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CHEMISTRY

ORGANIC CHEMISTRY II

Level & Board

AQA (A-LEVEL)

TOPIC:

NMR SPECTROSCOPY

PAPER TYPE:

QUESTION PAPER - 4

TOTAL QUESTIONS

10

TOTAL MARKS

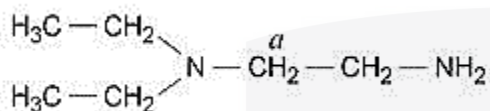
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NMR Spectroscopy - 4

1. There are several isomers with the molecular formula $C_6H_{16}N_2$

One isomer is shown.



- (a) Give the number of peaks in the ^{13}C NMR spectrum of this isomer.

State and explain the splitting pattern of the peak for the hydrogens labelled a in its ^1H NMR spectrum.

(3)

- (b) Draw the structure of the isomer of $C_6H_{16}N_2$ that contains two primary amine groups and has only two peaks in its ^{13}C NMR spectrum.

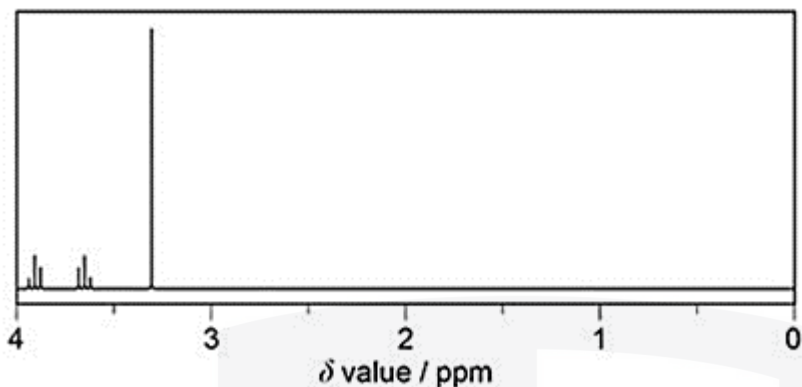
(1)

- (c) Draw the structure of the isomer of $C_6H_{16}N_2$ that contains two tertiary amine groups and has only two peaks in its ^{13}C NMR spectrum.

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(1)

2. Figure shows the ^1H NMR spectrum of Q, C_3H_7ClO



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.

Explain your answer.

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(5)

3. Two isomers of $\text{CH}_3\text{CHClCOCH}(\text{CH}_3)_2$ each have two singlet peaks only in their ^1H NMR spectra.

In both spectra the integration ratio for the two peaks is 2:9
Deduce the structures of these two isomers.

(3)

6. When the molecular formula of a compound is known, spectroscopic and other analytical techniques can be used to distinguish between possible structural isomers.

Draw one possible structure for each of the compounds.

(a) K and L are cyclic compounds with the molecular formula $C_6H_{10}O$.

Both have four peaks in their ^{13}C n.m.r. spectra.
K is a ketone and L is an aldehyde.

(2)

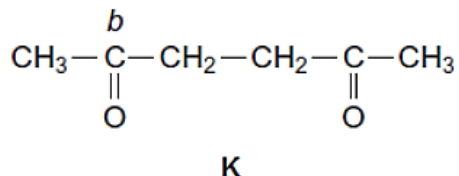
(b) Compounds M and N have the molecular formula $C_6H_{15}N$.

M is a tertiary amine with only two peaks in its 1H n.m.r. spectrum.
N is a secondary amine with only three peaks in its 1H n.m.r. spectrum.

(2)

7. N.m.r. spectroscopy can be used to study the structures of organic compounds.

Compound K was studied using ^{13}C n.m.r. spectroscopy.



(a) Give the number of peaks in the ^{13}C n.m.r. spectrum of K.

(1)

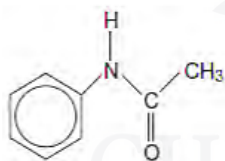
(b) Suggest a δ value of the peak for the carbon labelled b.

(1)

(c) Give the IUPAC name of K.

(1)

8. The structure of N-phenylethanamide is Use this structure to determine the number of peaks in the ^{13}C n.m.r. spectrum of N-phenylethanamide.



(1)

9. Describe and explain the different ways that a high resolution n.m.r. spectrum can give information about a molecule.

(7)

10. This question is about NMR spectroscopy.

A compound is usually mixed with $\text{Si}(\text{CH}_3)_4$ and either CCl_4 or CDCl_3 before recording the compound's ^1H NMR spectrum.

State why $\text{Si}(\text{CH}_3)_4$, CCl_4 and CDCl_3 are used in ^1H NMR spectroscopy.

Explain how their properties make them suitable for use in ^1H NMR spectroscopy.



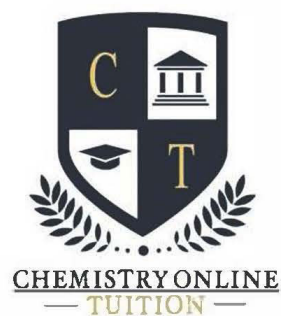
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(6)

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