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

Instructions to Candidates

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

Question ONE

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

b) Define the first law of thermodynamics and right the differential form of the law (3 marks)

c) Differentiate between molar heat capacity and specific heat of a substance (4 marks)

d) $3dm^3$ of hydrogen initially at STP are expanded isothermally and reversibly to a volume of $4dm^3$ calculate the work done (4marks)

e) 0.1 mole of an ideal gas expanded isothermally at 273K from 3dm3 to 5dm3 determine the energy absorbed from the surrounding (4marks)

f) Give the meaning of the following thermodynamic concepts (4 marks)

i) System

ii) Surrounding

iii) Extensive property
iv) Intensive property

g) The molar heat of fusion and vaporization of benzene are $10.9K^{-1}mol^{-1}$ and $31K^{-1}mol^{-1}$ respectively calculate the enthalpy change for the solid to liquid and liquid to vapour transition of benzene at 1 atm benzene melt at 5.5^oC and boils at 80.1^oC (5marks)

Question TWO

a) When one mole of a water at STP and 1 atm is converted to steam at 100^oC 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^oC is 44.83L to what volume must the gas be compressed adiabatically so as to attain a temperature of 30^oC (4marks)

c) The boiling point of water at pressure of 50 atm is 265^oC and at 1 atm its 100^oC assuming the temperature of the sink is 40^oC 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 THREE

a) Classify the following systems as open, closed or isolated

i) Nitrogen and hydrogen reacting to form ammonia in a sealed tube (1mark)
ii) Potassium chlorate and manganese dioxide are heated in unsealed test tube to form potassium chloride and oxygen (1mark)

b) Consider isochloric (change in V= 0) in which the pressure of a 2.35 mole sample of ideal gas changes from 1.60 atm at 197K to 2.70 atm. The final temperature during the change is 332K and C_V for the gas is 3/2R. Calculate q, w, change in E, and change in H for the process (7 marks)

c) Outline with the help of a diagram the compression of a gas and prove the work done by compression is positive (6 marks)

Question FOUR

a) Two moles of an ideal gas at STP are heated at constant volume to a temperature of 350K determine the increase in entropy for the system Cv = $12.47J^{-1}mol^{-1}K^{-1}$ (4marks)

b) sketch the density-temperature diagram ear 0oc showing clearly the anomalous behavior of water and explain the behavior (6marks)

c i) state the second law of thermodynamic (2marks)

ii) explain why heat engine with 100% efficiency would violate the second law of thermodynamic (3mrks)

Question FIVE

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