

27.1 Group 2 trends in thermal stability and solubility

Name: _____ Class: _____ Date: _____ Total: 9 marks

KEY WORDS thermal stability 热稳定性 • lattice energy 晶格能 • nitrate 硝酸盐
• carbonate 碳酸盐 • hydroxide 氢氧化物

Objective

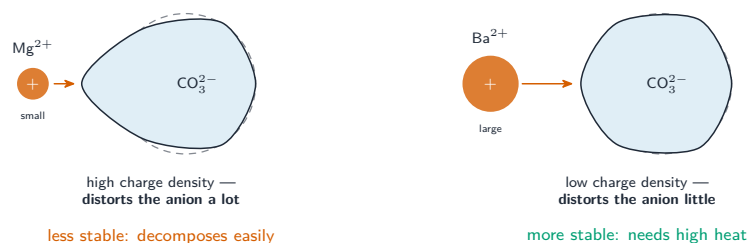
Build the skills to answer exam questions on the **Group 2 trends** — the **thermal stability** 热稳定性 of the nitrates and carbonates, and the **solubility** 溶解度 of the hydroxides and sulfates.

You must be able to:

- explain the thermal-stability trend using ionic radius and **polarisation** 极化
- explain the solubility/ ΔH_{sol} trends using lattice energy and hydration enthalpy

1 Worked examples

■ Thermal stability and polarisation



A small cation (high charge density) polarises the large anion more, weakening it — so stability rises down the group

Down the group the cation gets larger → lower charge density → polarises the anion less → the carbonate/nitrate is harder to decompose (more stable).

■ Solubility energetics

$$\Delta H_{\text{sol}} = -\Delta H_{\text{latt}} + \Delta H_{\text{hyd}}$$

hydroxides (small OH^-):
lattice energy falls a *lot* down the group
⇒ outweighs the smaller hydration fall → **more soluble**

sulfates (large SO_4^{2-}):
lattice energy stays almost constant
⇒ the hydration fall then dominates → **less soluble**

ΔH_{sol} depends on the balance of lattice energy and hydration enthalpy as both change down the group

Hydroxides become **more soluble**, sulfates **less soluble** down the group — because the lattice energy and hydration enthalpies change at different rates as the cation grows.

2 Practice

2.1 State the trend in thermal stability of the Group 2 carbonates down the group. [1]

2.2 State the trend in solubility of the Group 2 sulfates down the group. [1]

3 Exam-style questions

3.1 Magnesium carbonate decomposes at a lower temperature than barium carbonate because the Mg^{2+} ion: [1]

A	B
C	D

- A is larger
- B has a higher charge density and polarises the carbonate more
- C has a lower charge
- D is more soluble

3.2 The increasing thermal stability of the nitrates down Group 2 is explained by: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** increasing cation charge
B decreasing polarisation of the anion by the larger cation
C increasing anion size
D decreasing temperature

3.3 Explain, in terms of polarisation, why the thermal stability of the Group 2 nitrates increases down the group. [3]

3.4 ΔH_{sol} depends on the lattice energy and the hydration enthalpies. Explain why both quantities become **less** exothermic down Group 2. [2]
