

## 6.2 Review Questions (p. 309)

1. The regular and predictable changes in elemental properties as we move across a period or down a chemical family in the periodic table are known as periodic trends.
2. The quantum mechanical model tells us that the outer boundaries of an atom are not hard and definite, but rather are the edges of charge clouds enclosing the regions of highest probability of finding an atom's outer electrons.
3. Ionization energy and electronegativity both increase as we move left to right across a period and move up a chemical family in the periodic table.
4. As we move in any direction horizontally across a period or vertically in a chemical family, the trend in atomic size is generally opposite to the trends seen in ionization energy and electronegativity.
5. The valence electrons of both lithium and fluorine are in the second energy level and as a result, those valence electrons experience a similar amount of electron shielding. Because fluorine's nucleus has six more protons, the effective nuclear charge ( $Z_{\text{eff}}$ ) seen by fluorine's valence electrons is much greater than that experienced by lithium's single valence electron. As a result, fluorine atoms are smaller than lithium atoms.
6. The largest atoms are located in the lower left region of the periodic table and the smallest atoms are located in the upper right region of the periodic table.
7. (a) A cation will always be smaller than its parent neutral atom because of increased attraction of the outer electrons for the nucleus and decreased repulsion of the electrons for each other.  
  
(b) An anion will always be larger than its parent neutral atom because of decreased attraction of the outer electrons for the nucleus and increased repulsion of the electrons for each other.
8. Inner or "core" electrons are effective at shielding the outer electrons from the attractive force of the nucleus and exerting a repulsive force on those outer clouds. As the extent of that shielding increases, (which occurs when descending a chemical family), the atomic sizes increase and the ionization energies decrease.

9.

Where on the Periodic Table Elements Show:	
Largest Atomic Radii	lower left
Smallest Atomic Radii	upper right
Lowest Ionization Energy	lower left
Highest Ionization Energy	upper right
Lowest Electronegativity	lower left
Highest Electronegativity	upper right

10. Lithium's electron configuration is  $1s^2 2s^1$ . Lithium's single valence electron is shielded from the nuclear charge by the inner or core  $1s^2$  electrons. It is therefore relatively easy to remove that outer electron and so we see that the first ionization energy is low. After that electron is removed however, the next electron removed is an inner core electron, which is not shielded at all from the nuclear charge. As a result, lithium's second ionization energy is approximately 14 times greater than the first ionization energy!

11. When such reactions occur, elements with low ionization energies and low electronegativities will tend to lose valence electrons to elements whose ionization energies and electronegativities are high.

12. When such reactions occur, elements with high ionization energies and high electronegativities will tend to gain valence electrons from elements whose ionization energies and electronegativities are low. *(The results of the reactions described in questions 11 and 12 will be the formation of cations by atoms losing valence electrons and the formation of anions by atoms gaining valence electrons.)*

13. When two non-metal atoms, each with relatively high ionization energies and electronegativities react, as both attract their valence electrons strongly and neither have a tendency to lose them, they are likely to form bonds by sharing valence electrons rather than by transferring them.

14. Electron configuration for nickel:  $[\text{Ar}] 3d^8 4s^2$   
Electron configuration for zinc:  $[\text{Ar}] 3d^{10} 4s^2$

Notice that when the electron configurations are written in order of increasing sublevel size, rather than increasing energy, we see that zinc has a filled 3d sublevel with 2 more electrons in the inner 3d cloud than nickel. These 2 additional electrons increase the effective shielding of zinc's 2 outer electrons and thus reduce the attractive force they feel from the nucleus. As a result, zinc atoms are larger than nickel atoms.