ST PAUL'S VOCATIONAL SS-BUYANJA.

S.5 COMPETENCY BASED CHEMISTRY EXAM

END OF TERM 2.2025

TIME 2HOURS.

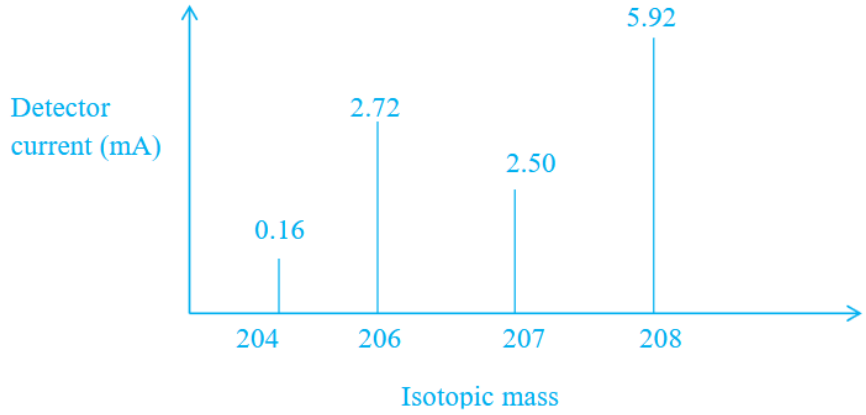
Attempt all items in this paper

ITEM 1

Cacodyl, which has an intolerable garlicky odor and is used in the manufacture of cacodylic acid, a cotton herbicide, has a mass composition 49.48% carbon, 5.76%hydrogen and 71.36% Astatine, As and molar mass 209.96g/mol.What is the molecular mass of cacodyl?(4scores)

ITEM 2

The Uganda National bureau of standards (UNBS) received complaints about metal contamination in several imported fruit juices after consumers reported symptoms of headaches, stomach pain and dizziness. The agency suspected that the juice might contain a toxic metal but the exact metal was unknown. When the juice sample was taken and analyzed, the suspected metal in juice had mass spectrometry analysis data as shown in support material below.



Task

As a chemistry student,

(a) Describe how the mass spectrometer operates in order to produce the results the analytical results the agency could have obtained. (08 scores).

(b) Using the spectroscopic data presented, show how the relative abundance and relative atomic mass of the suspected metal can be determined.(Illustrate your using a calculation).(7mks)

ITEM 3

In an exercise that was done by S.5 students in S.5 North class, a student wrote the electronic configuration of an element Q as $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^5$.

a i) Which block in the Periodic Table does this element belong to? (2scores)

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(ii) Which group and period does it belong to? (2scores).

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_____

(iii) Identify this element. (1score)

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ITEM 4.

A chemical analysis of petroleum gave the following analytical data on a particular hydro carbon **L**. When L was burnt in excess oxygen, 14.4g of water and 26.4g of carbon dioxide were obtained. Its vapour density is 22.

Task.

Use the above data to determine the molecular formula of Hydrocarbon L present in L. (8scores).

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ITEM 5.

An analysist exploded 142cm^3 of a hydrocarbon Y C_xH_y, molecular mass 58g with excess oxygen and cooled it to room temperature, the volume of the residual gas was 694cm^3.On treatment with concentrated potassium hydroxide, the volume decreased to 126cm^3.

(a) Determine the molecular formula of Y.

(b) Write the structural formula and IUPAC name of all possible isomers of Y.

ITEM 6.

Technetium-99, **Tc** is used in the imaging of internal body organs, including the brain and heart. It is produced by a sequence of reactions in which molybdenum-98 is bombarded with neutrons to form molybdenum-99, which undergoes β decay to ^{99}**Tc**.Write the balanced nuclear equations for this sequence.(Technetium-Tc and Molybdenum, Mo

SECTION B

(Respond to these items on the answer sheets provided)

ITEM 7

A student is given a sample of an organic compound and tasked with identifying its structure and functional group. The compound is part of the alkane homologous series.

a) **Define** a homologous series and **explain** why alkanes are considered a homologous series. (4 scores).
b) The student analyzes a few compounds and observes different structural forms. **Explain** the concept of isomerism and describe two types of isomerism that can be seen in organic compounds, using examples. (6 scores).

c) The compound in question is found to contain a hydroxyl group (-OH). **Identify** the functional group and name the class of compounds it belongs to. Also, provide the IUPAC name of the compound given that the carbon chain has 5 carbon atoms. (6 scores)

d) A molecule of the compound exhibits stereoisomerism due to the spatial arrangement of atoms. **Explain** what stereoisomerism is and provide an example of a compound that can exhibit this type of isomerism. (4 scores).

ITEM 8

A material scientist wanted to design a new alloy for aerospace applications. Among the factors to be considered is screening effect, atomic radius, ionic radius and ionization energy. An element with a lower ionization energy is the best choice to consider. The following elements sodium, magnesium and aluminium are under investigation.

Tasks.

(a) What is meant by the terms screening effect, atomic radius and ionization energy.(3scores)

(b) Explain the variation of atomic radius and ionization energy across these elements.(8scores)

(c) Identify the element which could be the best choice for the intended purpose.(give a justification for your choice) (4mks).

ITEM 9.

A compound has the molecular formula C_6H_{14}. The student is tasked with identifying possible structural isomers of this compound, considering it is part of the alkane series.

a) **Draw** the structural isomers of C_6H_{14} that are possible, and name them using IUPAC nomenclature. (8 scores)

b) **Explain** the types of isomerism shown by these compounds. Specifically, focus on structural isomerism and provide examples from the isomers you drew. (6 scores)

c) **Discuss** the concept of functional group isomerism. How does it differ from structural isomerism, and provide an example of functional group isomerism. (4 scores)

d) **Evaluate** how the unique bonding properties of carbon contribute to the formation of isomers in organic compounds. (2scores)

END