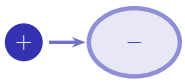
Group 2

A-Level Chemistry ▪ Topic 27

A-Level Chemistry



What we will cover

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

limestone decomposes in a kiln

1 Group 2 trends

Thermal stability and polarisation

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

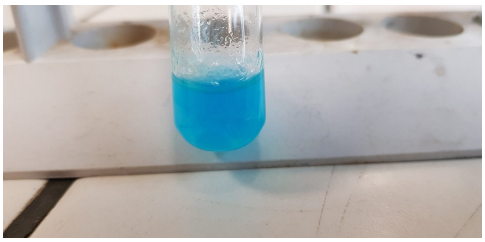
> A small cation has high charge density, so it **polarises** 极化 the large anion more – weakening it. Larger cations polarise less, so the compound is more stable.

Thermal stability and polarisation

A small, highly charged cation **polarises** 极化 a large anion, distorting it until it decomposes ($CO_3^{2-} \rightarrow CO_2 + O^{2-}$). 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.

Solubility and energetics



Two energy changes compete when a solid dissolves:

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

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 → more soluble

sulfates 硫酸盐 ↓

large SO_4^{2-}: lattice ≈ constant → less soluble

2 Recap

Worked example – thermal stability

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

- Decomposition: $MCO_3 \rightarrow MO + CO_2$.
- 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 ⇒ polarises strongly ⇒ decomposes easily.
- Ba^{2+} is much larger, low charge density ⇒ weak polarising ⇒ 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

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

3 Hydroxides

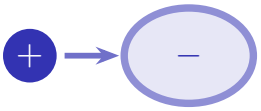
more soluble down (lattice falls a lot)

4 Sulfates

less soluble down (lattice ≈ constant)

Check yourself

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



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