

Exercise walk-through

22.1

Infrared spectroscopy

A-Level Chemistry

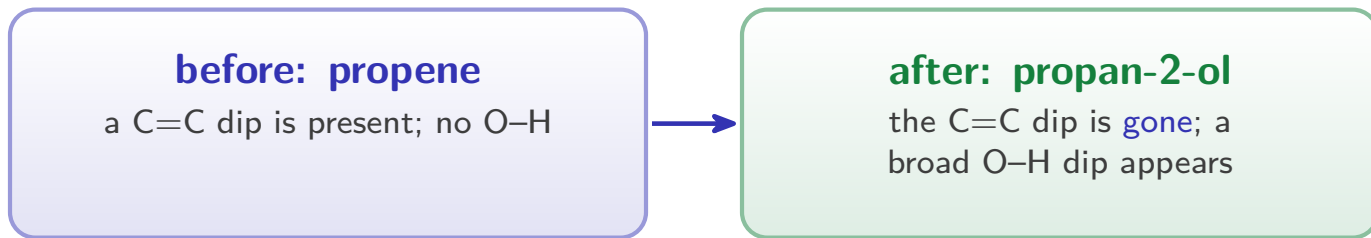
Infrared spectroscopy

Infrared spectroscopy finds the **functional group** : each bond absorbs at its own **wavenumber** .

- broad O—H $\sim$ 3200–3650
- C=O $\sim$ 1700
- broad 2500–3000 + C=O $\rightarrow$ acid

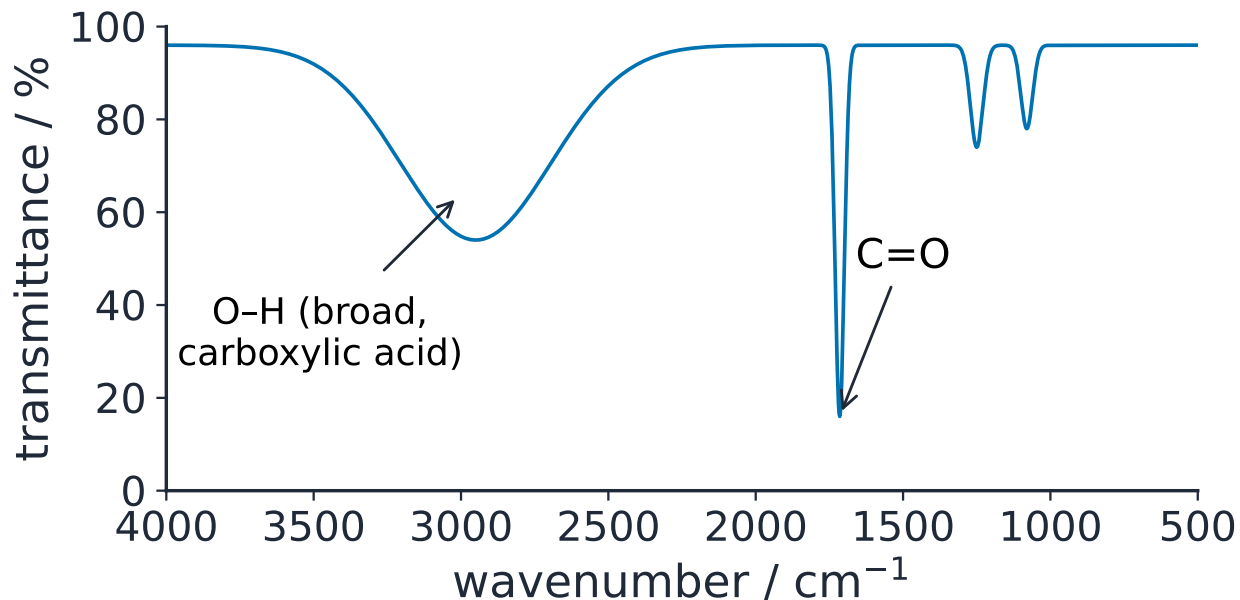
Using an IR spectrum to check a reaction

Each bond absorbs infrared at its own range of **wavenumber** (cm^{-1}). You are **given** the data table – the skill is matching dips to bonds, not memorising numbers.



That pair of changes – one dip gone, one appeared – is how the exam asks you to prove a reaction happened. Name the bond, not just the number.

Infrared spectroscopy, in detail



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

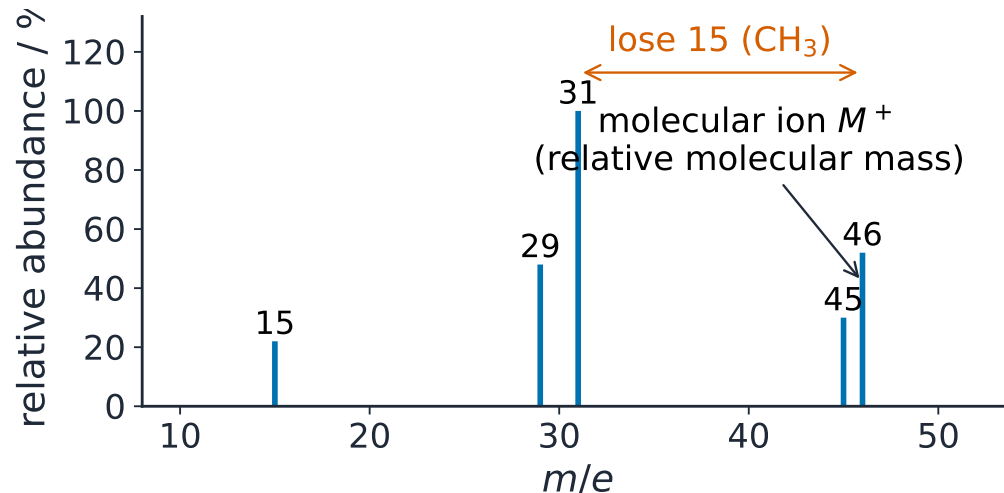
An infrared spectrum: each bond gives a dip at its own wavenumber. A broad O-H dip together with a C=O dip identifies a carboxylic acid

Mass spectrometry

Mass spectrometry sorts ions by **mass-to-charge ratio** (m/e).

The highest- m/e peak is the **molecular ion** M^+ ($= M_r$); the gaps between peaks give the masses of the lost **fragments** (loss of 15 = CH_3).

Mass spectrometry, in detail



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

A mass spectrum: the highest- m/e peak is the molecular ion (M^+ , the M_r); the gaps between peaks give the masses of the lost fragments

Exercises 2.1·2.2

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]

Exercises 2.1·2.2

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

2.1

- a C=O (carbonyl) bond
-

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

2.2

- an O–H group (in an alcohol)

Exercises 3.1·3.2

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 an alcohol

B an alkane

C a carboxylic acid

D a halogenoalkane

3.2 IR spectroscopy is most useful for identifying: [1]

☐

A the relative atomic mass

B the functional groups present

C the number of carbon atoms

D the boiling point

Exercises 3.1·3.2

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]

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- A an alcohol
- B an alkane
- C a carboxylic acid
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3.1 C

- The broad $2500\text{--}3000\text{ cm}^{-1}$ plus a $\text{C}=\text{O}$ peak indicates a carboxylic acid

3.2 IR spectroscopy is most useful for identifying: [1]

☐

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

3.2 B

- IR identifies the functional groups present

Exercise 3.3 (a)

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]

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(a)

- the broad O–H absorption ($\sim 3200\text{--}3650\text{ cm}^{-1}$) disappears; a C=O absorption ($\sim 1700\text{ cm}^{-1}$) appears

Exercise 3.3 (b)

3.3 Butan-2-ol is oxidised to butanone.

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

[2]

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3.3 Butan-2-ol is oxidised to butanone.

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

[2]

(b)

- losing the O–H and gaining a C=O shows the alcohol has been oxidised to a carbonyl (ketone)