EASTERN UNIVERSITY, SRI LANKA
FIRST EXAMINATION IN SCIENCE 2001/2002(May 2002)
FIRST SEMESTER
CH 102 THERMODYNAMICS AND INTRODUCTION TO ELECTRO CHEMISTRY

TIME: 01 HOUR

ANSWER **ALL** QUESTIONS.

1) Answer all three parts (a),(b) and (c)

a) Explain the following terms

i) System and surroundings

ii) Reversible process

b) Assume that a real gas A obeys the Vander waals equation of state,

$$\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$$

Show that the maximum work done (W) when 'n' moles of the gas A expands isothermally and reversibly from volume V_1 to V_2 is given by

$$W=nRT\ln\left(\frac{V_1-nb}{V_2-nb}\right)+n^2a\left(\frac{1}{V_1}-\frac{1}{V_2}\right)$$

Hence for an ideal gas show that it is given by

$$W=nRT\ln\left(\frac{V_1}{V_2}\right)$$

Contd.....

c) i) Explain what is meant by Joule – Thomson effect and write the mathematical expression for Joule – Thomson coefficient (μ_{J-T})

ii) The Joule – Thomson coefficient for nitrogen gas at 500° C and pressure between 0 – 60 atm can be represented by

$$\mu_{J-T} = 0.014 - 2.50 \times 10^{-4} P$$

Find the expected temperature drop (ΔT) when the gas is expanded from 60 atm to 20 atm.

2) Answer **both** parts (a) and (b)

a) i) By using A = A(V,T) , derive the Maxwell relation

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

ii) Using the above Maxwell relation, derive the thermodynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

(Hint: dU = TdS – PdV)

iii) Show that for an ideal gas $\left(\frac{\partial U}{\partial V}\right)_T = 0$

b) i) What is meant by ' electrode potential'

ii) Calculate the emf of a Zn – Ag cell at 30° C when activity of Zn^{2+} ions is 0.5 and activity of Ag^{+} ions is 10.

$(E^{\theta}_{Ag^+,Ag} = 0.799V, E^{\theta}_{Zn^{2+},Zn} = -0.760V)$

iii) Can a solution of 1M copper sulphate be stored in a vessel made of Nickel metal?

Given that $E^{\theta}_{Ni,Ni^{2+}} = 0.25$ and $E^{\theta}_{Cu,Cu^{2+}} = -0.34V$.

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