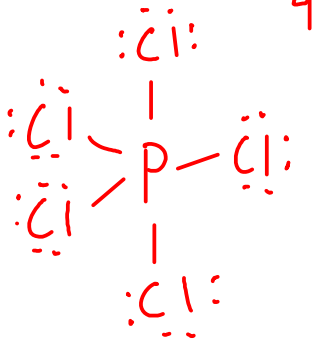
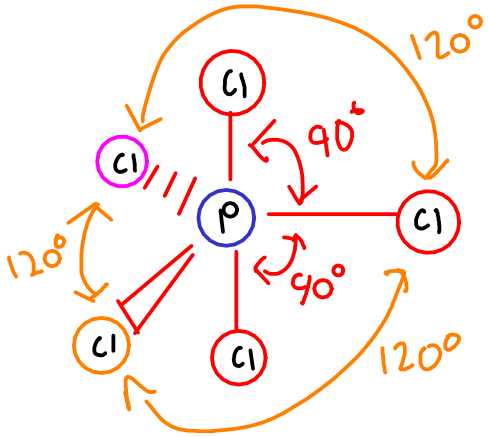
SHAPES OF EXPANDED VALENCE MOLECULES

PCl_5 : P : 5
Cl : 7 × 5 = 40

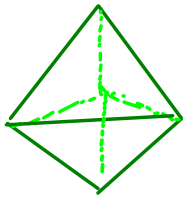


There are five atoms bonded to the central phosphorus atom, and they will attempt to get as far apart as possible from one another!



The top and bottom atoms are 90 degrees apart from the atoms around the center.

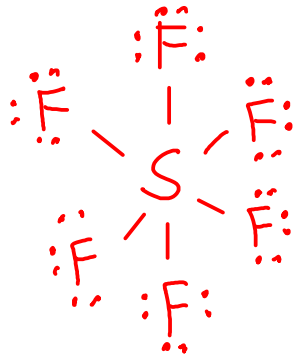
The atoms around the center are 120 degrees apart from each other.



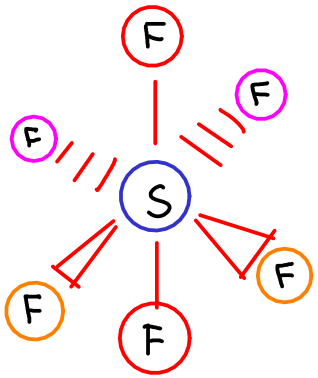
There are acually two DIFFERENT bond angles in this structure. It's called TRIGONAL BIPYRAMIDAL.

There are several derivatives of the trigonal bipyramidal shape (like the tetrahedral shape) - depending on how many things around the central atom are atoms!

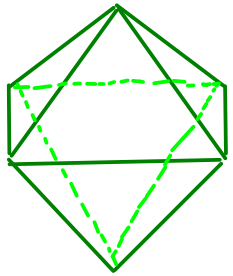
SF_6 : S : 6
F : 7x6
48



There are six atoms bonded to the central sulfur atom, and they will attempt to get as far apart as possible from one another!



All bond angles in this arrangement are 90 degrees!



This shape is called OCTAHEDRAL, since it has eight sides.

Like the tetrahedral and trigonal bipyramidal arrangements, there are several derivatives of the octahedron - depending on how many of the six things around the center are atoms!

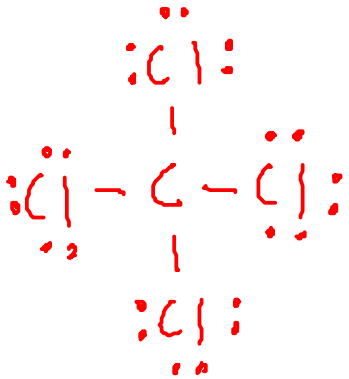
Examples:

CCl_4

C: 1x4

Cl: 4x7

32 e^-



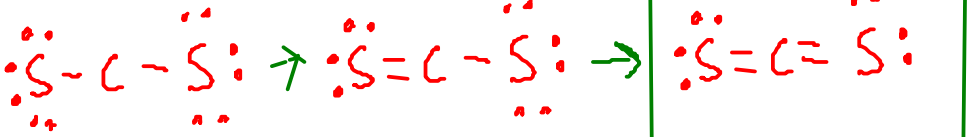
Shape? The central carbon atom is surrounded by FOUR CHLORINE ATOMS (and nothing else), so the shape of this molecule is TETRAHEDRAL.

CS_2

C: 1x4

S: 2x6

16 e^-



skeletal structure

final structure

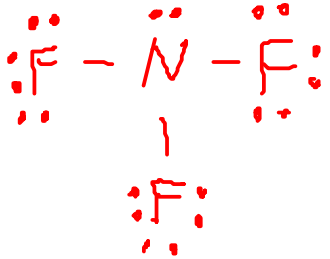
Shape? There are two sulfur atoms bonded to the central carbon atom (and no lone pairs), so this is a LINEAR molecule.

NF_3

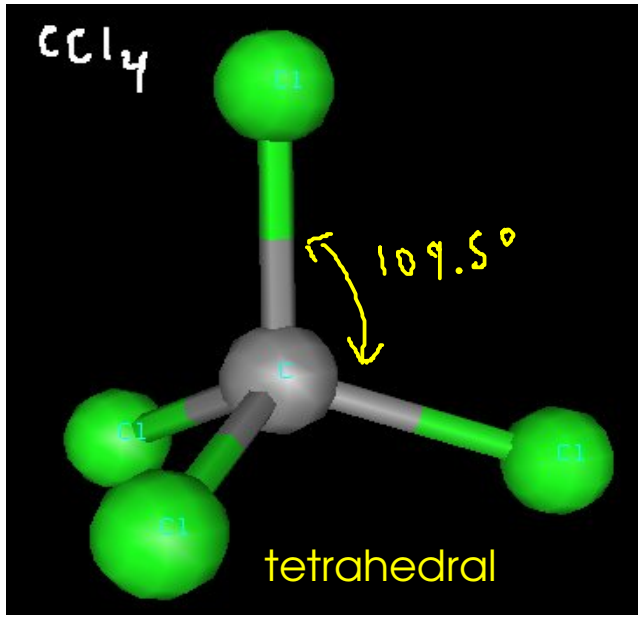
N: 1x5

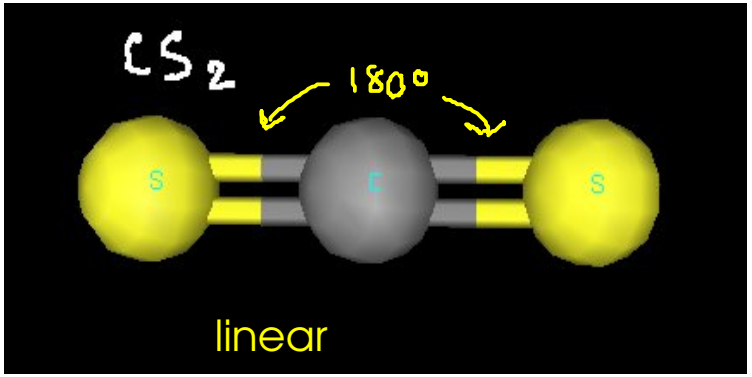
F: 3x7 = 21

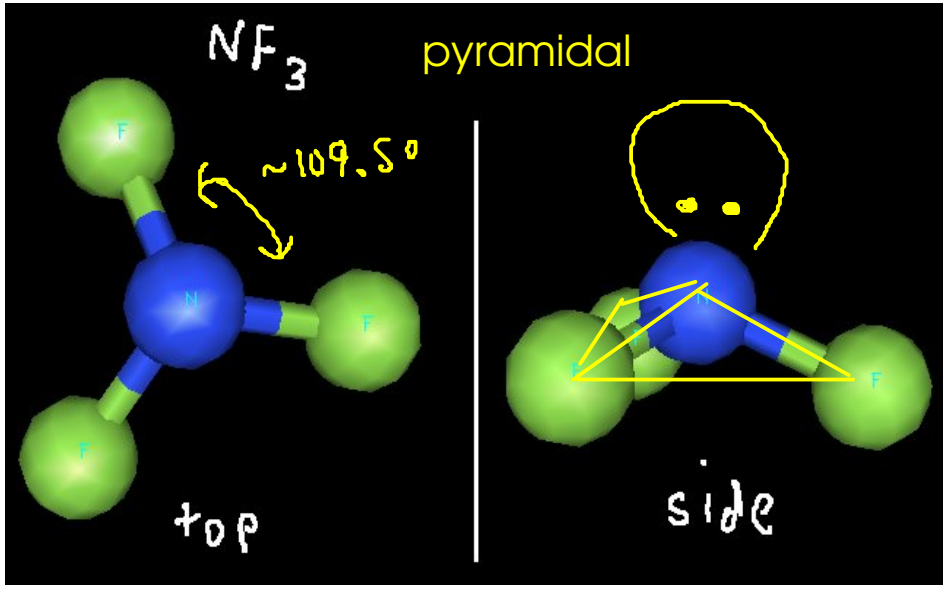
26 e^-



Shape? There are THREE fluorine atoms bonded to the nitrogen center, and there's also a lone pair on the nitrogen. Since there are 3+1=4 groups around the central atom, the GEOMETRY is tetrahedral (109.5 degree angles). Because we have a lone pair, the SHAPE is pyramidal.


CCl_4
109.5°
tetrahedral


CS_2
180°
linear

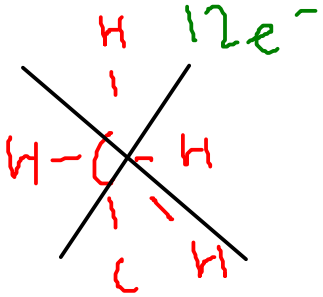

NF_3
pyramidal
~109.5°
top
side

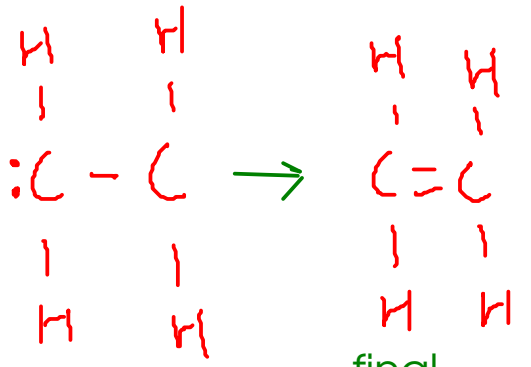
C_2H_4

C: 2 × 4

H: 4 × 1

12 e⁻





skeletal structure

final structure

Shape? This molecule has TWO "central" carbon atoms, so we'll just describe the shape of the molecule around each one.

Each carbon has THREE othet atoms attached to it and NO lone pairs, so the shape of the molecule around each carbon is TRIGONAL PLANAR.

H-, H-, C = ... three other atoms

Structure tip: Multiple carbon atoms mean multiple "central atoms"

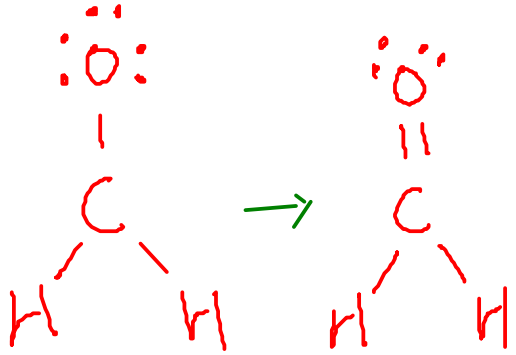
H_2CO

H: 2 × 1

C: 1 × 4

O: 1 × 6

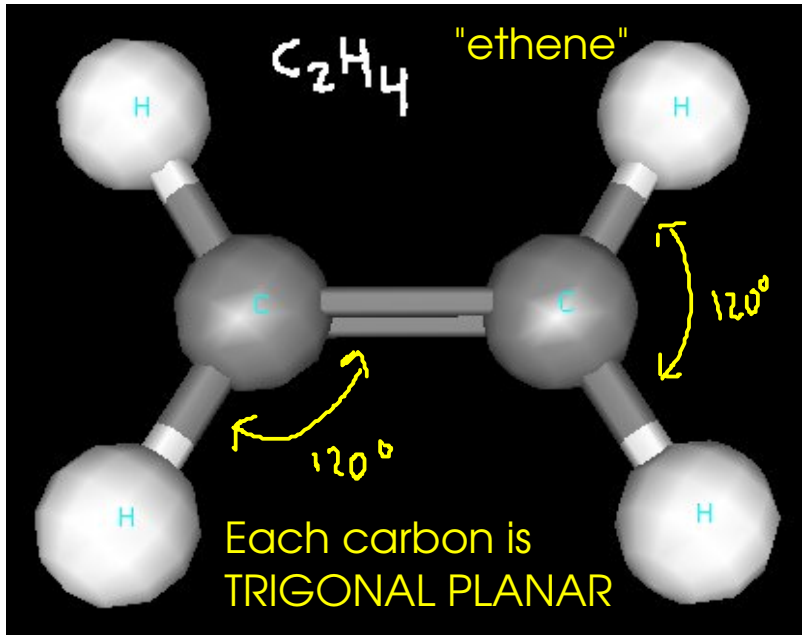
12 e⁻

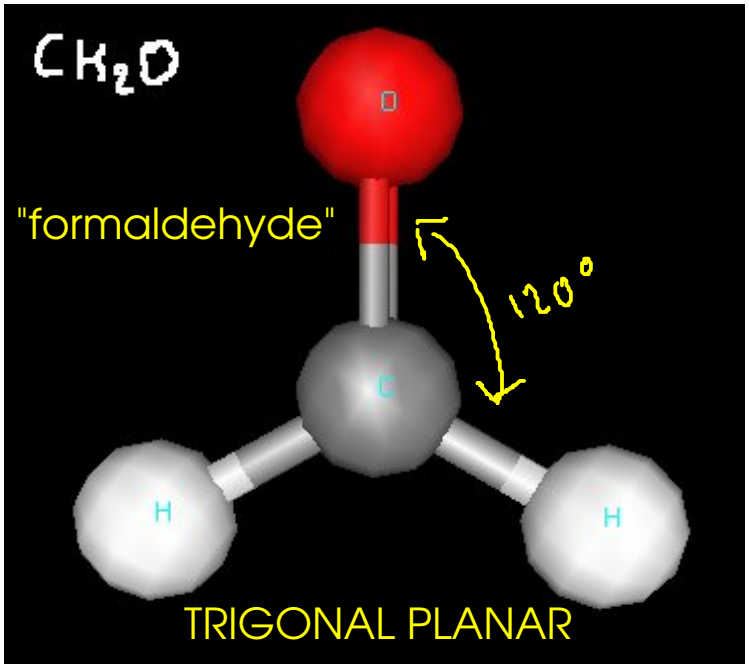


skeletal structure

final structure

Shape? This molecule has three other atoms (O, H, H) around the central carbon atom and no lone pairs, so it's TRIGONAL PLANAR.


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

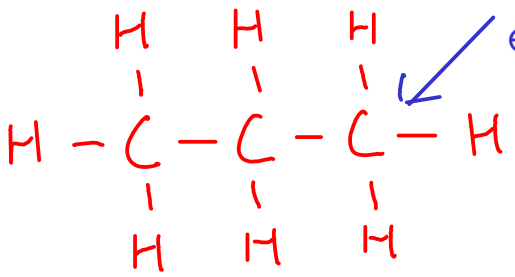

CH_2O
O
"formaldehyde"
120°
C
H
H
TRIGONAL PLANAR

VSEPR and large molecules

- Large molecules have more than one "center" atom

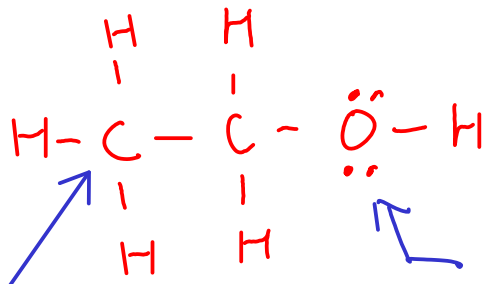
- Describe the molecule by describing the shape around each "center".

C_3H_8:



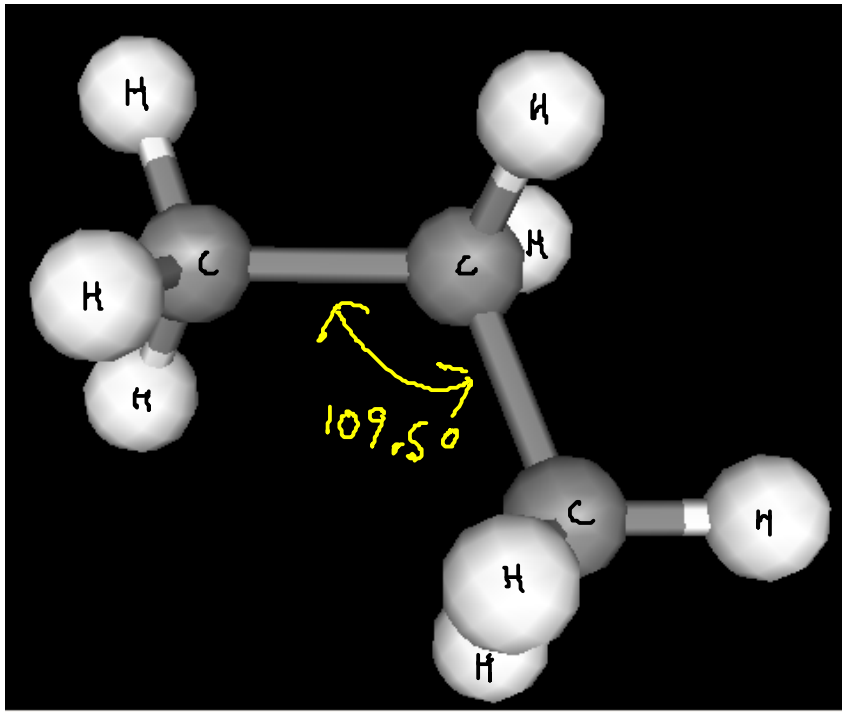
Each of the three carbon centers is TETRAHEDRAL, since each are surrounded by four groups.

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.