



EBENEZER CHRISTIAN SS NAMULANDA

UGANDA ADVANCED CERTIFICATE OF EDUCATION

COMPETENCE BASED ASSESSMENT

BEGINNING OF TERM 11 EXAMS 2025

S.5 CHEMISTRY PAPER 1

TIME 2 ½ Hours

NAME SIGN.....

INSRTUCTIONS

ATTEMPT ALL ITEMS

A local pharmaceutical company is developing a new cough syrup. During quality control, several organic compounds are detected as possible impurities. As part of your internship with the quality assurance team, you are asked to identify and name these compounds using IUPAC nomenclature.

You are provided with the following molecular structures (or condensed formulas), and your task is to ensure they are correctly identified and named according to IUPAC rules to avoid any dangerous mix-ups during drug formulation.

List of Detected Compounds (in condensed form):

1. $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
2. $\text{CH}_3\text{CH}_2\text{COOH}$
3. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
4. $\text{CH}_3\text{COCH}_2\text{CH}_3$

5. $\text{ClCH}_2\text{CH}_2\text{CH}_3$

Task

(a) Identify and name each compound using IUPAC rules.

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(b) Which functional groups are present, and how do they affect naming and numbering?

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(c) One of the detected compounds has similar structure to a known narcotic. How would you use structural information and IUPAC naming to distinguish between a harmless and a harmful compound in a lab report?

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Item 2

You are part of a national science competition where your school has been tasked with solving a mystery involving a malfunctioning industrial machine used in metal processing. The machine separates metals based on their reactivity and electronic configuration, but it has stopped working correctly due to a suspected programming error in how it identifies elements.

Your team is given a list of six elements used in the machine’s sorting system:

Iron (Fe, 26)

Magnesium (Mg, 12)

Calcium (Ca, 20)

Manganese (Mn, 25)

Potassium (K, 19)

Zinc (Zn, 30)

Task

(a) You must reprogram the machine to correctly sort these elements by confirming their electronic configurations.

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(b) The machine accidentally classified manganese and zinc in the same category. Based on their configurations, explain why this is incorrect

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(c) Suggest how the machine should differentiate elements with partially filled d-orbitals from those with filled ones

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Item 3

An environmental agency is investigating air pollution near an industrial zone. They suspect illegal flaring of hydrocarbons at night. A portable eudiometer is used to sample gases released during a suspected flare event. A 100.0 mL gas sample is collected and analyzed. The gases are assumed to be primarily from the combustion of a gaseous hydrocarbon fuel.

The sample is reacted with excess oxygen in the eudiometer and sparked. After the reaction:

Total gas volume drops from 100.0 mL to 70.0 mL.

The remaining gases are passed through aqueous KOH. After absorption, the volume drops further to 50.0 mL.

The agency believes that incomplete combustion may be occurring, releasing carbon monoxide (CO), a toxic gas, into the environment.

Task:

- (a) . Using the data, determine the molecular formula of the hydrocarbon (assume it completely combusted in this reaction).

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(b). Identify how much carbon dioxide was produced.

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(c) Critically evaluate whether the combustion was complete or incomplete.
Use the volumes to support your answer.

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(d) Propose a practical societal solution to prevent the release of toxic gases
from industrial flares, based on the chemical behavior observed

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Item 4

A local government is launching a campaign to reduce the overuse of fertilizers in farming. As part of a pilot study, a team of chemists analyzes the amount of ammonium nitrate (NH_4NO_3) being used by farmers in a rural area.

One farmer reports using 500 kg of ammonium nitrate per season. The chemists want to understand the potential impact on the local water supply, since excess nitrates can lead to eutrophication in nearby lakes.

Tasks:

(a) . Calculate the number of moles of ammonium nitrate in 500 kg.

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(b) Determine the number of nitrogen atoms delivered to the soil.

(c). Assuming 10% of the nitrate leaches into water systems, calculate how many moles of nitrate ions enter the environment.

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(d). Based on your results, discuss how chemistry can help address environmental concerns related to fertilizer overuse

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SECTION B

ITEM 5

In a small rural town, local artisans and entrepreneurs are exploring ways to produce alternative fuels and useful chemical products using available resources. A team of young chemists is consulted to advise on the chemical processes and safety implications of the following:

1. A community wants to produce ethene (a compound used to make lightweight plastics) from ethanol using concentrated sulfuric acid.
2. A refrigeration technician reports the accidental release of chlorinated propane derivatives after exposure of propane gas to sunlight in an area where cleaning chemicals containing chlorine were being used.
3. A small-scale soap manufacturer considers using propene and halogens to synthesize disinfectant additives.
4. The same manufacturer later realizes a dihalide compound is forming when bromine water is added to propene and wants to know how it forms and whether it is safe.

Task

As a consulting chemist, you are tasked with the following:

- a) Analyze and write a chemical equation for each reaction implied in the situations above.
- b) Identify the type of reaction occurring in each case (e.g., elimination, substitution, addition) and outline the complete reaction mechanism, stating all required conditions.
- c) Evaluate the potential risks and suggest safety or environmental considerations for each process, especially in a rural or low-resource context.
- d) Propose one sustainable alternative or improvement for any one of the processes above that would reduce harm to people or the environment while still meeting the community's goal (15 SCORES)

END