NATIONAL OPEN UNVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE & APPLIED SCIENCES
SEPTEMBER, 2020_1 EXAMINATION QUESTIONS

CHM 405-CHEMICAL THERMODYNAMICS

Credit Unit:2

Duration 2 hours

INSTRUCTION: Answer question 1 and any other three questions.

Instruction: Unless otherwise stated, the following constants should be used: Standard temperature =298 K, Standard pressure = 102325 Nm^2, R = 8.314 J/K/mol)

QUESTION 1

1(a) What is equation of state and state function in equation of state? **(2 marks)**
(b) State the gas laws that are applicable to the following conditions:
(i) Constant temperature and mass of a gas **(1.5 mark)**
(ii) Constant pressure and mass of a gas **(1.5 mark)**
(c) Write and expression for Van der Waal equation of state **(1 mark)**
(d) In an automobile combustion cylinder, fuel-air mixture in a cylinder of 1000 cm^3 capacity experiences a temperature rise from 25 to 2200 □C before and after combustion. Calculate the peak pressure given that normal atmospheric pressure is 101325 P **(3 marks)**
(e) Using one sentence for each, highlight the three major types of intermolecular forces that operates in molecules **(3 marks)**
(f) Given a thermodynamic function expressed as $y = f(x, z)$, write an equation to represent its exact differential. **(2 marks)**
(g) Define the terms, thermodynamic system and boundary. **(2 marks)**
(h) List the three major groups of thermodynamic processes. **(3 marks)**
(i) State the first law of thermodynamics and show that the heat absorbed at constant pressure is equal to change in enthalpy. **(6 marks)**

QUESTION 2
2(a) What is entropy? **(1 mark)**
(b) Using the reaction of oxygen with hydrogen as an example, highlight four features of thermochemical equations **(6 marks)**
(c) State Laplace and Hess laws of thermochemistry. **(3 marks)**
(d) Draw a diagram to show the pattern expected for the variation of order number,Ω with microstate. **(3 marks)**

(e) What are the features of Maxwell-Boltzmann statistics with respect to distinguishability of particle? **(2 marks)**

QUESTION 3

3.(a) State Dalton law of partial pressure and write a mathematical equation for the law **(3 marks)**

(b) Calculate the volume of 1 mole of an ideal gas at 1 atm pressure and at) °C. What conclusion can you draw from your results **(4 marks)**

(c) A mixture of 6.5 mol of hydrogen gas and 3.5 mol of oxygen gas was placed in a 3 m^3 container at 273 K. Calculate the partial pressures of the individual gases and the total pressure **(8 marks)**

QUESTION 4

4. (a) Based on forces of attraction, how would you classify intermolecular forces **(3 marks)**

(b)(i) A given gas mixture consists of 2.24 mol of nitrogen and 1.37 mol of oxygen; Use the ideal gas equation to calculate the total pressure of 10 m3 of the gas mixture at 273 K. **(4 marks)**

(ii) Use the mole fraction of the respective components of the gas mixture to calculate the corresponding partial pressures. **(3 marks)**

(c) Differentiate between inter molecular and intramolecular forces **(1 marks)**

(d) State three properties of entropy **(3 marks)**

(e) State the zeroth law of thermodynamics **(1 mark)**

QUESTION 5

5.(a) What is dipole-dipole interaction and its effect on the potential energy **(2 marks)**

(b) Consider a piston (whose cross-sectional area is A), compressing a gas (at pressure, P and volume, V). If the piston moves a distance called dx. Show that the work done by the piston can be expressed as, $W = P(V_2 - V_1)$ **(5 marks)**

(c) Derive an expression for the work done in isothermal expansion of an ideal and real gases **(5 marks)**

(d) If the volume of 2 mol of an ideal gas change from 40 to 400 m3 at 296 K, calculate the work done during the isothermal expansion of the gas. **(3 marks)**