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

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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, ΔU & ΔH 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

$$Cd(s) + Cu^{2+}(aq) \rightarrow Cd^{2+}(aq) + Cu(s)$$

(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 (ΔG^{θ}) 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

$$Zn(s)/Zn^{2+}(aq, 0.004\ M)//Cu^{2+}(aq, 0.033\ M)/Cu(s)$$

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

(30 marks)

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