Mr Cole Science

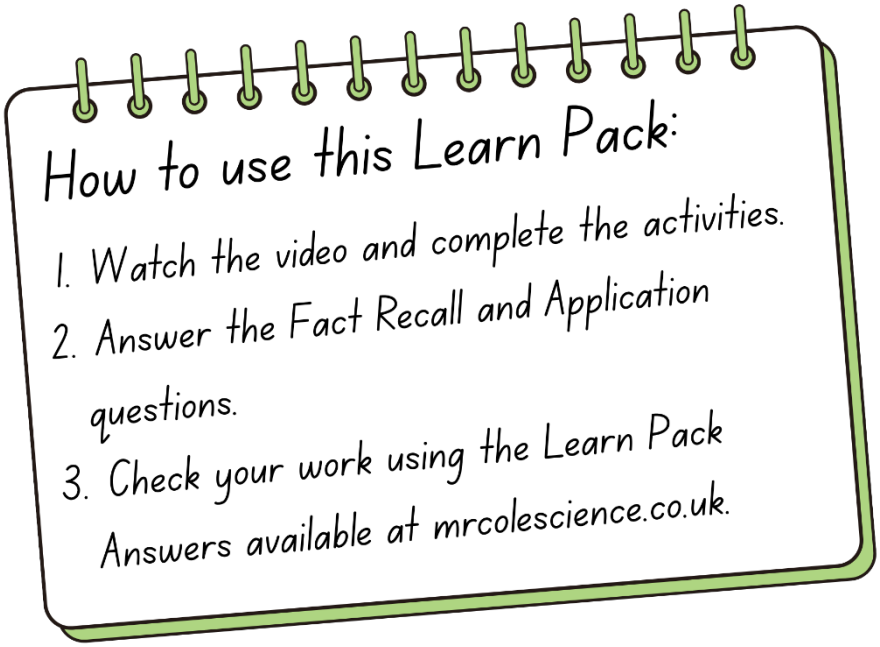
Name: _____ **Date:** _____

AQA A-LEVEL CHEMISTRY

Introduction to Halogenoalkanes: Structure, Naming and Polarity

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.

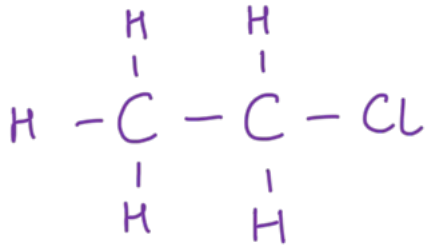


WATCH THE LESSON

Halogenoalkanes

Halogenoalkanes are alkanes that have had one or more hydrogen atoms substituted with a halogen atom.

Draw an example of a halogenoalkane below:



Lesson Objectives:

- Understand how halogenoalkanes are structured and how they are named using IUPAC rules.
- Explain why carbon–halogen bonds are polar and how their polarity varies between different halogenoalkanes.
- Understand why halogenoalkanes are more reactive than alkanes and why they remain insoluble in water.

Naming Halogenoalkanes

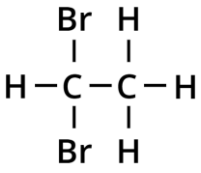
Halogenoalkanes are named using the standard IUPAC rules. Prefixes are used to denote which halogen(s) are present in the molecule and when there is more than one of any type of halogen present another prefix is added to indicate how many are present in the molecule.

Complete the tables below:

Halogen	Prefix
Fluorine	Fluoro–
Chlorine	Chloro–
Bromine	Bromo–
Iodine	Iodo–

No. of Halogen atoms	Prefix
2	di–
3	tri–
4	tetra–
5	penta–

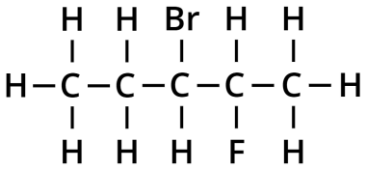
Name the following halogenoalkanes and identify the common mistakes that are made when naming them:



Name: 1,1-dibromoethane

Common mistakes:

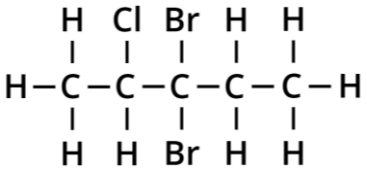
- Not providing the locant numbers.
- Only giving one locant number.
- Forgetting the di- prefix.



Name: 3-bromo-2-fluoropentane

Common mistakes:

- Listing the prefixes in locant number orde rather than alphabetical order.



Name: 3,3-dibromo-2-chloropentane.

Common mistakes:

- Taking the di- prefix into account when determining alphabetical order.

Polarity of Halogenoalkanes

Carbon-halogen bonds are polar and this significantly affects both the physical properties and reactivity of halogenoalkane molecules. Carbon-halogen bonds are polar due to the difference in electronegativity between carbon and the halogens.

Define electronegativity:

The tendancy of an atom to attract electron density from within a covalent bond.

All halogens are more electronegative than carbon.

Explain why this causes the carbon-halogen bond to be polar:

$$C^{\delta+} - X^{\delta-}$$

As the halogen atoms have a greater electronegativity value than carbon they attract the electron density from within the covalent bond more than the carbon atom does. This means the electron density is unevenly distributed leaving a partial positive charge on the carbon & a partial negative charge on the halogen.

The electronegativity value of the halogens decreases as you move down the group. This means that the polarity of the carbon-halogen bond also decreases as you move down the group.

Reactivity

Alkanes are relatively unreactive for two reasons:

1. They contain only strong C-C and C-H bonds that require a lot of energy to break.
2. C-C and C-H bonds are non-polar.

Since carbon-halogen bonds are polar this makes halogenoalkanes significantly more reactive than their alkane equivalents.

Solubility

Halogenoalkanes are also insoluble in water; despite the carbon-halogen bond being polar, it is not polar enough to make them soluble in water.

Practise Questions – Fact Recall

1. What is a halogenoalkane?

   An alkane with at least one halogen atom in place of a hydrogen atom.

2. Which carbon-halogen bond is the most polar?

   C-F

3. What is electronegativity?

   The tendancy of an atom to attract electron density from within a covalent bond.

4. What prefix is used to indicate there are three of the same halogen present in a halogenoalkane molecule?

   Tri –

5. What prefix is used to indicate the presence of a bromine atom in a halogenoalkane molecule?

   Bromo –

Practise Questions – Application

1. Explain why carbon-halogen bonds are polar.

As the halogen atoms have a greater electronegativity value than carbon they attract the electron density from within the covalent bond more than the carbon atom does. This means the electron density is unevenly distributed leaving a partial positive charge on the carbon & a partial negative charge on the halogen.

2. Explain why halogenoalkanes are more reactive alkanes.

They contain a polar carbon-halogen bond which means they are more likely to interact with other polar or charged species.

Next Steps

Check your work using the Learn Pack Answers: