

S.5 CHEMISTRY- 2025

GROUP ASSIGNMENT COO2

GROUP	NAME:	STREAM:	•••••
GROUP	CHAIRPERSON:	EXPECTED SCORE:	•••••



ITEM 1: BONDING AND STRUCTURE.

At the newly built Kawaanda Science Innovation Centre, a water purification system stopped working. The filtration unit, which depends on layers of graphite, aluminium sheets, and teflon membranes, was corroding faster than expected. Another unit was studied which depended on layers of frozen chlorine gas and brine. The engineers sent samples to a Senior Five chemistry class to investigate why some materials were degrading quickly while others held up well.

Students were given the following samples:

- A sample of graphite
- An aluminium strip
- A sample of brine: NaCl
- A gas jar of chlorine
- The molecular formula of a substance found in the teflon membrane: NH3

After the investigation, the innovation centre wants a scientific explanation about:

- The form of structure and nature of bonding in each sample.
- Illustrations of how bonding happens in each sample.
- · Why studies show that the teflon membrane hydrogen bonds with water.
- How the substance in the teflon membrane adopts its 3D shape.
- The nature of bonding that would most likely happen when the teflon

membrane is dipped in a solution of hydrogen ions during the study.

 Why graphite was slippery and could conduct electricity in the filtration unit but not chlorine.

- · Why graphite withstood the highest temperatures.
- · How the nature and properties of NaCl differ from that(ose) of NH3.

✓
✓ Task:

As a chemistry student, respond to the innovation centre.

(20 scores)

ITEM 2: THERMOCHEMISTRY.

In Kabale District, an NGO invited Senior Five Chemistry students to assist in testing low-cost chemical heating kits for use in mountain-based refugee camps. These kits are meant to heat food and water where firewood or electricity is unavailable.

The students were given two kits to evaluate:

- Heater A: A sealed pouch containing hydrated calcium chloride ($CaCl_2 \cdot 2H_2O$), activated when poured into water. It generated rapid heat and warmed food quickly, but sometimes caused the container to overheat and crack.
- Heater B: A pouch of ammonium nitrate, which when mixed with water, caused the solution to cool down rather than heat up leaving meals cold. The team was shocked by the drop in temperature, despite expecting heat release.

After their initial analysis, a visiting engineer from Makerere University proposed a third option — **Heater** C — based on the combustion of ethanol (C_2H_5OH) in a reusable burner unit. She explained:

"Combustion gives consistent, high energy per gram and is reliable in cold zones. But students must evaluate it based on enthalpy values, safety, and practicality."

She also provided energy data to support the evaluation:

Process	ΔH (kJ/mol)
Combustion of ethanol	-1367
Dissolution of CaCl2·2H2O in water	-81
Dissolution of ammonium nitrate in water	+25

Now, the students must compare all options and advise the NGO team on which heater is safest, most effective, and easiest to explain to users. Students must also resolve unfamiliar terms ,to the residents of Kabale, such as enthalpy, enthalpy change, exothermic reaction, endothermic reaction, combustion, enthalpy of combustion, activation energy and the role of the later in reaction mechanisms.

As a chemistry student,

- (a) Clearly resolve, using examples, the unfamiliar terms to the residents of Kabale.
- (b) Giving reasons, classify each heater (A, B, C) as exothermic or endothermic.
- (c) Draw a **well-labelled** energy profile diagrams for:
 - (i) · Heater B
 - (ii) · Heater C
- (d) Using the data provided, calculate:
 - i) The total energy released when 0.1 moles of ethanol are burned.
 - ii) The mass of hydrated calcium chloride required to release the same amount of energy above. [Ca=40, Cl=35.4, H=1, O=16].
- (e) Comment on the Engineer's proposal.

(20 scores)

ITEM 3: INTRODUCTION TO ORGANIC CHEMISTRY.

In Jinja City, an innovation competition was launched for students to create ecofriendly everyday products using chemistry. The theme was:

"Green Chemistry for Ugandan Homes"

Six student teams submitted entries based on locally sourced organic compounds, aiming to replace synthetic products used in;

Cleaning agents
Cooking fuel
Cosmetics

•Preservatives •Flavouring agents •Fragrances

However, when the judging panel arrived, they were disappointed. Many students used common names like banana spirit, fire foam, or shiny oil without explaining the actual chemical identities of their products.

The panel selected six products for final analysis and asked the chemistry team to list them:

Product A: C_6H_{14} (Its forms are used as a natural fuel boosters)

Product B: CH₃CH=CHCH₃ (Claimed to hold gasoline scent)

Product C: CH₃CH₂COOH (Used in cleaning kits for stains)

<u>Product D</u>: CH₃CH₂CH₂CH₂OH (Used as ingredient in herbal hand sanitizers)

<u>Product E</u>: C₄H₉Cl (Has "a hidden perfume molecule" with sweet smell)

Product F: $\cdot \%C = 62.04\%$ $\cdot \%H = 10.42\%$ $\cdot \%O = ?\%$ $\cdot Vapour density = 29$

The panel tasked the chemistry team to:

- 1. First explain *briefly* what is meant by terms; 'functional group, homologous series, isomerism (talk about the types too), isomers and isomer'.
- 2. Write the structure and name of the functional group exhibited by each product.
- 3. Classify each product into homologous series.
- 4. Generate structural formulae and IUPAC names of all possible isomers for each product (if any) and specify whether the isomer is a 'chain, position or functional' isomer. (State the functional group and homologous series for the functional isomer if any)

As a chemistry student, accomplish what the panel tasked the chemistry team. In your response, assure them that the uniqueness of carbon is the basis of isomerism by stating how its unique and which characteristics make it behave uniquely.

(20 scores)

Yours Academically,

CMoS Assignments,

Set By PaulTutor,

Challenges Build Champions

"CMOS- CREATING COMPETENT CHEMISTRY AND MATH STUDENTS IN UGANDA"

