



EASTERN UNIVERSITY, SRI LANKA
FIRST SEMESTER FIRST EXAMINATION IN SCIENCE

2008/2009 (July/ August 2010)

External degree (2005/2006)

EXTCH 102 Introduction to Electrochemistry and Thermodynamics

Answer all questions

Time: one Hour

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}, 2.303 RT/F = 0.0591 \text{ V}$$

1] (a) Explain graphically the work done by the system in a reversible expansion of an ideal gas is greater than that of irreversible process. [20 marks]

(b) One mole of a gas is allowed to expand isothermally and reversibly from a volume of 1 dm^3 to 50 dm^3 at 273 K . Calculate w , q and ΔU assuming Van der Waals behaviour. Van der Waals constants are $a = 6.5 \text{ atm dm}^6 \text{ mol}^{-2}$; $b = 0.056 \text{ dm}^3 \text{ mol}^{-1}$ and $R = 0.082 \text{ atm dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$. [40 marks]

(c) i. Derive an expression for the entropy change $\Delta S = C_V \ln\left(\frac{T_2}{T_1}\right) + R \ln\left(\frac{V_2}{V_1}\right)$. [20 marks]

ii. Calculate the entropy change experienced by 2 mol of an ideal gas which is allowed to expand from an initial state of 100 dm^3 at 323 K to a final state of 150 dm^3 at 423 K . [$C_{V,m} = 4R$] 20 marks

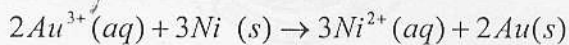
2]

(a) i. Derive the Maxwell relation $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$. [15 marks]

ii. 0.5 moles of methane expands isothermally from 1.00 l to 1.50 l . Find $\left(\frac{\partial P}{\partial T}\right)_V$ and calculate the entropy change (ΔS), assuming that methane obeys the Van der Waals equation of state. [Van der Waals constants are $a = 6.5 \text{ atm dm}^6 \text{ mol}^{-2}$; $b = 0.056 \text{ dm}^3 \text{ mol}^{-1}$ and $R = 0.082 \text{ atm dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$] [25 marks]

Cont..

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



- (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_{cell}^{θ}) for the cell.
 $[E_{Au^{3+}/Au}^{\theta} = 1.38V, E_{Ni^{2+}/Ni}^{\theta} = -0.23V]$
- (v) Calculate the cell potential (E_{cell}) for the cell when $[Au^{3+}] = 1.2 \times 10^{-6} M$ and $[Ni^{2+}] = 1.10 M$

[60 marks]