EASTERN UNIVERSITY, SRI LANKA
FIRST YEAR IN SCIENCE 2002/2003 (FIRST SEMESTER)
EXTERNAL DEGREE
EXTCH 102 THERMODYNAMICS AND INTRODUCTION TO ELECTROCHEMISTRY (2004)

ANSWER ALL QUESTIONS **Time: 1 hour**

1. a) From the fundamental equations of thermodynamics, derive the following.

(i) $dU = TdS - PdV$
(ii) $dA = -PdV - SdT$
(iii) $dG = VdP - SdT$
(iv) $dA = -PdV - SdT$

b) Derive Gibbs – Helmholtz equation $\Delta G = \Delta H + T\,(\partial(\Delta G) / \partial T)_P$

c) By using Euler's theorem, show the following.
1. $(\partial V/\partial T)_P = -(\partial S/\partial P)_T$
2. $(\partial S/\partial V)_T = (\partial P/\partial T)_V$
3. $-(\partial P/\partial S)_V = (\partial T/\partial V)_S$

2. a) O_2 gas obeys the equation of state
$(P + n^2 a /V^2)(V + nb) = nRT$
Where $a = 1.36\ l^2\ atm\ mol^{-2}$ and b=0.

Suppose two moles of $O_2(g)$ expands reversibly and isothermally at 300 K from an initial volume of 1.0 l to a final volume of 10.0 l. Calculate the work done by the gas and compare it with the work done if the above gas behaved ideally.

b) A cell consist of a Mg electrode in a 1.0 M $Mg(NO_3)_2$ solution and a Ag electrode in a 1.0 M $AgNO_3$ solution. Calculate the standard emf of this cell at 25^0 C.

$Mg^{2+}_{(aq)} + 2e \longrightarrow Mg_{(S)}$ $\quad E^0 = -2.37$ V
$Ag^{+}_{(aq)} + e \longrightarrow Ag_{(S)}$ $\quad E^0 = 0.8$ V

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