

Name : _____ Signature _____

May 2025

S5 Beginning of term 2

CHEMISTRY THEORY

Paper 1

2 hours

INSTRUCTIONS TO CANDIDATES

This paper consists of five examination items; attempt any **four** (4) items.

All items carry equal scores

Begin your response to each item on a fresh page.

1. The mass spectrum below was presented in a class plenary session by the teacher to your study group:

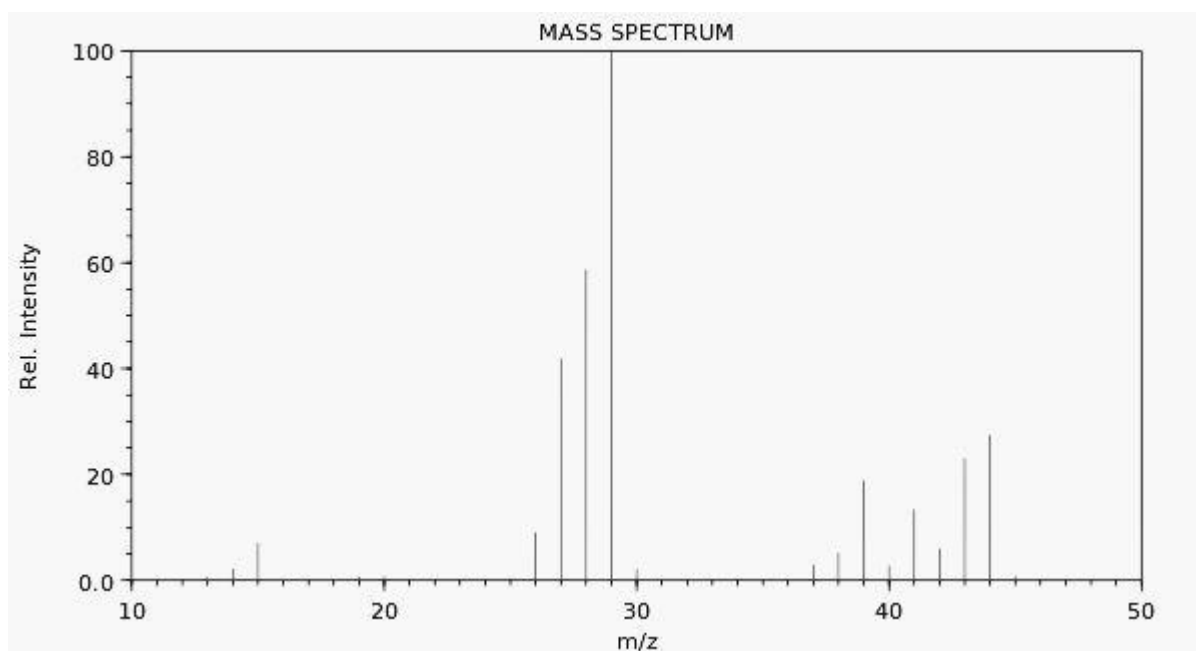


Fig 1 : mass spectrum of hydrocarbon Q

Q is a hydrocarbon that is 81.818% carbon by mass and is commonly used as a fuel gas that comes in canisters of 13 kg each.

Tasks

As a leader of your study group, the teacher requires you to

- a) Explain the mechanism of the analytical method that produces the mass spectrum in figure 1 and; explain the main features on the mass spectrum.
 - b) Use the information off figure 1 and work out the mass in kilograms of carbon dioxide that gets let into the atmosphere when 13 kg of **Q** burn completely as a fuel gas.
(Take atomic masses, C = 12; H = 1; O = 16)
2. During a plenary session in class, you lead a study group, tasked with evaluating elements for their suitability for use in advanced technologies. Your group is exploring the use of Group II(A) (alkaline earth) main group elements—specifically Beryllium (Be, atomic number 4), Magnesium (Mg, atomic number 12), and Calcium (Ca, atomic number 20)—for applications in stable compound formation , electrical conductivity , and construction materials.

Task

You are required to analyse their electron configurations, relate these to their chemical and physical properties, and recommend their suitability for the specific industrial applications.

3. A National medical stores (NMS) van had an accident on a high way through a community called Buloba. The accident cracked open a sealed can containing radium – 223, a radioisotope used in the treatment of prostate cancer. It targets alpha radiation to kill cancer cells in bone metastases while minimising exposure for healthy tissue. The radioisotope leaked into a local natural water source. As a response the government forced people to not use the water and to evacuate the immediate area. It advised the residents to stay away for atleast six months when the activity of the radioisotope will have reached the safe level of 0.037 counts per second (cps).

Tasks

As a student of Chemistry

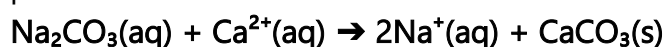
- a) Use the information in the table below and evaluate the government's advice to residents to stay away for at least six months

Table 1 : time – activity data for radium – 223 taken in Buloba.

Time (days)	0	5	10	15	20	25
Activity (cps)	2.50	1.84	1.36	1.00	0.741	0.547

- b) Produce a brief write up educating the community members about the dangers of radioisotopes and how these should be mitigated.

4. A water engineering firm uses anhydrous sodium carbonate that comes in 12kg bags each 65000 UgX, to remove calcium ions from hard water by the process:



A procurement officer has been tasked to estimate the cost of sodium carbonate that will be required to complete a job of softening 550,000 liter of a hard water containing 35.8mg of calcium ions per 200 cm³.

The procurement officer has sought after your help.

Task

- a) Showing a clear working, help the procurement officer estimate the number of bags of anhydrous sodium carbonate the job will require.
(1 mg = 10⁻³g; Na =23, C = 12, O = 16 and Ca = 40)
- b) If the National Drug Authority (NDA) and Uganda National Bureau of Standards (UNBS) recommend drinkable water to not contain more

than 50mg per liter of sodium, determine whether the process of water treatment is lawful or not.

As a student of Chemistry educated in areas of bonding and properties of substances as a result of type of bonding, you have been approached for help in assessing the suitability of magnesium oxide, copper, and silicon dioxide to be used in designing a new composite material for a high-performance aerospace component. The component must withstand extreme temperatures, conduct electricity, and resist corrosion.

Tasks

- a) Discuss bonding in each material provided and its suitability for the task of designing the aerospace component.
- b) Evaluate the substances for the task of designing the aerospace component.

END

