

P525/1
Chemistry
Paper 1
JULY/AUG 2026
3¼ hours

Random No						Person



PROVINCIAL EXAMINATIONS AGENCY (PEA)
COUHEIA MOCK EXAMINATIONS 2026
Uganda Advanced Certificate Of Education
CHEMISTRY
Paper 1 (THEORY)
Time: 2 Hours and 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 this Section. All responses to these sections, must be written in the answer booklet(s) provided. Respond to **four** items in all. Responses to any item attempted, should start on a fresh page. Additional item(s) responded to will not be scored.

For Scorer's Use Only

Item No	Basic code	Weighted score	Scorer's initials
1			
2			
3/4			
5/6			

SECTION A

All items in this Section are **compulsory**. All answers are to be written in the answer booklet(s) provided.

ITEM 1

A manufacturing company specializing in construction materials uses thermal stability as a key factor when choosing raw materials. An industrial chemist advised that aluminium oxide, Al_2O_3 , could be a suitable raw material despite the fact that it is amphoteric and reacts with both acids and bases. In a parallel view, an environmental chemist, after noticing a high level of concentration of aluminium ions in water discharged by the company, advised that before discharge aluminium metal could be recovered from solution using metal Q and provided the following thermochemical and electrochemical data.

Thermochemical data provided;

Standard enthalpy of formation of Aluminium Oxide = $-1675 \text{ kJ mol}^{-1}$

Standard enthalpy of atomization of Aluminium = $+330 \text{ kJ mol}^{-1}$

1st ionization energy of Aluminium = $+577 \text{ kJ mol}^{-1}$

2nd ionization energy of Aluminium = $+1817 \text{ kJ mol}^{-1}$

3rd ionization energy of Aluminium = $+2745 \text{ kJ mol}^{-1}$

Standard enthalpy of atomization of Oxygen = $+249 \text{ kJ mol}^{-1}$

1st electron affinity of Oxygen = -141 kJ mol^{-1}

2nd electron affinity of Oxygen = $+798 \text{ kJ mol}^{-1}$

Electrochemical data provided;

Half-cell	E° / V
$\text{Al}^{3+}(\text{aq}) / \text{Al}(\text{s})$	-1.66
$\text{Q}^{2+}(\text{aq}) / \text{Q}(\text{s})$	-0.76

Task:

- Analyse the observations made using the data provided.
- Assess how the use of metal Q can optimize the recovery of aluminium ions from the solution and make recommendations, if any.

ITEM 2

Chemical industries producing dyes and pharmaceuticals rely on solvents like naphthalene and precise knowledge of molecular characteristics of additives and impurities. At the same time, the local water supply shows signs of contamination, with an unknown weak acid solute T affecting the freezing point of water in storage tanks. The water treatment facility collected the following data on solute T:

Concentration of T (g/dm ³)	0	30	60	90	120	150
Freezing point (°C)	0	-0.16	-0.32	-0.49	-0.65	-0.81

The Cryoscopic constant for water is $1.86\text{ }^{\circ}\text{C kg mol}^{-1}$.

After identifying T, the company decided to reuse it. T is a weak monobasic acid HT. To make a disinfectant solution for equipment cleaning, the technician must prepare a sample solution whose pH change should be less than 5.0, because bacteria don't thrive well in that range.

The technician mixes sodium hydroxide with the purified acid HT to form its salt NaT, but is confused why the solution does not appear neutral. He has tasked you with rigorous analysis to ensure the disinfectant is safe and effective.

Technical Data:

K_a for HT = $1.8 \times 10^{-5}\text{ mol dm}^{-3}$ and $K_w = 1.0 \times 10^{-14}\text{ mol}^2\text{ dm}^{-6}$ at 25°C

Batch 1: Created by mixing 50cm^3 of 0.05M HT with 50cm^3 of 0.02M NaOH solution.

Batch 2: Created by mixing 50cm^3 of 0.02M HT with 20cm^3 of 0.05M NaOH solution.

Task:

- Assess the company's concerns on solute T used
- Evaluate the technician's disinfectant batches and comment on their effectiveness and safety uses.

0.05M HT
0.02M NaOH

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

ITEM 3

Aero space construction company are in the process of selection of the materials based on their durability once put into use. A class of senior five students are exploring the materials that make aero plane body and engines.

The information they got, shows that the materials needed for use are aluminium and iron, and their selection for use depends on their structural properties, how they interact with environmental conditions and their health/environmental side effect(s). Additional information shows that the engine propellers made of iron can be coated with magnesium but not the engine blocks while the aero plane body can be constructed with beryllium instead of aluminium due to their similar properties. These students failed to understand the information they obtained and they have been referred to you for help.

Task:

- a. Assess the properties of the materials and comment with reason which of these materials would best for selection in the aerospace construction.
- b. Analyze the interactions of the materials with the environment and help the learners understand the information on preference of the materials in different parts of the aero plane.
- c. Assess the impacts of using these materials to the environment.

ITEM 4

A chemical plant near Lake Victoria is exploring Group 17 elements and their compounds to treat drinking water for a nearby community. In order to access safe water, the structural properties such as atomic radii and boiling points of the elements, they intend to focus on so as they can balance their effectiveness and safety for workers as well as the environment.

Your chemistry class intends to visit this plant to explore more about these elements, their compounds and practical applications in daily life. To achieve the study purpose, your chemistry teacher has given you the following guiding questions which will be used during the study time in the plant.

1. Between chlorine and iodine which one would be suitable for water treatment and why?

2. Why would dumping of industrial wastes containing hydrofluoric acid into the water is considered less harmful compared to hydroiodic acid.
3. Why concentrated sodium hydroxide is used to trap fumes containing chlorine gas produced in the production process.

Your subject teacher wants you to assess and evaluate about these elements and their compounds by making detailed report that will be presented to the headteacher of your school.

Element	F	Cl	Br	I
Atomic radius (nm)	0.072	0.099	0.114	0.133
Boiling point/ $^{\circ}\text{C}$	-188	-34	+58	+185

The site safety quality officer, responded to those questions that the gaseous fume should be treated using strong alkalis to prevent its emission in the atmosphere. And the liquid industrial wastes containing the strong hydride can be treated with calcium oxide before disposal.

Task:

- a. Analyze the observations you obtained during the study at the plant.
- b. Justify the responses given by the tour guide.
- c. Assess the impacts of using these products to the environment.

SECTION B Part II

Respond to any one item in this part

ITEM 5

Use of perfumed deodorants is growing fast in Uganda. Abacus pharmaceutical Company plans to start production. The company chemist reported two production routes:

Chloroethane is obtained from compound X, straight chain hydrocarbon with 2 carbon atoms that is used to make compound Y, methyl ethanoate serving as fragrance.

Compound X is used as a feedstock to make organic compound W an alcohol with 3 carbon atoms that produces propanoic acid needed for deodorant action. For proper waste control, the company analyst suggested reacting any leftover of chloroethane with benzene and any leftover of compound X with liquid bromine with a suitable organic solvent. The company's management is interested in the suitability of the products, their applications, and synthesis

pathways for the products, with lasting mitigation reactions for the unreacted raw materials and the associated environmental impact of the application of its product.

Task:

- a. Examine the compounds provided to help the company determine the production of the most suitable active organic ingredients.
- b. Analyze the reaction mechanisms and processes involved in the formation of organic products from any leftover chloroethane, with benzene, compound X and bromine.
- c. Evaluate the practical applications of the various organic products intended to be produced by the plant including any side effects of the products.

ITEM 6:

The use of polymers and solvents in grease production is growing rapidly in Uganda. A manufacturing company uses propene to make polystyrene, and propanol as a solvent for grease.

As their daily routine mitigation measures, the company runs two parallel reactions:

1. Propene with bromine water.
2. Ethanol with concentrated Sulphuric acid at 180°C to form a hydrocarbon R.
3. The compound R serves as feedstocks for making benzene, a six-carbon hydrocarbon and phenylethane, an aromatic hydrocarbon with 8 carbon atoms and molar mass of 104.

Additional information from the company, shows that they always conduct impact assessment of their polymer raw materials with appropriate mitigation measures before availing them in the market for use.

Task:

- a. Examine the compounds provided to the plant, to help the team determine the most suitable for making plastic materials and solvents.
- b. Analyze the reaction mechanisms including the processes involved in the formation of propene and bromine water, ethanol to hydrocarbon R, benzene to phenylethane.
- c. Evaluate the impact(s) of the product(s) intended to be produced.

END