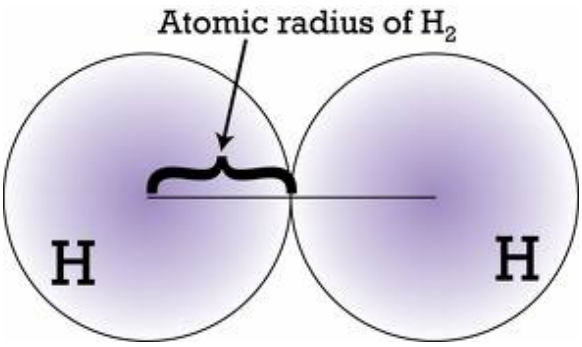
Name:

Chemical Bonding	**Objectives**
7. Trends in The Periodic Table	-define and explain atomic radius -explain the general trends in values of atomic radii (covalent radii only) • down a group • across a period (main group elements only) -define and explain first ionisation energy -explain how chemical properties of elements depend on their electronic structure -explain how atomic radius, screening effect and nuclear charge account for general trends in properties of elements in groups I and VII -recognise the trends in electronegativity values down a group and across a period -explain the general trends in electronegativity values • down a group • across a period

Trends in Atomic Radii:

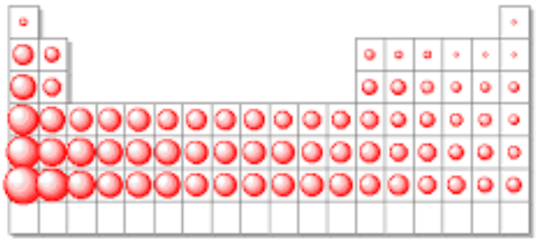
Def^n^: The **atomic radius** of an atom is defined as half the distance between the nuclei of two atoms of the same element that are joined by a single covalent bond.



The values of the atomic radius increases going down groups in the periodic table.

Reasons:

1. Each time we move down the periodic table we add an extra energy level further away from the nucleus, making it bigger.
2. With these extra energy levels further from the nucleus as we move down the periodic table, the **screening effect** of the inner electrons reduces (cancels out) the pull the positive nuclear charge has on the outer electrons.



The values of the atomic radius decreases going across periods in the periodic table.

Reasons:

1. The effective nuclear charge of the nucleus increases going across a period (more positive charge as we have more protons in the nucleus), which pulls the outer electrons closer to the nucleus.
2. No increase in screening effect as all elements in the same period have the same outer energy level.

Trends In Electronegativity:

The values of electronegativity decrease going down groups in the periodic table.

Reasons:

1. Increasing atomic radius. This means that as you go down a group, the atom gets bigger, meaning that the atom has a weaker pull on electrons in a bond as they are further away.
2. The Screening Effect of the inner electrons increases going down a group. This reduces the pull that the nucleus has on outer electrons involved in bonding.

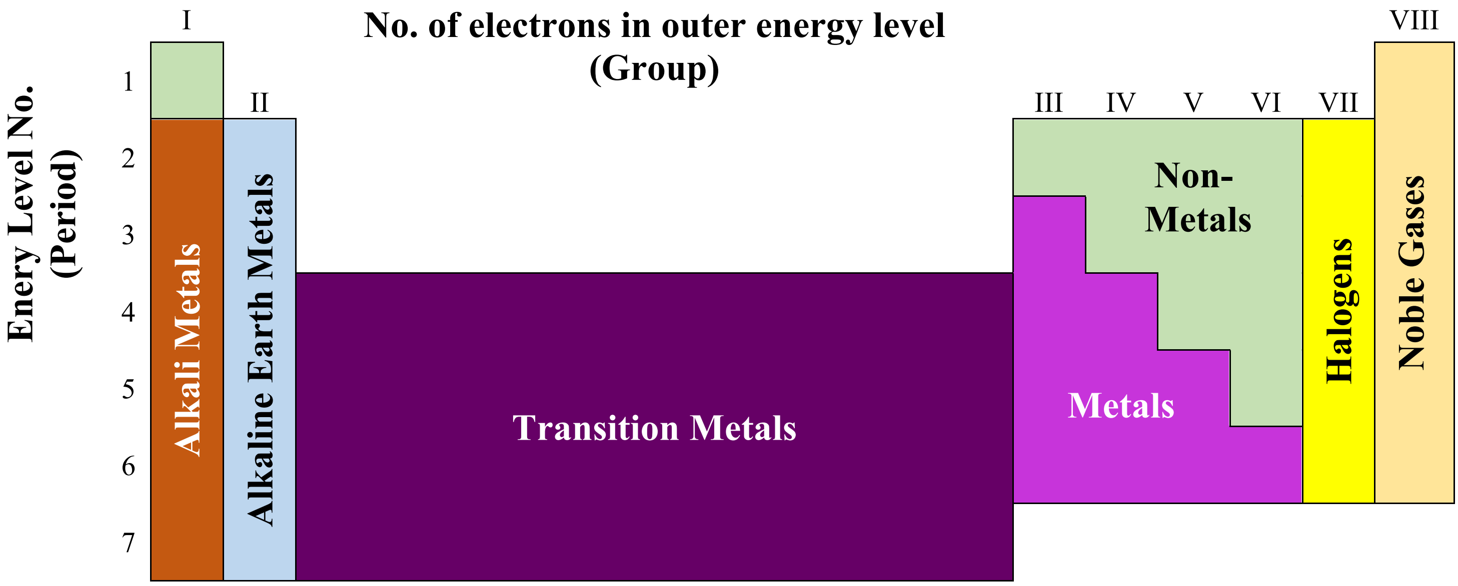
The values of electronegativity increase going across periods in the periodic table.

Reasons:

1. Increasing effective nuclear charge. This increases the pull of the nucleus on the outer electrons involved in bonding.
2. Decreasing atomic radius. As you go across a period, atomic radius gets smaller, meaning that the nucleus is closer to the outer electrons involved in bonding. This results in the nucleus having a stronger pull (attraction) on the outer bonding electrons.

Trends Within Groups:

The names of certain groups in the priodic table need to be known. They are shown below:



Trends in the Alkali Metals (Group I):

All Alkali Metals are very reactive because the have only 1 electron in their outer energy level, which is easy to remove as can be seen by their Ionisation Energies.

Trend: The chemical reactivity of the Alkali Metals increases going *down* the group.

Reasons:

1. As you go down the group, you add an extra energy level further from the nucleus with every step down. This increases the screening effect on the inner electrons, making the outer electron easier to remove.
2. By adding an extra energy level with each step down, we also increase the atomic radius, reducing the pull that the nuclear charge has on the outer electron, making it easier to remove.

Important Reactions with Alkali Metals:

1. **Reaction with Oxygen (O_2):**
   All Alkali Metals react with oxygen to form oxides:

$$2K + \tfrac{1}{2}O_2 \rightarrow K_2O$$

Potassium + Oxygen → Potassium Oxide

Any other Alkali Metal can replace the Potassium in this reaction.

Notes:

- This reaction is the reason why Alkali Metals are stored under oil – so they wont react with oxygen in the air.
- This reaction causes Alkali Metals to lose their shiny colour when exposed to air – the oxides are dull.

2. **Reaction with Water (H_2O):**
   All Alkali Metals react with water vigourously to form hydroxides and Hydrogen gas (H_2):

$$Na + H_2O \rightarrow NaOH + ½H_2$$

Sodium + Water → Sodium Hydoxide + Hydrogen

   Any other Alkali Metal can replace the Sodium in this reaction.

Notes:

- This reaction demonstrates the increasing reactivity of the Alkali Metals going down a group. Potassium reacts much more vigourously with water than Lithium does.

Trends in the Halogens (Group VII):

All Halogens are very reactive because they only need 1 extra electron to fill their outer energy level.

Trend: The reactivity of the Halogens increases going *up* the group.

Reason:

1. The Halogens are the most electronegative of all elements. The values of their electronegativities increase going up the group, meaning that the higher up the group we go, the greater the pull they have on electrons, making it easier for them to react and fill their outer energy level.