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Date: _____

AQA A-LEVEL CHEMISTRY

Rate of Nucleophilic Substitution: Reactivity of Halogenoalkanes

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



Reactivity of Halogenoalkanes

The rate of nucleophilic substitution in halogenoalkanes is dependent upon the strength of the carbon-halogen bond.

During nucleophilic substitution the carbon-halogen bond is broken and the

greater the bond enthalpy, the more difficult it is to break and so the longer the reaction takes.

Lesson Objectives:

- Explain how and why the carbon-halogen bond enthalpy influences the rate of reaction.
- Know how to investigate the reactivity of halogenoalkanes using hydrolysis reactions.

List the carbon-halogen bonds in order from strongest to weakest:

C-F, C-Cl, C-Br, C-I

Investigating the Rate of Hydrolysis

The reactivity of halogenoalkanes can be investigated by comparing the rate of hydrolysis reactions.

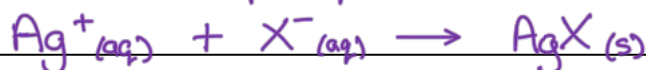
Define the term hydrolysis:

Hydrolysis is defined as the splitting of a molecule using water.

During the hydrolysis of halogenoalkanes water acts as a nucleophile to react with halogenoalkanes to form an alcohol whilst also giving out halide ions. Aqueous silver nitrate is used to identify when the halide ions have been formed.

Using an ionic equation for the reaction, explain why silver nitrate can be used in this way:

The silver ions react with the halide ions to form an insoluble coloured precipitate:



The method:

1. Add equal volumes of each halogenoalkane being tests into separate test tubes.
2. Place the test tubes into a water bath.
3. Add equal volumes of aqueous silver nitrate solution of the same concentration into each test tube.
4. Time how long it takes for the precipitate to appear, the less time taken, the faster the rate of reaction.

Explain why the test tubes are placed into a water bath:

Temperature has a significant effect on rates of reactions.
Placing the test tube in a water bath controls the temperature ensuring a fair test.

Explaining the Reactivity of Halogenoalkanes

List the order in which you would expect the silver halide precipitates to form:

1. Silver iodide (yellow).
2. Silver bromide (cream).
3. Silver chloride (white).

Silver fluoride is soluble in water and so therefore does not form a precipitate. The rate of reactions involving fluoroalkanes therefore cannot be investigated using this method.

Explain what these results tell us about the reactivity of halogenoalkanes:

The stronger the carbon-halogen bond (the greater its bond enthalpy) the less reactive the halogenoalkane and so the longer the reaction takes.

Practise Questions – Fact Recall

1. Define the term hydrolysis.

The splitting of a molecule using water.

2. Which carbon-halogen bond has the lowest bond enthalpy?

Carbon-iodine

3. What colour precipitate is formed by silver bromide?

Cream

4. Give two control variables for investigating the rate of substitution in halogenoalkanes.

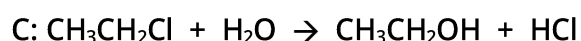
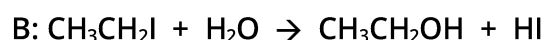
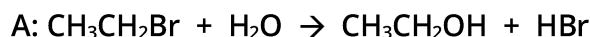
Temperature / Volume of halogenoalkane / Volume of AgNO_3 /
Concentration of AgNO_3 .

5. What determines the rate of reaction in halogenoalkanes?

The bond strength / enthalpy of the carbon-halogen bond.

Practise Questions – Application

1. Which of the following reactions would happen the fastest? Explain your answer.



B as carbon-iodine has the lowest bond enthalpy and so is therefore the weakest resulting in a faster rate of reaction.

Next Steps

Check your work using the Learn
Pack Answers:

