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**

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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 J mol^{-1} 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:

$$Bi(s) + 3Fe^{3+}(aq) \rightarrow 3Fe^{2+}(aq) + Bi^{3+}(aq)$$

(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^{θ}_{cell}) for this cell.

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

(40 marks)

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

$$Sn(s)/Sn^{2+}(aq,0.225M)//Pb^{2+}(aq,0.015M)/Pb(s)$$

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

(30 Marks)
