Bonding

Bonding can occur in 2 ways:

1. Electron transfer (ionic)
2. Electron sharing (covalent)

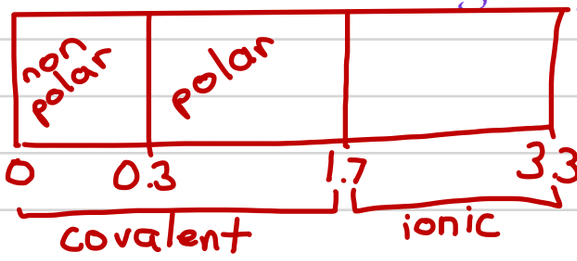
1. Ionic bonding - chemical bond resulting from the attraction of positive and negative ions

Cation- positive ion (these are predominately metals)
Anion- negative ion (these are predominately non metals)

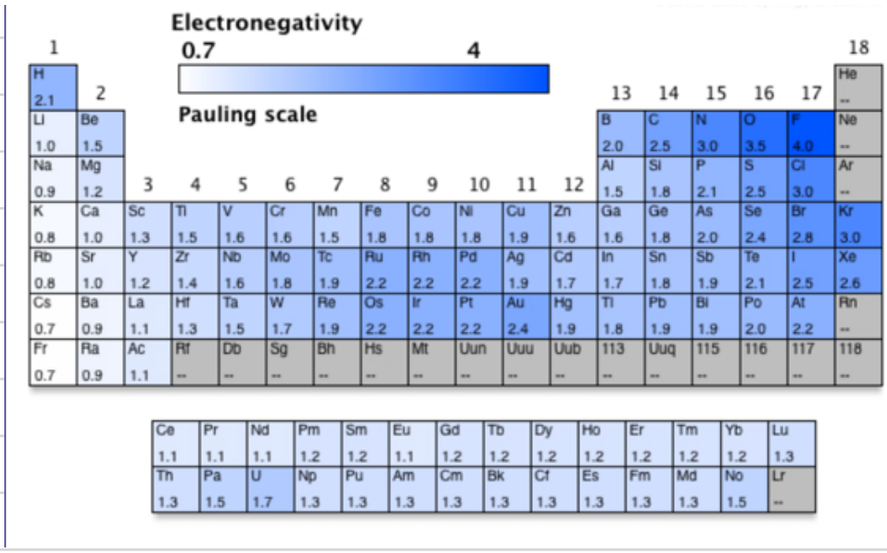
*most frequently, ionic bonds are made up of a metal and a non metal.

2. Covalent bond- chemical bond resulting from sharing e-.
   - group 14, 15, and Hydrogen tend to share.

Differences in electro negativity determine bond types.



The biggest # takes the e- and is δ-. Only applies for polar covalent bonds.



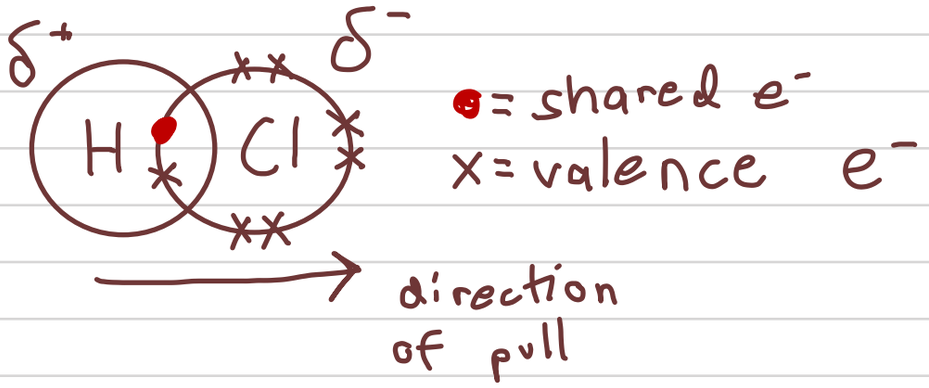
δ = partial charge

↓ review

http://www.chemguide.co.uk/atoms/bonding/electroneg.html

Polar Bonds

- to share e-, orbitals must overlap.



Hydrogen has hardly any (-) charge
Chlorine has most of (-) charged particles because Cl has a higher e value.

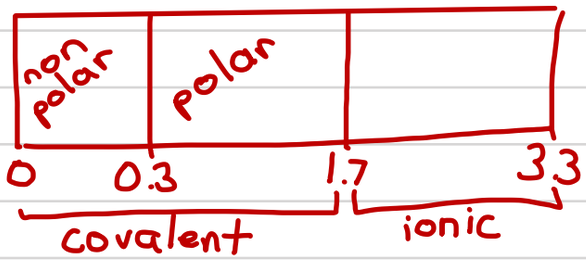
Sometimes, covalent bond can form in which the sharing is so unequal, charged ends result and the bond is called polar covalent (oppositely charged poles).

Ionic Compounds

- similar bonding methods lead to similar properties
- characteristics of ionic compounds
  - hard
  - high m.p.
  - conduct electricity in solution
  - no odor
  - soluble in water

- covalent bonds occur between nonmetals
- nonmetals share to complete their outer shell (octet rule)

Can a bond be polar but a molecule be nonpolar?

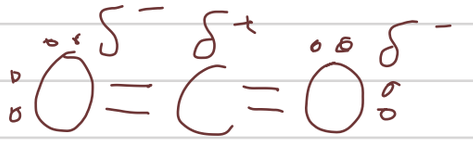


CO_2

3.5 − 2.5 = 1

O − C = polar

To be a polar molecule, opposite ends must have opposite charges.



nonpolar molecule

Answer:

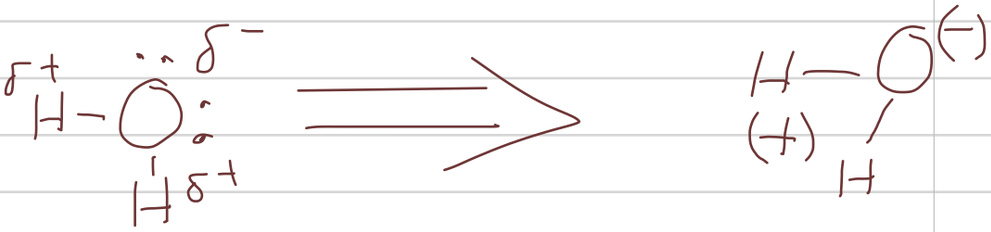
- Polar bonds occur when atoms share e-, but the e- spends more time in the electron cloud of the atom with the higher e value.
- Polar molecules are molecules who's opposite ends have opposite charges. Bonds do not matter when accounting for molecule type.

2.1 3.5

H_2O

= 1.4

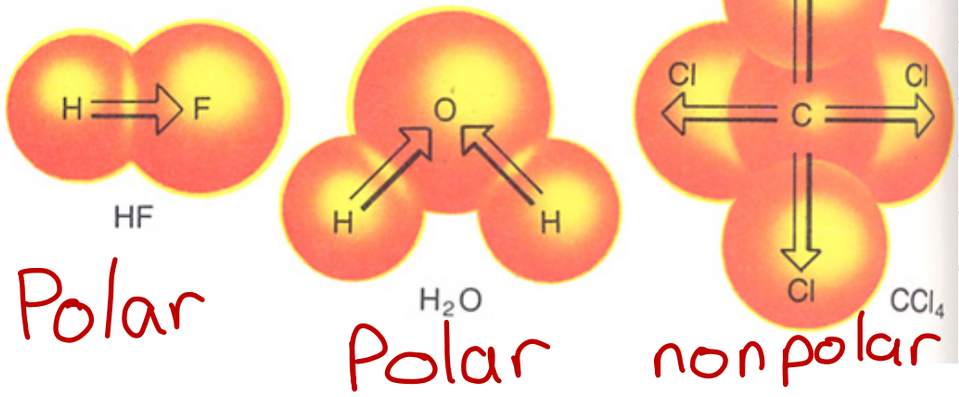
polar bond



The above molecule is polar because one end (O) has a δ- charge and the other end (H2) has a δ+ charge.

Polar Molecules

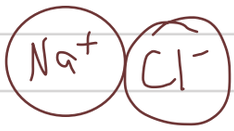
FIGURE 14-1. Both HF and H_2O are polar molecules because the arrangement of polar bonds is not symmetrical. The CCl_4 molecule is nonpolar in spite of the fact that it contains four polar bonds.

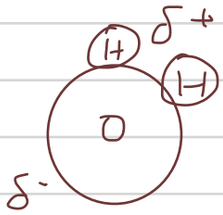


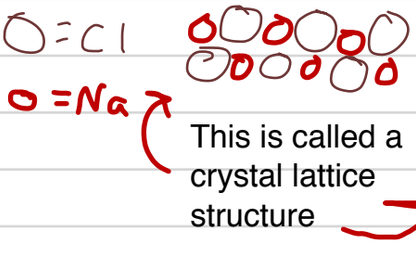
Polar Polar nonpolar

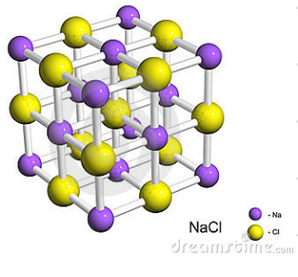
How water dissolves salt (dissociation)

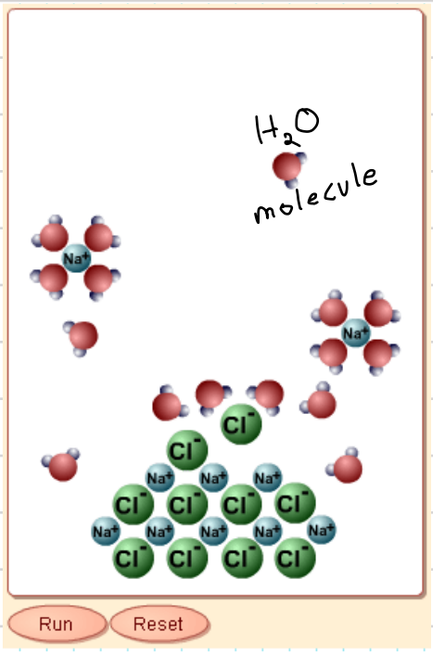
Water is polar covalent and salt is ionic, so they both have opposite ends.



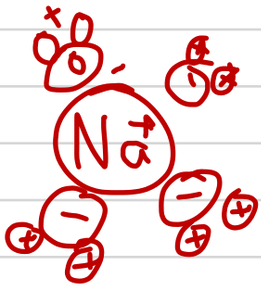


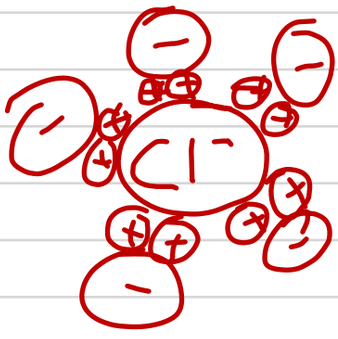






The positive (H) ends of H2O molecules are attracted to the (-) Cl, just as the (-) O end of H2O surround th e (+) Na. When Na and Cl are surrounded by enough opposite charge (Na=>O, Cl=>H), enough force is present to break the ionic bonds of salt and pull the Na or Cl away from the crystal lattice structure. The Na and Cl ions are now considered to be "hydrated" because they are surrounded by H2O molecules. The dissolving, or dissociation, ends when there are not enough H2O molecules to break any more of the bonds in NaCl. When this happens, the salt settles out on the bottom and the solution is called saturated.





An increase in the temperature of the solvent can dissolve more solute because the space in between molecules increases, so there's more room for molecules (such a NaCl or sugar).

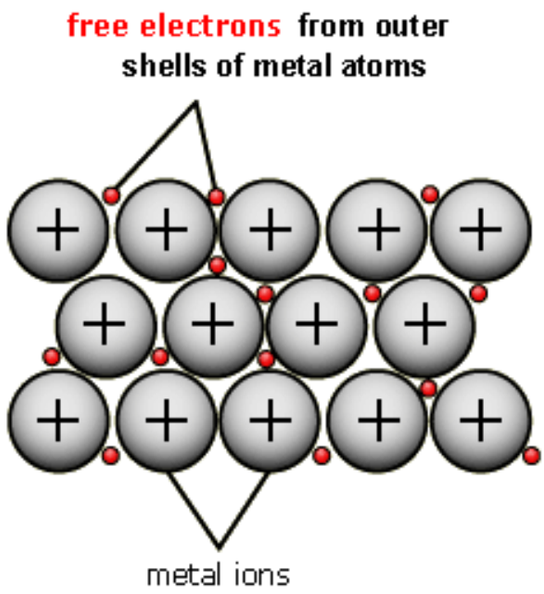
Metallic Bonds

Ionization energy- the amount of energy required to remove e- from an atom

Metallic bond- a chemical bond resulting from the attraction between positive ions and surrounding, mobile e-.

Properties of metals:

- shiny
- conduct electricity
- high MP
- low ionization energy
- ductile (able to be drawn into wire)
- malleable (able to be pounded into sheets)
- tend to give away e-



Metals are tightly packed and have very few valence e-. Since the atoms are so close, e- can easily jump from atom to atom.

When the e- jump, it is called electron dislocation.

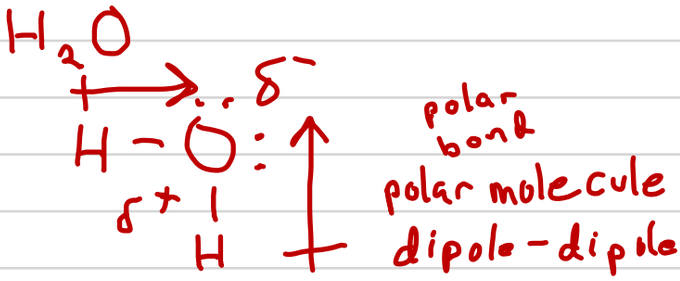
E- dislocation is made possible because metals have very low electronegativity values as well as a low IE (ionization energy).

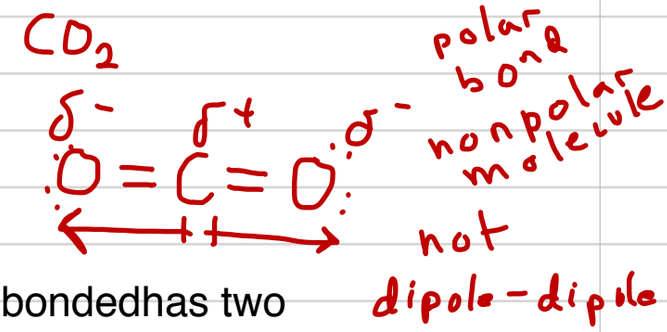
Intermolecular Forces

These are forces of attraction between two already-bonded molecules

There are three types of intermolecular forces:

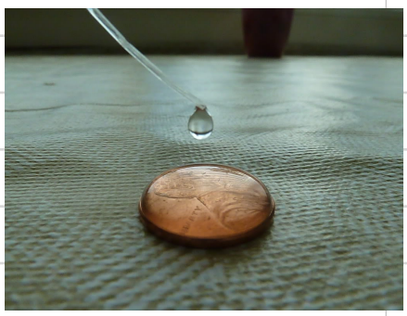
1. Dipole-dipole (needs polar covalent bond and polar molecule)
   - this bond is caused when the unequal sharing of e- creates equal but oppositely charged ends separated by a dipole.





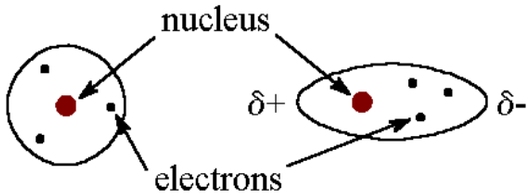
*Note that when a molecule that is ionically bondedhas two opposite poles, it is called a crystal lattice structure instead of dipole-dipole.

2. Hydrogen bonding (special type of dipole-dipole)
   - this intermolecular force is the attraction between a hydrogen atom and a strongly electronegative atom such as F, N, O, or Cl together in a molecule.
   - this type of bond explains surface tension and cohesion of water. The positive (H) ends of water are attracted to the negative (O) ends, causing them to



Surface tension is caused by hydrogen bonding of the H2O molecules

3. London Dispersion Forces (vanDerWaals forces)
   - this force is present in everything and becomes stronger in atoms with more e-.
   - based on the idea that e- in any molecule are in constant motion, so at any given instant, the e- distribution may be uneven, causing a temporarily induced dipole.



*One dipole can induce a dipole in neighboring atoms

symmetrical distribution

unsymmetrical distribution