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AQA A-LEVEL CHEMISTRY

Substitution Vs Elimination: Conditions and Reaction Pathways

Learn Pack

This pack is designed to be completed alongside the video to help you build a secure understanding of this topic before moving on to revision and exam practice.

How to use this Learn Pack:

1. Watch the video and complete the activities.
 2. Answer the Fact Recall and Application questions.
 3. Check your work using the Learn Pack
- Answers available at mrcolescience.co.uk.

WATCH THE LESSON



Substitution Vs Elimination Reactions

During nucleophilic substitution reactions halogenoalkanes react with hydroxide ions to form alcohols.

During elimination reactions halogenoalkanes react with hydroxide ions to form alkenes.

Lesson Objectives:

- Understand concurrent substitution and elimination reactions of halogenoalkanes.
- Be able to explain the role of the hydroxide ions as both a nucleophile and a base.
- Understand how the conditions used can favour one reaction over the other.

Both reactions however use the same reactant, sodium/potassium hydroxide, meaning that both reactions tend to occur alongside one another, or concurrently.

Reaction Conditions

The conditions under which the reaction takes place have a significant impact on which of the two reaction types is more likely to occur.

Complete the table below to summarise which conditions favour which reaction:

Factor	Nucleophilic Substitution	Elimination
Solution Type	<u>Aqueous</u>	<u>Ethanolic</u>
Temperature	<u>Warm</u>	<u>Hot</u>
Refluxing	<u>Not necessary</u>	<u>Yes</u>

However, regardless of which conditions are used, it's highly likely that both types of reaction will occur simultaneously, or concurrently and so you're likely to end up with a mixture of products.

Role of the Hydroxide Ions

Depending upon the type of reaction occurring the hydroxide ion will have different roles.

During nucleophilic substitution reactions the hydroxide ions are behaving as a nucleophile since they are donating a pair of electrons. Whereas during an elimination reaction the hydroxide ions are acting as a base since they are accepting a proton.

Questions – Fact Recall

1. What conditions favour a nucleophilic substitution reaction between halogenoalkanes and potassium hydroxide?

Warm, aqueous solution of sodium or potassium hydroxide

2. What conditions favour elimination reactions over nucleophilic substitution?

Hot, ethanolic sodium or potassium hydroxide heated under reflux.

3. What type of reagent does the hydroxide ion act as during an elimination reaction?

Base

4. During a nucleophilic substitution reaction, hydroxide ions behave as what?

Nucleophiles

5. What does the term concurrent mean?

Happening at the same time.

Questions – Application

1. Explain why changing the solvent from water to ethanol changes the reaction that is favoured when 2-bromopropane reacts with hydroxide ions.

Ethanolic solutions favour elimination reactions over nucleophilic substitution

2. A student carries out the reaction between 2-bromopropane and aqueous potassium hydroxide. They obtain both propan-2-ol and propene. Explain why a mixture of products is obtained.

As both nucleophilic substitution and elimination reactions would occur concurrently despite favouring substitution.

3. A student claims: "If ethanolic potassium hydroxide is used, only elimination occurs because the hydroxide ions are acting as bases." Is the student's statement correct? Explain your answer.

The student is incorrect as the conditions used only favour elimination reactions, they do not prevent nucleophilic substitution from occurring.

4. Hydroxide ions can behave as either a nucleophile or a base when reacting with a halogenoalkane. Explain how the hydroxide ion behaves differently in the two reactions.

In a nucleophilic substitution reaction the hydroxide ions act as a nucleophile as they donate a pair of electrons.
In an elimination reaction, hydroxide ions act as a base as they accept a proton.

Next Steps

Check your work using the Learn
Pack Answers:

