

Chemical Reactions

Keyword	Definition
Endothermic	Reactions that take in heat
Exothermic	Reactions that give out heat
Oxidation	Reaction of other elements with oxygen
Combustion	Burning fuel in oxygen
Thermal Decomposition	When a substance is broken down into 2 or more products by heat
Reactivity series	List of metals in order of reactivity
Displacement	A more reactive metal will displace a less reactive metal from its compound
Catalyst	A substance that increases the rate of a reaction but is not itself used up.
Polymer	Long chain molecules made up of many monomers.
Fuel	Contain hydrocarbons – compounds containing hydrogen and carbon atoms only.
Activation Energy	The minimum amount of energy that colliding particles must have for them to react

Further Reading:

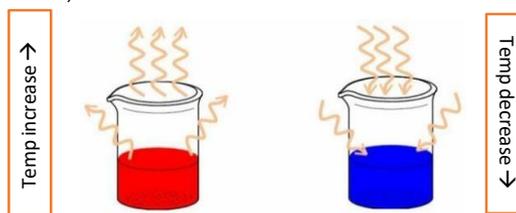
<https://www.bbc.com/bitesize/guides/zqd2mp3/revision/3>
<https://www.bbc.com/bitesize/articles/zcwxcj6>
<https://www.bbc.com/bitesize/guides/zqd2mp3/revision/5>
<https://www.bbc.com/bitesize/guides/zqd2mp3/revision/6>

Endothermic Reactions

In an endothermic reaction, thermal energy is taken in from the surroundings, therefore there is a temperature decrease. Thermal decomposition is an example.

Exothermic Reactions

In an exothermic reaction, thermal energy is given out to the surroundings, therefore there is a temperature increase. Combustion, oxidation and neutralisation reactions are all examples.



Combustion

Combustion is another name for burning. It is an example of an exothermic reaction. There are two types of combustion – complete combustion and incomplete combustion.

Complete Combustion

Coal, oil and gas are fuels. They contain hydrocarbons (compounds of hydrogen and carbon atoms only). When these fuels burn, it reacts with oxygen in the air to produce carbon dioxide and water vapour.



Incomplete Combustion

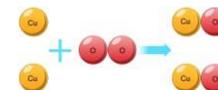
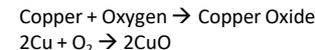
If there is not enough oxygen in the air for complete combustion, incomplete combustion will happen instead. This time either carbon monoxide is produced (a toxic gas which can lead to death) or carbon is produced (appears as soot and smoke which can cause breathing problems).



Oxidation Reactions

In an oxidation reaction, a substance gains oxygen. Metals and non-metals can take part in oxidation reactions.

Metals react with oxygen in the air to produce metal oxides. For example, copper reacts with oxygen to produce copper oxide when it is heated in the air.



Thermal Decomposition

Some compounds break down when heated, forming two or more products from one reactant.

Many metal carbonates can break down easily when it is heated:



Copper carbonate is green, copper oxide is black. We can test for carbon dioxide using limewater. Limewater is colourless, but turns cloudy when carbon dioxide is bubbled through it.

Reactivity Series

Some metals are very unreactive. This means they don't take part in chemical reactions. For example platinum. Some metals are very reactive and they take part in chemical reactions easily to form new substances.

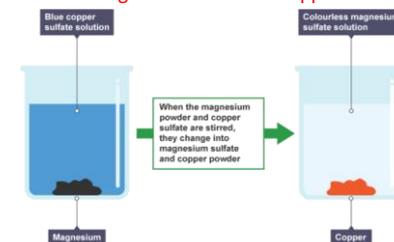


Displacement Reactions

Displacement reactions involve a metal and a compound of a different metal. In displacement reactions, a more reactive metal will displace a less reactive metal from its compound.



Magnesium is more reactive than copper, so it displaces (pushes out) the copper within the compound.

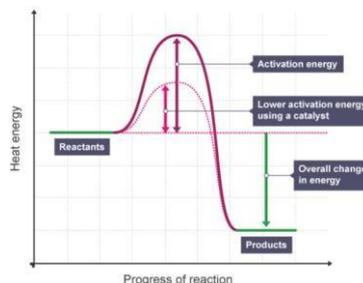


Catalysts

A catalyst is a substance that:

- Speeds up the rate of a chemical reaction
- Does not alter the products of the reaction
- Is unchanged chemically and in mass at the end of the reaction.

Catalysts provide an alternative reaction pathway that has a lower activation energy than the uncatalysed reaction.



Reactivity series

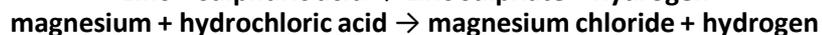
Key Terms	Definitions
Displacement reaction	Reaction where a more reactive substance will take the place of a less reactive substance in a compound
Electrolysis	The separation of a compound using an electrical current
Reduction	Reaction where oxygen is removed from a substance. It also means a gain in electrons.

Reactions of Metals

Acids react with most metals and a salt and hydrogen gas are produced. This is the general word equation for the reaction:



The salt produced depends upon the metal and the acid. Here are two examples:



Displacement reactions involve a metal and a compound of a different metal. In a displacement reaction a more reactive metal will displace a less reactive metal from its compounds. Displacement reactions are easily seen when a salt of the less reactive metal is in the solution. During the reaction:

- the more reactive metal gradually disappears as it forms a solution
- the less reactive metal coats the surface of the more reactive metal

Testing for different Gases

You need to know the following tests:

Hydrogen

A lighted wooden splint makes a popping sound in a test tube of hydrogen.

Oxygen

A glowing wooden splint relights in a test tube of oxygen.

Carbon dioxide

Bubble the test gas through limewater - calcium hydroxide solution. Carbon dioxide turns limewater cloudy white.

Ammonia

Ammonia has a characteristic sharp, choking smell. It also makes damp red litmus paper turn blue. Ammonia forms a white smoke of ammonium chloride when hydrogen chloride gas, from concentrated hydrochloric acid, is held near it.

Chlorine

Chlorine has a characteristic sharp, choking smell. It also makes damp blue litmus paper turn red, and then bleaches it white. Chlorine makes damp starch-iodide paper turn blue-black.

The Reactivity Series

In a reactivity series, the most reactive element is placed at the top and the least reactive element at the bottom. More reactive metals have a greater tendency to lose electrons and form positive ions.

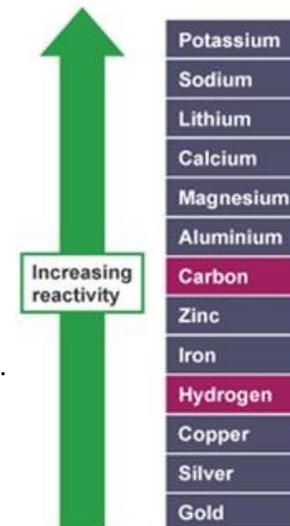
Observations of the way that these elements react with water, acids and steam enable us to put them into this series.

Metals are very useful. A **metal ore** is a rock containing a metal, or a metal compound, in a high enough concentration to make it economic to extract the metal.

The method used to extract metals from the ore in which they are found depends on their reactivity.

For example, reactive metals such as aluminium are extracted by *electrolysis*, while a less-reactive metal such as iron may be extracted by *reduction* with carbon or carbon monoxide.

Thus the method of extraction of a metal from its ore depends on the metal's position in the reactivity series.



The Periodic Table

Keyword	Definition
Periodic Table	A tabular representation of all known elements in order based on atomic number.
Atomic Number	The number of protons in the nucleus of an atom. Also called the proton number.
Periods	A horizontal row in the periodic table.
Groups	A vertical column in the periodic table containing elements with similar chemical properties.
Element	A substance made of only one type of atom.
Compound	A Substance where two or more elements have chemically joined together.
Mixture	Two or more substances that are not joined together. The substances can be elements, compounds or both.
Reactive	The tendency of a substance to undergo a chemical reaction.

Further Reading:

<https://www.bbc.com/bitesize/guides/z3vwxnb/revision/5>
<https://www.bbc.com/bitesize/guides/z84wixs/revision/1>

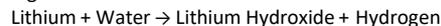
The periodic table is arranged in rows called periods and columns called groups. Groups contain elements with similar chemical properties.

Group 1 – Alkali Metals

Group 1 metals are very soft metals which can be cut with a knife. They have very low melting and boiling points and are very reactive compared to other metals. The elements become more reactive as you go down group 1.

When the group 1 metals react in water they produce a metal hydroxide and hydrogen gas.

E.g.



Group 2 – Alkali Earth Metals

Group 2 metals are reactive, but less reactive than group 1 elements.

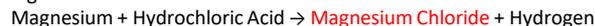
Group 2 metals react with acids to produce a salt and hydrogen. The name of the salt depends on the acid used.

Hydrochloric Acid – Chloride

Sulfuric Acid – Sulfate

Nitric Acid - Nitrate

E.g.



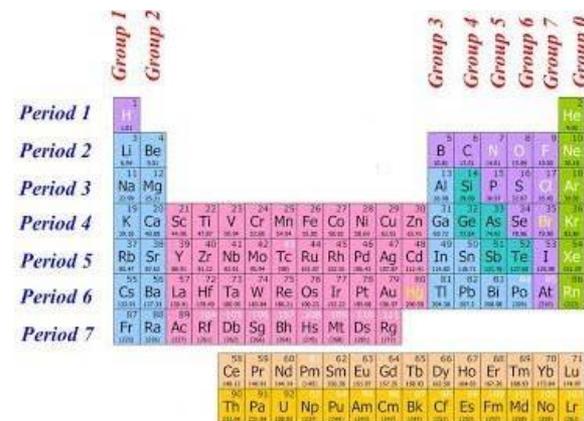
Group 2 metals become more reactive when you go down group 2.

Group 7 – The Halogens

Group 7 elements become less reactive when you move down the group. This can be shown as a displacement reaction.

Group 0 – The Noble Gases

Group 0 elements are not reactive. This is because the atoms have full outer shells.



Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Lithium - Li Sodium - Na Potassium - K	Beryllium – Be Magnesium – Mg Calcium - Ca	Boron – B Aluminium – Al Gallium – Ga	Carbon – C Silicon – Si Germanium – Ge	Nitrogen – N Phosphorus – P Arsenic – As	Oxygen – O Sulfur – S Selenium - S	Fluorine – F Chlorine – Cl Bromine - Br	Helium – He Neon – Ne Argon - Ar

Periodic table

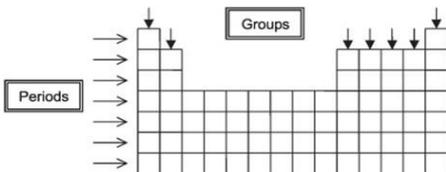
The periodic Table

All the different elements are arranged on the periodic table. The elements are arranged in order of increasing atomic number. On the periodic table, we can see the metal elements and non metal elements.

The section in the middle of the periodic table is known as the transition metals.

Groups and Periods

Elements are arranged on the periodic table in groups and periods. Horizontal rows are called periods and vertical columns are called groups.



Groups are labelled 1-7 from left to right, with last group being called either group 8 or 0. Elements in the same group have similar properties, because of this we can make predictions about trends.

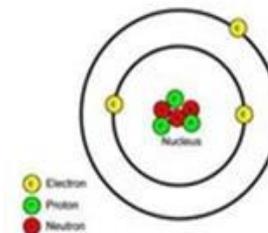
Key Terms

Definitions

Atom	Contains protons neutrons and electrons, and makes up all elements
Proton	A sub atomic particle with a positive charge
Electron	A sub atomic particle with a negative charge
Neutron	A sub atomic particle with a neutral charge
Atomic number	The number of protons in an atom

Structure of the Atom

- An atom is made up of three subatomic particles: protons, electrons and neutrons.
- Protons and neutrons are found in the nucleus of the atom (in the centre).
- Electrons are found orbiting the nucleus in shells (also known as *energy levels*).
- Protons have a positive charge.
- Electrons have a negative charge.
- Neutrons have a no charge.



Atomic Number and Mass Number

This is the total of protons + neutrons **Mass Number** → 23

This is the number of protons **Atomic Number** → 11

Na

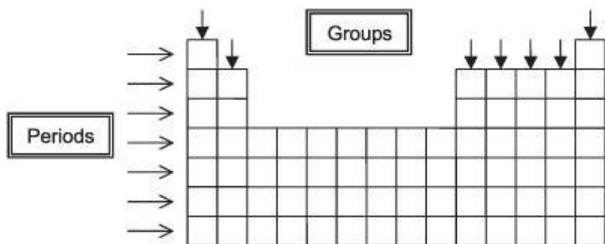
Therefore sodium has 11 protons, 11 electrons and $23 - 11 = 12$ neutrons.

Periodic table

Key Terms	Definitions
Group	The vertical groups of elements in the periodic table
Period	The horizontal groups of elements in the periodic table

Groups and Periods

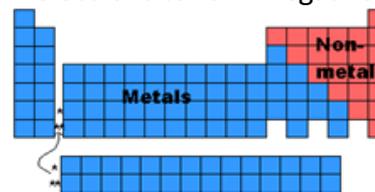
Elements are arranged on the periodic table in groups and periods. Horizontal rows are called periods and vertical columns are called groups.



Groups are labelled 1-7 from left to right, with last group being called either group 8 or 0. Elements in the same group have similar properties, because of this we can make predictions about trends. See the table below:

Metals and Non-Metals

- Metals are found on the left hand side of the periodic table, the majority of elements are metals.
- When metals react, they lose electrons to form positive ions.
- Non metals gain electrons to form negative ions.



- Properties of metals are, high density, high melting point (except mercury) and good conductors of heat and electricity.
- Only three metals are magnetic (iron, cobalt and nickel).
- Metals react with oxygen to make metal oxides e.g.
Magnesium + Oxygen → Magnesium Oxide

	Physical properties	Chemical Properties	Equation	Trends/Explanation
Group 1 (Alkali metals)	Soft, low density	React vigorously with water releasing hydrogen	Sodium + Water → Sodium Hydroxide + Hydrogen	More reactive as you go down, electron further from the nucleus easier to lose
Group 7 (Halogens)	Low melting point, exist as pair (Cl ₂)	React with group 1 metals to form compounds. Can carry out displacement reactions	Sodium + Chlorine → Sodium Chloride Sodium Bromide + Chlorine → Sodium Chloride + Bromine	Higher melting point as you go down the group (higher molecular mass). Less reactive as you go down the group.
Group 0 (Noble Gases)	Low melting point/boiling point Eight electrons in outer shell (except helium)	Unreactive	N/A	Higher melting point and boiling point as you go down the group (due to increase ion density)