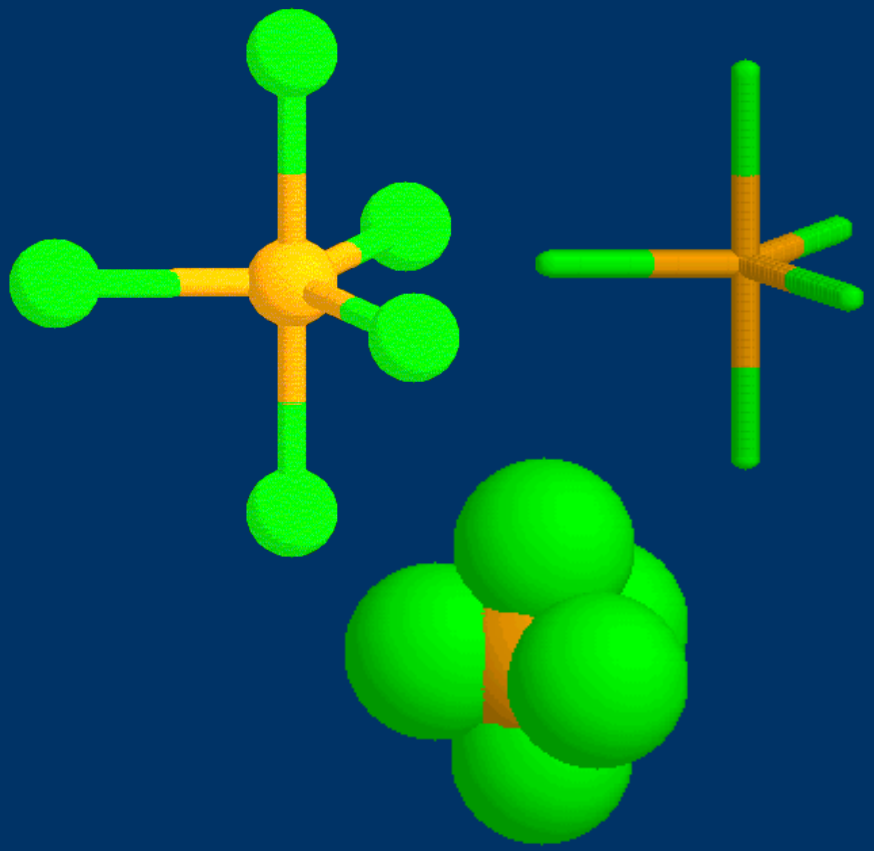
Unit 7 – Molecular Structure



II. Molecular Geometry (p. 183 – 187)

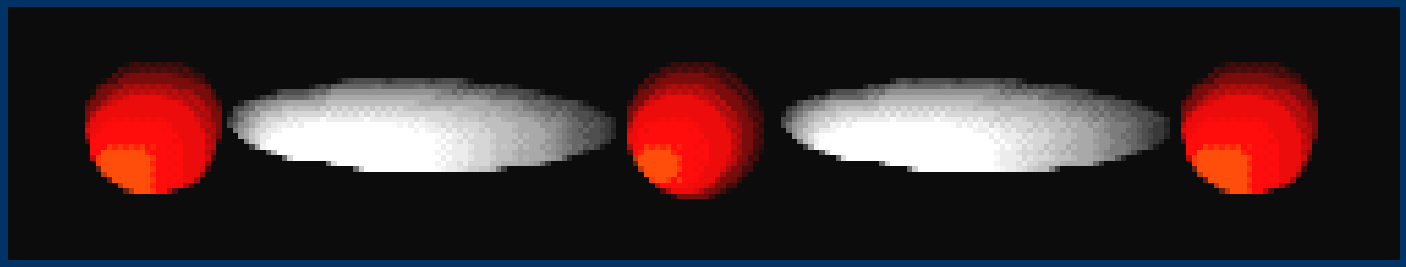
I II III

The specific three dimensional arrangement of atoms in molecules is referred to as molecular geometry.

- There are various instrumental techniques such as X-Ray crystallography and other experimental techniques which can be used to tell us where the atoms are located in a molecule. Using advanced techniques, very complicated structures for proteins, enzymes, DNA, and RNA have been determined.
- Molecular geometry is associated with the chemistry of vision, smell and odors, taste, drug reactions and enzyme controlled reactions to name a few.
- Molecular geometry is associated with the specific orientation of bonding atoms. A careful analysis of electron distributions in orbitals will usually result in correct molecular geometry determinations.
- In addition, the simple writing of Lewis diagrams can also provide important clues for the determination of molecular geometry.

A. VSEPR Theory

- Valence Shell Electron Pair Repulsion Theory
- Electron pairs orient themselves in order to minimize repulsive forces.



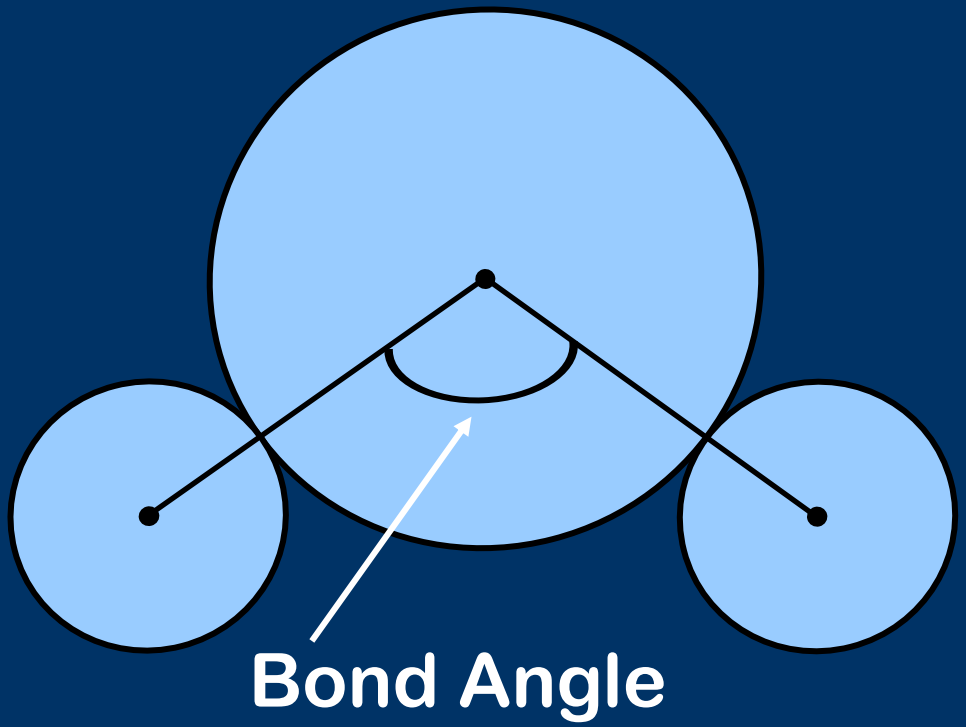
A. VSEPR Theory

- **Types of e^- Pairs**
  - Bonding pairs - form bonds
  - Lone pairs - nonbonding e^-

Lone pairs repel more strongly than bonding pairs!!!

A. VSEPR Theory

- Lone pairs reduce the bond angle between atoms.



B. Determining Molecular Shape

- Draw the Lewis Diagram.
- Tally up e^- pairs on central atom.
  - double/triple bonds = ONE pair
- Shape is determined by the # of bonding pairs and lone pairs.

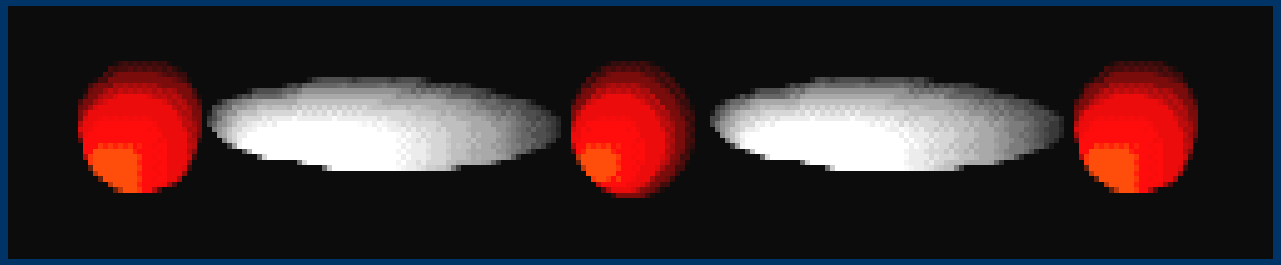
Know the 8 common shapes & their bond angles!

C. Common Molecular Shapes

2 total

2 bond

0 lone



BeH_2

LINEAR

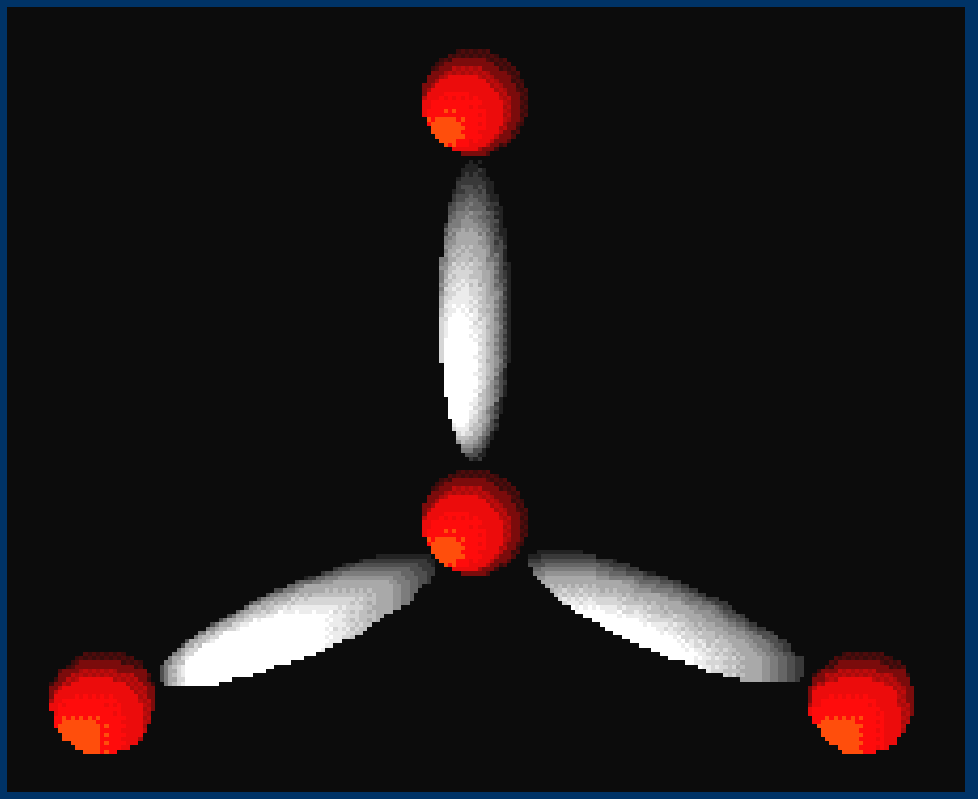
180°

C. Common Molecular Shapes

3 total

3 bond

0 lone



BF_3

TRIGONAL PLANAR

120°

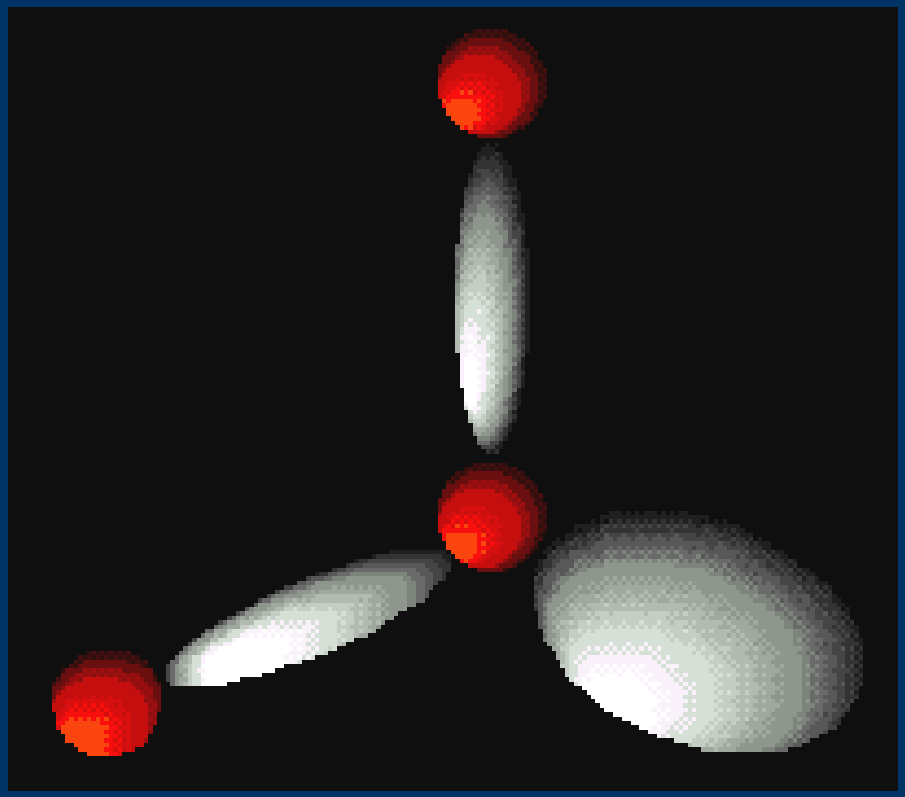
C. Common Molecular Shapes

3 total

2 bond

1 lone

SO_2



BENT

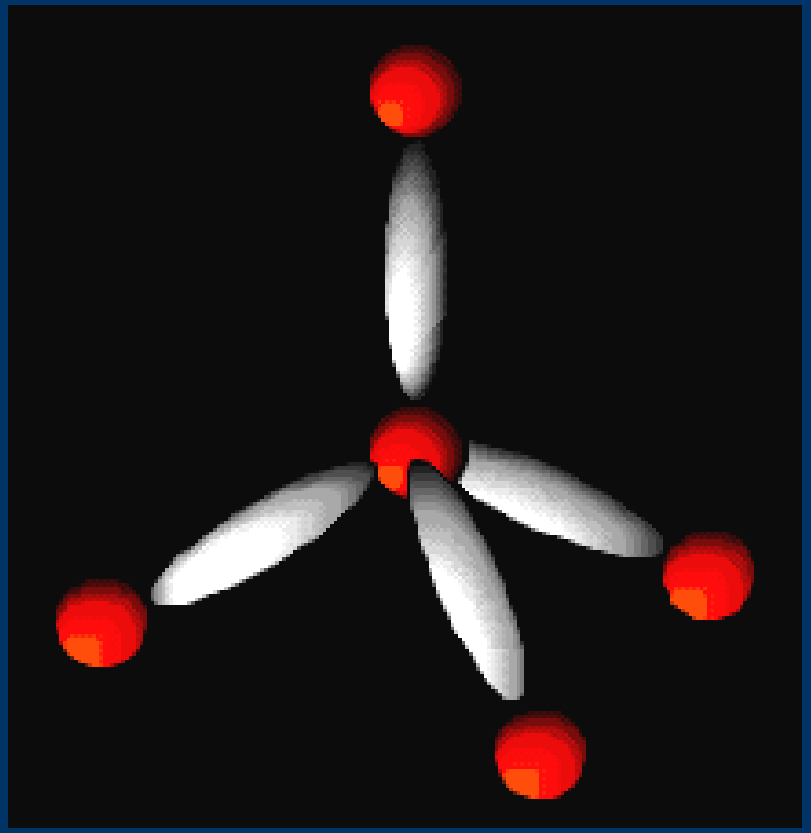
<120°

C. Common Molecular Shapes

4 total

4 bond

0 lone



CH_4

TETRAHEDRAL

109.5°

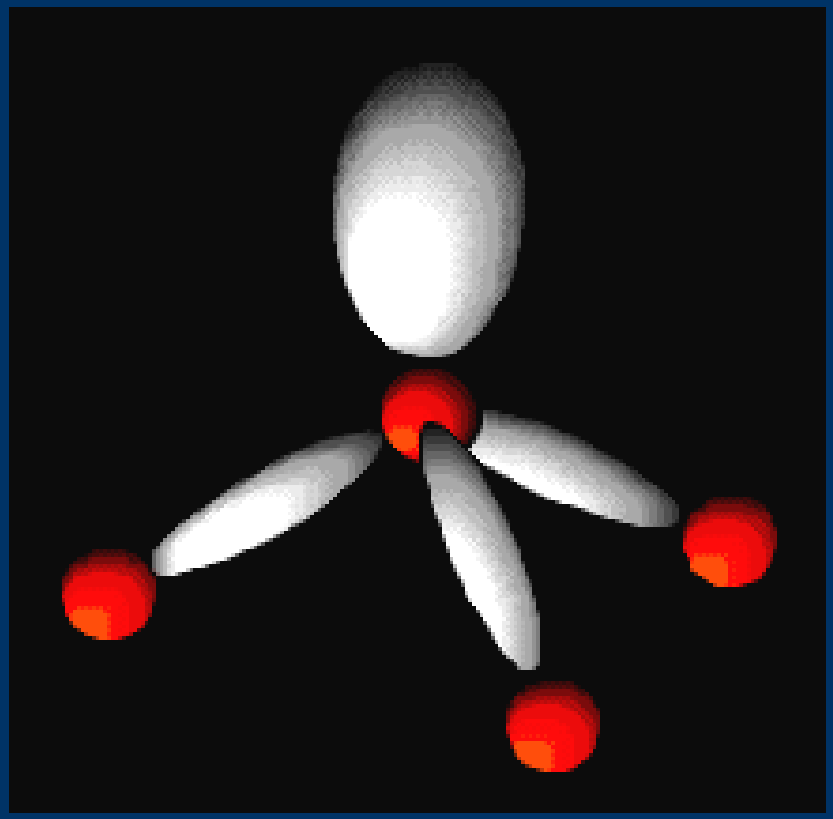
C. Common Molecular Shapes

4 total

3 bond

1 lone

NH_3



TRIGONAL PYRAMIDAL

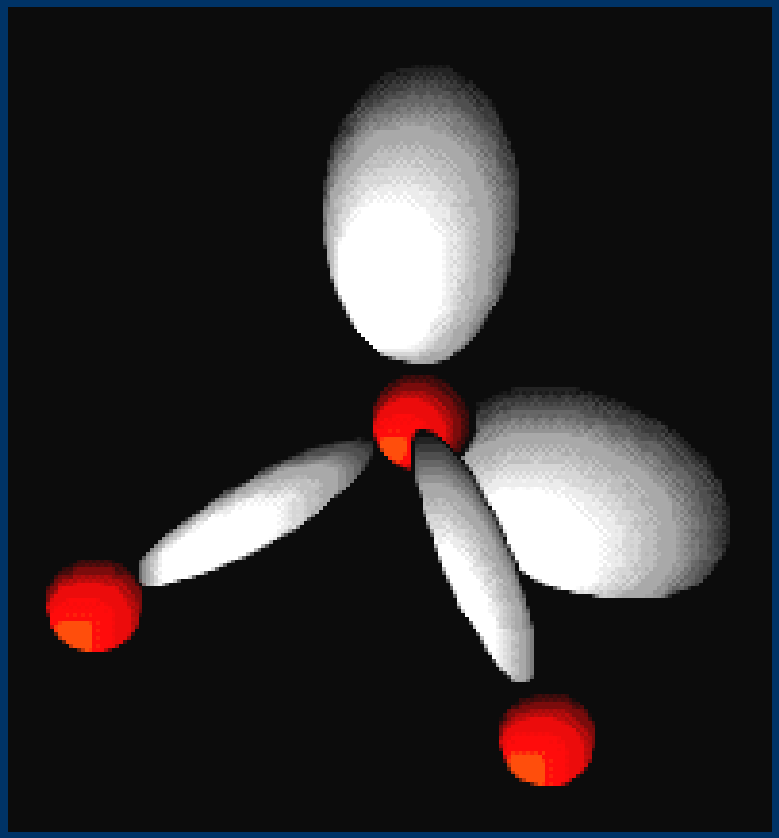
107°

C. Common Molecular Shapes

4 total

2 bond

2 lone



H_2O

BENT

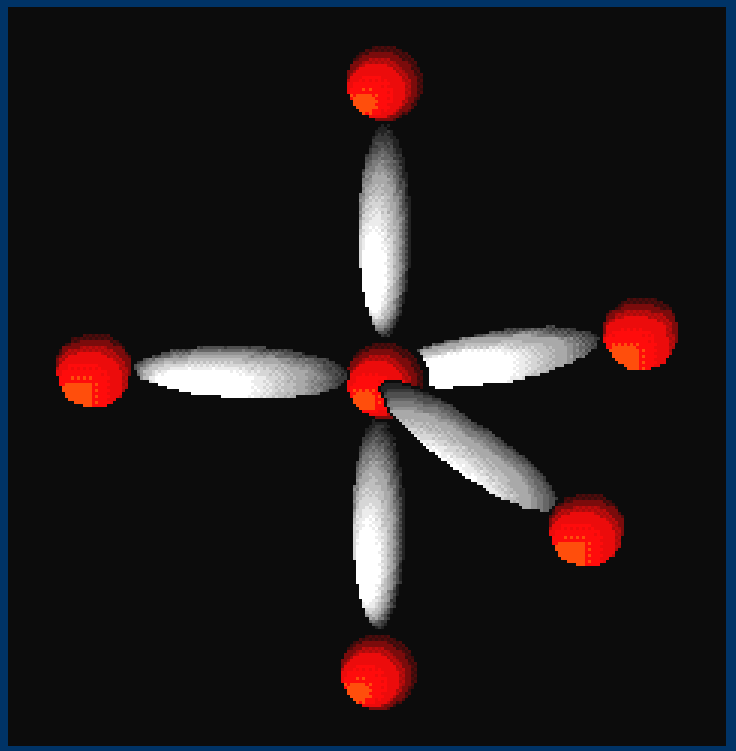
104.5°

C. Common Molecular Shapes

5 total

5 bond

0 lone



PCl_5

TRIGONAL BIPYRAMIDAL

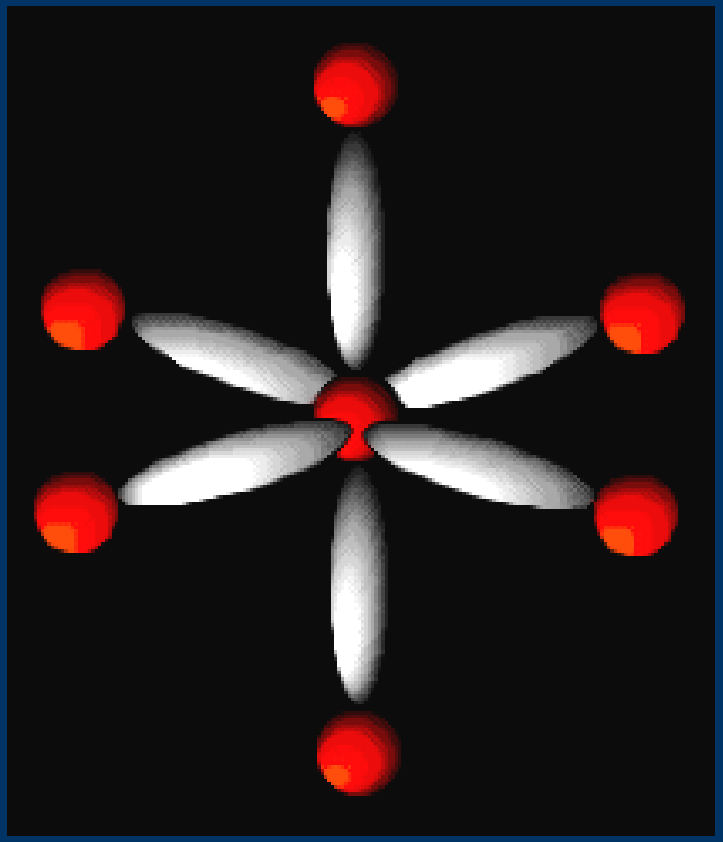
120°/90°

C. Common Molecular Shapes

6 total

6 bond

0 lone



SF_6

OCTAHEDRAL

90°

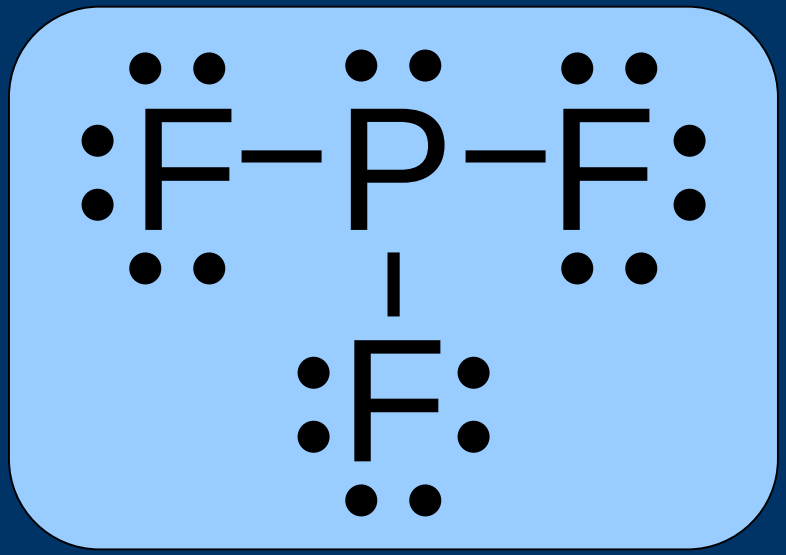
D. Examples

- PF_3

  4 total

  3 bond

  1 lone



TRIGONAL PYRAMIDAL

107°

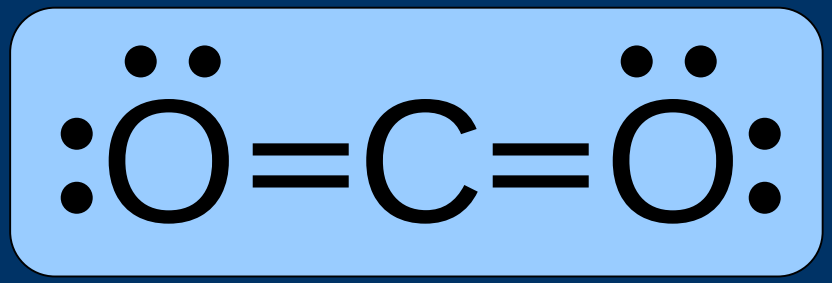
D. Examples

- CO_2

2 total

2 bond

0 lone



LINEAR

180°