

Metals and acids

- If a metal reacts with an acid, it produces a **salt** and hydrogen gas.
- All acid compounds have hydrogen in them.
- When the hydrogen is replaced by a metal, the compound is called a salt.

For example, sulfuric acid has the formula H_2SO_4 . Copper sulfate has the formula CuSO_4 – it is a salt because the copper has taken the place of the hydrogen in sulfuric acid.

The three main acids are hydrochloric acid, sulfuric acid, and nitric acid. Metals can react with all of these acids to produce a salt and hydrogen gas.

copper + hydrochloric acid → copper chloride + hydrogen

iron + sulfuric acid → iron sulfate + hydrogen

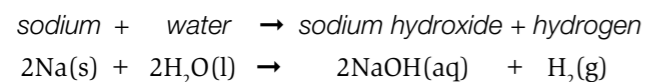
magnesium + nitric acid → magnesium nitrate + hydrogen

Testing for hydrogen gas

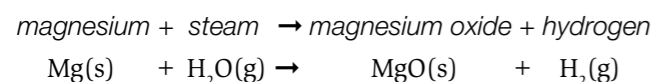
The gas produced when reacting a metal and a salt can be collected in an upturned test tube, and a test performed to check that the gas is hydrogen. Insert a lit splint into the upturned test tube – if the gas is hydrogen, there will be a 'pop' sound.

Metals and water/steam

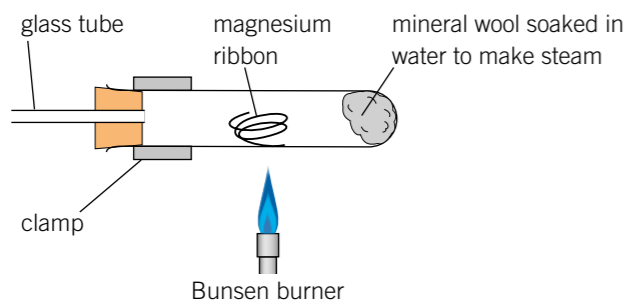
- Very reactive metals like sodium will react with cold water to produce a metal hydroxide and hydrogen gas.



- Other metals like magnesium only react with steam, and produce a metal oxide and hydrogen.



Magnesium can be reacted with steam using the following experimental set-up.



Metals and oxygen

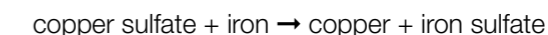
- Many metals will react with oxygen from the air to produce a metal oxide.
- Often, they will need to be heated before they can react.

Metal	Reaction with oxygen
magnesium	burns vigorously
zinc	burns less vigorously
iron	burns
lead	do not burn; when heated, form layer of oxide on surface
copper	do not burn; when heated, form layer of oxide on surface
gold	no reaction

Metal displacement reactions

- A **displacement reaction** occurs when a more reactive element takes the place of a less reactive element in a compound. In metals, this means that the more reactive metal will become a compound, and the less reactive one an element.

For example, iron is more reactive than copper so:



The iron has displaced the copper from its compound. The solution changes from blue to pale green and the metal changes from grey to rose coloured, indicating that a chemical reaction has happened.

The reactivity series

most reactive
potassium
sodium
lithium
calcium
magnesium
aluminium
zinc
iron
lead
copper
silver
gold
least reactive

↑ Increasing reactivity

State symbols

- Symbol equations have letters in brackets after each substance.
- These tell you the state of matter of each substance, and are called **state symbols**:

(s) = solid, (l) = liquid, (g) = gas, (aq) = dissolved in water

For example, $\text{H}_2\text{O(s)}$ is ice, $\text{H}_2\text{O(l)}$ is water, $\text{H}_2\text{O(g)}$ is steam, and NaCl(aq) is sodium chloride (table salt) dissolved in water.

Materials

A **ceramic** is a hard, brittle material that is made by firing a material, such as clay, at a high temperature. Ceramics also have similar chemical properties to each other. They do not react with water, acids, or alkalis.

A **polymer** is a substance with very long molecules. There are many polymers. Different polymers have different properties. Their properties make them suitable for their uses. Natural polymers include wool and rubber. Synthetic polymers include polyester and nylon.

A **composite** is a mixture of materials. Each material has different properties. The composite has properties that are a combination of the properties of the materials that are in it.

Metal extraction

Only very unreactive metals like gold and platinum are found as their metals themselves in nature. Most metals are found in compounds called minerals. Chemical reactions can be used to extract the metal element from its compound. Minerals that have enough metal in them to make it financially worthwhile to extract the metal are called ores.

Key words

Make sure you can write definitions for these key terms.

acid ceramic composite displacement reaction hydrogen material metal polymer reaction reactivity reactivity series salt state symbol

