

# Halogenoalkanes

## Question Paper

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Halogenoalkanes
Booklet	Question Paper

**Time Allowed:** 44 minutes  
**Score:** /36  
**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

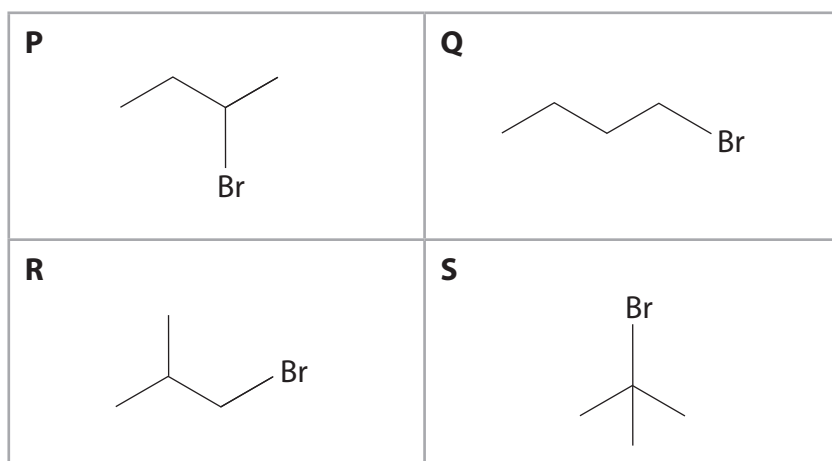
- 1 What is the empirical formula of a bromoalkane containing, by mass, 22.0% carbon, 4.6% hydrogen and 73.4% bromine?

(Relative atomic masses: C = 12, H = 1, Br = 80)

- A C<sub>3</sub>H<sub>7</sub>Br
- B C<sub>2</sub>H<sub>5</sub>Br
- C C<sub>2</sub>H<sub>3</sub>Br
- D CH<sub>3</sub>Br

(Total for Question 1 = 1 mark)

- 2 Four isomers with the formula C<sub>4</sub>H<sub>9</sub>Br are shown.



Which of the isomers are primary halogenoalkanes?

- A P and R
- B P and S
- C Q and R
- D Q only

(Total for Question 2 = 1 mark)

- 3 How many different alkenes could be formed when 2-iodopentane, CH<sub>3</sub>CHICH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>, reacts with **alcoholic** potassium hydroxide?

- A 1
- B 2
- C 3
- D 4

(Total for Question 3 = 1 mark)

4 Which is a tertiary halogenoalkane?

- A  $\text{CHBr}_3$
- B  $(\text{CH}_2\text{Br})_3\text{CH}$
- C  $(\text{CH}_3)_3\text{CBr}$
- D  $\text{BrCH}_2\text{C}(\text{CH}_3)_3$

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(Total for Question 4 = 1 mark)

5 Propene can be formed by heating 1-bromopropane with alcoholic potassium hydroxide solution.

This reaction is an example of

- A reduction.
- B hydrolysis.
- C elimination.
- D substitution.

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(Total for Question 5 = 1 mark)

6 Equal amounts of 1-chlorobutane and 1-iodobutane are warmed with aqueous silver nitrate in the presence of ethanol.

Why does 1-chlorobutane react more slowly?

- A The C—Cl bond is more polar than the C—I bond.
- B The C—Cl bond is stronger than the C—I bond.
- C The C—I bond is more polar than the C—Cl bond.
- D The C—I bond is stronger than the C—Cl bond.

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(Total for Question 6 = 1 mark)

- 7 Bromoethane reacts with concentrated alcoholic ammonia to produce ethylamine. However, in this reaction mixture, the ethylamine formed further reacts with the bromoethane to produce diethylamine.

This further reaction of ethylamine can best be limited by carrying out the reaction with

- A iodoethane instead of bromoethane.
- B less concentrated ammonia.
- C excess bromoethane.
- D excess ammonia.

(Total for Question 7 = 1 mark)

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- 8 The reaction between aqueous hydroxide ions and a halogenoalkane to produce an alcohol is classified as

- A electrophilic substitution with heterolytic bond fission.
- B electrophilic substitution with homolytic bond fission.
- C nucleophilic substitution with heterolytic bond fission.
- D nucleophilic substitution with homolytic bond fission.

(Total for Question 8 = 1 mark)

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- 9 Which of the following are properties of the liquid, 1-bromobutane?

	Solubility in water	Effect of a charged rod on a stream of the liquid
<input type="checkbox"/> A	soluble	stream diverted
<input type="checkbox"/> B	soluble	stream unaffected
<input type="checkbox"/> C	insoluble	stream diverted
<input type="checkbox"/> D	insoluble	stream unaffected

(Total for Question 9 = 1 mark)

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10 Which of the following does **not** damage the ozone layer?

- A  $\text{CCl}_3\text{CF}_3$
- B  $\text{CF}_4$
- C NO
- D  $\text{CH}_2\text{ClF}$

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(Total for Question 10 = 1 mark)

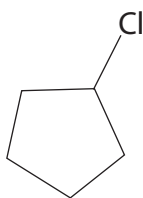
11 In the mechanism for the addition of bromine to an alkene, a bromide ion attacks a carbocation. The attacking bromide ion is acting as

- A a catalyst.
- B an electrophile.
- C a free radical.
- D a nucleophile.

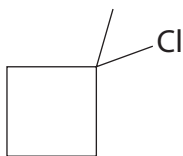
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(Total for Question 11 = 1 mark)

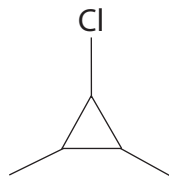
12 The skeletal formulae of some five-carbon halogenoalkanes are shown below.



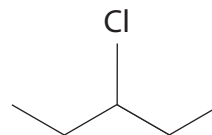
**A**



**B**



**C**



**D**

(a) Which of the above halogenoalkanes is **not** a structural isomer of the others?

- A**
- B**
- C**
- D**

(1)

(b) Which of the above is **not** a secondary halogenoalkane?

- A**
- B**
- C**
- D**

(1)

**(Total for Question 12 = 2 marks)**

13 The reaction for the preparation of propene from 1-bromopropane is shown below.



This reaction is classified as

- A** elimination.
- B** oxidation.
- C** reduction.
- D** substitution.

**(Total for Question 13 = 1 mark)**

14 The molecule shown below is 3-chloro-3-methylhexane.



It reacts with hot, alcoholic potassium hydroxide to produce a number of different alkenes. Which of the following could be produced from 3-chloro-3-methylhexane?

- A hex-2-ene
- B 3-methylhex-1-ene
- C 3-methylhex-2-ene
- D 3-methylhex-4-ene

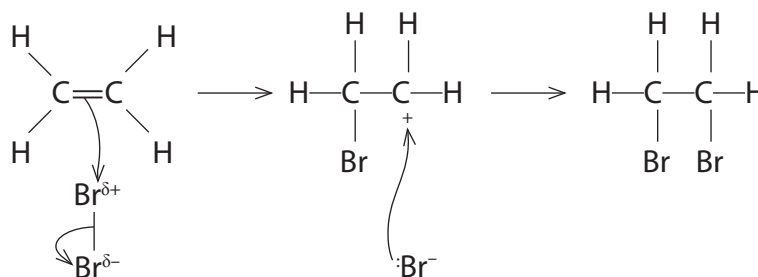
(Total for Question 14 = 1 mark)

15 Which of the following has **not** been a use of chlorofluorocarbons (CFCs)?

- A Fuels
- B Dry-cleaning solvents
- C Fire-retardants
- D Refrigerants

(Total for Question 15 = 1 mark)

16 Consider the reaction mechanism shown below.

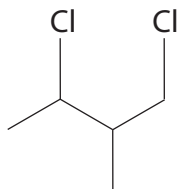


The bromide ion acts as

- A an electrophile.
- B a catalyst.
- C a free radical.
- D a nucleophile.

(Total for Question 16 = 1 mark)

17 The halogenoalkane shown below



can be classified as

- A just primary.
- B primary and secondary.
- C just secondary.
- D secondary and tertiary.

(Total for Question 17 = 1 mark)

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18 When 2-bromopropane is heated with concentrated, alcoholic potassium hydroxide, the major product is

- A propene.
- B propan-1-ol.
- C propan-2-ol.
- D potassium propoxide.

(Total for Question 18 = 1 mark)

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19 The rates of hydrolysis of different halogenoalkanes can be compared by carrying out the reaction in the presence of aqueous silver nitrate solution.

When an iodoalkane is used, the experimental observation would be

- A effervescence.
- B a white precipitate and bubbles.
- C a yellow precipitate.
- D a dark grey solid.

(Total for Question 19 = 1 mark)

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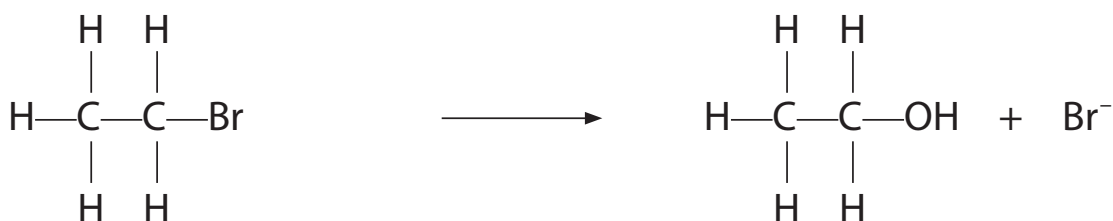


20 This question is about mechanisms involving halogenoalkanes.

(a) Bromoethane reacts with dilute aqueous potassium hydroxide in a nucleophilic substitution reaction to form ethanol.

(i) Complete the mechanism for the reaction by adding curly arrows and the relevant dipole.

(3)



(ii) Explain the meaning of the term **nucleophilic substitution** in this mechanism.

(2)

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- (b) Chlorofluorocarbons, CFCs, were used for refrigerants, solvents and aerosol propellants because they are unreactive and neither flammable nor toxic.

However, in the stratosphere, ultraviolet radiation breaks CFCs into free radicals and these react with ozone.

Write the equation for the formation of two free radicals from a molecule of chlorotrifluoromethane,  $\text{CF}_3\text{Cl}$ . Curly arrows are not required.

(1)

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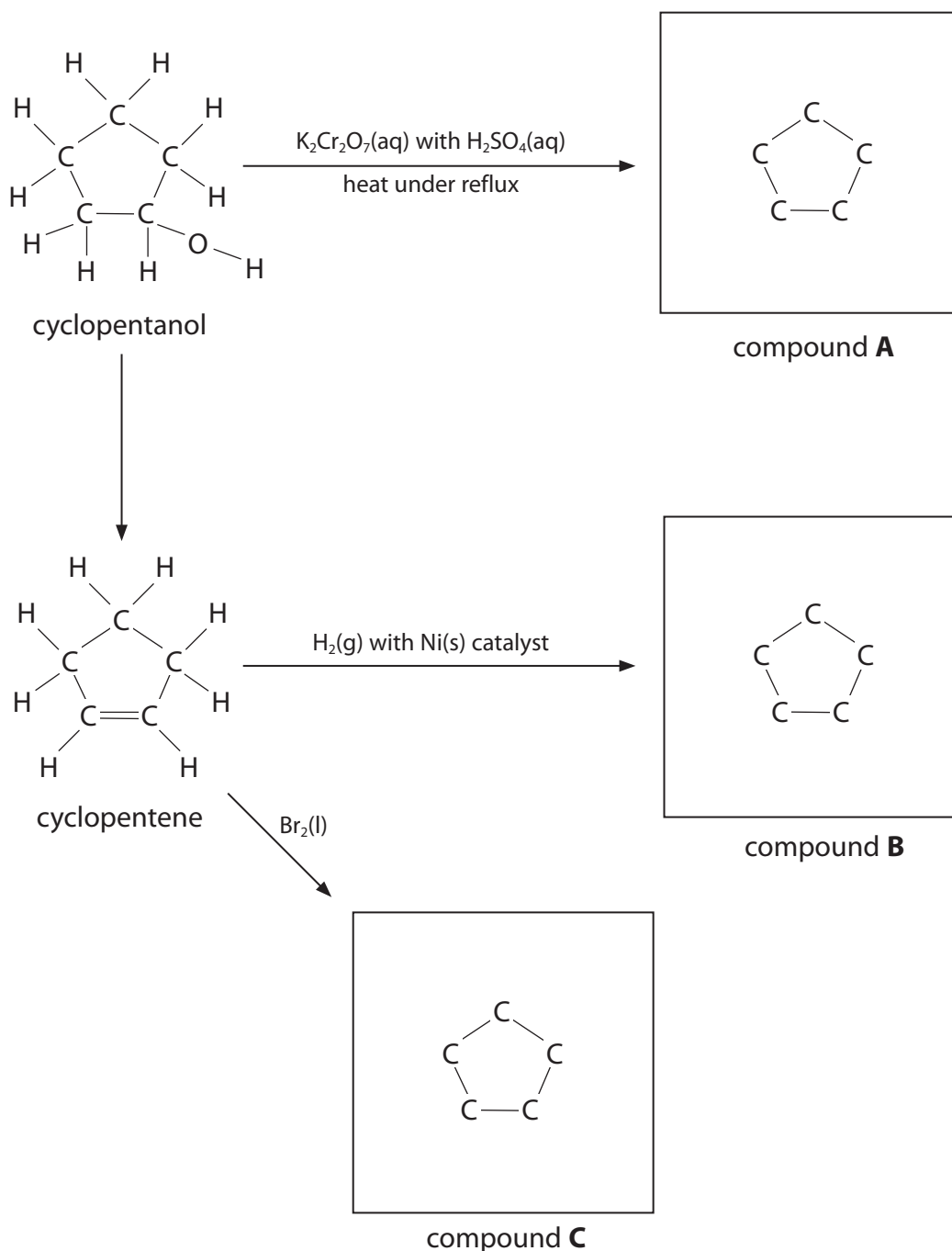
**(Total for Question 20 = 6 marks)**

21 Cyclopentene is a cyclic alkene and cyclopentanol is a cyclic alcohol.

(a) Some reactions involving cyclopentene and cyclopentanol are shown in the flowchart.

Complete the displayed formulae in the boxes to show the compounds **A**, **B** and **C**, which are the **organic** products of the reactions.

(3)

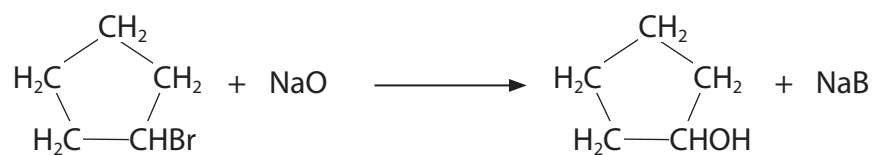


- (b) Give the colour change that would be observed in the reaction between liquid bromine, Br<sub>2</sub>, and excess cyclopentene.

(1)

From ..... to .....

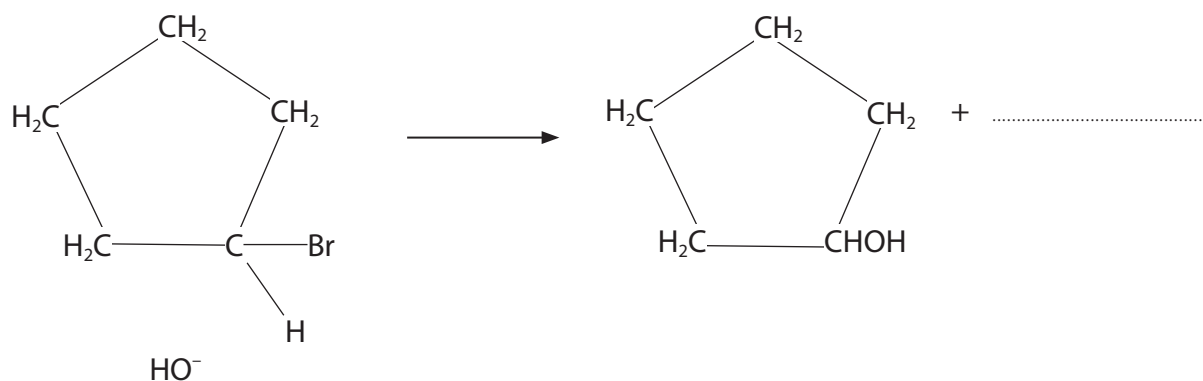
- (c) Bromocyclopentane reacts when heated with aqueous sodium hydroxide solution, according to the following equation.



- (i) Complete the mechanism for this reaction on the following diagram.

Use 'curly arrows' where necessary and show any relevant dipoles.

(3)



- (ii) Classify both the type of reaction and mechanism shown in (c)(i).

(2)

Type of reaction: .....

Mechanism: .....

- (iii) What type of bond fission occurs in this reaction?

(1)

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**(Total for Question 21 = 10 marks)**