

# Haloalkanes

## AS & A Level

### Question Paper 3

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Haloalkanes
Paper	AS & A Level
Booklet	Question Paper 3

**Time allowed:** 50 minutes

**Score:** /37

**Percentage:** /100

**Grade Boundaries:**

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

## Question 1

This question is about the hydrolysis of haloalkanes.

- (a) The rate of hydrolysis of a haloalkane depends on the halogen present.

State and explain how the halogen in the haloalkane affects the rate of hydrolysis.

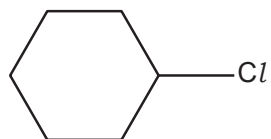
[2]

- (b) Chlorocyclohexane is hydrolysed with aqueous sodium hydroxide.

Outline the mechanism for this reaction.

Show curly arrows, relevant dipoles and the products.

[3]



(c) A student hydrolyses a haloalkane, **E**, using the following method.

- 0.0100 mol of haloalkane **E** is refluxed with excess NaOH(aq) to form a reaction mixture containing an organic product **F**.
- The reaction mixture is neutralised with dilute nitric acid.
- Excess AgNO<sub>3</sub>(aq) is added to the reaction mixture. 1.88 g of a precipitate **G** forms.

Organic product, **F**, has a molar mass of 74.0 g mol<sup>-1</sup> and has a chiral carbon atom.

- (i) Draw a **labelled** diagram to show how the student would carry out the hydrolysis of haloalkane **E**.

[2]

- (ii) Analyse the information to identify **E**, **F** and **G**.

Show your working.

[3]

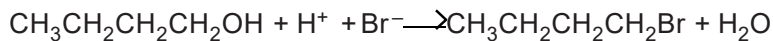
**(Total 10 marks)**

## Question 2

(a) 1-Bromobutane is an organic liquid with a boiling point of 102 °C.

A student prepares 1-bromobutane by reacting butan-1-ol with sulfuric acid and sodium bromide. The student boils the mixture for one hour.

The equation is shown below.



The student obtains a reaction mixture containing an organic layer (density = 1.27 g cm<sup>-3</sup>) and an aqueous layer (density = 1.00 g cm<sup>-3</sup>).

(i)\* Draw a labelled diagram to show how you would safely set up apparatus for the preparation. Outline a method to obtain a pure sample of 1-bromobutane from the reaction mixture.

[6]

(ii) The student used 0.150 mol of butan-1-ol. The student obtained a 61.4% percentage yield of 1-bromobutane.

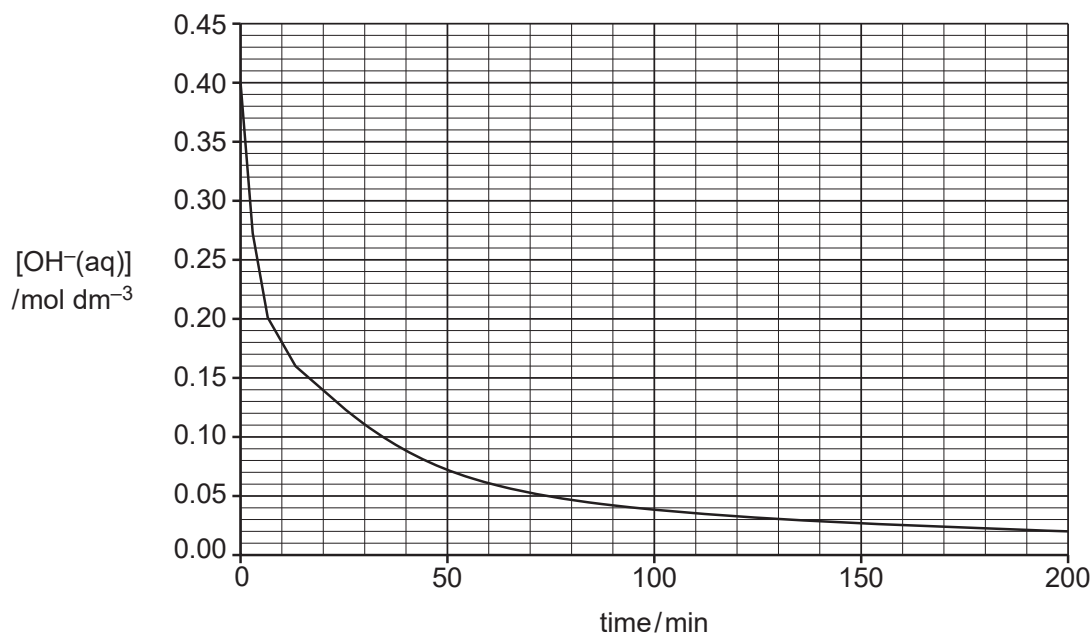
Calculate the mass of 1-bromobutane obtained.

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

[2]

(b) A student investigates the rate of reaction of 1-bromobutane with aqueous hydroxide ions.

The graph shows how the hydroxide ion concentration,  $[\text{OH}^-(\text{aq})]$ , changes during the reaction.



Using the graph, calculate the rate of reaction, in  $\text{mol dm}^{-3} \text{ min}^{-1}$ , at 30 minutes.

Show your working on the graph and in the space below.

[2]

**(Total 10 marks)**

### Question 3

Organic compounds can be prepared in the laboratory using synthetic routes with two or more stages.

(a) A student devises a two-stage synthesis of cyclohexene from bromocyclohexane.



(i) Suggest the structure of **intermediate E** and the reagent(s) and conditions for **step 2**.

[2]

(ii) The student carries out this synthesis and obtains 1.23 g of pure cyclohexene from 5.50 g of bromocyclohexane.

Calculate the percentage yield of cyclohexene.

Give your final answer to an **appropriate** number of significant figures.

[3]

(b) Cyclohexene is reacted with bromine to prepare the organic compound **F**.

Give the structure of compound **F** and outline the mechanism for this reaction.

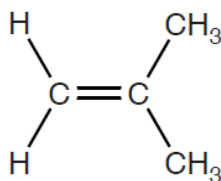
**[4]**

Include curly arrows, charges and relevant dipoles.

**(Total 9 marks)**

## Question 4

Compound **B**, shown below, can be used to synthesise organic compounds with different functional groups.



**Compound B**

- (a) (i) Compound **B** is a member of a homologous series.

Name the homologous series and state its general formula.

Homologous series .....

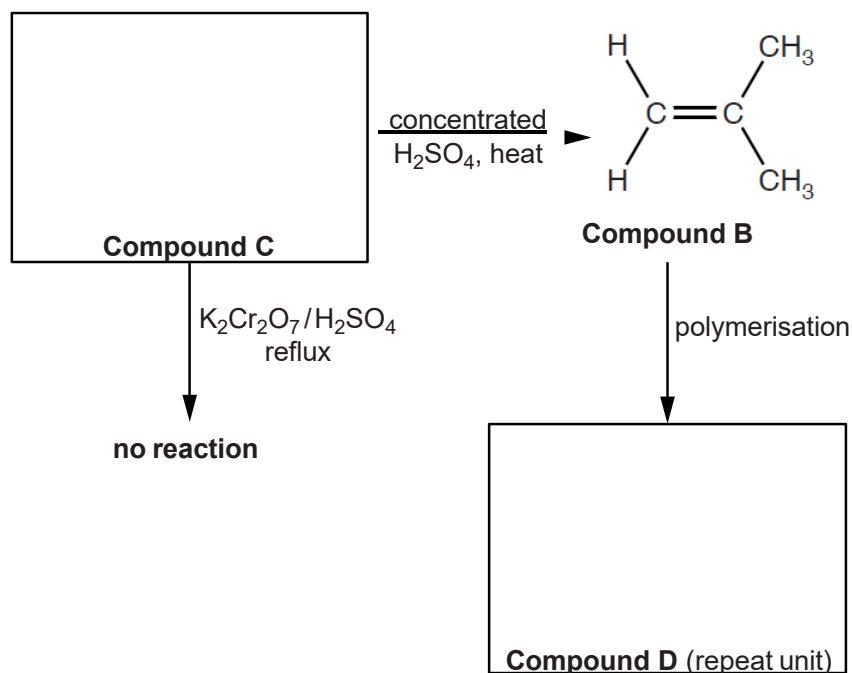
General formula ..... [1]

- (ii) What reagents and conditions are needed to convert compound **B** into a saturated hydrocarbon?

[1]

- (b) Some reactions involving compound **B** are shown in the flowchart below.

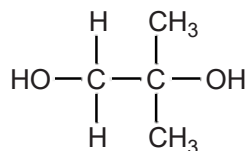
Complete the flowchart, showing the structures of organic compounds **C** and **D**.



[2]



(c) The structure of compound **F** is shown below.



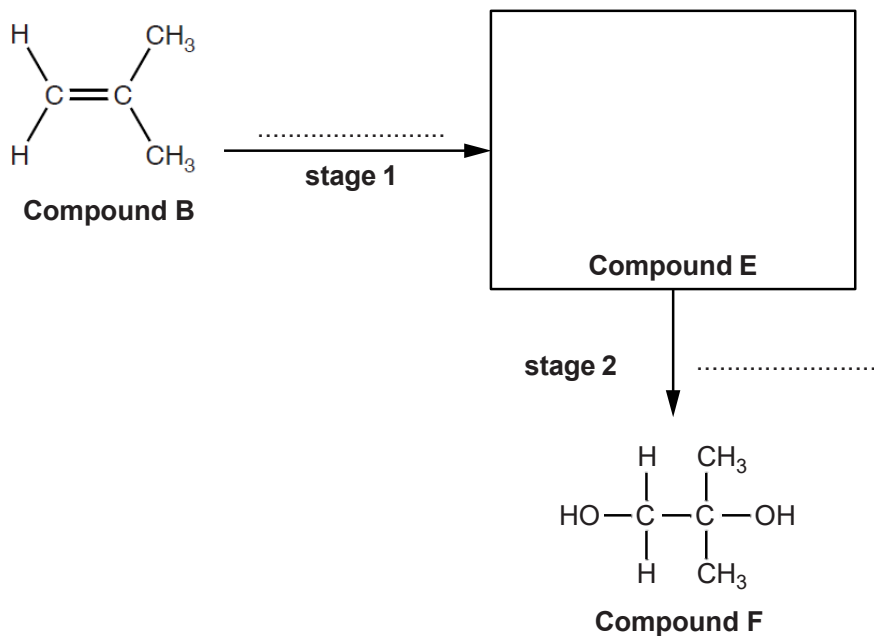
**Compound F**

(i) What is the empirical formula of compound **F**? [1]

(ii) A student plans a two-stage synthesis for preparing compound **F** from compound **B**.

The synthesis first prepares compound **E**, as shown in the flowchart.

Draw the structure of compound **E** in the box and state the reagents for each stage on the dotted lines.



[3]

(Total 8 marks)