EASTERN UNIVERSITY, SRI LANKA

FIRST YEAR FIRST SEMESTER EXAMINATION IN SCIENCE

2016/2017 (AUGUST/ SEPTEMBER 2018)

CH 1013 PRINCIPLES OF CHEMISTRY -I

Answer all questions *Time: 03 hours*

Gas constant (R) = 8.314 J mol^{-1} K^{-1} $2.303\frac{RT}{F} = 0.0591$ V Faraday constant (F) = 96500 $Cmol^{-1}$

Plank's constant (h) =$6.63x10^{-34}$ Js, Velocity of light(C) = $3x10^{8}$ ms^{-1}, Mass of electron=$9.1\ x10^{-31}$ kg,

ε_o= 8.854×10^{-12} $C^2N^2m^{-2}$, e = 1.602×10^{-19} C, 1eV = 1.6×10^{-19} J

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1) a) *Define* the following terms.

i) Extensive properties ii) Adiabatic process

(10 marks)

b) i) *Write* the mathematical expression for the first and second laws of thermodynamics.

ii) 2 moles of an ideal gas (C_v = 2.5 R) is maintained in a volume of 11.2 dm^3 at 273 K. The temperature of the gas is raised to 373 K. *Calculate* w, ΔU, q , and ΔH at constant volume

iii) *Calculate* the work done for an isothermal reversible expansion of 3 moles of Hydrogen gas from volume 2 dm^3 to 100 dm^3 at 273 K, which obeys to the equation of state $P\ (v - \beta) = nRT$ where β is a constant and its value is 0.015 dm^3.

(50 marks)

Contd.

c) i) Using the first and second laws of thermodynamics *show that* the entropy cha[nge] on heating of 'n' moles of substance reversibly from temperature T_1 to T_2 at [constant] volume is,

$$\Delta S = C_v \ ln\left(\frac{T_2}{T_1}\right)$$

Assume that C_v is independent of temperature.

ii) *Calculate* the entropy change (ΔS) of 2 moles of an ideal gas (C_v = 2.5 R) at [...] heated to $127\,^0$C

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d) *Show that* the following auxiliary relations for a reversible process.

i) $dA = -SdT - PdV$

ii) $dH = TdS + VdP$

(2

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

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

iii) Using the above Maxwell relation, *derive* the thermodynamic equation of s[tate]

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P \quad (Hint: dU = TdS - PdV)$$

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

b) The following redox reaction occurs in a cell:

$$Mg(s) + Sn^{2+}(aq) \rightarrow Mg^{2+}(aq) + Sn(s)$$

i) *Write* the half-cell reactions.

iii) *Represent* the electrochemical cell

iv) *Calculate* the standard electrode potential E^{θ}_{cell} for this cell at 298 K.

v) *Calculate* the change in standard Gibb's free energy (ΔG^{θ}) at 298 K.

($E^{\theta}_{Mg^{2+},\ Mg}$ = - 2.37 V, $E^{\theta}_{Sn^{2+},\ Sn}$ = - 0.14 V)

Con[td]