

CHAPTER 11: GROUP 2

Physical and chemical properties of G2 elements:

Be		• Number of valence electrons: 2
Mg		• Fixed oxidation state of +2
Ca		• Valence electrons occupy s orbital
Sr		Going down the group,
Ba		• outer electrons occupy a new principal quantum shell further from the nucleus
Ra		• metallic radius increases, IE decreases
		• reactivity increases

Solubility of G2 hydroxides and sulfates in water:

- **G2 Hydroxides**
 - o Increases going down group 2
- **G2 Sulfates**
 - o Decreases going down group 2
 - o Solubility (insoluble)
 - Sr: sulphur
 - Ba: barium
 - Ca: calcium
 - Pb: lead, Pb
 - S: strontium, Sr

Thermal decomposition (TD) of G2 carbonates and nitrates:

- **G2 Carbonates**
 - o Example: $\text{CaCO}_3(\text{s}) \xrightarrow{\Delta} \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
limestone
 - o Observation:
 - White solid
 - Gas turns limewater chalky
 - o Trend going down group 2:
 - Temperature at which TD occurs increases
 - Thermal stability increases
- **G2 Nitrates**
 - o Example: $2\text{Ca}(\text{NO}_3)_2(\text{s}) \xrightarrow{\Delta} 2\text{CaO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$

G2 hydroxides + HCl:

Element	Chemical equation
Mg	$\text{Mg(OH)}_2(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
Ca	$\text{Ca(OH)}_2(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
Sr	$\text{Sr(OH)}_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{SrCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
Ba	$\text{Ba(OH)}_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{BaCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$

(Similar to reaction between G2 oxides + HCl)

G2 hydroxides + H₂SO₄:

Element	Observation	Chemical equation
Mg	Clear solution formed	$\text{Mg(OH)}_2(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{MgSO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
Ca	Reaction stops quickly to form sparingly soluble ppt	$\text{Ca(OH)}_2(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CaSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$
Sr	Reaction stops quickly to form insoluble, white ppt	$\text{Sr(OH)}_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{SrSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$
Ba	Reaction stops quickly to form insoluble, white ppt	$\text{Ba(OH)}_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$

*Trend: solubility of sulfates decrease down the group

*SuBaCaPS: sulfates of barium, calcium, lead and strontium are insoluble in water

G2 carbonates + HCl:

Element	Chemical equation
Mg	$\text{MgCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
Ca	$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
Sr	$\text{SrCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{SrCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
Ba	$\text{BaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{BaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

CHAPTER 12: GROUP 17

Properties of halogens:

Halogen	Melting point / °C	Boiling point / °C	Appearance	E(X-X) / kJ mol ⁻¹	E(H-X) / kJ mol ⁻¹
F ₂ (extra)	-220	-188	Pale yellow gas	158	562
Cl ₂ (g)	-101	-35	Yellow-green gas	242	431
Br ₂ (l)	-7	59	Red-brown liquid (Brown gas)	193	366
I ₂ (s)	114	184	Dark grey solid (Purple gas)	151	299

Colour and volatility of halogens:



Chlorine, Cl₂
Yellow-green gas
Boiling point: -35 °C



Bromine, Br₂
Red-brown liquid / Brown gas
Boiling point: 59 °C



Iodine, I₂
Dark grey solid / Purple gas
Boiling point: 184 °C

- Molecule size / number of electrons increase
→ Stronger id-id forces
→ Hence **boiling point increases**

Bond strength of halogens:

Bond	Bond enthalpy / kJ mol ⁻¹	Trend going down Group 17
F - F	158	(extra) high electron density in F ₂ causes additional repulsive forces, weakening the F-F bond
Cl - Cl	242	→ Increasing distance between nuclei → Weaker orbital overlap → Attraction between nuclei and electrons decreases
Br - Br	193	
I - I	151	