

# 11.1 Physical properties of the Group 17 elements

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

## Objective

Build the skills to answer exam questions on the **physical properties of the halogens** 卤素—their colours, the trend in **volatility** 挥发性, and the trend in bond strength.

**You must be able to:**

- describe the colours and the trend in volatility of chlorine, bromine and iodine
- explain volatility in terms of instantaneous dipole–induced dipole forces
- describe and explain the trend in halogen bond strength

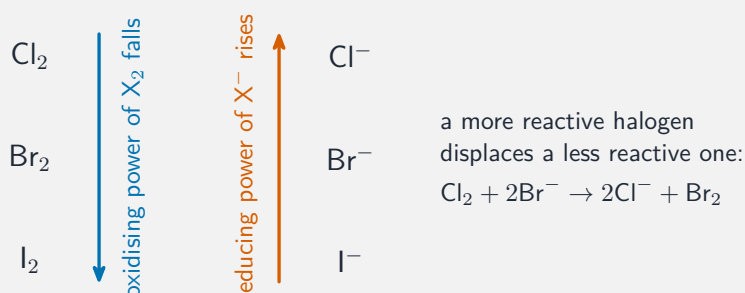
## 1 Worked examples

### ■ Colours and volatility

volatility decreases (intermolecular forces get stronger) →



Down Group 17 volatility falls: chlorine (gas) → bromine (liquid) → iodine (solid)



Volatility **decreases** down the group because the molecules get larger with more electrons, so the **instantaneous dipole–induced dipole** forces between them get stronger —harder to overcome, so boiling point rises.

#### ■ Bond strength

The X–X bond energy generally **falls** from Cl to I : the shared electrons are further from the nuclei in larger atoms.

## 2 Practice

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**2.1** State the colour and physical state of bromine at room temperature. [2]

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**2.2** State the trend in volatility down Group 17. [1]

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## 3 Exam-style questions

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**3.1** Why is iodine a solid while chlorine is a gas at room temperature? [1]

- **A** iodine has stronger covalent bonds
  - **B** iodine molecules have more electrons, so stronger id–id forces
  - **C** iodine is ionic
  - **D** chlorine has more electrons
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**3.2** The type of force broken when iodine sublimates is: [1]

- **A** the I–I covalent bond
  - **B** instantaneous dipole–induced dipole forces
  - **C** ionic bonds
  - **D** hydrogen bonds
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**3.3** Explain, in terms of intermolecular forces, why the boiling points of the halogens increase down the group. [3]

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**3.4** Suggest why the bond energy of I is less than that of Cl .

[2]

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## 4 Go further

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You are now ready for the real exam questions on this subtopic. Open the **11.1 Physical properties of the Group 17 elements** past-paper sheet in the Library, or try this in **Practice mode**:

- 9701/24 N25 —Q1 (halogens, structured)

## Solutions

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**2.1** red-brown / orange-brown; liquid.

**2.2** volatility decreases down the group.

**3.1 B.** Iodine has more electrons, so stronger id–id forces between molecules.

**3.2 B.** Subliming breaks the intermolecular (id–id) forces, not the covalent bond.

**3.3** down the group the molecules have more electrons; so the instantaneous dipole–induced dipole forces are stronger; more energy is needed to separate the molecules, so the boiling point rises.

**3.4** the I atoms are larger, so the shared bonding electrons are further from the nuclei; the weaker attraction gives a lower bond energy.