

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

[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  $11.2 \text{ dm}^3$  at  $273 \text{ K}$ . The temperature of the gas is raised to  $373 \text{ K}$ . At constant volume calculate  $w$ ,  $\Delta U$ ,  $q$  and  $\Delta H$ . [Hint:  $dU = C_V dT$  ]

(25 marks)

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

(10 marks)

(b) (i) Derive the Maxwell 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  $b = 0.039 \text{ l mol}^{-1}$

(15 marks)

Cont..

[2].

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

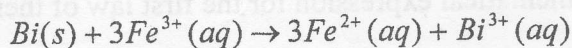
$$\log\left(\frac{P_1}{P_2}\right) = \frac{\Delta H_{\text{vap}}(T_2 - T_1)}{2.303RT_1T_2}$$

(15 marks)

- (ii) The boiling point of benzene at 1 atm is 80.1 °C. What should the pressure to distill benzene at 25 °C? The enthalpy of vaporization of benzene ( $\Delta H_{\text{vap}}$ ) is 30.76 kJ mol<sup>-1</sup>

(20 marks)

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

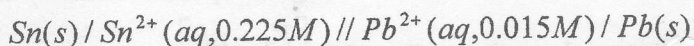


- Identify the oxidizing agent in the reaction
- How many electrons are transferred in the redox reaction
- Represent the electrochemical cell for the cell reaction
- Calculate the standard cell potential ( $E_{\text{cell}}^{\theta}$ ) for this cell.

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

(30 marks)

- (c) Determine the emf of the following cell ( $E_{\text{cell}}$ ):



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

(35 marks)

**End of Paper**