

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

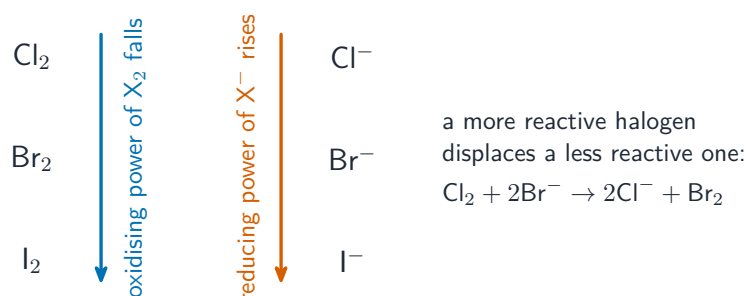
Build the skills to answer exam questions on the **chemical properties of the halogens and hydrogen halides** — the halogens as **oxidising agents** 氧化剂, reactions with hydrogen, and the thermal stability of the **hydrogen halides** 卤化氢.

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



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

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

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

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 (Cl_2 explosive in light; I_2 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
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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.

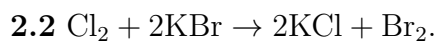
[2]

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.



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.