

Past-paper walk-through

Proton (^1H) NMR spectroscopy ■ 37.4

eXercise

Questions in this set

- 9701/42 N25 Q7 ■ 11 marks

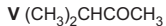
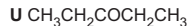
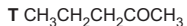
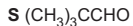
Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 7

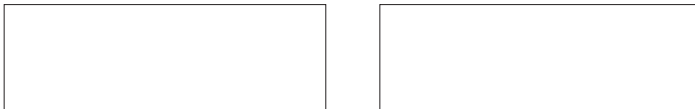
9701/42 N25 ■ Q7 ■ 11 marks

- 7 **P, Q, R, S, T, U,** and **V** are the seven structural isomers with molecular formula $C_5H_{10}O$ that have a carbonyl group.



- (a) Only one of these seven compounds has stereoisomers.

Draw three-dimensional diagrams of the **two** stereoisomers of this compound.



Question 7

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[2]

(b) **P, Q, R, S, T, U,** and **V** are treated separately with alkaline $I_2(aq)$ and the product mixture is acidified.

(i) Identify the **two** compounds that give a positive result with alkaline $I_2(aq)$.

Question 7

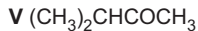
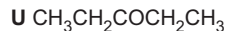
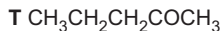
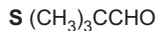
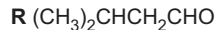
- (ii) Describe the observations when **one** of the compounds you have identified in **(b)(i)** is treated with alkaline $I_2(aq)$ and give the structural formulae of the **two** carbon-containing products of this reaction.

Question 7

Question 7

Question 7

[2]

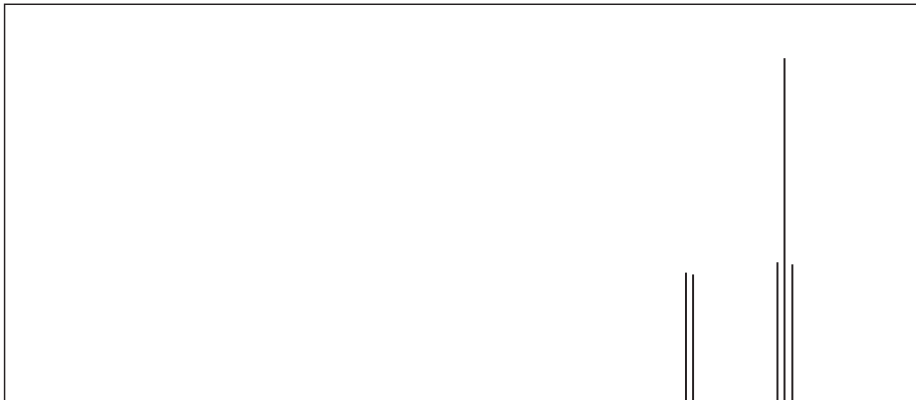


(c) The proton (^1H) NMR spectra of **P**, **Q**, **R**, **S**, **T**, **U**, and **V** are compared.

(i) Identify the only compound that gives a spectrum with two singlets and no other peaks.

Question 7

Fig. 7.1 shows the spectrum obtained from one of the compounds.



Question 7

I

III.

III

I

Question 7

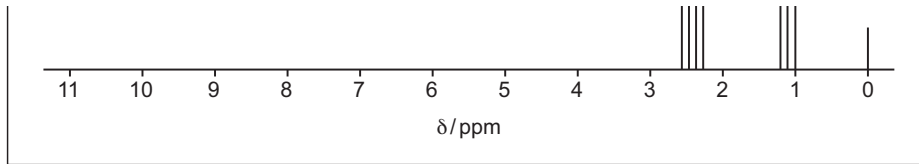


Fig. 7.1

(ii) Identify the compound that gives this spectrum.

Question 7

(iii) Name the splitting pattern of the peak at $\delta = 1.1$ in Fig. 7.1.

Give the reason for this splitting.

Question 7

Question 7

[1]

- (iv) Identify the substance that gives the small peak at $\delta = 0$ in Fig. 7.1.

Question 7

(d) The carbon-13 NMR spectra of **R**, **S**, **T** and **U** are compared.

Complete Table 7.1 to state the number of peaks in the spectrum of each compound.

Table 7.1

compound	number of peaks
R $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$	
S $(\text{CH}_3)_3\text{CCHO}$	
T $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_3$	
U $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$	

Question 7

1/4

Question 7

[Total: 11]

Solution 7

(a)

Mark scheme

- M1: Q $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CHO}$
- M2:
- 2

Solution 7

(b)(i)

Mark scheme

- T $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_3$ AND V $(\text{CH}_3)_2\text{CHCOCH}_3$
- 1

Solution 7

(b)(ii) Mark scheme

- ■
- yellow solid
- ■
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ OR $(\text{CH}_3)_2\text{CHCOOH}$
- ■
- CHI_3
- Any two [1], all three [2]
- 2

Solution 7

(c)(i)

Mark scheme

- S (CH₃)₃CCCHO
- 1
- AND
- 9701/42
- October/November 2025

Solution 7

(c)(ii)

Mark scheme

- U $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
- 1

(c)(iii)

Mark scheme

- triplet AND two hydrogen atoms on neighbouring carbon atoms
- 1

Solution 7

(c)(iv)

Mark scheme

- TMS / tetramethylsilane / $\text{Si}(\text{CH}_3)_4$
- 1

Solution 7

(d)

Mark scheme

- 4
- 3
- 5
- 3
- Any two [1], all four [2]
- 2