Group 2

Group 2 elements: Redox eactions:

The Group 2 elements:

- These are also called the alkaline earth metals as their hydroxides are alkaline.
- Remember that the reactivity increases as you move down Group 2 (see ionisation energies)

Physical properties:

- All light metals.
- Compounds are white or colourless.
- They have reasonably high melting and boiling points.

Electronic configuration:

- All in the s block sub - shell and all have s^2 electrons.

Reactivity of Group 2 elements:

- Group 2 metals are reactive:

$M \rightarrow M^{2+} + 2e^-$

- These elements give away 2 electrons when they react.
- This means that what ever they react with must gain electrons.
- Gaining electrons is a reduction reaction:

Oxidation
Is
Loss of electrons
Reduction
Is
Gain of electrons

- As the Group 2 elements cause the reduction of other compounds or elements we say it is a good **Reducing agent**.
- Reactivity increases as you go down the Group. This means they lose their electrons more readily.
- This means as you go down Group 2, they become better **Reducing agents**

Reaction with oxygen

- Group 2 metals react vigorously with oxygen to give the oxide:

Metal + Oxygen → Metal oxide

- The reaction gives an ionic product. If you apply oxidation numbers, you can see what has been oxidised and reduced:

Calcium + Oxygen → Calcium oxide

$2Ca_{(s)}$ + $O_{2(g)}$ → $2CaO_{(s)}$

Element	$2Ca_{(s)}$	+	$O_{2(g)}$	→	$2CaO_{(s)}$	Change in Ox No		Redox
						Up	Down	
Ca	0				+2	**2**		**Ox**
O			0		- 2		**2**	**Red**

Reaction with water

- Group 2 metals react with water to give the hydroxide and hydrogen gas:

Metal + Water → Metal hydroxide + Hydrogen

- The reaction gives an ionic product. If you apply oxidation numbers, you can see what has been oxidised and reduced:

Calcium + Water → Calcium hydroxide + Hydrogen

$Ca_{(s)}$ + $2H_2O_{(l)}$ → $Ca(OH)_{2(aq)}$ + $H_{2(g)}$

Element	$Ca_{(s)}$	+	$2H_2O_{(l)}$	→	$Ca(OH)_{2(aq)}$	+	$H_{2(g)}$	Change in Ox No		Redox
								Up	Down	
Ca	0				+2			**2**		**Ox**
H			+1		(+1)		0		**1**	**Red**
O			-2		-2		-	-	-	-

- Note that only one of the H from each water molecule has been reduced

Group 2 compounds: reactions

Group 2 oxides and hydroxides:

- These are bases as they neutralise acids to form salts and water:

$MgO_{(s)}$ + $2HCl_{(aq)}$ → $MgCl_{2(aq)}$ + $H_2O_{(l)}$

$Ca(OH)_{(s)}$ + $2HCl_{(aq)}$ → $CaCl_{2(aq)}$ + $2H_2O_{(l)}$

1) Group 2 oxides:

- These react with water to form metal hydroxide.

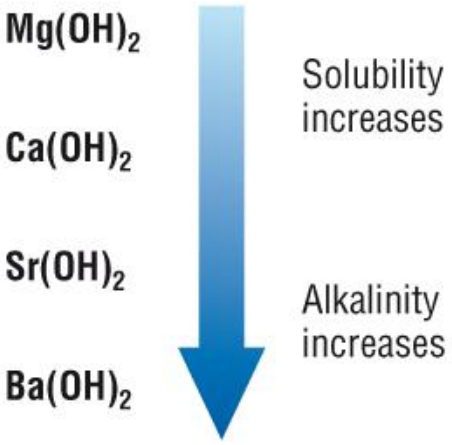
$$MgO_{(s)} + H_2O_{(l)} \rightarrow Mg(OH)_{2(aq)}$$

- These are soluble so dissolve in the water forming an alkali, pH10 - 12

2) Group 2 hydroxides:

- As these are soluble, they dissolve in water forming alkaline solutions::

$$Ca(OH)_{2(s)} + aq \rightarrow Ca^{2+}_{(aq)} + 2OH^-_{(aq}$$



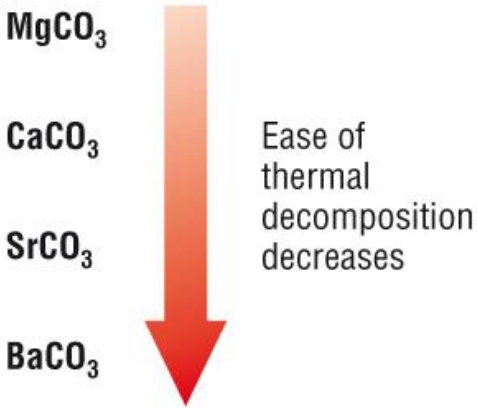
- The **solubility** of the Group 2 hydroxides **increases** as you go **down the Group**.
- This means that as you go **down Group 2 more hydroxide ions** are formed (for the same amounts).
- This means that as you go **down Group 2 they become more alkaline.**

3) Group 2 carbonates:

- The Group 2 carbonates **decompose** when **heated, Thermal Decomposition:**

Is the breaking down of a chemical substance with heat into at least 2 chemical substances

$$MgCO_{3(s)} \rightarrow MgO_{(s)} + CO_{2(g)}$$

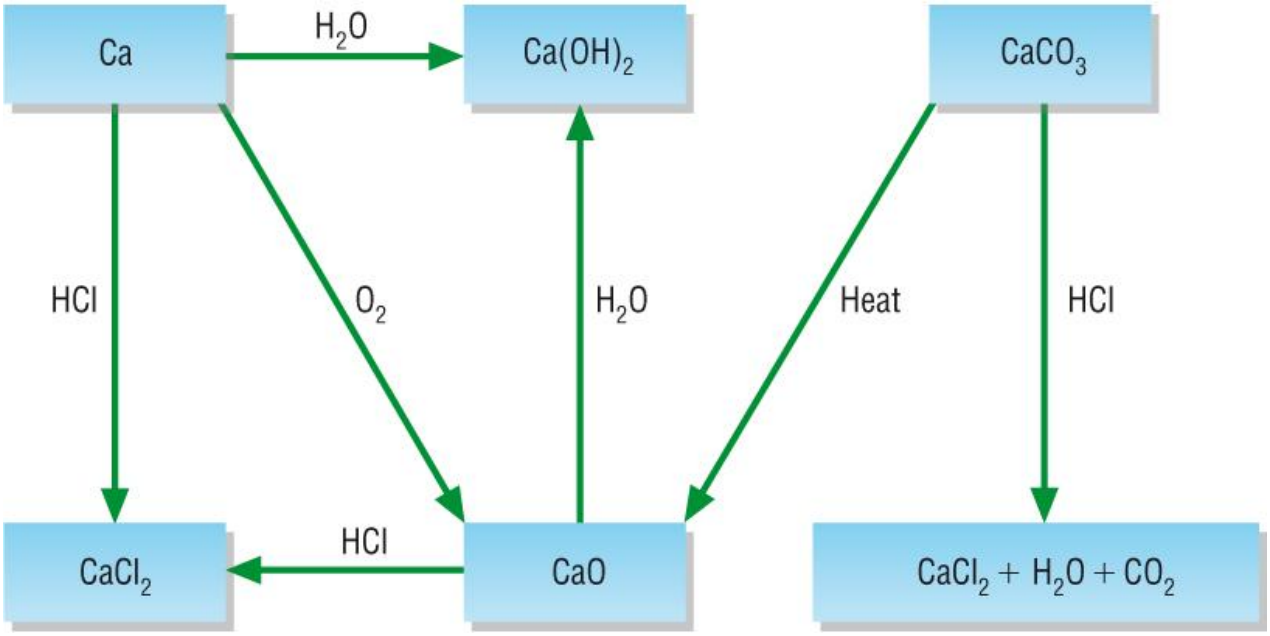


- **As you go down Group 2, the carbonates become harder to decompose.**

Properties of Group 2 elements and their compounds:

- Because of Periodicity we only have to learn the Chemistry for one of the elements in Group 2.
- **All the elements in Group 2 will react in the same way (but with different vigour).**
- As you go **down Group 2**: the elements become **more reactive**.
- As you go **down Group 2**: the carbonates **decompose at higher temperatures**.
- As you go **down Group 2**: the **hydroxides** become **more soluble** in water, making the solution **more alkaline**.

Reactions of calcium and its compounds (or any Group 2 element / compound)



Uses of Group 2 hydroxides:

1) Calcium hydroxide

- Is used to reduce the acidity of soil:

$Ca(OH)_{2(s)}$ + $2HCl_{(aq)}$ → $CaCl_{2(aq)}$ + $2H_2O_{(l)}$

2) Magnesium hydroxide

- Is used in indigestion tablets / 'milk of magnesia' to neutralise excess stomach acid.

$Mg(OH)_{2(s)}$ + $2HCl_{(aq)}$ → $MgCl_{2(aq)}$ + $2H_2O_{(l)}$