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**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.  $-(\partial P / \partial S)_V = (\partial T / \partial V)_S$

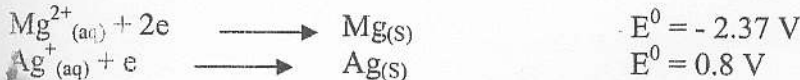
2. a) O<sub>2</sub> gas obeys the equation of state

$$(P + n^2 a / V^2) (V + nb) = nRT$$

Where  $a = 1.36 \text{ l}^2 \text{ atm mol}^{-2}$  and  $b=0$ .

Suppose two moles of O<sub>2</sub>(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<sub>3</sub>)<sub>2</sub> solution and a Ag electrode in a 1.0 M AgNO<sub>3</sub> solution. Calculate the standard emf of this cell at 25<sup>0</sup> C.



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