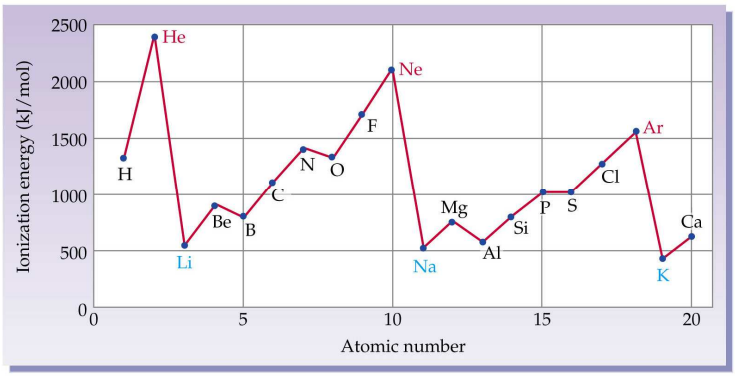
The first Ionisation energy of the elements



The shape of the graph for periods two and three is similar. A repeating pattern across a period is called **periodicity**.

The pattern in the first ionisation energy gives us useful information about electronic structure

You need to carefully learn the pattern in the 3rd period Na → Ar

Q. Why has Helium the largest first ionisation energy?

A. Its first electron is in the first shell closest to the nucleus and has no shielding effects from inner shells. He has a bigger first ionisation energy than H as it has one more proton

Many questions can be answered by application of the 3 factors that control ionisation energy

Q. Why do first ionisation energies decrease down a group?

A. As one goes down a group, the outer electrons are found in shells further from the nucleus and are more shielded so the attraction of the nucleus becomes smaller

Q. Why is there a general increase in first ionisation energy across a period?

A. As one goes across a period the electrons are being added to the same shell which has the same distance from the nucleus and shame shielding effect. The number of protons increases, however, making the effective attraction of the nucleus greater.

Q. Why has Na a much lower first ionisation energy than Neon?

This is because Na will have its outer electron in a 3s shell further from the nucleus and is more shielded. So Na's outer electron is easier to remove and has a lower ionisation energy.

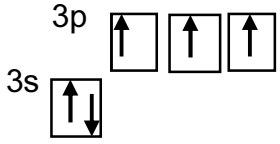
Q. Why is there a small drop from Mg to Al?

Al is starting to fill a 3p sub shell, whereas Mg has its outer electrons in the 3s sub shell. The electrons in the 3p subshell are slightly easier to remove because the 3p electrons are higher in energy and are also slightly shielded by the 3s electrons

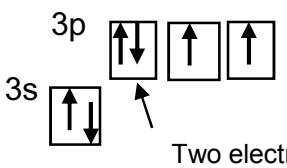
Learn carefully the explanations for these two small drops as they are different to the usual factors

Q. Why is there a small drop from P to S?

With sulphur there are 4 electrons in the 3p sub shell and the 4th is starting to doubly fill the first 3p orbital.
When the second electron is added to an orbital there is a slight repulsion between the two negatively charged electrons which makes the second electron easier to remove.



phosphorus $1s^1\ 2s^2\ 2p^6 3s^2 3p^3$



Two electrons of opposite spin in same orbital

sulphur $1s^1\ 2s^2\ 2p^6 3s^2 3p^4$