

Name : _____ Signature: _____

August 2025

S5 END OF TERM 2 EXAMINATIONS

CHEMISTRY Theory

Paper 1

2 hours 15 minutes

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY

Principle Subject

Paper 1

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

This paper consists of six examination items.

Attempt all items.

Answers are to be written only in the spaces provided

Item 1

An oil pipeline engineer made a mistake while attempting to locate a leak on an oil pipeline. He accidentally added 78g of radioactive substance at a pumping station. This set off alarms indicating the levels of radioactivity in the oil were very dangerous. The pipe had to be shut down. The facility and the nearby community was vacated due to the dangerously high levels of radiation.

The environmental authorities then set up meters that measured the levels of radioactivity in the area.

They got the data below:

Time (days)	0	10	20	30	40	50
Activity (counts per second)	21	8.9	3.8	1.6	0.7	0.3

The government is claiming that the area will be safe again if the amount of the radioactive substance in the oil reduces to 5% and that this will happen in two weeks.

Task

As a student of Chemistry and showing clear working, using the information provided, respond to the claims of the government.

(Use the graph paper attached)

Item 2

Barium fluoride and magnesium fluoride have various applications in optics due to their transparency over a wide range of wavelengths. A company is to synthesize one of these compounds to be used as a raw material for other optics related devices. The design of their manufacturing process requires that they select to produce the compound that gives out the less heat as it forms from its gaseous component ions.

Task

As a student of Chemistry consider the data below

MgF_2 : Standard heat of formation = -1124 kJ/mol ; standard heat of sublimation of magnesium = $+148 \text{ kJ/mol}$, $\text{IE}_1(\text{Mg}) = +738 \text{ kJ/mol}$, $\text{IE}_2(\text{Mg}) = +1451 \text{ kJ/mol}$, Bond dissociation energy (F_2) = $+159 \text{ kJ/mol}$, First electron affinity (F) = -328 kJ/mol .

BaF_2 : Standard heat of formation = -1207 kJ/mol , Standard heat of sublimation (Ba) = $+180 \text{ kJ/mol}$; $\text{IE}_1(\text{Ba}) = +503 \text{ kJ/mol}$; $\text{IE}_2(\text{Ba}) = +965 \text{ kJ/mol}$, $\text{EA}(\text{F}) = -328 \text{ kJ/mol}$.

Task:

- a) Use your knowledge of energy cycles and determine which of the two compounds will be the more suitable.

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b) Help the company chemical engineer understand the stability difference between the two compounds to address durability concerns in optical devices they are to make.

Item 3

Study the data below about the first ten successive energies (in kJ per mole) required to remove the first ten electron from the gaseous atom and then ions of an element **X** and another one **Y**.

X	495.8	4562	6910.3	9543	13354	16613	20117	25496	28932	141362
Y	577.5	1816.7	2744.8	11577	14842	18379	23326	27465	31853	38473

Tasks

As a student of Chemistry

- a) Explain the category of the process involved in the removal of the first electron and state any two factors that can affect the amount of the energy required.

- b) Suggest the acceptable formulae of the chlorides of these elements and explain your reasons

c) Which of the chlorides you have given in (b) above is more likely to dissolve in paraffin? Give a concise explanation of your reasons.

Item 4

A factory uses charcoal that comes in 65kg bags each at 65000 UgX in smelting process to produce iron. The reaction occurs as below:



A procurement and accounts planning officer has come to you from the factory with a problem. They need your help. They need an estimate on how much it will cost in charcoal to produce 150 tonnes of iron and how much they will pay in environmental protection tax if the rate is 78000 per tonne of carbon dioxide released into the atmosphere.

(Take atomic masses Fe = 56, C = 12 and O = 16)

Task

- a) Explain the category of reactions the factory uses in producing iron.

- b) With clear working, provide answers to the officer from the factory. (Assume the charcoal is 100% carbon)

[illegible]

c) Suggest ways in which the factory can minimise its contribution to environmental pollution.

Item 5

It is common knowledge in Chemistry that elements in a group of the Periodic Table have the similar physical and chemical properties. A closer study of properties of elements in the first three groups reveals that the first element in each group is similar in physical and chemical properties to the element in the next group to the right but in the next period below:

Tasks

Using your knowledge of periodic trends in the Periodic Table

- a) Identify the phenomenon described above.

- b) Describe the similarities in physical and chemical properties between any two elements that show the phenomenon you have identified in (a) above.

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c) Describe any two ways in which the implications of the phenomenon you have identified in (a) above are applied in industry.

Item 6

A factory plans to produce small amounts of carbon dioxide by thermally decomposing the any one of the carbonates : magnesium carbonate, calcium carbonate or barium carbonate in an electric heater. They need to achieve this with the least expenditure on electricity and minimum side effects from handling.

Tasks

Consider the data below:

Cation	Size (pm)
Mg ²⁺	72
Ca ²⁺	100
Ba ²⁺	135

Carbonate	Decomposition temperature (°C)
MgCO ₃	350
CaCO ₃	840
BaCO ₃	1350

a) Help the factory management

(i) make a choice.

(ii) Understand the chemistry principles of bonding and structure that make the choice you have made in (i) the most suitable.

- b) Describe the possible environmental impacts of this industrial process and suggest mitigation measures.

END