National Open University of Nigeria
Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi - Abuja
Faculty of Science
2021_2 Examination Questions

COURSE CODE: CHM405   **TIME ALLOWED: 2 Hours**

COURSE TITLE: CHEMICAL THERMODYNAMICS   **CREDIT: 2 Units**

Instruction: Answer question 1 and any other three questions
QUESTION 1

a. Define the following:

i. Thermodynamics   **1 ½ marks**

ii. Chemical thermodynamics   **1 ½ marks**

iii. What are the major objectives of chemical thermodynamics? **2 marks**

b. i. What is an equation of state?   **2 marks**

ii. State the Boyle's law   **(2 Marks)**

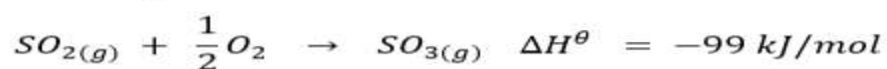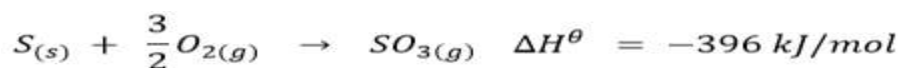c. Derive the following equations

i. Gibbs-Duhem equation   **5 marks**
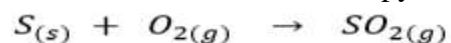
ii.. Clausius-Clapeyron   **6 ½ marks**

d. i. Describe the effect of inter and intra molecular forces on the various physical states of water
            2 ½ marks

ii. Given the following thermochemical equations,

$$S_{(s)} + \frac{3}{2} O_{2(g)} \rightarrow SO_{3(g)} \quad \Delta H^\theta = -396 \, kJ/mol$$

$$SO_{2(g)} + \frac{1}{2} O_2 \rightarrow SO_{3(g)} \quad \Delta H^\theta = -99 \, kJ/mol$$

Calculate the standard enthalpy change for the reaction;

$$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$$
            3 marks

QUESTION 2

a. Explain the following major types of intermolecular forces that operate between molecules;   6 marks

i. Ion-induced dipole forces

ii. Ion-dipole forces

iii. Van der Waals forces

b. Explain how the London force or induced dipole-induced dipole interaction operates in atom or molecules with non-zero dipole moments.   4 marks

c. i. State the third law of thermodynamics   **(2 Marks)**

iii. What is main application of the third law of thermodynamics?   **(1 Mark)**

iv. Which one is stronger between intermolecular forces and intra molecular forces? Why?   2 marks

QUESTION 3

a. i. State the Dalton's law of partial pressure   **(2 Marks)**

ii. What is the mathematical representation of Dalton's law?   **(2 Marks)**

b. Explain the terms of partial molar quantity with examples.   **6 marks**

c. Explain the following;

i. cyclic process   **2 ½ marks**

ii. phase   **2 ½ marks**

QUESTION 4

a. i. What is Van der Waal equation of state?   **2 marks**

ii. Give reasons why the London force is said to be universal among all intermolecular forces   **1 ½ mark**

iii. What is the mathematical expression of Van der Waal equation?   **1 ½ marks**

iv. Describe the relationship between the ideal gas equation and the Van der Waals equation of state Solution   **3 marks**

b. i. What is a state function?   **2 marks**

ii. What is a thermodynamic process?   **2 marks**

c. Describe the following;

i. Heat   **1 ½ marks**

ii. Work   **1 ½ marks**

QUESTION 5

a. Mention and explain the major types of intermolecular forces   **6 marks**

b. Mention and describe the types of processes involved in temperature-entropy conjugate pair that involve transfer of thermal energy as the result of heating.   **6 marks**

i. An isothermal process   **2 marks**

ii. An adiabatic process   **2 marks**

iii. An isentropic process   **2 marks**

c. Give three limitations of the third law of thermodynamics.   **3 marks**