



Eastern University, Sri Lanka

First Year First Semester Examination in Science

2015/2016 (July/August 2017)

CH 102 Introduction to Electrochemistry and Thermodynamics

(Repeat)

all questions

Time: 01 hour

Gas constant (R) =  $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

$2.303 RT/F = 0.0591 \text{ V}$

1.

(a) State the first law of thermodynamics

Consider 2 moles of an ideal gas at an initial pressure of 1 atm and initial temperature of 273.15 K. Assume it expands adiabatically against a pressure of 0.435 atm until its volume doubles. Calculate the work, the final temperature, and the  $\Delta U$  of the process.

(40 marks)

(b) Derive the expression for heat capacity at constant volume ( $C_V$ ) from the first principle.

The temperature of 1.00 mol of  $O_2(g)$ , changes from  $-20.0^\circ \text{C}$  to  $37.0^\circ \text{C}$  at constant volume. Evaluate change in internal energy,  $\Delta U$  in the following cases.

i) It is an ideal gas with  $C_V = 20.78 \text{ J mol}^{-1} \text{ K}^{-1}$

ii) It is a real gas with  $C_V = 21.6 + 4.18 \times 10^{-3} T - (1.67 \times 10^5)/T^2$

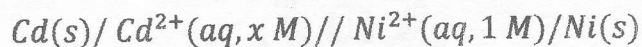
(60 marks)

2. (a) i) Derive the integrated form of Clausius – Clapeyron equation from Clapeyron equation between two sets of conditions,  $(p_1, T_1)$  and  $(p_2, T_2)$ .

ii) All liquids have characteristic vapour pressures that vary with temperature. The characteristic vapour pressure for pure water at  $22^\circ \text{C}$  is 19.827 mmHg and at  $30^\circ \text{C}$  is 31.824 mmHg. Use these data to calculate the change in enthalpy per mole for the vaporization process

(35 marks)

(c) For the following cell,

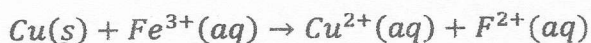


- i) Write the half-cell and cell reactions
- ii) Calculate standard electrode potential ( $E_{cell}^{\theta}$ )
- iii) If the electrode potential of the cell ( $E_{cell}$ ) is 2.4 V, determine the value

$$[E_{\text{Ni}^{2+}, \text{Ni}}^{\theta} = -0.23 \text{ V}, E_{\text{Cd}^{2+}, \text{Cd}}^{\theta} = -0.40 \text{ V}]$$

(40 m

- (d) Calculate the standard electrode potential ( $E_{cell}^{\theta}$ ), standard Gibb's energy ( $\Delta G^{\theta}$ ) and equilibrium constant K at 25°C for the following electrochemical reaction



(25 m

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