

P525/1
CHEMISTRY
Paper 1
2026
2¾ hours



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

CHEMISTRY
(Theory)
Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

*This examination paper consists of two sections; **A** and **B**. It has **six** examination items.*

*Section **A** has two **compulsory** items.*

*Section **B** has two parts; **I** and **II**. Respond to only **one** item from each part.*

*Respond to **four** items in all.*

*Any additional item(s) responded to will **not** be scored.*

*All responses **must** be written in the answer booklet(s) provided.*

Begin each item on a fresh page.

SECTION A

Respond to **both** items from this section.

1. The use of alternative energy sources other than firewood is being encouraged by the government as a way of reducing deforestation.

A farmer in one of the districts started making bio-gas from waste materials as a source of energy/fuel for cooking. A few days later, the farmer made the following observations:

- There was a lot of heat produced from the bio-digester pit.
- Whenever she adds waste matter to the digester pit every Monday, the gas production is high but by the time she adds again the following Monday, the gas production has reduced.
- Reduction in the amount of gas produced increased the cooking time.

The farmer got concerned about the observations and seeking for an explanation. The information in Table 1 and 2 about the formation of methane from glucose and the rate of combustion of methane gas has been provided to guide you in the explanation required.



Table 1

Compound in the bio- digester	Enthalpy of formation/ $kJmol^{-1}$
Glucose	-1273.3
Methane	-74.9
Carbon dioxide	-394

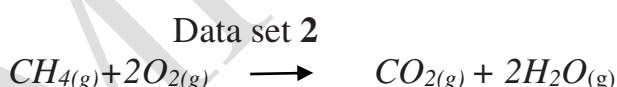


Table 2

Experiment	Initial concentrations ($mol\,dm^{-3}$)		Initial rate ($mol\,dm^{-3}\,s^{-1}$)
	CH_4	O_2	
A	0.1	0.2	5.0×10^{-4}
B	0.2	0.1	1.0×10^{-3}
C	0.2	0.2	40×10^{-4}

The rate equation for combustion of methane will also be required.

Task:

- Analyse the observations made using the data provided.
- Assess the ways through which the use of methane as a fuel can be maximised with reference to the data in Table 2.

2. Juice just like other beverages requires mixing with other additives but ensuring proper quantities of the additives is important.

A juice processing company in one of the cities of Uganda produces and supplies large quantities of juice to the surrounding communities. The sellers have however raised concerns about the quality of the juice supplied. They say that the juice possesses a sour taste and freezes more rapidly than usual when placed in refrigerators hence affecting their sales.

The company acknowledged that they usually added sodium benzoate, benzoic acid and sugar to the juice in order to maintain its *pH* and improve sweetness.

The company is investigating whether the quantities of these additives are responsible for the sellers' concerns. Data for the two samples that have always been used to prepare 50 cm³ of juice has been provided in Table 3.

Table 3

Substance	Sample A	Sample B
Benzoic acid (g)	1.525	1.525
Sodium benzoate(g)	0.1578	0.1578
Sugar (g)	20.0	5.0

During the investigation; the two samples were then placed in the fridge. The *pKa* of benzoic acid is 4.2 and *pH* range recommended for juice is 3.5 - 4.0.

Task:

- Assess the sellers' concerns.
- Evaluate the impacts of the additives to human life.

SECTION B

Part I

*Respond to any **one** item in this part.*

3. Glass is a widely used material in the construction industry and is usually manufactured from silica (SiO_2) as the main raw material.

Your class visited a nearby glass manufacturing factory for a study tour. To guide your data collection, your teacher provided the following questions for investigation:

- i. Why the company considered silica as the best raw material for glass making.
- ii. How calcium oxide or magnesium oxide can control soil contamination while aluminium oxide can not be used.
- iii. Why the fumes are considered to contaminate water.

At the factory, you presented those questions to the tour guide who provided you with the necessary responses. He further informed you that solid wastes can be treated using calcium oxide or magnesium oxide before disposal while chlorine tablets can be used in water treatment.

You observed that solid acidic wastes and fumes containing phosphorus and sulphur are produced in the production process.

Task:

- a) Analyse the observations you made during the study.
 - b) Justify the responses provided by the tour guide.
4. Road construction requires proper selection of the materials to be used so as to ensure durability.

Senior Five students from a certain school recently visited a bridge construction site on a river. The learners noticed that the materials available for use were aluminium and iron. One of the engineers on site told the learners that selection of the materials for use depended on factors like; structural properties, how the material interacted with the environment and their health or environmental impact.

On their return from the trip, students engaged in a discussion on which of the materials is better for bridge construction. One of the students said that iron can be used when coated with magnesium while another learner suggested use of beryllium instead of aluminium since both have similar properties. The rest of the class members failed to understand the information from the two learners.

Task:


- a) Analyse the properties of the materials and their interactions with the environment to enable the learners to select the best materials for the bridge.
- b) Assess the impact of these materials on the environment.

Part II

*Respond to any **one** item in this part.*

5. In Kampala, accumulation of plastic waste has caused blockages of drainage channels leading to flooding during heavy rains.

Joan, an environmental researcher observed that much of the waste collected from the drained channels consisted of plastic materials **Q** and **Y**, that could not easily be decomposed. She also visited a manufacturing factory producing the same plastics, **Q** and **Y**. She found out that;

- i. **Q** is structurally represented as $\{CH_2CH_2\}_n$
- ii. **Y** as $\{CHCH_2\}_n$.

- iii. **Q** is produced from vinegar. The active component in vinegar is ethanoic acid.
- iv. **Y** is produced from an aromatic ketone. This aromatic ketone is made from a chloride derivative of vinegar.

Joan further requires detailed information about; the synthesis and the key step reactions of plastics **Q** and **Y**, formation of the monomers of plastic **Q** and the aromatic ketone, and the environmental and health impact of plastics **Q** and **Y**.

Task:

- a) Analyse the observation made by Joan about the wastes collected from the drainage channels.
- b) Analyse the reactions of synthesis of plastics **Q** and **Y** and those highlighted in the scenario.
- c) Evaluate the impact of plastics **Q** and **Y**.

6. Active plant ingredients used in the making of pharmaceutical products are extracted using different solvents and processed in various ways.

A pharmaceutical industry in one of the towns in Uganda uses organic compounds as the extracting solvents. It makes nitrobenzene and ethylethanoate from benzene and compound **C** respectively. Propanone and phenylethanone are manufactured using compound **C** and **B** respectively as raw materials.

In a recent study carried out in the industry, the following compounds were found in the store:

Compound **A**, a straight chain hydrocarbon with 6 carbon atoms and molecular mass 86.

Compound **B**, an aromatic hydrocarbon with 7 carbon atoms and molecular mass 92.

Compound **C**, an alcohol with 2 carbon atoms and molecular mass 46.

Further information from the study showed that the industry always carries out impact assessment of the raw material before they can be used.

Task:

- a) Examine the compounds available in the store to determine the most suitable for extracting active organic ingredients from the raw material.
- b) Analyse the reactions mechanisms and processes involved in the formation of nitrobenzene and ethylethanoate, propanone and phenylethanone.
- c) Evaluate the practical applications of the various organic compounds kept in the store.