

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

ACH 4208 PHYSICAL CHEMISTRY II
END OF SEMESTER EXAMINATION

SERIES: DEC 2016

TIME: 2 HOURS

DATE:

Instructions to Candidates

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 one

QUESTION ONE

- A. Sketch a well labeled phase diagram of sodium chloride - water system and identify Eutectic point, Congruent point, Incongruent point and Phase boundaries. **5 marks**
- B. Define (i) standard enthalpy of formation (ii) Liquefaction of gases **4 marks**
- C. Differentiate between work in reversible and in irreversible process **3 marks**
- D. State characteristic of Eutectic point **3 marks**
- E. 1.22 grams of benzene C_6H_6 was burnt in constant volume calorimeter. Consequently the temperature of water rose from $15.17^\circ C$ to $22.84^\circ C$. If the quantity of water was 1500 grams and heat capacity of bomb calorimeter was 1.75×10^3 Joules / $^\circ C$. Calculate Heat of reaction on molar basis given specific heat of water as $4.184 J/^\circ C.g$ **5 marks**
- F. Calculate vapour pressure of water at 298 Kelvin given enthalpy of vaporization at normal Bp as $410.26 J/mol$ **5 marks**
- G. Calculate activity of the following cell at $25^\circ C$. **5 marks**
- $$Sn_s + Cu_2^+ \longrightarrow Sn_2^+ + Cu_s \quad E^0 = 0.29V$$

QUESTION TWO

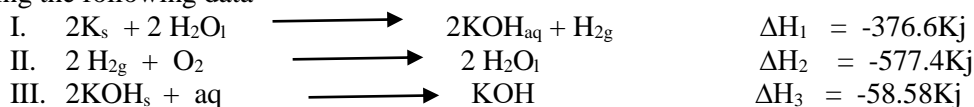
- A. Explain different methods of liquefying gases **6 marks**

- B. Given ΔH_f° of Ag_2O_s as -30.536KJ per mol and ΔS° as 132.18 Joules per kelvin Predict whether the process $2\text{Ag}_2\text{O}_s \longrightarrow 4\text{Ag}_s + \text{O}_{2g}$ is spontaneous at 298 kelvin. **6 marks**
- C. At 20°C the standard EMF of the cell $\text{Hg}, \text{Hg}_2\text{Cl}_2(s) | \text{HCl}(aq) | \text{H}_2(g) | \text{Pt}$ is 0.2692V and at 30°C is 0.2660V . Find the values of ΔG and hence ΔS at 25°C .
The cell reaction is $0.5\text{Hg}_2\text{Cl}_2(s) + 0.5\text{H}_2(g) \leftrightarrow \text{Hg}(l) + \text{HCl}(aq)$ **5 marks**
- D. State second and first laws of thermodynamics **3marks**

QUESTION THREE

- A. Differentiate between Entropy and free energy **4 marks**
- B. State :-
i. The Phase Rule **3marks**
ii. Limitation of Second law of thermodynamics **2 marks**
- C. Calculate Enthalpy of formation of benzene from heat of combustion of liquid benzene which is -630.31 per mole. Given enthalpy of formation of CO_2 and H_2O as -393.5 and -285.85 kilo joules respectively. **5 marks**
- D. Calculate the enthalpy of formation of KOH_s **6 marks**
 $\text{K}_s + \text{O}_2 + \text{H}_{2g} \longrightarrow \text{KOH}_s$

Using the following data



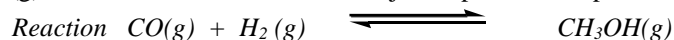
QUESTION FOUR

- A. State Zeroth law of thermodynamics **2 mark**
- B. Given enthalpy change at 25°C as 49.03 kilojoules per mole and standard entropy change as -253.1 joules per kelvin per mole predict if the reaction is spontaneous or non spontaneous **6marks**
- C. Determine Work done At 25°C for combustion of hydrocarbon at constant pressure if it releases 515.3kJ of heat **4 marks**
- D. Define Fractional crystallization **2 marks**
- E. Briefly explain Liquefaction of gases by Linde's Process **6 marks**

QUESTION FIVE

Derive an equation to Show that molar heat capacities measured at constant volume is less than molar heat capacities measured at constant pressure **6 marks**

Calculate equilibrium constant for the following reaction at 25°C . Given standard enthalpies of formation of $\text{CH}_3\text{OH}(g)$, $\text{CO}(g)$ and $\text{H}_2(g)$ as 161.9 , -110.5 and 130.6 Kilojoules per mole respectively. **6 marks**



Calculate Enthalpy of sublimation of ice given vapor pressures of ice at 268K and 273K as 2.965 and 4.560 pascal respectively. **5 marks**

State importance of Liquefaction of gases **3 marks**