

A level Chemistry A

H432/02 Synthesis and analytical techniques

Question Set 20

1. The relative molecular masses and boiling points of some fuels are shown in **Table 22.1**.

| Fuel | Relative molecular mass | Boiling point/°C |
|-------------|-------------------------|------------------|
| hexane | 86 | 69 |
| pentan-1-ol | 88 | 138 |
| heptane | 100 | 98 |

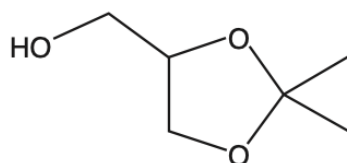
Table 22.1

- (a) Write an equation for the incomplete combustion of heptane. [1]
- (b) Explain the difference in the boiling points of the fuels in **Table 22.1**. [4]
- (c) Fuel additives are often used to improve the combustion of a fuel.
- (i) Compound **N** is a fuel additive containing carbon, hydrogen and oxygen only.

Complete combustion of 1.71 g of compound **N** produces 2.97 g of CO₂ and 1.62 g of H₂O. The relative molecular mass of compound **N** is 76.0.

Calculate the molecular formula of **N** and suggest a possible structure for the compound.

- (ii) Solketal has been investigated as a potential fuel additive. [5]



solketal

Solketal is synthesised from propane-1,2,3-triol and a carbonyl compound.

Construct a balanced equation for this synthesis.
Show structures for the organic compounds in your equation.

[2]

- (d)* A scientist is researching compounds that might be suitable as fuel additives. One of the compounds gives the analytical results below.

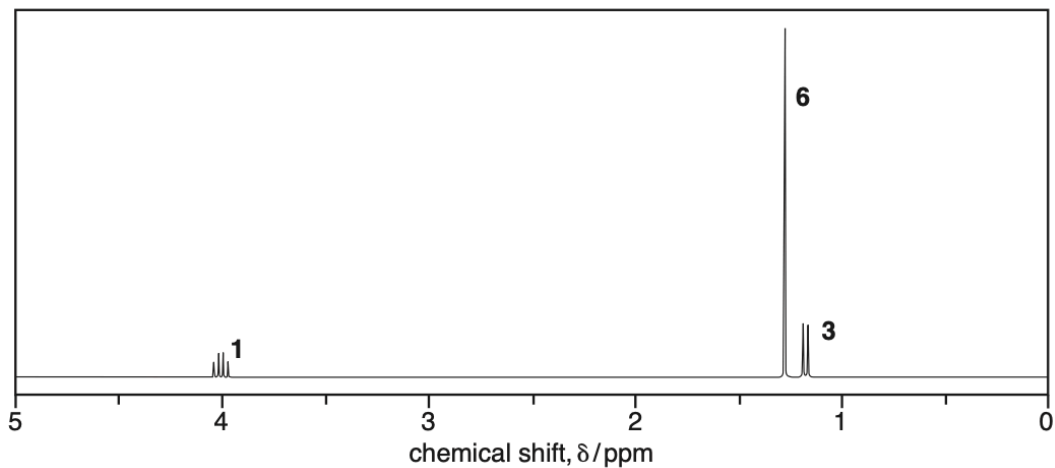
Elemental analysis by mass:

C: 54.54%; H: 9.10%; O: 36.36%

Mass spectrum:

Molecular ion peak at $m/z = 132.0$

^1H NMR spectrum in D_2O



The numbers by the peaks are the relative peak areas.

When the spectrum is run without D_2O , there are **two** additional peaks with the same relative peak areas at 11.0 ppm and 3.6 ppm.

Use the information provided to suggest a structure for the compound.

Show **all** your reasoning.

[6]

Total Marks for Question Set 20: 18

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