C2 Chapter 3: Metals and acids
Knowledge organiser

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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.

sodium + water → sodium hydroxide + hydrogen

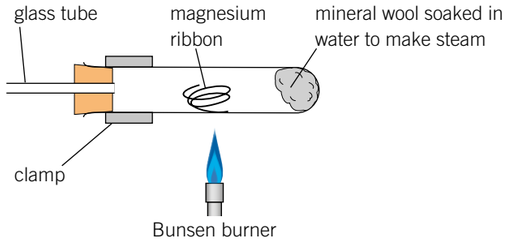
$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

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

magnesium + steam → magnesium oxide + hydrogen

$Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$

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	
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 reactivity series

Increasing reactivity

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

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, $H_2O(s)$ is ice, $H_2O(l)$ is water, $H_2O(g)$ is steam, and $NaCl(aq)$ is sodium chloride (table salt) dissolved in water.

Key terms Make sure you can write definitions for these key terms.

acid *displacement reaction* *metal* *reaction* *reactivity* *reactivity series* *salt* *state symbol*