Spectroscopy (MCQ)

1. Which isomer of $C_6H_{12}O_2$ produces the smallest number of peaks in its ^{13}C NMR spectrum?

A

B

C

D
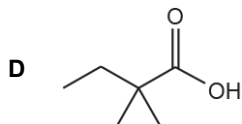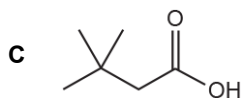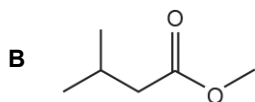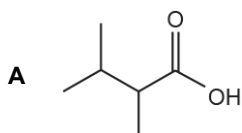
Your answer ☐ [1]

2. Which compound shows 4 peaks in its carbon-13 NMR spectrum?

A	
B	
C	
D	

Your answer ☐ [1]

3.   A compound produces the ^{13}C NMR spectrum below.

chemical shift, δ/ppm
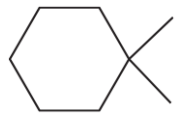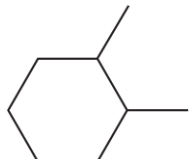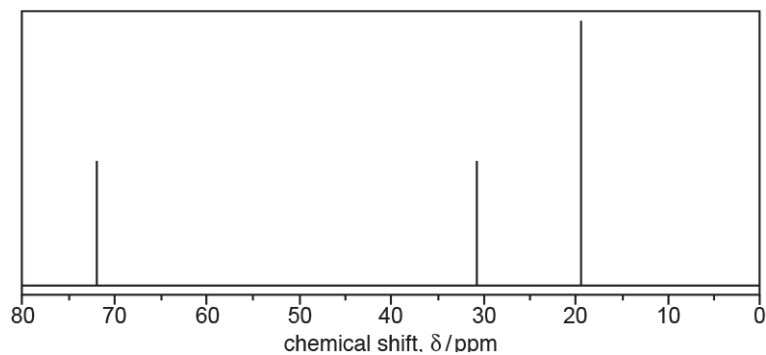
Which compound could have produced this spectrum?

A   Propane

B   2-Methylbutane

C   2-Methylpropan-1-ol

D   2-Methylpropan-2-ol

Your answer ☐   **[1]**

4.   What is the number of peaks in the ^{1}H NMR spectrum of $HOOCCH_2CHOHCH_2COOH$?

A   3

B   4

C   5

D   6

Your answer ☐   **[1]**

5.   Which compound is used as a standard for NMR chemical shift measurements?

A $Si(CH_3)_4$

B $CDCl_3$

C D_2O

D CCl_4

Your answer ☐   **[1]**

6. The compound below is analysed by ^{1}H NMR spectroscopy.
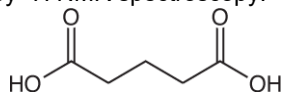
How many peaks are observed in the ^{1}H NMR spectrum?

A   5
B   4
C   3
D   2

Your answer ☐   [1]

7. How many peaks are observed in the ^{13}C NMR spectrum of 1,3-dimethylbenzene?

A   3
B   4
C   5
D   6

Your answer ☐

[1]

8. The skeletal formula of a hydrocarbon is shown below.
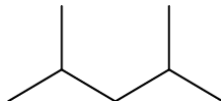
How many peaks would be seen in a ^{1}H NMR spectrum of this hydrocarbon?

A. 2
B. 3
C. 5
D. 7

Your answer ☐

[1]

9.   The structure of molecule **Z** is shown below.
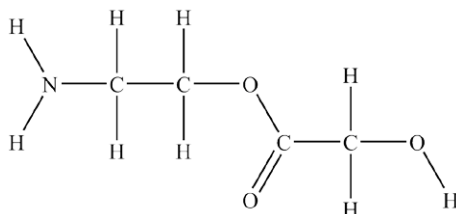
Which of the following statements is / are true?

1: The carbon-13 NMR spectrum of **Z** shows four peaks
2: The proton NMR spectrum of **Z** shows five peaks
3: The proton NMR spectrum of **Z** run in D_2O shows three peaks

A.   1, 2 and 3
B.   Only 1 and 2
C.   Only 2 and 3
D.   Only 1

Your answer

[1]

END OF QUESTION PAPER

Mark scheme – Spectroscopy (MCQ)

Question			Answer/Indicative content	Marks	Guidance
1			**C**	1 (AO2.2)	
			Total	**1**	
2			**B**	1 (AO 2.5)	**Examiner's Comments** Most candidates correctly selected B as the compound that would show four peaks in the ^{13}C NMR spectrum. Many candidates annotated the structures, indicating the different carbon environments with a circle. This proved a good strategy. Common incorrect responses included C and D which were seen in roughly equal proportions.
			Total	**1**	
3			**C**	1 (AO 2.5)	**Examiner's Comments** Many candidates identified that 2-methylpropan-1-ol (C) produced the ^{13}C NMR spectrum show. The majority of successful responses included diagrams showing the structures of the compounds to choose from. The most frequently seen incorrect response was D.
			Total	**1**	
4			**B**	1	**ALLOW** 4 (This is the number of peaks in the NMR spectrum) **Examiner's Comments** Many candidates correctly identified that the ^{1}H NMR spectrum would contain 4 peaks and selected B. In most cases candidates arrived at this answer by drawing out the structure and labelling the environments. A common distractor was A (3 peaks) which presumably arose from candidates assuming that the C–H and O–H protons in the centre of the structure were equivalent.
			Total	**1**	
5			**A**	1	**Examiner's Comments** Candidates found this question more challenging than anticipated. While many correctly chose A, a significant proportion of candidates selected C.

6.3.2 Spectroscopy MCQ

			Total	**1**	
6			C	1	**ALLOW** 3 (This is the number of peaks in the NMR spectrum) **Examiner Comments** This was well answered on the whole, with some candidates failing to include the peak associated with the −COOH part of the molecule. The common incorrect answer was D.
			Total	**1**	
7			**C**	1	
			Total	**1**	
8			B	1	
			Total	**1**	
9			A	1	
			Total	**1**	