

Hydrocarbons

AS & A Level

Question Paper 5

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Hydrocarbons
Paper	AS & A Level
Booklet	Question Paper 5

Time allowed: 59 minutes

Score: /44

Percentage: /100

Grade Boundaries:

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

Question 1

This question is about organic compounds containing nitrogen.

- (a) Sodium cyanide, NaCN, can be reacted with many organic compounds to increase the length of a carbon chain.
- (i) 1-Chloropropane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$, reacts with ethanolic sodium cyanide by nucleophilic substitution.

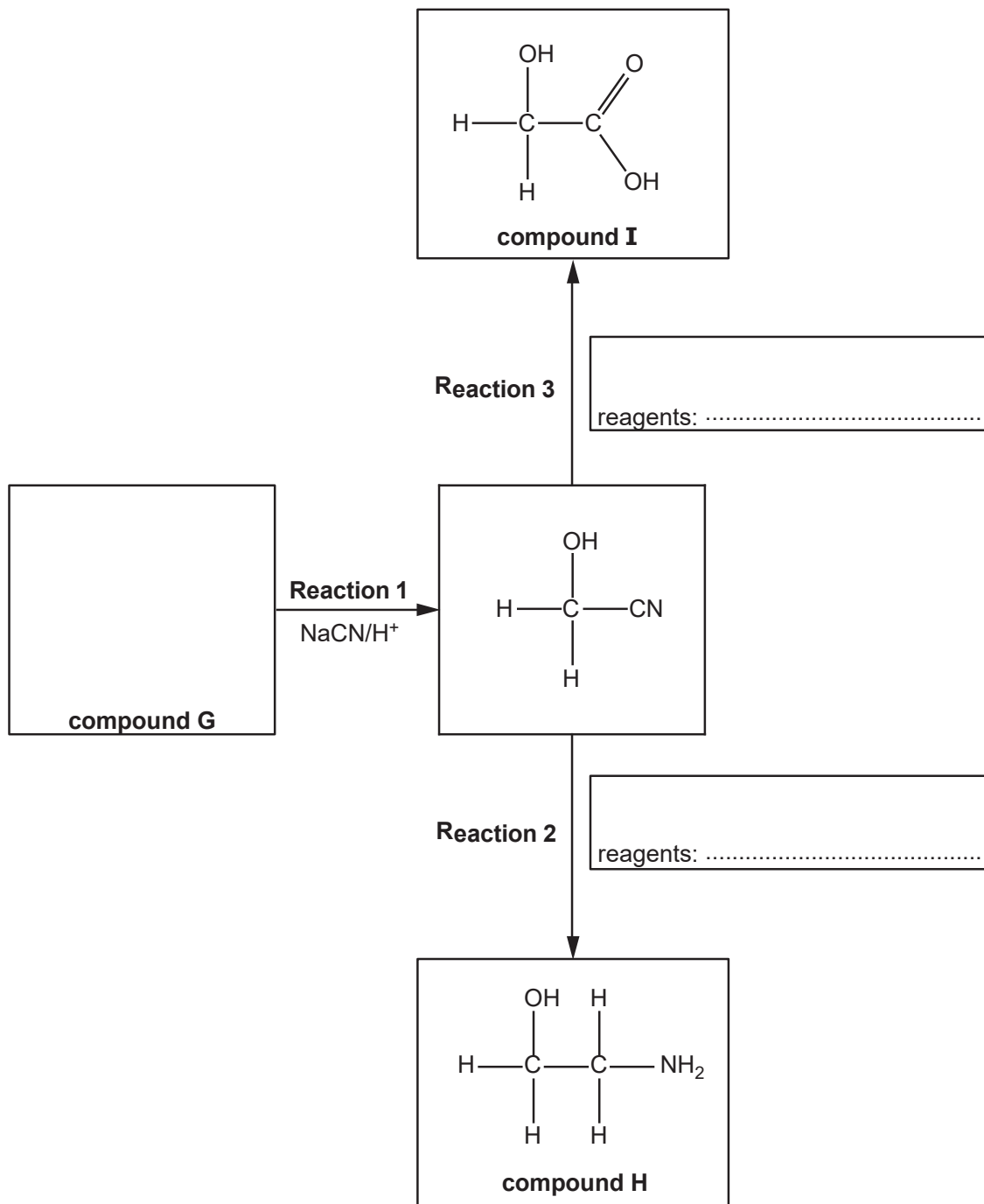
Outline the mechanism for this reaction.

Include curly arrows, relevant dipoles and the structure of the organic product.

[3]

(ii) Compound **G** is used to synthesise compounds **H** and **I** as shown in the flowchart below.

Complete the flowchart showing the structure of compound **G** and the **formulae** of the reagents for **Reaction 2** and **Reaction 3**.



[3]

- (iii) Compound **H** reacts with dilute hydrochloric acid to form a salt.

Explain why compound **H** can react with dilute hydrochloric acid and suggest a structure for the salt formed.

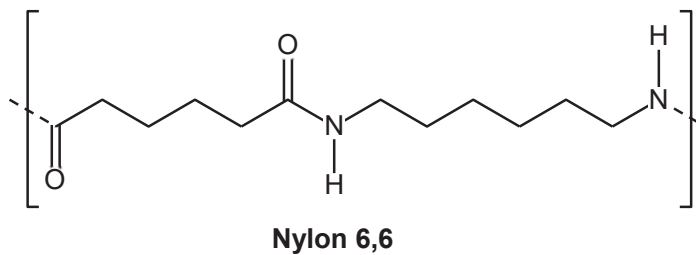
[2]

- (iv) Compound **I** is the monomer for the biodegradable polymer **J**.

Draw **two** repeat units of polymer **J** and suggest a reason why it is biodegradable.

[3]

(b) The repeat unit of Nylon 6,6 is shown below.



(i) Draw the structures of **two** monomers that can be used to form Nylon 6,6.

[2]

(ii) A sample of Nylon 6,6 has a relative molecular mass of 21500.

Estimate the number of repeat units in the sample.

Give your answer as a **whole** number.

[1]

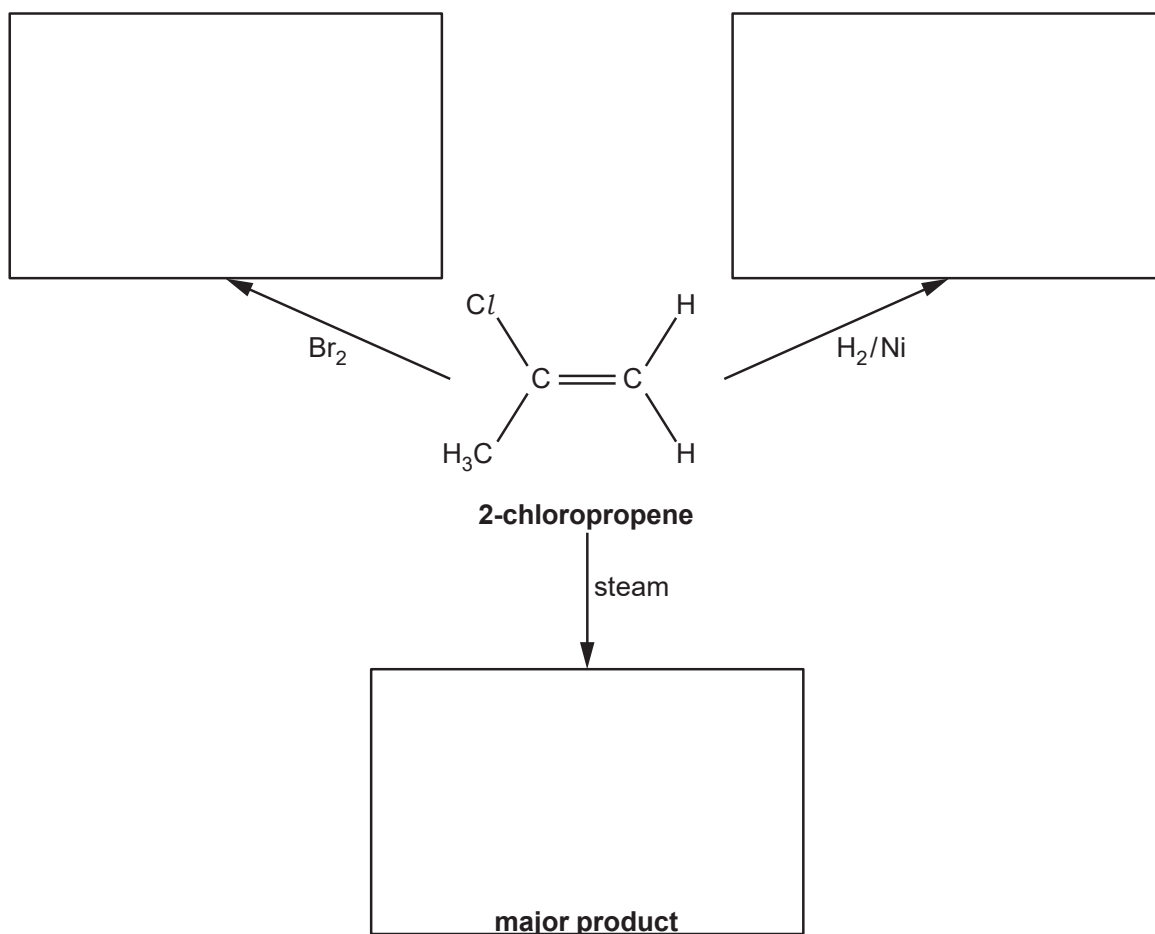
(Total 14 marks)

Question 2

This question is about 2-chloropropene, C_3H_5Cl .

(a) Three reactions of 2-chloropropene are shown in the flowchart below.

(i) Complete the flowchart to show the organic products formed in the reactions.



[3]

(ii) The reaction of 2-chloropropene with steam requires a catalyst.

State a suitable catalyst for this reaction.

[1]

(b) 2-chloropropene can be polymerised to form poly(2-chloropropene).

(i) Write a balanced equation for the formation of this polymer.

The equation should include the structure of the repeat unit of the polymer.

[2]

(ii) After their useful life, waste polymers can be disposed of by combustion.

State **one** particular problem with disposal of poly(2-chloropropene) by combustion.

[1]

(Total 7 marks)

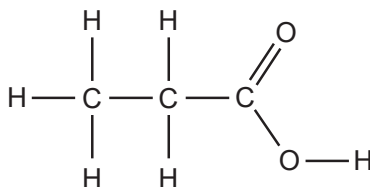
Question 3

Propanoic acid, $\text{CH}_3\text{CH}_2\text{COOH}$, is a member of the homologous series of carboxylic acids.

(a) Suggest the general formula for a carboxylic acid.

[1]

(b) The displayed formula for propanoic acid is shown below.



(i) State the shape and bond angle around a carbon atom in the alkyl group of propanoic acid. Explain the shape.

[2]

(ii) Suggest a value for the $\text{C}-\text{O}-\text{H}$ bond angle in propanoic acid.

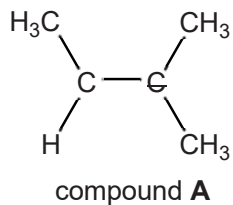
[1]

- (d) 2-Chloropropanoic acid, $\text{CH}_3\text{CHClCOOH}$, can be made by reacting propanoic acid with chlorine in a radical substitution reaction.
- (i) State the conditions for the reaction. [1]
- (ii) Write the overall equation for the reaction. [1]
- (iii) The first step in the reaction mechanism involves homolytic fission of a chlorine molecule to form two chlorine radicals.
- Why is this step an example of *homolytic fission*? [1]
- (iv) Write **two** equations to show the propagation steps in the mechanism for this reaction.
- Use dots, •, to show the unpaired electrons on radicals. [2]
- (v) Draw the displayed formula of the radical formed in the first propagation step.
- Use a dot, •, to show the position of the unpaired electron. [1]
- (vi) Further substitution forms a mixture of organic products.
- Draw the structure of an organic product formed from 2-chloropropanoic acid by further substitution. [1]

(Total 11 marks)

Question 4

Compound **A** is an alkene.



(a) The C=C bond in a molecule of compound **A** has restricted rotation because it comprises a σ bond and a π bond.

(i) Describe **one** difference between the σ bond and the π bond.

[1]

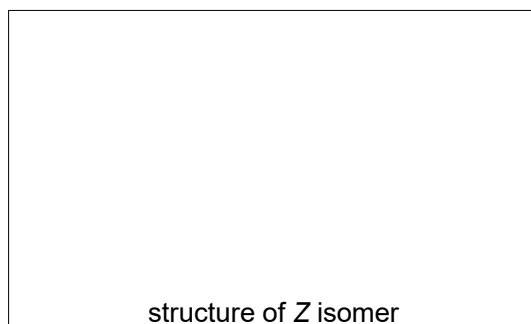
(ii) Explain why compound **A** does **not** have *E/Z* isomers.

[1]

(iii) A structural isomer of compound **A** has *E/Z* isomers.

Draw the structure of the *Z* isomer and then name this isomer.

[2]



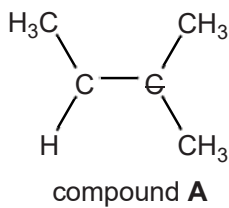
(b) Compound **A** can be made from alcohol **B** by heating with an acid catalyst.

Suggest **two** possible structures for alcohol **B**.

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[2]

(c)* Compound **A** reacts with hydrogen bromide to form a mixture of two different organic products.



Give the structures of the **two** possible organic products of the reaction.

Outline the mechanism, using the 'curly arrow' model, for the formation of one of the organic products from compound **A**.

Explain which of the two organic products is more likely to be formed.

[6]

(Total 12 marks)