

Spectroscopy (2011 VCE)

1) The IR wavenumber for bond stretching in a C-O bond ($1000\text{--}1300\text{ cm}^{-1}$) is lower than for a C-H bond ($2850\text{--}3300\text{ cm}^{-1}$). Which one of the following statements best explains this fact?

- a) Oxygen atoms are more electronegative than hydrogen atoms
- b) Oxygen atoms have a greater atomic mass than hydrogen atoms.
- c) Oxygen atoms have a greater atomic radius than hydrogen atoms.
- d) Oxygen atoms have a higher nuclear charge than hydrogen atoms..

Solution will appear here

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2) Petrol is a mixture of hydrocarbon molecules varying in size from six to ten carbon atoms. Forensic investigators suspect that traces of a substance found at a suspicious fire could be petrol that was used to start the fire. Which one of the following techniques could best be used to identify the substance?

- a) NMR spectroscopy
- b) UV-Visible spectroscopy
- c) atomic absorption spectroscopy
- d) gas chromatography followed by mass spectroscopy.

Solution will appear here

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3) The amount of copper in a solution of copper(II) sulfate can be determined using atomic absorption spectroscopy. When a blue copper (II) sulfate solution is introduced into an atomic absorption spectrometer, a green flame is observed. Consider the following.

- I) A copper (II) sulfate solution appears blue because it absorbs red light.
- II) The metal species undergoes oxidation in the flame.
- III) The flame is green due to electron transitions from a higher energy state to a lower energy state.

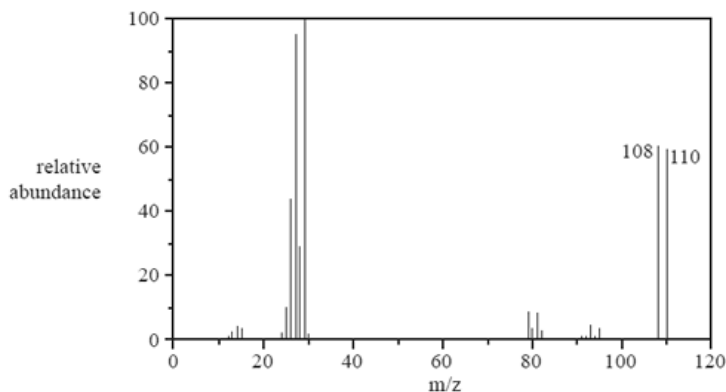
Which of the above statement are true?

- a) I only
- b) I and III only
- c) II and III only
- d) I, II and III

Solution will appear here

[Solution](#)

4) Bromine exists as two isotopes, ^{79}Br and ^{81}Br . The mass spectrum of bromoethane, $\text{C}_2\text{H}_5\text{Br}$ with two molecular ion peaks at m/z 108 and 110, is shown below.



Solution will appear here

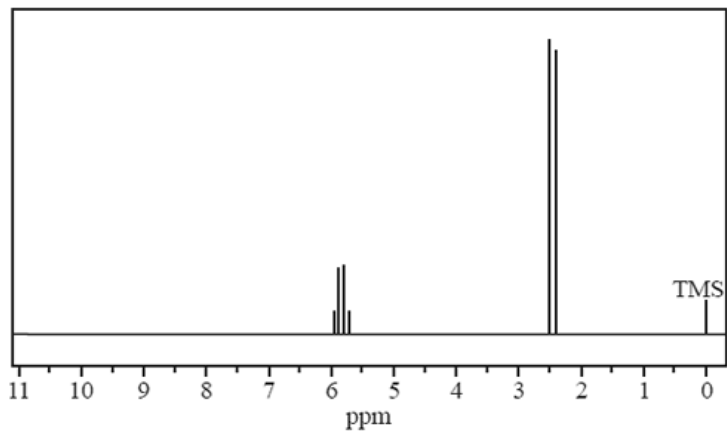
a) Identify the species that produces the peak at $m/z = 29$.

[Solution](#)

d) What do the two molecular ion peaks indicate about the relative abundance of ^{79}Br and ^{81}Br ? Give a reason

[Solution](#)

d) There are two compounds that have the molecular formula $\text{C}_2\text{H}_4\text{Br}_2$. The ^1H NMR spectrum of one of these compounds is provided below.



Solution will appear here

i) Draw the structural formula of each of the two compounds with the molecular formula $\text{C}_2\text{H}_4\text{Br}_2$.

[Solution](#)

ii) Which one of your two structures above corresponds to the ^1H NMR spectrum provided? Justify your answer by referring to both the ^1H NMR spectrum and to the structure of the compound.

[Solution](#)