



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: APRIL 2016

TIME: 2 HOURS

DATE: Pick Date Select Month Pick 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. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

$R = 8.314 \text{ J/mol/K}$, $1 \text{ atm} = 101325 \text{ Nm}^{-2}$

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, $\Delta H = -3264.58 \text{ kJ}$ at 298 K calculate the enthalpy of reaction at constant volume at the same temperature (6 marks)
- c) Determine the change in entropy for the following reactions
- i) $\text{C}_2\text{H}_2(\text{g}) + \text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_4(\text{g})$ (3 marks)
- ii) $2\text{C}(\text{s}) + 3\text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_6(\text{g})$ (3 marks)
- given entropies of $\text{C}_2\text{H}_2 = 200.82$, $\text{C}_2\text{H}_4 = 219.45$, $\text{C}_2\text{H}_6 = 229.49$, $\text{C} = 5.69$, $\text{H} = 130.59$ in $\text{J mol}^{-1} \text{ K}^{-1}$
- 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°C , calculate the initial temperature of the titanium. Heat capacity of titanium is $0.523 \text{ J/g}^\circ\text{C}$ (4 marks)
- e) Sketch a well labeled schematic flow diagram of heat engine (4 marks)

- 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°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°C is 44.83L to what volume must the gas be compressed adiabatically so as to attain a temperature of 30°C (4marks)
- c) The boiling point of water at pressure of 50 atm is 265°C and at 1 atm its 100°C assuming the temperature of the sink is 40°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)