TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF PURE & APPLIED SCIENCES

DIPLOMA IN SCIENCE LABORATORY & TECHNOLOGY (DSLT 12J)

ACH 2209: CHEMICAL THERMODYNAMIC & PHASE DIMENSION

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: JUNE 2013
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*

This paper consist of **FIVE** questions

Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Define Helmholtz and Gibbs free energy **(4 marks)**

b) When one mole of water at 100°C and latim pressure is converted to steam at 100°C the amount of heat observed is 40, 670. Calculate DE **(6 marks)**

c) 0.1 mole of an ideal gas is expanded isothermally at 273K from $3dm^3$ to $5dm^3$, determine the energy. **(4 marks)**

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

e) Two moles of an ideal gas at STP are heated at constant volume to temperature of 350K determine the increase in entropy for the system Cv = 12.475 $mol^{-1}k^{-1}$ **(4 marks)**

f) Calculate the change in free energy when $11.21dm^3$ of the perfect gas at 0°C and 760mmHz pressure expanded isothermally until its pressure is 190 mmHz **(4 marks)**

g) Differentiate between open and isolated system **(4 marks)**

Question Two

a) The molar heat of fusion and evaporization of senzene are 10.9w/mol and 31.0w/mol respectively. Calculate the entropy change for the solid – liquid and liquid – vapour transition for senzene at latim pressure, senzene meat at 5.5°C and boils at 80.1°C **(6 marks)**

b) Calculate the standard enthrophy or reactin at 125°C for the reaction.

$Na(s) + 3H_2(s) \quad - \quad 2NH_3(s)$ **(7 marks)**

$\Delta H^o 298 = -92.2k \ \ at \ 25^o C$

Value of molar heat capacities at constant pressure are given below.

Substance	Cp ($jk^{-1} mol^{-1}$)
CH_2	$(29.038 - 0.836 \times 10^{-3} T + 20.097 \times 10^{-7} T^2)jk^{-1}$
CN_2	$(26.957 + 5.906 \times 10^{-3}T - 3.373 \times 10^{-7} T^2)\ jk^{-1}$
CNH_3	$(25.870 + 32.968 \times 10^{-3}T - 30.430 \times 10^{-7} t^2)jk^{-1}$

c) State the first law of thermodynamic **(2 marks)**

Question Three

a) The equilibrium constant Kp for the reaction

$Na(s) + 3H_2(s)$ - $2NH_3(s)$ is 1.64×10^{-4} at 673K and 1.44×10^{-5} at 773K determine the ΔH_f mean enthropy of formation for one mole of ammonia from in element in this temperature range. **(8 marks)**

b) The boiling point of water at pressure of 50 atom is 265°C and at latim its 100°C, assuming the temperature of the sink is 40°C. Compare the theoretinc efficiencies of a steam engine operating between the boiling point of water and that of the sink at

(i) 1 atom

(ii) 50 atom **(7 marks)**

Question Four

a) State the thermo chemical laws associated with less and Kirchoff and show their thermodynamic basis. **(6 marks)**

b) Differentiate between isothermal and adiabatic system. **(4 marks)**

c) Estimate the heat of formation of HCL given that:

ΔH^o $431 kjmol$

H-CL - H +CL

ΔH^o $436 kjmol$

H-CL - 2H

ΔH^o $243 kjmol$

CL-CL - 2CL

Question Five

Illustrate water phase diagram and explain how it differs from those of other substance. **(15 marks)**