JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)

2^{ND} YEAR 1^{ST} SEMESTER 2022

MAIN REGULAR

COURSE CODE: SPB 9212

COURSE TITLE: BASIC KINETICS AND THERMODYNAMICS/PHYSICAL CHEMISTRY 1

EXAM VENUE: **STREAM: (BED SCI)**

DATE: **EXAM SESSION:**

TIME: 2:00 HRS

Instructions:

1. **Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

Useful Data

R= 0.0821 L atm. $K^{-1}mol^{-1}$
R = 8.314 J. $K^{-1}mol^{-1}$
1 J = 1 kgm^2s^{-2}
Mass of He = 4.0 $g.mol^{-1}$
1.01325 x 10^5 Pa = 1 atm
Molar mass O = 32 $g.mol^{-1}$
Molar mass of H = 1.01 $g.mol^{-1}$

INSTRUCTIONS: Answer Question 1 and any other TWO questions

SECTION A

QUESTION ONE (Compulsory) (30 marks)

(a) Define the following terms;

- (i) Intensive property
- (ii) Daltons law
- (iii) Adiabatic system
- (iv) Internal energy
- (v) Mean probable speed [10 marks]

(b) Derive the **FOUR** special forms of the first law of thermodynamics from its mathematical statement. [4 marks]

(c) Briefly discuss how to derive the pressure volume work for a gas confined by a frictionless piston. [6 marks]

(c) Differentiate between reversible and irreversible processes as used in thermodynamics. [6 marks]

(d) Distinguish between state and path functions with examples. [4 marks]

SECTION B

QUESTION TWO (20 marks)

(a) Derive the relationship between ΔH and ΔE. [5 marks]

(b) State the **FIVE** postulates of the kinetic theory of gases [5 marks]

(c) Determine the pressure (in atms) of 1.00 mole of carbon dioxide gas at 100 °C occupying 56 mL. Assume that CO_2 behaves ideally [2 marks]

(d) With the help of suitable examples, differentiate between a closed system and an isolated system. [4 marks]

(e) In the laboratory, nitrogen is heated to 115 °C in a vessel of constant volume. If it enters at a pressure of 100 mmHg and a temperature of 300 K, what pressure would it exert at the working temperature if it behaved as a perfect gas? [4 marks]

QUESTION THREE (20 marks)

(a) Given some values of pressure and volume for 2 g of hydrogen at 0 °C. Show whether the data verify Charles law. [4 marks]

Temperature (°C)	10	15	30	40	50
Volume (dm^3)	11.3	22.4	24.7	29.9	44.4

(b) Explain the following observations: [4 marks]

(i) A car tyre is inflated to a lesser pressure in summer than in winter

(ii) The kinetic energy of the gas increases with increase in temperature

(c) Write down the Van der Waals equation and explain clearly the meaning of the corrective terms for pressure and volume in it. [5 marks]

(d) Find the volume of 85 g of O_2 at 25 °C and 104.5 kPa in an ideal situation. [3 marks]

(e) Using the equation of state, show how you would derive an expression for enthalpy change (ΔH). [4 marks]

QUESTION FOUR (20 marks)

(a) Derive an expression for the work done by a gas in isothermal and reversible work expansion of an ideal gas [6 marks]

(b) Differentiate between a cyclic and an isochoric process. [4 marks]

(c) Calculate the root mean square speeds of helium gas in m/s at 25 °C. [5 marks]

(d) Find ΔE, q and w if 2.5 g of H_2 at 1200 mmHg pressure expand isothermally at 50 °C and reversibly to a presure of 700 mmHg. [5 marks]

QUESTION FIVE (20 marks)

(a) Derive the equation of state from the kinetic theory of gases. [6 marks]

(b) Prove that maximum work is done in the reversible expansion of an ideal gas. [5 marks]

(c) For the reaction:

$H_2F_{2\,(g)} \rightarrow H_{2\,(g)} + F_{2\,(g)}$ ΔE = -14.2 Kcal/mole at 25 °C.

Calculate ΔH for the reaction. [5 marks]

(d) Derive Boyles law from the kinetic gas equation. [4 marks]