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MAIN EXAMINATION

MAY – JULY 2016 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

SCHOOL FOCUSED PROGRAMME

CHEM 201: PHYSICAL CHEMISTRY II

Date: JULY 2016	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions	

Q1. a) Define the following terms as used in thermodynamics

i Isolated systems
ii State of a system
iii Extensive property
iv Reversible process
v Heat reservoir **(10 marks)**

b) A 0.5 mol of an ideal gas of 25^0C was compressed reversibly and isothermally from a volume of 100 ML to 80ML. Calculate

i The work done **(2 marks)**
ii Heat change **(1 mark)**
iii Internal energy change **(1 mark)**
iv Enthalpy change **(1 mark)**
v Entropy change **(2 marks)**
vi Gibb's free energy change **(2 marks)**

c) Determine the enthalpy change for the reaction

$2C_6H_{6(l)} + 15O_{2(g)} \longrightarrow 12CO_{2(g)} + 6H_2O_{(s)}$ given the following data

Component	ΔHf / Kj mol^{-1}
$CO_{2(g)}$	-393.5
$H_2O_{(c)}$	-285.8
$C_6H_{6(l)}$	48.6

(5 marks)

d) At O^0C and 1atm pressure the volume of a 1.5 mol of an ideal monoatomic gas is 33.63 L. The gas was expanded until its pressure was 0.60 atm by a reversible adiabatic process. Determine the final volume given that $C_v = {}^3/_2\ R$ **(6 marks)**

Q2. a) Calculate the standard free energy change for ammonia sysnthesis at 25^0C for the following sets of partial pressures 0.30 atm N_2, 1.2 atm H_2 and 1.6 atm NH_3 **(6 marks)**

b) i What is a carnot cycle? **(2 marks)**

ii A 0.5 mol of an ideal perfect gas was taken through a carnot cycle. Determine w, q, ΔE,ΔH and Δs for each of the step involved between the hot temperature Tn and the cold temperature Tl. **(10 marks)**

iii Express the efficiency of the carnot engine as a function of the temperatures. **(2 marks)**

Q3. a) Using the parth method or otherwise, derive the Kirchsff's equation and define all the terms. **(10 marks)**

b) i Describe the Joule Thompson experiment on gas expansion. **(6 marks)**

ii Using the above experimental results show that $dE = C_v dT$ and $dH = cpdT$ for 1 mol of an ideal gas. **(4 marks)**

Q4. a) Explain how the signs and magnitudes of ΔH and ΔS may be used to predict the spontaneity of a chemical process of various temperatures. **(10 marks)**

b) 4.8g of Magnesium ribbon was reacted with 500ML of a 0.8M $Hcl_{(aq)}$ solution at 25^0C. Calculate the work done if the reaction was carried out.

i In a vacuum **(2 marks)**

ii In a closed vessel of fixed volume **(2 marks)**

iii In an open beaker **(6 marks)**

(Mg = 24, Cl = 35.5, H = 1)

Q5. a) Using the 1st and 2nd laws of thermodynamics show that for a reversible expansion of an ideal gas $\Delta S = \int C_v dInT + \int RdInV$ **(10 marks)**

b) Given that PV^r = constant for adiabatic process, show that the work done in a reversible adiabatic expansion of 1 mol of an ideal gas is given by

$w = -\frac{R}{r-1}\left(T_f - T_i\right)$ **(10 marks)**