

Exercise walk-through

2.3.3

Halogens: displacement and disproportionation

Pearson Edexcel · International A-Level · Chemistry

Opposite solubility trends explain the evidence

- 1 **Set up** $\text{Ba}(\text{OH})_2$ is more soluble: its equal saturated volume contains more OH^- and needs more acid.
- 2 **Reason** BaSO_4 is less soluble: equal initial cation amounts give more solid with excess sulfate.
- 3 **Conclude** Solubility controls dissolved amount; it is different from dissociation strength.

Controls distinguish chemical evidence from contamination

- 1 Set up** Match measured amounts, particle size, apparatus and heating rate; compare sample temperature at a consistent decomposition criterion.
- 2 Reason** CO_2 : milky limewater; O_2 : glowing splint relights; NO_2 : brown and acidic.
- 3 Conclude** Clean flame-test wire and keep the flame region/loading consistent. Na yellow, K lilac, Ca brick-red, Sr crimson-red; sodium carry-over can mask another colour.

Independent identification

Your turn

$\text{C}_3\text{H}_6\text{O}$ has a carbonyl IR absorption and gives a positive Fehling's test. Which structure fits all evidence?

- A. CH_3COCH_3
- B. $\text{CH}_3\text{CH}_2\text{CHO}$
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D. CH_3COOH

Exercises 2.1·2.3

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]

Exercises 2.1·2.3

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

2.1 $\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$. I^- loses electrons and is the reducing agent.

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

2.2 Chlorine: pale-green gas; bromine: red-brown liquid; iodine: grey-black solid. Iodine vapour is purple, not its ordinary solid appearance.

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

2.3 Iodine has more electrons/more polarisable cloud, stronger London forces. Its larger radius/more shielding weakens attraction for an incoming electron.

Exercises 3.1·3.3

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]

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3.1 $3\text{Cl}_2 + 6\text{OH}^- \rightarrow 5\text{Cl}^- + \text{ClO}_3^- + 3\text{H}_2\text{O}$. Chlorine changes $0 \rightarrow -1$ and $0 \rightarrow +5$, so five atoms gain one electron each for every atom losing five.

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]

3.2 NaCl releases HCl by acid–base reaction, with no reduction of sulfuric acid. Bromide/HBr can reduce the acid: $2\text{HBr} + \text{H}_2\text{SO}_4 \rightarrow \text{Br}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$. SO_2 contains sulfur reduced from +6 to +4. This is a hazardous controlled demonstration.

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]

3.3 $\text{F}_2 > \text{Cl}_2 > \text{At}_2$ from increasing radius/shielding and weaker attraction for an incoming electron down the group. $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HCl} + \text{HClO}$. $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl}$. Disinfection reduces microbial disease; toxicity/harmful by-products require controlled dosing and monitoring.