AQA AS Chemistry

Chemical Equations for Module 1

Remember that the Specifications say that you should be able to:

- write balanced equations (full and ionic) for reactions studied; and
- balance equations for unfamiliar reactions when reactants and products are specified.

Group II (the alkaline earth metals)

Reactions with water

Beryllium at the top of group II is not typical of the group, as it will not react with water or steam, even if it is heated to red heat. As you go down the group, the metals become more reactive towards water:

Magnesium with water: $Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$ … and …

Magnesium with steam: $Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$

In general, for calcium, strontium and barium: $M(s) + 2H_2O(l) \rightarrow M(OH)_2(aq) + H_2(g)$ … and …

As an ionic equation: $M(s) + 2H_2O(l) \rightarrow M^{2+}(aq) + 2OH^-(aq) + H_2(g)$

Group II hydroxides

The solubilities of the group II hydroxides **increases** as you go down the group:

- $Be(OH)_2$ is almost insoluble and $Mg(OH)_2$ is only sparingly soluble (think of that horrible **Milk of Magnesia** stuff you can take for an upset stomach!)

Calcium hydroxide dissolving in water: $Ca(OH)_2(s) + aq \rightarrow Ca(OH)_2(aq)$ … this is **limewater**

Group II sulphates

The solubilities of the group II sulphates **decreases** as you go down the group. This is the opposite of the trend in solubilities of the group II hydroxides, so watch out!

Beryllium sulphate is soluble in water but barium sulphate is insoluble:

$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ … this makes it useful as a test for the presence of sulphate ions …

> Dilute hydrochloric acid or nitric acid is added to the test solution, then barium chloride solution or barium nitrate solution is added (to provide $Ba^{2+}(aq)$ ions). A white precipitate of barium sulphate forms if there are any sulphate ions in the test solution.

Beryllium is atypical [Note – this is not tested by AQA from January 2005 onwards]

Be^{2+} ions have a high surface charge density because they are small and have a 2+ charge.
They are able to polarise anions such as Cl^- strongly, so beryllium compounds are covalent in character:

- beryllium chloride is a poor conductor of electricity when molten; it dissolves in organic solvents; and it has a relatively low melting point of 415ºC (magnesium chloride melts at 714ºC).

Group II hydroxides are basic, but beryllium hydroxide is amphoteric (it reacts with acids and bases):

$Be(OH)_2(s) + 2H^+(aq) + 2H_2O(l) \rightarrow [Be(H_2O)_4]^{2+}(aq)$ … and … $Be(OH)_2(s) + 2OH^-(aq) \rightarrow [Be(OH)_4]^{2-}(aq)$

