

Carbonyl Compounds, Carboxylic Acids, Esters & Polyesters

AS & A Level

Question Paper 3

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Organic Chemistry & Analysis
Topic	Carbonyl Compounds, Carboxylic Acids, Esters & Polyesters
Paper	AS & A Level
Booklet	Question Paper 3

Time allowed: 57 minutes

Score: /42

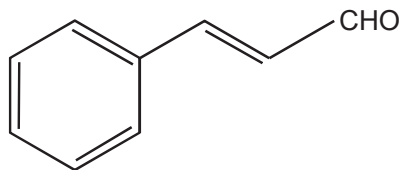
Percentage: /100

Grade Boundaries:

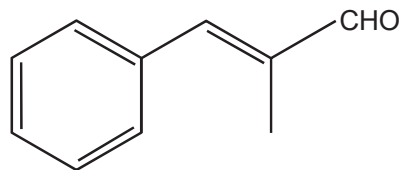
A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

Question 1

Cinnamaldehyde and methylcinnamaldehyde are naturally occurring organic compounds.



cinnamaldehyde



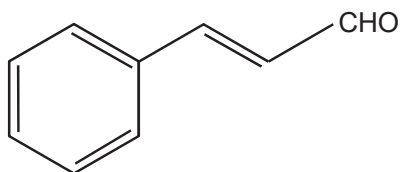
methylcinnamaldehyde

(a) Methylcinnamaldehyde is an *E* stereoisomer.

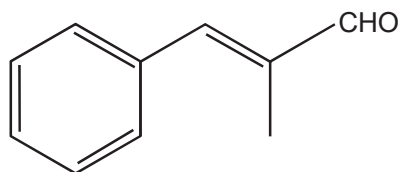
Explain this statement in terms of the Cahn-Ingold-Prelog (CIP) rules.

[2]

- (b) A student plans to carry out some chemical tests on both cinnamaldehyde and methylcinnamaldehyde.



cinnamaldehyde



methylcinnamaldehyde

- (i) Suggest a suitable chemical test to confirm that both compounds contain an unsaturated carbon chain.

Your answer should include the reagent and observations.

[1]

- (ii) Describe a chemical test to confirm that both compounds contain an aldehyde functional group.

Your answer should include the reagent and observations.

[1]

- (iii) Describe a chemical test to confirm that cinnamaldehyde and methylcinnamaldehyde contain a carbonyl group.

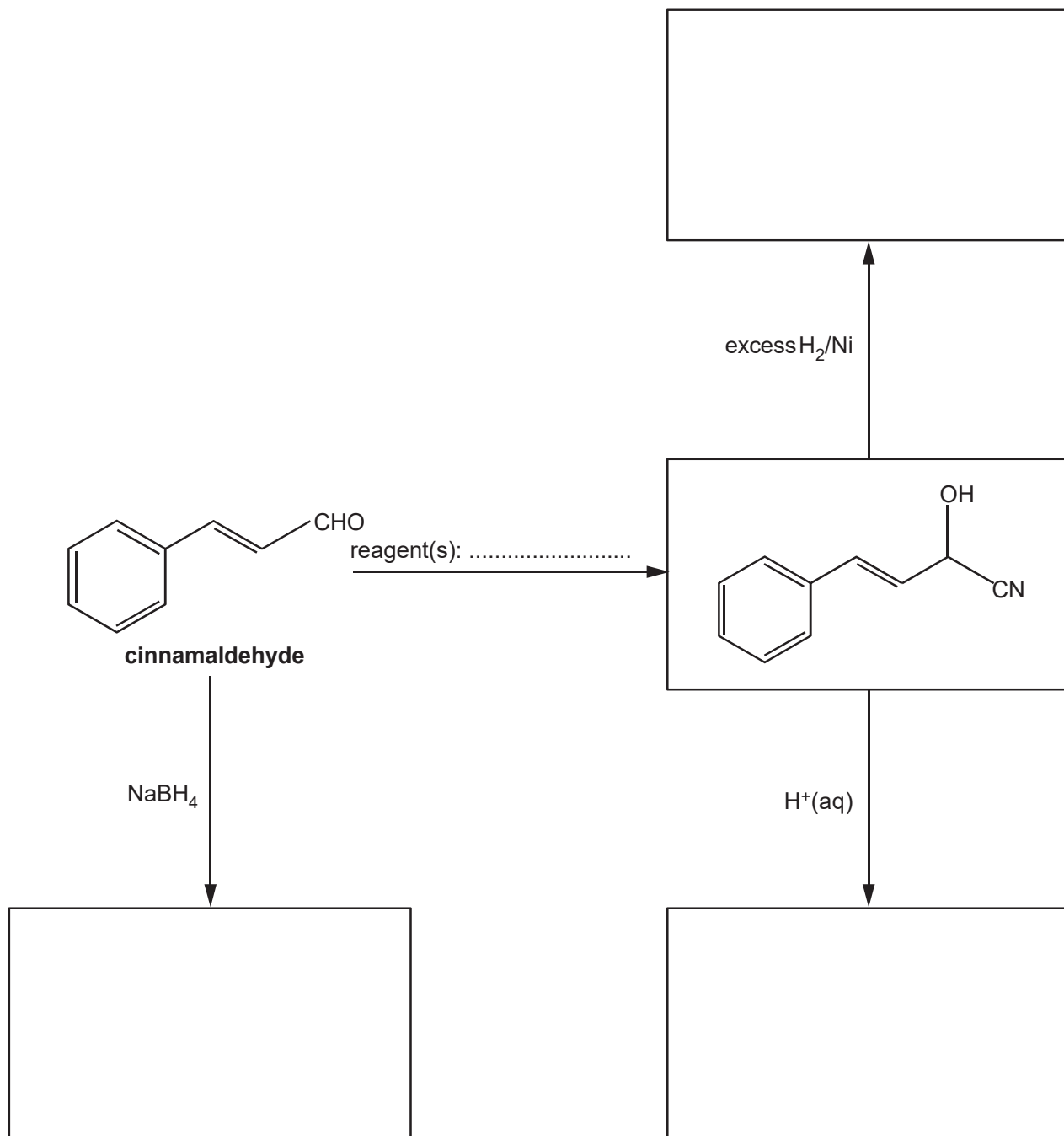
How could the products of this test be used to distinguish between the two compounds?

Your answer should **not** include spectroscopy.

[3]

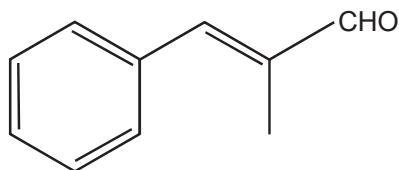
(c) The flowchart below shows some reactions starting with cinnamaldehyde.

Draw the structures of the missing organic compounds in the boxes and add the missing reagent(s) on the dotted line.



[5]

- (d)* Methylcinnamaldehyde reacts with iodine monochloride, ICl , by electrophilic addition. The reaction produces a mixture containing two different organic products.



methylcinnamaldehyde

The electronegativity values of chlorine and iodine are given in the table below.

	Pauling electronegativity value
Cl	3.0
I	2.5

Outline the mechanism, using the 'curly arrow' model, for the formation of **one** of the organic products and explain which of the two possible organic products is more likely to be formed.

In your mechanism, you can show the phenyl group as C_6H_5 .

[6]

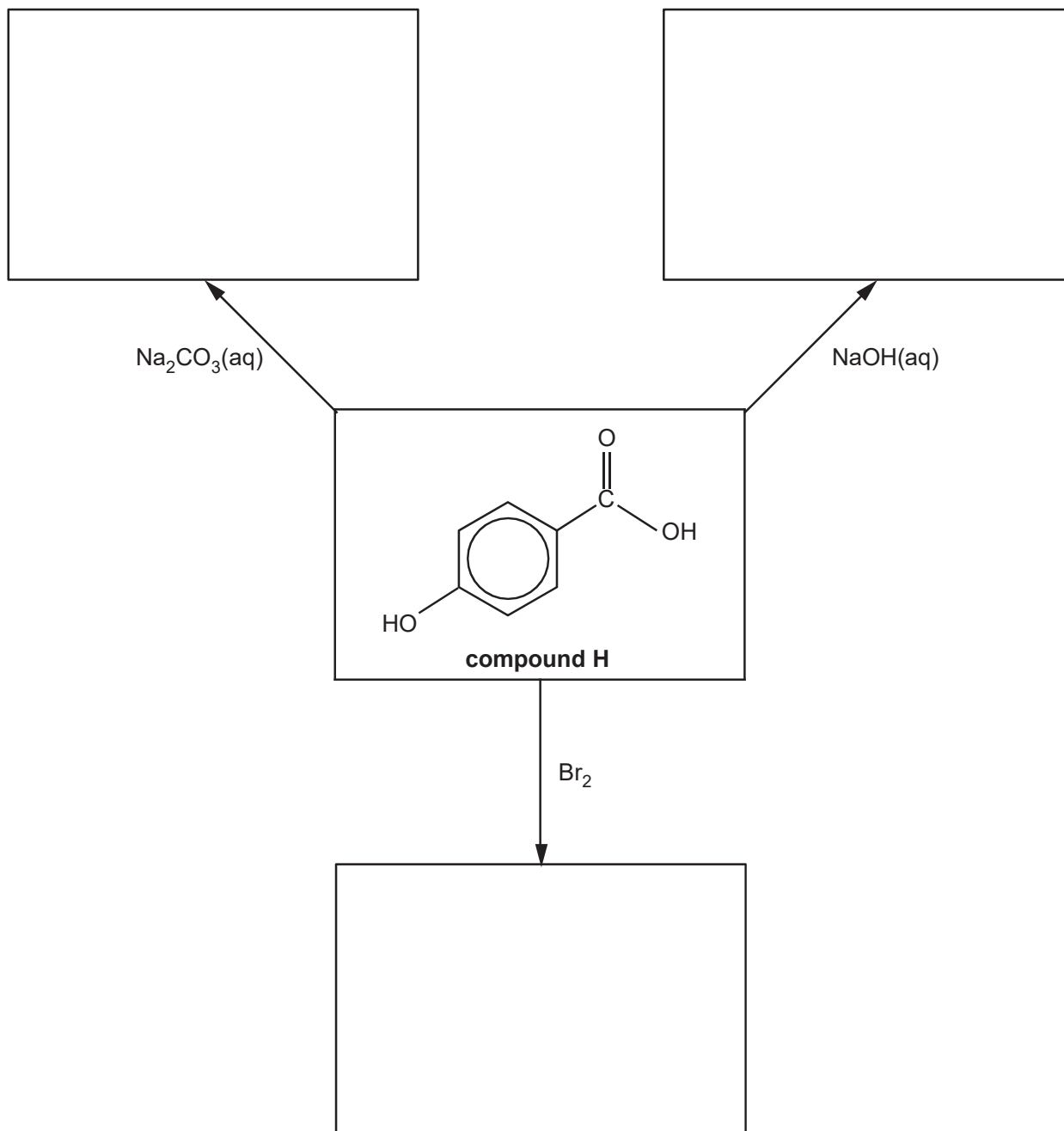
(Total 18 marks)

Question 2

This question is about aromatic carboxylic acids and their derivatives.

(a) The flowchart below shows some reactions of compound **H**.

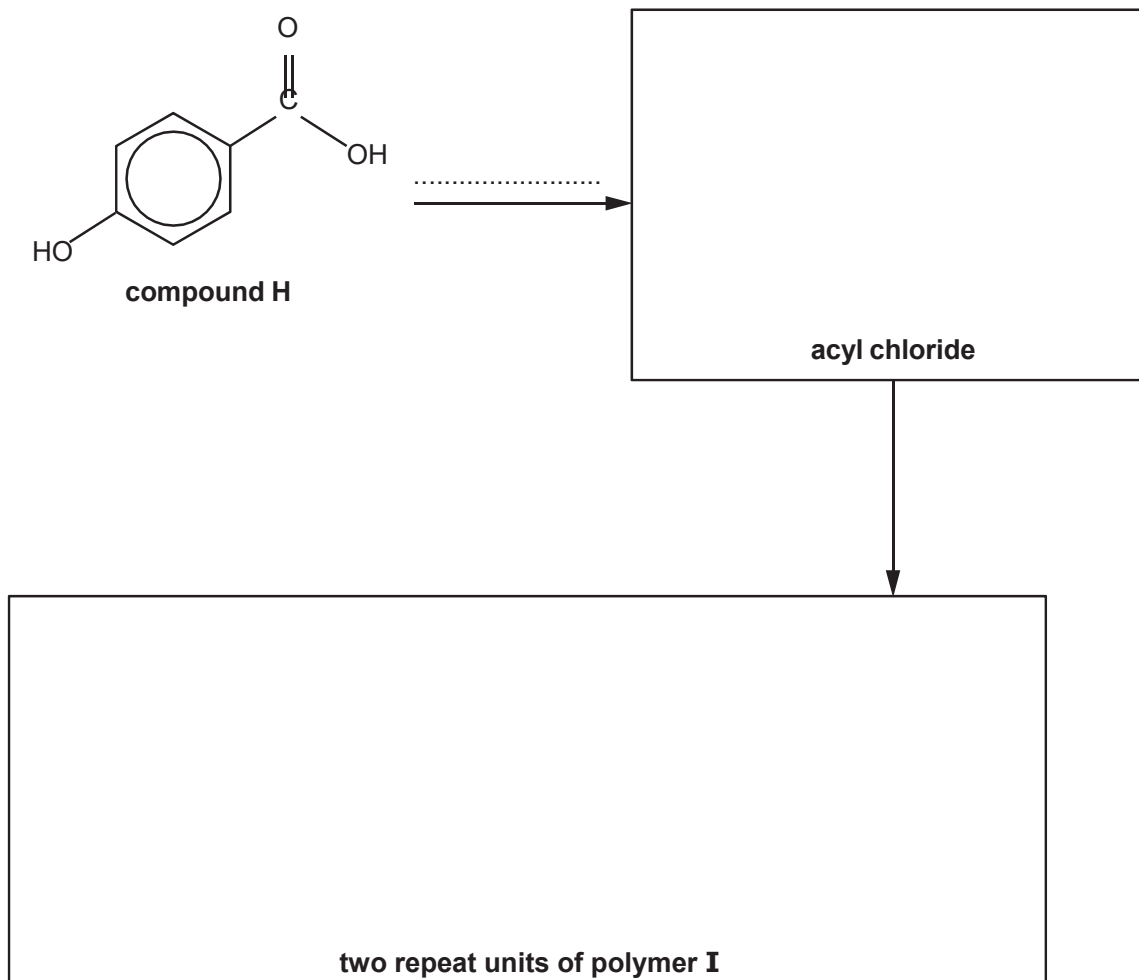
In the boxes, draw the organic products of these reactions.



[3]

(b) Compound **H** is used in the synthesis of polymer **I**, as shown in the flowchart below.

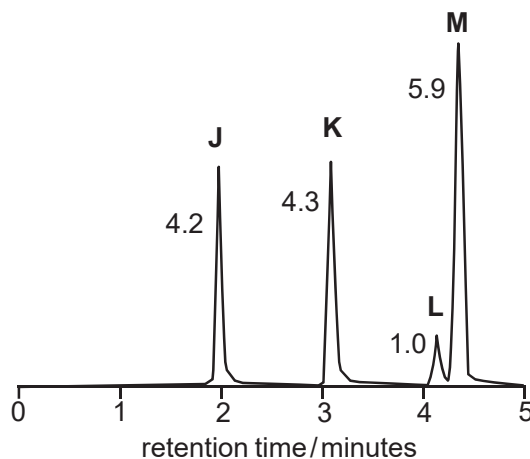
Complete the flowchart by drawing the structure of the acyl chloride and **two** repeat units of polymer **I**, and stating the **formula** of the reagent(s) required for the first stage on the dotted line.



[4]

- (c) A cosmetic product containing four esters, **J**, **K**, **L** and **M**, is analysed by gas chromatography and mass spectrometry. The results are shown below.

Gas chromatogram



The numbers by the peaks are the relative molar proportions of the compounds in the mixture.

Mass spectrometry

ester	<i>m/z</i> of molecular ion peak
J	152
K	166
L	180
M	180

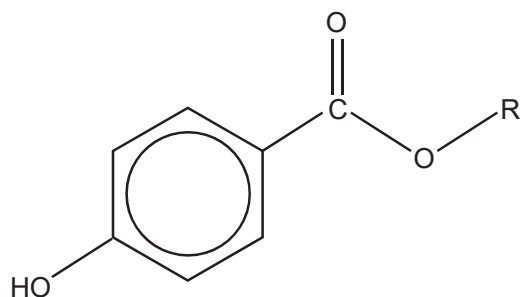
- (i) The concentration of ester **K** in the cosmetic product is $9.13 \times 10^{-2} \text{ g dm}^{-3}$.

Using the results, calculate the concentration, in mol dm^{-3} , of ester **M** in the cosmetic product.

Give your answer to **two** significant figures.

[2]

(ii) A general structure for esters **J**, **L** and **M** is shown below.



Where 'R' is an alkyl group.

Use the mass spectrometry results to deduce possible structures for esters **J**, **L** and **M**.

J	L	M
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[3]

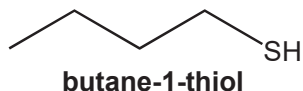
(Total 12 marks)

Question 3

This question is about organic molecules that have a strong smell.

- (a) Thiols are foul-smelling, organic sulfur compounds with the functional group –SH.

Butane-1-thiol, shown below, contributes to the strong smell of skunks.



- (i) Thiols are weak acids.

Write the expression for the acid dissociation constant, K_a , for butane-1-thiol.

[1]

- (ii) Thiols react with carboxylic acids to form thioesters.

Write an equation for the reaction of butane-1-thiol with ethanoic acid.

Use structures for all organic compounds with the functional groups clearly displayed.

[2]

- (iii) When beer is exposed to light, 3-methylbut-2-ene-1-thiol is formed, which gives an unpleasant smell and flavour to the beer.

Draw the **skeletal** formula for 3-methylbut-2-ene-1-thiol.

[1]

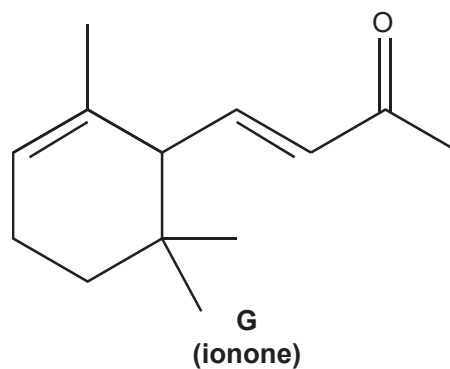
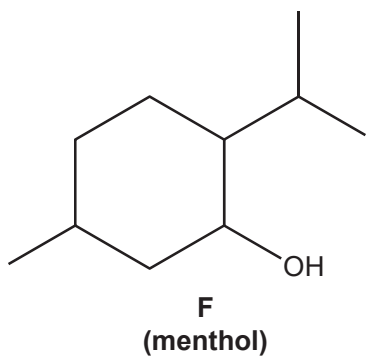
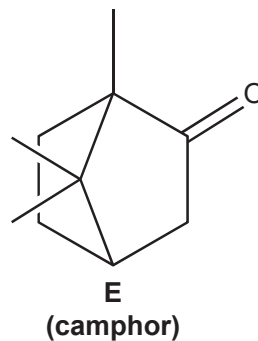
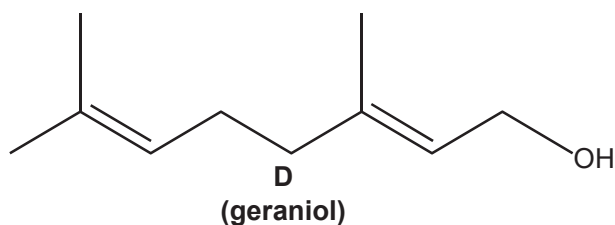
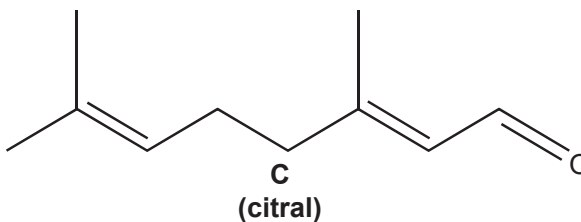
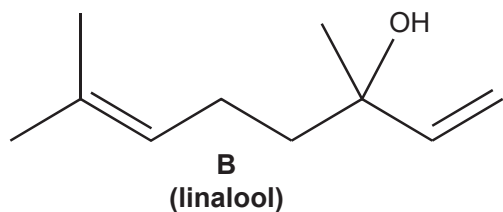
- (iv) Propane-1,3-dithiol reacts with carbonyl compounds in a condensation reaction to form a cyclic organic sulfur product.

Write an equation for the reaction of propane-1,3-dithiol with propanone.

Use structures for organic compounds.

[2]

- (b)* The structures for six naturally occurring organic compounds with pleasant smells, **B–G**, are shown below. The common names in brackets relate to their source and smell.



Explain how chemical tests would allow each compound to be distinguished from the other compounds.

In your answer, include essential details for all test procedures and observations.

Details of apparatus and quantities are **not** required.

[6]

(Total 12 marks)