

ORGANIC ANALYSIS

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QUALITATIVE TESTS

Qualitative tests use chemicals to see which functional groups are present in a molecule.

Functional group	Test	Result
Alkene	Bromine water	Orange to colourless
Haloalkane	Aqueous silver nitrate in ethanol	Precipitate forms Chloroalkane: white and dissolves in dilute NH_3 Bromoalkane: cream and dissolves in conc. NH_3 Iodoalkane: yellow and doesn't dissolve in NH_3
1°, 2° alcohol and aldehyde	Acidified $\text{Cr}_2\text{O}_7^{2-}$	Orange to green
Carboxylic acid	NaHCO_3	Carbon dioxide gas is formed - bubbles produced which turn limewater cloudy
Aldehyde	Tollens' reagent	Silver mirror produced
	Fehling's solution	Brick-red precipitate forms
Alcohol	Acidified potassium dichromate	Primary and secondary turn solution from orange to green
		Tertiary remains orange

INFRARED SPECTROSCOPY

ABSORBING ENERGY

Infrared radiation is light with a wavelength slightly longer than that of visible light. It is absorbed by bonds in molecules and causes them to vibrate.

IN THE ATMOSPHERE

Gases in the atmosphere absorb infrared radiation that's reflected from the Earth's surface. C-O , O-H and C-H bonds absorb a lot of infrared radiation in the atmosphere, trapping it and causing the temperature to increase. As a result, molecules with these bonds - e.g. carbon dioxide (CO_2), water (H_2O) and methane (CH_4) - are considered 'greenhouse gases' because they can trap heat inside the Earth's atmosphere. Humanity produces a lot of these gases, particularly CO_2 , and needs to reduce the emissions of these gases to reduce global warming.

FINGERPRINTING

Each molecule has a distinct pattern of peaks in the 'fingerprint region' (between 1500 cm^{-1} and 500 cm^{-1}). Once the functional groups in a molecule have been determined from the other peaks, the fingerprint region can be used to identify the exact molecule.



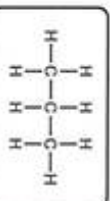
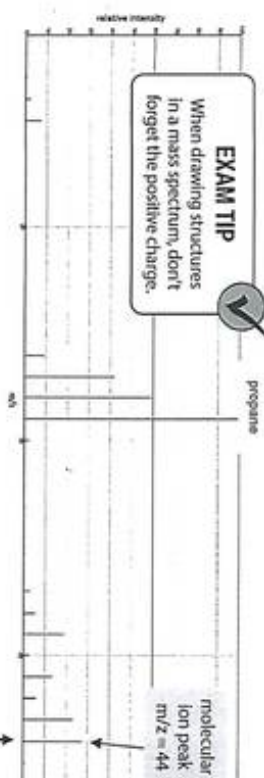
EXAM TIP

Most organic molecules have a peak at 3000 cm^{-1} due to the C-H bond. Don't confuse it with the O-H bond, which is much broader (wider).

MASS SPECTROMETRY

EXAM TIP

When drawing structures in a mass spectrum, don't forget the positive charge.



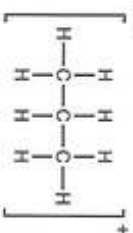
HIGH-PRECISION MASS SPECTROMETRY

A high-precision M^+ peak from a mass spectrum can be used to identify the molecular formula of the compound. The high precision of the mass spectrometer allows these two compounds to be distinguished.



MOLECULAR ION PEAK

Mass spectrometry can be used to find the mass of a compound. The peak furthest to the right is called the 'molecular ion peak' and has an m/z value which is the molecular mass.



IDENTIFYING BONDS FROM AN INFRARED SPECTRUM

Alcohols, ketones, aldehydes and carboxylic acids can be distinguished using infrared spectroscopy.

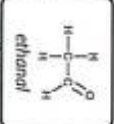
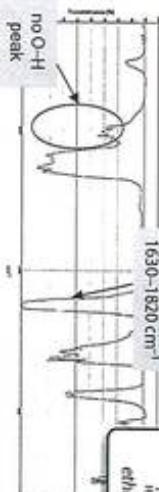
ALCOHOL

broad O-H peak
 $3200-3600\text{ cm}^{-1}$



ALDEHYDE/KETONE

C=O peak
 $1630-1820\text{ cm}^{-1}$



CARBOXYLIC ACID

very broad O-H peak
 $2500-3300\text{ cm}^{-1}$

