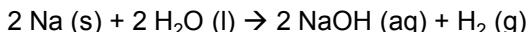


2. Periodicity of Period 3 Elements

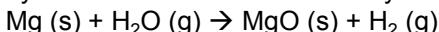
Trends in the reactions of the elements with water, limited to Na and Mg

Learn the equations

Sodium reacts with cold water. It fizzes around on surface etc.

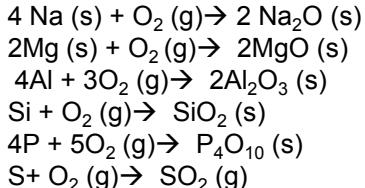


Magnesium reacts very slowly with cold water to form the hydroxide but reacts more readily with **steam** to form the oxide



Trends in the reactions of the elements Na, Mg, Al, Si, P and S with oxygen

The elements all react with oxygen to form oxides. Sodium burns with a yellow flame. Mg, Al, Si and P burn with a white flame and S with a blue flame.



You should be able to write these equations.

Learn the formulae of the oxides

A survey of the acid-base properties of the oxides of Period 3 elements

Understand the link between the physical properties of the highest oxides of the elements Na → S and their structure and bonding.

Ionic oxides

The metal oxides (Na_2O , MgO , Al_2O_3) are ionic. They have high melting points. They have ionic giant lattice structures: strong forces of attraction between ions : higher mp. They are ionic because of the large electronegativity difference between metal and O

The increased charge on the cation makes the ionic forces stronger going from Na to Al so leading to increasing melting points

Macromolecular oxides

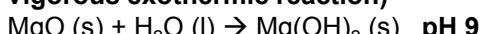
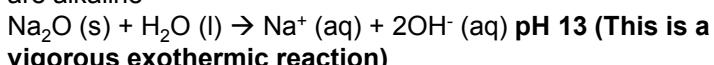
SiO_2 is Macromolecular: very strong covalent bonds between atoms. High energy needed to break the many strong covalent bonds – very high mp + bp

Simple molecular oxides:

P_4O_{10} , SO_2 are simple molecular with weak intermolecular forces between molecules (van der waals + permanent dipoles) so have lower mp's. They are covalent because of the small electronegativity difference between the non-metal and O atoms

The reactions of the oxides of the elements Na → S with water

Metal oxides tend to react with water to form hydroxides which are alkaline

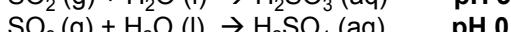
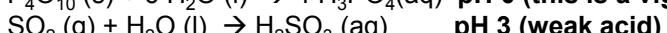
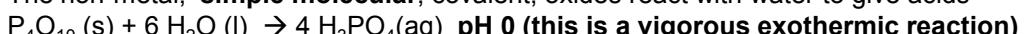


Mg(OH)_2 is only slightly soluble in water as its lattice is stronger so fewer free OH^- ions are produced and so lower pH

know the change in pH of the resulting solutions across the Period.

Al_2O_3 and SiO_2 **do not dissolve** in water because of the high strength of the Al_2O_3 ionic lattice and the SiO_2 macromolecular structure, so they give a neutral pH 7

The non-metal, **simple molecular**, covalent, oxides react with water to give acids



Learn the equations !

The trend is the **ionic metal oxides** show **basic** behaviour and the **non-metal covalent** oxides show **acidic** behaviour.

The slightly intermediate nature of the bonding in Aluminium oxide is reflected in its amphoteric behaviour: it can act as both a base and an acid

Acid base reactions between period 3 oxides and simple acids and bases.

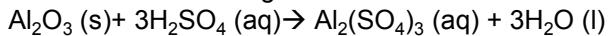
The **basic oxides** react with acids to make salts
 $\text{Na}_2\text{O} (\text{s}) + 2 \text{HCl} (\text{aq}) \rightarrow 2\text{NaCl} (\text{aq}) + \text{H}_2\text{O} (\text{l})$
 $\text{Na}_2\text{O} (\text{s}) + \text{H}_2\text{SO}_4 (\text{aq}) \rightarrow \text{Na}_2\text{SO}_4 (\text{aq}) + \text{H}_2\text{O} (\text{l})$
 $\text{MgO} (\text{s}) + 2 \text{HCl} (\text{aq}) \rightarrow \text{MgCl}_2 (\text{aq}) + \text{H}_2\text{O} (\text{l})$

Rather than learning the equations by rote,
learn the pattern. Most follow the pattern acid +
base = salt + water

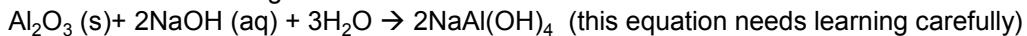
Amphoteric Oxides

Aluminium oxide can act as both an acid and an alkali and is therefore called amphoteric

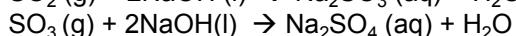
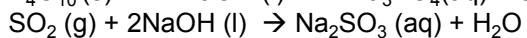
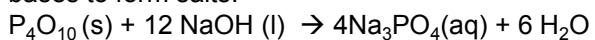
Aluminum oxide acting as a **base**



Aluminum oxide acting as a **acid**



The other simple molecular acidic oxides react with bases to form salts.



SiO_2 has a **giant covalent structure** with very strong bonds. This stops SiO_2 reacting with water and weak solutions of alkali. It will, however, react with very concentrated NaOH
 $2\text{NaOH} (\text{l}) + \text{SiO}_2 (\text{s}) \rightarrow \text{Na}_2\text{SiO}_3 (\text{aq}) + \text{H}_2\text{O}$
It is still classed as an acidic oxide