**12.1 Precipitation Reactions**

* When two solutions are mixed sometimes an insoluble compound is formed.
* This insoluble compound is a solid and separates from the solution. It is called a precipitate.

Example:

* When barium chloride (aq) is added to sodium sulphate (aq) a precipitate of barium sulphate forms.
* Barium chloride (BaCl2) is a soluble compound containg barium ions and chloride ions.
* Sodium sulphate (Na2SO4) is also a soluble compound containing sodium and sulphate ions.
* When the solutions are added together, the mixture is initially supersaturated with barium sulphate and hence a white precipitates forms.

BaCl2(aq) + Na2SO4(aq) BaSO4(s) + 2NaCl(aq)

* To identify which of the products in a precipitation reaction is the solid or precipitate refer to the solubility guide of common ionic substances (p199).
* Generally compounds that contain the ions Na+, K+, NH4+, or NO3- are soluble in water.
* This explains why sodium chloride remains in solution in the above reaction.
* This is a balanced chemical equation that produces a precipitate and is therefore called a **precipitation reaction.**

**Worked Example**

**A precipitate forms when a solution of lead nitrate (Pb(NO3)2) is added to a solution of potassium iodide (KI). Write a balanced equation identifying the precipitate.**

**Step 1: Identify possible products by swapping the positive and negative ions of the reactants.**

**Step 2: Write the correct formulas of the reactants and possible products.**

**Step 3: Write the equation and balance it.**

**Step 4: Deduce which of the products is the precipitates.**

**Ionic equations**

In the reaction between the solutions of barium chloride and sodium sulphate the equation is often written as:

However when the ionic substances dissolve in water the ionic compounds dissociate into their ions and the equations can be more accurately expressed as:

Barium sulphate, being insoluble is not dissociated into its ions and is still written as BaSO4(s). All other substances dissolve and are therefore present as ions in the solution.

On closer inspection the sodium and chloride ions have not reacted and remained in the same state and unchanged at the end of the reaction. Ions such as these are called spectator ions and can be omitted from the chemical equation.

Write the full equation again crossing out the spectator ions.

This reaction can therefore be represented by the simplified equation:

This type of equation, in which the spectator ions are omitted, is called an ionic equation. They are simpler than the full equations and focus on the reaction that takes place.

**Worked Example**

**Write an ionic equation for the reaction between solutions of lead nitrate and potassium iodide.**

**Step 1: Rewrite the equation with the soluble ionic compounds dissociated into ions.**

**Step 2: Remove the spectator ions to give the ionic equation for the reaction.**

**Text Questions: 1,2 Chapter Review: 6, 7, 11, 12**