22.1 Infrared spectroscopy

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS functional group • infrared spectroscopy • wavenumber • absorption • relative atomic mass

Objective

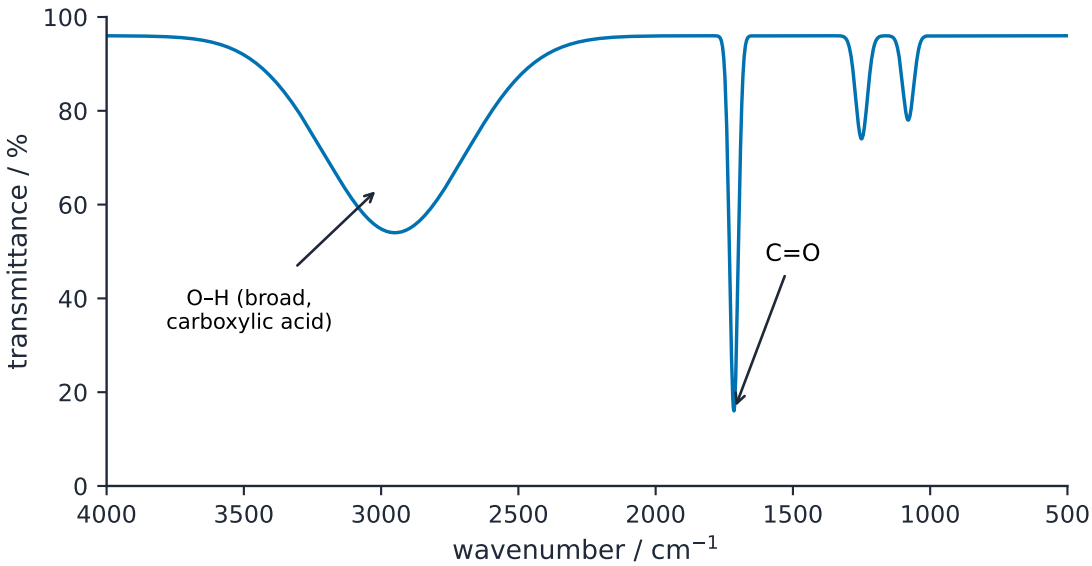
Build the skills to answer exam questions on **infrared spectroscopy** – using an IR spectrum to identify **functional groups** .

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

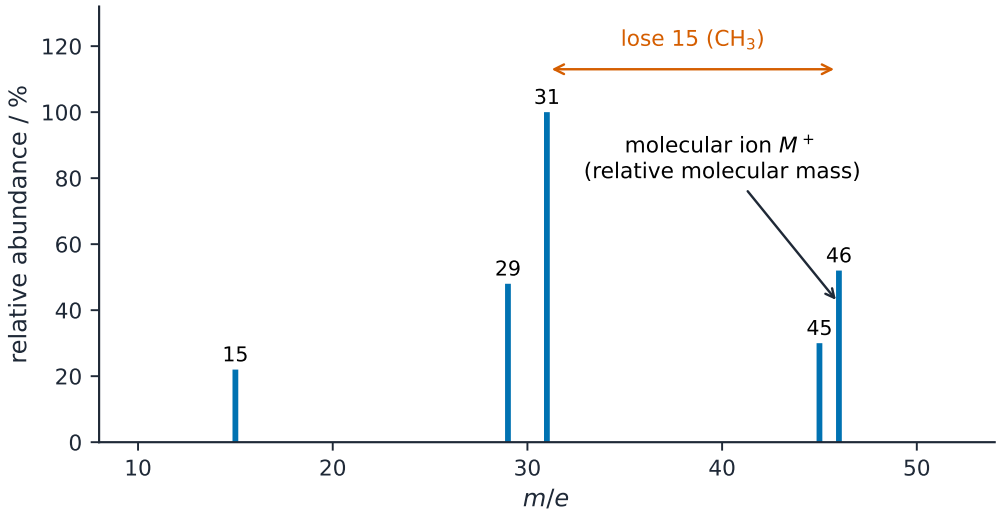
1 Key knowledge and worked examples

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

Checking a reaction: if propene → 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 3200–3650 cm^{-1}. [1]

3 Exam-style questions

3.1 An IR spectrum shows a broad absorption at 2500–3000 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

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]