EASTERN UNIVERSITY, SRI LANKA.

FIRST EXAMINATION IN SCIENCE 2005/2006 & 2006/2007 -PROPER
FIRST SEMESTER (SEPTEMBER 2007)
CH 102: INTRODUCTION TO ELECTROCHEMISTRY AND THERMODYNAMICS

Time allowed: **ONE Hour**

Answer all the questions

The use of a non-programmable calculator is permitted

[R = 8.314 J mol^{-1}K^{-1}, 2.303RT/F = 0.0591]

(1) (a) (i) Define the term 'Intensive property' *(08 marks)*

(ii) Classify the following into intensive and extensive properties (A) energy, (B) viscosity, (C) Molar volume, (D) Dipole moment (E) Specific heat capacity (F) Mass

(12 marks)

(b) Calculate the work done for an isothermal reversible expansion of 2 moles of Cl_2 gas from 1 dm^3 to 50 dm^3 at 273 K, which obeys according to (A) the Ideal gas law, and (B) the equation of state $PV = nRT + \alpha P$, where $\alpha = 0.0142$ dm^3

(35 marks)

(c) (i) Write the mathematical expression of isobaric heat capacity (C_P).

(10 marks)

(ii) One mole of methane (considered to be a perfect gas) initially at 25 °C and 1 atm pressure, is heated at constant pressure until the volume has doubled. The variation of the molar heat capacity with absolute temperature is given by

$$C_P = 22.3 + 48.1 \times 10^{-3} T$$

where C_P is in J K^{-1} mol^{-1}. Calculate the enthalpy change (ΔH)

(35 marks)

Turn over

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

(15 marks)

(ii) Show that the change in entropy (ΔS), when one mole of a van der Waals gas expands from V_1 to V_2 at a constant temperature is given by

$$\Delta S = R \ln\left(\frac{V_2 - b}{V_1 - b}\right)$$

(20 marks)

(iii) One mole of nitrogen gas is allowed to expand from 0.5 to 10 liter. Calculate the change in entropy using the van der Walls equation. Where $b = 0.039\ \text{l mol}^{-1}$.

(15 marks)

(b) (i) Write the Nernst equation for the following electrode reaction

$$Cu^{2+} + 2e \rightarrow Cu$$

(10 marks)

(ii) Calculate the electrode potential of a copper wire dipped in 0.1 M copper sulphate solution at 25 ^{o} C. At this temperature, the standard reduction electrode potential of copper is 0.34 V. Assume copper sulphate to be completely ionized and take the activity of copper ions equal to the molar concentration.

(15 marks)

(iii) Predict whether zinc and silver react with 1 M H_2SO_4 to give out hydrogen gas or not. Given that the standard reduction potentials of zinc and silver are –0.76 V and 0.80 V respectively.

(25 marks)

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