

3C Group 7

Group 7 elements: Redox reactions:



- These are F, Cl, Br, I and At

Physical properties:

- The melting and boiling point of the halogens increases with atomic number due to increased van der Waals.
- This can be seen by their physical states at room temperature.

F_2	Gas	Boiling point increases down the group
Cl_2	Gas	
Br_2	Liquid	
I_2	Solid	
At_2	Solid	

- Iodine sublimes to a purple vapour.

Electronic configuration:

F: $2s^2 2p^5$

Cl: $3s^2 3p^5$

Br: $4s^2 4p^5$

I: $5s^2 5p^5$

At: $6s^2 6p^5$

- Each Group 7 element has 7 electrons in the outer shell.
- Each have $s^2 p^5$ configuration, and known as p block elements.
- They require 1 electron to complete their outer shell

Halogens as oxidising agents:



- These elements gain 1 electron when they react.
- This means that what ever they react with must lose electrons.
- Losing electrons is an oxidation reaction:

Oxidation

Is

Loss of electrons

Reduction

Is

Gain of electrons

- As the Group 7 elements cause the oxidation of other compounds or elements we say it is a good **Oxidising agent**.
- Reactivity decreases as you go down the Group. This means they gain their electrons less readily.
- This means as you go **down Group 7**, their **oxidising power decreases**.

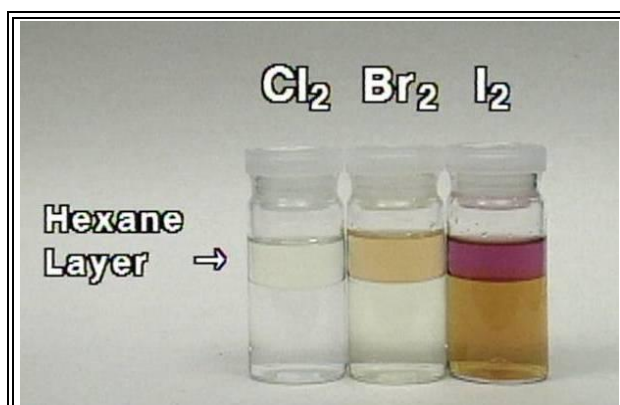
Explanation:

- There are more electron shells which increases **shielding** between nucleus and outer electron shell.
- As there are more electron shells, the **distance** between nucleus and outer shell increases.
- This means that attraction between the nucleus and outer electrons decreases.
- This means that the incoming electron is not captured as easily:

Redox reactions of the halogens:

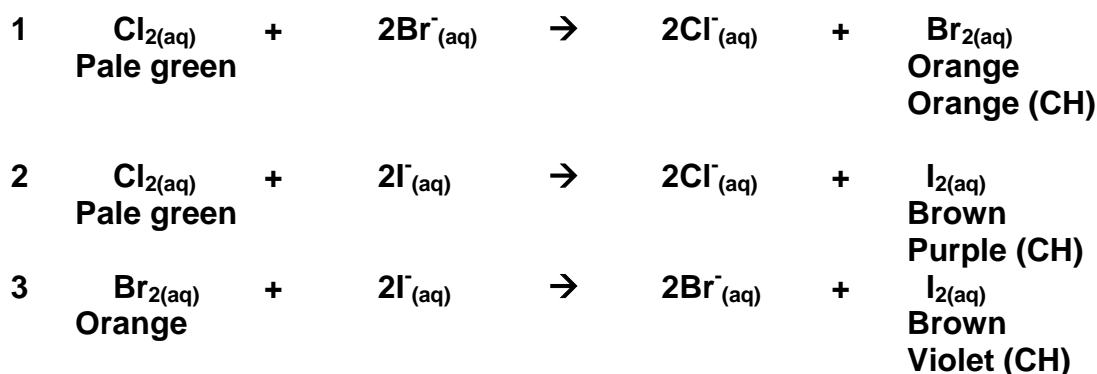
- Redox reactions can show how the Halogens ability to form ions reduces as you go down the Group (ie its reactivity)
- By competing the Halogens (Cl_2 , Br_2 , and I_2) with the Halides (Cl^{-} , Br^{-} , and I^{-})
- Each Halogen is mixed with the Halides.
- The more reactive Halogen will oxidise and displace the Halide of a less reactive Halogen.
- Halogens are coloured in solution, this can indicate whether a redox reaction has occurred:

Halogen	In water	In cyclohexane
Cl_2	Pale green	Pale Green
Br_2	Orange	Orange
I_2	Brown	Violet

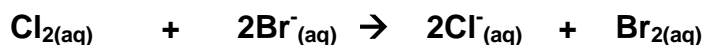


Interpretation:

- Reactivity **decreases** as you go **down group 7**.
- It becomes harder to capture an electron with increased distance and shielding. I.e the opposite of group 2 elements.
- The reactions are:-



- Reactions 1 – 3 involve a transfer of an electron from the halide to the halogen.



Element	Cl _{2(aq)}	+	2Br ⁻ (aq)	→	2Cl ⁻ (aq)	+	Br _{2(aq)}	Change in Ox No		Redox
								Up	Down	
Cl	0				-1				1	Red
Br			-1				0	1		Ox

- The reduction of Cl_{2(aq)} **oxidises** Br⁻(aq) → Cl_{2(aq)} is an **Oxidising agent**
- In each reaction the halogen is an oxidising agent and the halide is a reducing agent.
- As chlorine is the most reactive it is the strongest oxidising agent.

Disproportionation

This is a reaction when the same element has been both oxidised and reduced

Disproportionation of chlorine in water (Bleach):



Element	Cl _{2(aq)}	+	2H ₂ O(l)	→	HCl(aq)	+	HClO(aq)	Change in Ox No		Redox
								Up	Down	
Cl	0				-1				1	Red
Cl	0						+1	1		Ox

- In this reaction, the Cl has been oxidised and reduced

Disproportionation of chlorine in aq sodium hydroxide:



Element	Cl _{2(aq)}	+	2NaOH _(aq)	→	NaCl _(aq)	+	NaClO _(aq)	+	H ₂ O _(l)	Change in Ox No		Redox
										Up	Down	
Cl	0				-1						1	Red
Cl	0						+1			1		Ox

- The Cl has been oxidised and reduced in this reaction too.

Group 7 elements: Uses and halide tests

Properties of Group 7 elements and compounds:

- Because of Periodicity we only have to learn the Chemistry for one of the elements in Group 7.
- They all form diatomic covalent molecules, **X** will be used to represent any halogen.
- All the elements in Group 7 will react in the same way (but with different vigour).**
- Group 7 elements** form have **Van Der Waals forces of attraction** - increasing down the Group - more electrons
- As you go **down Group 7**: the elements become **less reactive**.
- As you go **down Group 7**: the elements become a **weaker oxidising agent**.
- Group 7 elements** form ionic halides with metals.

Fluorine:

- Is the most reactive element on the Periodic Table.
- It burns virtually anything in its path.
- Many Chemists have been killed in the explosion when using fluorine.

Halides:

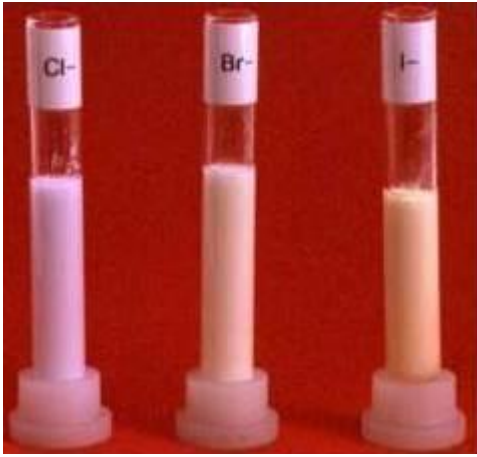
- Usually have a 1- charge, X¹⁻

Halide compound(s)	Use
NaCl	Table salt
NaF / SnF ₂	Toothpaste
CaF ₂ (Fluorite / flourspar)	Used to make lenses to focus IR light

Testing for Halide ions:

- A simple test tube test can be done to identify halide ions in compounds.
- Dissolve a small amount of compound in water
- Add silver nitrate, AgNO₃.
- The silver ions, Ag⁺ combines with the Halide ions, X⁻ to form a silver halide precipitate
- The silver halide precipitates are coloured depending upon the halide present.
- Sometimes it is difficult to judge the exact colour.
- Ammonia can be added as the different silver halides as they have different solubility's in ammonia

Interpretation:



Chloride: $\text{Ag}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})} \rightarrow \text{AgCl}_{(\text{s})}$ **White precipitate** **Soluble in dilute NH_3**

Bromide: $\text{Ag}^+_{(\text{aq})} + \text{Br}^-_{(\text{aq})} \rightarrow \text{AgBr}_{(\text{s})}$ **Cream precipitate** **Soluble in conc NH_3**

Iodide: $\text{Ag}^+_{(\text{aq})} + \text{I}^-_{(\text{aq})} \rightarrow \text{AgI}_{(\text{s})}$ **Yellow precipitate** **Insoluble in conc NH_3**

- The solubility of the precipitates decreases down the group.