

2.3.3 Halogens: displacement and disproportionation

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS disproportionation

Objective

Use oxidation-number and observation evidence while keeping reagent conditions explicit. All questions and marking guidance are original.

1 Key knowledge and worked examples

Cl_2 , Br_2 and I_2 become weaker oxidising agents down Group 7: an incoming electron is less strongly attracted as radius and shielding increase. Larger electron clouds strengthen London forces and raise boiling temperature.

■ Worked explanation

$\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$. Chlorine gains electrons and is reduced, so it is the oxidising agent. Bromide is oxidised and is the reducing agent. In water bromine is orange/brown; iodine is brown. In a suitable non-polar organic solvent iodine is violet.

Cold dilute OH^- gives Cl^- and ClO^- . Hot concentrated OH^- gives Cl^- and ClO_3^- . In each case chlorine starts at 0 and is both reduced and oxidised. Never mix bleach with acid as an informal test.

2 Practice

2.1 Write the ionic equation for bromine displacing iodide and identify the reducing agent. [3]

2.2 State the physical states and characteristic colours of chlorine, bromine and iodine at room temperature. [3]

2.3 Explain why iodine has a higher boiling temperature but is a weaker oxidant than chlorine. [4]

3 Exam-style questions

3.1 Balance $\text{Cl}_2 + \text{OH}^- \rightarrow \text{Cl}^- + \text{ClO}_3^- + \text{H}_2\text{O}$ for hot concentrated alkali. Use oxidation numbers to explain the coefficient ratio. [5]

3.2 Explain the different main reactions of solid NaCl and NaBr with concentrated H_2SO_4 . Give the redox equation involving HBr and name the sulfur product. [4]

3.3 Predict the relative oxidising powers of fluorine, chlorine and astatine using the Group 7 trend. Write equations for chlorine with water and hydrogen chloride with ammonia, then explain one benefit and one risk of chlorine water treatment. [5]
