

## Periodic table recap

The arrangement of the periodic table has changed.

### Early 1800s

- Arranged by **relative atomic mass**.
- Scientists had not yet discovered protons, neutrons or electrons.
- There were gaps for missing elements that had not been found yet.

### Dmitri Mendeleev

- Ordered mainly by **atomic mass**.
- Elements with similar properties in the same **group**.
- Gaps left for **elements** that hadn't been found yet.

### Modern Day

- In order of **increasing atomic mass**.
- Repeating patterns in the properties of the **elements**.
- **Metals** are on the left and **non-metals** are on the right.

**Properties of metals** - Ductile - Malleable  
- High melting and boiling point  
- Conduct heat - Conduct electricity

**Properties of non-metals** - Brittle  
- Insulators of heat and electricity  
- Not always solids - lower density

## Group 1: Alkali Metals

GROUP METALS

1	2				
Li	Be				H
Na	Mg				
K	Ca	Sc	Ti	V	
Rb	Sr	Y	Zr	Nb	
Cs	Ba	La	Hf	Ta	
Fr	Ra	Ac			

- The group 1 metals are known as the alkali metals
  - They form **alkaline solutions** when they react with water
- The group 1 metals are lithium, sodium, potassium, rubidium, caesium and francium and they are found in the first column of the periodic table
- The alkali metals share similar characteristic chemical properties because they each have one electron in their outermost shell
- Some of these properties are:
  - They are all **soft** metals which can easily be cut with a knife
  - They have relatively **low** densities and **low** melting points
  - They are **very reactive** (they only need to lose one electron to become highly stable)

## Physical Trends

- Apart from the chemical trends there are also patterns to be seen in the physical properties
- The alkali metals are **soft** and easy to cut, getting softer as you move down the group
- The first three alkali metals are less dense than water

## Group 1 reactions with water

Element	Reaction	Observations
Li	Lithium + Water $\longrightarrow$ Lithium hydroxide + Hydrogen $2\text{Li}(s) + 2\text{H}_2\text{O}(l) \longrightarrow 2\text{LiOH}(aq) + \text{H}_2(g)$	<ul style="list-style-type: none"> <li>◦ Relatively slow reaction</li> <li>◦ Lithium doesn't melt</li> <li>◦ Fizzing can be seen and heard as the lithium reacts</li> </ul>
Na	Sodium + Water $\longrightarrow$ Sodium hydroxide + Hydrogen $2\text{Na}(s) + 2\text{H}_2\text{O}(l) \longrightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$	<ul style="list-style-type: none"> <li>◦ Large amounts of heat released causes the sodium to melt</li> <li>◦ Hydrogen released catches fire and causes the ball of sodium to dash across the surface</li> </ul>
K	Potassium + Water $\longrightarrow$ Potassium hydroxide + Hydrogen $2\text{K}(s) + 2\text{H}_2\text{O}(l) \longrightarrow 2\text{KOH}(aq) + \text{H}_2(g)$	<ul style="list-style-type: none"> <li>◦ Reacts more violently than sodium</li> <li>◦ Enough heat released so hydrogen burns with a lilac coloured flame</li> <li>◦ Melts into a shiny ball that dashes around the surface</li> </ul>

## Group 0: Noble Gases

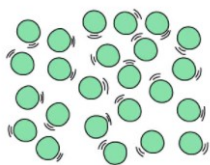
- The elements in group 0 of the periodic table are called the noble gases
- They are all non-metal, **monatomic** (exist as single atoms), **colourless**, **non-flammable** gases at room temperature
- The group 0 elements all have **full outer shells** of electrons; this electronic configuration is **extremely stable**
- Elements participate in reactions to complete their outer shells by losing, gaining, or sharing **electrons**
  - The Group 0 elements do not need to do this, because of their full outer shells which makes them unreactive and **inert**
- Other than helium which has 2 electrons in its outer shell, the noble gases have eight valence electrons (which is why you may see this group labelled "group 8")
- As with other groups, there are trends in the physical properties of the noble gases
- The noble gases have very **low melting** and **boiling** points
- They show an **increase** in boiling point as we move **down** the group due to an increase in the **relative atomic mass** (the atoms get larger as you move down the group)

NOBLE GASES

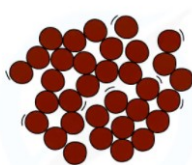
		0
		He
6	7	
O	F	Ne
S	Cl	Ar
Se	Br	Kr
Te	I	Xe
Po	At	Rn

## Group 7: Halogens

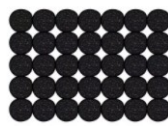
- The elements in group 7 are known as the halogens
  - These are fluorine, chlorine, bromine, iodine and astatine
- These elements are non-metals that are **poisonous**
- All halogens have similar reactions as they each have seven electrons in their outermost shell
- Halogens are **diatomic**, meaning they form molecules made of pairs of atoms sharing electrons (forming a single covalent bond between the two halogen atoms) such as  $F_2$ ,  $Cl_2$ , etc
- When halogen atoms gain an electron during reactions, they form  $-1$  ions called halide ions
  - The colours of the halogens also change as you descend the group - they become darker



CHLORINE



BROMINE



IODINE

Halogen	State & Appearance at Room Temperature	Characteristics	Colour in solution
Fluorine	Yellow gas	Very reactive, poisonous gas	-
Chlorine	Pale yellow-green gas	Reactive, poisonous and dense gas	Pale green
Bromine	Red-brown liquid	Dense red-brown volatile liquid	Orange
Iodine	Purple-black solid	Shimmery, crystalline solid, sublimates to form a purple vapour	Dark brown

## Energy Changes

Energy cannot be **created or destroyed**, you can only move it from place to place or change it to a different form of energy.

**Exothermic reactions** transfers energy to the surroundings. **The temperature of the surroundings increases.** This means the product molecules must have **LESS energy** than the reactant molecules.

Exothermic reactions include combustion, neutralisation and many oxidation reactions.

Uses: self-heating cans and hand warmers

**Endothermic reactions** absorb energy from the surroundings. **The temperature of the surroundings decreases.** This means the product molecules have **MORE energy** than the reactant molecules.

Endothermic reactions include thermal decompositions and the reaction of citric acid with sodium hydrogen carbonate.

Uses: sports injuries cold packs

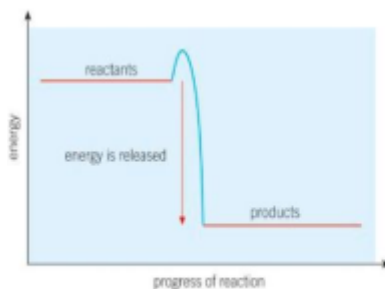


Figure 1 The reaction profile for an exothermic reaction

The reaction profile for exothermic shows the **products are at a lower energy level than the reactants**. This means when the reactants form the products, energy is transferred **TO the surroundings**. **The surroundings get warmer.**

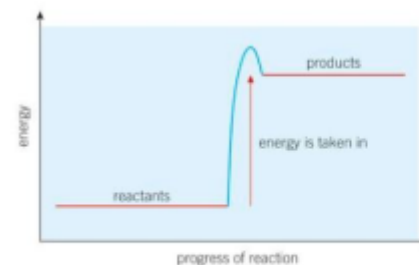


Figure 2 The reaction profile for an endothermic reaction

The reaction profile for endothermic shows the **products are at a higher energy level than the reactants**. This means when the reactants form the products, energy is transferred **FROM the surroundings**. **The surroundings get colder.**

Exothermic Reaction	Endothermic Reaction
Temp of surroundings INCREASES	Temp of surroundings DECREASES