# Halogen displacement reactions: supporting resources

# This resource supports the practical video Halogen displacement reactions, available here: <rsc.li/3tZxFgu>

**How to use the additional resources**

### Using the follow-up worksheets

Two worksheets are provided. The first is structured to support learners to recall the knowledge from this practical, whilst the second sheet provides more challenging questions and applies the learning to wider contexts. These sheets could be used to follow up the practical activity, for example as homework or a revision exercise.

## **Follow-up worksheet: support**

1. Some students decided to investigate the reactivity of the halogens by carrying out a series of displacement reactions.

They put two drops of chlorine solution in each of three dimples in the spotting tile Then, did the same for bromine water and iodine solution.

Complete the diagram by adding the following labels: **iodine solution, chlorine water, bromine water**.



1. Next they added two drops of potassium chloride to each dimple in the first column, two drops of potassium bromide in the second column and two drops of potassium iodide in the third column.

On each circle in the diagram, please put either a tick or a cross to indicate where a reaction will take place:



Potassium iodide

Potassium bromide

Potassium chloride



 = colour change will be observed

= no colour change will be observed

1. Write the halogens in order of decreasing reactivity:
2. Complete the word equations:

potassium chloride + bromine → +

potassium bromide + iodine → +

1. Predict what will be observed if fluorine gas is bubbled through a solution of potassium bromide.

(*Hint*: fluorine is found at the top of group 7 on the periodic table.)

## **Follow-up worksheet: challenge**

1. Define the term ‘displacement reaction’.
2. Complete the results table. State where no reaction will take place and describe the colour change observed where a reaction takes place.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Reaction with potassium chloride solution** | **Reaction with potassium bromide solution** | **Reaction with potassium iodide solution** |
| Chlorine water |  |  |  |
| Bromine water |  |  |  |
| Iodine solution |  |  |  |

1. Write the halogens in order of decreasing reactivity:
2. In these reactions, the potassium ion is often described as a spectator ion. Explain why?
3. Write a chemical equation for each colour changed observed. The first one has been done for you.

Cl2(aq) + 2KBr(aq) → 2KCl(aq) + Br2(aq)

1. Predict what will be observed if:
   1. astatine is mixed with sodium bromide solution
   2. fluorine is mixed with sodium iodide solution

Where appropriate you should include a chemical equation.

3. The halogens are more soluble in a hydrocarbon solvent than water. When added to a hydrocarbon solvent the following colours are observed.

|  |  |
| --- | --- |
| **Halogen** | **Colour in hydrocarbon solvent** |
| Chlorine | Pale yellow-green |
| Bromine | Pale yellow-orange |
| Iodine | Purple |

Use this information to answer the following question.

A student mixed some chlorine water with some potassium bromide solution and observed the colour change. He thought that a reaction had taken place but was slightly unsure. Describe another experiment the student could do, to determine whether he was right.

1. The reaction between bromine and potassium iodide can also be described as a redox reaction. Use your knowledge of oxidation and reduction to explain why.

You should include some ionic or half equations in your answer.

## **Follow-up worksheet: support ANSWERS**

1. Some students decided to investigate the reactivity of the halogens by carrying out a series of displacement reactions.

They put two drops of chlorine solution in each of three dimples in the spotting tile Then, did the same for bromine water and iodine solution.

Complete the diagram by adding the following labels: **iodine solution, chlorine water, bromine water**.



chlorine water

1. Next they added two drops of potassium chloride to each dimple in the first column, two drops of potassium bromide in the second column and two drops of potassium iodide in the third column.

iodine solution

bromine water

On each circle in the diagram, please put either a tick or a cross to indicate where a reaction will take place:



Potassium

chloride

Potassium

bromide

Potassium

iodide









 = colour change will be observed

= no colour change will be observed

1. Write the halogens in order of decreasing reactivity:

##### Chlorine Bromine Iodine

1. Complete the word equations:

potassium chloride + bromine → **potassium bromide + chlorine**

potassium bromide + iodine → **potassium iodide + bromine**

1. Predict what will be observed if fluorine gas is bubbled through a solution of potassium bromide.

(*Hint*: fluorine is found at the top of group 7 on the periodic table.)

##### The colourless liquid will turn an orange/ brown colour.

## **Follow-up worksheet: challenge ANSWERS**

1. Define the term ‘displacement reaction’.

##### A displacement reaction is a type of chemical reaction where part of one reactant is replaced with another reactant:

##### AB + C → AC + B

1. Complete the results table. State where no reaction will take place and describe the colour change observed where a reaction takes place.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Reaction with potassium chloride solution** | **Reaction with potassium bromide solution** | **Reaction with potassium iodide solution** |
| Chlorine water | **No reaction** | **The colourless solution turns a yellow colour** | **The colourless solution goes to a orange-brown colour** |
| Bromine water | **No reaction** | **No reaction** | **The colour darkens from yellow to orange-brown** |
| Iodine solution | **No reaction** | **No reaction** | **No reaction** |

1. Write the halogens in order of decreasing reactivity:

##### Chlorine, bromine, iodine.

1. In these reactions, the potassium ion is often described as a spectator ion. Explain why?

##### It does not take part in the reaction as it is present in both the reactants and the products.

1. Write a chemical equation for each colour changed observed. The first one has been done for you.

Cl2(aq) + 2KBr(aq) → 2KCl(aq) + Br2(aq) **Cl2(aq) + 2KI(aq) → 2KCl(aq) + I2(aq) Br2(aq) + 2KI(aq) → 2KBr(aq) + I2(aq)**

1. Predict what will be observed if:
   1. astatine is mixed with sodium bromide solution

##### No changes observed.

* 1. fluorine is mixed with sodium iodide solution

##### The solution would turn from colourless to brown. F2(aq) + 2NaI(aq) → 2NaF(aq) + I2(aq)

1. The halogens are more soluble in a hydrocarbon solvent than water. When added to a hydrocarbon solvent the following colours are observed.

|  |  |
| --- | --- |
| **Halogen** | **Colour in hydrocarbon solvent** |
| Chlorine | Pale yellow-green |
| Bromine | Pale yellow-orange |
| Iodine | Purple |

Use this information to answer the following question.

A student mixed some chlorine water with some potassium bromide solution and observed the colour change. He thought that a reaction had taken place but was slightly unsure. Describe another experiment the student could do, to determine whether he was right.

##### Put the products into a test tube and add about 1 cm3 of a non-polar hydrocarbon solvent such as cyclohexane. Stopper the test tube and shake it up. If a pale yellow-orange colour appears in the organic solvent layer, bromine is present and a reaction has taken place. Or if a pale green/yellow colour appears in the organic solvent then chlorine is present and a reaction has not taken place.

1. The reaction between bromine and potassium iodide can also be described as a redox reaction. Use your knowledge of oxidation and reduction to explain why.

You should include some ionic or half equations in your answer.

##### Oxidation occurs when there is a loss of electron and reduction occurs when there is a gain of electrons.

##### The ionic equation shows that:

##### Each bromine atom has gained an electron, so it has been reduced. Each iodide ion has loss an electron so it has been oxidised

##### Br2(aq) + 2I-(aq) → I2(aq) + 2Br-(aq)

##### Half equations are: Br2(aq) + 2e- → 2Br-(aq) 2I-(aq) → I2(aq) + 2e