



EASTERN UNIVERSITY, SRI LANKA

FIRST YEAR FIRST SEMESTER EXAMINATION IN SCIENCE

2016/2017 (August – September 2018)

CH 102: Introduction to Electrochemistry and Thermodynamics

Repeat - Old Syllabus

Answer all questions

Time: 01 hour

1) a) Define the following terms

- i) Closed system
- ii) Reversible process

(10 marks)

b) A sample consisting of 2.00 moles of Ar (behave as ideal) is expanded isothermally at 0 °C from 22.4 to 44.8 L. Calculate  $q$ ,  $w$ ,  $\Delta U$  &  $\Delta H$  for the following three process (i) Reversibly (ii) against a constant external pressure equal to the final pressure of the gas (iii) freely.

(30 marks)

c) i) Starting with the first law of thermodynamics and the definitions of  $c_p$  and  $c_v$ , Show that

$$c_p - c_v = \left(\frac{\partial V}{\partial T}\right)_p \left[ p + \left(\frac{\partial U}{\partial V}\right)_T \right]$$

ii) For a gas obeying the equation of state,  $p(V - nb) = nRT$ ,

I) Find the expression of  $\left(\frac{\partial V}{\partial T}\right)_p$  and  $\left(\frac{\partial P}{\partial T}\right)_V$

II) Use the result obtained in (c) and the relation  $p + \left(\frac{\partial U}{\partial V}\right)_T = T \left(\frac{\partial P}{\partial T}\right)_V$ , show that  $c_p - c_v = nR$

(60 marks)

Contd...

2) (a) (i) Show that the Maxwell relation  $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

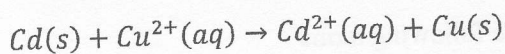
(15 marks)

(ii) For a gas follows a **van der Waals** equation of state show that

$$\left(\frac{\partial S}{\partial V}\right)_T = \frac{nR}{V-nb}$$

(20 marks)

(b) Assuming the following reaction occurs in an electrochemical cell



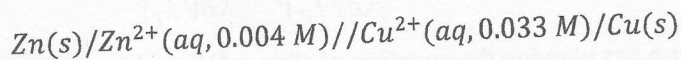
(i) What is the cell representation for the cell?

(ii) What is the standard electrode potential of the cell at 25°C?

(iii) Determine the standard change in Gibbs free energy ( $\Delta G^\theta$ ) and equilibrium constant, K of the cell 25 °C.

(35 marks)

(c) Calculate the electrode potential ( $E_{cell}$ ) of the following cell by using the Nernst equation



$$[E_{\text{Cu}^{2+},\text{Cu}}^\theta = 0.3394 V, E_{\text{Cd}^{2+},\text{Cd}}^\theta = -0.4022 V, E_{\text{Zn}^{2+},\text{Zn}}^\theta = -0.7618 V]$$

(30 marks)

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