

10.1 Group 2 metals, magnesium to barium

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS thermal stability 热稳定性 • thermal decomposition 热分解 • solubility 溶解度 • group 族
• oxide 氧化物

Objective

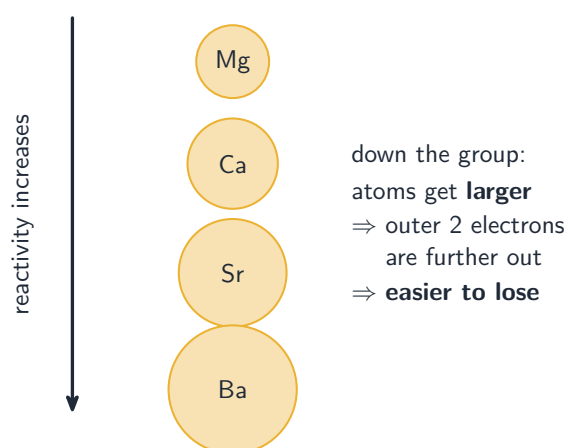
Build the skills to answer exam questions on the **Group 2 metals** 第二族金属 — their reactions, **thermal decomposition** 热分解 and **thermal stability** 热稳定性, and **solubility** 溶解度 trends.

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

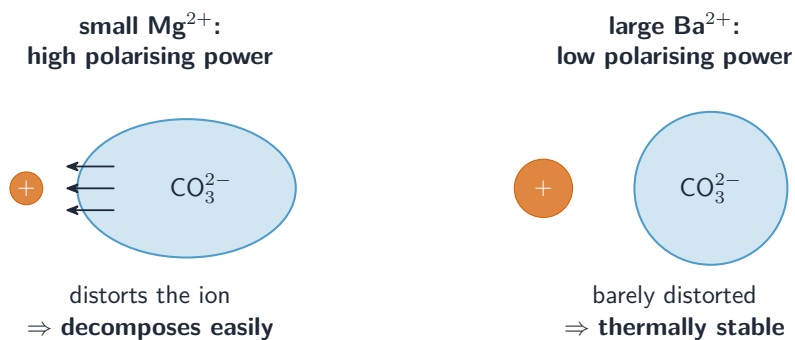


Reactivity increases down Group 2: larger atoms lose their two outer electrons more easily

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

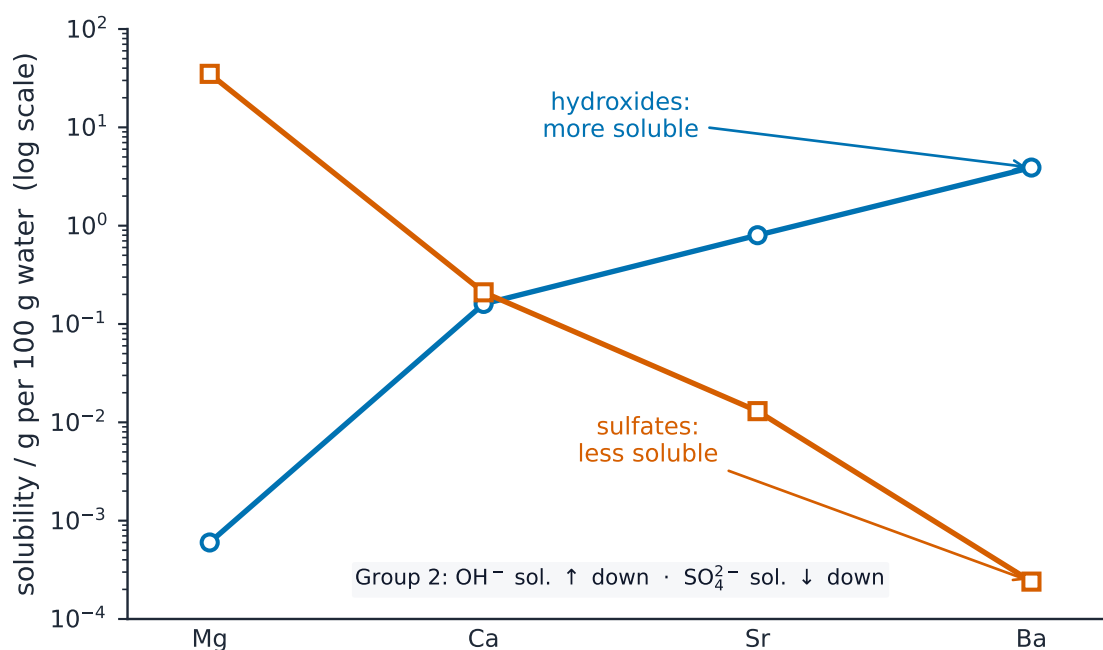
■ Thermal decomposition and stability



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

Carbonates $\rightarrow$ oxide + CO_2 ($\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$); nitrates $\rightarrow$ oxide + NO_2 + O_2 .
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_3
- B CaCO_3
- C SrCO_3
- D BaCO_3

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]

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.