



NATIONAL OPEN UNIVERSITY OF NIGERIA  
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JABI, ABUJA

FACULTY OF SCIENCES  
DEPARTMENT OF CHEMISTRY

2024 1 EXAMINATION

PROGRAMME : B.Sc. CHEMISTRY

COURSE CODE: CHM405 ( TYPE E)

COURSE TITLE: CHEMICAL THERMODYNAMICS

CREDIT UNIT : 2 CREDIT HOURS

TIME: 2 HOURS

INSTRUCTIONS: Answer question 1 and any other two(2) questions

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 (2 marks)
- (ii) Constant pressure and mass of a gas (2 marks)
- (c) In an automobile combustion cylinder, fuel-air mixture in a cylinder of 1000 cm<sup>3</sup> 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 Pa (5 marks)
- (d) Using one sentence for each, highlight the three major types of intermolecular forces that operates in molecules (6 marks)
- (e) Write an expression for Van der Waal equation of state (2 mark)
- (f) Show that the heat absorbed at constant pressure is equal to change in enthalpy (11 marks)

QUESTION 2

- 1.(a).i. What are the four (4) features of Maxwell-Boltzmann statistics with respect to distinguishability of particles? (8 marks)
- (iii) Use the equation given below to highlight four properties of thermochemical reactions
- $$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{2(l)}$$
- (7 marks)
- (c) State Hess and Laplace laws of thermochemistry (5 marks)

### QUESTION 3

- 3.(a) State Dalton law of partial pressure and write a mathematical equation for the law (5 marks)
- (b) Calculate the volume of 1 mole of an ideal gas at 1 atm pressure and at 0 °C. What conclusion can you draw from your results (7 marks)
- (c) A mixture of 6.5 mol of hydrogen gas and 3.5 mol of oxygen gas was placed in a 3 m<sup>3</sup> container at 273 K. Calculate the partial pressures of the individual gases and the total pressure (8 marks)

### QUESTION 4

( a ) Calculate the molar mass of ethane, if the density of ethane is 1.264g/dm<sup>3</sup> at 20 °C; Given that H=1.00794 and C= 12.0107, compare the result obtained from your calculation with the actual molecular mass. Give reason for any difference (15 marks)

( b ) Explain the term "Ion-induced dipole forces (5 marks)

### QUESTION 5

- (a) Based on the distribution law, highlight three(3 ) major ensembles which emanates from the three approaches that can be used to define a statistical thermodynamic system. (6 marks)
- (b) Derive the relationship between heat capacity at constant pressure ,  $C_p$  and heat capacity at constant volume ,  $C_v$  and hence show that
- $$C_p - C_v = R \text{ (10 marks)}$$
- ( c ) State the second law of thermodynamics (4 marks)