CMoS

S.5 CHEMISTRY- 2025

GROUP ASSIGNMENT C001

GROUP NAME: ……………………………………………………………………. STREAM: …………………………

GROUP CHAIRPERSON: ……………………………………………………………. EXPECTED SCORE: …………

ITEM 1: MASSES OF ATOMS AND MOLECULES.   (08 scores)

A company in Kampala that supplies balloons for birthday parties receives a special order for hydrogen-filled balloons. A worker at the company is told to fill ten balloons, each with 2.00 g of hydrogen gas. Unfortunately, the digital gas meter is broken. The supervisor tells the worker, "You've done Chemistry—calculate how many moles, molecules, and atoms of hydrogen gas we'll be giving out in total."   (H=1, He=4)

🔍 Tasks:

a). How many grams of hydrogen gas are needed to fill all 10 balloons?

b). Calculate the total number of moles of hydrogen gas in the 10 balloons.

c). Convert your answer in (b) to find the total number of molecules of hydrogen gas present.

d). Hydrogen gas exists as H_2. Use your answer in (c) to calculate the total number of hydrogen atoms released across all balloons.

e). Another worker suggests using helium instead, saying "It's safer!" Helium is monoatomic. If the same 20.00 g of helium were used, would it contain more, fewer, or equal atoms compared to the hydrogen atoms you calculated in (d)? Justify your answer with calculations.

ITEM 2: CHEMICAL FORMULAE AND CHEMICAL EQUATIONS.   (08 scores)

A farming cooperative in Mbale is suspicious about a new supplier who claims to sell "high nitrogen fertilizer." A 10.00 g sample of the white powder is sent to a school lab, where a Senior Five student is asked to investigate its composition.

Lab analysis shows the following:

• Nitrogen = 3.50 g   • Hydrogen = 0.50 g   • Oxygen = 6.00 g

A separate mass spectrometry test confirms the compound has RFM 80.

🔬 **Tasks**:

   i). Calculate the number of moles of each element present in the sample.

   ii). Determine the simplest whole-number ratio of the atoms.

   iii). Write the empirical formula of the compound.

   iv). Calculate the empirical formula mass (EFM).

   v). Use the RFM to deduce the molecular formula.

   vi). Identify the compound and state one reason it is used in fertilizers.

ITEM 3: <u>SOLUTIONS AND CONCENTRATIONS</u>.   *(10 scores)*

A Senior Five Chemistry class is asked to help the school lab assistant standardize a sodium hydroxide solution. The assistant had earlier prepared the solution by dissolving 4.00 g of NaOH into 250.0 cm³ of water, but forgot to label its concentration.

The students are provided with a standard hydrochloric acid solution of known concentration 0.1 M. During the titration, it is observed that 25.0 cm³ of HCl completely reacts with 20.0 cm³ of the NaOH solution.

📌 **Tasks**:   (RAM: Na = 23, O = 16, H = 1)

   a). Write the equation for the reaction that took place.

   b). Calculate the number of moles of hydrochloric acid used.

   c). Determine the number of moles of NaOH that reacted.

   d). Calculate the concentration of sodium hydroxide in mol/dm³.

   e). Based on the initial preparation (4.00 g in 250.0 cm³), calculate the theoretical concentration of NaOH and compare it with your result in (4). Comment on the accuracy of the lab assistant's preparation.

ITEM 4: <u>**CHEMICAL FORMULAE AND CHEMICAL EQUATIONS**</u>.   *(08 scores)*

A metal recycling plant in Jinja, an engineer tries to extract zinc from old machine parts. She crushes grey zinc oxide powder and mixes it with black carbon granules. The mixture is heated strongly in a furnace until a shiny molten metal forms and a gas escapes from the top of the setup.

The gas is passed through limewater, which turns milky.

📝<u>**Tasks**</u>:

i). Write the chemical formula of the reactants and the products in the reaction described.

ii). Write a well-balanced chemical equation for the reaction, including state symbols for all substances.

iii). From the scenario, explain the evidence that helped you identify:

• *(a) the state of zinc metal*   • *(b) the gas released*   • *(c) formed metal*

iv). Identify the type of chemical reaction taking place and briefly explain your choice.

MEGA ITEM 5: <u>**MASS SPECTROMETRY AND ELECTRONIC CONFIGURATION**</u>. *(26s)*

In the hills of Karamoja, a local Chemistry research team makes an exciting discovery: traces of an unknown shiny metal found in ancient tools and reddish soil.

They take it to a nearby lab, where it is labeled Element X until fully studied. The team decides to use mass spectrometry to learn more. They're also preparing to educate the community about this discovery and explain the chemistry behind it.

From the mass spectrometry results, two major mass:charge peaks appear and team tells the community that those peaks represent isotopes and the height of the peaks denotes the relative intensities or abundancies of the isotopes.

The relative atomic mass (RAM) of X proves to be 63.5.

Later, after advanced analysis, scientists observe that Element X can form two ions: X^+ and X^{2+}. The lab also investigates electronic configuration and confirms that Element X has an atomic number 29.

To help the locals understand how mass spectrometry works, the researchers must do the following tasks;

(i) Define/resolve terms that are unfamiliar to the Karamojongs such as mass spectrometry, mass:charge, isotopes, relative intensities, relative abundances, RAM and how it differs from RMM, ions, electronic configuration, atomic number and how it differs from mass number, etc.

(ii) Explain to the community how, (during mass spectrometry),

- The sample of X is vaporized.

- The sample is ionized.

- Ions are accelerated.

- Ions are deflected and collected.

- Ions are recorded.

(iii) Convince the community about why mass spectrometry was chosen over other methods to determine the RAM of X and some of the precautions taken when using the mass spectrometer.

(iv) Show the community how the electrons of X are arranged to come up with its configuration stating the group, period and block of X as well as a genuine comment about its reactivity giving a reason in each case.

(v) Educate the community about how the two ions were formed and the electronic configuration of those ions.

(vi) Help the community tell the likely identity of element X with strong reasons from the periodic table.

❓**Your Task**:

As a chemistry student, assist the researchers with the tasks above including more uses of the mass spectrometer and uses of the mass spectrum.   **(26 scores)**

END!!!

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