InkChemistry

ANSWER BOOK

Infrared spectroscopy

Organic analysis · Unit C19

AQA 3.3.6.3 · OCR A 4.2.4

13 questions · 42 marks

NAVY EDITION

Every question in this book has a code beside its number.
Type inklearning.co.uk/q/ followed by the code to open that question online.

© 2026 Ink Learning Ltd. All rights reserved.

inklearning.co.uk/chemistry/

SECTION A · Short, 1 to 2 marks

A1 IN-Q7

B1 1750 cm^{-1} is C=O and 1210 cm^{-1} is C–O. **B1** there is no broad O–H absorption, so S is an ester and not a carboxylic acid. [2]

A2 IN-Q8

B1 a broad absorption at about 3230–3550 cm^{-1}, from the O–H of an alcohol. **B1** sharp absorptions at about 2850–3000 cm^{-1}, from C–H. [2]

SECTION B · Standard, 3 to 5 marks

B1 IN-Q2

B1 the radiation absorbed has the same frequency as the natural vibration frequency of the bond. **B1** the energy absorbed increases the vibration of the bond, as stretching or bending. **B1** a vibration absorbs infrared only if it changes the dipole of the molecule. **B1** N_2 and O_2 each join two identical atoms, so the bond has no dipole and stretching it changes none; reject 'they are unreactive'. [4]

B2 IN-Q4

B1 when the molecule bends, or one C=O stretches as the other shortens, it becomes unsymmetrical and its dipole changes, so it can absorb. **B1** the Earth's surface, warmed by the Sun, emits infrared radiation; reject radiation arriving from the Sun. **B1** carbon dioxide absorbs some of this radiation, at the wavenumbers at which its bonds vibrate. **B1** the energy is re-emitted in all directions, some back towards the surface, so less escapes to space and the lower atmosphere warms. [4]

B3 IN-Q9

M1 $\lambda = 5.80 \times 10^{-4}$ cm, so wavenumber $= 1 \div (5.80 \times 10^{-4})$. **A1** 1720 cm^{-1} to three significant figures, absorbed by C=O. **M1** wavelength $= 1 \div 3000 = 3.33 \times 10^{-4}$ cm $= 3.33 \times 10^{-6}$ m. **A1** 3.33 µm, to three significant figures. [4]

B4 IN-Q14

B1 both show a strong C=O absorption, ethanoic acid near 1715 cm^{-1} and ethyl ethanoate near 1745 cm^{-1}. **B1** both show C–H absorptions near 2950–3000 cm^{-1}. **B1** ethanoic acid shows a very broad O–H absorption from 2500 to 3000 cm^{-1}. **B1** ethyl ethanoate has no O–H, so it shows no broad absorption in that region. [4]

B5 IN-Q15

B1 the absorption at 1745 cm^{-1} shows C=O, which is consistent with the ester. **B1** ethanoic acid also has C=O, so this absorption alone cannot show that the acid has been removed. **B1** the absence of any broad O–H absorption between 2500 and 3550 cm^{-1} would show that no ethanol, ethanoic acid or water remains in detectable amounts. **B1** the claim needs the fingerprint region matched peak for peak to a reference spectrum, with no extra absorptions, before purity is accepted. [4]

© 2026 Ink Learning Ltd. All rights reserved.

B6 IN-Q3

B1 the O–H groups in the liquid are hydrogen bonded to one another. **B1** each O–H is hydrogen bonded to a different extent, so the O–H bonds have a range of strengths. **B1** a range of bond strengths absorbs over a range of wavenumbers, roughly 3230 to 3550 cm^{-1}. [3]

B7 IN-Q10

B1 1715 cm^{-1} is C=O and the very broad absorption from 2500 cm^{-1} is the O–H of a carboxylic acid, so the compound contains COOH. **B1** COOH accounts for 45 of the 60, leaving 15, which is a CH_3 group. **B1** the compound is ethanoic acid, CH_3COOH. [3]

B8 IN-Q11

B1 a C=O absorption appears in the product, in the range 1680–1750 cm^{-1}. **B1** the broad alcohol O–H absorption at 3230–3550 cm^{-1} is absent, showing no propan-2-ol remains. **B1** no very broad O–H appears at 2500–3000 cm^{-1} either, since a ketone is not oxidised further to an acid. [3]

B9 IN-Q12

B1 absorption near 2950 cm^{-1} is by C–H bonds, which ethanol and propanone both contain. **B1** propanone would therefore also absorb at 2950 cm^{-1} and could give a false high reading. **B1** absorption near 1050 cm^{-1} is by the C–O bond of ethanol, which propanone does not have, so it measures ethanol alone. [3]

B10 IN-Q13

B1 both contain a C=O bond and absorb in the same range, 1680–1750 cm^{-1}, and neither has O–H. **B1** the fingerprint region, below about 1500 cm^{-1}, holds a pattern of absorptions unique to each compound. **B1** the sample's fingerprint region is matched against a database of reference spectra of the two compounds; reject assigning its peaks to bonds. [3]

B11 IN-Q17

B1 the polar bond in carbon monoxide absorbs infrared at a characteristic wavenumber, near 2140 cm^{-1}. **B1** the absorption is measured at that wavenumber, where carbon dioxide, present in far greater amounts, does not absorb. **B1** the greater the absorption, the higher the concentration of carbon monoxide in the gas. [3]

© 2026 Ink Learning Ltd. All rights reserved.

THIS BOOK ONLINE

Scan the code, or type the address, to open the questions in this book online:

inklearning.co.uk/chemistry/practise/questions/infrared-spectroscopy/

© 2026 Ink Learning Ltd. All rights reserved.