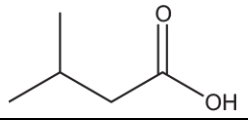
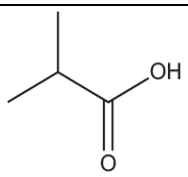
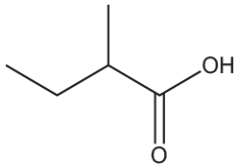
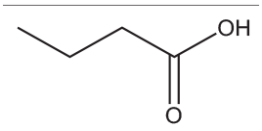
Analytical Techniques (MCQ)

1. The mass spectrum of a carboxylic acid contains peaks at *m /z* = 29 and *m /z* = 102.

Which compound could have produced the spectrum?

A	
B	
C	
D	

Your answer ☐ **[1]**

2. Which statement about infrared radiation is **not** correct?

A The energy from IR radiation causes some covalent bonds to vibrate more.

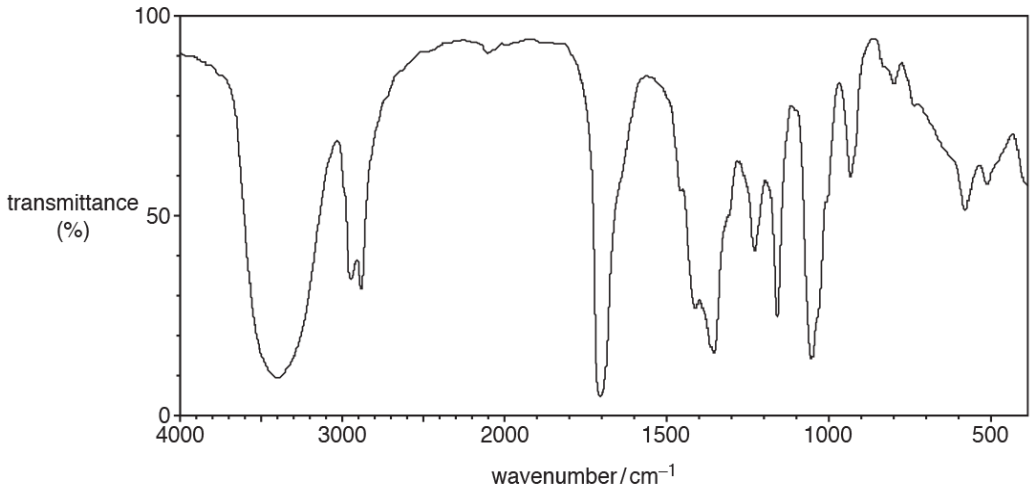
B Absorption of IR radiation by some atmospheric gases is linked by some scientists to global warming.

C IR radiation is used to monitor gases causing air pollution.

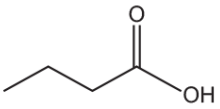
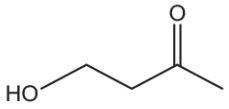
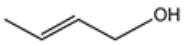
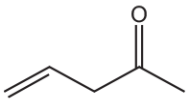
D The action of IR radiation on CFCs in the upper atmosphere leads to the formation of chlorine radicals.

Your answer ☐ **[1]**

3. An unknown compound produces the infrared spectrum below.

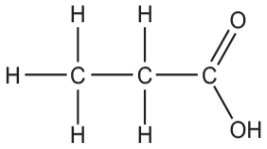
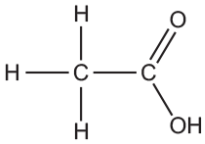
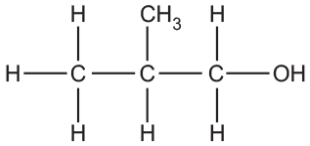
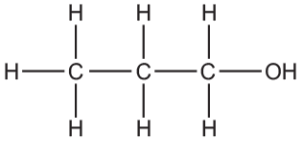


Which compound could have produced the infrared spectrum?

A	
B	
C	
D	

Your answer ☐ **[1]**

4. Which compound is **not** likely to have a fragment ion at *m / z* = 43 in its mass spectrum?

A	
B	
C	
D	

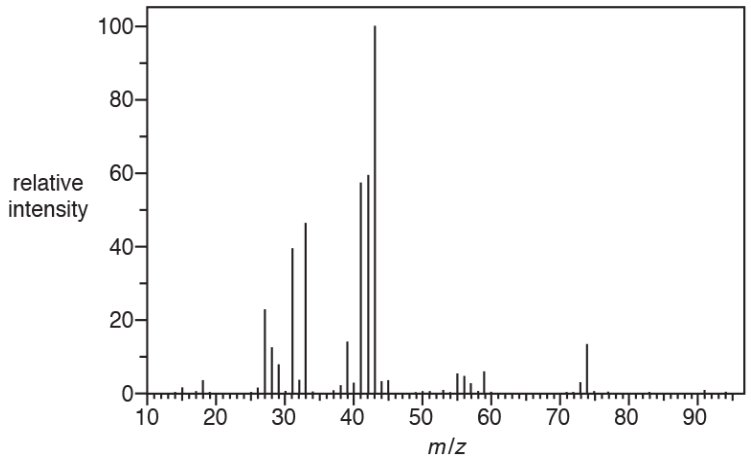
Your answer ☐ **[1]**

5. Which alcohol is likely to have a fragment ion at *m* / z = 31 in its mass spectrum?

A $CH_3CH_2CH(OH)CH_3$
B $CH_3CH_2CH_2C(OH)(CH_3)_2$
C $CH_3CH(OH)CH_2CH_2CH_3$
D $(CH_3)_2CHCH_2OH$

Your answer ☐ **[1]**

6. The mass spectrum of $(CH_3)_2CHCH_2OH$ is shown below.

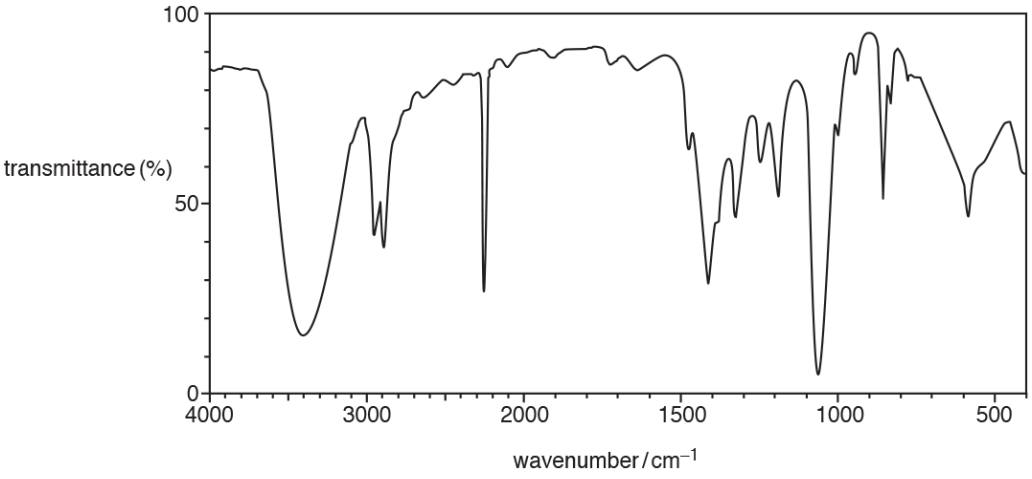


Which ion is responsible for the peak with the greatest relative intensity?

A $CHCH_2OH^+$
B $CH_3CH_2CH^+$
C $(CH_3)_2CH^+$
D CH_3CO^+

Your answer ☐ **[1]**

7. Which compound could have produced the IR spectrum below?

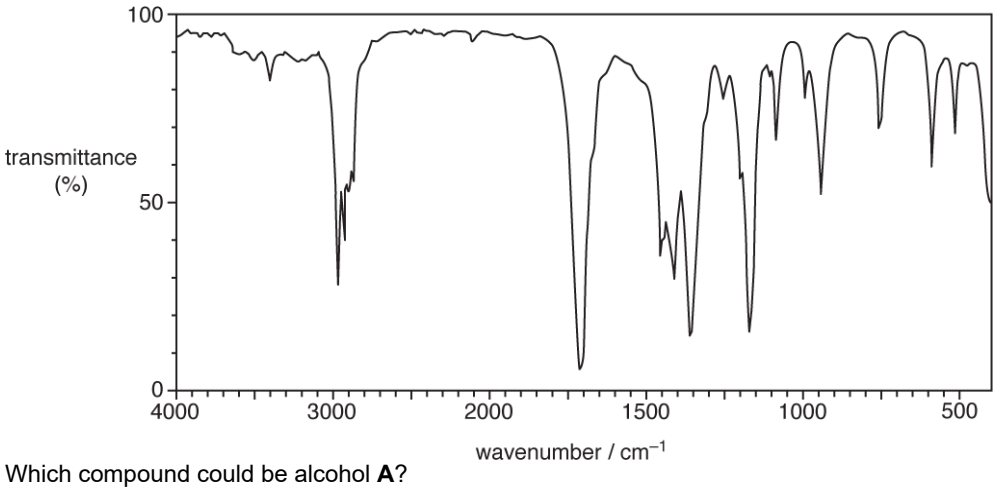


A CH_3CH_2OH
B $CH_3CHOHCN$
C CH_3COOH
D CH_3CONH_2

Your answer ☐ **[1]**

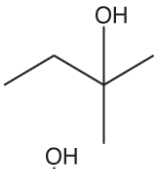
8. An alcohol **A** is heated under reflux with sulfuric acid and potassium dichromate(VI).

The organic compound formed produces the infrared spectrum below.

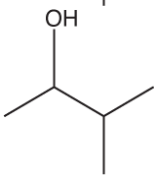


Which compound could be alcohol **A**?

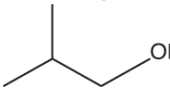
A



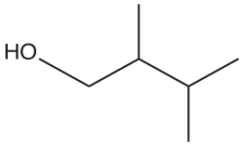
B



C



D



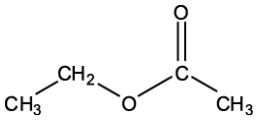
Your answer ☐ **[1]**

9. Which alcohol is **not** likely to have a fragment ion at $m / z = 43$ in its mass spectrum?

A $CH_3CH_2CH(OH)CH_3$
B $CH_3CH_2CH_2CH_2OH$
C $CH_3CH(OH)CH_2CH_2CH_3$
D $(CH_3)_2CHCH_2OH$

Your answer ☐ **[1]**

10. The structure of an ester is shown below.



Which statement is most likely to be true about the mass spectrum of the ester?

A. The peak at m/z = 45 is due to the fragment $[C_2H_5O]^+$.
B. The peak at m/z = 44 is due to the fragment $[C_3H_8]^+$.
C. The peak at m/z = 88 is the M+1 peak.
D. There is no peak at m/z = 43.

Your answer ☐

[1]

END OF QUESTION PAPER

Mark scheme – Analytical Techniques (MCQ)

Question			Answer/Indicative content	Marks	Guidance
1			**C**	1 (AO2.6)	**Examiner's Comments** From the working on the scripts, the best approach was to reduce the options down to A and C, the two with a molecular mass of 102. The best candidates then identified option C as the one with a CH3CH2 group for 29. Option A was the key distractor.
			Total	**1**	
2			**D**	1 (AO1.1)	**Examiner's Comments** Less than half the candidates correctly chose option D. This part discriminated well, with less able candidates selecting the incorrect A and C in similar amounts. A small number of candidates selected B.
			Total	**1**	
3			**B**	1 (AO2.5)	**Examiner's Comments** Able candidates selected option B, identifying that the O–H peak matches an alcohol rather than carboxylic acid from the wavenumbers. Many candidates opted for option A, the carboxylic acid, which would have a much broader O–H peak with slightly lower wavenumber range. Annotations were common on the spectrum and a sizeable number labelled the C–H peak with O–H, a clear misconception which was also mentioned in the report for H032/01 from June 2018.
			Total	**1**	
4			**A**	1 (AO2.5)	**Examiner's Comments** Candidates found this part difficult. Less than half the candidates selected the correct option A, with 'B' being the main distractor. From annotations on scripts, successful candidates often drew rings around parts of the structures which helps in identifying parts of a structure that might fragment.
			Total	**1**	

5			**D**	**1**	**Examiner's Comments** Overall, candidates answered this question well with many selecting the correct response of D. From scripts, successful candidates drew vertical lines to isolate likely fragments.
			Total	**1**	
6			**C**	**1**	**Examiner's Comments** Most candidates were able to identify C as the fragment responsible for the peak at *m/z* = 43. A number of different approaches were used. Some candidates determined the mass of each fragment shown while others drew the structures to see which were likely to be formed from $(CH_3)_2CHCH_2OH$.
			Total	**1**	
7			**B**	**1**	**Examiner's Comments** Most candidates correctly identified B as the compound after labelling the O-H and C≡N peaks in the spectrum.
			Total	**1**	
8			B	**1**	**Examiner's Comments** Just over half of the candidates identified the correct alcohol. The common incorrect answer was C.
			Total	**1**	
9			A	**1**	**Examiner's Comments** Fewer than half the candidates obtained the correct alcohol (A). The common incorrect answer was C.
			Total	**1**	
10			A	1	
			Total	**1**	