



**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<sup>ND</sup> YEAR 1<sup>ST</sup> SEMESTER 2022**  
**MAIN REGULAR**

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**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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**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**

$R = 0.0821 \text{ L atm. K}^{-1}\text{mol}^{-1}$

Molar mass K =  $39.09 \text{ g.mol}^{-1}$

Molar mass N =  $14 \text{ g.mol}^{-1}$

Molar mass O =  $16 \text{ g.mol}^{-1}$

Molar mass Cl =  $35.5 \text{ g.mol}^{-1}$

Molar mass H =  $1.01 \text{ g.mol}^{-1}$

Molar mass of C =  $12 \text{ g.mol}^{-1}$

$a = 6.70 \text{ L}^2 \text{ atm.mol}^{-2}$ ,

$b = 5.6 \times 10^{-2} \text{ L.mol}^{-1}$

$R = 8.314 \text{ J.K}^{-1}\text{mol}^{-1}$ ,  $1 \text{ J} = 1 \text{ kgm}^2\text{s}^{-2}$ ).

**Answer question ONE and TWO other questions in Section B**

**SECTION A**  
**QUESTION ONE (Compulsory) (30 marks)**

1. (a) Define the following terms;
- (i) Equation of state
  - (ii) Mean square speed
  - (iii) Closed system
  - (iv) Real gas
  - (v) Path functions
  - (vi) Isothermal reversible expansion [12 marks]
- b) Two moles of an ideal carbon dioxide gas was found to occupy 3.2 litres at  $-15\text{ }^{\circ}\text{C}$  and a pressure of 18.4 atms. Calculate the pressure that would have been expected from the van der waals equation. Comment on the results. [5 marks]
- c) Deduce Charles law from kinetic gas equation. [5 marks]
- d) Differentiate between average velocity and most probable speed. [4 marks]
- e) Calculate the most probable speed of chlorine gas at 55 Torr and  $237\text{ }^{\circ}\text{C}$ . [4 marks]

**SECTION B**

**QUESTION TWO (20 marks)**

- 2.
- a) There are **THREE** thermodynamic systems. Briefly explain. [6 marks]
  - b) Distinguish between an adiabatic system and isolated system. [4 marks]
  - c) A gas at 10 atm pressure occupies a volume of 10 litres at 300 K. It is allowed to expand at the constant temperature of 300 K under a constant external pressure till the volume equilibrates at 100 litres. Calculate the work done. [4 marks]
  - d) Calculate the most probable speed of ethane gas in m/s at  $25\text{ }^{\circ}\text{C}$ . [6 marks]

### QUESTION THREE (20 marks)

- a) State the expression for the van der waals equation. [2 marks]  
i) Under which ways does it differ from the ideal gas law. [2 marks]  
ii) Under what conditions is it closest to the ideal equation. [2 marks]
- b) Using the kinetic theory of gases, derive the Avogadros law [4 marks]
- c) State the **FIVE** postulates of the Kinetic theory of gases [10 marks]

### QUESTION FOUR (20 marks)

- a) One mole of an ideal gas expands isothermally and reversibly from 1 litre to 100 litres at  $27^{\circ}\text{C}$ . Calculate  $w$ ,  $q$ ,  $\Delta E$ , and  $\Delta H$  for the process. [5 marks]
- b) Calculate the density of sulphur dioxide in grams per litre at 70 Torr and  $30^{\circ}\text{C}$ . [5 marks]
- c) Give two definitions of First law of thermodynamics. [2 marks]
- d) Differentiate between a reversible and an irreversible system. [4 marks]
- e) Using examples differentiate between an intensive and extensive properties. [4 marks]

### QUESTION FIVE (20 marks)

- a) Using the kinetic theory of gases derive the ideal gas law. [6 marks]
- b) Calculate the root mean square velocity of carbon dioxide gas at 78 mmHg and  $1000^{\circ}\text{C}$ . [5 marks]
- c) Explain clearly the meaning of the corrective terms for pressure and volume in van der waals equation. [4 marks]
- d) State the first law of thermodynamics. Give its mathematical statement and explain each term involved. [5 marks]