KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
SUPPLEMENTARY/SPECIAL EXAMINATIONS

FOR THE DEGREE OF B.Sc. (CHEMISTRY)

COURSE CODE: **SCH 213**

COURSE TITLE: **BASIC CHEMICAL THERMODYNAMICS**

DATE: **18/7/2022** **TIME:** **8:00AM-10:00AM**

INSTRUCTIONS TO CANDIDATES:

TIME: 2 Hours

Answer **Question ONE** and **any TWO** of the remaining

QUESTION ONE (30 Marks)

(a) Define the following terms

i. Process **(2Marks)**

ii. Work **(2Marks)**

iii. Heat **(2Marks)**

iv. Reversible process **(2Marks)**

(b) Deduce the numerical values of gas constant R using ideal gas equation $pv = nRT$ **(3Marks)**

(c) (i) State the Hess's law **(2marks)**

(ii) . From the following enthalpies of reaction

$H_{2\,(g)} + F_{2\,(g)} \rightarrow 2HF_{\,(g)}$ $\Delta H = -537$ kJ

$C_{(s)} + 2\,F_{2\,(g)} \rightarrow CF_{4\,(g)}$ $\Delta H = -680$ kJ

$2\,C_{(s)} + 2\,H_{2\,(g)} \rightarrow C_2H_{4\,(g)}$ $\Delta H = -52.3$ kJ

Calculate the ΔH for the reaction of $C_2H_{4\,(g)}$ with $F_{2\,(g)}$ to make $CF_{4\,(g)}$ and $HF_{\,(g)}$ **(3marks)**

(d)(i) Starting with $E = q + W$, show that the heat capacity at constant pressure is given by $C_p = (\frac{dH}{dT})$ **(4Marks)**

(e) (i) Define a system **(2Marks)**

(ii)State the three thermodynamic systems **(3Marks)**

(f)Using $E = ½mv^2$ show that kinetic energy of a system is given by $E_k = \frac{3}{2}RT$ **(5Marks)**

Question Two (20 Marks)

(a)Using the first law of thermodynamics $(dE = dq + dw)$, show the specific heat capacity at constant pressure is given by $C_p = \left(\frac{dH}{dT}\right)$ **(10Marks)**

(b) Using the ideal gas equation. Derive and state the physical significance of gas constant R **(5 marks)**

(c) Show that $C_p - C_v = 1$ **(5 marks)**

QUESTION THREE (20 Marks)

(a) (i) Using $E = q + W$, show that $\left(\frac{T_2}{T_1}\right) = \left(\frac{V_1}{V_2}\right)^{\propto -1}$ for reversible adiabatic expansion **(10Marks)**

(ii) 2 moles of ideal gas 300K is compressed adiabatically to ¼ of the original volume. Find temperature of the gas after compression $(C_v = 12.5jk^{-1}mol^{-1})$ **(10Marks)**

QUESTION FOUR (20 Marks)

(a) (i) State the Carnot theorem **(2Marks)**

(ii) Using the efficiency of the transformation of heat into work in a heat engine, show that $\frac{q_2}{T_2} + \frac{q_1}{T_1} = 0$ **(10Marks)**

(iii) From $\Delta S = C_v ln\frac{T_2}{T_1} + Rln\frac{V_2}{V_1}$ for one mole of a gas when temperature and volume are variables deduce the equation for entropy changes when pressure and temperature are variables **(8Marks)**

QUESTION FIVE (20 Marks)

(a) Calculate the standard Gibbs free energy for the reaction at 25°C **(5Marks)**

$H_{2(s)} + ½O_{2\,(g)} \rightarrow H_2O_{\,(g)}$

$(\Delta H^o = -285.64 kJmol^{-1}, \Delta S = 1.89 jK^{-1})$

(b) (i) State the second law of thermodynamics **(2Marks)**

(ii) Define the term entropy **(2Marks)**

(iii) Using the information given below, calculate the entropy of the reaction $2CO_{(s)} + O_{2\,(g)} \rightarrow 2CO_{2\,(g)}$ at 25°C **(6Marks)**

	$S^\theta jK^{-1}mol$
CO_2	148
CO	47
O_2	205

(c) (i) What is a state variables **(2Marks)**

(ii) State any three examples of state variables **(3Marks)**