EASTERN UNIVERSITY, SRILANKA

FIRST YEAR IN SCIENCEFIRST SEMESTER 2002/2003

CH 102 THERMODYNAMICS AND INTRODUCTION TO ELECTROCHEMISTRY

Time: 01 Hour.

Answer all questions

1. (a) 3.0 mole of an ideal monoatomic gas at 300 K and 6 atm pressure undergoes expansion adiabatically and irreversibly to half the initial pressure against an external pressure of 3 atm. Calculate the following.

   (1) The heat absorbed (q)
   (2) The work done by the system (w) and
   (3) The change in internal energy (ΔU) for the process at constant volume.

   (b) 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.

2. (a) Derive the Clapeyron equation, $dP/dT = (\Delta H_m) / (T\ \Delta V_m)$ for a phase transition where ΔV_m isthe change in molar volume.

   If the molar volumes of liquid water and steam at 100^0C and 1 atm. are 0.019 and 30.20 dm^3 respectively, what is the change in the boiling point of water due to a change in pressure by 10 mmHg?

   (The latent heat of vapourisation (ΔH_m) of water is 40.65kJ mol^{-1}. Assume that there are no changes in molar volumes of liquid water and steam due to a change in pressure by 10 mmHg)

   (b) n moles of an ideal gas at temperature T_1 and volume V_1 undergo a reversible isothermal expansion to a final volume V_2. Derive an expression for the change in entropy (ΔS) in the above process.

   If 0.012 mol of the above gas is expanded reversibly and isothermally at 298 K from 40 ml to 100 ml, calculate the change in entropy (ΔS) for the process. (1 Pa = 1 Jm^{-3}, 1 atm = 1.01325×10^5 Pa)

(7)

(c) Write down the Nernst equation for the following redox reaction

$P^{n+}_{(aq)} + ne \longrightarrow P_{(s)}$

The standard electrode potentials of the following reactions are given below

$Pb^{2+} + 2e \longrightarrow Pb \quad E^0 = -0.13\ V$

$Zn^{2+} + 2e \longrightarrow Zn \quad E^0 = -0.76\ V$

1) Write down the total cell reaction
2) Calculate the E^0_{cell}
3) Calculate the E_{cell} of the following cell

$Zn_{(s)} / Zn^{2+}_{(aq)} (1.0\ M) // Pb^{2+}_{(aq)} (0.001\ M) / Pb_{(s)}$