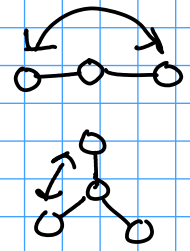
VSEPR

- "Valence Shell Electron Pair Repulsion" model
- assumes that the bonded and unbonded electrons around an atom will push each other as far away as possible.
- leads to simple geometric molecular shapes!

* unpaired electrons OR bonds to other atoms

VSEPR shapes:

Groups* around central atom	Shape	Bond angle(s) in degrees
2	linear	180
3	trigonal planar	120
4	tetrahedral / pyramidal / bent	109.5
5	trigonal pyramidal (and derivatives)	90 and 120
6	ocrahedral (and derivatives)	90

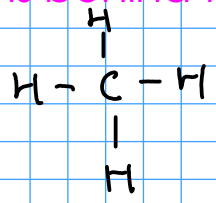


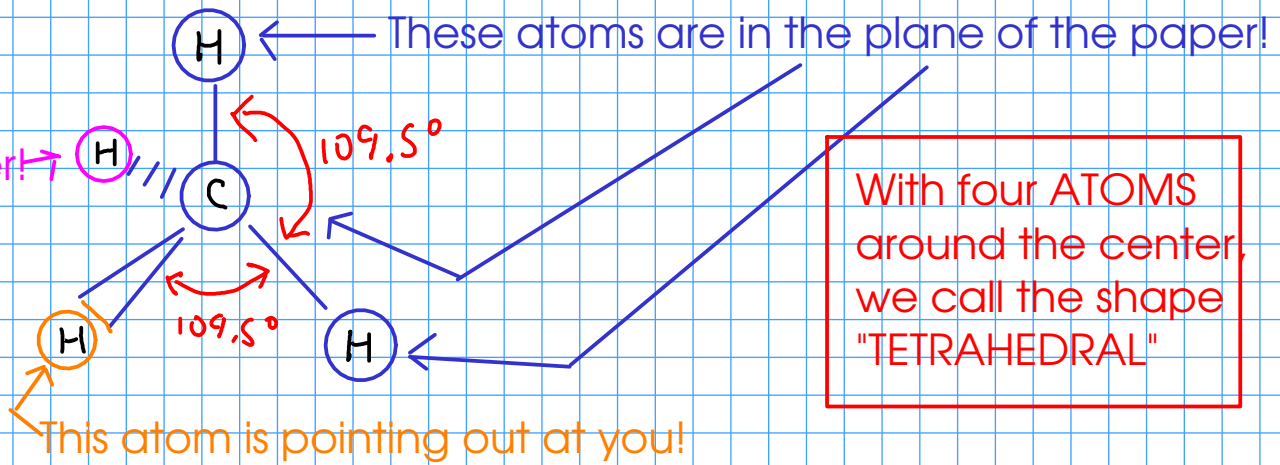
5 and 6 violate "octet rule"

More on "4 things around a central atom":

- A compound that obeys the octet rule can have a maximum of four groups around its central atom. But we describe the molecular shape based on how ATOMS are arrnaged around the center. What if some of those groups aren't atoms, but pairs of UNSHARED electrons?

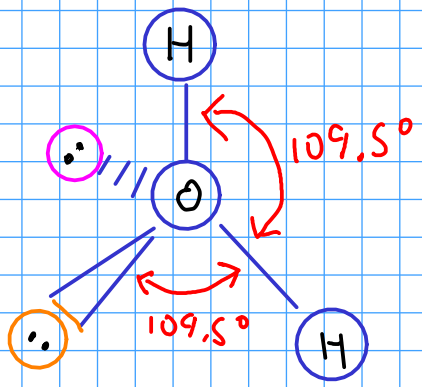
CH_4:

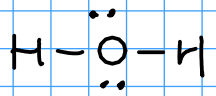




With four ATOMS around the center, we call the shape "TETRAHEDRAL"

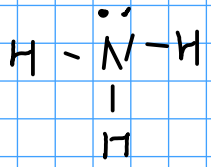
H_2O:

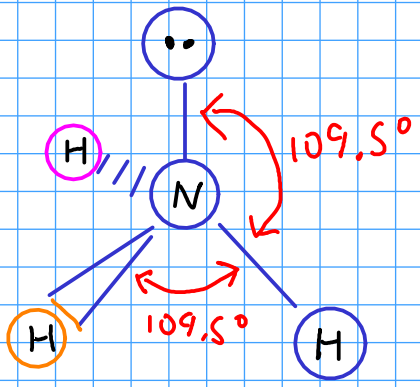


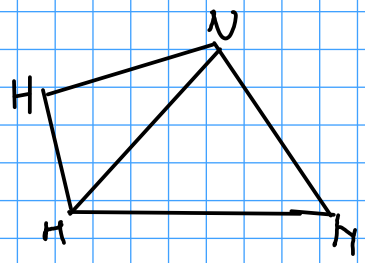


With two ATOMS and two LONE PAIRS, we call the shape "BENT"

NH_3:







With three ATOMS and one LONE PAIR, we call the shape "PYRAMIDAL"

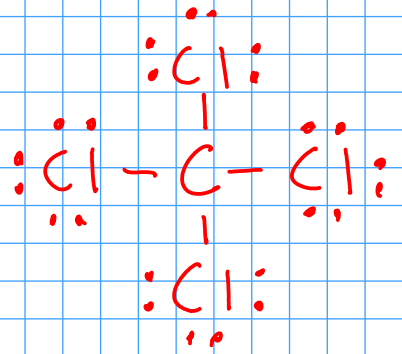
Examples:

CCl_4

C : 4

Cl : 4x7

32



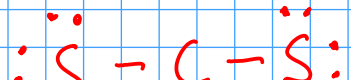
Molecular shape? There are FOUR atoms bonded to carbon (and no lone pairs). This give a TETRAHEDRAL shape to the molecule.

CS_2

C : 4

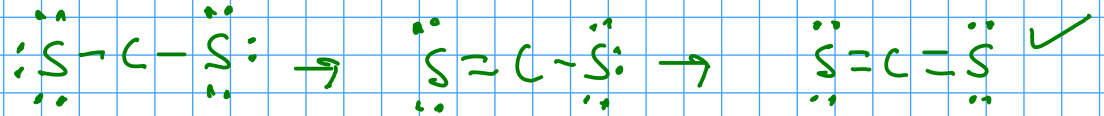
S : 6x2

16



Molecular shape? There are only two things (two sulfur atoms) surrounding the carbon. There are no lone pairs on carbon, either. This is a LINEAR molecule!

Intermediate steps for drawing this structure:

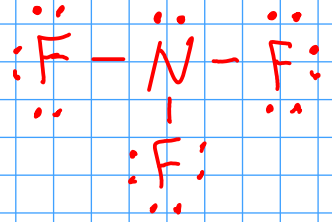


NF_3

N : 5

F : 7x3

26



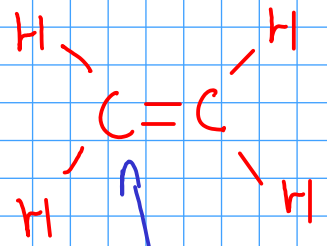
Molecular shape? There are three fluorine ATOMS around the nitrogen, AND a single lone pair of electrons. This means that the shape is a derivative of tetrahedral. Since there are only three ATOMS around the center, this molecule is PYRAMIDAL.

C_2H_4

C: 4 x 2

H: 1 x 4

12

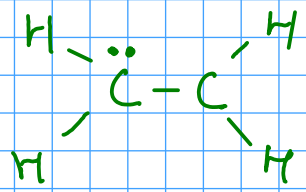


Shape? This molecule has TWO centers, so we should describe the shape of the molecule around each center!

Each carbon is TRIGONAL PLANAR (surrounded by three groups!)

3 groups : H−, H−, =C

Intermediate step for drawing this structure:



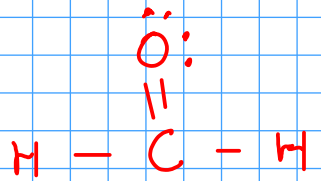
H_2CO

H: 1 x 2

C: 4

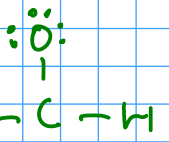
O: 6

12



Shape? This molecule has THREE atoms and no lone pairs around the central carbon, so it's TRIGONAL PLANAR!

Intermediate step for drawing this structure:

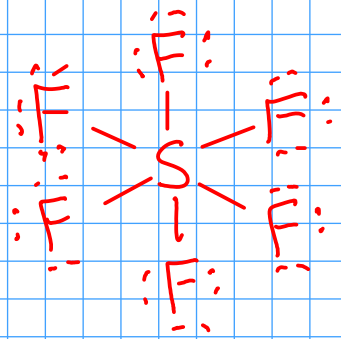


SF_6

S: 6

F: 7 x 6

48



Shape? This molecule has SIX fluorine atoms and no lone pairs surrounding the sulfur center. This forms an OCTAHEDRAL geometry, where atoms are 90 degrees apart!

Intermediate steps for drawing this structure: