

# Analytical Techniques (IR & Mass Spec) AS & A Level Question Paper 1

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Analytical Techniques (IR & Mass Spec)
Paper	AS & A Level
Booklet	Question Paper 1

**Time allowed:** 34 minutes

**Score:** /25

**Percentage:** /100

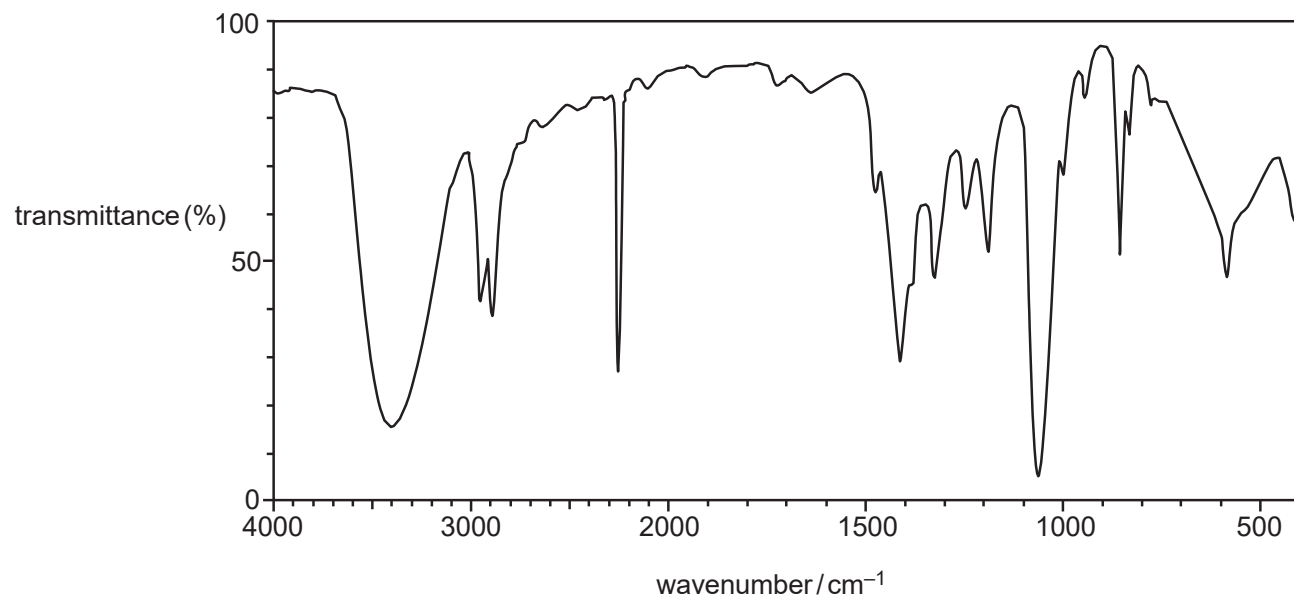
**Grade Boundaries:**

A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

## Question 1

Which compound could have produced the IR spectrum below?

[1]

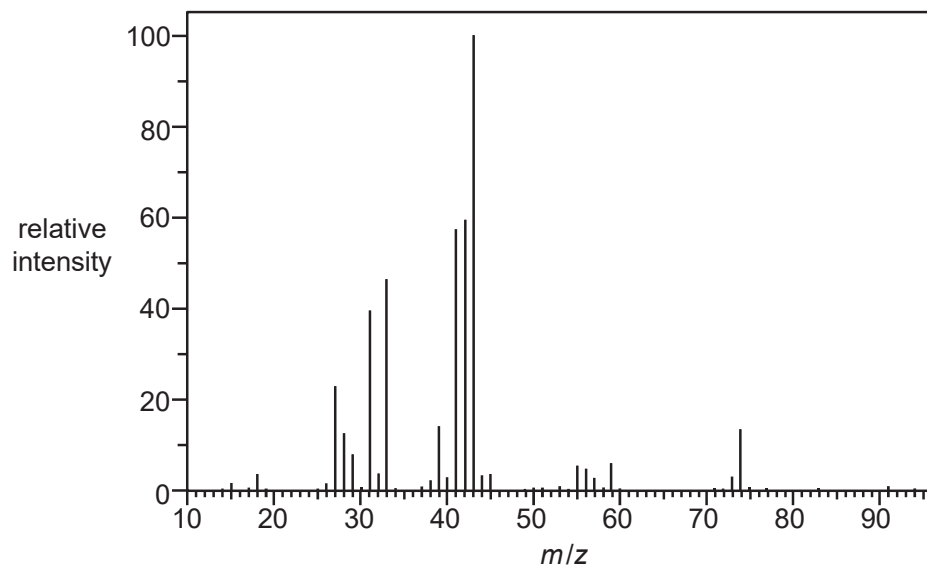


- A.  $\text{CH}_3\text{CH}_2\text{OH}$
- B.  $\text{CH}_3\text{CHOHCN}$
- C.  $\text{CH}_3\text{COOH}$
- D.  $\text{CH}_3\text{CONH}_2$

## Question 2

The mass spectrum of  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$  is shown below.

[1]



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

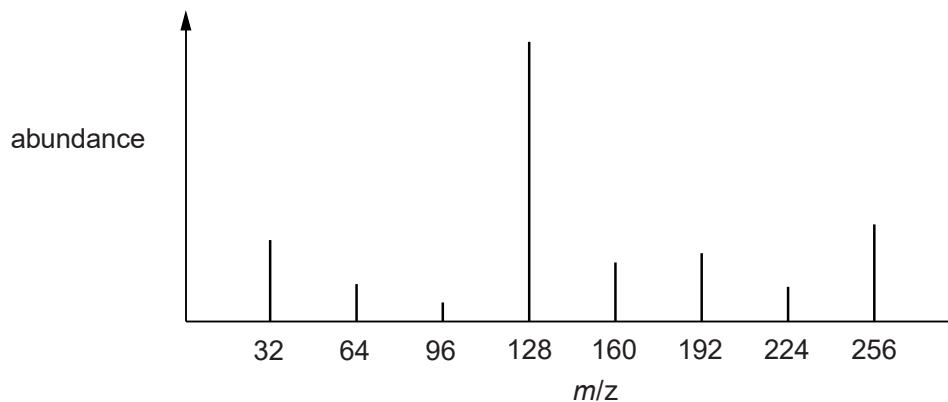
- A  $\text{CHCH}_2\text{OH}^+$
- B  $\text{CH}_3\text{CH}_2\text{CH}^+$
- C  $(\text{CH}_3)_2\text{CH}^+$
- D  $\text{CH}_3\text{CO}^+$

### Question 3

Mass spectrometry and infrared spectroscopy are used in analysis.

(a) The element sulfur exists as molecules,  $S_n$ .

The mass spectrum that would be given by a sample of sulfur is shown below.  
All the sulfur atoms are the same isotope.

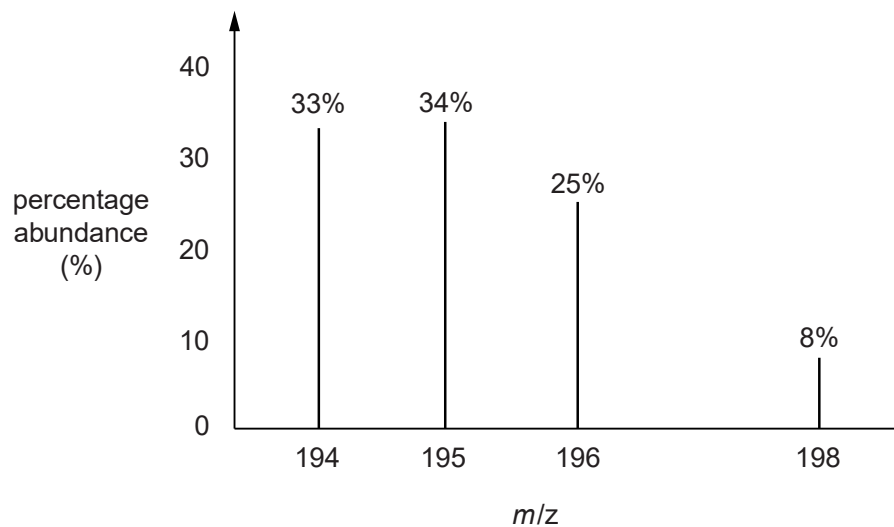


(i) State the  $m/z$  value of the molecular ion. [1]

(ii) Suggest the formula for a molecule of sulfur. [1]

(iii) What is the formula for the fragment ion with  $m/z = 128$ ? [1]

(b) A sample of an element, **L** is analysed using mass spectrometry.  
The mass spectrum is shown below.



Calculate the relative atomic mass of **L**.  
Give your answer to **one** decimal place.

[2]

(c) Give an everyday use for infrared spectroscopy.

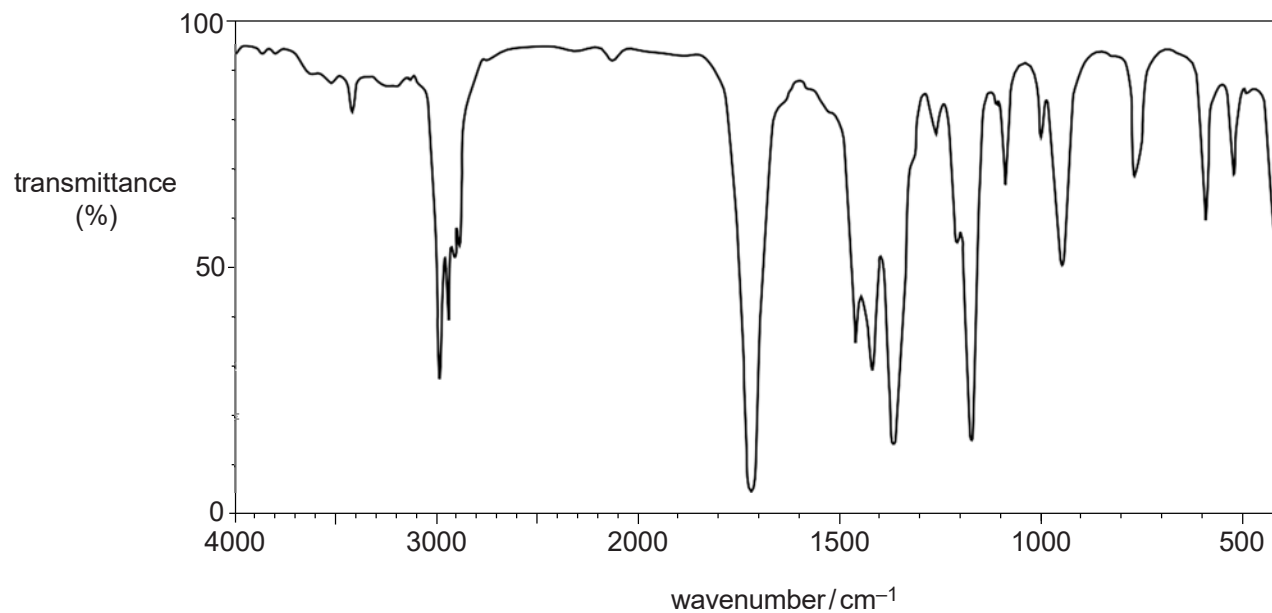
[1]

(d) The solvent, **M**, is an organic compound used in paints. The solvent **M** was analysed.

**M** has a relative molecular mass of 72.0.

The percentage composition by mass of **M** is C, 66.7%; H, 11.1%; O, 22.2%.

The infrared spectrum of **M** is shown below.



The analysis produces several possible organic structures.

Suggest, with reasons, **two** possible structures for **M**.

[5]

[Total 11 Marks]

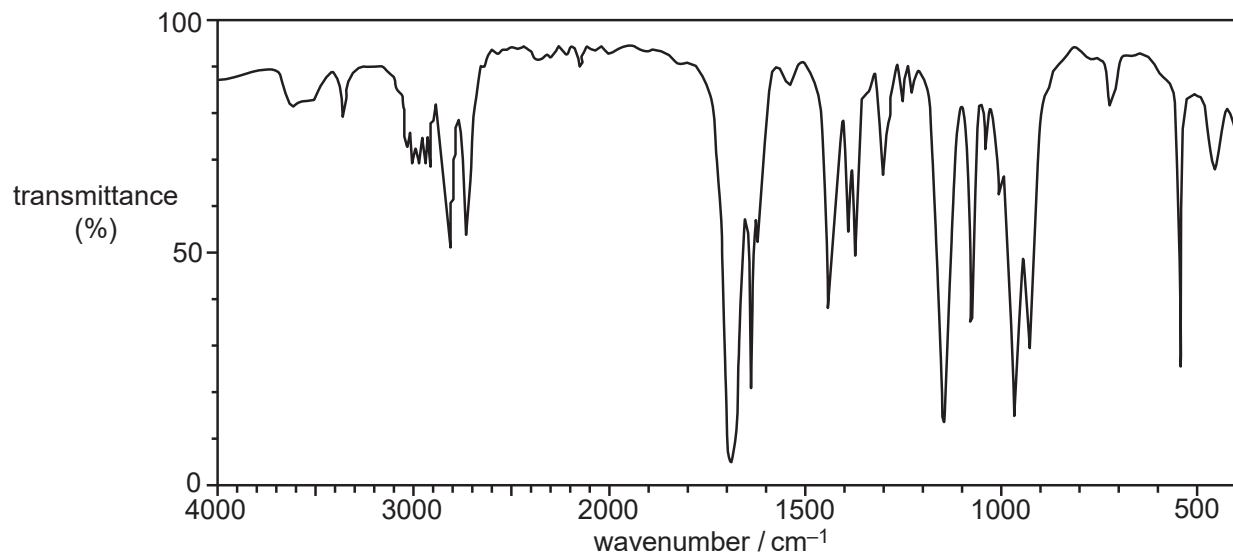
## Question 4

Compound **F** is a *trans* stereoisomer which is a useful intermediate in organic synthesis.

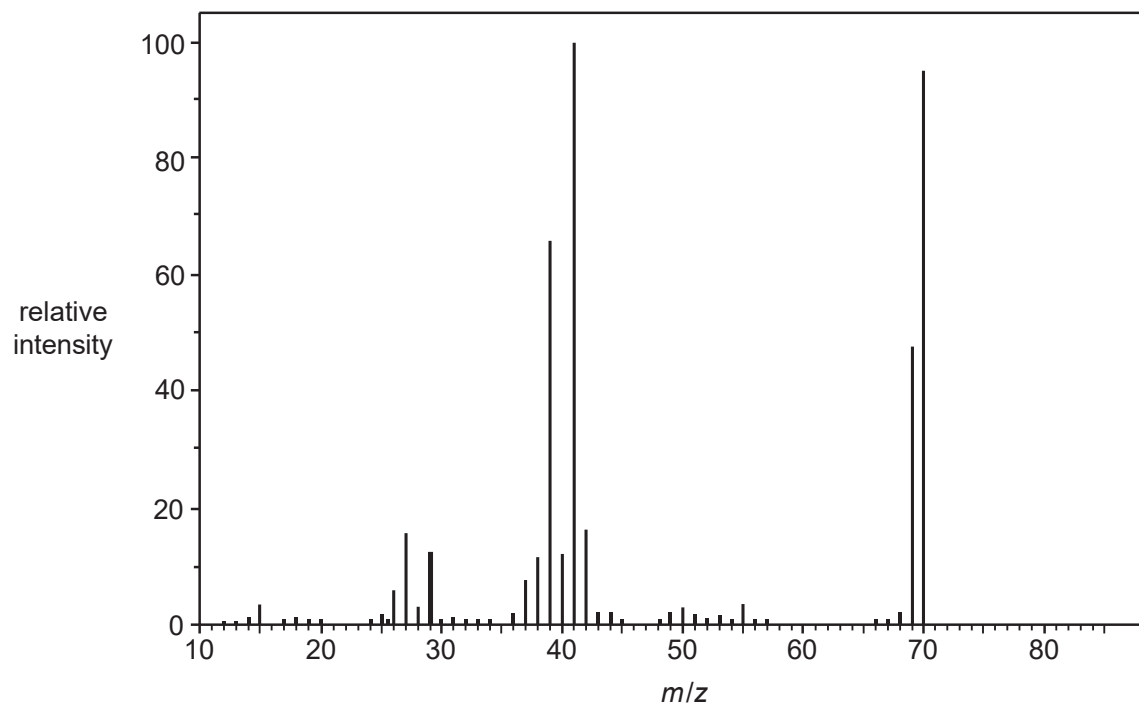
The results of elemental and spectral analysis of compound **F** are shown below.

Percentage composition by mass: C, 68.6 %; H, 8.6 %; O, 22.8 %.

### Infrared spectrum



### Mass spectrum



In the mass spectrum, the peak with the greatest relative intensity is caused by the loss of a functional group from the molecular ion of compound **F**.

Determine the structure of compound **F**.

Explain your reasoning and show your working.

**[6]**

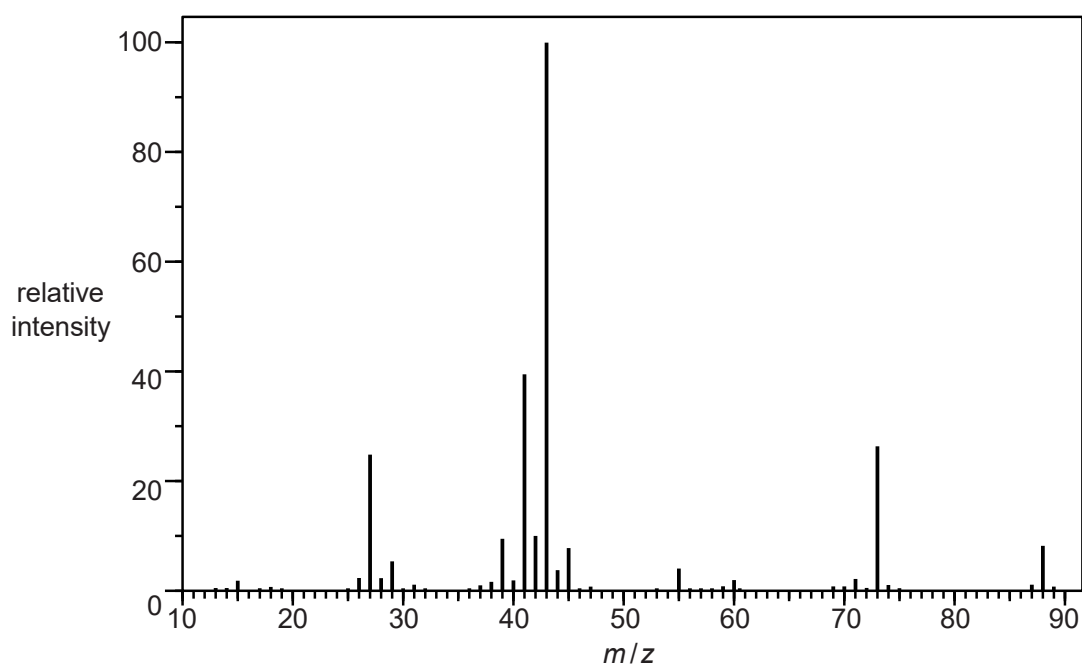
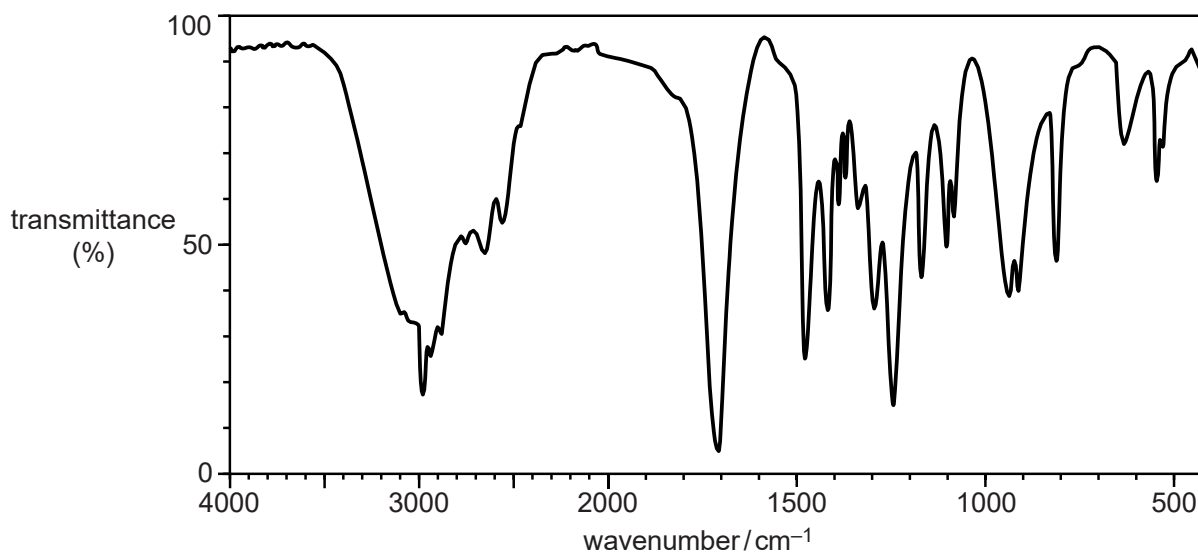
**(Total 6 marks)**



## Question 5

Organic compound **C** has the following percentage composition by mass:  
C, 54.5%; H, 9.1%; O, 36.4%.

The infrared spectrum and mass spectrum of compound **C** are shown below.



In the mass spectrum, a secondary carbocation is responsible for the peak with the greatest relative intensity.

Identify compound **C**.

In your answer you should make clear how your conclusion is linked to all the evidence.

**[6]**

**(Total 6 marks)**