

MEASUREMENT Core (SL & HL)

1. An unknown organic compound, X, was investigated using a variety of analytical techniques.

(a) Elemental analysis found that the compound had the following composition by mass:
54.5% carbon, 9.2% hydrogen and 36.3% oxygen.

(i) Determine the empirical formula of compound X.

[2]

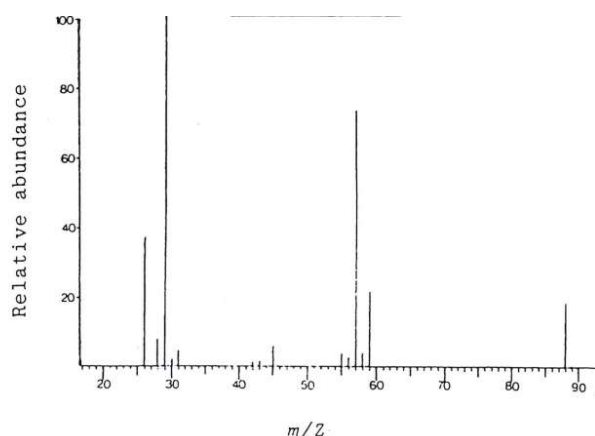
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(b) The mass spectrum of compound X is shown below.



(i) Determine the mass of the molecular ion peak, and hence deduce the molecular formula for compound X.

[2]

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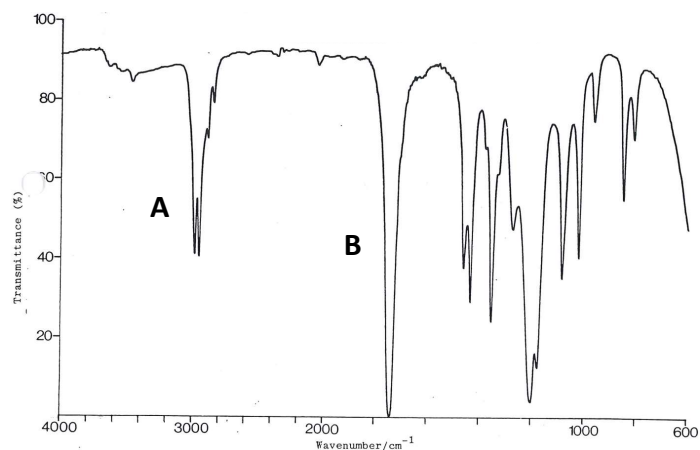
(ii) Using section 28 of the data booklet, identify species responsible for peaks at $m/z = 29$ and 57 .

[2]

29:.....

57:.....

(c) The infrared (IR) spectrum of compound X is shown below.

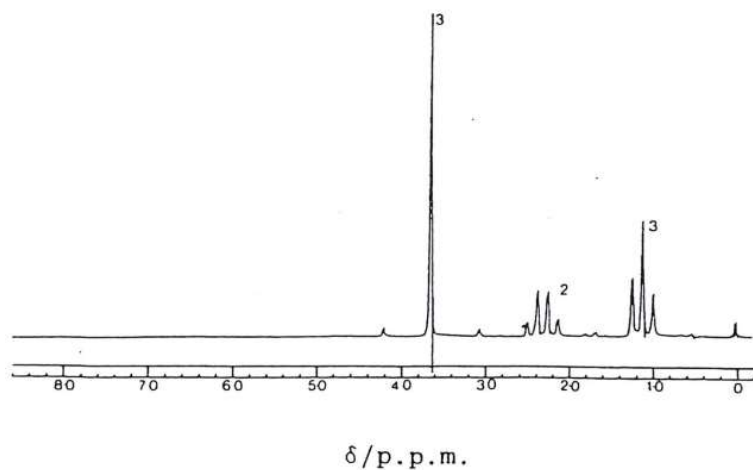


(i) Identify the bonds in the molecule causing the bands labelled **A** and **B** (using section 26 of the data booklet).

[2]

<p>A:.....</p> <p>B:.....</p>

(d) The ^1H -NMR spectrum of compound X is shown below:



(i) Deduce the full structural formula of compound X using section 27 of the data booklet.

[1]

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2. Two isomers, propanal and propanone, have molecular formula C_3H_6O .

(a) State whether infrared (IR) spectroscopy could be used to distinguish between propanal and propanone. Explain your reasoning.

[1]

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(b) Using section 28 of the data booklet, identify the m/z of a species that might be found in the mass spectrum of **both** propanal and propanone.

[1]

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(c) Using section 28 of the data booklet, identify the m/z of a species that might be found in the mass spectrum of propanal, but **not** in propanone.

[1]

.....

(d) Identify the number of hydrogen environments and hence the number of peaks in the 1H -NMR spectrum of propanal and propanone.

[2]

Propanal:.....

Propanone:.....

3. Deduce the index of hydrogen deficiency for ethyne ($H-C\equiv C-H$) and for compound Y:



[2]

Ethyne:.....

Compound Y:.....

Total Marks 16 (24 minutes)