{3+}/\text{Bi}}^\theta = 0.311\text{V}]$$

(40 marks)

(c) Determine the E_{cell}^θ and E_{cell} of the following cell:



$$[E_{\text{Pb}^{2+}/\text{Pb}}^\theta = -0.126\text{V}, E_{\text{Sn}^{2+}/\text{Sn}}^\theta = -0.140\text{V}]$$

(30 Marks)