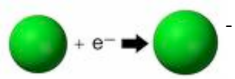
# Reactive Reactions and Formulas

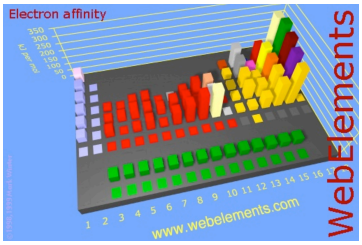
How Electron Affinity and Ionization Energies and Atomic Radii—Understanding Chemical Formulas and Chemical Equations

## Ionization Energy

- Ionization Energy is the energy required to remove an electron from an atom or ion
- Ex: Na → $Na^+ + e^-$
- Electron Affinity the amount of energy released when an electron is added to an ion or element.
- Ex: $Cl_2 + 2e^- \rightarrow 2Cl^-$




## Atomic Radii and Electron Affinity




One follows the other, both reflect increase in pull of electrons toward the nucleus of an atom. Chlorine has the highest electron affinity of its period.

## Ionization Energy

When radii are larger, the force holding the outer electrons to the atom is generally less than that when the radii are smaller. Na has one of the lower ionization energy so tit is fairly easy to remve electrons.

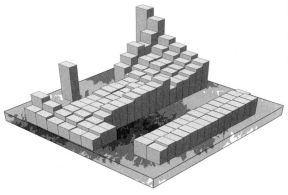


FIG. 6.

The kingdom plotted in terms of the ionization energies of the elements. This view is from the southwest. The three highest peaks in the distance are fluorine, neon, and helium.

## How does this relate to the reaction between $Cl_2$ and Na?

- Alone neither element would become an ion.
- But when the are together the fact that the chlorine is eager for the electron and the sodium not that attached to it leads to dramatic reaction.
- There is a bit more to it, there are other things driving the reaction, but the ability of Cl to accept electrons and Na to give them is key to these.

## Both Chlorine and Sodium are Quite Reactive

- Na is not stable under room condition
  - It reacts with oxygen and with water readily
  - Must be stored under oil
- $Cl_2$ is very reactive.
  - It causes lethal harm to organisms
  - And reacts with many of the things it comes in contact with.

## For Comparison

- Elemental Boron does form compounds-but not not a problem under normal conditions. Its crystals do not react with HF or HCl.
- Elemental carbon is useful but pretty stable.
- Elemental Nitrogen is often useful because of its tendency to not react, and is often described as inert.
- Oxygen burns readily, and reacts readily with many metals to form oxides, though the reactions do not tend to be dramatic.

## Alkali Earth Metals and Chlorine Reactivities

- Quantum mechanics has explained the pronounced reactivity of these 2 groups, and using similar reasoning can explain why reactivity increase as atomic numbers increase for Alkali Earth Metals while reactivity for the Halogens decreases as atomic numbers increase.
- Be sure that you can explain the trends with in these groups by yourself.

## $MgCl_2$, $CaCl_2$, etc.

- There are other periodic trends in these groups that are not explained simply by referencing trends in atomic radii.

$2Na + Cl_2 \rightarrow 2NaCl$

$Mg + Cl_2 \rightarrow MgCl_2$

- Electronic Configurations can be used to explain this difference too, but first, what exactly is meant by NaCl, Cl2, MgCl2 and the extra numbers?