Eastern University, Sri Lanka

First Year First Semester Examination in Science

2008/2009 (March/April 2010)

CH 102 Introduction to Electrochemistry and Thermodynamics

(Proper & Repeat)

Answer **all** questions **Time: 01 hour**

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[1].

(a) (i) Write the mathematical expression for the first law of thermodynamics

(05 marks)

(ii) 2 mole of an ideal gas ($C_V = 2.5\ R$) are maintained in a volume of 11.2 dm^3 at 273 K. The temperature of the gas is raised to 373 K. At constant volume calculate w, ΔU, q and ΔH. [Hint: $dU = C_V dT$]

(25 marks)

(iii) What would be the work done (w) at constant pressure. (10 marks)

(b) (i) Derive the Maxwel relation $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ (15 marks)

(ii) When 'n' moles of an van der Waals gas expands from V_1 to V_2, determine $\left(\frac{\partial P}{\partial T}\right)_V$ and hence show that $\Delta S = nR \ln\left[\frac{V_2 - nb}{V_1 - nb}\right]$ (30 marks)

(iii) Two moles of nitrogen gas is allowed to expand 0.5 to 10.0 liter. Calculate the change in entropy using the Van der Waals equation. Where b = 0.039 l mol^{-1}

(15 marks)

Cont..

[2].

(a) (i) Write the Clasius – Clapeyron equation and hence show that the integrated form of this equation is

$$\log\left(\frac{P_1}{P_2}\right) = \frac{\Delta H_{vap}(T_2 - T_1)}{2.303 R T_1 T_2}$$

(15 marks)

(ii) The boiling point of benzene at 1 atm is 80.1 ^{0} C. What should the pressure to distill benzene at 25 ^{0} C? The enthalpy of vaporization of benzene (ΔH_{vap}) is 30.76 kJ mol^{-1}

(20 marks)

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

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

(i) Identify the oxidizing agent in the reaction

(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.

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

(30 marks)

(c) Determine the emf of the following cell (E_{cell}) :

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

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

(35 marks)

End of Paper