

GROUP 2 : INORGANIC CHEM

Also known as the "Alkaline Earth metals" or "S-block elements"

- are found in nature as ores
- as they are reactive metals, they are found combined with other elements like O, N, and S
- they react with water to form alkalis

Name	Symbol	Atomic Number	Electronic configuration
Beryllium	Be	4	$1s^2 2s^2$
Magnesium	Mg	12	$1s^2 2s^2 2p^6 3s^2$
Calcium	Ca	20	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
Strontium	Sr	38	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2$
Barium	Ba	56	$[Xe] 6s^2$
Radium	Ra	88	Radioactive

PHYSICAL PROPERTIES

1. Atomic Radius

- Increases down the group because each successive element has one new/extra shell of electrons, so the outer-most electrons are progressively further away from the nucleus

2. Ionic Radius

- Increases down the group
- There are more complete shells of electrons

3. Ionisation Energy

- Decreases down the group
- Electrons enter new shells, which are further away from the nucleus and more shielded from the positively charged nucleus.
- So less energy is needed to remove an electron

4. Melting / Boiling Point

- Decrease down the group
- As atomic radius increases, the delocalized mobile valence electrons are further away (more diffused) and there is a weaker attractive force between the sea of electrons and the cations

↳ Therefore, the strength of the metallic bond decreases and less energy is required to melt and the melting point decreases

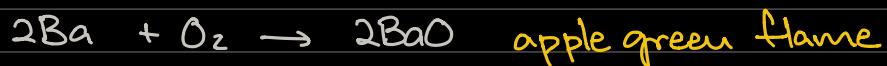
5. Hardness

- Decreases as the metallic bonds become weaker down the group

CHEMICAL PROPERTIES

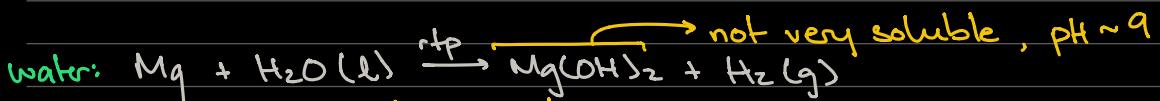
1. Reaction of element with oxygen → form oxides (on burning)

General : 2 Metal + O₂ $\xrightarrow{\text{burn}}$ 2 Metal Oxide

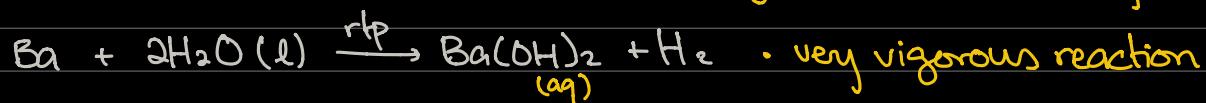
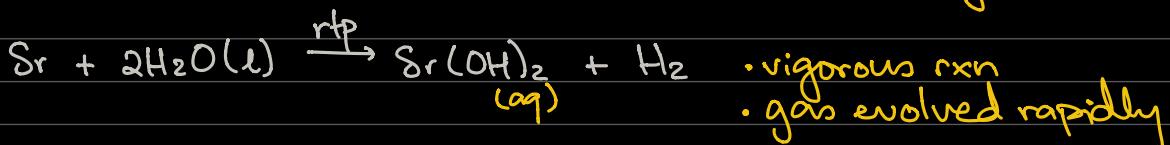
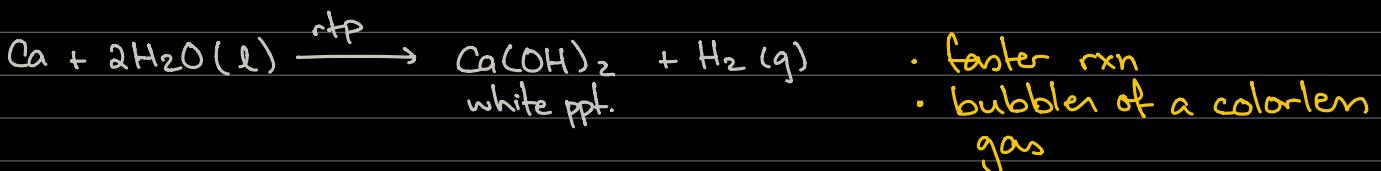
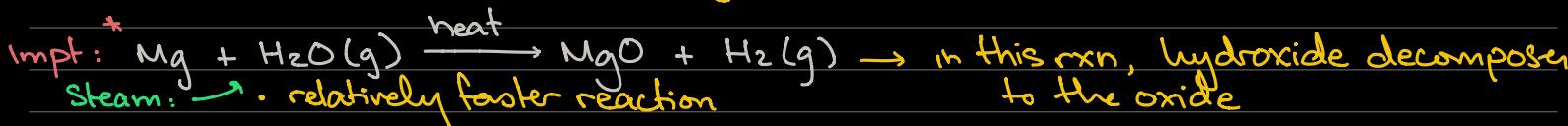


- ## 2. Reactions of the elements with water

- All group 2 elements (except Beryllium) react with water to produce hydroxides and hydrogen gas



- very slow reaction
 - bubbles of colourless gas evolved



Be					
Mg	+ H ₂ O	weakly alkaline pH ~ 9	Mg(OH) ₂	Solubility increases	MgSO ₄
Ca	Reactivity		Ca(OH) ₂		CaSO ₄
Sr	Increases	pH ~ 10-13 strongly alkaline	Sr(OH) ₂		SrSO ₄
Ba			Ba(OH) ₂		BaSO ₄

3. Reactions of oxides with acids

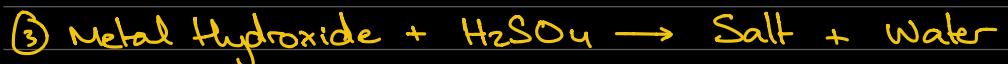
- BeO is an amphoteric oxide
 - MgO, CaO, SrO, BaO → basic oxides
Hence they react with acids to form salt and water
- $$\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$$
- $$\text{MgO} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O}$$

Note: Solubility trends for hydroxides and sulfates should be learned

Hydroxides → more soluble down the group
Sulfates → less soluble down the group

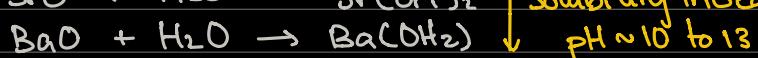
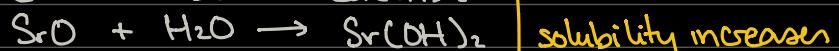
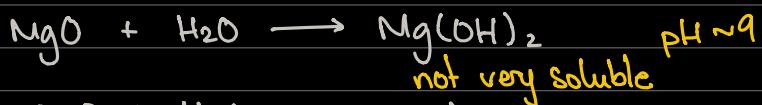


4. Preparation of Sulfates



- all group I salts are soluble
- all nitrates are soluble

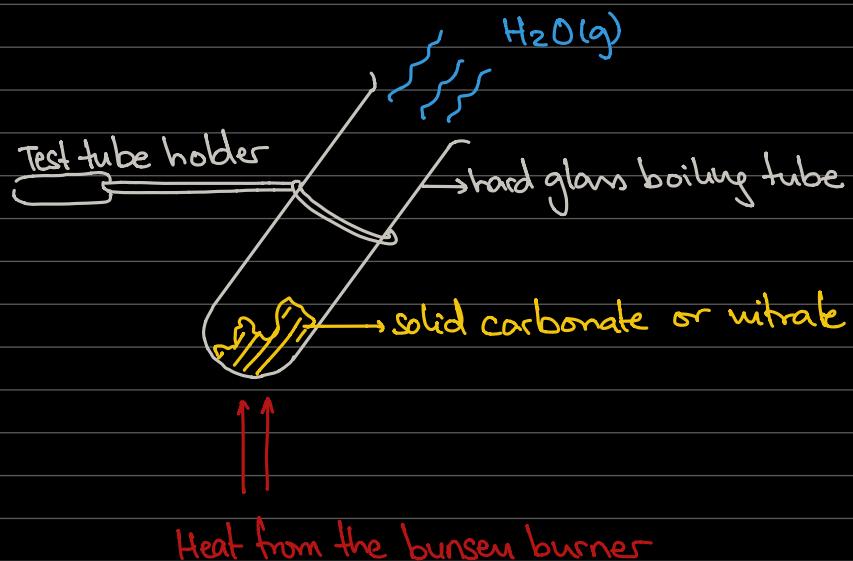
5. Reaction of oxides with water



solubility increases
pH ≈ 10 to 13

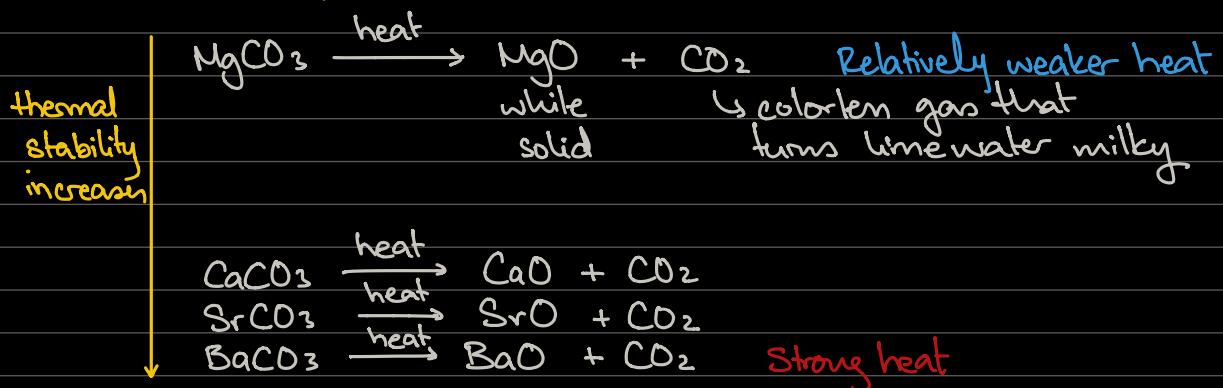
THERMAL STABILITY OF NITRATES & CARBONATES

OF GROUP 2



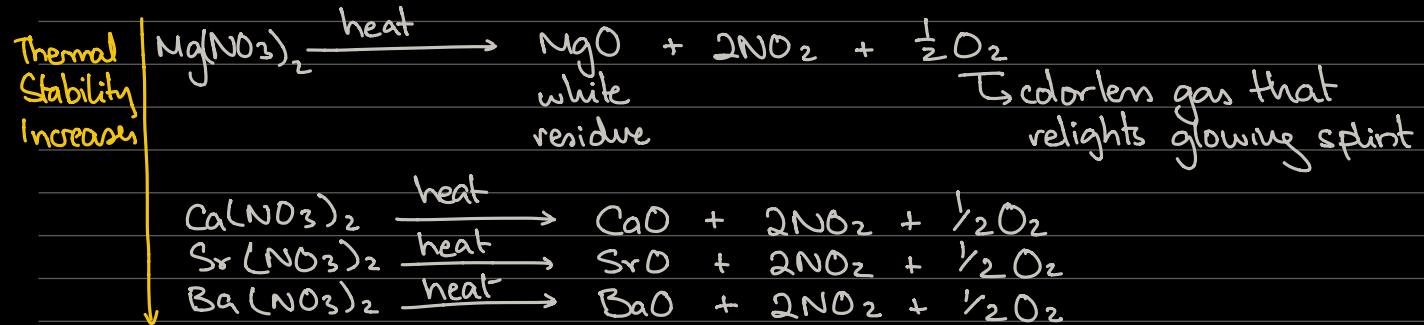
- Heat gently at first to make sure water vapour in the sample evaporates first
- Then heat strongly to decompose the salt
 - Keep the boiling tube over the flame steadily

Carbonates: decompose to form oxide and CO₂



- The carbonates become more thermally stable to heat as we go down the group, ie. higher temps are needed to decompose them.

Nitrates: Decompose to form the oxide NO₂(g) and O₂(g)



- Thermal stability increases down the group
- They are more stable to heat

USES OF PARTICULAR GROUP II COMPOUNDS

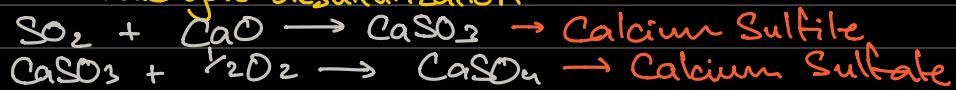
1. MgO

- Used as a refractory material - ie. to line furnaces, as it can withstand high temperatures
 - ↳ It has a giant ionic structure with strong ionic bonds so its melting point is very high
- It is also resistant to attack by most chemicals
- It has low thermal conductivity, so it is a good insulator

2. Calcium Compounds

a) CaO — quick lime

- Used to neutralize acidic soils / increase pH of soil
- Used for "flue gas desulfurization"



b) Ca(OH)₂ (s) — Slaked lime

- Also used to neutralize acidic soils

c) Ca(OH)₂ (aq) — lime water

- Used in test for CO₂



d) CaCO₃ — Limestone / Marble

e) CaO — Used for flue gas desulfurization

