

Name: Stream:

P525/1

CHEMISTRY (theory)

Paper 1

2 $\frac{3}{4}$ hours

BULOBA ROYAL COLLEGE

Uganda advanced certificate of education

END OF TERM 1 EXAMINATIONS APRIL 2026

S.5 CHEMISTRY

Paper 1

TIME; 2 $\frac{3}{4}$ hours

INSTRUCTIONS TO LEARNERS:

- This paper consists of **five** examination items.
- Attempt **all items** in Section A and **one item** from each Part of Section B.
- Responses to items in Section A are to be written in the spaces provided while in Section B part I (Inorganic) and part II (Organic) **must** be written on answer booklets provided.
- Graph paper is provided.
- A Periodic Table is provided.
- Mathematical tables and silent non- programmable calculators may be used.
- You are advised to carefully read each item and the **plan** appropriately before starting. (Molar gas volume at s.t.p is 22400cm³)

For Scorer's Use Only

| Item | 1 | 2 | 3 or 4 | 5 |
|-------------------|----------------|---|--------|---|
| Weighted Score | | | | |
| Scorer's Initials | | | | |
| | TOTAL SCORE | | | |

SECTION A (mole and equations)

Item 1;

During agricultural research at National Agricultural Research Organization (**NARO**) in, investigations were carried to analyze an unusual soil PH which was affecting crop health in Hoima district. Soil samples were taken to the laboratory and analyzed and found out to contain a sodium salt with a formula $\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$ and a magnesium salt with a formula $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$. The following procedures were carried out.

- 8.58g of $\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$ was dissolved in water and made to one liter. 20cm^3 of this solution needed 12cm^3 of 0.1M Nitric acid for complete neutralization.

Task; As a student help the organization to discover the actual formula of salt by;

- a) Writing down a balanced chemical equation for the reaction.

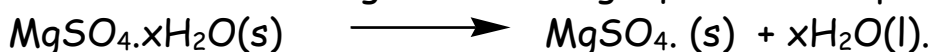
.....(1½scores)

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- b) Calculating the moles of nitric acid used. (2scores)

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e) 12.3g of the hydrated magnesium sulphate crystals were heated strongly until a constant mass was obtained. After heating, the mass reduced to 6.0g. the following equation took place,



i) calculate the mass of water lost. (1score)

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ii) Determine the number of moles of anhydrous MgSO_4 and water lost respectively. (2scores)

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iii) Find the simplest mole ratio of MgSO_4 to water and hence deduce the formula of the hydrated salt. (2scores)

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ITEM 2

While in the laboratory, an argument rose up between two senior three students after seeing certain information on one of the bottles in the laboratory. This information is for compound Q which is an organic acid whose formula is: $\text{H}_x\text{C}_y\text{O}_z \cdot n\text{H}_2\text{O}$. On its bottle its written that Q contains 26.7% Carbon, 2.2% hydrogen and 71.1% oxygen by mass. On the same bottle its written that it has a vapour density of $5.625 \times 10^{-3} \text{gcm}^{-3}$ at s.t.p. You as a chemistry student help the senior three students under the issue at hand. In your message include the following:

(a) Determine the values of x , y and z given that the molar mass of the anhydrous Q is 90g hence write down the molecular formula of the **anhydrous form** of Q. (7scores)

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(b) Determine the molecular mass of the whole compound, value of n and hence write the formula of the hydrated Q. (5scores)

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(c) Write the Chemical name of Q. (1score)

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(d) Determine the percentage of water of crystallization in Q.
(2scores)

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SECTION B;

PART I (Inorganic Chemistry)

(Attempt one item from this part on a new page)

ITEM 3:

A laboratory technician ordered for new shipment of metals to be used in a practical. They arrived and the labels on their bottles were partially removed. The only visible information was the atomic numbers which were 12, 20, 24, 27, and 30.

The laboratory technician is responsible for ensuring that laboratory safety is a priority and chemicals are stored properly to prevent accidents.

Task;

The teacher has asked you to **Write the electronic configurations of the metal atoms and their ions**, clarify on their position in the Periodic Table (**Group, Period and Block**) hence **predict and analyze their reactivity**. (15scores)

An element E forms both E^{2+} and E^{3+} ions. Its atomic number is 26.

i) Write the electronic configuration of E, E^{2+} and E^{3+} .

ii) Briefly explain between E^{2+} and E^{3+} ion which one is most stable (5scores)

ITEM 4;

At **Buloba royal college** in Wakiso district, Senior Five learners are carrying out a chemistry investigation to understand why different elements in period 2 have different **atomic radius** and behave differently in daily life. During a science club activity their teacher introduces the idea that the **chemical reactivity of elements** depends on how easily they lose or gain electrons. To support this discussion, the teacher provides the learners with data showing the **atomic radius of Period 2 elements**, as shown below.

| Element | Li | Be | B | C | N | O | F | Ne |
|--------------------|-----|-----|----|----|----|----|----|----|
| Atomic radius (nm) | 152 | 112 | 85 | 70 | 65 | 60 | 50 | 38 |
| Atomic number | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Task: As a chemistry learner, help the learners;

- (a) To understand what is meant by the term atomic radius. (02 scores)
- (b) Plot a graph of atomic radius against atomic number for the Period 2 elements provided and use it to explain the **general trend** in atomic radius across period 2 elements (10 scores)
- (c) Compare the reactivity between lithium and beryllium basing on electron arrangement in their atoms. (3scores)
- d) A community health officer in a town is analyzing various substances used in daily life such as water treatment chemicals, fertilizers, cleaning agents and medicines. You are asked to help identify and write the correct chemical formulae of these substances. (5scores)
 - i) Aluminium hydroxide
 - ii) Ammonium nitrate
 - iii) Copper (II) sulphate-5-water
 - iv) Sodium hydrogen carbonate
 - v) Calcium phosphate

PART II (Organic Chemistry)

(Attempt **this** item from this part on a new page)

Item 5:

A fuel technology company is developing a new **hydrocarbon-based fuel additive W**, aimed at improving engine efficiency. To evaluate the additive's chemical nature and reactivity, the research team performed a combustion analysis. In this analysis, complete combustion of a sample produced 1.820g of carbon dioxide and 0.741g of water. Further tests revealed that when vaporized, 298.67 cm³ of the additive weighed 0.56g at s.t.p.

You came across the above information before it was published and picked interest in it.

Task: As a Chemistry learner,

(a) What is meant by the term a hydro carbon. (1 score)

(ii) Determine the empirical and molecular formula of fuel **W** to understand its chemical composition. (07 scores)

(iii) Identify the fuel additive **W** by giving its structural formula and IUPAC name. (02 scores)

b) A fertilizer additive has the structure **HOOC-CH₂-CH(NH₂)-COOH** and its mainly composed of carbon as the main element.

i) Suggest 3 reasons why carbon is able to form such a stable compound. (3scores)

ii) identify all the functional groups present in the compound.(give name and structure). (2scores)

END

THE PERIODIC TABLE

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|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 8 |
| 1.0 H 1 | | | | | | | | | | | | | | | | 1.0 H 1 | 4.0 He 2 |
| 6.9 Li 3 | 9.0 Be 4 | | | | | | | | | | | 10.8 B 5 | 12.0 C 6 | 14.0 N 7 | 16.0 O 8 | 19.0 F 9 | 20.2 Ne 10 |
| 23.0 Na 11 | 24.3 Mg 12 | | | | | | | | | | | 27.0 Al 13 | 28.1 Si 14 | 31.0 P 15 | 32.1 S 16 | 35.4 Cl 17 | 40.0 Ar 18 |
| 39.1 K 19 | 40.1 Ca 20 | 45.0 Sc 21 | 47.9 Ti 22 | 50.9 V 23 | 52.0 Cr 24 | 54.9 Mn 25 | 55.8 Fe 26 | 58.9 Co 27 | 58.7 Ni 28 | 63.5 Cu 29 | 65.7 Zn 30 | 69.7 Ga 31 | 72.6 Ge 32 | 74.9 As 33 | 79.0 Se 34 | 79.9 Br 35 | 83.8 Kr 36 |
| 85.5 Rb 37 | 87.6 Sr 38 | 88.9 Y 39 | 91.2 Zr 40 | 92.9 Nb 41 | 95.9 Mo 42 | 98.9 Tc 43 | 101 Ru 44 | 103 Rh 45 | 106 Pd 46 | 108 Ag 47 | 112 Cd 48 | 115 In 49 | 119 Sn 50 | 122 Sb 51 | 128 Te 52 | 127 I 53 | 131 Xe 54 |
| 133 Cs 55 | 137 Ba 56 | 139 La 57 | 178 Hf 72 | 181 Ta 73 | 184 W 74 | 186 Re 75 | 190 Os 76 | 192 Ir 77 | 195 Pt 78 | 197 Au 79 | 201 Hg 80 | 204 Tl 81 | 207 Pb 82 | 209 Bi 83 | 209 Po 84 | 210 At 85 | 222 Rn 86 |
| 223 Fr 87 | 226 Ra 88 | 227 Ac 89 | | | | | | | | | | | | | | | |
| | | | 139 La 57 | 140 Ce 58 | 141 Pr 59 | 144 Nd 60 | 147 Pm 61 | 150 Sm 62 | 152 Eu 63 | 157 Gd 64 | 159 Tb 65 | 162 Dy 66 | 165 Ho 67 | 167 Er 68 | 169 Tm 69 | 173 Yb 70 | 175 Lu 71 |
| | | | 227 Ac 89 | 232 Th 90 | 231 Pa 91 | 238 U 92 | 237 Np 93 | 244 Pu 94 | 243 Am 95 | 247 Cm 96 | 247 Bk 97 | 251 Cf 98 | 254 Es 99 | 257 Fm 100 | 256 Md 101 | 254 No 102 | 260 Lw 103 |