

Dr Clays A-level Chemistry

# UNIT 3 TOPIC 4
# ORGANIC ANALYSIS

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Unit 3 Topic 4– Organic Analysis

**EXERCISE 1 – Analytical Techniques**

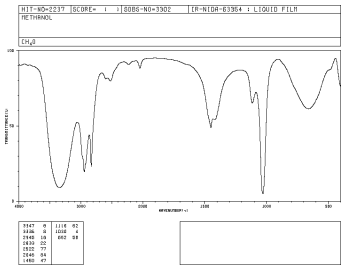
1. a) Low resolution mass spectrometry identified the molecular ion peak of an organic molecule as 86. Suggest three possible molecular formulae for the molecule.

b) High resolution mass spectrometry identified the molecular ion peak of the organic molecule as 85.998. Deduce the molecular formula of the molecule, given the following relative isotopic masses:

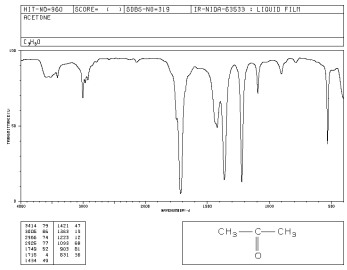
| isotope | Relative isotopic mass |
|---|---|
| $^{16}O$ | 15.994 |
| $^{12}C$ | 12.000 |
| $^{1}H$ | 1.008 |

2. Identify the bonds responsible for all the peaks in the non-fingerprint region of the following infra-red spectra, and hence state the functional group present:

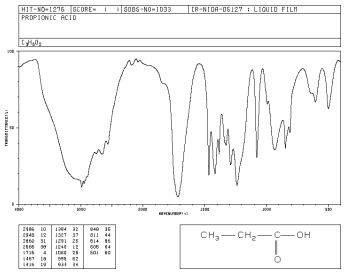
a)



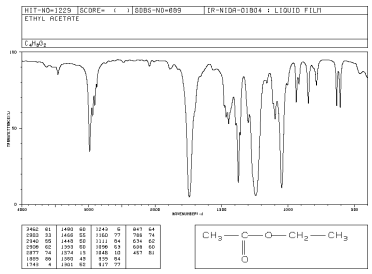

b)




c)




d)




3. Three compounds A, B and C, all with molecular formula $C_4H_8O_2$, are found to have very different infra-red spectra. All three spectra contain a sharp peak at 1700 $cm^{-1}$, but the infra-red spectrum of A contains a broad peak at 2500 – 3000 $cm^{-1}$, the infra-red spectrum of B contains no broad peaks, and the infra-red spectrum of C contains a broad peak at 3000 – 3300 $cm^{-1}$. Suggest possible structures for A, B and C.

4. Suggest how infra-red spectroscopy could be used to determine the exact structure of a molecule containing only C-H absorptions and a C=O absorption in the region 1500 – 3500 $cm^{-1}$.

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**EXERCISE 2 – Tests for Functional groups**

1 A student has an unknown organic compound. It contains only carbon, oxygen and hydrogen atoms. He adds it to a test tube containing a solution of Tollens' reagent. He warms the test tube for a while, and silver metal starts to coat the inside of the test tube.

What homologous series does his compound belong to?

2 A student has two compounds, A and B. She knows one is a ketone. She adds the two compounds, A and B, to separate test tubes

containing Benedict's solution. A red precipitate forms in the test tube containing compound A, but nothing happens with compound B. Which compound, A or B, is the ketone?

3 A student is investigating the behaviour of primary alcohols.

a) She firstly adds a primary alcohol to a solution containing potassium dichromate(VI) ions and refluxes the mixture. What colour change would you expect her to see?

b) She then adds a spatula of calcium carbonate to the resulting solution. The solution starts to fizz. The student bubbles the resulting gas through a test tube containing limewater. What would you expect the student to observe?

4 A student has three test tubes. Each test tube contains one of three carbonyl compounds: propanal, propanoic acid or propanone. Outline a series of tests the student could carry out to identify which test tube contains which compound. You should include details of any reagents, conditions and expected observations.

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a) State why warming samples of a substance with acidified potassium dichromate(VI) solution is not enough on its own to distinguish whether it is a primary alcohol or a secondary alcohol.

b) Describe an experiment that you could perform to distinguish between samples of a primary alcohol and a secondary alcohol.