TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY (INDUSTRIAL OPTION)

BTAC 15S SEPT 2015

PHYSICAL CHEMISTRY II   ACH 4208
END OF SEMESTER EXAMINATION

SERIES: DEC 2016

TIME:2 HOURS

DATE:

<u>**Instructions to Candidates**</u>

You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of FIVE questions. Attempt Question one compulsory and any other two question
Do not write on the question paper.

Paper two

QUESTION ONE

A. Define
   i.   standard enthalpy of formation   (iii) Liquefaction of gases
   ii.   activity of ideal gases   **(iv)** heat capacity   **8 marks**

B. At 20^0C the standard EMF of the cell $Hg|Hg_2Cl_2(s) | HCl(aq)$ H2, Pt is 0.2692V and at 30^0C it is 0.2660V. Find the values of change in free energy, Enthalpy of reaction and entropy change at 25^0C.
   Reaction is $0.5Hg_2Cl_2(s) + 0.5H_2(g)$ $Hg(l) + HCl(aq)$ **7 marks**

C. Calculate   the standard free energy change for the following reaction at25°c . Given standard enthalpies of formation of $Fe_2O_3(g)$, $CO(g)$, Fe(S) and $CO_2(g)$ as -824.3, -110.5,0 and 393.5 Kilojoules per mole respectively wile Entropies of $Fe_2O_3(g)$, CO(g), Fe(S) and $CO_2(g)$ as 87.4, 197.6, 27.3 and 213.6 joules per kilo mole respectively.
   $Fe_2O_3(g)$ + $CO(g)$⟶   Fe(S)   + $CO_2(g)$ **8 marks**

D. Sketch phase diagram for a substance X (not specific substance) dissolve in ice using the following data and identify Eutectic and congruent melting points   **7 marks**

Composition in mole percent	20	30	25	35
Temperature ^{0}C	-20	-10	5	10
Compound			X .$4H_2O$	X. $2H_2O$

QUESTION TWO

A. Differentiate between Incongruent melting and Congruent melting **4 marks**

B. During combustion of 1.5 grams of Naphthalene $C_8 H_{10}$ in constant volume colorimeter, temperature of 1500 grams water rose from 15.17°C to 22.84°C. given heat capacity of Naphthalene as 1.8×10^3 Joules /°C and specific heat of water as 4.184J/°C.g calculate Molar Enthalpy of combustion of Naphthalene **6 marks**

C. Differentiate between path function and state function **3 marks**

D. Given standard enthalpies of formation of $NH_4NO_3(s)$, NH_4^+ (aq), NO_3^- (aq) as -365.56, -132.51 and -205.0 Kilojoules per mole respectively and standerd Entropies of $NH_4NO_3(s)$, NH_4^+ (aq), NO_3^- (aq) as 151.08, 113.4 and 146.4 joules per kilo mole respectively Calculate standard free energy change at 25°c for the reaction :

*Reaction $NH_4NO_3(s) + H_2O(l) \rightarrow NH_4^+ (aq) + NO_3^- (aq)$* **7 marks**

QUESTION THREE

A. Given partial pressures at 300 kelvin fo the following equilibrium as $CH_4(g)$ as 0.320, $CS_2(g)$ as 0.252 , H_2S as 0.125 and $H_2(g)$ as 0.1 Calculate change in free energy and Predict if below equilibrium is spontaneous or non spontaneous

Reaction $CH_4(g) + 2H_2S (g) \rightleftharpoons CS_2(g) + 4H_2(g)$ **6 marks**

B. Outline the importance of gas Liquefaction **4 marks**

C. Change in free energy and entropy During adiabatic isothermal compression of one mole of an ideal gas at 300 kelvin from 101.3 KPa to 10.13MPa.calculate y. **4 marks**

D. Calculate the enthalpy of formation of KOHs **6 marks**

$$K_s + O_2 + H_{2g} \longrightarrow KOH_s$$

Using the following data

I.	$2K_s + 2 H_2O_l \longrightarrow 2KOH_{aq} + H_{2g}$		$\Delta H_1 = -376.6Kj$
II.	$2 H_{2g} + O_2 \longrightarrow 2 H_2O_l$		$\Delta H_2 = -577.4Kj$
III.	$2KOH_s + aq \longrightarrow KOH$		$\Delta H_3 = -58.58Kj$

QUESTION FOUR

A. The critical constant of chlorine are Pc = 45.0 atmospheric and Vc =275.8 L per mol calculate Vander Waals constants a and b **4 marks**

B. Two liquids A and B form ideal solution. At 300 K, the vapour pressure of a solution containing 1 mole of A and 3 moles of B is 550 mm of Hg. At the same temperature, if one more mole of B is added to this solution, the vapour pressure of the solution increases by 10 mm of Hg. Determine the vapour pressure of A and B in their pure states. **6 marks**

C. At 30 °C combustion of hydrocarbon at constant pressure release 515.3kj determine
   Work done

       Reaction $C_X H_{N(L)} + 12 O_{2(g)} \longrightarrow 6CO_{2(g)} + 5 H_2O_{(L)}$ **6marks**
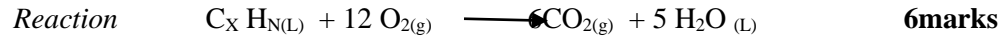
   D. state Joule-Thomson effect   **4 marks**

QUESTION FIVE

A. An aqueous solution containing 28% by mass of a liquid A (moleculer Mass = 140) has a vapour pressure of 160 mm at 37°C. Find the vapour pressure of the pure liquid A. (The vapour pressure of water at 37°C is 150 mm).   **6 marks**

B. Define
   i.   Equilibrium thermodynamics
   ii.   Non-equilibrium   **5 marks**

C. Sketch a well label diagram of water showing all phases at equilibrium   **6 marks**

D. state zeroth law of thermodynamics   **3 marks**