

Group 2

A-Level Chemistry ■ Topic 27

A-Level Chemistry



Group 2

What we will cover

- 1 Thermal stability & polarisation
- 2 Solubility & energetics
- 3 Why the trends are opposite



limestone decomposes in a kiln

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Group 2 trends

Group 2

└ Group 2 trends

Thermal stability and polarisation

Thermal stability 热稳定性 of the nitrates & carbonates **increases** down the group.

A small cation has high charge density, so it **polarises** 极化 the large anion more – weakening it. Larger cations polarise less, so the compound is more stable.

Group 2

└ Group 2 trends

Thermal stability and polarisation

A small, highly charged cation **polarises** 极化 a large anion, distorting it until it decomposes ($\text{CO}_3^{2-} \rightarrow \text{CO}_2 + \text{O}^{2-}$). Down Group 2 the cation gets larger, so it polarises less: carbonates and nitrates become **more thermally stable**.

Group 1 carbonates (except Li) do not decompose in a Bunsen flame; Group 2 ones do, more readily at the top of the group.

Group 2

└ Group 2 trends

Solubility and energetics



Two energy changes compete when a solid dissolves:

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

Pull the lattice apart, then **hydrate** 水合 the ions. Down the group both get smaller – but at different rates.

Why the trends are opposite

hydroxides 氢氧化物 ↑

small OH^- : lattice energy falls a lot $\rightarrow$ more soluble

sulfates 硫酸盐 ↓

large SO_4^{2-} : lattice $\approx$ constant $\rightarrow$ less soluble

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Recap

Worked example – thermal stability

Explain why BaCO_3 needs a higher temperature to decompose than MgCO_3 .

- Decomposition: $\text{MCO}_3 \rightarrow \text{MO} + \text{CO}_2$.
- The cation **polarises** 极化 the carbonate ion, distorting its electron cloud and weakening a C–O bond.
- Mg^{2+} is **small** with high charge density $\Rightarrow$ polarises strongly $\Rightarrow$ decomposes easily.
- Ba^{2+} is much **larger**, low charge density $\Rightarrow$ weak polarising $\Rightarrow$ survives to a higher temperature.

Thermal stability rises **down** Group 2 – the cation gets bigger and polarises less. The same argument works for the nitrates.

Topic 27 – key takeaways

1 Stability

rises down; large cations polarise less

2 Dissolving

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

3 Hydroxides

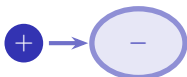
more soluble down (lattice falls a lot)

4 Sulfates

less soluble down (lattice $\approx$ constant)

Check yourself

- Which way does thermal stability change down Group 2?
- What does a small cation do to a large anion?
- Which become more soluble down the group?
- Which become less soluble down the group?



Answers 1. increases 2. polarises (distorts) it 3. the hydroxides 4. the sulfates