The Periodic Table

The elements in the Periodic Table are arranged in order of increasing **atomic number**.

The **horizontal** rows are called **Periods**. The **vertical** columns are called **Groups**.

Elements in the same group have the **same number of outer shell electrons**, therefore they have **very similar chemical properties** – react in the same way.

Group number = number of outer shell electrons Period number = number of occupied shells

Metals are on the left hand side of the Periodic Table, non-metals are on the right.

Metals are good conductors of electricity and heat. Non-metals usually do not conduct electricity (except carbon and silicon).

Metals oxides are usually **basic** whereas **non-metal oxides** are usually **acidic**.

Group 1

Lithium
Sodium
Potassium

All have 1 outer shell electron.
They are relatively soft metals.
Melting point decreases down the group.
Density increases down the group.
Reactivity increases down the group.

Reaction with water: $2K + 2H_2O \rightarrow 2KOH + H_2$

Observations for sodium:

- Sodium floats and moves around on surface
- Melts into a ball
- Fizzing (hydrogen produced)
- Piece of sodium gets smaller

For lithium use words that imply that the reaction is less vigorous and for potassium that the reaction is more vigorous, e.g. K burst into flames

Reactions of alkali metals with water all involve the formation of a 1+ ion by the loss of the outermost electron. The outer electron (-) gets further from the nucleus (+) as you go down the group. This reduces the force of electrostatic attraction between the electron and the nucleus, making it easier to lose the outer electron as you go down the group. Therefore the alkali metals become more reactive as you go down the group.

Reactions with air: All the metals are stored in oil to prevent them reacting with air and water. The metals are shiny when freshly cut but tarnish rapidly in air due to the reaction of the metal with oxygen in the air.

Order of rate of tarnishing
Potassium (fastest) > sodium > lithium

Lithium can also react with nitrogen in the air to form lithium nitride (Li_3N)

Reaction with oxygen: $4K + O_2 \rightarrow 2K_2O$

Group 7

Chlorine
Bromine
Iodine

All have 7 outer shell electrons.
All form diatomic molecules – two atoms joined together by a covalent bond (X_2)
Colour gets darker down the group.
Melting point increases down the group.
Reactivity decreases down the group.

Element	Formula	State at 25 °C	Colour
Fluorine	F_2	gas	yellow
Chlorine	Cl_2	gas	Green
Bromine	Br_2	liquid	Red-brown liquid Orange-brown vapour
Iodine	I_2	solid	Grey solid purple vapour

The properties of other elements in Group 7 can be predicted from the properties of these elements, e.g. astatine will have a higher melting point than iodine and be darker in colour

Displacement reactions of halogens.
The more reactive halogen will displace the less reactive halogen from solution.
E.g. chlorine displaces bromine from solution.

Displacement reactions are REDOX reactions.

	$KCl_{(aq)}$	**$KBr_{(aq)}$**	**$KI_{(aq)}$**
$Cl_{2(aq)}$	No reaction	pale green to orange (bromine) $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$ Cl_2 is reduced and Br^- is oxidised	pale green to red/brown colour (iodine) $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$ Cl_2 is reduced and I^- is oxidised
$Br_{2(aq)}$	No reaction	No reaction	orange to red/brown colour (iodine) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$ Br_2 is reduced and I^- is oxidised
$I_{2(aq)}$	No reaction	No reaction	No reaction

Make sure you use the correct term – are you talking about a chlorine atom/molecule or a chloride ion?

The reactions between e.g. Cl_2 and KCl are not usually carried out as a halogen cannot displace itself from solution.

Explanation of the trend reactivity of halogens
In the displacement reactions halogens form 1- ions (halide ions).

- A chlorine atom is smaller than a bromine atom
- When an electron is added to the outer shell of a Cl atom it is closer to the nucleus and attracted more strongly by the nucleus than an electron added to the outer shell of bromine.
- Chlorine therefore has a stronger tendency to form a 1- ion.

Noble gases - in Group 0.

They all have a full outer shell of electrons and are therefore unreactive (inert). Because the outer shell of electrons is full they have no tendency to lose/gain/share electrons in a chemical reaction.