

37.3 Carbon-13 NMR spectroscopy

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS carbon-13 nmr 碳 • nmr 核磁共振 • chemical shift 化学位移
• chemical environment 化学环境

Objective

Build the skills to answer exam questions on **carbon-13 NMR** 碳-13 核磁共振 — using the number and position of peaks to count carbon **chemical environments** 化学环境 and suggest structures.

You must be able to:

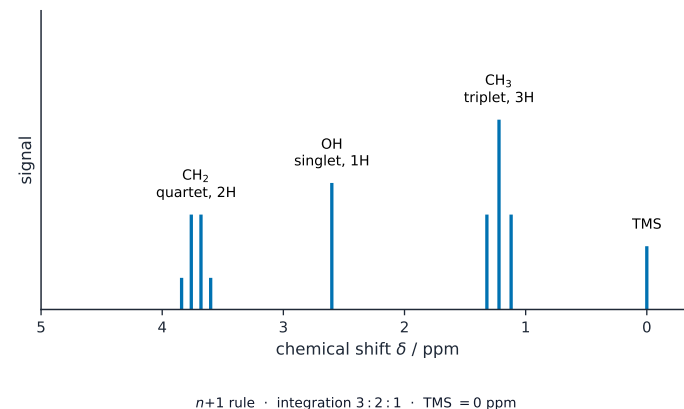
- state what the number of peaks in a ^{13}C NMR spectrum tells you
- use chemical shift to suggest the type of carbon
- deduce possible structures from a ^{13}C spectrum

1 Worked examples

■ Counting carbon environments



NMR uses a very strong magnetic field (from a superconducting magnet) to study how nuclei behave



An NMR spectrum from a carbon environment count

- in ^{13}C NMR, each different **carbon environment** gives **one peak** (equivalent carbons share a peak).
- number of peaks** = number of different carbon environments.
- chemical shift** (peak position) suggests the type of carbon (e.g. $\text{C}=\text{O}$ is far downfield).

Example: ethanol $\text{CH}_3\text{CH}_2\text{OH}$ has 2 carbon environments → **2 peaks**.

2 Practice

2.1 State what the number of peaks in a ^{13}C NMR spectrum tells you. [1]

2.2 State how many peaks propanone, CH_3COCH_3 , gives in its ^{13}C spectrum. [1]

3 Exam-style questions

3.1 In ^{13}C NMR, two carbon atoms in the **same** environment give: [1]

A	B
C	D

- A two separate peaks
- B a single peak
- C no peak
- D a split peak

3.2 How many peaks does propan-1-ol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, give in its ^{13}C spectrum? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A 1
B 2
C 3
D 4

3.3 A compound $\text{C}_3\text{H}_6\text{O}$ gives **two** peaks in its ^{13}C NMR spectrum, one far downfield (a $\text{C}=\text{O}$).

(a) Deduce a possible structure. [2]

(b) Explain how the number of peaks supports your structure. [1]

3.4 Explain why ethanoic acid, CH_3COOH , gives **two** peaks in its ^{13}C NMR spectrum.[2]
