Atomic Theory 1.9

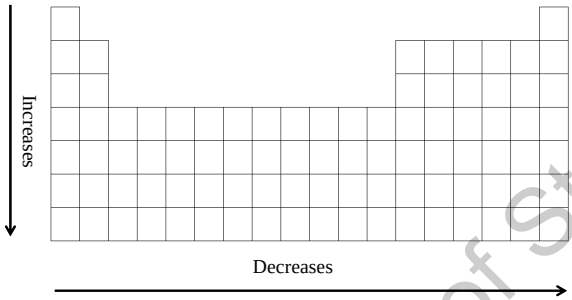
Periodicity
Atomic and Ionic Radii
Ionization Energy
Electron Affinity
Electronegativity

Periodicity

Predictable physical and chemical trends that occur as one moves across a period or down a group in the periodic table.

- Atomic radii
- Ionic radii
- Ionization energies
- Electron affinities
- Electronegativity

Atomic Radius



Atomic Radius

Down a Group

- New shells are added (the principal quantum number increases)
- Valence electrons have more energy and are further from the nucleus.

Left to Right Across a Period

- Valence electrons are in the same shell.
- Moving from left to right, more protons are added.
- This increases the forces of attraction experienced by the electrons, thereby decreasing the radius.

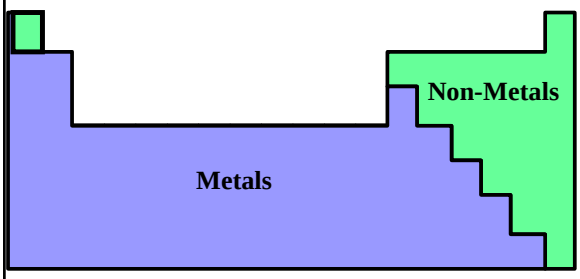
Ion Formation

Metals lose electrons to form cations.

$K \rightarrow K^+ + e^-$

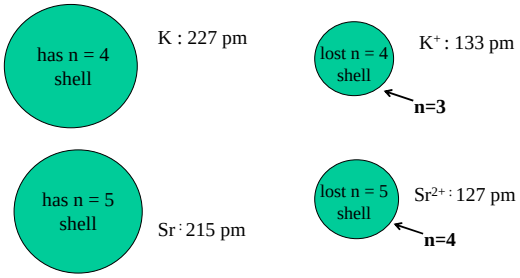
Non-metals gain electrons to form anions.

$Cl + e^- \rightarrow Cl^-$



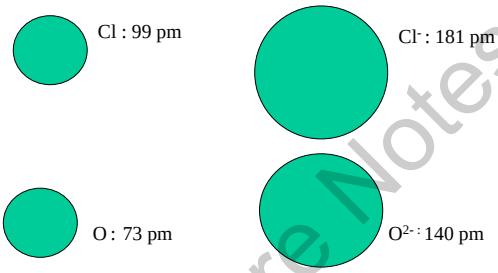
Ionic Radius

Cations are smaller than neutral atoms.



Ionic Radius

Anions are larger than neutral atoms.



Ionic Radius

Down a Group

- Radii increase as the principal quantum number increases.

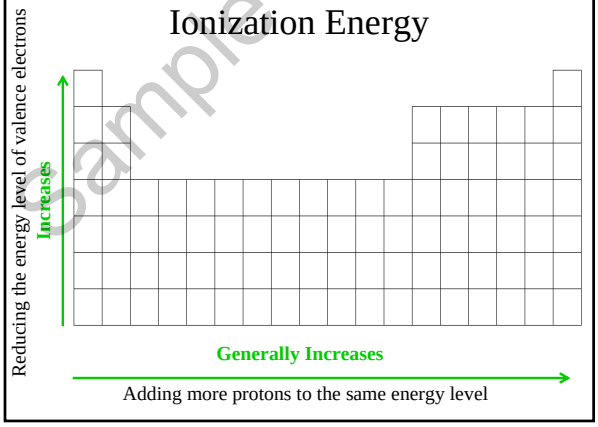
From Left to Right Across a Period

- The radii of cations decrease as the effective nuclear charge increases.
- When you encounter the first anion, the radius increases dramatically, then the radii continue to decrease.

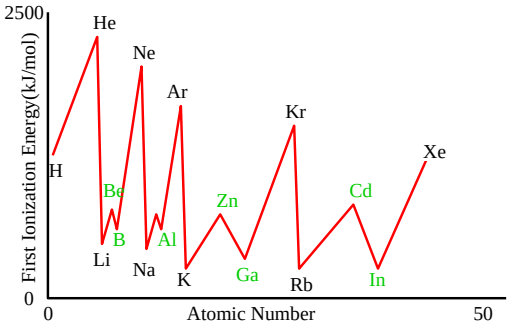
Ionization Energy
Ionization Potential

- The amount of energy that is required to remove an electron from a gaseous atom that is in its ground state.
- Energy must always be added to remove an electron.

Ionization Energy



Ionization Energy



Ionization Energy

- Generally increases as atomic radii decrease.
  - Due to the stronger force of attraction between protons and valence electrons.
- It requires more energy to pull an electron from a full d-subshell than it does to pull the only electron in a p-subshell (when in the same period).
- It requires more energy to pull an electron from a full s-subshell than it does to pull the only electron in a p-subshell (when in the same period).
  - That single electron is easier to remove, as it is the only electron in the higher energy subshell.
  - That single electron has much more energy than the electrons in the full subshell of the previous element.

Ionization Energy

- The second ionization potential for an atom is always greater than the first.
  - The radius is reduced after the first electron is removed, and the ratio of protons (positive charges) to electrons (negative charges) increases.
- Every element had one extremely large increase in ionization energy.
  - This occurs when the electron configuration drops a principal quantum number, causing the radius to shrink much more than other ionizations.

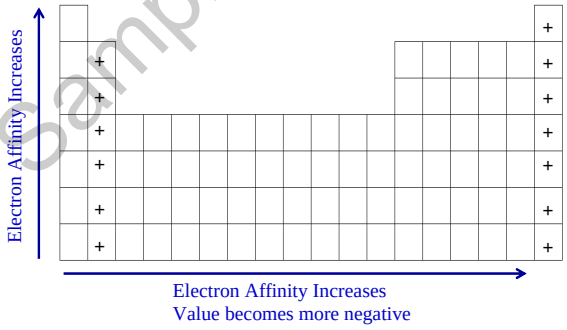
Electron Affinity

- The energy change that occurs when an electron is added to a gaseous atom to form a negative ion.
- It is a measure of how much an element wants to accept another electron.

Electron Affinity

- If the value is negative it releases energy.
  - It wants to accept the electron.
  - The more negative the more it wants to accept
- If the value of positive it requires energy.
  - It does not want to accept the electron.

Electron Affinity



Electronegativity

- An elements ability to attract electrons in a chemical bond
- The electrons will spend more time around the more electronegative element in a chemical bond.