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CHEMISTRY

ORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	NMR SPECTROSCOPY
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	10
TOTAL MARKS	/24

NMR Spectroscopy - 2

1. Bromobutane, $CH_3CH_2CH_2CH_2Br$, can be reacted with hot aqueous sodium hydroxide to prepare butan-1-ol.

$CH_3CH_2CH_2CH_2Br + OH^- \rightarrow CH_3CH_2CH_2CH_2OH + Br^-$

The butan-1-ol produced can be analysed by mass spectrometry.

(a) Predict two fragment ions that you would expect to see in the mass spectrum of butan-1-ol and state the m/z value of each ion.

(2)

(b) State a use of mass spectrometry outside of the laboratory.

(1)

2. Which one of the following does not have a singlet peak in its proton n.m.r. spectrum?

A. Butyl methanoate
B. Propyl ethanoate
C. Ethyl propanoate
D. Methyl butanoate

I am Sorry !!!!!

(1)

3. Compound Q has the molecular formula C_4H_7ClO and does not produce misty fumes when added to water.

(a) The infra-red spectrum of Q contains a major absorption at 1724 cm^{-1}.

Identify the bond responsible for this absorption.

(1)

(b) The mass spectrum of Q contains two molecular ion peaks at m/z = 106 and m/z = 108. It also has a major peak at m/z = 43.

Suggest why there are two molecular ion peaks.

(1)

(c) A fragment ion produced from Q has m/z = 43 and contains atoms of three different elements.

Identify this fragment ion and write an equation showing its formation from the molecular ion of Q.

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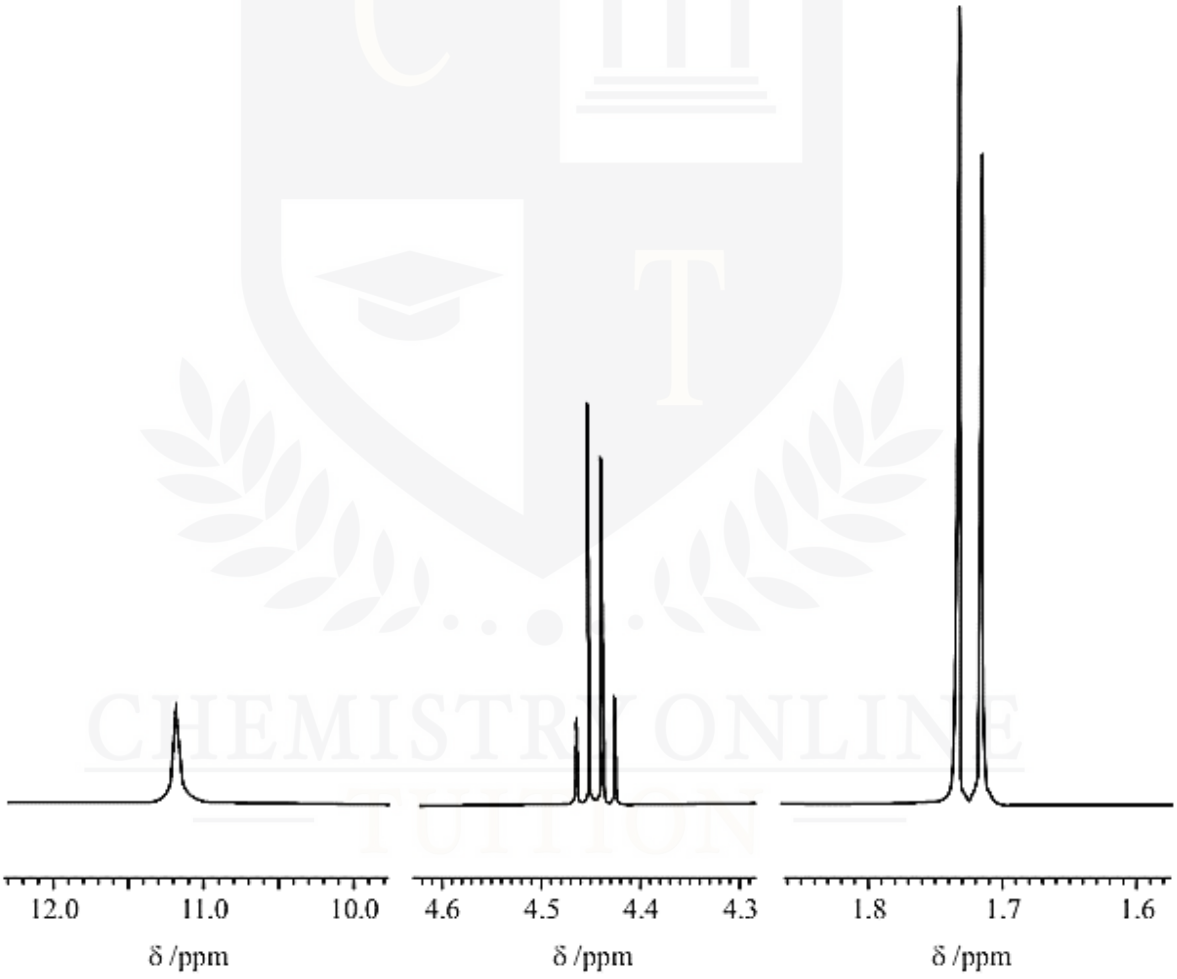
(2)

4. Which one of the following has a singlet peak in its proton n.m.r. spectrum?

A. Ethyl propanoate
B. propyl methanoate
C. hexan-3-one
D. 2-chlorobutane

(1)

5. Three sections of the proton n.m.r. spectrum of $CH_3CHClCOOH$ are shown below.



(a) Name the compound $CH_3CHClCOOH$.

(1)

(b) Explain the splitting patterns in the peaks at δ 1.72 and δ 4.44

(2)

(c) Predict the splitting pattern that would be seen in the proton n.m.r. spectrum of the isomeric compound $ClCH_2CH_2COOH$.

(1)

6. Propene reacts with hydrogen bromide to form a mixture of saturated organic products.

The proton n.m.r. spectrum of the major organic product has

A. 3 peaks with relative intensities 3 : 2 : 2
B. 2 peaks with relative intensities 3 : 4
C. 3 peaks with relative intensities 3 : 1 : 3
D. 2 peaks with relative intensities 6 : 1

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(1)

7. Proton n.m.r. spectra are recorded using a solution of a substance to which tetramethylsilane (TMS) has been added.

(a) Give two reasons why TMS is a suitable standard.

(2)

(b) Give an example of a solvent which is suitable for use in recording an n.m.r. spectrum.

Give a reason for your choice.

(2)

8. How many peaks will be observed in the low-resolution proton n.m.r. spectrum of $(CH_3)_2CHCOO(CH_2)_3CH_3$?

A. 4
B. 5
C. 6
D. 7

(1)

9. Butenedioic acid, HOOCCH=CHCOOH, occurs as two stereoisomers.

One of the isomers readily forms the acid anhydride $C_4H_2O_3$ when warmed.

Describe and explain the appearance of the proton n.m.r. spectrum of butenedioic acid.

(3)

10. State the number of peaks in the proton n.m.r. spectra of $CH_3CH_2CH_2CH_2OH$ and of $(CH_3)_3COH$. (Analysis of peak splitting is not required.)

(2)

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