

Electron configurations

We describe most chemical changes in terms of a rearrangement of electrons. It's therefore crucial to have an accurate understanding of the **arrangement of electrons (the electron configuration)** in atoms and ions. Electron configurations give us insight into the bonds that atoms are likely to form and the relative stability of ions.

Building on earlier concepts

You will be familiar with electron configurations such as **2,8,1** for an atom of **sodium** from your pre-16 chemistry course. This means two electrons in the first shell, eight in the second shell and one in the third shell. What may not have been as clear is that **shells** are the allowed **energy levels** of electrons. The **first shell** has the **lowest energy** and the energies **increase** as the electrons get **further away** from the positively charged nucleus.

Refining the model

Because electrons have **wavelike properties** (as well as some particle-like properties) they can only have the energy allowed by the various standing waves possible around the nucleus in the atom. When we look closely, we find that all shells but the first are subdivided into different energy levels called **subshells** with different shaped **orbitals**. The second shell is divided into two subshells – s and p. The third shell is divided into three subshells – s, p and d.

Energy levels are filled lowest energy first, so the electron configuration of sodium can be represented as **1s², 2s², 2p⁶, 3s¹**. **Orbitals** are the **regions in space** in which we are likely to find electrons. The drawings of these regions are usually the **95% probability** contour line, ie the electrons in the orbital spend 95% of their time within the boundary drawn. Each orbital can contain just two electrons, which have to have **opposite spin** from each other:

Subshell	Number of orbitals in subshell	Maximum number of electrons in subshell
s	1	2
p	3	6
d	5	10
f	7	14

This explains aspects of the **periodic table** – sodium is in the **s-block**, which is two elements wide. The **p-block** is six elements wide – these are all elements with their highest energy electrons in the **p subshell**.

As the shells increase in energy, so the number of subshells increases:

Shell	Subshells	Number of electrons
1	s	2
2	s, p	8
3	s, p, d	18

This explains why the periodic table gets wider towards the bottom.