

Exercise walk-through

11.3

Some reactions of the halide ions

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



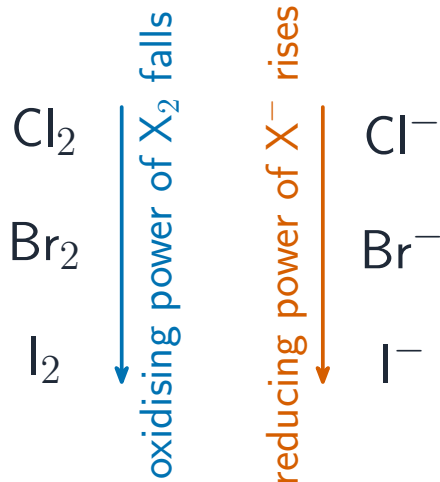
chlorine kills microbes

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:



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.

Exercises 2.1·2.2

2.1 State the colour of the precipitate formed when silver nitrate is added to (a) chloride and (b) iodide ions. [2]

2.2 State the trend in reducing power of the halide ions down the group. [1]

Exercises 2.1·2.2

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2.1

(a)

- white

(b)

- yellow

2.2 State the trend in reducing power of the halide ions down the group. [1]

2.2

- reducing power increases down the group

Exercise 3.1

3.1 A halide gives a cream precipitate with silver nitrate that dissolves only in concentrated ammonia. The halide is: [1]

☐

A chloride

B bromide

C iodide

D fluoride

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A chloride

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3.1 B

- A cream precipitate dissolving only in concentrated ammonia is bromide

Exercise 3.2

3.2 Which halide is oxidised to a coloured element by concentrated sulfuric acid, also producing H_2S ? [1]

☐

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B bromide

C iodide

D none of them

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3.2 C

- Iodide is the strongest reducing agent, reducing the acid to H_2S

Exercise 3.3

3.3 (a) Describe how you would use silver nitrate and ammonia to distinguish between solutions of sodium chloride and sodium iodide. [3]

(b) Explain why iodide ions are oxidised by concentrated sulfuric acid but chloride ions are not. [2]

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3.3

(a)

- add silver nitrate to each – both give a precipitate; chloride gives white, iodide gives yellow; add ammonia – the chloride (white) dissolves in dilute ammonia, the iodide (yellow) is insoluble

(b)

- iodide ions are stronger reducing agents (lose their electron more easily), so they reduce the sulfuric acid; chloride ions are too weak a reducing agent

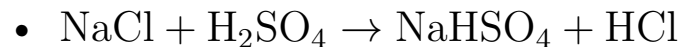
Exercise 3.4

3.4 Write the equation for the reaction of solid sodium chloride with concentrated sulfuric acid. [1]

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Exercise 3.5 (a)

3.5 Separate samples of solid NaCl, NaBr and NaI are each warmed with concentrated sulfuric acid.

(a) State what is observed with each solid, naming the sulfur-containing product where one is formed. [5]

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- NaCl: steamy white fumes of HCl only – no redox occurs. NaBr: steamy fumes of HBr, plus orange-brown bromine vapour and a colourless choking gas, **sulfur dioxide**. NaI: purple-black iodine, a yellow solid (sulfur) and the smell of bad eggs – **hydrogen sulfide**

Exercise 3.5 (b)

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(b) Explain the pattern in (a) in terms of the reducing power of the halide ions. [3]

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(b)

- Reducing power increases down the group; the ion gets larger, so its outermost electron is further from the nucleus and better shielded and is lost more easily; iodide can

therefore reduce sulfur from +6 all the way to -2 , whereas chloride cannot reduce it at all

Exercise 3.5 (c)

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(c) Describe the test that distinguishes chloride, bromide and iodide ions **in solution**, giving the result in each case and the effect of adding aqueous ammonia. [4]

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(c)

- Acidify with dilute nitric acid, then add aqueous silver nitrate. White precipitate = chloride, cream = bromide, yellow = iodide. The white dissolves in **dilute** ammonia; the cream dissolves only in **concentrated** ammonia, and the yellow dissolves in neither

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(d)

- To remove carbonate and other ions that would themselves precipitate with silver nitrate and give a false positive