1 How many molecular ion peaks (parent ion peaks) are in the mass spectrum of

1,2-dibromoethane?

Assume the only isotopes present are ^{1}H, ^{12}C, ^{79}Br and ^{81}Br.

☒ **A** 1

☒ **B** 2

☒ **C** 3

☒ **D** 4

(Total for Question = 1 mark)

2 This question is about two isomeric alcohols and two isomeric carbonyl compounds.

Butan-1-ol, $CH_3CH_2CH_2CH_2OH$

Butan-2-ol, $CH_3CH_2CH(OH)CH_3$

Butanal, $CH_3CH_2CH_2CHO$

Butanone, $CH_3CH_2COCH_3$

(a) Which of these compounds would **not** produce a colour change when heated with acidified sodium dichromate(VI) solution?

(1)

☒ **A** Butan-1-ol

☒ **B** Butan-2-ol

☒ **C** Butanal

☒ **D** Butanone

(b) Which compound could give a peak at *m*/*e* = 31 in its mass spectrum?

(1)

☒ **A** Butan-1-ol

☒ **B** Butan-2-ol

☒ **C** Butanal

☒ **D** Butanone

(c) Which compound could **not** give a peak at *m*/*e* = 43 in its mass spectrum?

(1)

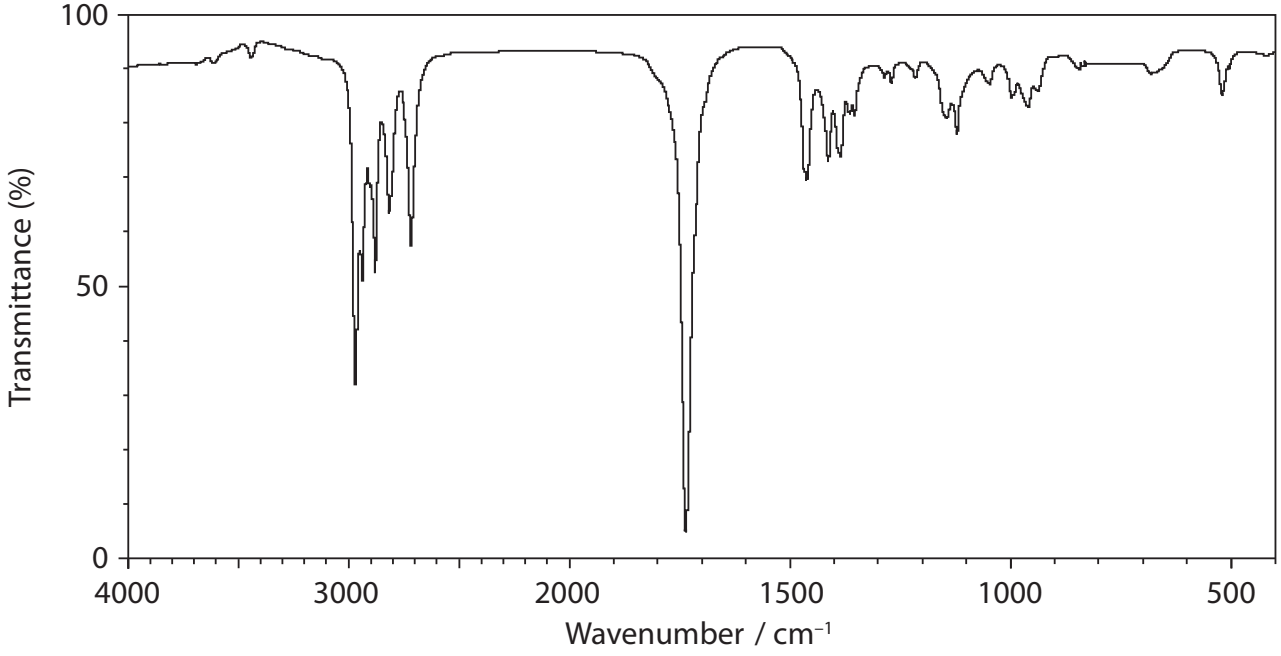
☒ **A** Butan-1-ol

☒ **B** Butan-2-ol

☒ **C** Butanal

☒ **D** Butanone

(d) The infrared spectrum of one of these compounds is given below.



Use the infrared absorptions, in wavenumbers, to identify the compound.

Bond	Wavenumber range / cm^{-1}
O—H (alcohol)	3750 – 3200
C—H (alkane)	2962 – 2853
C—H (aldehyde)	2900 – 2820 and 2775 – 2700
C=O (aldehyde or ketone)	1740 – 1680

The compound with this IR spectrum is

(1)

☒ **A** butan-1-ol.

☒ **B** butan-2-ol.

☒ **C** butanal.

☒ **D** butanone.

(Total for Question = 4 marks)

3 The correct sequence for the processes that occur in a mass spectrometer is

☒ **A** vaporization, ionization, acceleration, deflection and detection.

☒ **B** vaporization, acceleration, ionization, deflection and detection.

☒ **C** ionization, vaporization, acceleration, deflection and detection.

☒ **D** ionization, vaporization, deflection, acceleration and detection.

(Total for Question = 1 mark)

4 Which of the following ions would be deflected **most** in a mass spectrometer?

☒ **A** $^{35}Cl^{+}$

☒ **B** $^{37}Cl^{+}$

☒ **C** $^{37}Cl^{2+}$

☒ **D** $(^{35}Cl —^{37}Cl)^{+}$

(Total for Question = 1 mark)

5 In a mass spectrum of butane, C_4H_{10}, where would a peak be seen for the molecular ion if it had a charge of 2+?

☒ **A** 29

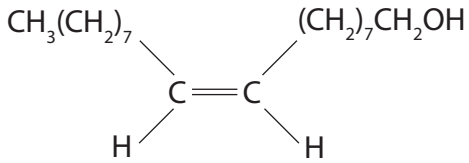
☒ **B** 56

☒ **C** 58

☒ **D** 60

(Total for Question = 1 mark)

6 The formula for oleyl alcohol, which is present in sperm whale oil and was used as a lubricant, is shown below.



(a) The systematic name for oleyl alcohol is

(1)

☒ **A** *E*-octadec-9-en-1-ol.

☒ **B** *Z*-octadec-9-en-1-ol.

☒ **C** *E*-octadec-8-en-1-ol.

☒ **D** *Z*-octadec-8-en-1-ol.

(b) Which intermolecular forces are present between oleyl alcohol molecules?

(1)

☒ **A** London forces only

☒ **B** Hydrogen bonds and London forces only

☒ **C** Hydrogen bonds and permanent dipole–dipole forces only

☒ **D** Hydrogen bonds, permanent dipole–dipole and London forces

(c) Which of the following is the most likely structure of the species to cause a peak at *m/e* 31 in the mass spectrum of oleyl alcohol?

(1)

☒ **A** CH_3O

☒ **B** CH_2OH

☒ **C** CH_3O^+

☒ **D** CH_2OH^+

(d) What would you expect to see if oleyl alcohol is tested separately with bromine water and heated with acidified sodium dichromate(VI) solution?

(1)

	Bromine water	Acidified sodium dichromate(VI) solution
☒ **A**	Decolorises	Turns green
☒ **B**	No colour change	No colour change
☒ **C**	Decolorises	No colour change
☒ **D**	No colour change	Turns green

(Total for Question = 4 marks)

7 Bromine has two isotopes with relative isotopic masses 79 and 81. Which of the following values for mass/charge ratio could correspond to a peak in the mass spectrum of bromine, Br_2? You should assume the ions detected have a single positive charge.

- ☒ **A** 79.9
- ☒ **B** 80
- ☒ **C** 159
- ☒ **D** 160

(Total for Question = 1 mark)

8 The concentration of a solution of potassium iodate(V) can be determined by the liberation of iodine, followed by titration with sodium thiosulfate.

A suitable indicator is

- ☒ **A** methyl orange.
- ☒ **B** phenolphthalein.
- ☒ **C** starch.
- ☒ **D** universal indicator.

(Total for Question = 1 mark)

9 The thermite reaction, shown below, is a useful industrial process.

$$Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe(l) + Al_2O_3(s)$$

The iron in this reaction undergoes

☒ **A** disproportionation.

☒ **B** oxidation.

☒ **C** redox.

☒ **D** reduction.

(Total for Question = 1 mark)

10 This question is about the following isomeric compounds with the molecular formula C_4H_8O and molar mass 72 g mol^{-1}.

A $CH_3CH_2CH_2CHO$

B $(CH_3)_2CHCHO$

C $CH_3CH_2COCH_3$

D $CH_3CH{=}CHCH_2OH$

(a) Which compound would you expect to give a peak at *m/e* = 41 in its mass spectrum?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) Which compound would NOT react with an acidified solution of potassium dichromate(VI)?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(c) Which compound would give a pale yellow precipitate when reacted with iodine in alkaline solution?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(d) Which compound can be reduced to give a chiral product?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(e) Which compound would NOT react with hydrogen cyanide under suitable conditions to form a hydroxynitrile?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question = 5 marks)

11 There would be a major peak in the mass spectrum for butan-1-ol, $CH_3CH_2CH_2CH_2OH$, but **not** for butan-2-ol, $CH_3CH_2CH(OH)CH_3$, at *m/e* value

☒ **A** 15

☒ **B** 17

☒ **C** 29

☒ **D** 43

(Total for Question 1 mark)

12 How many molecular ion peaks (parent ion peaks) occur in the mass spectrum of 1,2-dibromoethane, CH_2BrCH_2Br?

Assume the only isotopes present are ^{1}H, ^{12}C, ^{79}Br and ^{81}Br.

☒ **A** 1

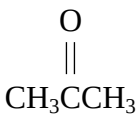
☒ **B** 2

☒ **C** 3

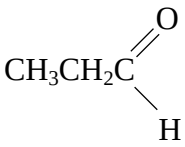
☒ **D** 4

(Total for Question 1 mark)

13 Which of the following features is shown by the mass spectra of propanone and propanal?



propanone

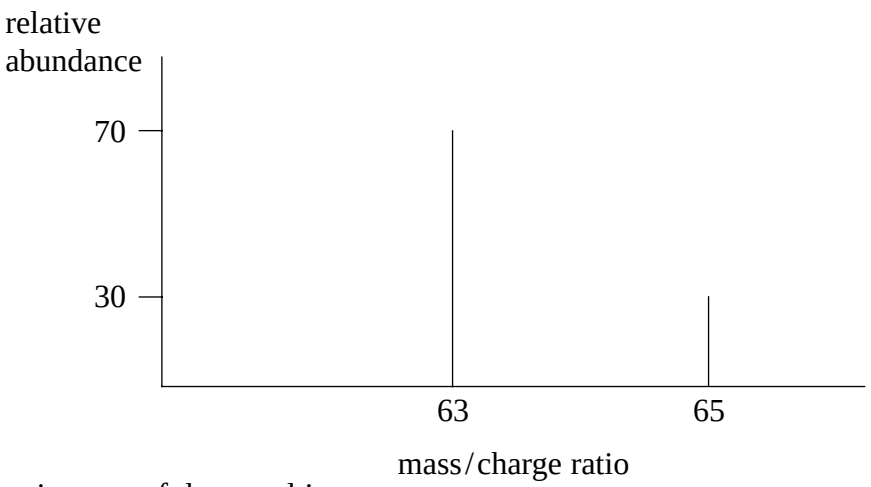


propanal

		m/e of the molecular ion	Fragmentation pattern
☒	**A**	same	same
☒	**B**	same	different
☒	**C**	different	same
☒	**D**	different	different

(Total for Question = 1 mark)

14 The mass spectrum for a sample of a metal is shown below.



The relative atomic mass of the metal is

☒ **A** 63.2

☒ **B** 63.4

☒ **C** 63.6

☒ **D** 64.0

(Total for Question = 1 mark)

15 Which of the following ions would undergo the greatest deflection in a mass spectrometer?

☒ **A** $^{35}Cl^{2+}$

☒ **B** $^{35}Cl^{+}$

☒ **C** $^{37}Cl^{+}$

☒ **D** $^{35}Cl^{37}Cl^{+}$

(Total for Question = 1 mark)

16 Which of the following values for the mass/charge ratio for singly charged ions would be present in the mass spectrum of propanal, CH_3CH_2CHO, but not of propanone, CH_3COCH_3?

☒ **A** 15

☒ **B** 29

☒ **C** 43

☒ **D** 58

(Total for Question = 1 mark)

17 Propanal, CH_3CH_2CHO, and propanone, CH_3COCH_3, are isomers, but only propanal has a significant peak in its mass spectrum at mass/charge ratio

☒ **A** 15

☒ **B** 29

☒ **C** 43

☒ **D** 58

(Total for Question = 1 mark)

18 Two ketones, $CH_3COCH_2CH_2CH_3$ and $CH_3CH_2COCH_2CH_3$, both have M_r 86. Which peak due to fragmentation into singly charged ions would you expect to be present in the mass spectrum of one but not the other?

☒ **A** 71

☒ **B** 57

☒ **C** 43

☒ **D** 29

(Total for Question 1 mark)