

11.1 Physical properties of the Group 17 elements

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS volatility 挥发性 • bond energy 键能 • group 族 • induced dipole 诱导偶极 • instantaneous dipole 瞬时偶极

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

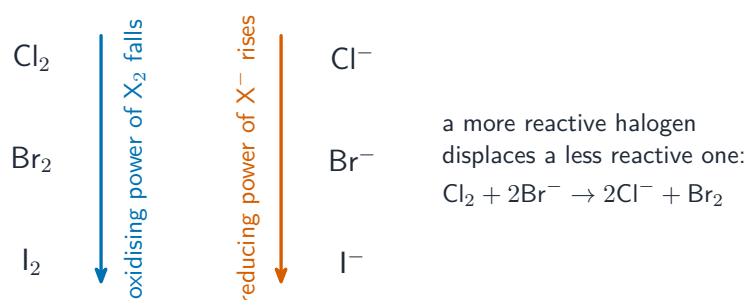
1 Worked examples

■ Colours and volatility

volatility decreases (intermolecular forces get stronger) →



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



Trends in oxidising power down Group 17

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 Cl₂ to I₂: the shared electrons are further from the nuclei in larger atoms.

2 Practice

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

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

3 Exam-style questions

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

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

3.3 Explain, in terms of intermolecular forces, why the boiling points of the halogens increase down the group. [3]

3.4 Suggest why the bond energy of I_2 is less than that of Cl_2 . [2]

Solutions

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_2 atoms are larger, so the shared bonding electrons are further from the nuclei; the weaker attraction gives a lower bond energy.