

22.1 Infrared spectroscopy

Name: _____ Class: _____ Date: _____

Total: 8 marks

KEY WORDS functional group 官能团 • infrared spectroscopy 红外光谱 • wavenumber 波数
• absorption 吸收 • relative atomic mass 相对原子质量

Objective

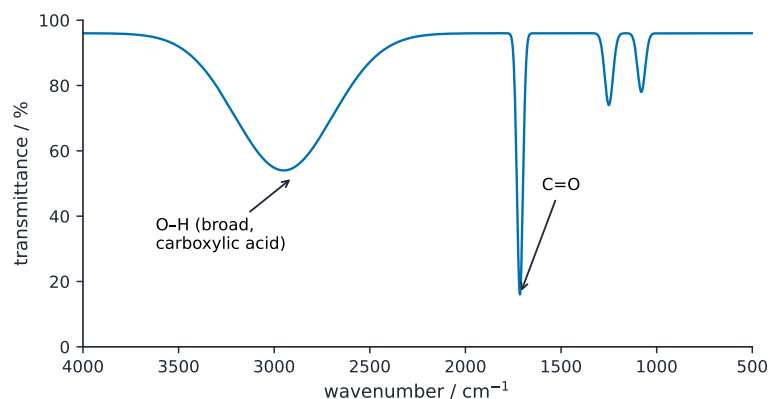
Build the skills to answer exam questions on **infrared spectroscopy** 红外光谱 — using an IR spectrum to identify **functional groups** 官能团.

You must be able to:

- analyse an IR spectrum to identify functional groups (using the given data table)
- use IR to check that a reaction has happened

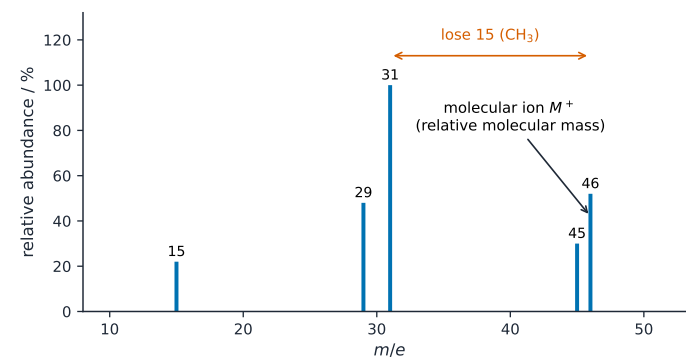
1 Worked examples

■ Reading an IR spectrum



IR: dips at characteristic wavenumbers identify functional groups (e.g. C=O, O-H)

Each bond absorbs at its own wavenumber, giving a dip. You are given the data table — just match the dips to bonds



M^+ peak $\approx M_r$ • gaps between peaks = mass of fragments lost

IR with mass spectrometry in structure determination

- broad dip $\sim 3200\text{--}3650\text{ cm}^{-1} \rightarrow \text{O-H}$ of an alcohol.
- dip $\sim 1700\text{ cm}^{-1} \rightarrow \text{C=O}$ (aldehyde, ketone, acid, ester).
- broad dip $\sim 2500\text{--}3000\text{ cm}^{-1}$ **plus** a C=O dip $\rightarrow$ a **carboxylic acid**.

Checking a reaction: if propene $\rightarrow$ propan-2-ol, the C=C dip disappears and an O-H dip appears.

2 Practice

2.1 State the bond responsible for a strong absorption at about 1700 cm^{-1} . [1]

2.2 State which functional group gives a broad absorption around $3200\text{--}3650\text{ cm}^{-1}$. [1]

3 Exam-style questions

3.1 An IR spectrum shows a broad absorption at $2500\text{--}3000\text{ cm}^{-1}$ together with a peak at 1710 cm^{-1} . The compound is most likely: [1]

A	B
C	D

- A an alcohol
- B an alkane
- C a carboxylic acid
- D a halogenoalkane

3.2 IR spectroscopy is most useful for identifying:

[1]

- | | |
|---|---|
| A | B |
| C | D |
- A** the relative atomic mass
B the functional groups present
C the number of carbon atoms
D the boiling point

3.3 Butan-2-ol is oxidised to butanone.

(a) State the change you would see in the IR spectrum (which absorption disappears and which appears). [2]

(b) Explain how IR confirms the oxidation has worked. [2]
