Reactions of Period 3

- Sodium is more reactive than magnesium because it takes less energy to remove one electron from sodium than two from magnesium.

- Sodium reacts vigorously with (cold) water producing H_2 gas.

$$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$$

→ strong alkali

- Magnesium reacts very slowly with cold water, hard to see anything happening but will form weakly alkaline solution (pH 9-10). Magnesium Oxide (~~Hydroxide~~) is not very soluble. It reacts much more readily with steam!

steam

$$Mg_{(s)} + H_2O_{(g)} \rightarrow MgO_{(s)} + H_{2(g)}$$

no hydroxide as any $Mg(OH)_2$ thermally decomposes to give MgO. $+ H_2O$

cold water

$$Mg_{(s)} + 2H_2O_{(l)} \rightarrow Mg(OH)_2 + H_{2(g)}$$

- Most period 3 elements react readily with oxygen. They form oxides and are usually oxidised to their highest oxidation state (Group No.). Sulphur is the exception as it usually forms SO_2 (+4). It needs high temperature and a catalyst to form SO_3.

Equations are all : Element + oxygen → oxide

* $2Na_{(s)} + \frac{1}{2}O_2 \rightarrow Na_2O_{(s)}$

* $Mg_{(s)} + \frac{1}{2}O_2 \rightarrow MgO_{(s)}$

$2Al_{(s)} + 1\frac{1}{2}O_2 \rightarrow Al_2O_{3(s)}$

$Si_{(s)} + O_{2(g)} \rightarrow SiO_{2(s)}$

* $P_{4(s)} + 5O_{2(g)} \rightarrow P_4O_{10(s)}$

* $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$

* = reacts easily in air

Sodium = yellow flame Magnesium = white flame

phosphorus = white flame Sulphur = Blue flame.

- Ionic oxides are alkaline, Covalent oxides are acidic.

Ionic

$Na_2O_{(s)} + H_2O \rightarrow 2NaOH_{(aq)}$
pH 12-14
V. Soluble

$MgO_{(s)} + H_2O \rightarrow Mg(OH)_2$
pH 9-10
Sparingly soluble

Simple Covalent

$P_4O_{10(s)} + 6H_2O \rightarrow 4H_3PO_{4(aq)}$ phosphoric Acid
$SO_{2(g)} + H_2O \rightarrow H_2SO_{3(aq)}$ sulphurous Acid
$SO_{3(g)} + H_2O \rightarrow H_2SO_{4(aq)}$ sulphuric Acid

(pH 0-2).

Giant Covalent

SiO_2 is INSOLUBLE in water <u>but</u> will react with bases to form salts so is classified as acidic.

Aluminium oxide has both ionic and covalent characteristics and is insoluble in water. It will react with <u>BOTH</u> acids and bases to produce salts so it is amphoteric (acts as both an acid and a base).

Neutralisation equations! Acid + Base → Salt + Water.

Basic Oxides

$Na_2O_{(s)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_2O$
$MgO_{(s)} + H_2SO_{4(aq)} \rightarrow MgSO_{4(aq)} + H_2O$

Acidic Oxides

$SiO_{2(s)} + 2NaOH_{(aq)} \rightarrow Na_2SiO_{3(aq)} + H_2O$
$P_4O_{10(s)} + 12NaOH_{(aq)} \rightarrow 4Na_3PO_{4(aq)} + 6H_2O$
$SO_{2(g)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{3(aq)} + H_2O$
$SO_{3(g)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O$

Amphoteric oxides

$Al_2O_{3(s)} + 3H_2SO_{4(aq)} \rightarrow Al_2(SO_4)_{3(aq)} + 3H_2O$

- The bonding and structure of period 3 oxides affect melting points.

- Na_2O, MgO and Al_2O_3 (metal oxides). → High melting points. → giant ionic lattices

- MgO melting point is higher due to forming 2+ ions (bonds are stronger).

- Al_2O_3 is lower than MgO surprisingly. This is due to the +3 ions distorting oxygens electron cloud causing partially covalent bonds. (Al^{3+} small with v high charge - pulls some e^- density towards it ∴ covalent character)

- SiO_2 has a higher melting point than other non metal oxides due to giant macromolecular structure.

- P_4O_{10} and SO_2 have low melting points because they have simple molecular structures. (Dipole-dipole and Van der Waals are relatively weak).