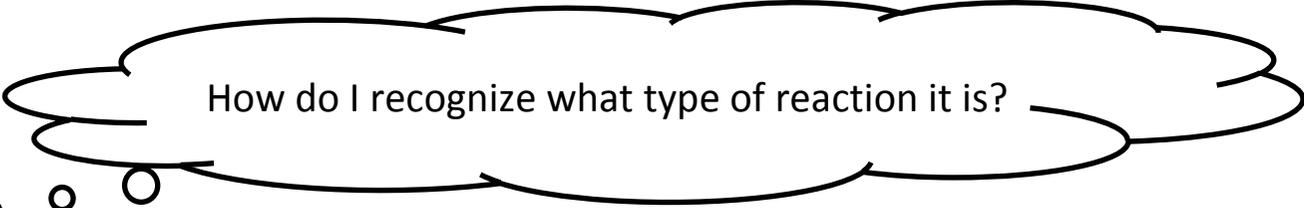


Achievement Standard Chemistry 90934

Types of chemical reaction

You will have come across these different types of chemical reaction.

precipitation ● thermal decomposition ● decomposition ● displacement (exchange) ● combination



How do I recognize what type of reaction it is?

Clues

- Precipitation: $\text{___(aq)} + \text{___(aq)} \rightarrow \text{___(s)} + \text{___(aq)}$ or “+ ion” (aq) + “- ion” (aq) \rightarrow ___(s) (s) is solid – the precipitate!
Refer to solubility rules given in the Resource booklet
- Thermal decomposition: reaction ALWAYS needs heat $\text{___(s)} \rightarrow$ 2 or 3 simpler compounds
 - metal carbonate \rightarrow metal oxide + carbon dioxide
 - sodium hydrogen carbonate \rightarrow sodium carbonate + water + carbon dioxide
 - metal hydroxide \rightarrow metal oxide + water
- Decomposition (catalytic): hydrogen peroxide \rightarrow water + oxygen
- Displacement: a more reactive metal displaces another less reactive metal from a solution of its salt; refer to activity series given in the Resource booklet e.g. $\text{A} + \text{B sulfate} \rightarrow \text{B} + \text{A sulfate}$ (as long as metal A is more reactive than B)
- Combination: $\text{A} + \text{B} \rightarrow \text{AB}$ 2 elements \rightarrow a compound e.g. metal + oxygen \rightarrow metal oxide

It is impossible to produce an exhaustive list of all the reactions you should know and their observations but the following table shows some “common” ones. Concentrate on linking the observations to the “species” involved in the reaction.

precipitation ● thermal decomposition ● decomposition ● displacement ● combination

Reaction	Type of reaction	Observations	Equation
Add a piece of zinc to about 2 cm depth of copper sulfate solution in a test tube.	displacement / exchange	Pinky orange solid forms; grey metal dissolves and blue colour of the solution fades & eventually becomes colourless	* $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$
Burn magnesium ribbon in air (or oxygen gas).	combination	Silvery grey metal burns with a bright white light in the colourless gas (or air) forming a grey-white ash	$2\text{Mg(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{MgO(s)}$
Heat a little copper(II) carbonate in a tube.	thermal decomposition	The green powder “bubbles” as a colourless gas escapes, leaving a black solid	$\text{CuCO}_3(\text{s}) \rightarrow \text{CuO(s)} + \text{CO}_2(\text{g})$
Heat a piece of iron wool in air or plunge it into oxygen gas.	combination	The grey metal burns with red-orange sparks light in the colourless gas (or air), and a grey-black solid is formed	$4\text{Fe(s)} + 3\text{O}_2(\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3(\text{s})$
Heat sodium hydrogen carbonate strongly; pass the gas produced through lime water.	thermal decomposition	White powder remains white but a colourless gas is formed which turns limewater milky	$2\text{NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O(l)} + \text{CO}_2(\text{g})$
Heat some sulfur in air (or oxygen gas) until it burns.	combination	The yellow solid melts, and then catches fire light in the colourless gas (or air), burning with a blue flame	$\text{S(s)} + \text{O}_2(\text{g}) \rightarrow \text{SO}_2(\text{g})$
Hold a piece of copper metal in tongs and heat strongly in a Bunsen flame.	combination	The pinky orange metal glows red hot light in the colourless gas (or air) and becomes coated with a black layer	$2\text{Cu(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{CuO(s)}$
Mix 3 mL of copper(II) sulfate solution with 3 mL of sodium hydroxide solution.	precipitation	The blue & colourless solutions form a blue precipitate in a colourless solution	* $\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Cu(OH)}_2(\text{s})$
Mix equal volumes of magnesium nitrate and sodium carbonate solutions together.	precipitation	The two colourless solutions mix forming a white precipitate in a colourless solution.	* $\text{Mg}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{MgCO}_3(\text{s})$

Place iron and sulfur in a test tube and heat the mixture.	combination	The grey and yellow mixture glows even after heat is removed, to make a black solid.	$\text{Fe(s)} + \text{S(s)} \rightarrow \text{FeS(s)}$
Place some hydrogen peroxide solution in a tube and add a little manganese dioxide powder.	catalytic decomposition	Bubbles of colourless gas are seen in the colourless liquid that relights a glowing splint.	$2\text{H}_2\text{O}_2(\text{aq}) \rightarrow 2\text{H}_2\text{O(l)} + \text{O}_2(\text{g})$
Put 3 mL of iron (II) sulfate solution in a test tube and add a piece of magnesium ribbon.	displacement / exchange	Grey magnesium dissolves. Pale green solution fades to colourless; a new dark grey solid is produced	$* \text{Mg(s)} + \text{Fe}^{2+}(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{Fe(s)}$
Put a little calcium carbonate in a tube and heat it very strongly.	thermal decomposition	White powder remains white but a colourless gas is formed which turns limewater milky	$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO(s)} + \text{CO}_2(\text{g})$
Heat copper(II) hydroxide strongly in a dry test tube.	thermal decomposition	Green solid turns to a black solid and water vapour is detected on cooler part of tube	$\text{Cu(OH)}_2(\text{s}) \rightarrow \text{CuO(s)} + \text{H}_2\text{O(l)}$
Heat sodium metal and plunge it into chlorine gas.	combination	Sodium reacts with a bright yellow light in the yellow green chlorine making white fumes that forms white crystals	$2\text{Na(s)} + \text{Cl}_2(\text{g}) \rightarrow 2\text{NaCl(s)}$
Heat iron wool as chlorine gas is passed over it.	combination	Green yellow chlorine reacts with grey iron which glows a bright orange to form a brown solid	$2\text{Fe(s)} + 3\text{Cl}_2(\text{g}) \rightarrow 2\text{FeCl}_3(\text{s})$

*** ionic equations – spectator ions now shown;**
 ionic equations can be written for displacement and precipitation reactions