

Exercise walk-through

Similarities and trends in the properties of the Group 2 metals, magnesium ■ 10.1

eXercise

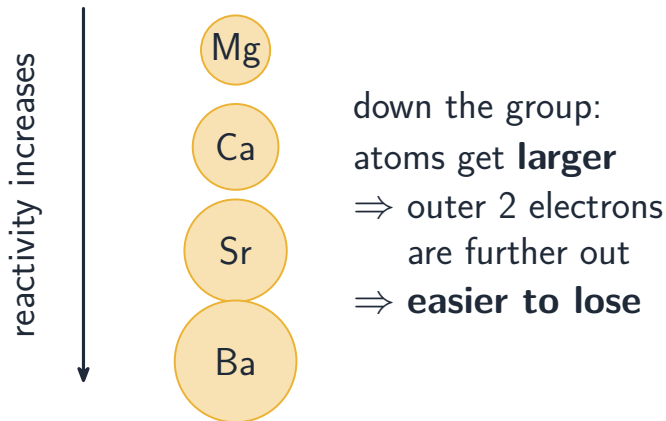
You must be able to

- write equations for the reactions with oxygen, water and dilute acids
- describe the thermal decomposition of the carbonates and nitrates and the stability trend
- state the solubility trends of the hydroxides and sulfates

Method — Reactivity and reactions

- **oxygen:** $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$.
- **water:** $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ (faster down the group).
- **acid:** $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$.

Method — Reactivity and reactions



Group 2 atoms growing larger down the group, with reactivity increasing

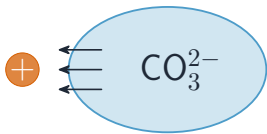
Method — Thermal decomposition and stability

Carbonates $\rightarrow$ oxide + CO (CaCO₃ $\rightarrow$ CaO + CO₂); nitrates $\rightarrow$ oxide + NO + O .

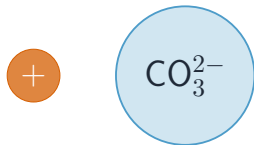
Thermal stability increases down the group (a larger ion polarises less).

Method — Thermal decomposition and stability

small Mg^{2+} : high polarising power large Ba^{2+} : low polarising power

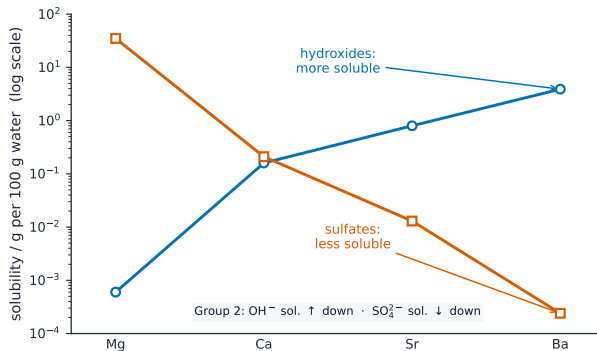


distorts the ion
 $\Rightarrow$ **decomposes easily**



barely distorted
 $\Rightarrow$ **thermally stable**

Method — Solubility



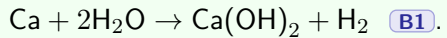
Hydroxide solubility rising and sulfate solubility falling down the group

Practice 2.1 ■ 1 mark

Write the equation for the reaction of calcium with water.

Solution 2.1

Worked steps



Practice 2.2 ■ 2 marks

State the trend in reactivity down Group 2 and why.

Solution 2.2

Method: Reactivity and reactions

Worked steps

reactivity increases down the group **B1**; the atoms are larger, so the two outer electrons are lost more easily **B1**.

Exam-style 3.1 ■ 1 mark

Which carbonate is the **most** thermally stable?

A MgCO_3

B CaCO_3

C SrCO_3

D BaCO_3

Solution 3.1

A MgCO

B CaCO

C SrCO

D BaCO



Worked steps

D. Thermal stability increases down the group, so BaCO is most stable.

Exam-style 3.2 ■ 1 mark

Down Group 2, the solubility of the sulfates:

- A** increases
- B** decreases
- C** stays the same
- D** first rises then falls

Solution 3.2

Method: Solubility

A increases

B decreases 

C stays the same

D first rises then falls

Worked steps

B. Sulfate solubility decreases down Group 2.

Exam-style 3.3 ■ 2 marks

- (a) Write the equation for the thermal decomposition of calcium nitrate.
- (b) Explain why barium carbonate is more thermally stable than magnesium carbonate.

Solution 3.3

Method: Thermal decomposition and stability

Worked steps

(a) $2\text{Ca}(\text{NO}_3)_2 \rightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$ **M1** **A1** *products, balanced.*

(b) the Ba^{2+} ion is larger (lower charge density) than Mg^{2+} **M1**; it polarises/distorts the carbonate ion less **M1**; so the C–O bonds are weakened less and a higher temperature is needed to decompose it **A1**.

Exam-style 3.4 ■ 2 marks

Describe and explain the trend in reactivity of the Group 2 metals with water.

Solution 3.4

Method: Reactivity and reactions

Worked steps

reactivity increases down the group **M1**; larger atoms hold their outer electrons less tightly, so they react faster with water **A1**.