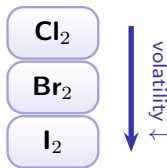


Group 17

A-Level Chemistry ■ Topic 11

A-Level Chemistry



What we will cover

- 1 States & volatility
- 2 Oxidising power & displacement
- 3 The silver halide test
- 4 Halides & sulfuric acid
- 5 Reactions of chlorine



chlorine kills microbes



States and volatility

Down Group 17 the molecules get larger, so instantaneous dipole–induced dipole forces get stronger. Melting and boiling points [rise](#).



pale yellow gas



green gas



red-brown liquid



grey-black solid

Colour, state, and bond strength down the group

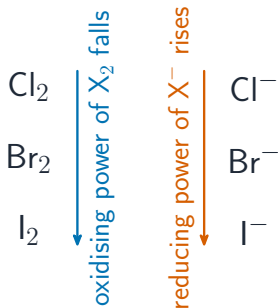
Element	Colour and state at room temperature
chlorine	pale green gas
bromine	red-brown liquid
iodine	grey-black solid, sublimes to a purple vapour

The **bond energy** of X–X generally **falls** from Cl_2 to I_2 : the shared pair sits further from both nuclei. That is why the reaction with hydrogen gets **less** vigorous down the group – chlorine explodes in light, bromine needs heat, iodine reacts slowly and only partly.

Oxidising power and displacement

- halogens gain an electron – **oxidising power** falls down
- **halide ions** lose an electron – **reducing power** rises down

A more reactive halogen **displaces** a less reactive one: $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$.



a more reactive halogen
displaces a less reactive one:



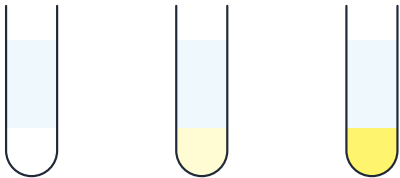
The silver halide test



Add Ag^+ , then **ammonia**, to identify the halide:

- Cl^- – **white**, dissolves in dilute NH_3
- Br^- – **cream**, only in conc. NH_3
- I^- – **yellow**, insoluble

Silver halide precipitates



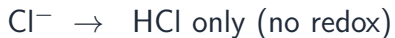
add $\text{Ag}^+(\text{aq})$,
then $\text{NH}_3(\text{aq})$

Cl^-	Br^-	I^-
AgCl white dissolves in dilute NH_3	AgBr cream needs conc. NH_3	AgI yellow insoluble in NH_3

Silver halide precipitates: AgCl is white, AgBr cream and AgI yellow – and their solubility in ammonia confirms which halide is present

Halides with concentrated sulfuric acid

reducing power increases
↓

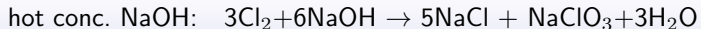


The stronger reducing agents are oxidised by the acid:

- Cl^- – only HCl (no redox)
- Br^- – also Br_2 & SO_2
- I^- – I_2 , H_2S & SO_2 (strongest reducer)



Reactions of chlorine



Both are **disproportionation** (Cl goes up *and* down from 0). In water, $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HOCl} + \text{HCl}$ – HOCl kills **bacteria** .

With sodium hydroxide

With **cold, dilute** sodium hydroxide, chlorine reacts to form chloride and chlorate(I):

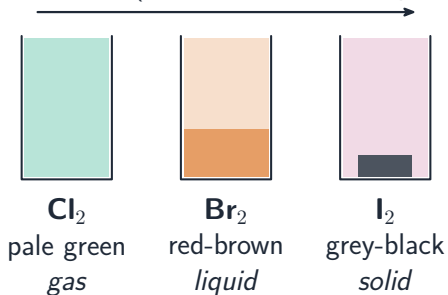
Physical properties of the halogens



Bromine is a Group 17 halogen – a dark liquid that gives off an orange vapour.

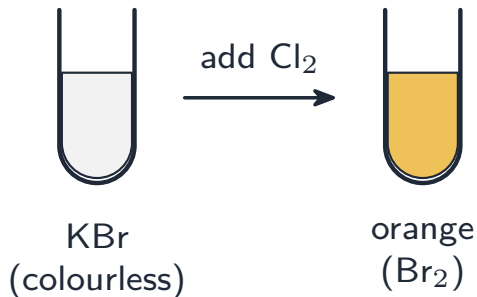
Down Group 17 the halogens change from

volatility decreases (intermolecular forces get stronger)



Down Group 17 the halogens change from a pale green gas to a red-brown liquid to a grey-black solid as volatility falls

Halogens as oxidising agents



Chlorine displaces bromine: the solution turns orange

Thermal stability, and chlorine in water

a hydrogen halide

HF, HCl, HBr, HI

thermal stability

decreases down the group – HI decomposes most easily

why

the H–X bond gets longer and weaker as the halogen atom grows

chlorine in water

disproportionates: $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HCl} + \text{HOCl}$

water purification

the active species HOCl and ClO^- kill **bacteria**, making the water safe to drink

the oxidation number point

chlorine goes from 0 to both -1 and $+1$ in one reaction – that is what disproportionation means

With concentrated H_2SO_4 : NaCl gives HCl only, NaBr also gives brown Br_2 and SO_2 , NaI gives purple I_2 , H_2S and a yellow solid – the reducing power rises down the group.

Exam tips

- Halogens get **less reactive down** the group (harder to gain an electron); oxidising power decreases.
- **Displacement:** a more reactive halogen displaces a less reactive halide – state the colour change.
- Test halide ions with AgNO_3 : white (Cl^-), cream (Br^-), yellow (I^-), then confirm with dilute/concentrated ammonia.
- Chlorine with water and with cold NaOH are **disproportionation** – show the oxidation-number changes.



Worked example – halogen displacement

Chlorine water is added to potassium bromide solution. State what is seen and give the ionic equation.

- Cl_2 is a **stronger oxidising agent** than Br_2 , so it takes the electrons.
- $\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$
- Seen: the solution turns **orange** as Br_2 forms.
- Cl_2 is **reduced** ($0 \rightarrow -1$); Br^- is **oxidised** ($-1 \rightarrow 0$).

A halogen displaces any halide **below** it. Oxidising power falls down the group: $\text{Cl}_2 > \text{Br}_2 > \text{I}_2$.

Topic 11 – key takeaways

1

Volatility

falls down; gas to liquid to solid

2

Redox trends

oxidising power down; reducing power up

3

Halide test

AgCl white, AgBr cream, AgI yellow

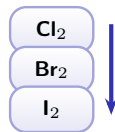
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Chlorine

disproportionation with NaOH; purifies water

Check yourself

- 1 Which way does oxidising power change down Group 17?
- 2 Colour of the AgI precipitate?
- 3 Which halide is oxidised to I_2 by conc. H_2SO_4 ?
- 4 What type of reaction is Cl_2 with NaOH?



Answers 1. decreases 2. yellow 3. iodide (I^-) 4. disproportionation