

10.1 Group 2 metals, magnesium to barium

Name: _____ Class: _____ Date: _____

Total: 12 marks

Objective

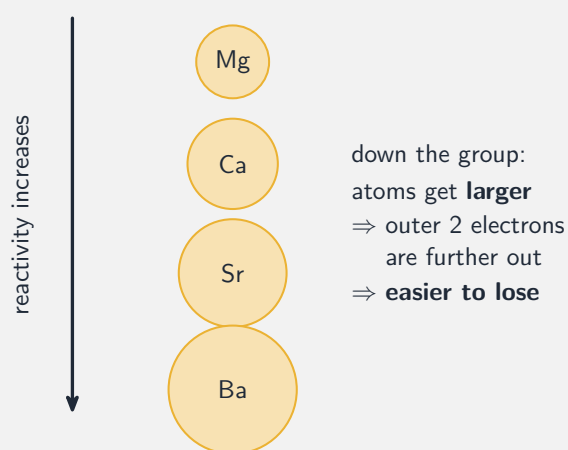
Build the skills to answer exam questions on the **Group 2 metals** 第二族金属—their reactions, **thermal decomposition** 热分解 and **thermal stability** 热稳定性, and **solubility** 溶解度 trends.

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

1 Worked examples

■ Reactivity and reactions

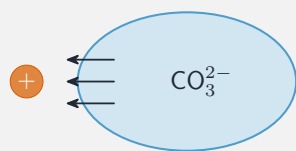


Reactivity increases down Group 2: larger atoms lose their two outer electrons more easily

- **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:** $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$.

■ Thermal decomposition and stability

small Mg^{2+} : high polarising power



distorts the ion
⇒ **decomposes easily**

large Ba^{2+} : low polarising power



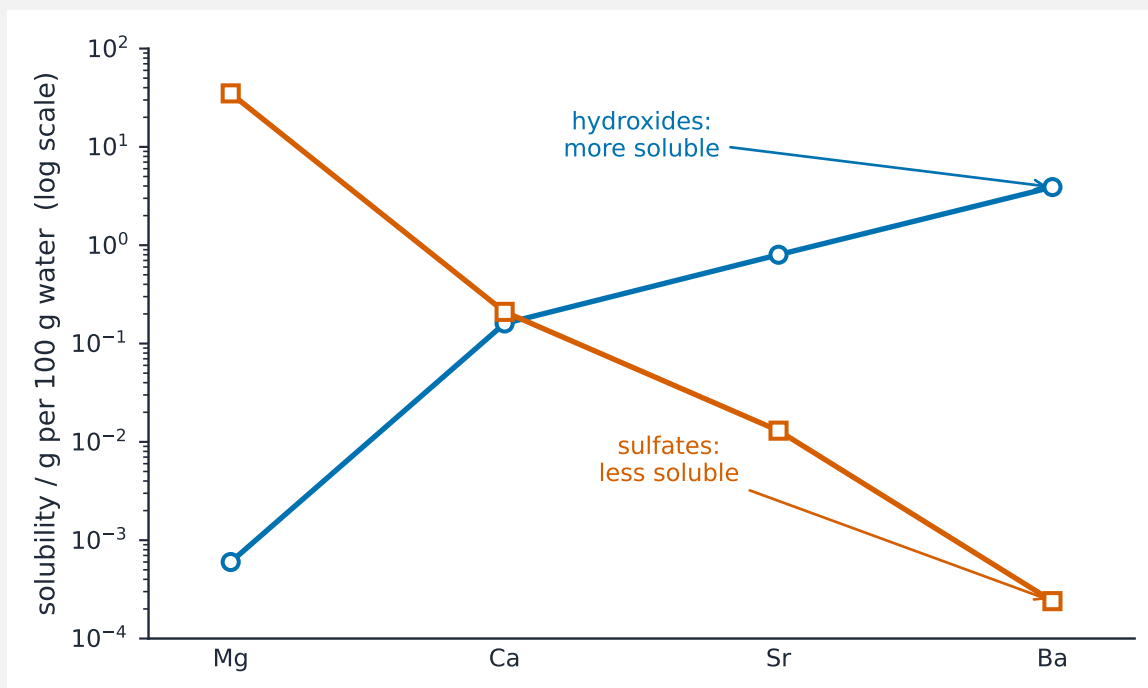
barely distorted
⇒ **thermally stable**

A small cation polarises the carbonate more, weakening it —so stability rises down the group

Carbonates → oxide + CO ($\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$); nitrates → oxide + NO + O .

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

■ Solubility



Down Group 2: hydroxides become more soluble; sulfates become less soluble

2 Practice

2.1 Write the equation for the reaction of calcium with water.

[1]

2.2 State the trend in reactivity down Group 2 and why. [2]

3 Exam-style questions

3.1 Which carbonate is the **most** thermally stable? [1]

- **A** MgCO
- **B** CaCO
- **C** SrCO
- **D** BaCO

3.2 Down Group 2, the solubility of the sulfates: [1]

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

3.3 (a) Write the equation for the thermal decomposition of calcium nitrate. [2]

(b) Explain why barium carbonate is more thermally stable than magnesium carbonate.[3]

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

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **10.1 Group 2 metals** past-paper sheet in the Library, or try these in **Practice mode**:

- 9701/11 N25 —Q19 (Group 2)
- 9701/12 N25 —Q20 (thermal stability)
- 9701/14 N25 —Q19 (Group 2 trends)

Solutions

2.1 $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$.

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

3.1 D. Thermal stability increases down the group, so BaCO_3 is most stable.

3.2 B. Sulfate solubility decreases down Group 2.

3.3 (a) $2\text{Ca}(\text{NO}_3)_2 \rightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$.

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

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