

- 1 A chemist compares the rates of hydrolysis of 1-chloropropane and 1-bromopropane in ethanol.

Which reagent in aqueous solution should be used?

- A** Silver chloride
- B** Silver nitrate
- C** Potassium chloride
- D** Potassium nitrate

Your answer

[1]

- 2 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]

- 3 The breakdown of ozone is catalysed by NO radicals.

Which equation is a propagation step in the mechanism for this process?

- A** $\text{NO} + \text{O}_2 \rightarrow \text{N} + \text{O}_3$
- B** $\text{NO} + \text{O}_2 \rightarrow \text{NO}_2 + \text{O}$
- C** $\text{N} + \text{O}_3 \rightarrow \text{NO} + \text{O}_2$
- D** $\text{NO}_2 + \text{O} \rightarrow \text{NO} + \text{O}_2$

Your answer

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[1]

4 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.

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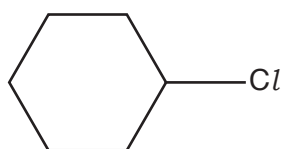
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(b) Chlorocyclohexane is hydrolysed with aqueous sodium hydroxide.

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 AgNO₃(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⁻¹ 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]

5 This question is about haloalkanes

- (a)** Freon-13, is a CFC with the molecular formula CClF_3 .
In the upper atmosphere, the presence of Freon-13 can lead to ozone depletion.

Explain, with the aid of equations, how Freon-13 can lead to this ozone depletion.

Use 'dots' ($\bullet$) to show the position of unpaired electrons.

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..... [3]

- 6 Which statement is correct for the different rates of hydrolysis of RCl and RBr ?
- A** RBr is hydrolysed faster because Cl is more electronegative than Br .
- B** RBr is hydrolysed faster because the $\text{C}-\text{Cl}$ bond enthalpy is greater than $\text{C}-\text{Br}$.
- C** RCl is hydrolysed faster because Cl is more electronegative than Br .
- D** RCl is hydrolysed faster because the $\text{C}-\text{Br}$ bond enthalpy is greater than $\text{C}-\text{Cl}$.

Your answer

[1]

- 7 A student investigates the rate of hydrolysis of different iodoalkanes using aqueous silver nitrate in ethanol.

What colour of precipitate is seen?

- A** Brown
- B** Cream
- C** White
- D** Yellow

Your answer

[1]

- 8 The CFC CCl_2F_2 can cause the breakdown of ozone in the upper atmosphere.

Which initiation step could occur with ultraviolet radiation to catalyse this breakdown?

- A** $\text{CCl}_2\text{F}_2 \rightarrow \bullet\text{C} + \bullet\text{Cl}_2\text{F}_2$
- B** $\text{CCl}_2\text{F}_2 \rightarrow \bullet\text{F} + \bullet\text{CCl}_2\text{F}$
- C** $\text{CCl}_2\text{F}_2 \rightarrow \bullet\text{Cl} + \bullet\text{CClF}_2$
- D** $\text{CCl}_2\text{F}_2 \rightarrow \bullet\text{Cl}_2 + \bullet\text{CF}_2$

Your answer

[1]

9 This question is about haloalkanes.

- (a) Haloalkanes can be synthesised by reacting alkanes with halogens in the presence of ultraviolet radiation.

An alkane reacts with bromine to form 2-bromo-2-methylpropane.

- (i) Write the equation for this reaction, showing the structures of the organic compounds.

Name the reaction mechanism and the type of bond fission that occurs.

Equation

Name of reaction mechanism

Type of bond fission

[3]

- (ii) Describe **two** limitations of the synthesis of 2-bromo-2-methylpropane from an alkane and bromine.

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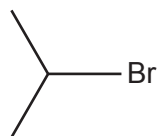
[2]

10 This question is about reactions of haloalkanes.

(a) Haloalkanes can react with potassium cyanide to form new carbon–carbon bonds.

(i) Outline the mechanism for the reaction of 2-bromopropane with cyanide ions.

Show curly arrows, relevant dipoles and products.



[3]

(ii) Name this type of mechanism.

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- (b) The table below shows the boiling points of propan-1-ol and 1-bromopropane.

	Propan-1-ol	1-Bromopropane
Boiling point/°C	97	71

Propan-1-ol can be reacted to form 1-bromopropane.

- (i) Suggest suitable reagents for this reaction.

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- (ii) The reaction to form 1-bromopropane from propan-1-ol is carried out in a flask.

After the reaction, the flask contains a mixture of an organic layer (density = 1.35 g cm^{-3}) and an aqueous layer (1.04 g cm^{-3}).

Describe how to obtain pure **1-bromopropane** from the mixture.

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