TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ANALYTICAL CHEMISTRY

DAC 14S

ACH 2210: Chemical Thermodynamics and Phase Equilibrium

END OF SEMESTER EXAMINATION

SERIES:APRIL2016

TIME:2HOURS

DATE: Pick DateSelect MonthPick Year

<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. Attemptquestion ONE (Compulsory) and any other TWO questions.
Do not write on the question paper.

$R = 8.314 J/mol/K$, $1 \, atm = 101\,325 \, Nm^{-2}$

Question ONE

a) Differentiate between isothermal and adiabatic process (4 mark)

b) When one mole of a liquid benzene is completely burnt in oxygen to form liquid water and carbon dioxide gas, $\Delta H = -3264.58 Kj$ at 298K calculate the enthalpy of reaction at constant volume at the same temperature (6marks)

c) Determine the change in entropy for the following reactions
 i) $C_2H_{2\,(g)} + H_{2\,(g)} \longrightarrow C_2H_{4\,(g)}$ (3marks)
 ii) $2C_{(s)} + 3H_{2\,(g)} \longrightarrow C_2H_{6\,(g)}$ (3marks)
 given entropies of $C_2H_2 = 200.82$, $C_2H_4 = 219.45$, $C_2H_6 = 229.49$, $C = 5.69$, $H = 130.59$ in $Jmol^{-1}K^{-1}$

d) A sample of titanium is heated with an electric coil. If 102 joules of energy are added to a 12.4 g sample and the final temperature is 37.2^0C, calculate the initial temperature of the titanium. Heat capacity of titanium is $0.523 \, J/g^0C$ (4 marks)

e) Sketch a well labeled schematic flow diagram of heat engine (4marks)

f) State briefly the thermodynamic meaning of the following terms: system, surrounding
    and universe   (6 marks)

Question TWO

a) Outline with the help of a diagram the compression of a gas and prove the work done
   by compression is positive   (6 marks)
b) Differentiate between molar heat capacity and specific heat of a substance   (4 marks)
c) sketch the density-temperature diagram ear 0oc showing clearly the anomalous behavior of water
   and explain the behavior   (5marks)

Question THREE

a) When one mole of a water at STP and 1 atm is converted to steam at $100^{\circ}C$ the amount
    of heat absorbed is 40670J calculate change in energy   (6marks)
b) The volume of a sample of an ideal monatomic gas at $0^{\circ}C$ is 44.83L to what volume
    must the gas be compressed adiabatically so as to attain a temperature of $30^{\circ}C$ (4marks)
c) The boiling point of water at pressure of 50 atm is $265^{\circ}C$ and at 1 atm its $100^{\circ}C$ assuming
    the temperature of the sink is $40^{\circ}C$ compare the theoretical efficiencies of a steam engine
    operating between the boiling point of water and that of the sink at
        a) 1 atm   (2.5 marks)
        b) 50 atm   (2.5 marks)

Question FOUR

a) The molar enthalpies of combustion of ethene, hydrogen and ethane are -1411.59J,
    -285.56J and -1558.85J respectively at 298K determine the enthalpy o formation of ethane (7marks)
b) One mole of an ideal monatomic gas at STP is heated at constant volume to a temperature of 323K
    determine the change in entropy for the process   (4marks)
c) Name any FOUR conditions required for compression of a gas in a cylinder   (4 marks)

Question FIVE

Explain how water's phase diagram differs from that of carbon dioxide gas (15marks)