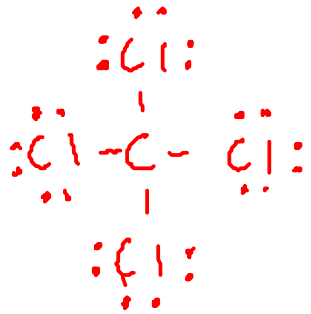
Examples:

CCl_4

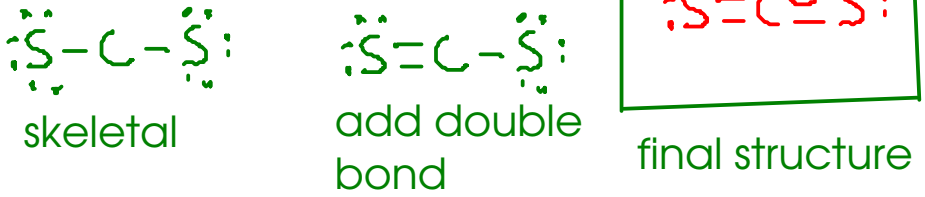
C: 1 x 4
Cl: 4 x 7 = 28
32 e⁻



Shape? The central atom has four other atoms bonded to it, which gives the TETRAHEDRAL shape!

CS_2

C: 1 x 4
S: 2 x 6
16 e⁻



skeletal

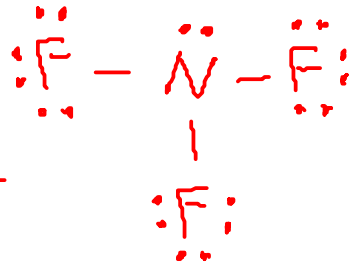
add double bond

final structure

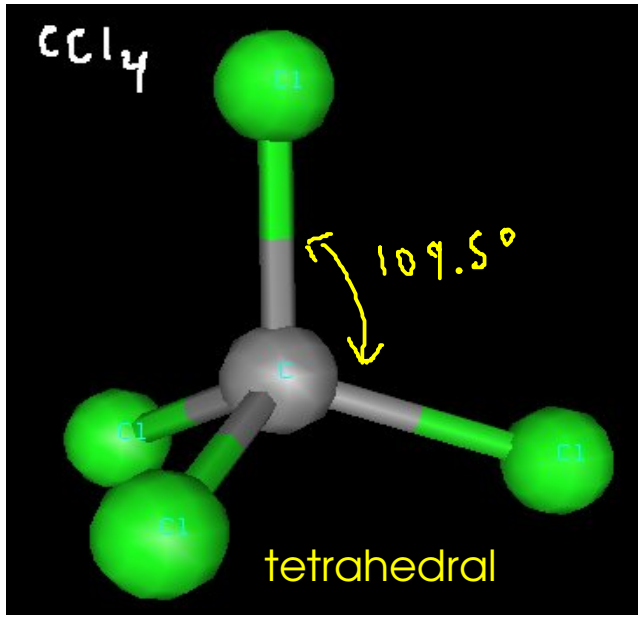
Shape? Since there are ony two things attached to the carbon center, they can get 180 degrees apart, giving us a LINEAR molecule.

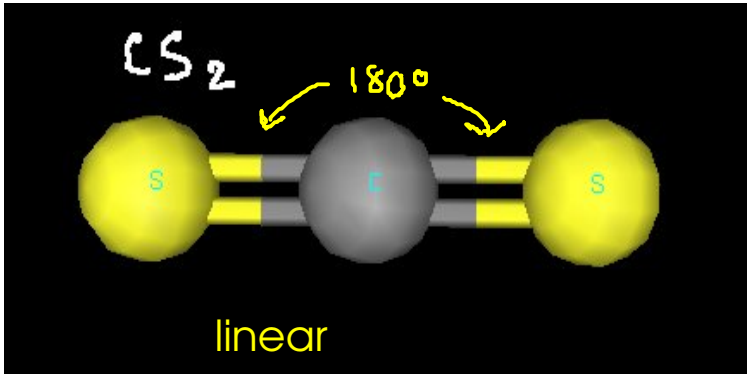
NF_3

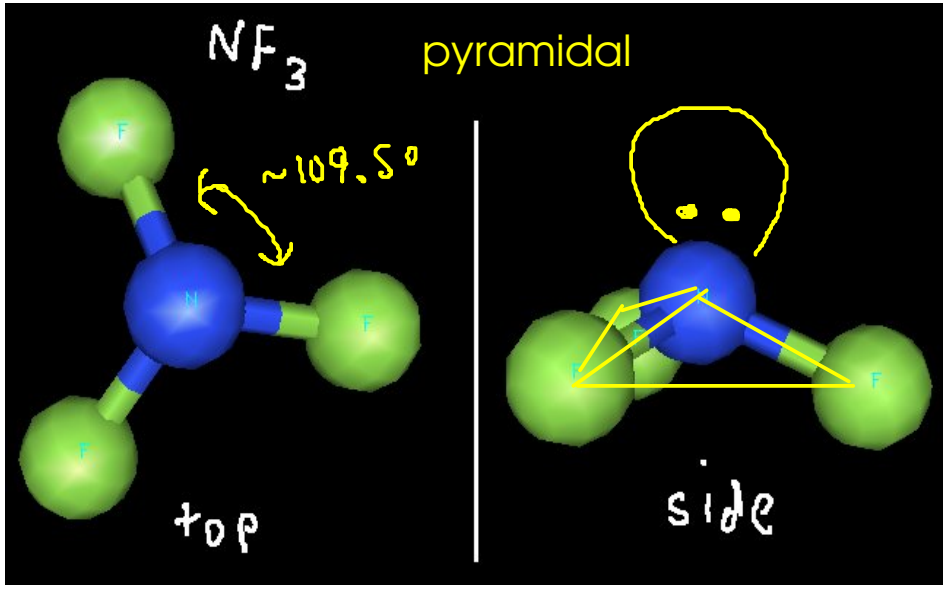
N: 1 x 5
F: 3 x 7 = 21
26



Shape? This molecule has four groups attached to the central nitrogen (same bond angles as the tetrahedral molecule). Snce only THREE of the groups are atoms, this is a PYRAMIDAL structure.

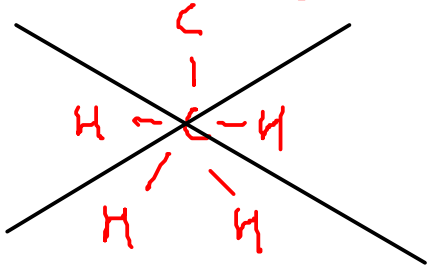

CCl_4
Cl
109.5°
C
Cl
Cl
Cl
tetrahedral


CS_2
180°
S
C
S
linear

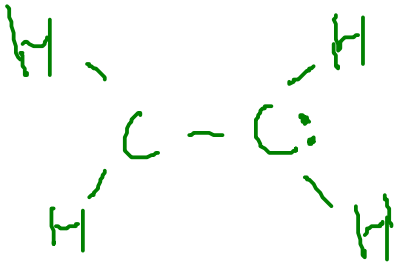

NF_3
pyramidal
F
~109.5°
N
F
F
top
F
F
F
side

C_2H_4

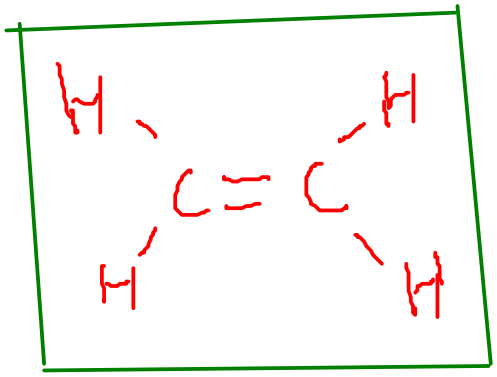
C : 2 x 4 = 8
H : 4 x 1 = 4
12 e⁻



Use multiple centers instead of this (Carbon can't take 10 electrons)



skeletal

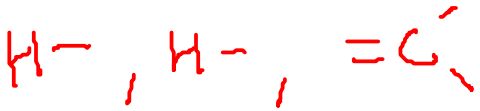


Final structure

Shape? THis molecule has TWO central atoms (the carbons), and each has three other atoms attached.

Since there are no lone pairs on either carbon, each carbon must be TRIGONAL PLANAR.

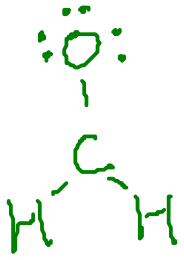
Each carbon has these attached:



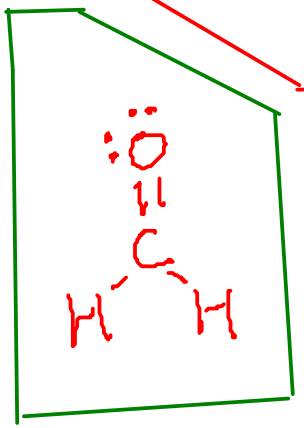
... so each carbon here is surrounded by three atoms and no lone pairs: TRIGONAL PLANAR

H_2CO

H : 2 x 1
C : 1 x 4
O : 1 x 6
12 e⁻

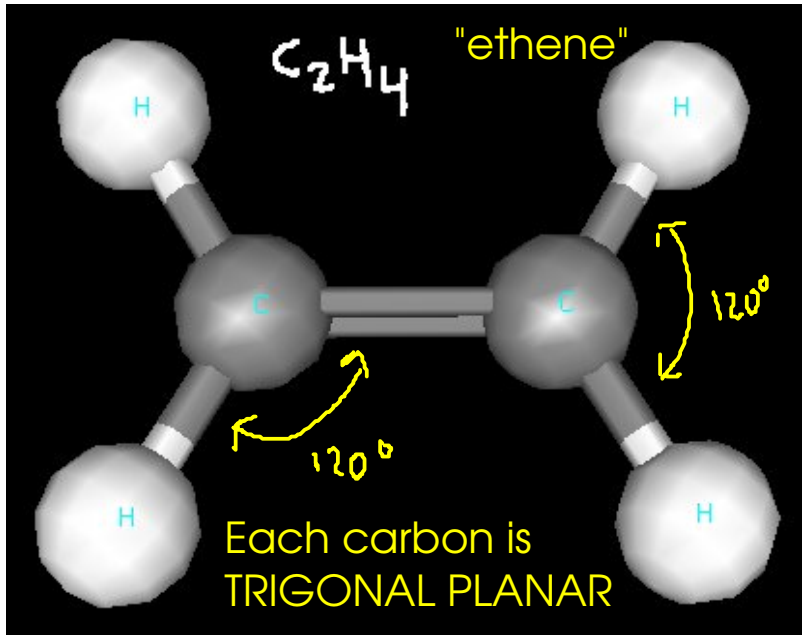


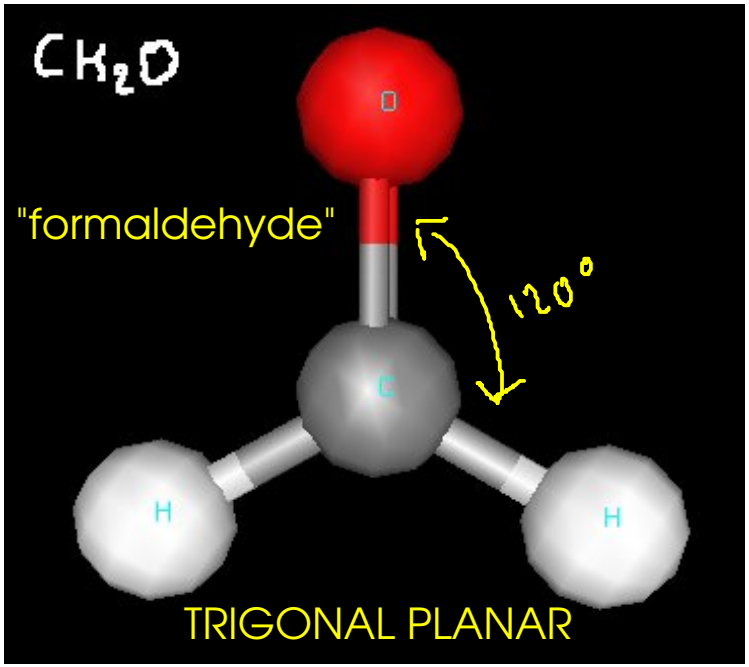
skeletal



final structure

Shape? There are three other atoms (and no lone pairs) attached to the carbon center, so this is a TRIGONAL PLANAR molecule.


C_2H_4
"ethene"
H
H
C
C
120°
120°
H
H
Each carbon is
TRIGONAL PLANAR


CH_2O
O
"formaldehyde"
120°
C
H
H
TRIGONAL PLANAR

VSEPR and large molecules

- Large molecules have more than one "center" atom

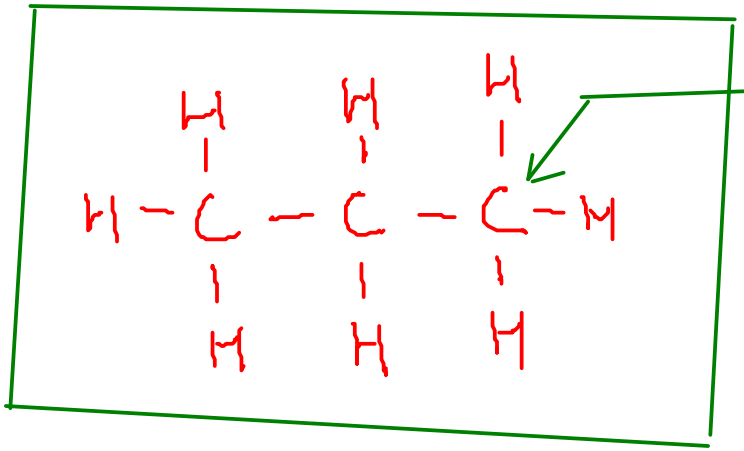
- Describe the molecule by describing the shape around each "center".

C_3H_6:

C: 3 x 4

H: 8 x 1

20 e⁻



Each carbon center is surrounded by FOUR other atoms, giving a TETRAHEDRAL shape.

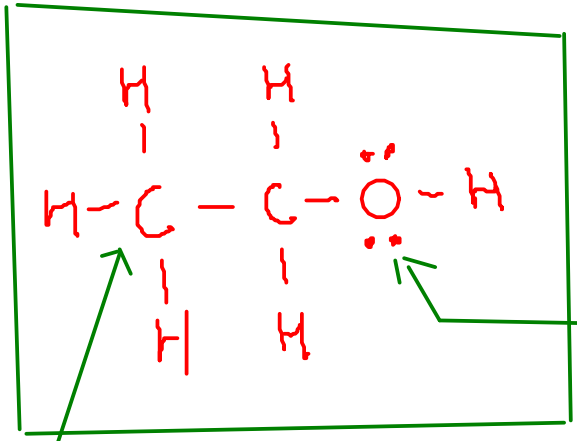
CH_3CH_2OH

C: 2 x 4 = 8

H: 6 x 1 = 6

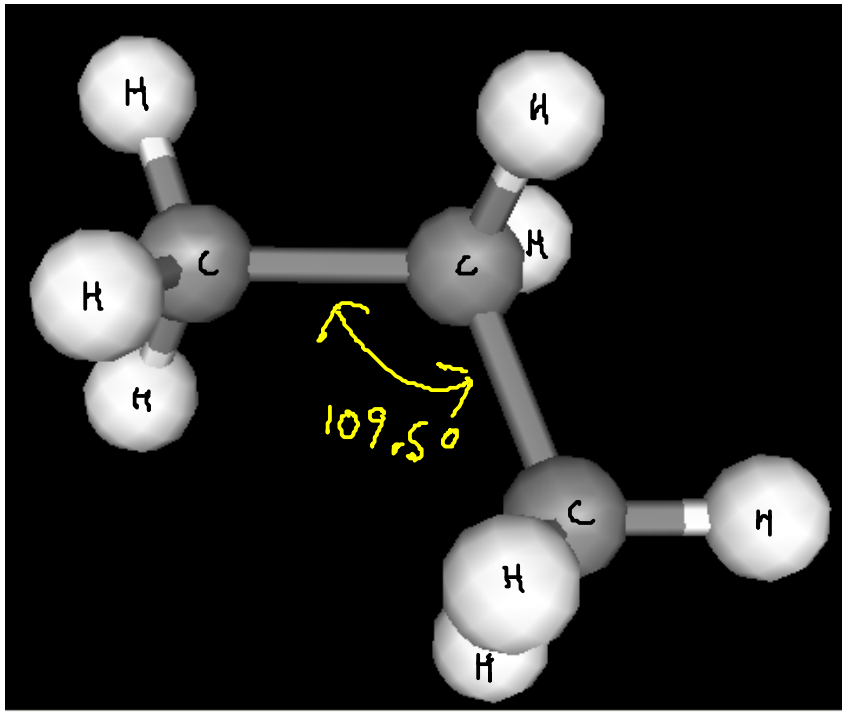
O: 1 x 6 = 6

20 e⁻



The carbon atoms are TETRAHEDRAL.

The oxygen atom is surrounded by two other atoms AND two lone pairs. So, we have the tetrahedral angles (109.5), and we call the shape BENT.

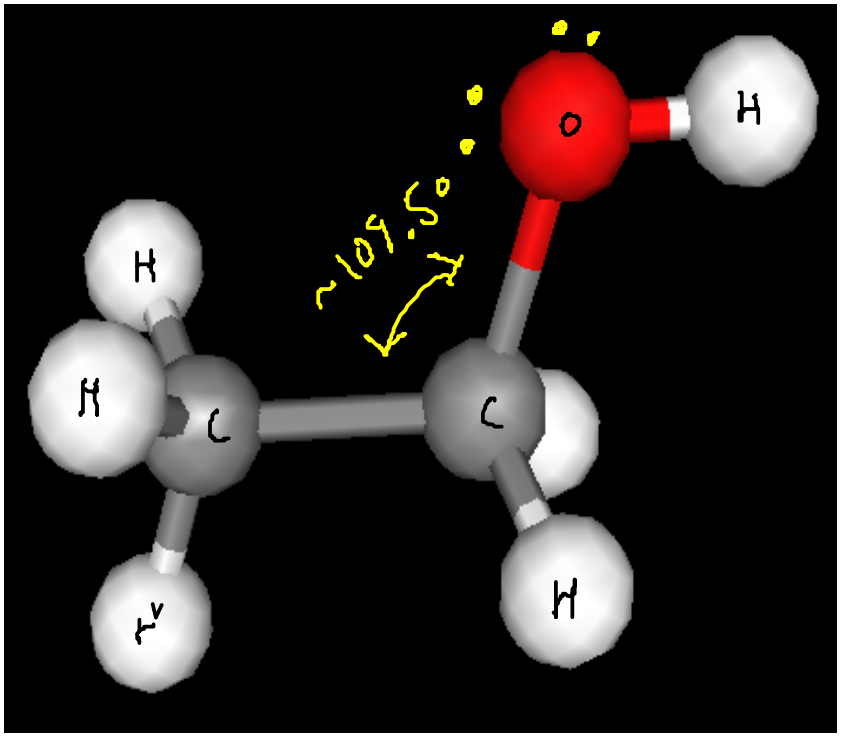


C_3H_8 ←

All bond angles in the propane molecule are 109.5 degrees

CH_3CH_2OH →

Like propane, the bond angles in ethanol are also close to 109.5 degrees.



POLARITY and shape:

- A polar molecule has an uneven distribution of electron density, making it have ends (poles) that are slightly charged.

POLARITY influences several easily observable properties.

- Melting point. (Polar substances have higher melting points than nonpolar substances of similar molecular weight.)

- Boiling point. (Polar substances have higher boiling points than nonpolar substances of similar molecular weight.)

- Solubility. (Polar substances tend to dissolve in other polar substances, while being insoluble in nonpolar substances. Nonpolar substances dissove other nonpolar substances, and generally have poor solubility in polar solvents.)

- Polar molecules contain POLAR BONDS arranged in such a way that they do not cancel each other out.

... but how can we tell whether or not a bond will be POLAR? Use experimental data on ELECTRONEGATIVITY!

ELECTRONEGATIVITY:
-A measure of how closely to itself an atom will hold shared electrons

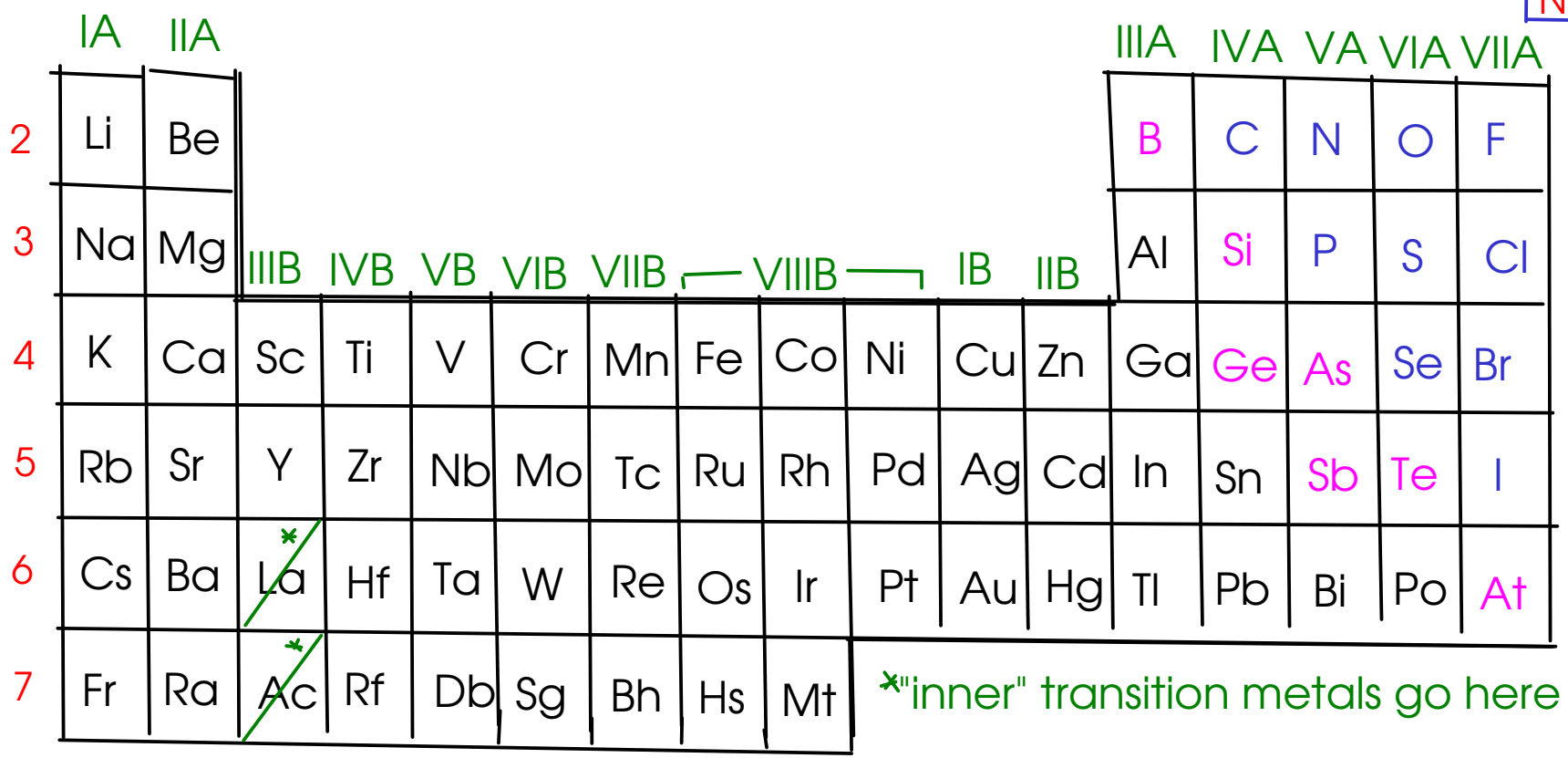
- A bond where there is a LARGE electronegativity difference between atoms will be either POLAR or (for very large differences) IONIC! (chart, p 346)

- A bond with little or no electronegativity difference between atoms will be NONPOLAR

ELECTRONEGATIVITY TRENDS

- You may look up elecronegativity data in tables, but it helps to know trends!

INCREASING ELECTRO-NEGATIVITY



Notes:

1. - FLUORINE is the most elecronegative element, while FRANCIUM is the least!
2. - All the METALS have low electronegativity, and metal/nonmetal combinations form IONIC bonds
3. - HYDROGEN is similar in electronegativity to CARBON, so C-H bonds are considered NONPOLAR