

# VSEPR Theory CC-01 → Inorganic Chemistry

## Valence Shell Electron Pair Repulsion (VSEPR) Theory:

The theory was introduced by Gillespie & Nyholm and can be summarized as:

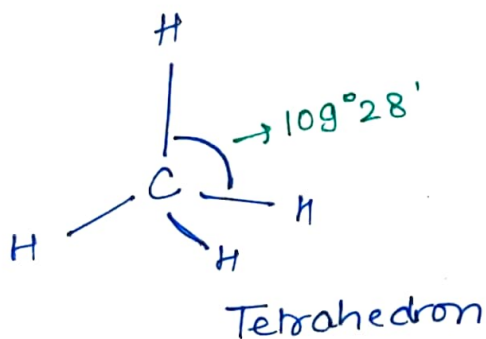
- ① The shape of molecule is determined by repulsions between all of the electron pairs present in the valence shells.
- ② A lone pair of electrons takes up more space around the central atom than the bond pair. Since, the lone pair is attracted to the one nucleus while the bond pair is shared by ~~the~~ two nuclei.
- ③ The repulsions between two lone pairs is greater than the bond pairs, which in turn is greater than the repulsion between two bond pairs.
- ④ The presence of lone pairs on the central atom causes slight distortion of the bond angles from ideal shapes. If the angle between lone pair, central atom and bond pair is increased, it follows that actual bond angles between the atoms must be decreased.
- ⑤ The magnitude of repulsions between bonding pairs of  $e^-$  depends on the electronegativity difference between the central atom and other atoms.
- ⑥ Double bonds cause more repulsion than the single bonds, and triple bonds cause more repulsion than a double bonds.

## Effect of lone pairs:

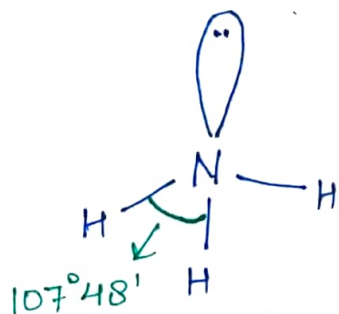
l.p. → lone pair  
b.p. → bond pairs

→ Molecules with 4 e<sup>-</sup> pairs in their outer shell are based on tetrahedron.

eg. CH<sub>4</sub> → 4 bonding pairs of e<sup>-</sup> in outer shell of C-atom.



For → Ammonia, NH<sub>3</sub>



4 electron pairs

3 → bond pairs

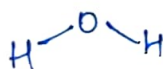
1 → lone pair

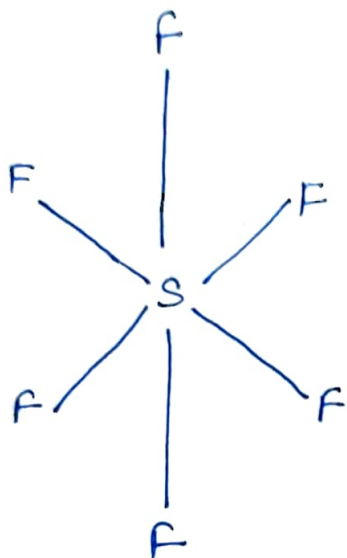
\* Due to the lone pair bond and between H-N-H is reduced

For H<sub>2</sub>O

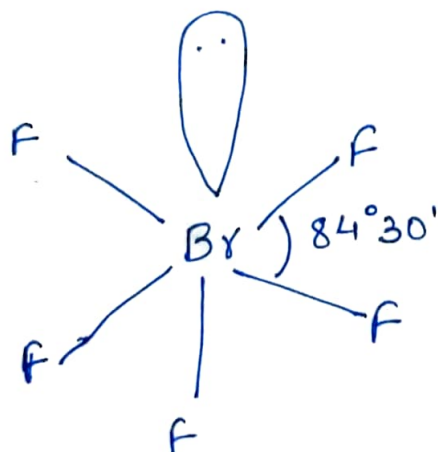
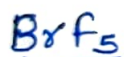


Two lone pairs further decrease the bond angle between

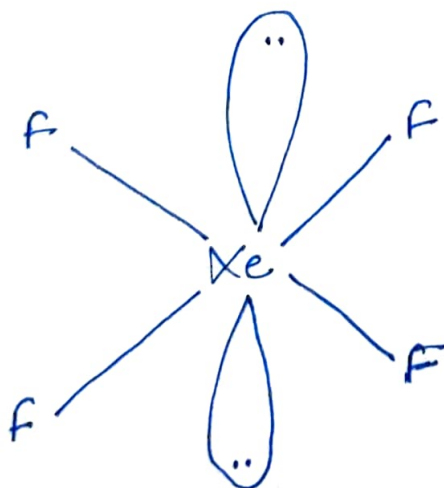




6 → bond pair  
regular octahedron  
bond angles exactly  
90°.



5 → bond pair  
1 → lone pair



4 bond pairs  
2 lone pairs  
Bond angle 90°

since the lone pairs are trans to each other the angle between F-Xe-F is 90°. The structure is regular square planar arrangement.