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SHAPES OF MOLECULES

BASIC IDEAS

Shapes of molecules and ions depends on total number of electron pairs around the central atom.

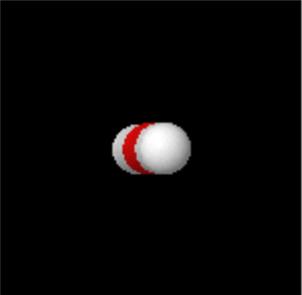
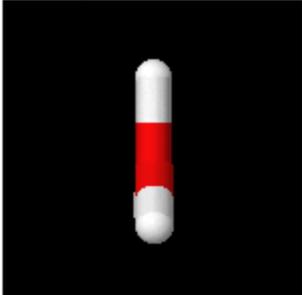
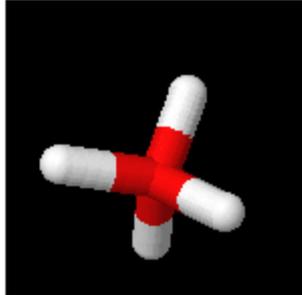
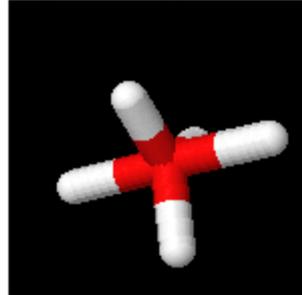
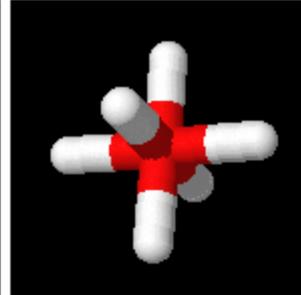
Two types of electron pairs:

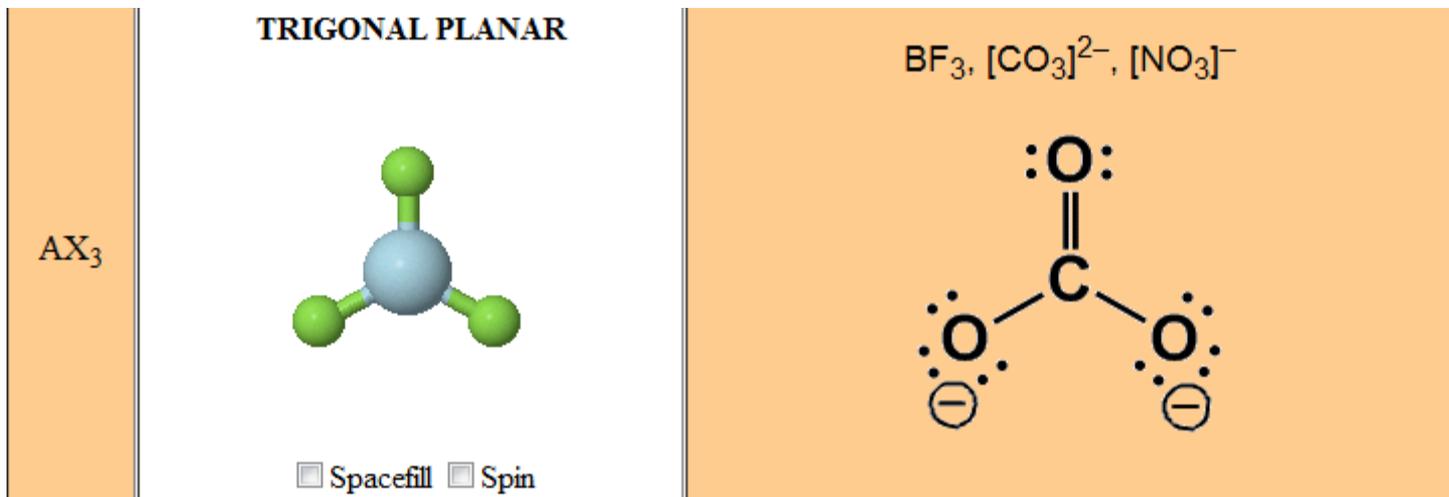
- Bonding pairs (i.e. e^- 's in a covalent bond)**
- Non-bonding pairs (i.e. lone pairs)**

These electron pairs repel as far as possible (but lone pairs repel more than bonding pairs).

Very useful website (all rotateable)

<https://people.ok.ubc.ca/wsmcneil/vsepr.htm>

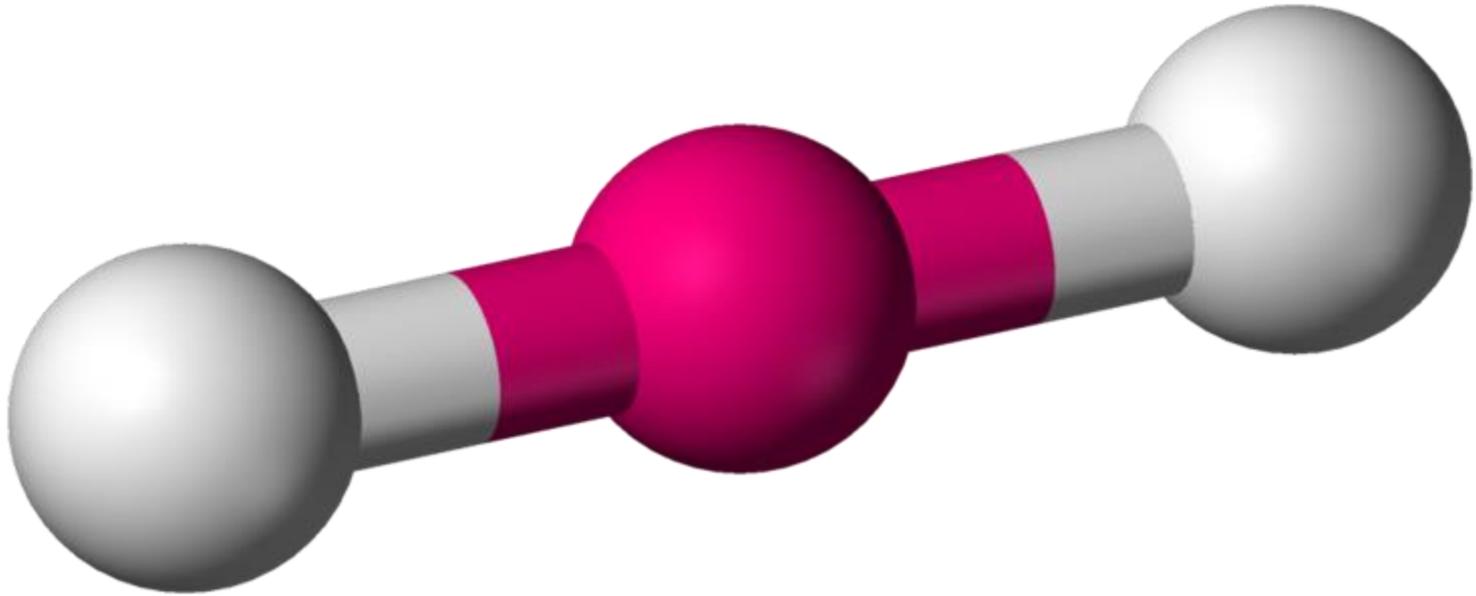
Regions of Electron Density	2	3	4	5	6
	<i>linear</i>	<i>trigonal planar</i>	<i>tetrahedral</i>	<i>trigonal bipyramidal</i>	<i>octahedral</i>
Arrangement					
Bond Angles	180°	120°	109.5°	120° and 90°	90°
	<input type="checkbox"/> Surface <input checked="" type="checkbox"/> Spin	<input type="checkbox"/> Surface <input checked="" type="checkbox"/> Spin	<input type="checkbox"/> Surface <input checked="" type="checkbox"/> Spin	<input type="checkbox"/> Surface <input checked="" type="checkbox"/> Spin	<input type="checkbox"/> Surface <input checked="" type="checkbox"/> Spin



2 ELECTRON PAIRS

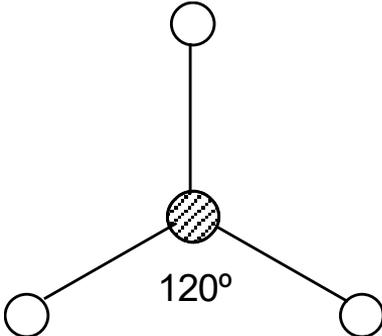
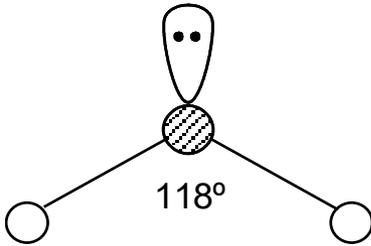
electron pairs	bonding pairs	lone pairs	shape	
2	2	0	 <p>A diagram showing a central atom (represented by a shaded circle) bonded to two terminal atoms (represented by white circles) in a straight line. The bond angle is labeled as 180°.</p>	linear

2 bonding pairs

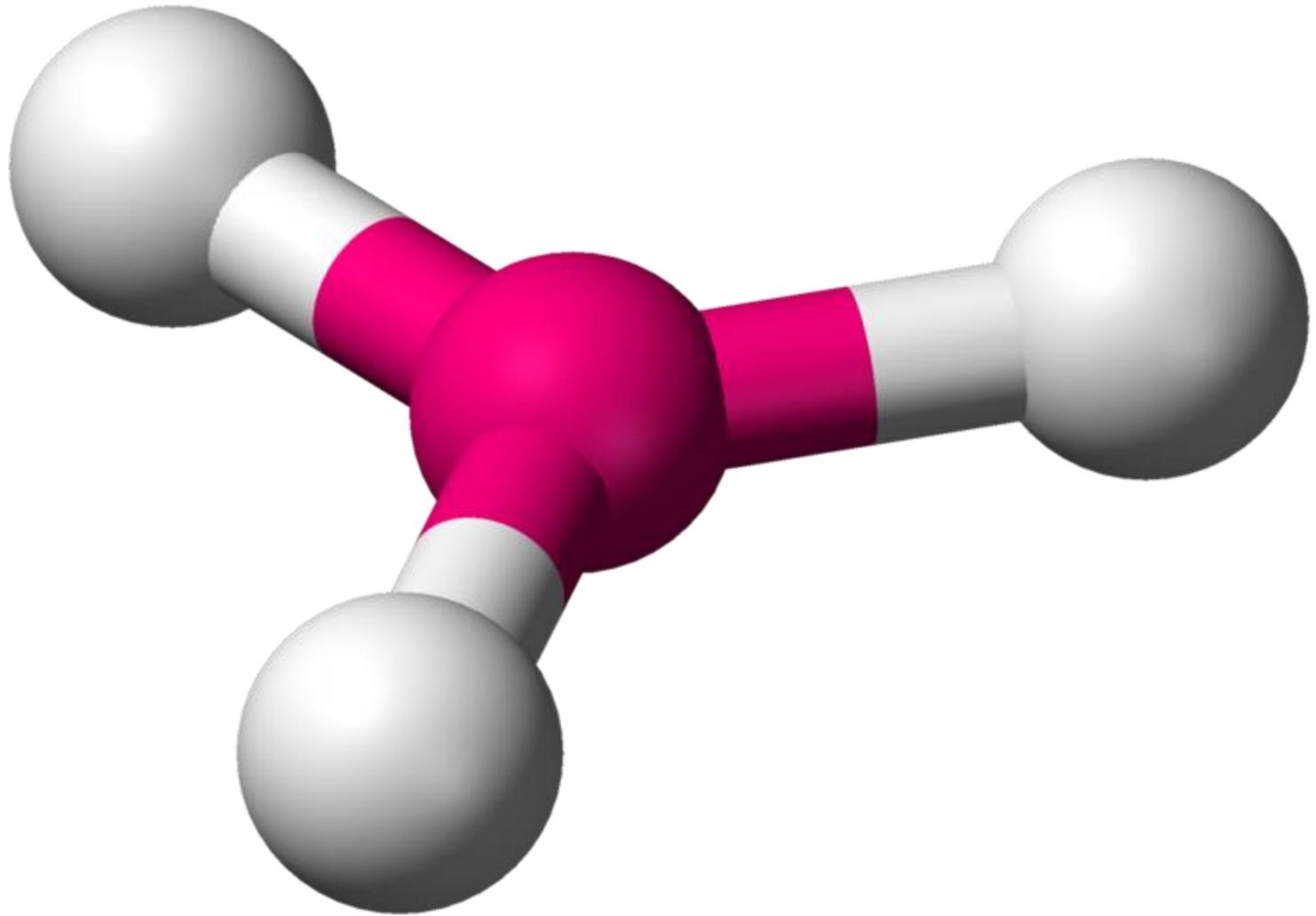


linear

3 ELECTRON PAIRS

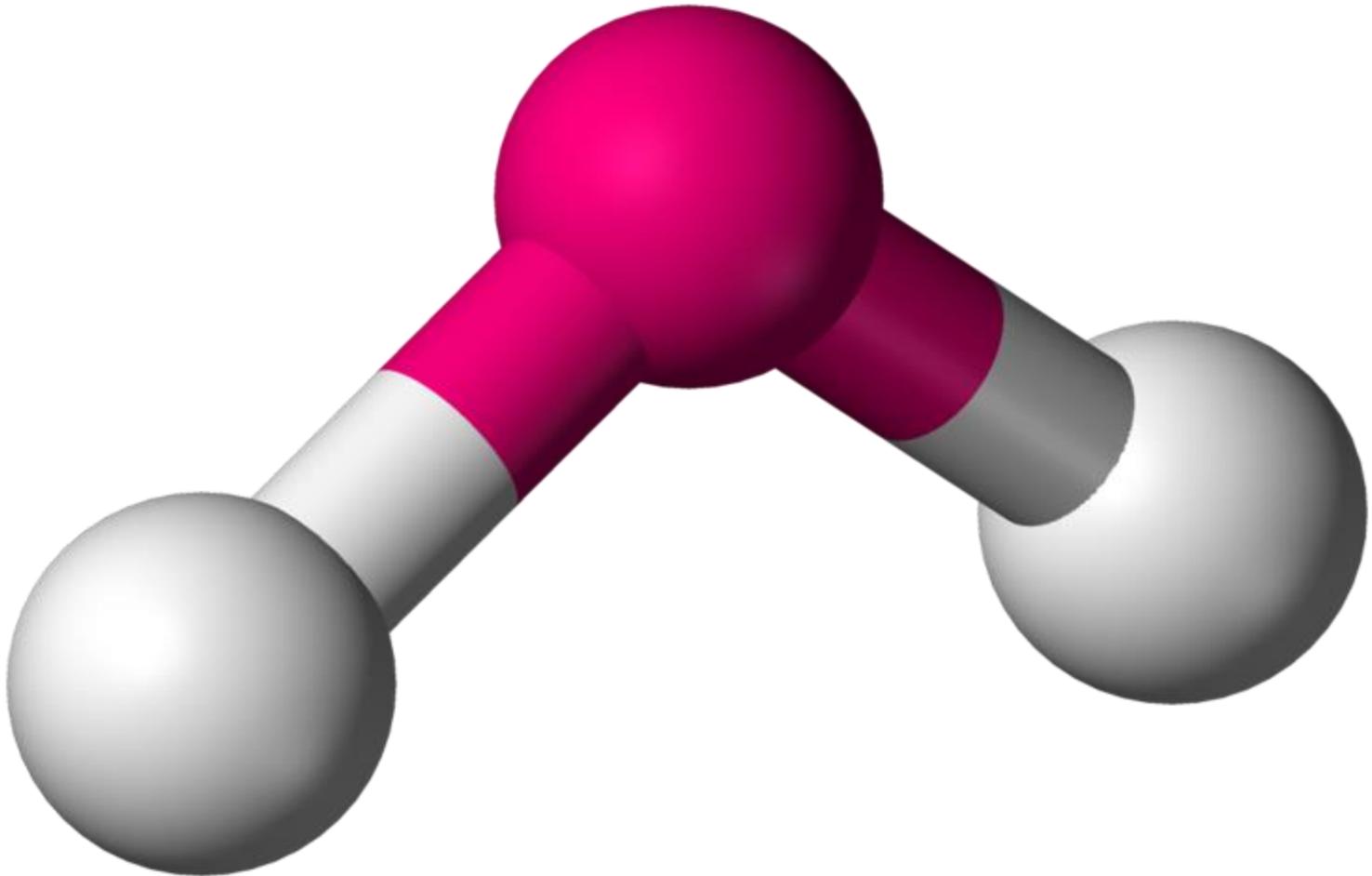
electron pairs	bonding pairs	lone pairs	shape	
3	3	0		Trigonal planar
3	2	1		Bent (V-shape)

3 bonding pairs

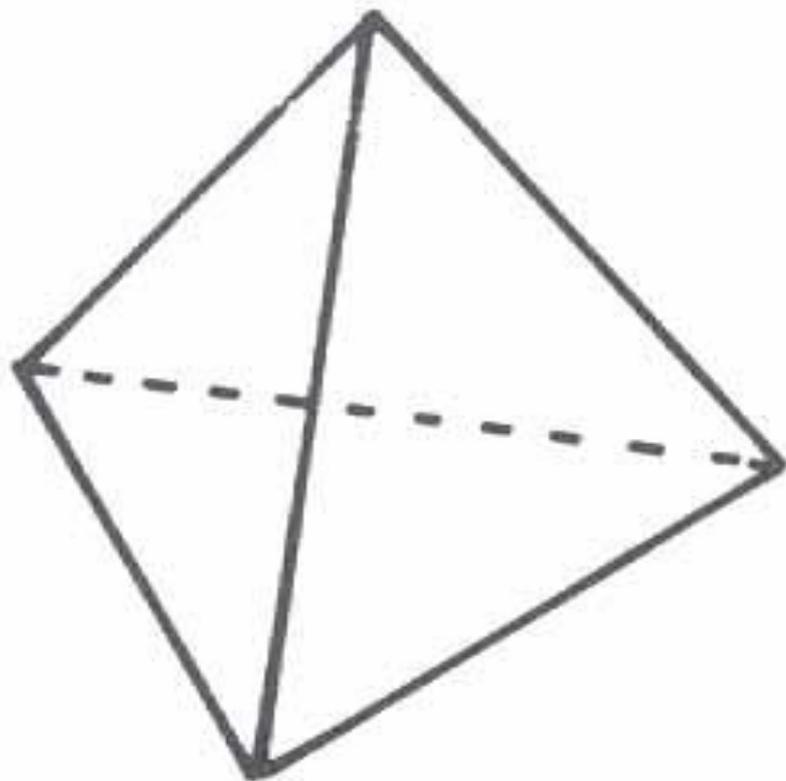
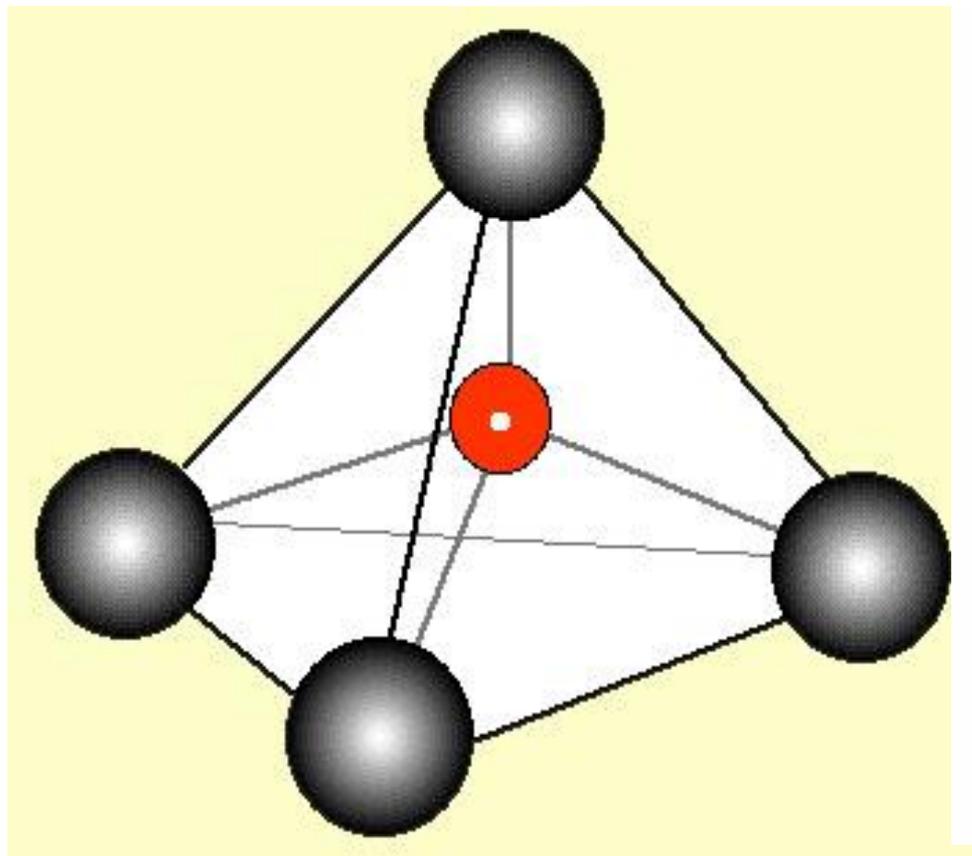


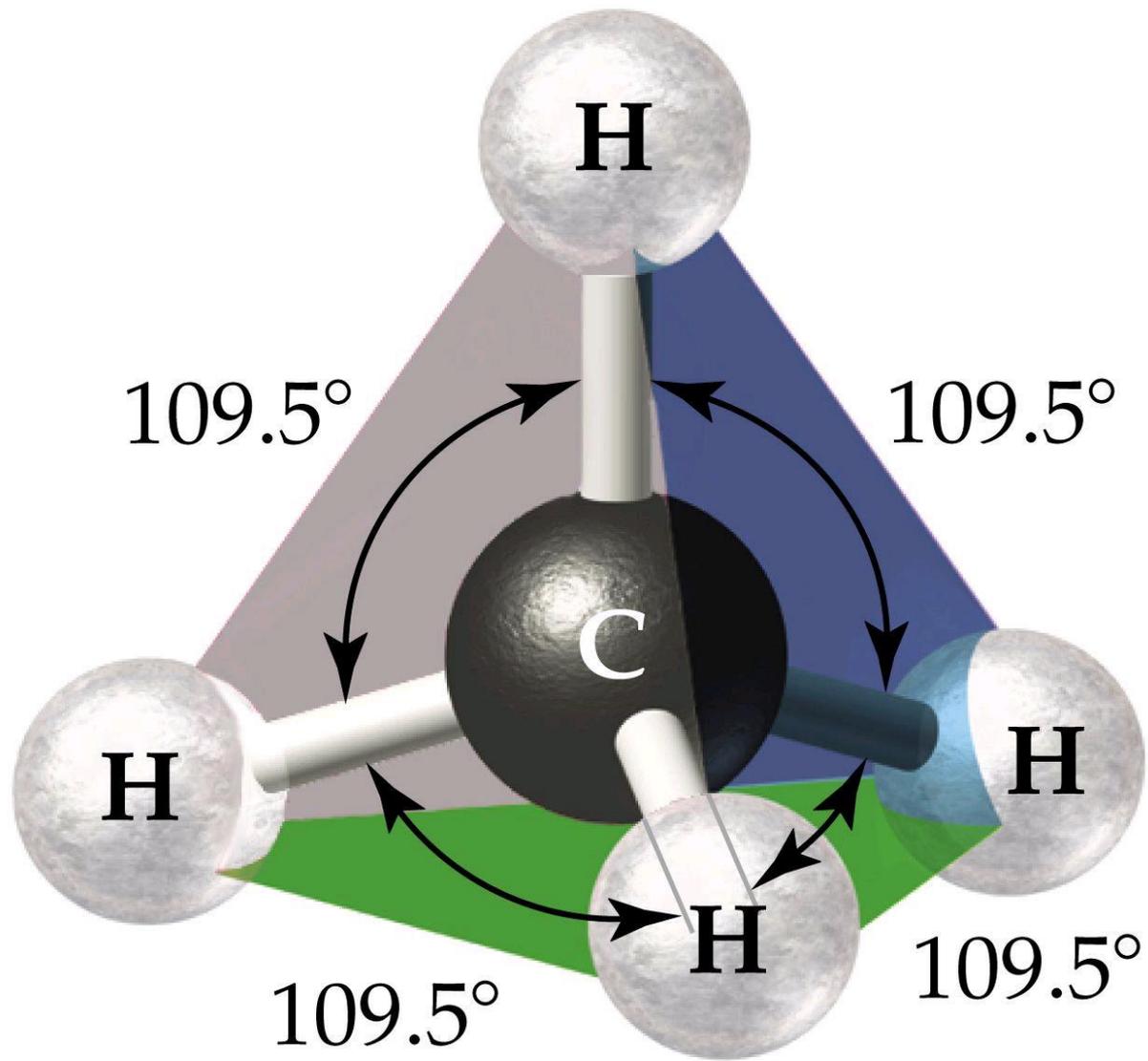
Trigonal planar

2 bonding pair + 1 lone pair

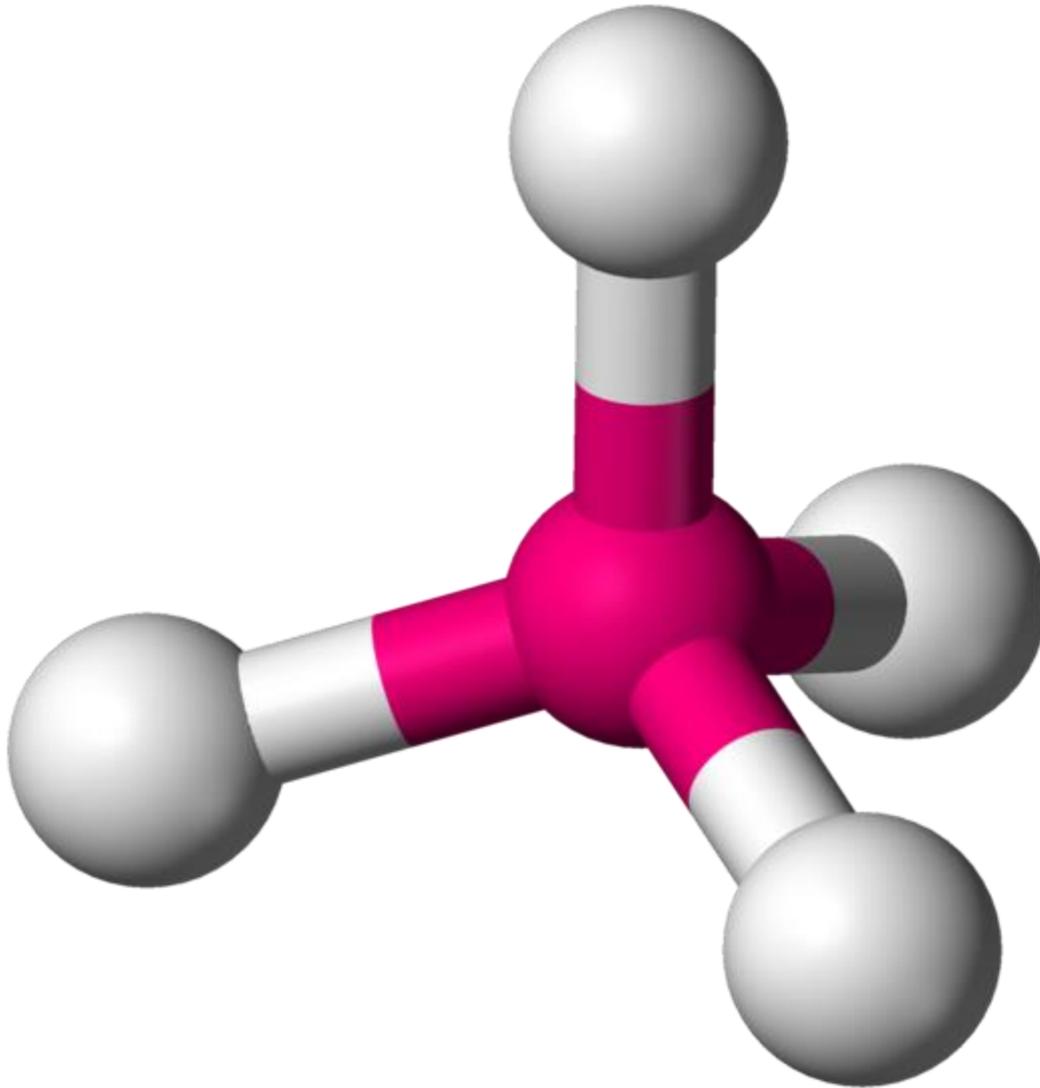


Bent



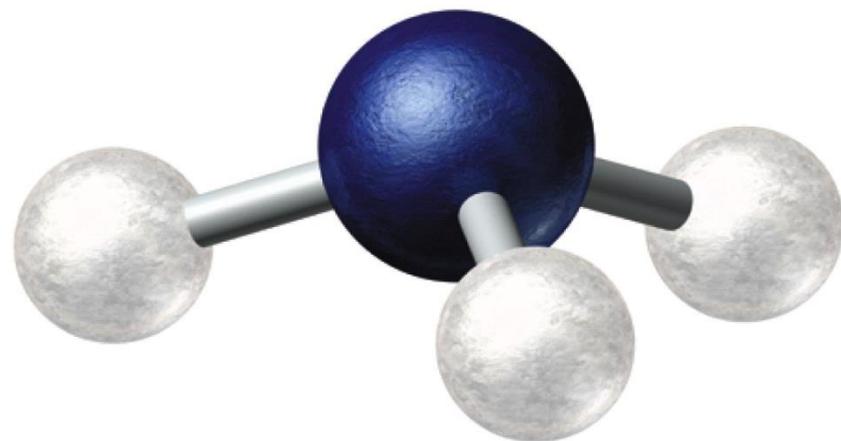
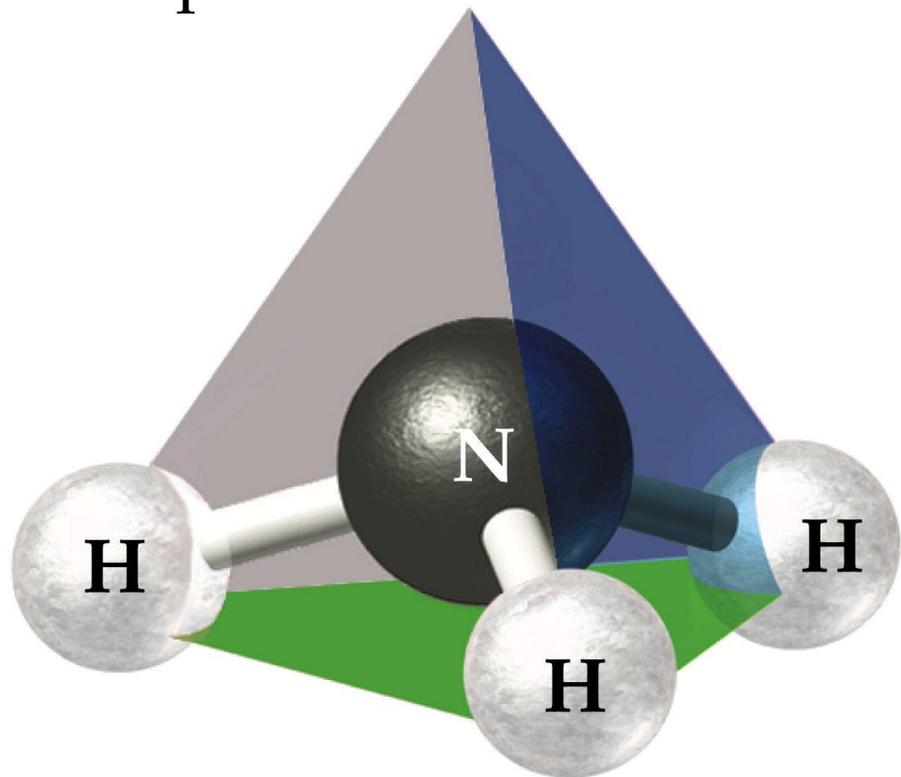


4 electron pairs



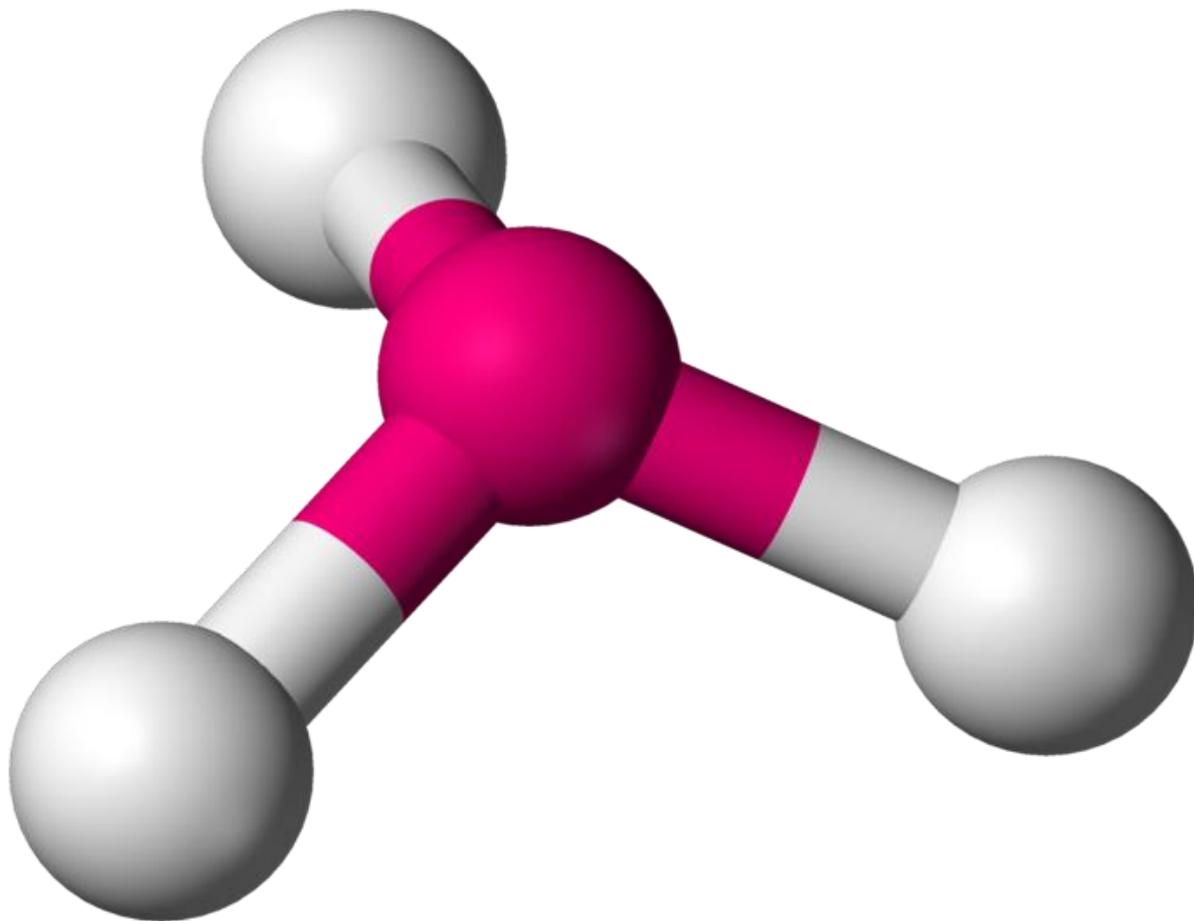
tetrahedral

Lone pair — ● ●

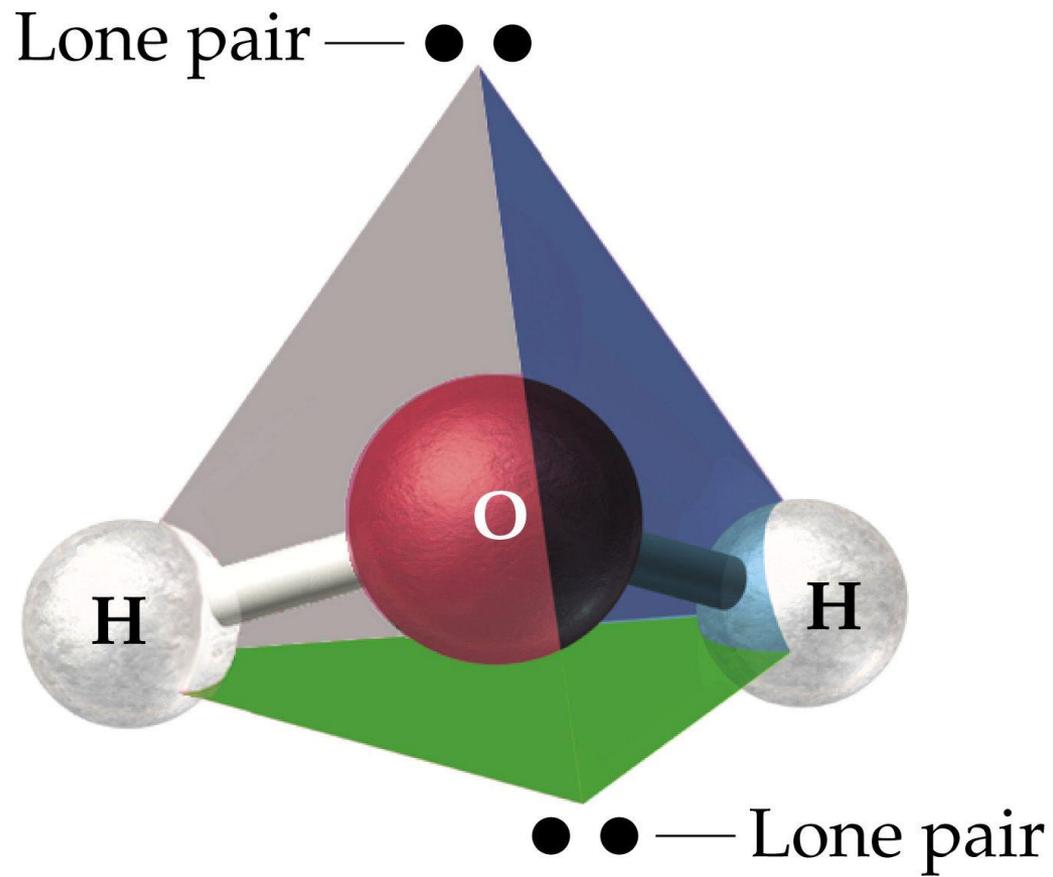


Pyramidal
structure

3 electron pairs + 1 lone pair

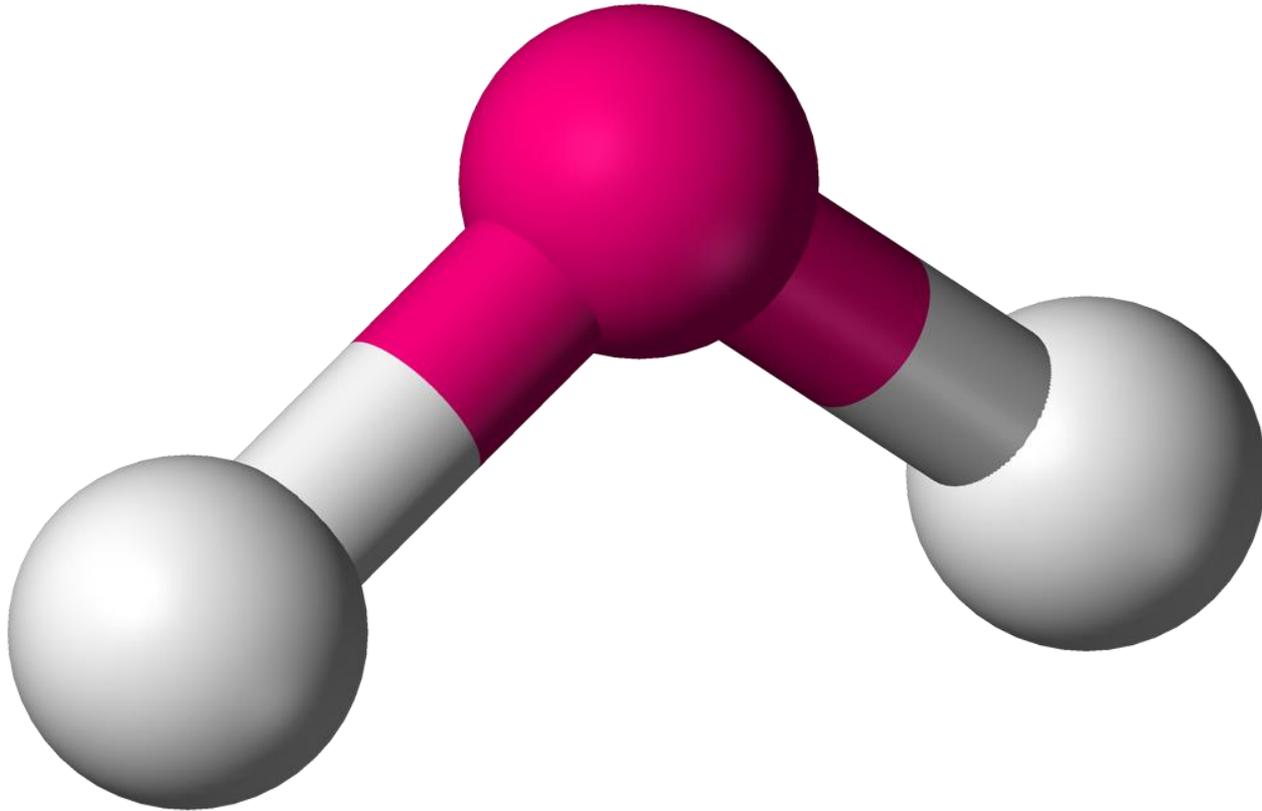


trigonal pyramid



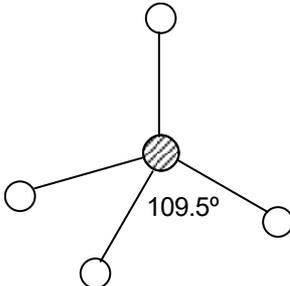
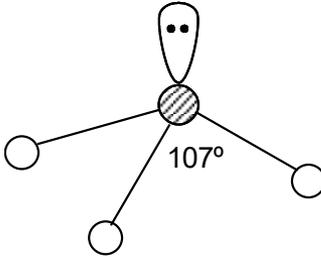
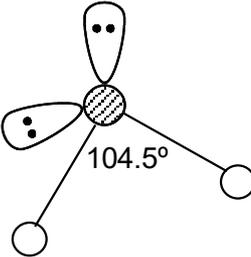
Bent structure

2 bonding pairs + 2 lone pairs

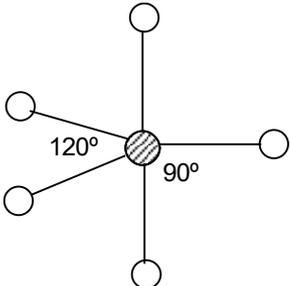
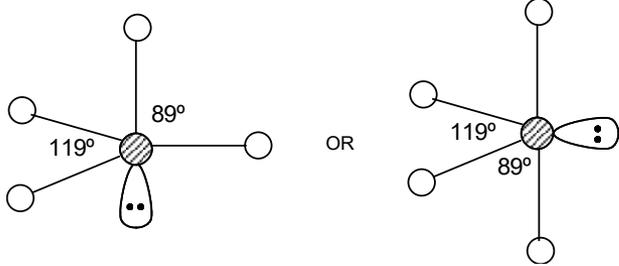
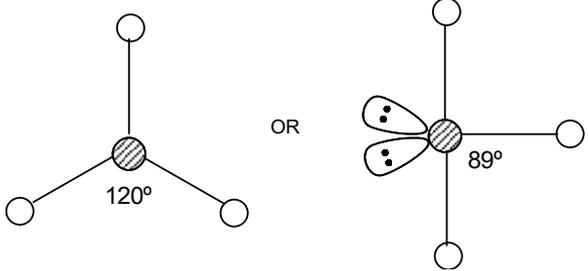


bent

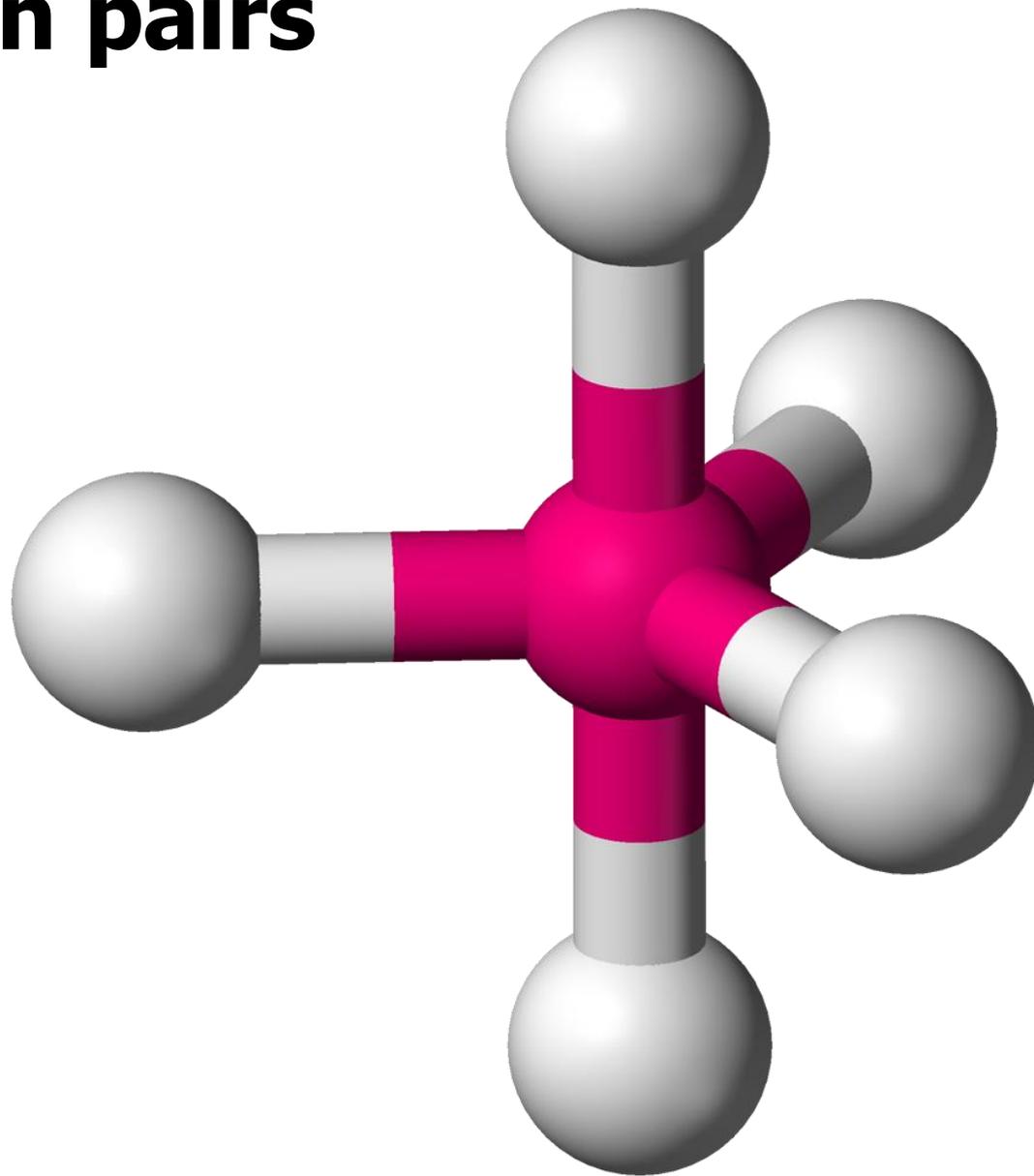
4 ELECTRON PAIRS

electron pairs	bonding pairs	lone pairs	shape	
4	4	0	 <p>A central atom (shaded circle) is bonded to four other atoms (white circles) in a tetrahedral arrangement. One bond is vertical, and the other three are angled downwards. The angle between two bonds is labeled as 109.5°.</p>	Tetrahedral
4	3	1	 <p>A central atom (shaded circle) is bonded to three other atoms (white circles) in a pyramidal arrangement. A lone pair is represented by two dots in a lobe above the central atom. The angle between two bonds is labeled as 107°.</p>	Pyramidal
4	2	2	 <p>A central atom (shaded circle) is bonded to two other atoms (white circles) in a bent (V-shape) arrangement. Two lone pairs are represented by two dots in lobes above and to the left of the central atom. The angle between the two bonds is labeled as 104.5°.</p>	Bent (V-shape)

5 ELECTRON PAIRS

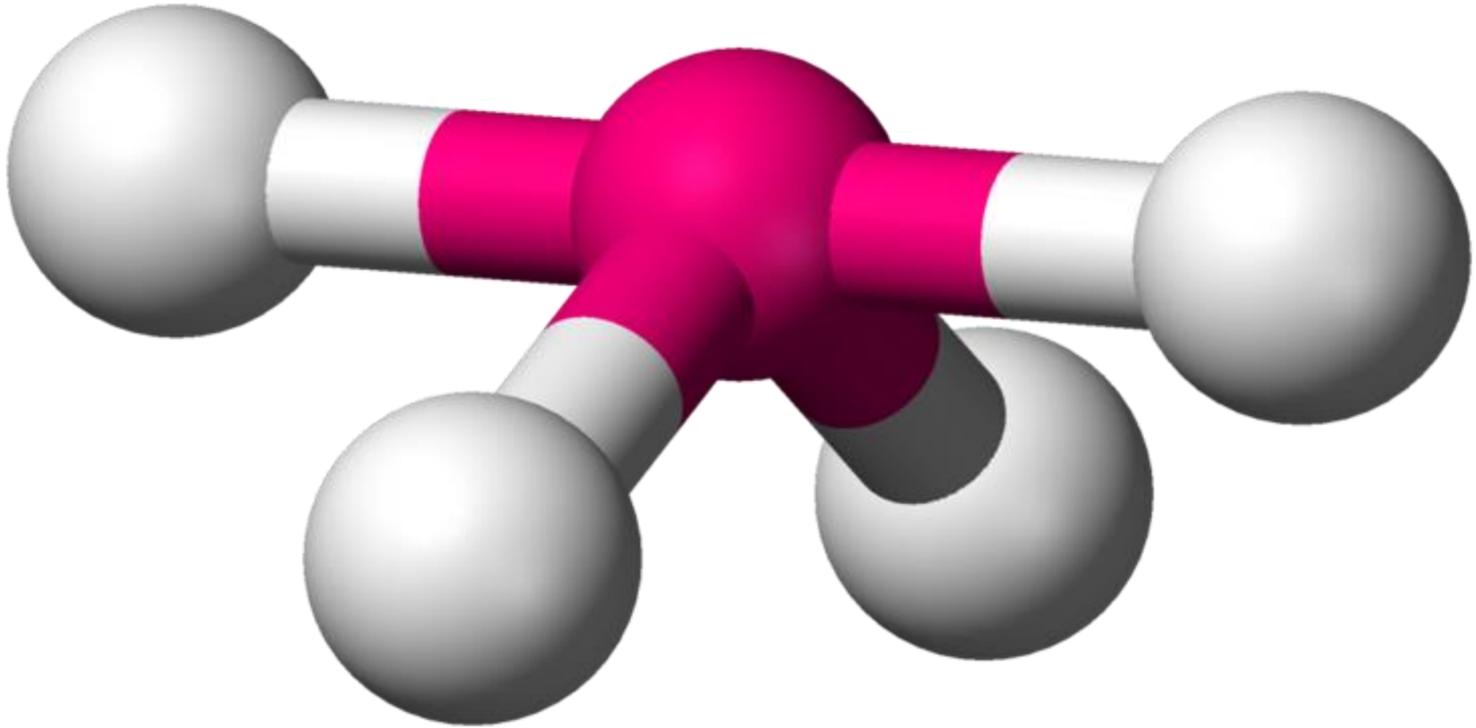
electron pairs	bonding pairs	lone pairs	shape	
5	5	0		Trigonal bipyramidal
5	4	1		
5	3	2		Trigonal planar or T-shape

5 electron pairs



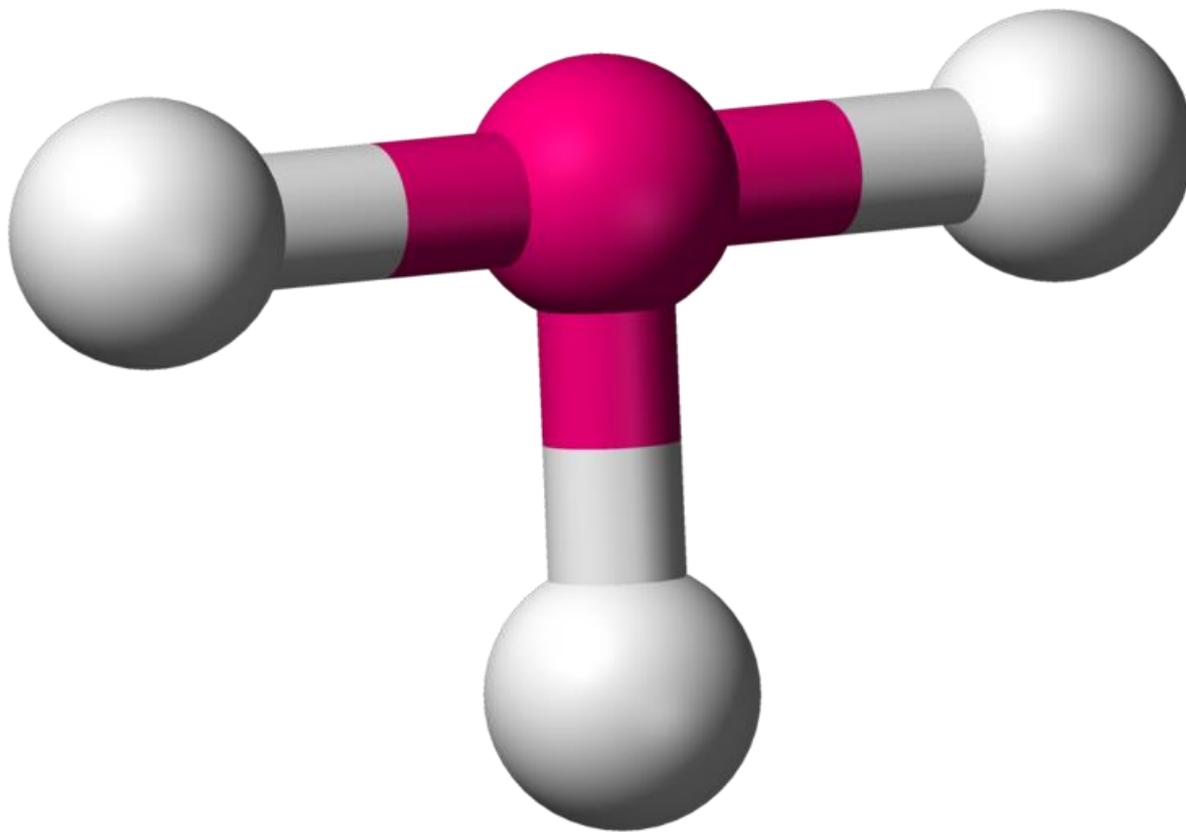
Trigonal bipyramidal

4 bonding pairs + 1 lone pair



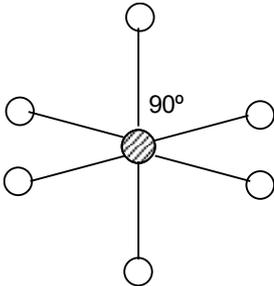
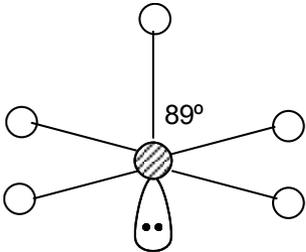
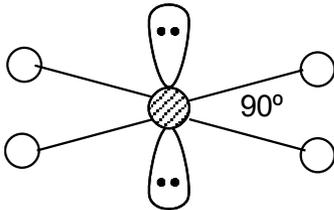
Seesaw

3 bonding pairs + 2 lone pairs

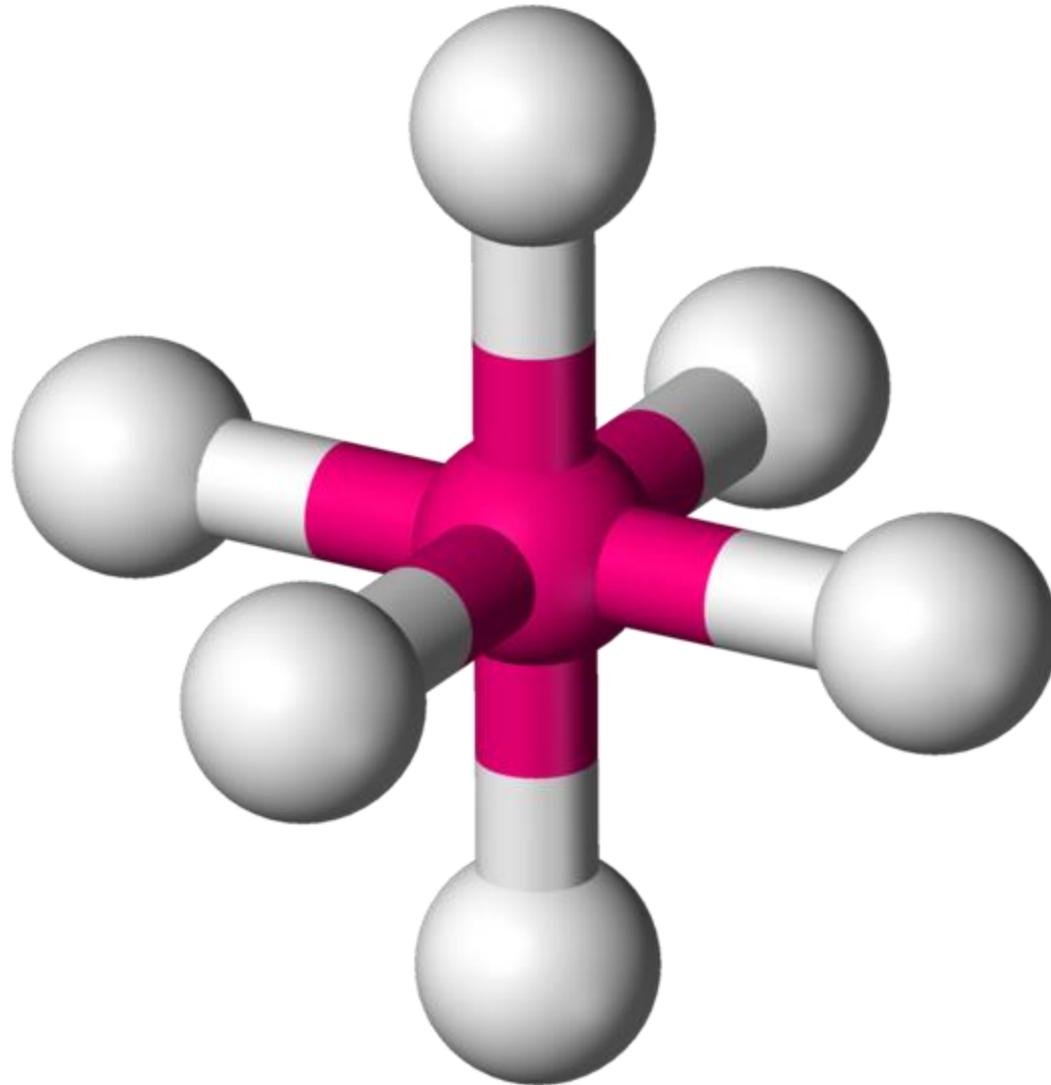


T-shape

6 ELECTRON PAIRS

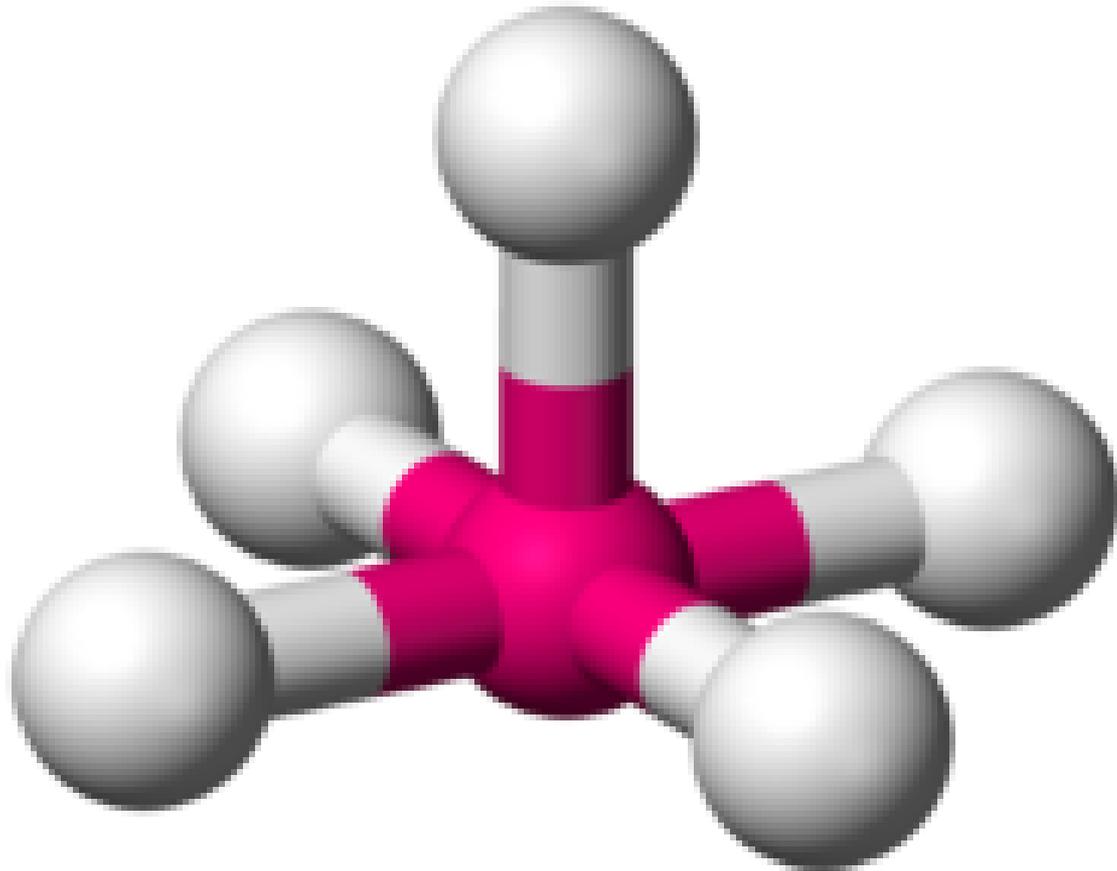
electron pairs	bonding pairs	lone pairs	shape
6	6	0	 <p>Octahedral</p>
6	5	1	 <p>Distorted square pyramid</p>
6	4	2	 <p>Square planar</p>

6 electron pairs



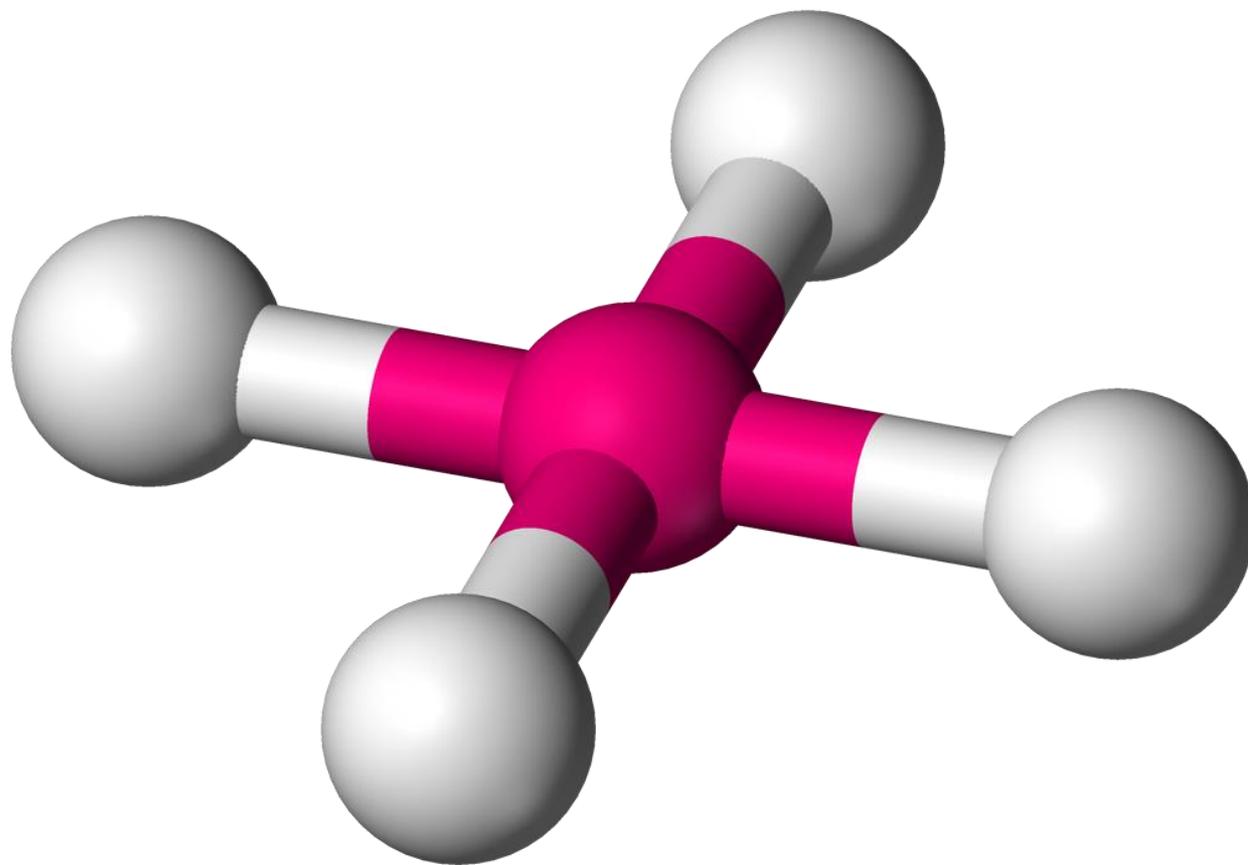
octahedral

5 bonding pairs + 1 lone pairs

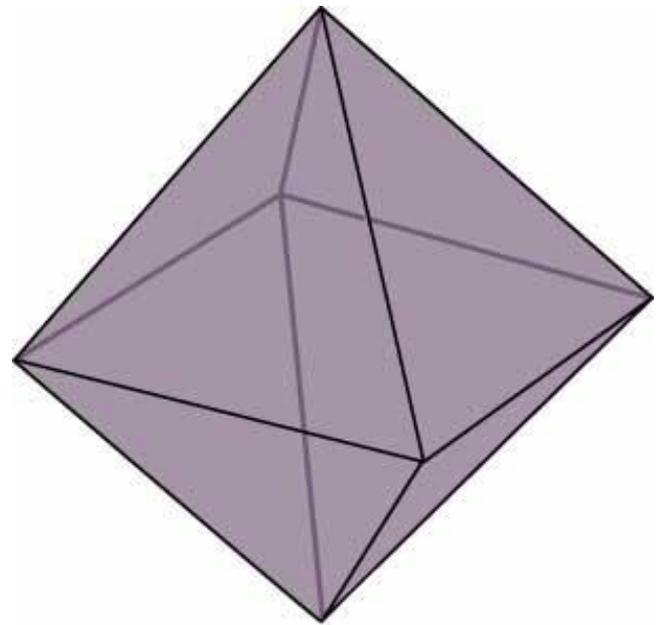


square pyramid

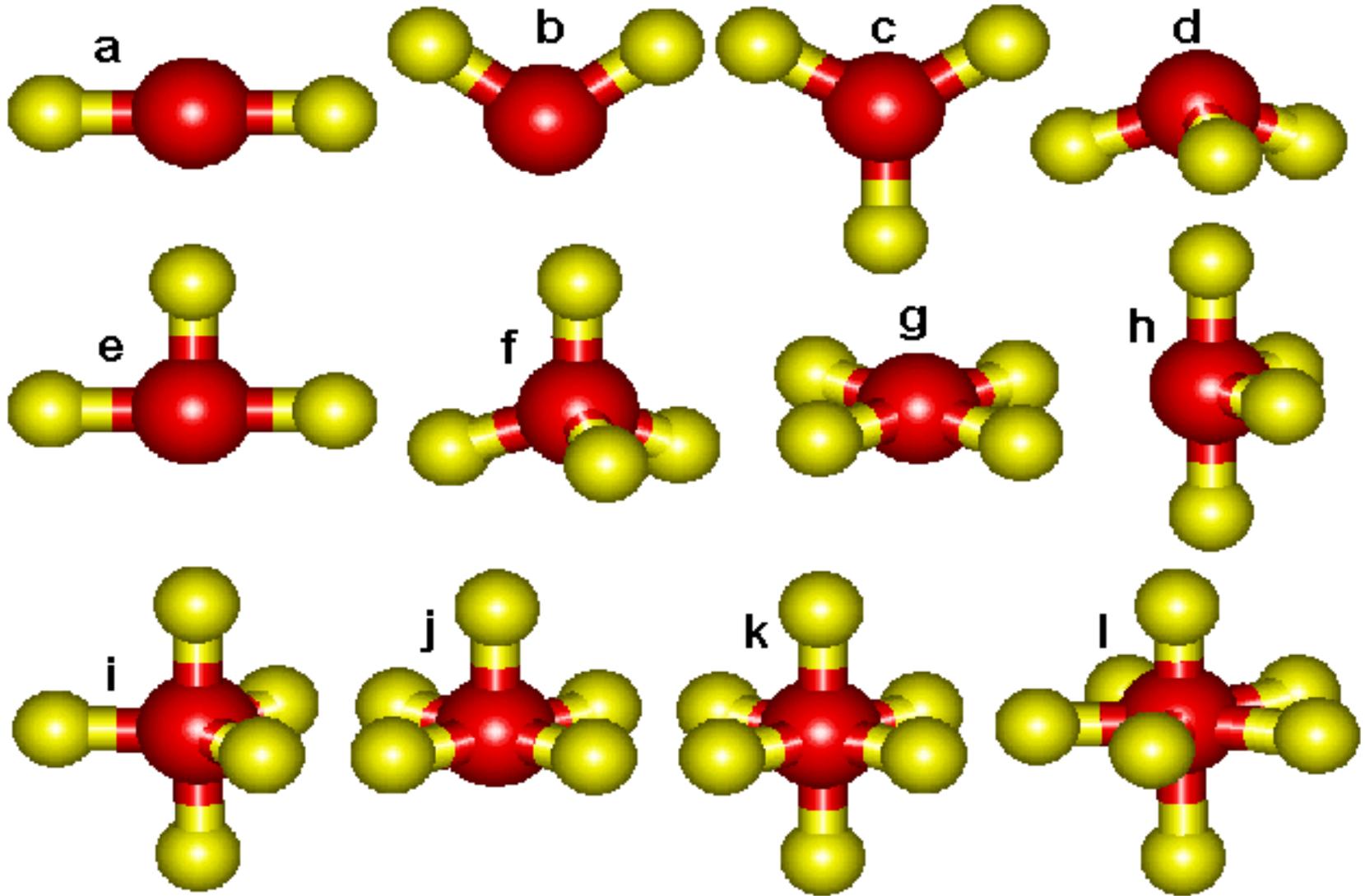
4 bonding pairs + 2 lone pairs



square planar

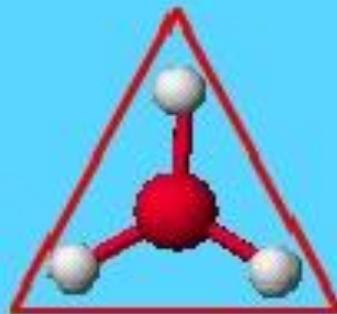


Academy Artworks

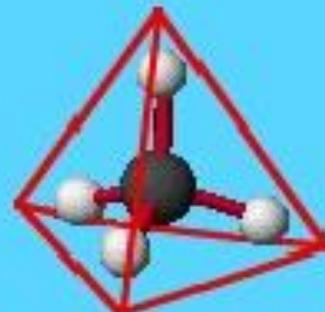




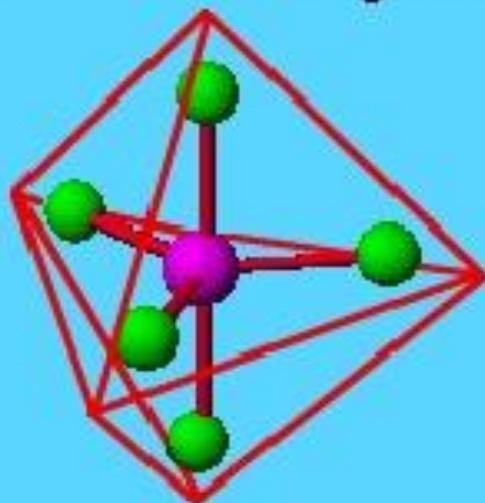
Linear



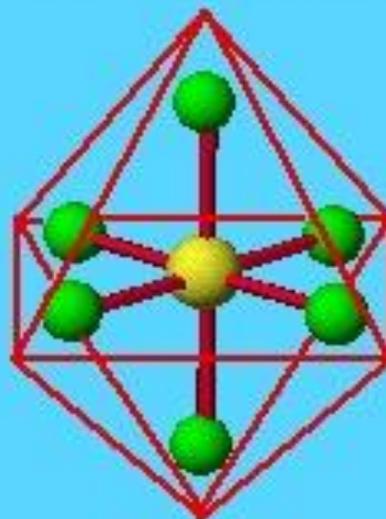
Trigonal Planar



Tetrahedral



Trigonal Bipyramidal



Octahedral