

## Displacement reactions of Halogens

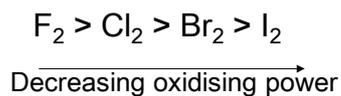
N Goalby  
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### Displacement reactions of Halogens

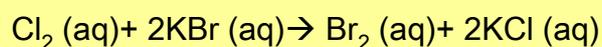
The displacement reactions of the Halogens can be used to determine the relative powers of the halogens to act as oxidising agents

A halogen that is a strong oxidising agent will displace a halogen that has a lower oxidising power from one of its compounds

Order of strength as oxidising agents for halogens

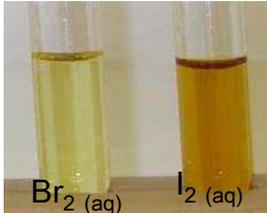


Example reaction



Observations for reactions			
	Chlorine (aq)	Bromine (aq)	Iodine (aq)
potassium chloride (aq)	Very pale green solution, no reaction	Yellow solution, no reaction	Brown solution, no reaction
potassium bromide (aq)	Yellow solution, Cl has displaced Br	Yellow solution, no reaction	Brown solution, no reaction
potassium iodide (aq)	Brown solution, Cl has displaced I	Brown Solution, Br has displaced I	Brown Solution, no reaction

*The colour of the solution in the test tube shows which free halogen is present in solution.*  
 Chlorine = very pale green solution (often colourless),  
 Bromine = yellow solution  
 Iodine = brown solution (sometimes black solid present)



All the halide salt solutions (KI, NaBr, KCl etc.) are colourless

Displacement reactions are redox reactions

$$\text{Cl}_2 (\text{aq}) + 2\text{I}^- (\text{aq}) \rightarrow \text{I}_2 (\text{aq}) + 2\text{Cl}^- (\text{aq})$$

Oxidising agent

0      -1      0      -1

oxidation      reduction

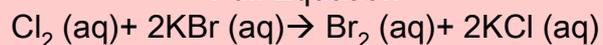
Oxidation half equation (losing electrons)  
 $2\text{I}^- (\text{aq}) \rightarrow \text{I}_2 (\text{aq}) + 2\text{e}^-$

Reduction half equation (gaining electrons)  
 $\text{Cl}_2 (\text{aq}) + 2\text{e}^- \rightarrow 2\text{Cl}^- (\text{aq})$

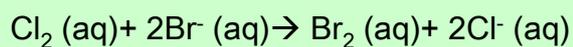
$\text{Cl}_2$  is the oxidising agent because it causes  $\text{I}^-$  to lose electrons and so acts as an electron acceptor

Different ways of writing displacement reactions  
(know them all!)

Full Equation



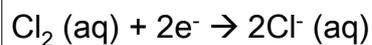
Ionic equation



Oxidation half equation (losing electrons)

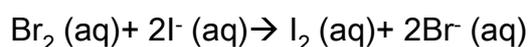
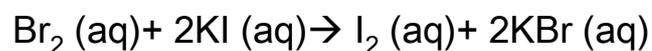
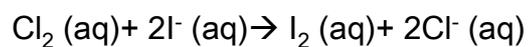
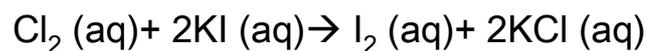


Reduction half equation (gaining electrons)



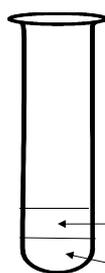
This reaction can be used for the extraction of Bromine from sea water. Chlorine is bubbled through sea water and bromine is displaced.

Equations for other displacement reactions



### Alternative method for observing the Displacement reactions of Halogens

A halogen will displace a less reactive halogen from one of its compounds



The colour of the hydrocarbon layer shows which free halogen is present.

Chlorine = colourless,  
Bromine = yellow,  
Iodine = purple

extra

	Chlorine	Bromine	Iodine
potassium chloride	colourless, no reaction	yellow, no reaction	purple, no reaction
potassium bromide	yellow, Cl has displaced Br	yellow, no reaction	purple, no reaction
potassium iodide	purple, Cl has displaced I	purple, Br has displaced I	purple, no reaction

Colours refer to colour in hydrocarbon layer

extra