

Group 17 — The Halogens

01 · APPEARANCE AND VOLATILITY

Halogen	State	Colour
Cl ₂	gas	pale green
Br ₂	liquid	red-brown
I ₂	solid	grey-black, purple vapour

All are diatomic. Boiling point **rises down the group**: more electrons per molecule means stronger London forces, so volatility falls.

02 · OXIDISING POWER

Decreases down the group. The atom gets larger and more shielded, so it attracts an electron less strongly and is reduced less readily.

Electronegativity and electron affinity both fall down the group, and E° values follow: F₂ +2.87, Cl₂ +1.36, Br₂ +1.07, I₂ +0.54 V.

03 · DISPLACEMENT REACTIONS

A halogen displaces the halide of any halogen **below** it.

Added to	Cl ⁻	Br ⁻	I ⁻
Cl ₂	—	orange	brown
Br ₂	none	—	brown
I ₂	none	none	—

Cl₂ + 2Br⁻ → 2Cl⁻ + Br₂. Shake with an organic solvent to confirm: Br₂ orange, I₂ violet in the hydrocarbon layer.

04 · HALIDE IONS AS REDUCING AGENTS

Reducing power increases down the group — the larger ion loses its outer electron more easily. This is the reverse of the halogens' oxidising trend.

Shown by the reaction with concentrated H₂SO₄, where the halide reduces the sulfur to progressively lower oxidation states.

05 · HALIDES WITH CONCENTRATED H₂SO₄

Halide	Products	Seen
Cl ⁻	HCl only	steamy fumes
Br ⁻	HBr + Br ₂ + SO ₂	red-brown fumes
I ⁻	HI + I ₂ + H ₂ S	purple vapour, bad-egg smell

Sulfur is reduced from +6 to +4 (SO₂) by Br⁻ and as far as -2 (H₂S) by I⁻, proving iodide is the strongest reducing agent.

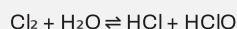
06 · TESTING FOR HALIDE IONS

Acidify with dilute HNO₃ (removes carbonate), then add AgNO₃(aq):

Ion	Precipitate	In NH ₃ (aq)
Cl ⁻	white	dissolves in dilute
Br ⁻	cream	dissolves in concentrated
I ⁻	pale yellow	insoluble

Ag⁺ + X⁻ → AgX(s). Solubility in ammonia falls down the group, which is what separates the three.

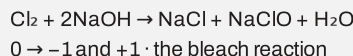
07 · CHLORINE WITH WATER



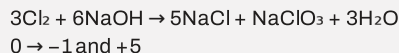
Chlorine **disproportionates**: 0 → -1 and +1. HClO is the bactericide used to treat water; the risk of chlorine's toxicity is judged against the far larger benefit of killing waterborne pathogens.

08 · CHLORINE WITH ALKALI

Cold dilute NaOH



Hot concentrated NaOH



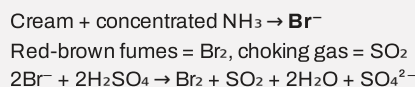
09 · HYDROGEN HALIDES

All are colourless gases that fume in moist air and dissolve to give acidic solutions.

Thermal stability decreases down the group — the H-X bond gets longer and weaker, so HI decomposes to iodine and hydrogen on gentle heating while HCl does not.

10 · WORKED EXAMPLE — IDENTIFY THE HALIDE

A solution gives a cream precipitate with acidified AgNO₃ that dissolves only in concentrated ammonia. Warmed with concentrated H₂SO₄ it gives red-brown fumes and a choking gas.

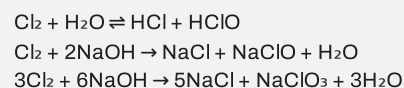
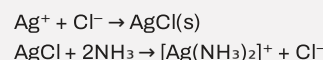
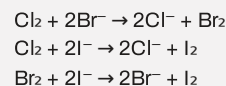


11 · USES

Chlorine — water treatment, bleach, PVC and solvents. Bromine — flame retardants and silver bromide in photography. Iodine — antiseptic and dietary supplement.

Chlorofluorocarbons were once used as refrigerants and propellants but are now banned because their chlorine radicals catalyse ozone depletion.

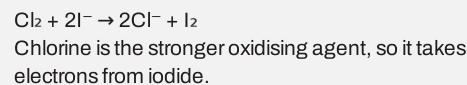
12 · EQUATIONS TO KNOW



13 · WORKED EXAMPLE — DISPLACEMENT

Chlorine water is shaken with aqueous potassium iodide and a little hexane. Describe and explain what is seen.

The aqueous layer turns brown as iodine forms; the hexane layer above turns violet because iodine is more soluble in the non-polar solvent.



TRENDS IN ONE LINE

Down Group 17: radius ↑, electronegativity ↓, boiling point ↑, oxidising power of X₂ ↓, reducing power of X⁻ ↑, stability of HX ↓.

Two ideas do all the explaining: increasing atomic size with more shielding, and increasing numbers of electrons for London forces.

MARKS LOST HERE

— Reversing the two trends: X₂ gets **less** oxidising down the group while X⁻ gets **more** reducing.

— Acidifying the halide test with HCl, which adds chloride of its own.

— Missing the change in oxidation numbers when asked to prove disproportionation.

— Explaining boiling points by "stronger covalent bonds"; it is London forces between molecules.