

11.2 Chemical properties of the halogens and hydrogen halides

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS oxidising agent 氧化剂 • hydrogen halide 卤化氢 • thermal stability 热稳定性
• group 族 • halogen 卤素

Objective

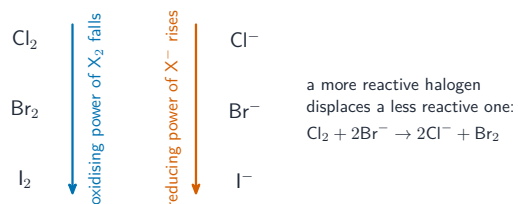
Build the skills to answer exam questions on the **chemical properties of the halogens and hydrogen halides** — the halogens as **oxidising agents** 氧化剂, reactions with hydrogen, and the thermal stability of the **hydrogen halides** 卤化氢.

You must be able to:

- describe the relative reactivity of the halogens as oxidising agents
- describe the reactions with hydrogen and explain the reactivity trend
- explain the thermal stabilities of the hydrogen halides in terms of bond strength

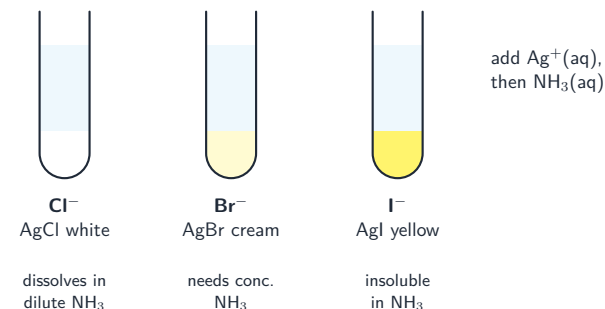
1 Worked examples

■ Halogens as oxidising agents



a more reactive halogen
displaces a less reactive one:
 $\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$

Oxidising power of the halogens falls down the group (the larger atom attracts an extra electron less)



Silver halide tests distinguish the halides

Each halogen gains one electron to form X⁻, so it is an **oxidising agent**. A more reactive halogen **displaces** a less reactive one: $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$.

■ Reactions with hydrogen and HX stability

$\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ — the reaction gets **less vigorous** down the group (Cl₂ explosive in light; I₂ slow). The thermal stability of HX **decreases** down the group, because the H-X bond weakens as the atom gets larger (HI breaks easily; HCl is stable).

2 Practice

2.1 State the trend in oxidising power down Group 17 and explain it. [2]

2.2 Write the equation for the displacement reaction of chlorine with potassium bromide. [1]

3 Exam-style questions

3.1 Which is the strongest oxidising agent? [1]

- A Cl_2
- B Br_2
- C I_2
- D they are equal

3.2 Which hydrogen halide is the **least** thermally stable? [1]

- A HCl
- B HBr
- C HI
- D HF

3.3 (a) State and explain whether bromine would displace chlorine from sodium chloride. [2]

(b) Explain why HI is less thermally stable than HCl. [2]

3.4 Explain why the halogens become less reactive as oxidising agents down the group. [2]

Solutions

2.1 oxidising power decreases down the group; the larger atoms attract an extra electron less strongly.

2.2 $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$.

3.1 A. Chlorine is the strongest oxidising agent.

3.2 C. HI is the least thermally stable (weakest H-X bond).

3.3 (a) no; bromine is a weaker oxidising agent than chlorine, so it cannot displace chloride.

(b) the H-I bond is longer and weaker than H-Cl, so HI decomposes more easily on heating.

3.4 down the group the atoms get larger with more shielding, so they attract an extra electron less strongly — weaker oxidising agents.