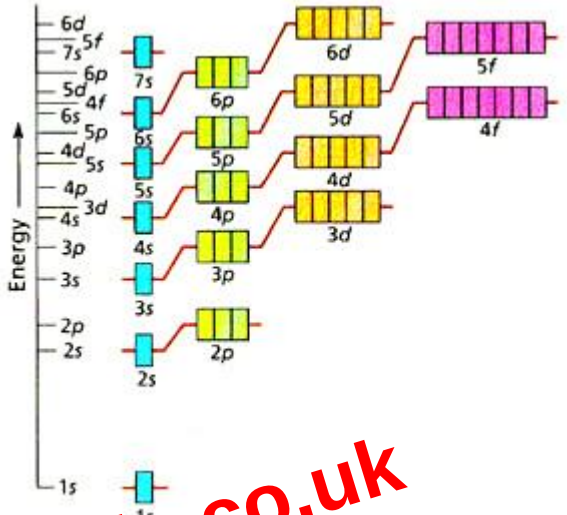
Electron Configurations

The arrangement of electrons in an atom is known as the atom's **electron configuration**. Because atoms of different elements have different numbers of electrons, a unique electron configuration exists for the atoms of each element. The lowest-energy arrangement of the electrons for each element is called the element's *ground-state electron configuration*.

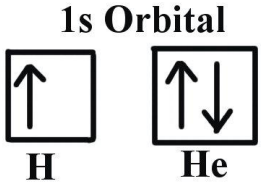
Rules Governing Electron Configurations

To build up electron configurations for the ground state of any particular atom, first the energy levels of the orbitals are determined. Then electrons are added to the orbitals one by one according to three basic rules.

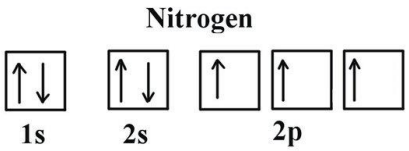


The first rule shows the order in which electrons occupy orbitals. According to the **Aufbau principle**, *an electron occupies the lowest-energy orbital that can receive it*. The orbital with the lowest energy is the 1s orbital. The 2s orbital is the next highest energy, then the 2p orbitals. Starting with the third main energy level, n=3, the energies of the sublevels in the different main energy levels begin to overlap.

The second rule reflects the importance of the spin quantum number. According to the **Pauli Exclusion Principle**, *no two electrons in the same atom can have the same set of four quantum numbers*. The principal, angular momentum, and magnetic quantum numbers specify the energy, shape, and orientation of an orbital. The two values of the spin quantum number reflect the fact that for two electrons to occupy the same orbital, they must have opposite spins states.



According to the Pauli Exclusion Principle, an orbital can hold two electrons of opposite spin states. Helium, each arrow represents one of the atom's two electrons. The direction of the arrow indicates the electron's spin state.



The figure shows how 3 electrons fill the p sublevel of a given main energy level according to Hund's rule.

The third rule requires placing as many unpaired electrons as possible in separate orbitals in the same sublevel. In this way, electron-electron repulsion Is minimized so that the electron arrangements have ht lowest energy possible. According to **Hund's rule**, *orbitals of equal energy are each occupied by one electron before any orbital is occupied by a second electron, and all electrons in singly occupied orbitals must have the same spin state*.

Representing Electron Configurations

Three methods, or notations, are used to indicate electron configurations, which will be discussed later. IN a ground-state hydrogen atom, the single electron is in the lowest energy orbital, the 1s orbital. The electron can be in either one of its two spin states.

Orbital Notation

In orbital notation, an unoccupied orbital is represented by a line, ___, with the orbital's name written underneath the line. An orbital containing on electron is represented as ↑__. An orbital containing two electrons is represented as , showing the electrons paired and with opposite spin states. The lines are labeled with the principal quantum number and sublevel letter.