**SAC 1 Unit 4: Mystery molecule Total: 30 marks**

Unless otherwise stated, assume the questions are all about the same mystery molecule.

A 4.400 g sample of an organic chemical is analysed and found to contain 0.600 g of hydrogen and 0.800 g of oxygen

1. a. What is the mass of carbon? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

 b. Determine the empirical formula of the mystery molecule. 2 marks

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The mass spectrum of the mystery molecule is drawn below. 

2. a. What is the molecular formula of the mystery molecule? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

 b. Explain how you arrived at your answer. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3. a. Suggest a fragment that might be causing the base peak. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

 b. What has been knocked off the molecule to form the peak at 73? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

4. Draw and name 3 possible structural isomers with the molecular formula above. 4 marks

 isomer 1 isomer 2 isomer 3

 name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 The IR spectrum of the mystery molecule is shown below:



5. Refer to two possible absorbances to explain what conclusions you can draw from this spectrum about our

 mystery molecule. 3 marks

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The C-NMR of the mystery molecule is shown below



6. a. How many carbon environments does the molecule have? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

 b. Draw a molecule with the correct molecular formula that is ruled out as a possible alternative by this

 C-NMR. Explain why it is ruled out. 2 marks

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The H-NMR is shown below:



Splitting, from left to right:

sextet

singlet

quartet

sextet

doublet

triplet

7. Use this spectrum, and other information provided, to decide on the structure for the mystery molecule.

 Outline clearly how you reached this conclusion. 4 marks

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8. Outline how you could make this molecule from a suitable alkene. Include in your answer whether your

 pathway produces molecules other than the mystery molecule. 4 marks

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9. a. If the mystery molecule is reacted with K2Cr2O7 in acid conditions, draw the molecule that will form.

 1 mark

 b. Write a balanced half-equation for the reaction of Cr2O72-to form Cr3+. 1 mark

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 c. What category of reaction is this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

10. If you are the one preparing the mystery molecule from the alkene, what preparation do you need to do to

 comply with applicable safety guidelines? 2 marks

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END OF TASK