11.1 Spectroscopic Identification

Question Paper

Course	DP IB Chemistry
Section	11. Measurements & Data Processes
Topic	11.1 Spectroscopic Identification
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

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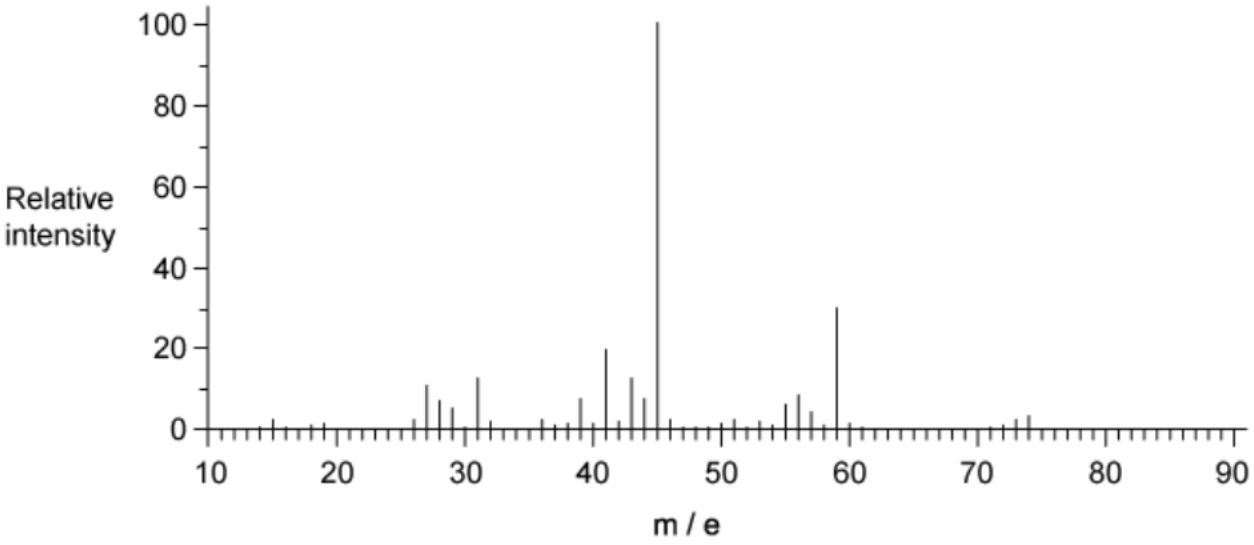
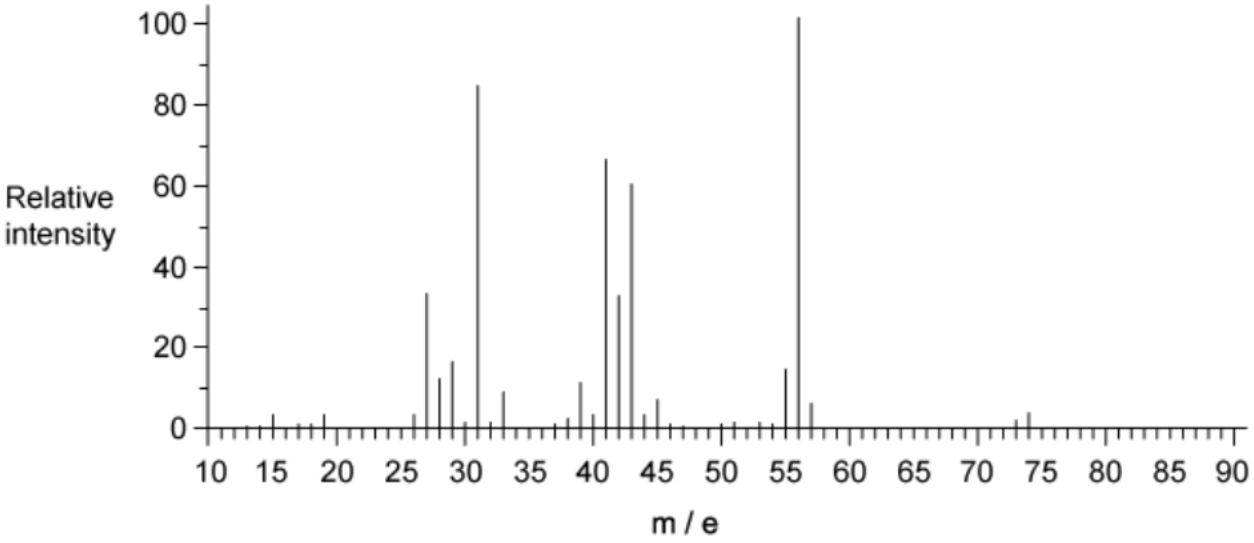
Question 1

The mass spectra of three compounds A, B and C are shown below.

Compound A



Compound B



Compound C

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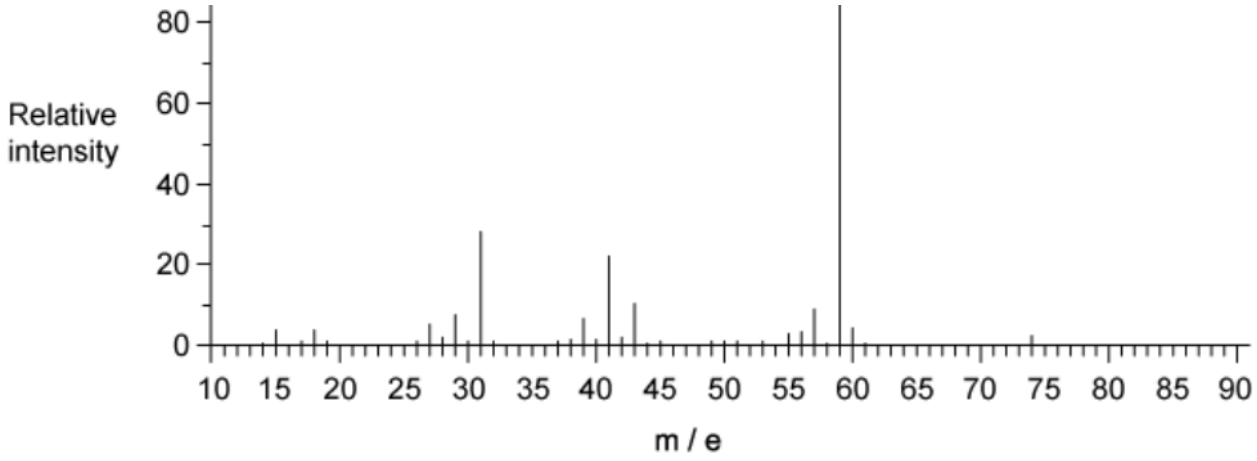

What evidence from the spectra of the three compounds A, B and C, suggests they could be isomers?

A all show a molecular ion peak at 74

B all show a molecular ion peak at 13

C all show a molecular ion peak at 73

D all show a molecular ion peak at 33

[1 mark]

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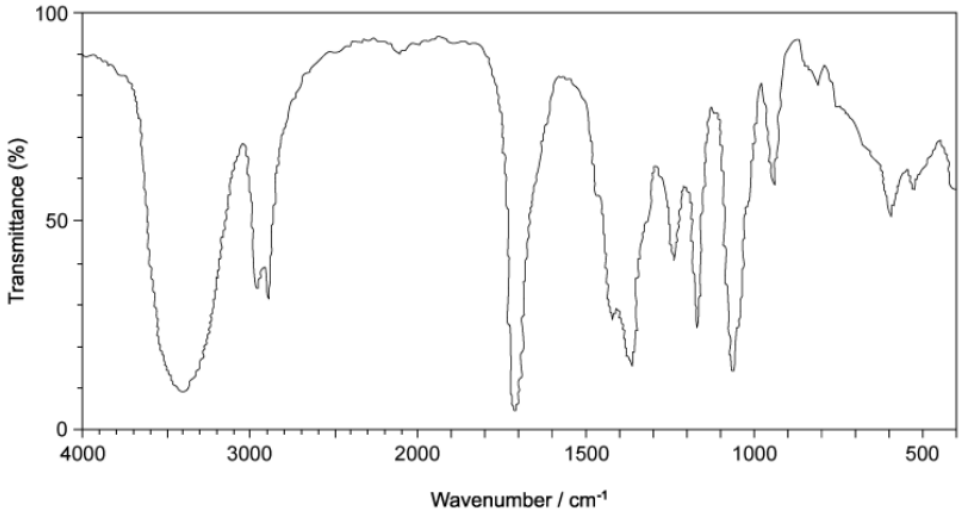
Question 2

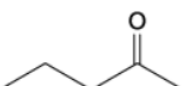
The infrared spectrum below shows an unknown compound.



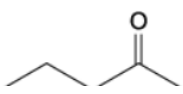
bond	wavenumber range/ cm^{-1}
C–O; hydroxyl, ester	1040 – 1300
C=C; aromatic compound, alkene	1500 - 1680
C=O amide carbonyl, carboxyl ester	1640 – 1690 1670 – 1740 1710 - 1750
C≡N; nitrile	2200 – 2250
C–H; alkane	2850 – 2950
N–H; amine, amide	3300 – 3500
O–H; carboxyl hydroxyl	2500 – 3000 3200 - 3600

Which compound could have produced the infrared spectrum?

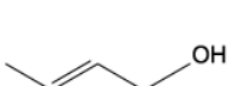
A



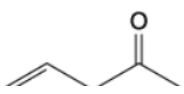
B



C



D



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[1 mark]

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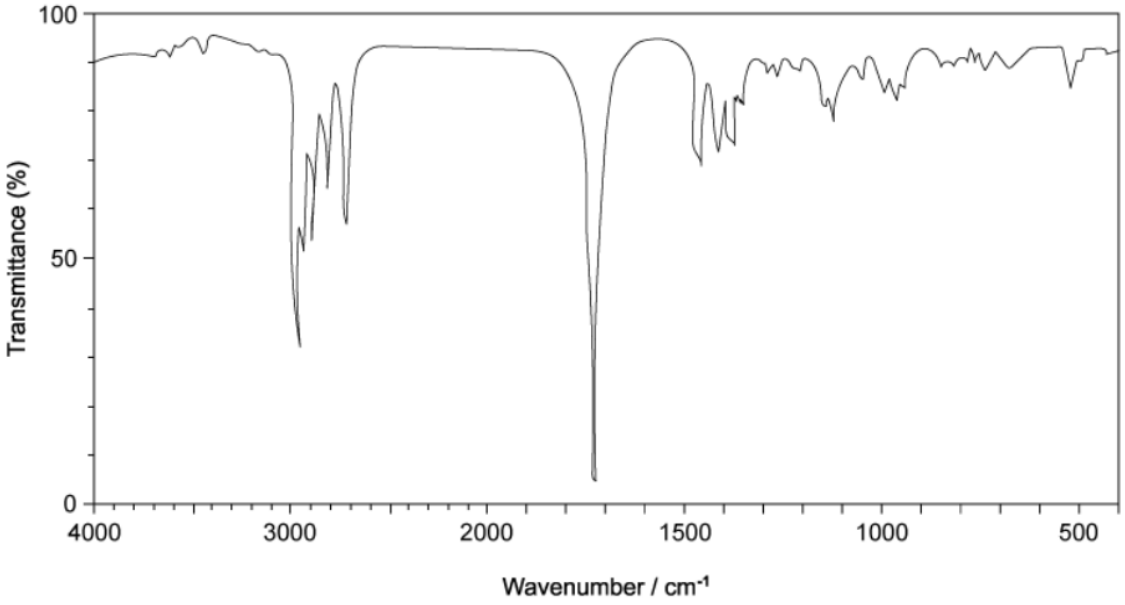
Question 3

The diagram shows an infrared spectrum of a compound.



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Which compound would give this spectrum?

A butanoic acid

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B butanal

C butan-1-ol

D 1-bromobutane

[1 mark]

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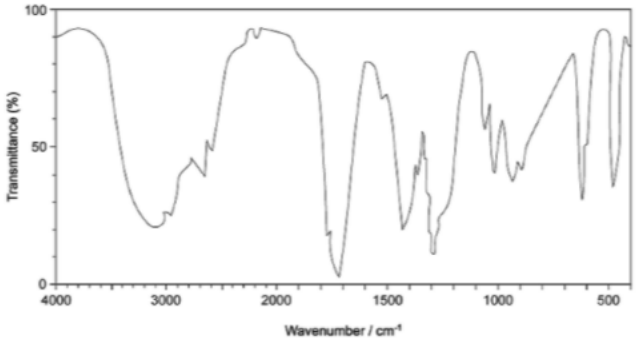
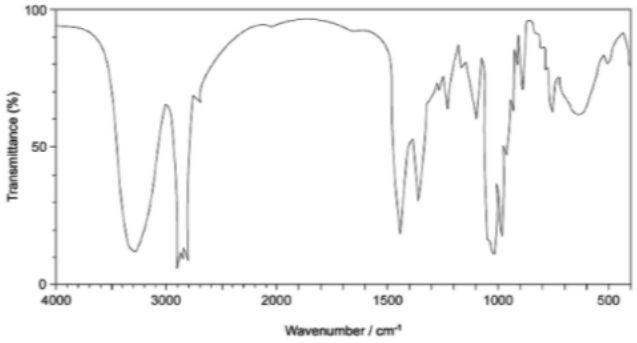
Question 4

Which of the following infrared spectra could show a carboxylic acid?

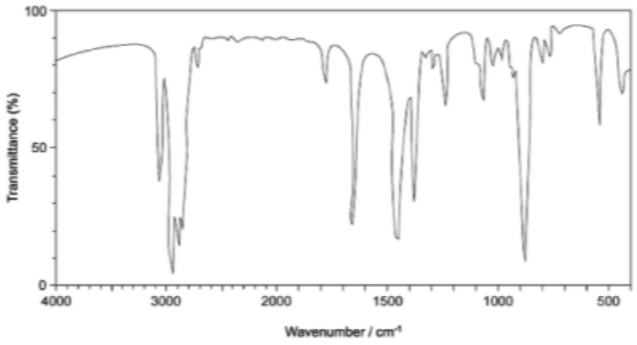
A



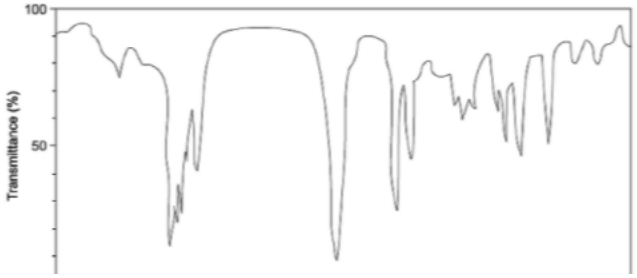
B



C



D



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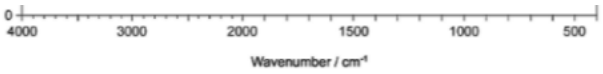

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[1 mark]

Question 5

A periodic table is needed for this question

A compound XF_n is a fluoride of another halogen, X, and it is known that n > 1. The highest m/e peak in the mass spectrum of XF_n is assigned to the parent ion and comes as a single peak at *m/e* = 222.

Which of the following statements is **incorrect**?

A n = 5

B the compound could contain bromine

C there are no isotopes of X or F

D the compound is a fluoride of iodine

[1 mark]

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Question 6

An organic compound is analysed by mass spectrometry and infrared spectroscopy. The following data is obtained.

mass spectrometry	infrared spectroscopy
molecular ion peak at *m/e* = 128 fragment ion peak at *m/e* = 15	sharp peak at 1720 cm^{-1} no broad peak around 3200 cm^{-1}

bond	wavenumber range/ cm^{-1}
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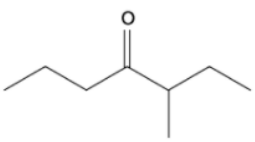
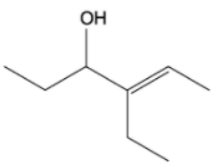
C≡N; nitrile	2200 – 2250
C−H; alkane	2850 – 2950
N−H; amine, amide	3300 – 3500
O−H; carboxyl hydroxyl	2500 – 3000 3200 - 3600

Which of the following compounds could be consistent with the data given?

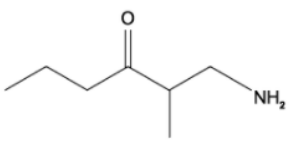
A



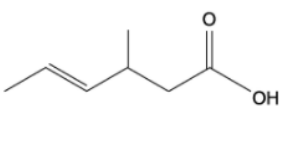
B



C



D



[1 mark]

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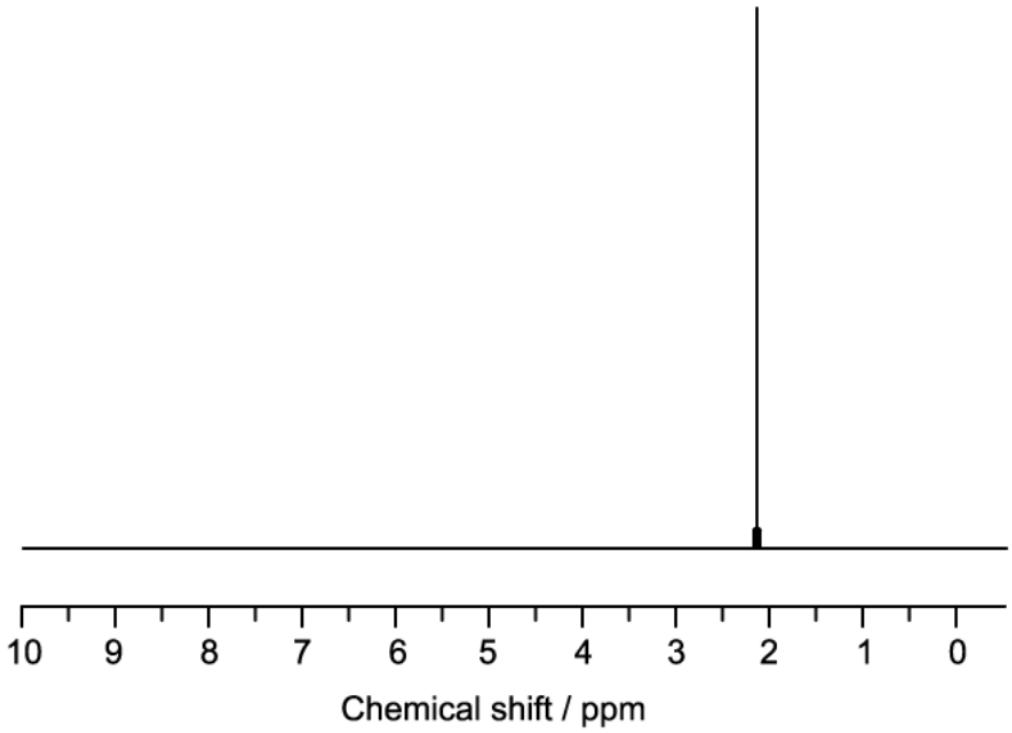
Question 7

What does the 1H NMR spectrum below tell you about a molecule?



A There is only one isotope of hydrogen present in the molecule

B The molecule is a hydrocarbon

C There is only one hydrogen atom in the molecule

D There is only one hydrogen environment in the molecule

[1 mark]

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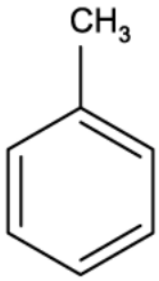
Question 8

How many peaks would you expect to see in a ^{1}H NMR spectrum of methylbenzene?



A 3

B 4

C 5

D 6

[1 mark]

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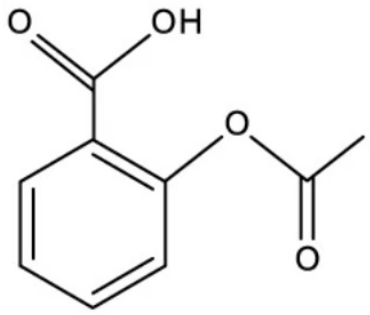
Question 9

What is the index of hydrogen deficiency (IHD) for this molecule of aspirin?



A 3

B 4

C 5

D 6

[1 mark]

Question 10

Which molecule has an index of hydrogen deficiency (IHD) = 1?

A. C_6H_{10}

B. C_2Br_2

C. C_4H_9N

D. C_3H_8O

[1 mark]

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