JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

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

2ND YEAR 1ST SEMESTER 2018/19

MAIN REGULAR

COURSE CODE: SCH 201

COURSE TITLE: PHYSICAL CHEMISTRY 1

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

DATE: **EXAM SESSION:**

TIME: 2:00 HRS
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<u>**Instructions:**</u>

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. $K^{-1}mol^{-1}$
Molar mass of propanol = 60 g/mol
R = 8.314 $J.K^{-1}mol^{-1}$
Mass of N = 14 $g.mol^{-1}$
Mass of Li = 7 $g.mol^{-1}$
1 J = 1 kgm^2s^{-2}

SECTION A
QUESTION ONE (Compulsory)   (30 marks)

1. (a) State the following

(i)   Boundary
(ii)   Heterogenous system
(iii)   Isolated system
(iv)   Intensive property
(v)   Isochoric process
(vi)   Path functions   [12 marks]

(b)   Differentiate between extensive and intensive properties.   [4 marks]

(c)   Calculate the work done when four moles of the gas is expanded reversibly and isothermally from 6 atm to 2 atm at 20°C.   [4 marks]

(d)   A piece of lithium metal undergoes complete reaction with water as follows;

$$Li + H_2O \rightarrow LiOH + H_2$$

The hydrogen gas is collected over water at 25 °C. The volume of the gas is 225 mL measured at 1.00 atm. Balance and calculate the number of grams of lithium used in the reaction given that the vapour pressure of the water at 25 °C is 90 Torr.

[6 marks]

(e) In the laboratory, nitrogen is heated to 150 °C in a vessel of constant volume. If it enters at a pressure of 100 atm and a temperature of 300 K, what pressure would it exert at the working temperature if it behaved as a perfect gas?   [4 marks]

SECTION B
QUESTION TWO (20 marks)

2. (a) Propanol (C_3H_7OH) burns in air
$$C_3H_7OH + O_2 \rightarrow CO_2 + H_2O$$

Balance the equation and determine the volume of air in litres at 30 °C and 80 Torr required to produce 23 g of carbon dioxide. Assume air to be 21.0 % O_2 by volume.

[5 marks]

(b) One mole of an ideal gas at 52 °C is allowed to expand reversibly at constant temperature from a volume of 0.1 m^3 to 0.2 m^3. Calculate the work done by the gas in joules. [3 marks]

(c) i) Calculate the root mean square speeds of nitrogen molecule in m/s at 25 °C.
[6 marks]

ii) Calculate the average velocity of the nitrogen molecule in m/s at the 25 °C.
[6 marks]

QUESTION THREE (20 marks)

3. (a) Derive the equation of state from the kinetic theory. [7 marks]

(b) Given some values of pressure and volume for 2 g of hydrogen at 0 °C. Show that the data verify Boyles law. [3 marks]

Pressure (atm)	2.00	1.00	0.90	0.75	0.50
Volume (dm^3)	11.3	22.4	24.7	29.9	44.4

(c) State the **FIVE** postulates of the Kinetic theory of gases. [10 marks]

QUESTION FOUR (20 marks)

4. (a) Distinguish between reversible and irreversible processes. [4 marks]

(b) Describe the special forms of first law of thermodynamics. [8 marks]

(c) Derive Boyle's law and Charles law from the kinetic gas equation. [8 marks]

QUESTION FIVE (20 marks)

5. (a) Briefly discuss the meaning of the corrective terms for pressure and volume in a Van der Waals equation. [4 marks]

(b) Determine the ΔE, q and w if 0.5 moles of H$_2$ at 4 atm pressure expand isothermally at 25 °C and reversibly to a presure of 1.5 atm. [4 marks]

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

(d) Derive the relationship existing between ΔH and ΔE.   [6 marks]