

What causes reactivity of elements

- All atoms want to have a completely full valence shell (normally 8 electrons).
- For the moment we will only concentrate on main group elements
- Noble gases are already full.
- Elements that are really close, desperately want to get there (halogens and alkali), and tend to be the most reactive.

Gaining electrons

- metals lose electrons, nonmetals gain electrons and metalloids can go either way is a loose rule.
- Obviously the quickest way for something that has more than 4 electrons to get to 8 is to gain electrons (through chemical bonds).
- halogens want to gain 1, oxygen group wants to gain 2, nitrogen group wants to gain 3.

Losing Electrons

- Metals will gain a full valence shell by losing electrons.
- (there is a full shell underneath unless it is hydrogen)
- alkali will lose 1 electron, alkaline earth will lose 2 etc.

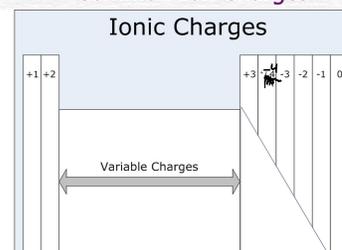
Vocabulary

- Ion- charged atom or molecule
- Something becomes an ion by gaining or losing electrons (not protons)
- anion-negatively charged ion
- A Negative ION**
- Caused by gaining electrons
- cation-positively charged ion
- ca⁺ion
- Caused by losing electrons

charges on groups

- Alkali metals want to lose 1 electron.
- alkali metals form ions with a +1 charge
- Write this as Na⁺ or K⁺
- alkaline earth- Ca²⁺ Mg²⁺
- halogens want to gain one electron
- Cl⁻ or Br⁻
- oxygen group wants to gain 2
- O²⁻ or S²⁻

Common Ion Charges



Ions are completely different from the element of the same name

- Valence electrons are mainly responsible for chemical/physical properties.
- alkali metals are so reactive because they "want" to get rid of that electron.
- An ion is the element after it got rid of the electron.
- Therefore the atom is nowhere near as reactive as it used to be.
- This is like comparing the ashes from a stick of dynamite to the stick of dynamite.

So are ions like noble gases?

- No, ions are not the same as noble gases
- valence electrons are mainly responsible for chemical/physical properties but not solely responsible. Protons and neutrons still have a role.
- When K loses an electron or Cl gains an electron it has the same number of electrons as Ar, however protons and neutrons are different.
- so K⁺, Cl⁻, and Ar are different things, even though they have the same number of electrons.

charges also affect properties

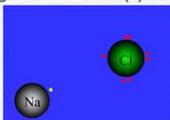
- Ar is neutral so it would be unaffected by a positive or negative charge.
- Cl⁻ is attracted to a positive charge and repelled by a negative charge.
- K⁺ would be attracted by a negative charge and repelled by a positive charge.

Ionic Bonding

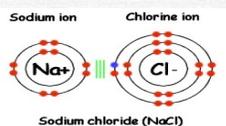
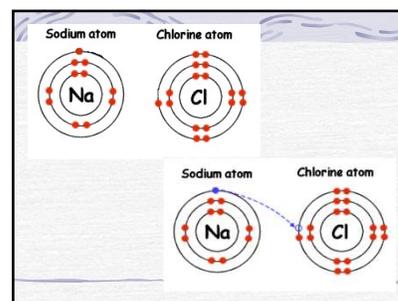
- ☞ a metal will have an ionic bond with a nonmetal
- ☞ Something from the left bonding with something from the right

What are ionic bonds?

- ☞ ionic bonding- a transfer of electrons
- ☞ something gives up electron(s)
- ☞ something takes electron(s)



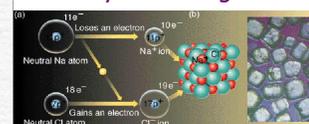
- ☞ for NaCl
- ☞ Na give an e^- ; Cl takes that e^-



What holds them together?

- ☞ bond implies they are stuck together, but there is nothing shared between them.
- ☞ Ionic bonds are held together by electromagnetic force (opposites attract)
- ☞ so Na^+ is attracted to Cl^-
- ☞ when large amounts get together they stack in a crystal arrangement

Crystal Arrangement



There isn't exactly an ionic "molecule", just a ratio of loose ions stacked together. This is sometimes called a **formula unit**.

How strongly are they held together?

- ☞ An ionic bond is the weakest bond that is considered a bond
- ☞ ionic bonding is only an attraction between particles
- ☞ However the attraction is strong enough to call it a bond
- ☞ *there are other attractive forces between particles that are not bonds

Salts

- ☞ salt does NOT just mean table salt NaCl
- ☞ salts are any of 1000's of ionic crystalline solids
- ☞ road salt is $CaCl_2$ (you don't want to eat this)
- ☞ salt- ionic compounds resulting from an acid-base reaction