**Trial SAC task: Instrumentation and pathways**

**Molecule A**

The composition of a 2.820 g sample of an organic chemical is tested and found to contain 1.538 g of carbon and 0.256 g of hydrogen. The remainder is oxygen.

**1**. Complete the table below.

|  |  |
| --- | --- |
| **Element** | **Mass g** |
| carbon |  |
| hydrogen |  |
| oxygen |  |

1 mark

**2**. Use the above data to calculate the empirical formula of the compound.

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2 marks

**3. a**. The molar mass of this molecule is 44 g mol-1. What is the molecular formula of the

molecule?

Explain how you arrived at your answer.

2 marks

**b**. Is this formula consistent with (explain your answer)

i. a typical alcohol \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ii. a typical carboxylic acid? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

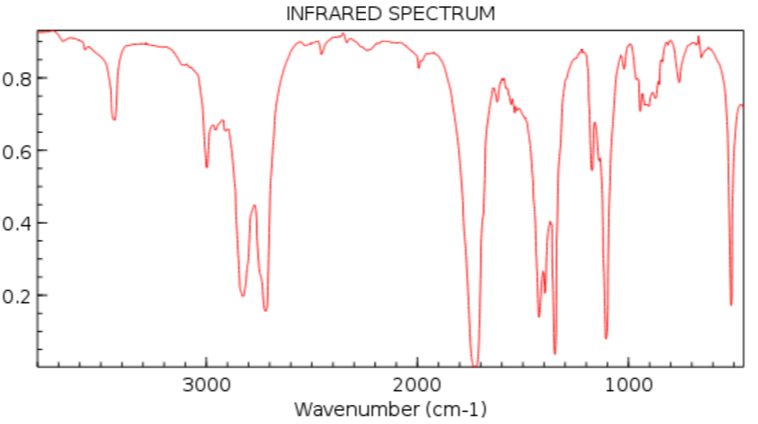
2 marks

**4**. Draw two possible structures for this substance. Provide the systemmatic name for the

substances you have drawn.(Molecule is not necessarily alkane based)

4 marks

The infrared spectrum of the molecule is provided below.



**5**. **a**. Select two absorptions on the spectrum that can help you identify the molecule you are

studying.

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**b**. Sometimes the absence of an absorption can be as important as the presence of an

absorption. Use this spectrum to provide an example to support this statement.

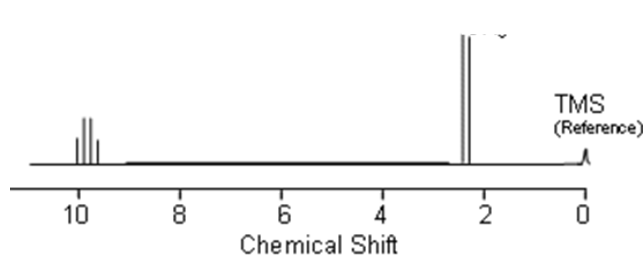
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**c**. What conclusion can you draw at this point about the identity of the substance?

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2 + 1 + 2 = 5 marks

The proton NMR is shown below.



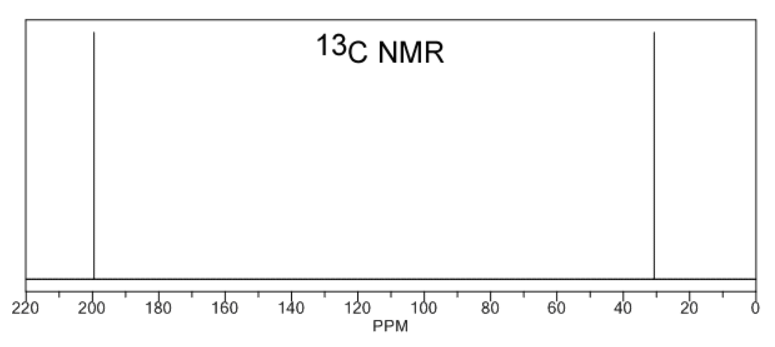
**6.** Explain clearly how this NMR can confirm the identity of the substance in question.

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3 marks

The carbon NMR is shown below.



**7**. Explain clearly how this NMR can confirm the identity of the substance in question.

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2 marks

**8**. Explain whether this molecule is likely to be soluble in water or not.

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2 marks

**9**. This substance is flammable. Write a balanced equation for its complete combustion in air.

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1 mark

**10**. Explain how you would manufacture this substance from an appropriate alkene. Include

the name of all necessary reagents.

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3 marks

**11**. If a sample of this molecule sits on a window sill in a beaker for a month it is slowly converted to a new substance.

1. Draw the structure of the new product. 1 mark
2. Write a balanced half-equation for the reaction occurring. 2 marks

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1. What is the most significant change you would see on the infrared spectrum of the sample as the new product forms? 1 mark

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**Molecule B**

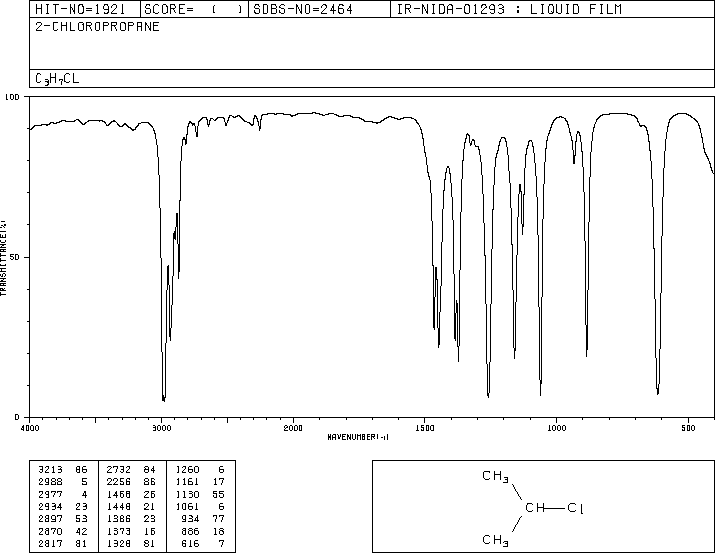
**Data**

The molecular formula of a molecule is C3H7Cl.

The infrared spectrum of the mystery molecule is shown below

**1**. **a**. There is no significant peak over 3000 cm-1. What conclusion might this lead to?

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**b**. There is a significant peak at 3000 cm-1. What conclusion might this lead to?

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**c**. The infrared spectrum is a relatively plain one. What conclusion might this lead to?

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1 + 1 + 1 = 3 marks

**2**. Draw and name two possible isomers with the molecular formula of this mystery

molecule.

2 marks

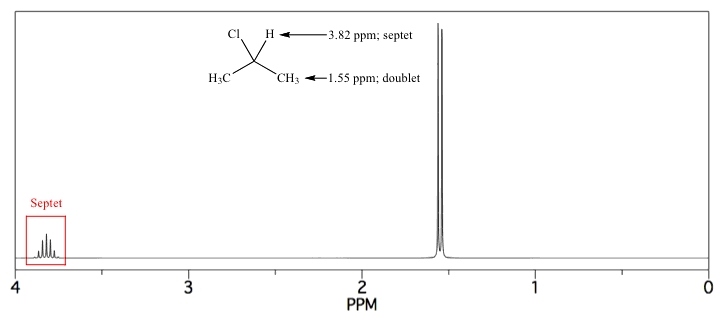
The 1H NMR spectrum for the mystery molecule is drawn below

**3. a**. How many different hydrogen environments does this molecule have? \_\_\_\_\_\_\_\_

1. What conclusion can you draw from the splitting on the left set of peaks?

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1. What conclusion would you draw from the splitting on the right set of peaks?



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1 + 1 + 1 = 3 marks

**4.** Use the NMR to explain carefully which isomer is the correct one.

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3 marks

**5. a**. How many different carbon environments does this molecule have? \_\_\_\_\_\_\_\_

**b**. Would you expect this molecule to be polar or non polar. Explain your answer.

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1 + 1 = 2 marks

6. Write a balanced equation for the formation of this molecule from propane.

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