

AQA A-Level Chemistry

NMR

Questions only

The newest questions, about an hour. All 7 are in the exam generator.

Questions

6

Total marks

41

Time allowed

53 min

Name

Class or teacher

Date

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the AQA Data Sheet.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2024 A-level P2 Q6	12	
2	2018 A-level P3 Q16	1	
3	2025 A-level P2 Q7	12	
4	2021 A-level P3 Q11	1	
5	2021 A-level P2 Q7	9	
6	2022 A-level P2 Q6	6	

Total _____ / 41 **Percentage** _____ %

Questions from AQA past papers, 2018–2025, reproduced for revision. Practise these topics online, with instant marking:

whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions?topics=nmr&len=0

Questions

NMR · 6 questions · 41 marks · time allowed 53 min

Q1 · June 2024 · Paper 2 · Q6 · [12 marks]

This question also needs Optical isomerism.

Compounds V, W, X and Y are isomers with the molecular formula $C_5H_{10}O_2$

Isomers V and W are carboxylic acids with formulas that can be written as C_4H_9COOH

(a) Give an equation for the reaction of C_4H_9COOH with sodium hydrogencarbonate.

[1 mark]

(b) Isomer V has an asymmetric carbon atom.

Deduce the structure of V.

[1 mark]

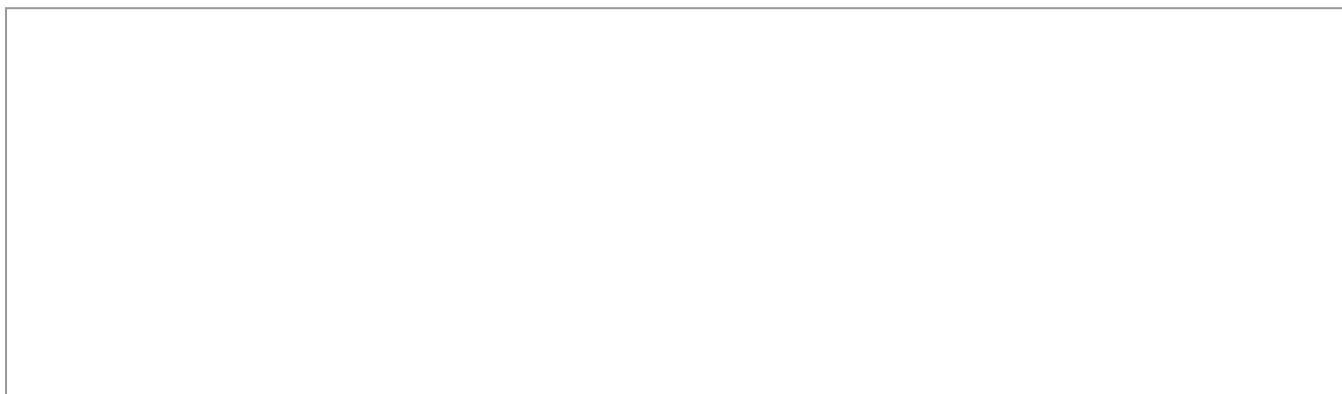
(c) Isomer W has four peaks in its ^1H NMR spectrum.

Deduce the structure of W.

Deduce the integration ratio for the four peaks in the ^1H NMR spectrum of W.

[2 marks]

Structure



Integration ratio



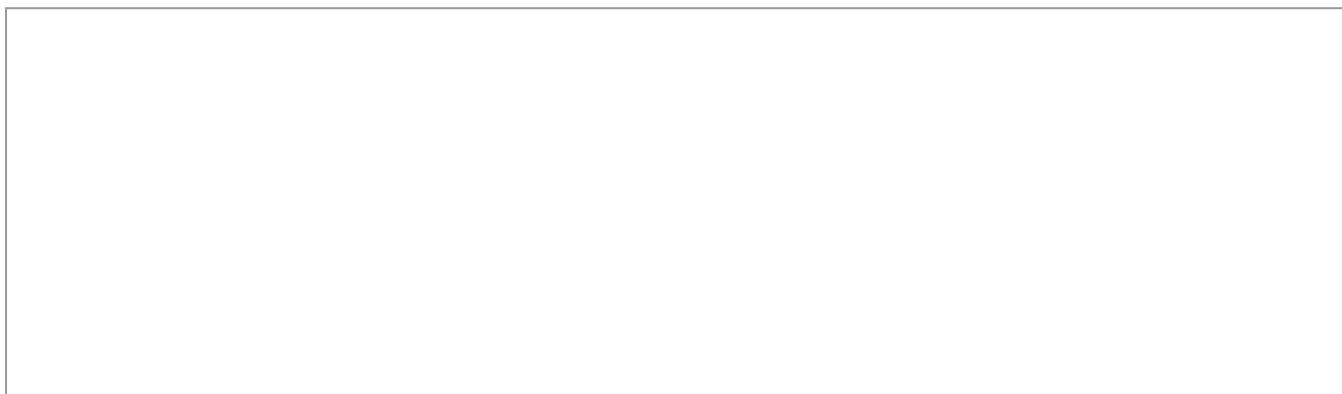
(d) Isomer X has three singlets with integration ratio 1:3:6 in its ^1H NMR spectrum.

Deduce the structure of X.

Explain why the peaks in the ^1H NMR spectrum are singlets.

[2 marks]

Structure



Explanation



(e) The table below shows information about the peaks in the ^1H NMR spectrum of isomer Y.

Chemical shift δ / ppm	Integration ratio	Splitting pattern
3.65	2	singlet
1.19	3	singlet

Draw the parts of the structure of Y that can be deduced from each of these peaks.

Deduce the structure of Y.

State how many peaks are in the ^{13}C NMR spectrum of Y.

Part of structure from peak at $\delta = 3.65$ ppm

Part of structure from peak at $\delta = 1.19$ ppm

[6 marks]

Structure of Y

Number of peaks in ^{13}C NMR spectrum of Y

Q2 · June 2018 · Paper 3 · Q16 · [1 mark]

How many peaks are there in the ^{13}C NMR spectrum of 1,4-dimethylbenzene?

Tick (✓) one box.

☐ **A** 8

☐ **B** 4

☐ **C** 3

☐ **D** 2

Q3 · June 2025 · Paper 2 · Q7 · [12 marks]

This question also needs Organic analysis.

This question is about spectroscopy.

07.1 Compound P is a hydrocarbon with only one peak (a singlet) in its ^1H NMR spectrum.

P has a precise M_r of 84.09396

Carbon has a precise A_r of 12.00000

Hydrogen has a precise A_r of 1.00783

Use this information to deduce the molecular formula of P. Show your working.

Suggest two possible structures for P.

Explain how P can be identified using its infrared spectrum above 1500 cm^{-1}

Use Table A in the Data Booklet to help you to answer this question.

[5 marks]

Molecular formula

Structure 1

Structure 2

Explanation

07.2 Compound Q has the molecular formula $C_5H_8O_2$

Figure 7 shows the ^{13}C NMR spectrum of compound Q.

Figure 8 shows the ^1H NMR spectrum of compound Q.

Figure 7

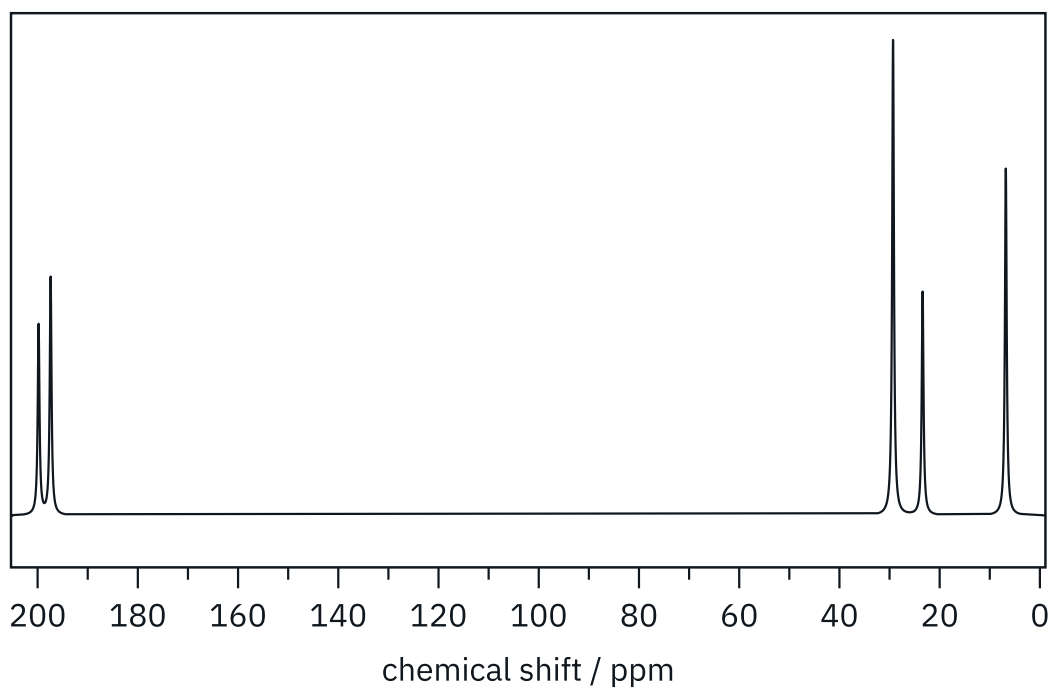
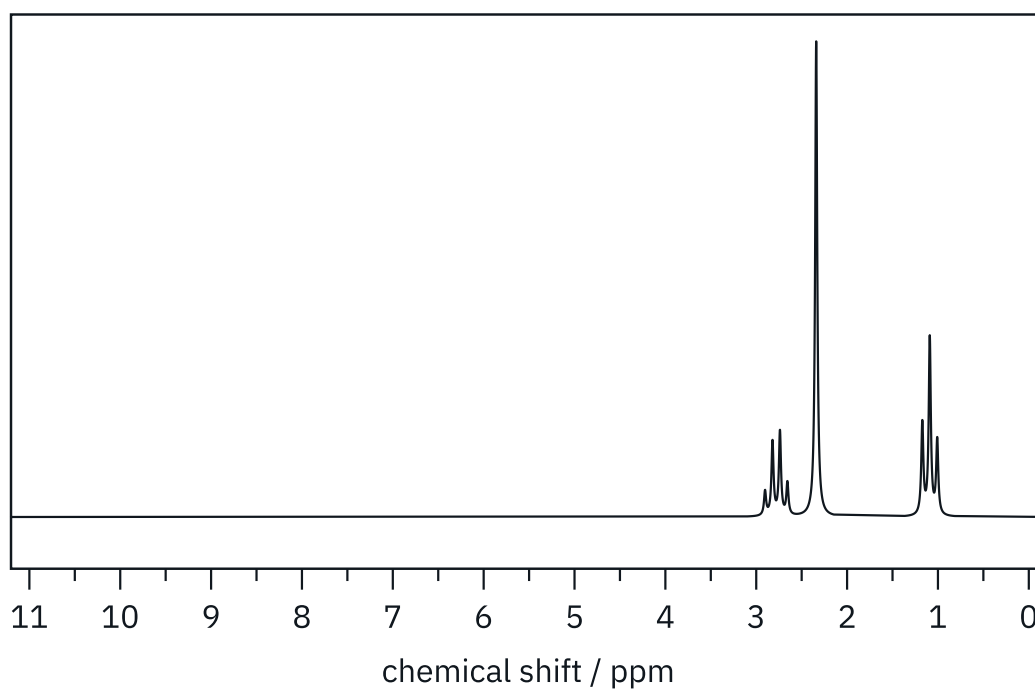


Figure 8



Explain what you can deduce about the structure of compound Q.

In your answer you should refer to

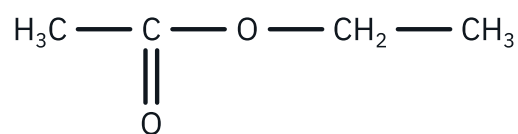
- the peaks in the ^{13}C NMR spectrum
- the chemical shift values for the peaks in the ^1H NMR spectrum
- the splitting pattern for the peaks in the ^1H NMR spectrum.

Give the structure of compound Q.

[7 marks]

Q4 · November 2021 · Paper 3 · Q11 · [1 mark]

Which statement does not support the suggestion that an unknown organic compound is



Tick (✓) one box.

- ☐ **A** Its ^1H NMR spectrum has 3 peaks with an integration ratio of 2:3:3
- ☐ **B** Its ^{13}C NMR spectrum has 3 peaks.
- ☐ **C** Its infrared spectrum has an absorption at 1735 cm^{-1}
- ☐ **D** It has 36.36% by mass of oxygen and 9.09% by mass of hydrogen.

Q5 • November 2021 • Paper 2 • Q7 • [9 marks]

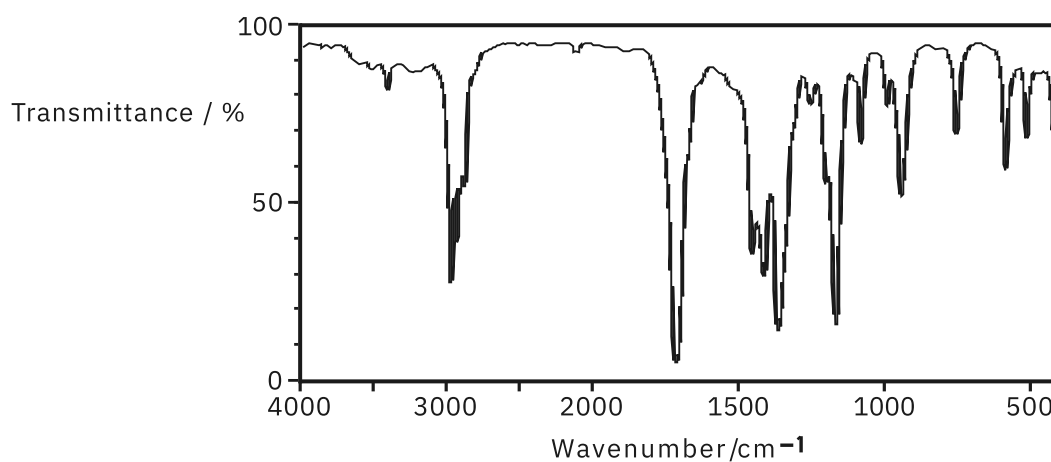
This question also needs Amines.

This question is about spectroscopy.

(a) Compound K has molecular formula C_4H_8O

Figure 1 shows the infrared spectrum of K.

Figure 1



Which functional group does K contain?

Tick (✓) one box.

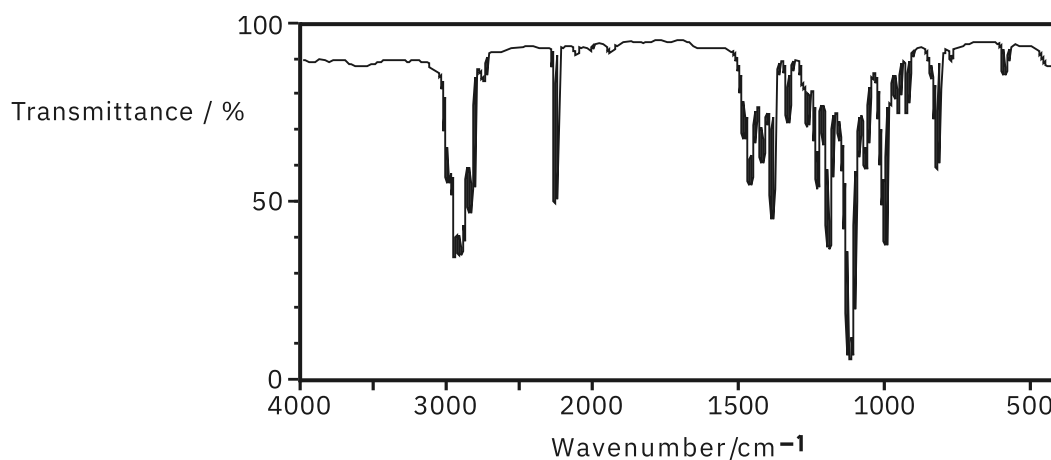
Functional Group				
alcohol	alkene	amine	carbonyl	nitrile

[1 mark]

(b) Compound L has molecular formula C_4H_7NO

Figure 2 shows the infrared spectrum of L.

Figure 2



L reacts with H_2 in the presence of a nickel catalyst to give compound M.

Suggest three ways in which the infrared spectrum of M is different from the infrared spectrum of L.

[3 marks]

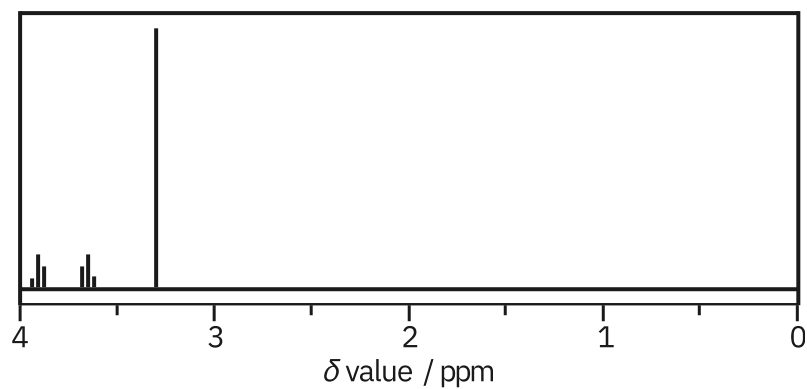
1

2

3

(c) Figure 3 shows the ^1H NMR spectrum of Q, $\text{C}_3\text{H}_7\text{ClO}$

Figure 3



The table below shows the chemical shifts (δ values) and integration values for each peak.

δ value / ppm	3.95	3.65	3.35
Integration value	0.6	0.6	0.9

Deduce the structure of Q.

E

[5 marks]

[illegible]

Q6 · June 2022 · Paper 2 · Q6 · [6 marks]

This question also needs Organic analysis.

This question is about compound X with the empirical formula $\text{C}_2\text{H}_4\text{O}$

Figure 1 shows the infrared spectrum of X.

Figure 2 shows the ^{13}C NMR spectrum of X.

The ^1H NMR spectrum of X shows four peaks with different chemical shift values.

The table below gives data for these peaks.

Figure 1

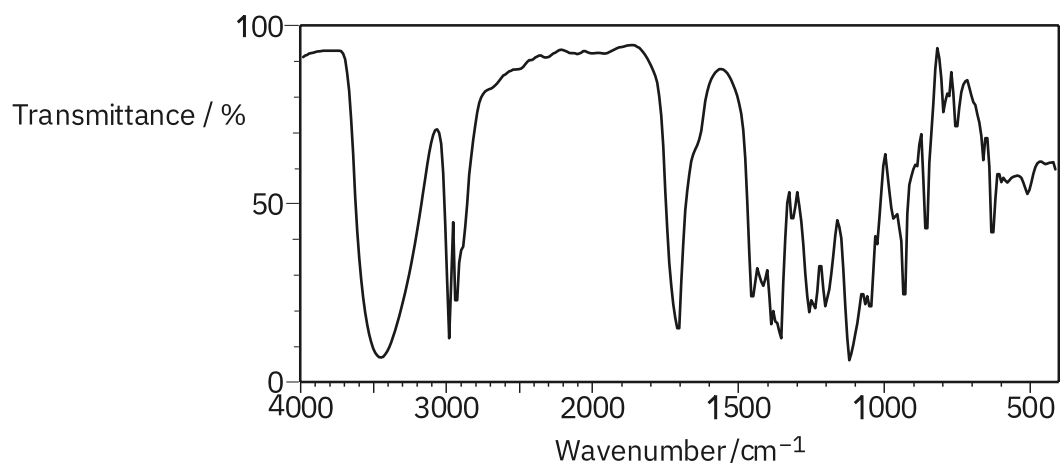
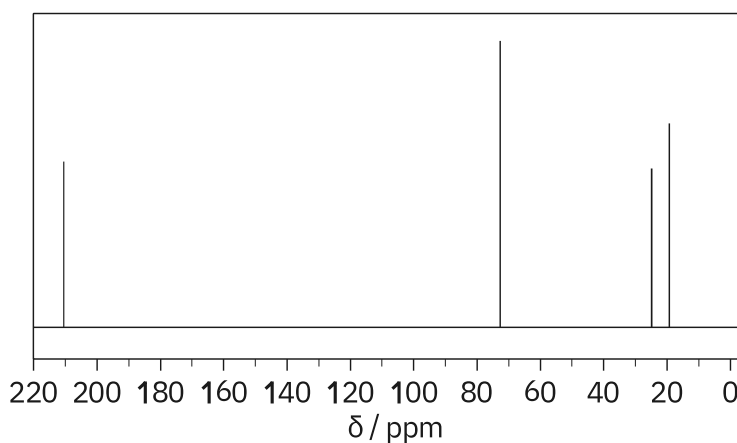


Figure 2



Chemical shift δ / ppm	3.9	3.7	2.1	1.2
Splitting pattern	quartet	singlet	singlet	doublet
Integration value	1	1	3	3

Show how information from Figure 1, Figure 2 and the table can be used to deduce the structure of compound X.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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