Electron Configuration and the Periodic Table

Periods and Blocks of the Periodic Table

While the elements are arranged vertically in the periodic table in groups that share similar chemical properties, they are also organized horizontally in rows, or periods. The length of each period is determined by the number of electrons that can occupy the sublevels being filled in that period. Also, the period of an element can be determined from the element's electron configuration. Based on the electron configurations of the elements, the periodic table can be divided into four blocks, the s, p, d, and f blocks.

The s-Block Elements: Groups 1 and 2

The elements of the s block are chemically reactive metals. The Group 1 metals are more reactive than those of Group 2. The outermost energy level in an atom of each Group 1 element contains a single s electron. *The elements of Group 1 of the periodic table (lithium, sodium, potassium, rubidium, cesium, and francium) are known as the* **alkali metals**. In their pure state, all of the alkali metals have a silvery appearance and are soft enough to cut with a knife, however, because they are so reactive, alkali metals are not found in nature as free elements. They combine vigorously with most nonmetals. They react strongly to water to produce hydrogen gas and aqueous solutions of substances known as alkalis. Because of this, they are usually stored in kerosene.

The elements of Group 2 of the periodic table (beryllium, magnesium, calcium, strontium, barium, and radium) are called the **alkaline-earth metals**. Atoms of alkaline-earth metals contain a pair of electrons in their outermost s sublevel. Consequently, the group configuration for Group 2 is ns . The Group 2 metals are harder, denser, and stronger than the alkali metals. They also have higher melting points. Although they are less reactive than the alkali metals, the alkaline-earth metals re also too reactive to be found in nature as free elements.

Hydrogen and Helium

Hydrogen has an electron configuration of 1s , but despite the ns configuration, it does not share the same properties as the elements of Group1. Although it is located above the Group 1 elements in many periodic tables, hydrogen is a unique element, with properties that do not closely resemble those of any group.

Like the Group 2 elements, helium has an ns group configuration. Yet it is part of Group 18. Because its highest occupied energy level is filled by two electrons, helium possesses special chemical stability, exhibiting the unreactive nature of a Group 18 element. The group 2 metals have no special stability; their highest occupied energy levels are not filled because each metal has an empty available p sublevel.

The d-Block Elements: Groups 3-12

For energy level n, there are n possible sublevels, so the d sublevel first appears when n = 3. This 3d sublevel is slightly higher in energy than the 4s sublevel, so these are filled in the order of 4s3d. This order of filling is also seen for higher values of n. Each d sublevel consists of five orbitals with a maximum of two electrons each, or up to 10 electrons possible in each d sublevel. Group 3 elements each have one electron in the d sublevel of the (n-1) energy level. The group configuration for Group 3 is therefore (n - 1)d ns . Atoms of the Group 12 elements have 10 electrons in the d sublevel plus two electrons in this sublevel. The group configuration for Group 12 is (n – 1)d ns .

Notice, however, that in each case the sum of the outer s and d electrons is equal to the group number.

The d-block elements are metals with typical metallic properties and are often referred to as **transition elements**. They are good conductors of electricity and have a high luster, and typically less reactive than the alkali metals and the alkaline-earth metals.