CONCEPT 3

The periodic table shows how properties of elements change in predictable ways.

Activity

On Trend

What does the term *trend* mean to you? Write a brief definition. How have you seen the term used in the news media and on social media? How is your life influenced or affected by trends?

periodic trend a regular variation in the properties of elements based on their atomic structure

In chemistry, the term **periodic trend** refers to a regular variation in the properties of elements based on their atomic structure. The periodic table is a powerful tool for analyzing such trends because it can help you see and compare variations in groups and periods. One trend that can be analyzed in this way is atomic size.

Atomic Size Trends

Figure 2.20 compares the sizes of atoms of each main-group element. Observe the sizes of the atoms in each group and period.

1. *Atomic size increases moving down a group.* As you move down a group in the periodic table, elements have atoms with increasing numbers of energy shells. The greater the number of shells, the farther the valence electrons are from the nucleus, and therefore the larger the atom is.

2. *Atomic size decreases moving left to right across a period.* Elements have increasing numbers of electrons in their valence shells as you move left to right across a period. And yet the atomic size *decreases*. Why? As you move from left to right in a period, the number of occupied valence shells stays the same, but the number of protons in the nucleus increases. The attraction between each valence electron and the nucleus increases because a greater positive charge on the nucleus pulls more strongly on the negatively charged electrons. As a result, the valence electrons are pulled more tightly towards the nucleus.

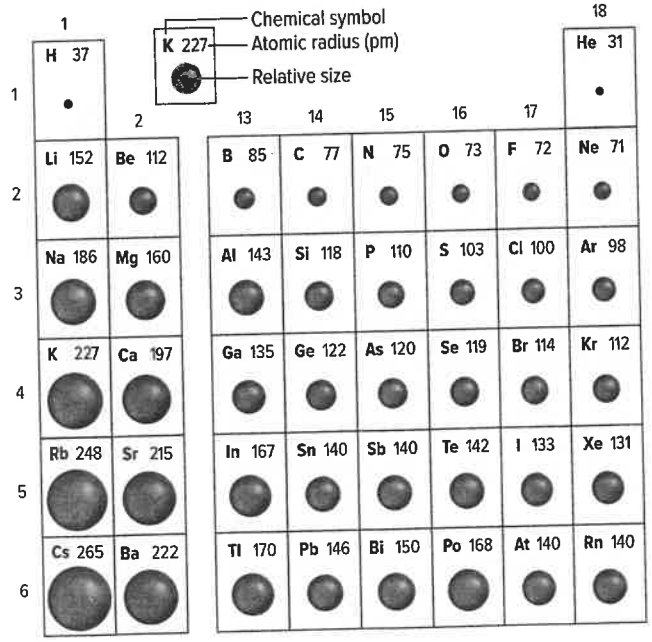


Figure 2.20 Atomic size is represented here by the sizes of the spheres. The number under each element is the radius of the atom in picometres (pm). One picometre is equal to 1/1 000 000 000 000 m.

Metal Reactivity and Atom Size

Figure 2.21 compares what happens when potassium and sodium are added to water. As you can see, the reaction is more vigorous and violent for the potassium. In other words, potassium is more reactive than sodium. Why is this the case? They are both in Group 1, and both have one valence electron. The difference is that a potassium atom is larger than a sodium atom. A potassium atom's valence electron is farther away from the nucleus than the sodium atom's valence electron. As a result, the pull of the nucleus is weaker, and the electron is easier to remove. That is what makes potassium more reactive.

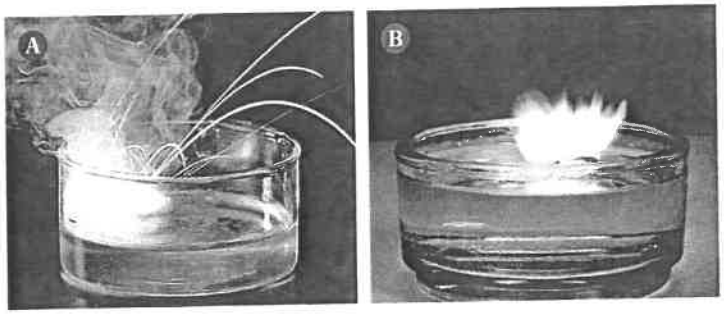
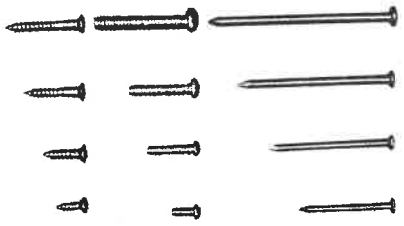


Figure 2.21 Potassium Ⓐ is more reactive than sodium Ⓑ because less energy is needed to remove the valence electron from potassium.

Activity

Recognizing Trends

The periodic table makes it easy to see trends in atomic properties such as atomic size. Can you use a similar arrangement to reveal trends in the characteristics of everyday objects?



1. Obtain a sample of fasteners, including nails, bolts, and screws.
2. Measure the length of each nail with a ruler.
3. Use a balance to measure the mass of each nail.
4. Place the nails in a series from smallest to largest.
5. Continue to arrange a series of screws and a series of bolts that also correspond to the series of nails created in Step 4.
6. Make a table listing the length and mass of each fastener according to its position.
7. Describe the following:
   a) the trend in mass as you go from left to right across each row
   b) the trend in mass as you go down each column of the table
8. Analyze your organization of the fasteners, and explain any other trends that you find in the table.
9. Describe how you could make a similar "periodic table" of another type of familiar item.

Before you leave this page . . .

1. Explain why atoms get larger down a group on the periodic table.
2. Explain why atoms get smaller from left to right across a period on the periodic table.
3. Explain why an alkali metal is more reactive than an alkaline-earth metal in the same period.