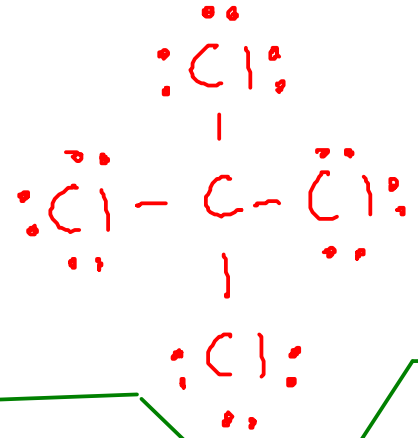
Examples:

CCl_4

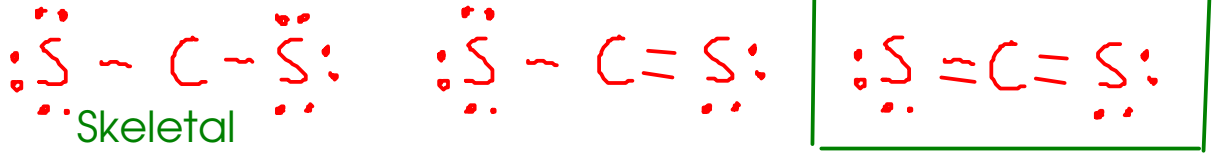
C: 4
Cl: 7 x 4 = 28
32 e^-



Shape? The geometry is tetrahedral, and so is the shape. There are FOUR GROUPS around the central atom, and all of them are other atoms (so they count for purposes of describing the shape!)

CS_2

C: 4
S: 6 x 2 = 12
16 e^-

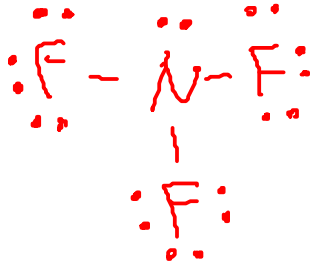


Skeletal structure

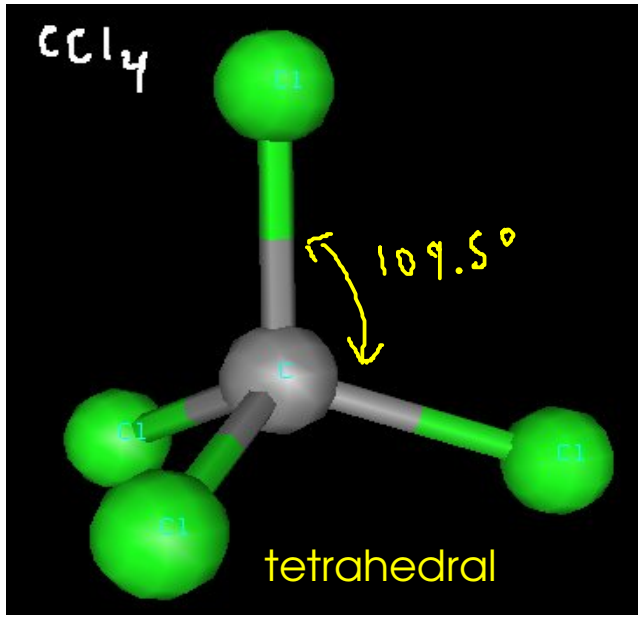
Shape? The geometry (and shape) of this molecule is LINEAR. The two doubly-bonded sulfur atoms will sit 180 degrees apart.

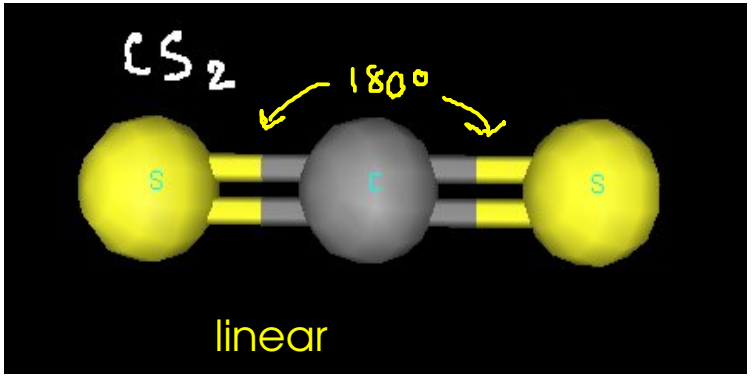
NF_3

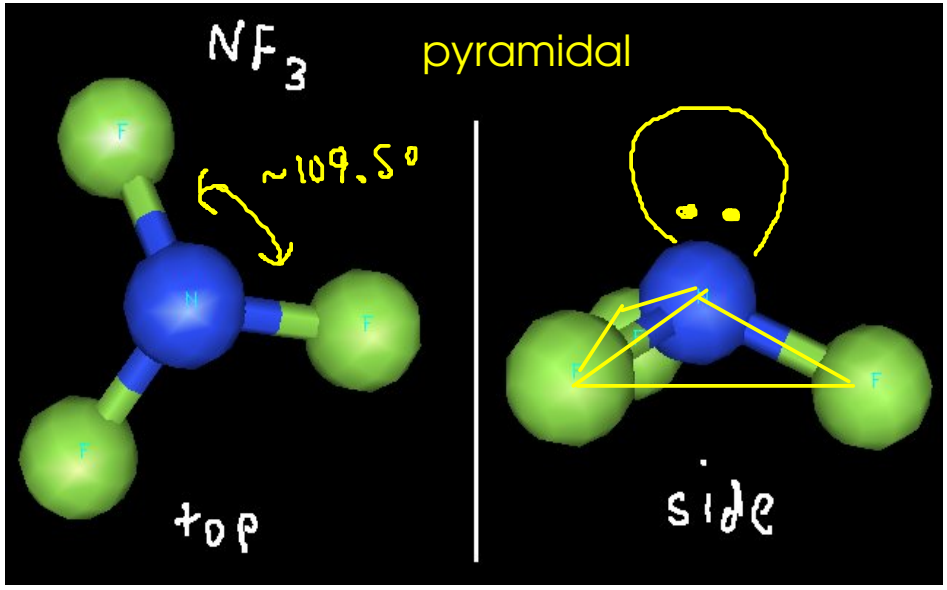
N: 5
F: 7 x 3 = 21
26 e^-



Shape? There are FOUR GROUPS attached to the central nitrogen, so the gemoetry is tetrahedral (like the first one!) The molecular SHAPE, though, is PYRAMIDAL - since one of our four groups is a lone pair.


CCl_4
Cl
109.5°
C
Cl
Cl
Cl
tetrahedral


CS_2
180°
S
C
S
linear

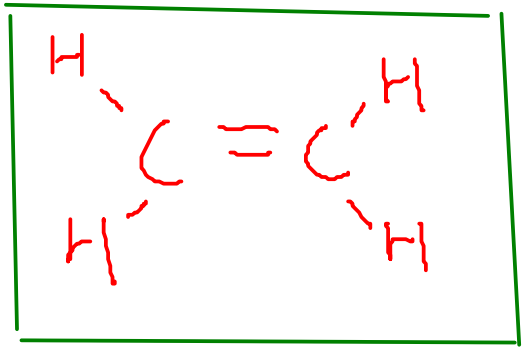

NF_3
pyramidal
F
~109.5°
N
F
F
top
F
F
F
side

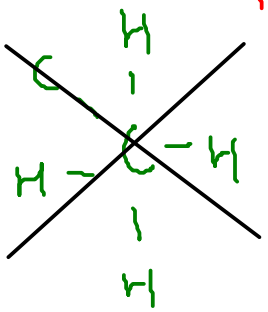
C_2H_4

C: 4 x 2 = 8

H: 1 x 4 = 4

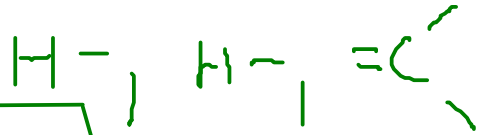
12 e⁻





Shape? The molecule has TWO central carbons, both of which are TRIGONAL PLANAR. Each of the two carbons is attached directly to three other atoms, and there are no lone pairs.

Multiple carbon atoms usually mean multiple centers!



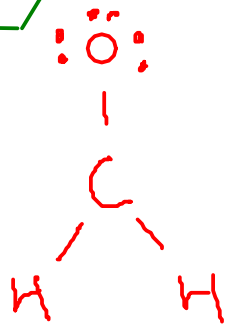
H_2CO

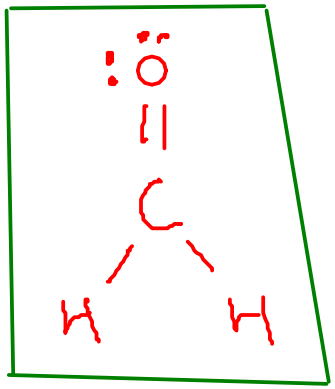
H: 1 x 2

C: 4

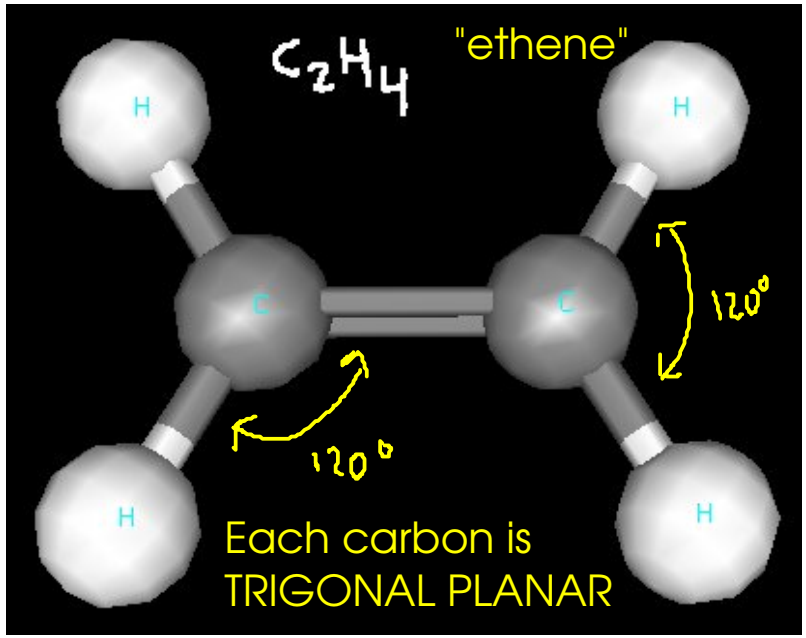
O: 6

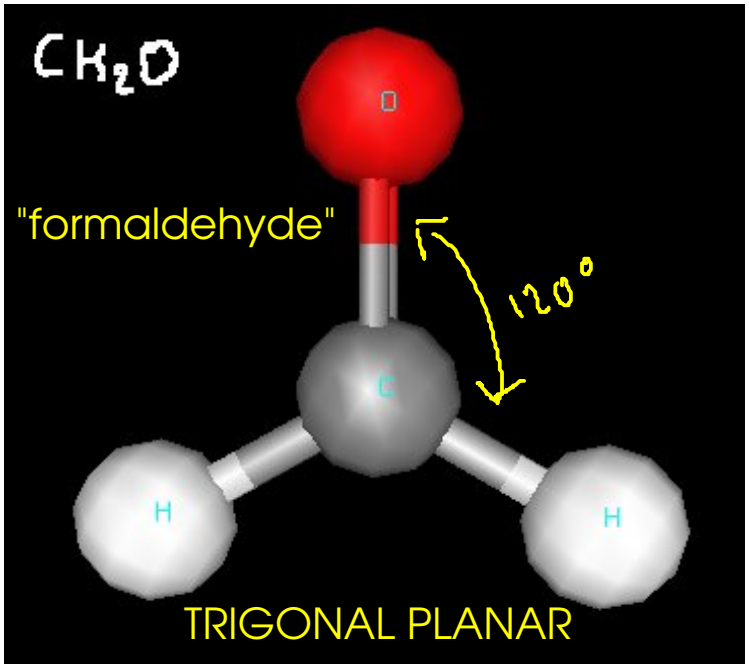
12 e⁻





Shape? The carbon atom is surrounded by three groups, all of which are other atoms: TRIGONAL PLANAR.


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

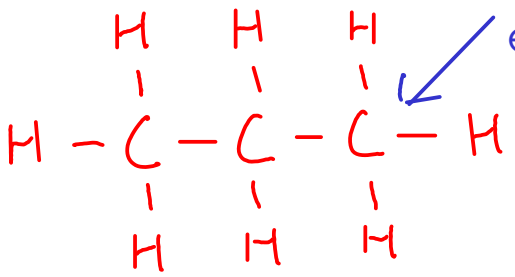

CH_2O
O
"formaldehyde"
120°
C
H
H
TRIGONAL PLANAR

VSEPR and large molecules

- Large molecules have more than one "center" atom

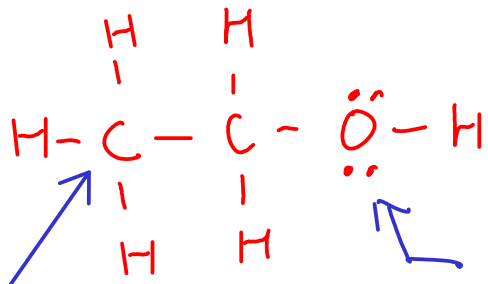
- Describe the molecule by describing the shape around each "center".

C_3H_8:



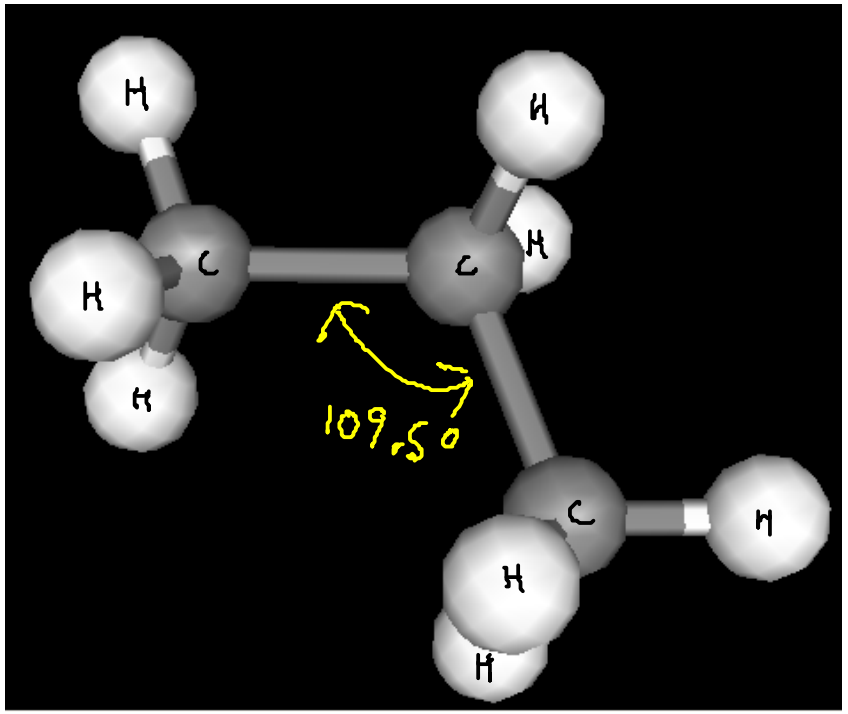
Each of the three carbon centers is TETRAHEDRAL, since each are surrounded by four groups.

CH_3CH_2OH:



The shape around this oxygen atom is BENT.

These carbon atoms have TETRAHEDRAL geometry.

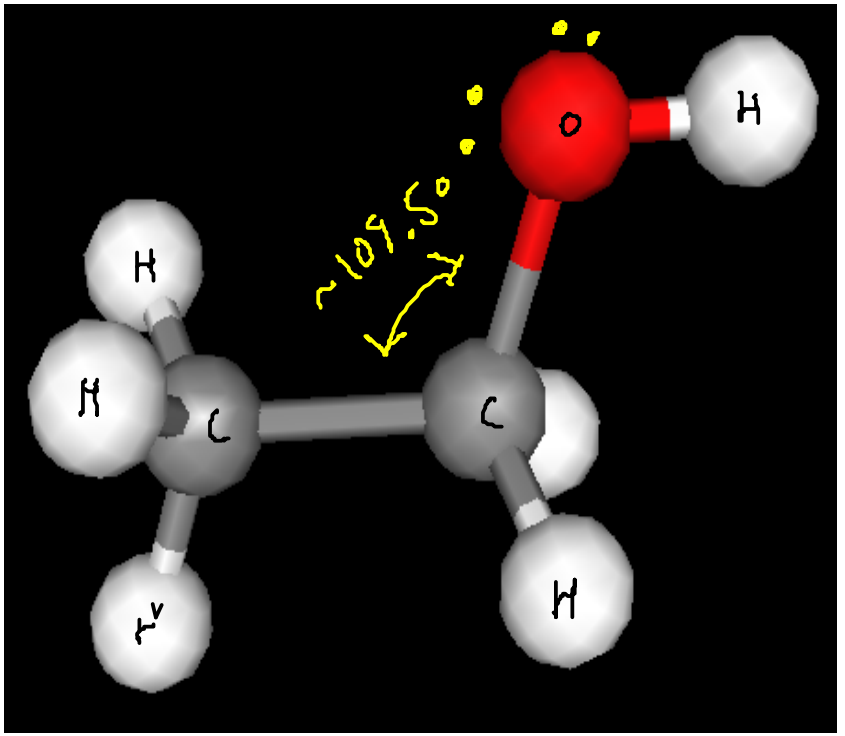


C_3H_8 ←

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

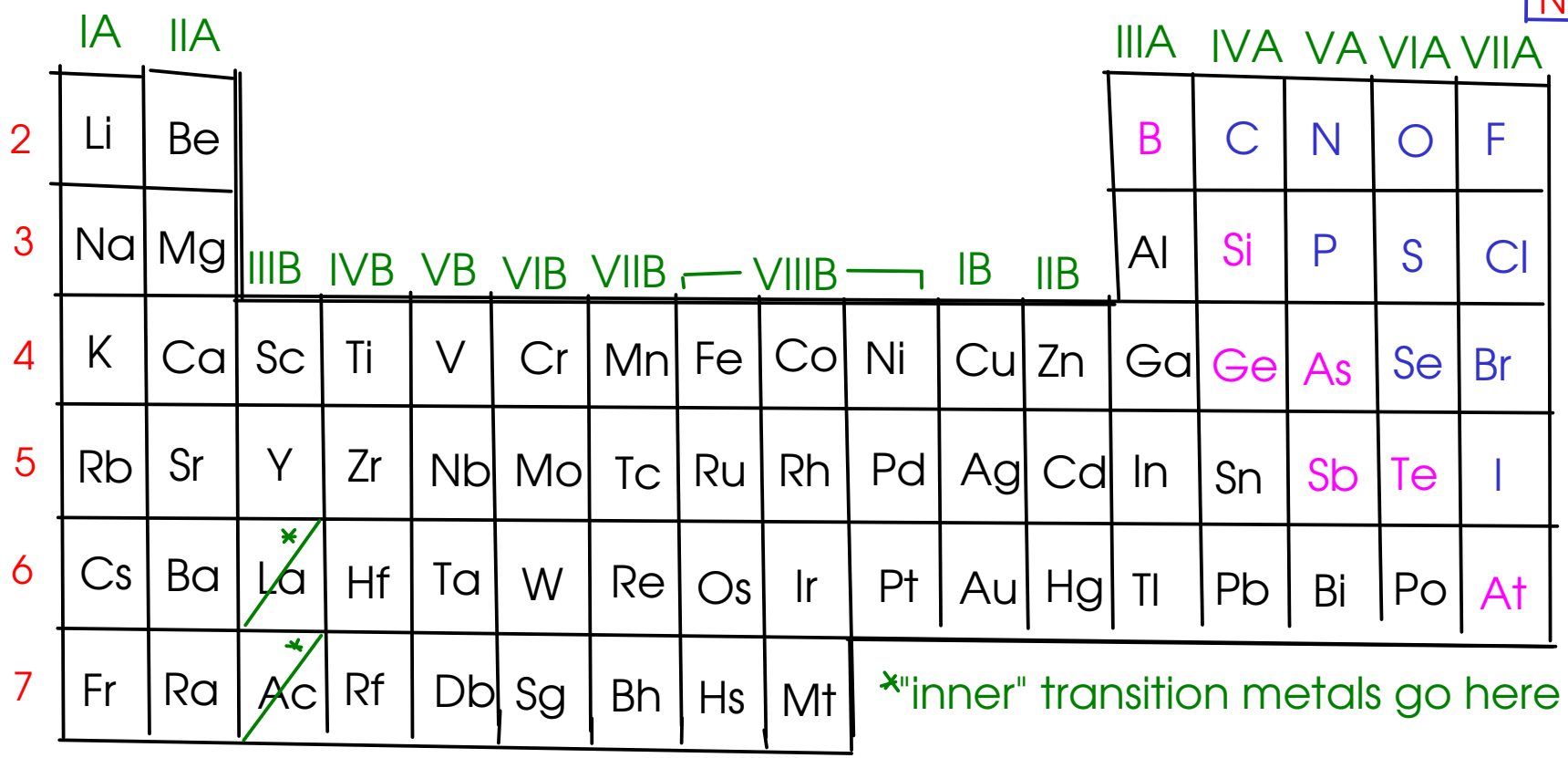
- A bond where there is a LARGE electronegativity difference between atoms will be either POLAR or (for very large differences) IONIC! (chart, p 352)

- 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