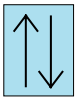


1*s* orbital

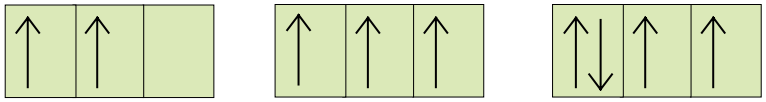
FIGURE 17 According to the Pauli exclusion principle, an orbital can hold two electrons of opposite spin states. In this electron configuration of a helium atom, each arrow represents one of the atom's two electrons. The direction of the arrow indicates the electron's spin state.

occupy a 3*d* orbital.) Once the 3*d* orbitals are fully occupied, which sublevel will be occupied next?

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 spin states (see **Figure 17**).

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 the 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.* Applying this rule shows, for example, that one electron will enter each of the three *p* orbitals in a main energy level before a second electron enters any of them. This is illustrated in **Figure 18.** What is the maximum number of unpaired electrons in a *d* sublevel?

FIGURE 18 The figure shows how (a) two, (b) three, and (c) four electrons fill the *p* sublevel of a given main energy level according to Hund's rule.



(a) (b) (c)

Representing Electron Configurations

Three methods, or notations, are used to indicate electron configurations. Two of these notations will be discussed in the next two sections for the first-period elements, hydrogen and helium. The third notation is used mostly with elements of the third period and higher. It will be discussed in the section on third-period elements.

In a ground-state hydrogen atom, the single electron is in the lowest-energy orbital, the 1*s* orbital. The electron can be in either one of its two spin states. Helium has two electrons, which are paired in the 1*s* orbital.

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 one 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