



**CHEMISTRY ONLINE**  
— **TUITION** —

Phone: +442081445350

[www.chemistryonlinetuition.com](http://www.chemistryonlinetuition.com)

Email: [asherrana@chemistryonlinetuition.com](mailto:asherrana@chemistryonlinetuition.com)

# CHEMISTRY

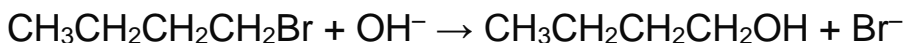
## INORGANIC CHEMISTRY II

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

**ChemistryOnlineTuition Ltd reserves the right to take legal action against any individual/ company/organization involved in copyright abuse.**

## NMR Spectroscopy - 2

1. Bromobutane,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ , can be reacted with hot aqueous sodium hydroxide to prepare butan-1-ol.



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

(1)

3. Compound Q has the molecular formula  $\text{C}_4\text{H}_7\text{ClO}$  and does not produce misty fumes when added to water.

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

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.

CHEMISTRY ONLINE  
— TUITION —

(2)

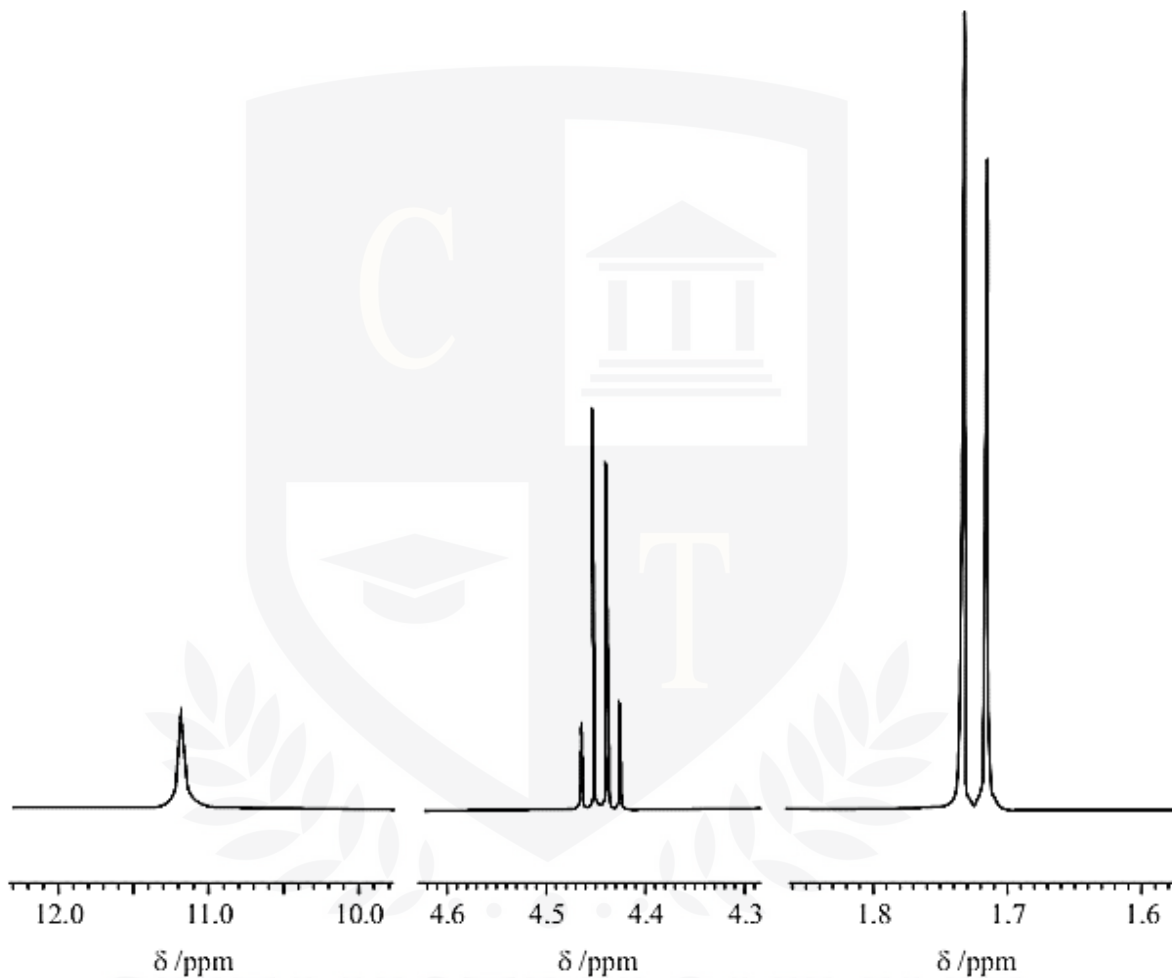
4. Which one of the following has a singlet peak in its proton n.m.r. spectrum?

- 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  $\text{CH}_3\text{CHClCOOH}$  are shown below



- (a) Name the compound  $\text{CH}_3\text{CHClCOOH}$ .

(1)

- (b) Explain the splitting patterns in the peaks at  $\delta$  1.72 and  $\delta$  4.44

(2)

(c) Predict the splitting pattern that would be seen in the proton n.m.r. spectrum of the isomeric compound  $\text{ClCH}_2\text{CH}_2\text{COOH}$

(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

(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  $(\text{CH}_3)_2\text{CHCOO}(\text{CH}_2)_3\text{CH}_3$ ?

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

(1)

9. Butenedioic acid,  $\text{HOOCCH}=\text{CHCOOH}$ , occurs as two stereoisomers.

One of the isomers readily forms the acid anhydride  $\text{C}_4\text{H}_2\text{O}_3$  when warmed.

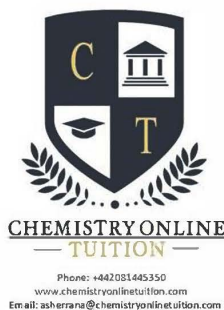
Describe and explain the appearance of the proton n.m.r. spectrum of butenedioic acid.

(3)

I am Sorry !!!!  
10. State the number of peaks in the proton n.m.r. spectra of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  and of  $(\text{CH}_3)_3\text{COH}$ . (Analysis of peak splitting is not required.)



**DR. ASHAR RANA**



- Founder & CEO of Chemistry Online Tuition Ltd.
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, and Math's Tutor

## CONTACT INFORMATION FOR **CHEMISTRY ONLINE TUITION**

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: [www.chemistryonlinetuition.com](http://www.chemistryonlinetuition.com)
- Email: [asherrana@chemistryonlinetuition.com](mailto:asherrana@chemistryonlinetuition.com)
- Address: 210-Old Brompton Road, London SW5 OBS, UK