

Exercise walk-through

11.4

The reactions of chlorine

A-Level Chemistry

Reactions of chlorine

cold dilute NaOH: $\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaCl} + \text{NaClO} + \text{H}_2\text{O}$

hot conc. NaOH: $3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$

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):

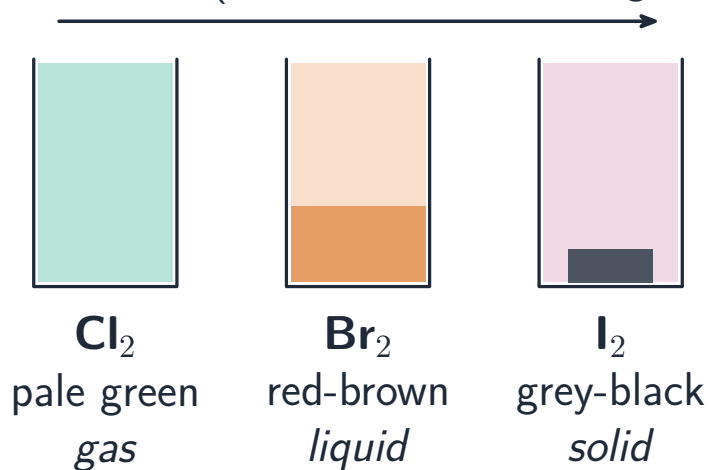
Physical properties of the halogens



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

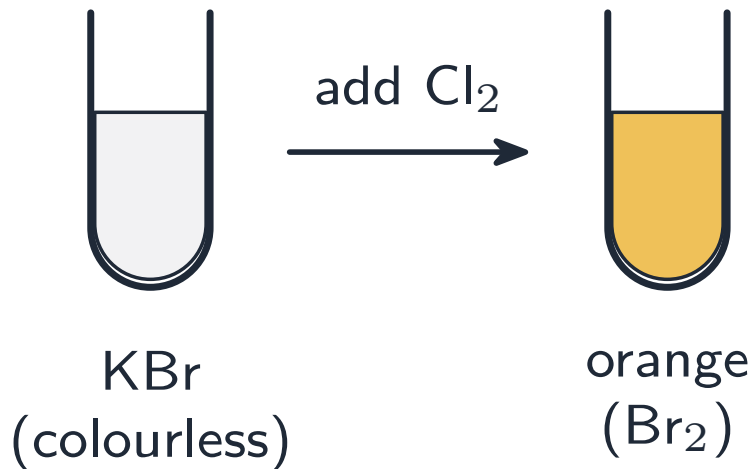
Down Group 17 the halogens change from

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

Exercises 2.1·3.1

2.1 Write the equation for chlorine reacting with cold, dilute sodium hydroxide. [1]

2.2 Name the active species, formed when chlorine reacts with water, that kills bacteria.[1]

3.1 Chlorine reacting with cold dilute NaOH is a disproportionation reaction because:[1]

☐

A chlorine is only oxidised

B chlorine is only reduced

C chlorine is both oxidised and reduced

D no redox occurs

Exercises 2.1·3.1

2.1 Write the equation for chlorine reacting with cold, dilute sodium hydroxide. [1]

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- $\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaCl} + \text{NaClO} + \text{H}_2\text{O}$
-

2.2 Name the active species, formed when chlorine reacts with water, that kills bacteria.[1]

2.2

- HOCl (chloric(I) acid) / ClO^-
-

3.1 Chlorine reacting with cold dilute NaOH is a disproportionation reaction because:[1]

- ☐ **A** chlorine is only oxidised
B chlorine is only reduced
C chlorine is both oxidised and reduced
D no redox occurs

3.1 C

- Chlorine is both oxidised and reduced – disproportionation

Exercise 3.2

3.2 What is the oxidation number of chlorine in the chlorate(I) ion, ClO^- ? [1]

☐

A -1

B 0

C $+1$

D $+5$

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3.2 C

- Chlorine in ClO^- is $+1$

Exercise 3.3 (a)

3.3 When chlorine reacts with hot concentrated sodium hydroxide:

(a) Write the equation.

[2]

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(a)



Exercise 3.3 (b)

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(b) Give the oxidation number of chlorine in each chlorine-containing product, and explain why this is disproportionation. [3]

Exercise 3.3 (b)

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(b) Give the oxidation number of chlorine in each chlorine-containing product, and explain why this is disproportionation. [3]

(b)

- Cl in NaCl = -1 ; Cl in NaClO₃ = $+5$; chlorine starts at 0 and is both reduced (to -1) and oxidised (to $+5$)

Exercise 3.4

3.4 Explain, with an equation, how chlorine makes drinking water safe.

[2]

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3.4

- chlorine reacts with water: $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HOCl} + \text{HCl}$; the HOCl/ClO^- kills bacteria, making the water safe