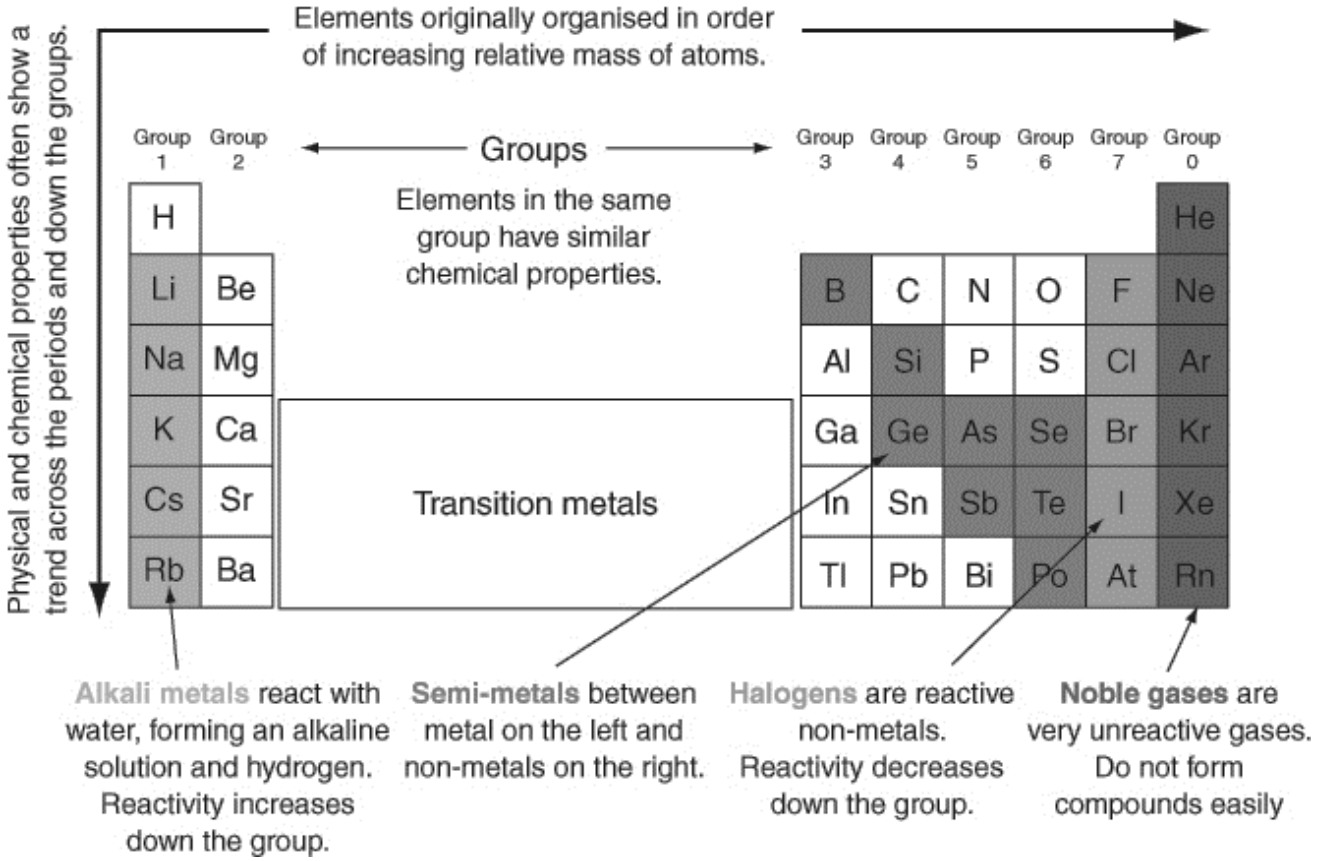
Summary Sheet Year 8 Metals and non-metals:

The periodic table

The **periodic table** arranges the elements so that elements with similar properties are in the same vertical **group**. The periodic table also allows us to spot trends and patterns.



Metals and non-metals

The common **properties** of most **metals** are:

- high melting and boiling points
- solids at room temperature
- strong and flexible
- shiny (when polished)
- good conductors of heat and electricity
- malleable (can be bent and shaped)
- ductile (can be stretched into wires)
- sonorous (make a ringing noise when hit)

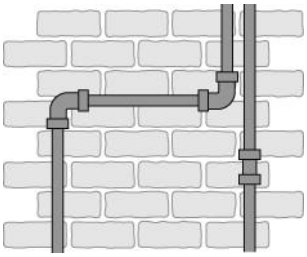
The common properties of most **non-metals** are:

- low melting point and boiling points
- many are gases at room temperature
- brittle (when solid)
- dull (not shiny)
- poor conductors of heat and electricity.

Summary Sheet Year 8 Metals and non-metals:

Uses of metals

Metals have many **uses** depending on their different **properties**. For example, copper is used in electrical wires as it is ductile and a good conductor of electricity. It is also used for roof sheets and water pipes as it is malleable and doesn't react with water.



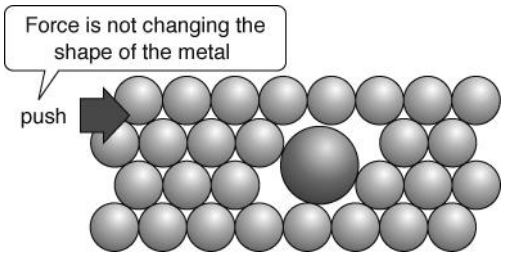
Alloys

Alloys are mixtures of metals with one or more other elements. Alloys have different properties from the pure metal and so can be more useful.

For example, steel, an alloy of iron, is stronger and does not rust as quickly.

Pure metals have a fixed, precise melting point where as alloys have a lower melting point and melt over a range of temperatures. Melting points can therefore be used to identify pure metals.

Alloys are usually also harder than pure metals because the different sized atoms disrupt the regular structure making it harder for the layers of atoms to slip over each other.



The properties of a substance are what it looks like or what it does. There are two types of properties:

- **chemical properties** (e.g. flammability, pH, reaction with acid)
- **physical properties** (e.g. melting point, boiling point, density).

Metal and non-metal oxides

Many elements burn in air/oxygen to form oxides; e.g.:

- calcium + oxygen → calcium oxide
- metal oxides tend to form alkaline solutions.
- carbon + oxygen → carbon dioxide
- non-metal oxides tend to form acidic solutions.

The chemical properties of metals

The **chemical properties** of metals refers to their reactions with other substances.

For example, metals can react with many non-metals:

e.g. calcium + chlorine → calcium chloride

(Note: When naming a compound the ending of the non-metal is changed to **_ide**)

Metals can also react with air (oxygen), water and acids. Some metals react very quickly; they are **reactive**. Calcium is a reactive metal. Other metals do not react quickly; they are **unreactive**. Gold is a very unreactive metal.

Summary Sheet Year 8 Metals and non-metals:

Metals as catalysts

Some metals act as **catalysts**. These are substances that speed up chemical reactions without being used up themselves. Catalysts have many uses, for example, platinum is used in catalytic converters in cars.

Oxidation of metals

The reaction of metals with oxygen forms **metal oxides**:

metal + oxygen → metal oxide

e.g. **word equation**: calcium + oxygen → calcium oxide

This is called an **oxidation** reaction.

Some metals like sodium react quickly with water and oxidise immediately when scratched. Other metals do not react easily, for example silver changes colour very slowly as it reacts with oxygen.

Rusting of Iron (Corrosion)

Corrosion is the weakening of a metallic structure caused by a reaction of the metal with oxygen. The corrosion of **iron** is called **rusting**. It destroys iron and steel structures because **rust** is weak and crumbly. Water and oxygen must be present for iron to rust.

iron + water + oxygen → iron hydroxide

Steel is an alloy containing iron mixed with small amounts of carbon and sometimes other metals. Iron and steel need air and water to rust. Salt makes them rust more quickly than usual.

Rusting can be prevented by:

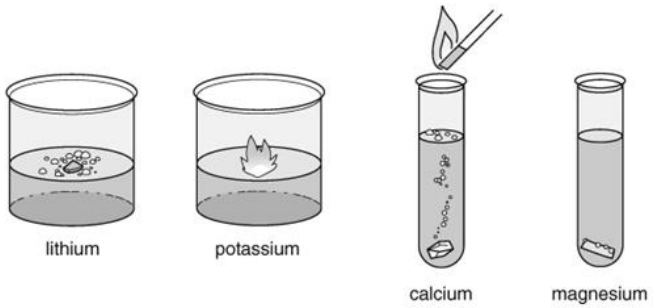
- a **physical barrier** to stop the air and water being in contact with the iron. Coating the iron with paint, plastic, etc. acts as a barrier to oxygen and water and stops iron rusting.
- **sacrificial protection**, in which blocks of a more reactive metal, such as zinc or magnesium, are attached to the iron. They then corrode instead of the iron.

Galvanising is coating the metal in zinc. The zinc acts like a physical barrier, but is also more reactive than the iron beneath so also protects the iron by sacrificial protection.

Summary Sheet Year 8 Metals and non-metals:

Metals and water

Some metals can react with cold water.



All the metals that react with water form a **metal hydroxide** (an alkaline solution) and **hydrogen** gas.

metal + water → metal hydroxide + hydrogen

The **test for hydrogen gas** is that **when lit** with a splint, it burns with a **'squeaky pop'**.

Again, the equations can be written using words or symbols:

sodium + water → sodium hydroxide + hydrogen

$2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$

Metals and acids

The metals that react with water react very quickly with acids. Some metals that don't react with water do react with acids.

When metals react with acids, they produce hydrogen and a salt.

metal + acid → salt + hydrogen

The name of the salt formed depends on the name of the acid:

- hydrochloric acid → chlorides
- sulfuric acid → sulfates
- nitric acid → nitrates

Again, the equations can be written using words or symbols:

magnesium + sulfuric acid → magnesium sulfate + hydrogen

$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

Other examples: zinc + hydrochloric acid → zinc chloride + hydrogen

calcium + nitric acid → calcium nitrate + hydrogen

Summary Sheet Year 8 Metals and non-metals:

Reactivity Series

The reactions of metals with oxygen, water and acids allows us to put the metals in order of reactivity:

Potassium, K

Sodium, Na

Lithium, Li

Calcium, Ca

Magnesium, Mg

Aluminium, Al

Zinc, Zn

Iron, Fe

Tin, Sn

Lead, Pb

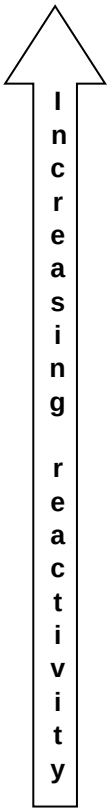
Copper, Cu

Mercury, Hg

Silver, Ag

Gold, Au

Platinum, Pt



Metal	Reaction with oxygen in air	Reaction with cold water	Reaction with dilute acid
potassium	🔥	🔥	explosive
sodium	🔥	✓✓✓	explosive
lithium	🔥	✓✓	✓✓✓
calcium	🔥	✓✓	✓✓✓
magnesium	🔥	✓	✓✓
aluminium	✓✓✓	●●●	✓✓
zinc	✓✓	●●●	✓✓
iron	✓✓	●●●	✓
tin	✓	●●●	✓
lead	✓	●●●	✓
copper	✓	✗	✗
mercury	●●●	✗	✗
silver	●●●	✗	✗
gold	✗	✗	✗
platinum	✗	✗	✗

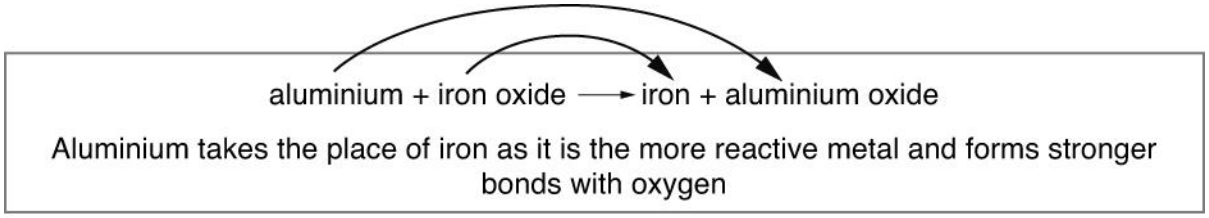
Key

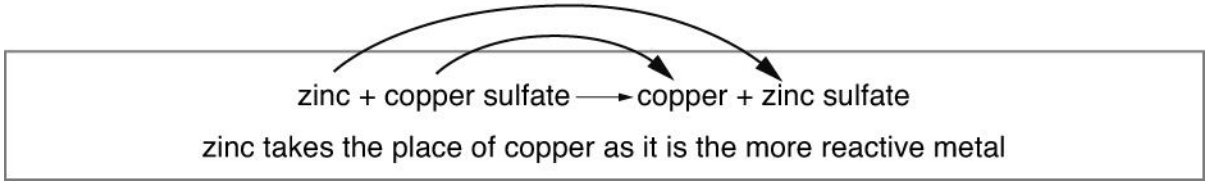
explosive	🔥 can catch fire	✓✓✓ reacts very quickly
✓✓ reacts quickly	✓ reacts	●●● slow or partial reaction
✗ no reaction		

The reactivity of metals can be linked to their uses. For example, metals used for building need to have a low reactivity, otherwise they will corrode away.

Displacement Reactions

In a **displacement reaction** a more reactive metal takes the place of a less reactive metal in a compound.





However: copper + magnesium sulfate → copper + magnesium sulfate (ie. no reaction)

The copper is less reactive than the magnesium so is unable to displace it