

# Haloalkanes

## AS & A Level

### Question Paper 2

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Haloalkanes
Paper	AS & A Level
Booklet	Question Paper 2

**Time allowed:** 69 minutes

**Score:** /51

**Percentage:** /100

**Grade Boundaries:**

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

## Question 1

The list shows the structural formulae of some halogenoalkanes.

<b>N</b>	$\text{CF}_3\text{CFCI}_2$	<b>R</b>	$\text{CH}_3\text{CH}_2\text{CHClCH}_3$
<b>O</b>	$\text{CH}_3\text{CH}_2\text{Br}$	<b>S</b>	$\text{CH}_3\text{CHBrCH}_2\text{CHICH}_3$
<b>P</b>	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$	<b>T</b>	$(\text{CH}_3)_3\text{CBr}$
<b>Q</b>	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{I}$		

(a) Choose from the list above, the **letter** of the halogenoalkane that is extremely unreactive. [1]

(b) Halogenoalkanes react with hot  $\text{KOH}(\text{aq})$  to make alcohols.

(i) Choose from the list above, the **letter** of the halogenoalkane which reacts with hot  $\text{KOH}(\text{aq})$  to form a diol (a molecule with two OH groups) [1]

(ii) Using the curly arrow model, describe the mechanism of the reaction between  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$  and hot  $\text{KOH}(\text{aq})$  to make an alcohol.

Include relevant dipoles and the name of the mechanism. [4]

(iii) Why is the reaction of **P** with hot  $\text{KOH}(\text{aq})$  slower than the reaction of **Q** with hot  $\text{KOH}(\text{aq})$ ? [1]

(c) Write one equation, using structural formulae, to show how but-2-ene can be converted into one of the listed halogenoalkanes, **N**, **O**, **P**, **Q**, **R**, **S** or **T**.

[2]

(d) CFCs were once used as propellants but have now been replaced by biodegradable alternatives.

State **one** type of a biodegradable alternative.

[1]

[Total 10 Marks]

## Question 2

Chlorofluorocarbons, CFCs, were once used as propellants in aerosols. CFCs contribute to ozone depletion in the upper atmosphere.

(a) A CFC has the formula  $\text{CF}_2\text{Cl}_2$ .

State the three-dimensional shape of a  $\text{CF}_2\text{Cl}_2$  molecule and the  $\text{F-C-Cl}$  bond angle .. [2]

(b) Two reasons that  $\text{CF}_2\text{Cl}_2$  was used as an aerosol propellant are that it has low reactivity and will not hydrolyse in water.

(i) State **one** other reason why  $\text{CF}_2\text{Cl}_2$  was developed for use as an aerosol. [1]

(ii) Suggest why  $\text{CF}_2\text{Cl}_2$  does **not** hydrolyse in water. [1]

(c) Explain, with the aid of equations, how the presence of CFCs in the upper atmosphere leads to ozone depletion. [3]

(d) Why are scientists concerned about ozone depletion? [1]

(e) International agreements have reduced the use of CFCs. However the concentration of atmospheric CFCs has hardly changed.

Suggest **two** reasons why. [2]

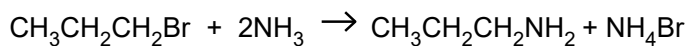
[Total: 10 Marks]

### Question 3

This question is about halogenated hydrocarbons.

- (a) Halogenoalkanes undergo nucleophilic substitution reactions with ammonia to form amines. Amines contain the  $\text{-NH}_2$  functional group.

For example, 1-bromopropane reacts with ammonia to form propylamine,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ .

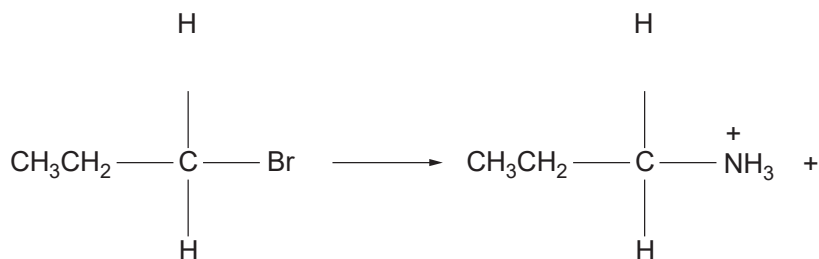


- (i) Iodoethane is reacted with ammonia.

Write an equation for this reaction..

[2]

- (ii) The first step in the mechanism of the reaction between  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$  and  $\text{NH}_3$  is shown below. It is incomplete.



Complete the mechanism.

Include relevant dipoles, lone pairs, curly arrows and the missing product.

[3]

(b) A student investigates the rate of hydrolysis of six halogenoalkanes.

The student mixes 5 cm<sup>3</sup> of ethanol with five drops of halogenoalkane. This mixture is warmed to 50 °C in a water bath. The student adds 5 cm<sup>3</sup> of aqueous silver nitrate, also heated to 50 °C, to the halogenoalkane. The time taken for a precipitate to form is recorded in a results table.

The student repeats the whole experiment at 60 °C instead of 50 °C.

halogenoalkane	time taken for a precipitate to form / s	
	at 50 °C	at 60 °C
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> Cl	243	121
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> Br	121	63
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> I	40	19
CH <sub>3</sub> CH <sub>2</sub> CHBrCH <sub>3</sub>	89	42
(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> Br	110	55
(CH <sub>3</sub> ) <sub>3</sub> CBr	44	21

Describe and explain the factors that affect the rate of hydrolysis of halogenoalkanes.

Include ideas about

- the halogen in the halogenoalkanes
- the groups attached to the carbon of the carbon–halogen bond (the type of halogenoalkane)
- the temperature of the hydrolysis.



*In your answer you should link the evidence with your explanation.*

[7]

(c) Poly(tetrafluoroethene), PTFE, and poly(chloroethene), PVC, are halogenated plastics.

(i) Write an equation, using displayed formulae, for the reaction to form PTFE from its monomer. [3]

(ii) The combustion of waste polymers can be used for energy production.

What problem is caused by disposing of PTFE and PVC in this way?

[1]

**[Total: 16 Marks]**

## Question 4

A reaction mechanism shows the individual steps that take place during a reaction.

(a) Methane reacts with bromine in the presence of ultraviolet radiation to form several products. Two of these products are bromomethane and hydrogen bromide.

(i) Write an equation for the reaction between methane and bromine to make bromomethane and hydrogen bromide. [1]

(ii) Name one other bromine-containing organic product which is formed when methane reacts with bromine. [1]

(iii) The mechanism for this reaction is called radical substitution.

Describe the mechanism for the radical substitution of methane by bromine to make bromomethane.

Use the mechanism to suggest why a small amount of ethane is also formed.



*In your answer, you should organise your answer and use the correct technical terms.*

[7]

- (b) The 'curly arrows' model is used in reaction mechanisms to show the movement of electron pairs during chemical reactions.

Choose a reaction mechanism that you have studied involving the curly arrow model.

Name and describe your chosen reaction mechanism.

In your answer, include:

- an example of the reaction with the chosen mechanism,
- the type of bond fission that occurs,
- relevant dipoles.

[6]

[Total 15 Marks]