

4 Which alkane has the strongest London forces in the liquid phase?

- A $(\text{CH}_3)_4\text{C}$
- B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- C $(\text{C}_2\text{H}_5)_4\text{C}$
- D $\text{CH}_3(\text{CH}_2)_7\text{CH}_3$

(Total for Question 4 = 1 mark)

2: (a) Methane burns to produce carbon dioxide and water vapour.



Some bond enthalpy data are shown.

Bond	Bond enthalpy / kJ mol^{-1}
C—H	413
O=O	498
O—H	464

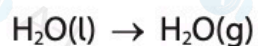
What is the mean bond enthalpy for the C=O bond, in kJ mol^{-1} ?

(1)

- A 552
- B 801
- C 1016
- D 1265

(b) A data book value for the standard enthalpy change of combustion of methane is -890 kJ mol^{-1} .

What is the experimental value for the enthalpy change of vaporisation of water in kJ mol^{-1} ?



(1)

- A -40
- B +40
- C -80
- D +80

(Total for Question 2 = 2 marks)

8 Equal volumes of some 0.01 mol dm^{-3} solutions were mixed.

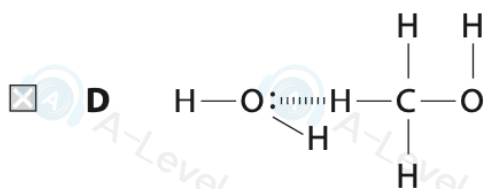
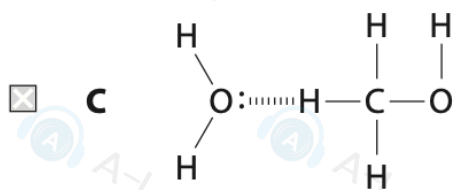
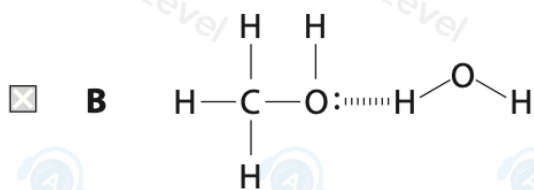
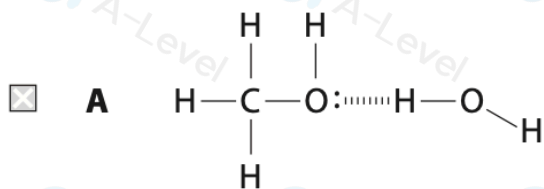
Which pair of solutions gave the greatest mass of precipitate?

- A BaCl_2 and AgNO_3
- B BaCl_2 and Ag_2SO_4
- C BaCl_2 and NaNO_3
- D BaCl_2 and Na_2SO_4

(Total for Question 8 = 1 mark)

7 Hydrogen bonds are formed when methanol dissolves in water.

Which structure best represents a hydrogen bond between methanol and water?



(Total for Question 7 = 1 mark)

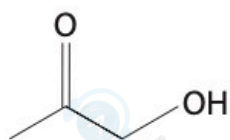
11 Which alkane has the **highest** boiling temperature?

- A** hexane
- B** pentane
- C** 2-methylpentane
- D** 2,3-dimethylbutane

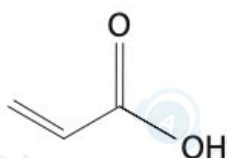
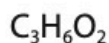
5 Which order is correct for the solubilities of Group 2 sulfates?

- A** barium > strontium > magnesium
- B** calcium > strontium > magnesium
- C** magnesium > barium > calcium
- D** calcium > strontium > barium

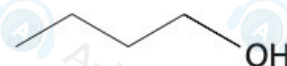
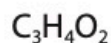
*20 A bottle has lost its label. The content of the bottle is thought to be one of 1-hydroxypropanone, propenoic acid or butan-1-ol.



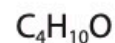
1-hydroxypropanone



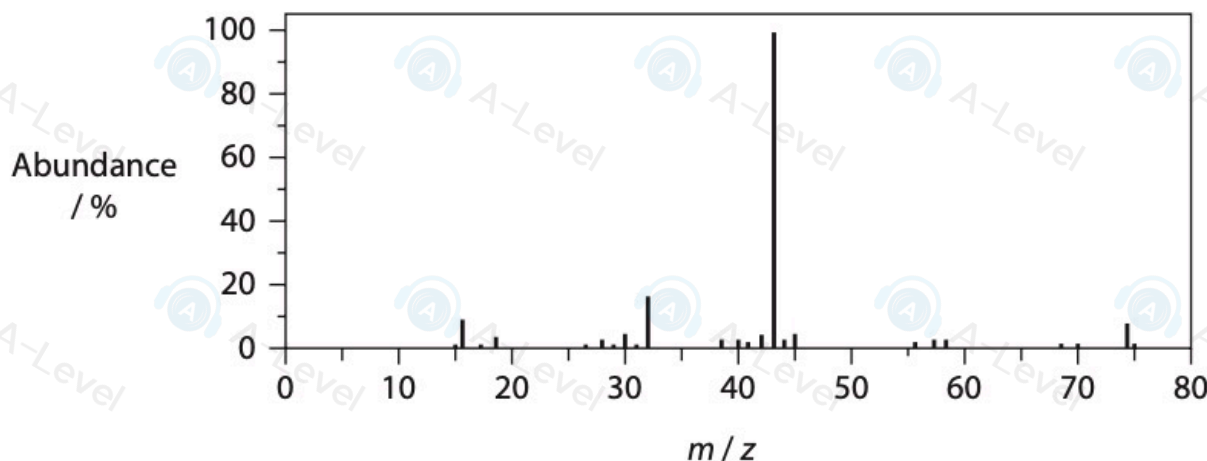
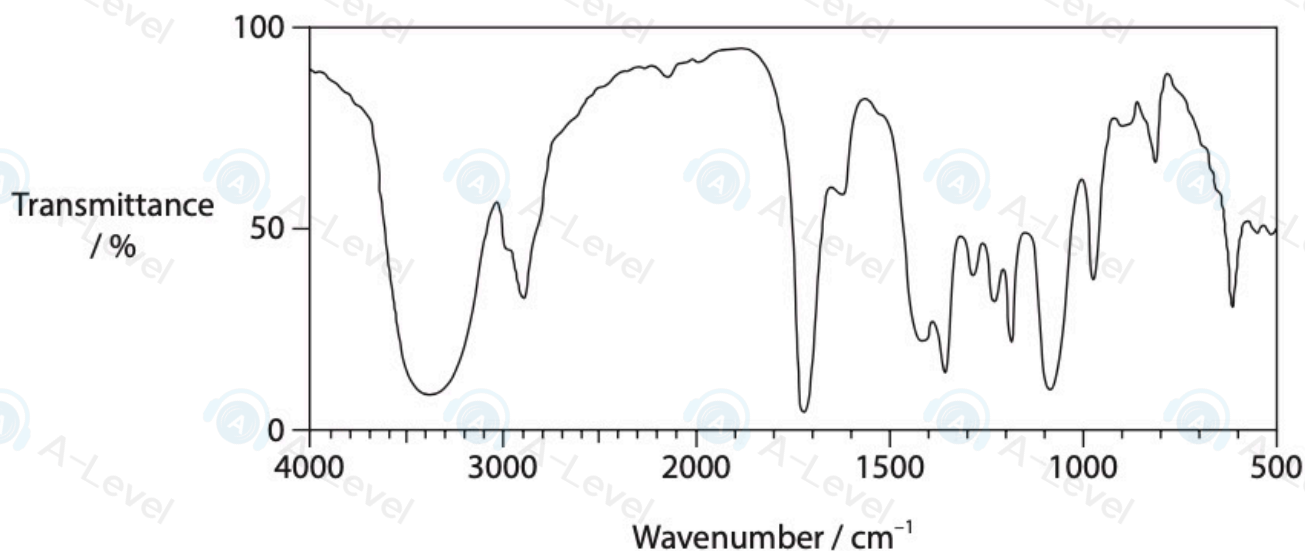
propenoic acid



butan-1-ol



The infrared and mass spectra of the unknown compound are shown.



Compare and contrast the spectra shown with the expected spectra of the three possible compounds, and so identify the unknown.

(6)

20 An organic compound, acetoin, is one of the compounds that gives butter its characteristic flavour.

(a) Acetoin contains 54.5 % by mass of carbon and 9.1 % by mass of hydrogen. The remainder is oxygen.

(i) Calculate the empirical formula of acetoin.
You must show all your working.

(3)

(ii) The molar mass of acetoin is 88.0 g mol^{-1} .

Use this information to calculate the molecular formula of acetoin.

(1)

(b) Acetoin contains **two** functional groups.

(i) Some chemical tests were carried out on acetoin. These tests identify **one** of the two functional groups.

Acetoin produced steamy fumes when reacted with PCl_5 .

Acetoin did **not** react with sodium hydrogencarbonate solution.

Acetoin turned hot acidified potassium dichromate(VI) solution from orange to green.

State what can be deduced from each of these three tests and hence identify this functional group.

(3)

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(ii) Acetoin also contains the carbonyl group $\text{C}=\text{O}$, in the form of a ketone **not** an aldehyde.

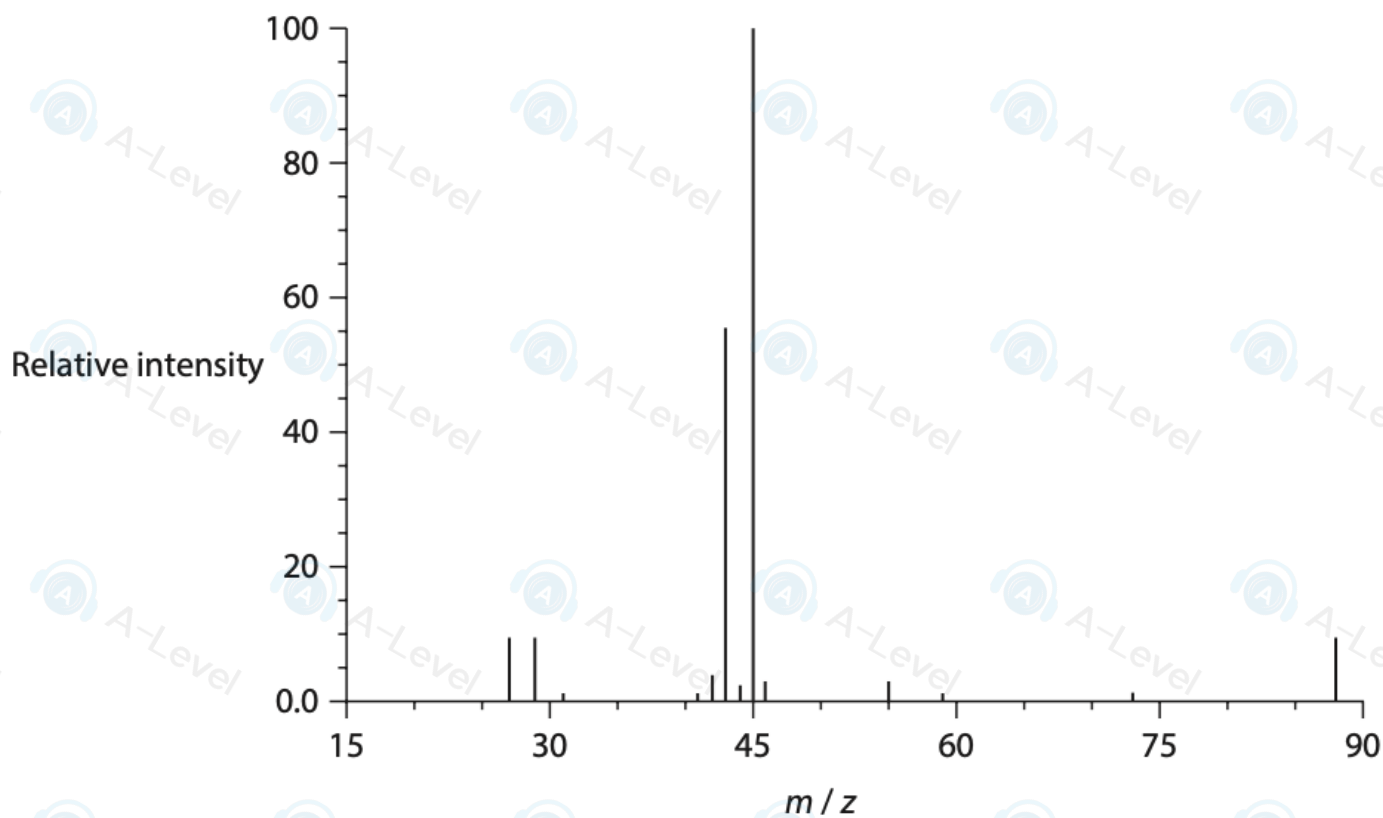
Use page 5 of your Data Booklet to show how infrared spectra data could be used to prove that acetoin contains a ketone not an aldehyde.

Complete the table.

(3)

	Bond	Wavenumber range / cm^{-1}
Absorption present in acetoin but not in an aldehyde		
One absorption present in an aldehyde but not in acetoin		
Another absorption present in an aldehyde but not in acetoin		

(iii) Part of the mass spectrum of acetoin is shown.



Determine a possible structure of acetoin using your answer to part (b)(i), the information given in (b)(ii) and the mass spectrum.

In your answer, identify the two ions responsible for the two peaks of highest intensity.

(3)