



A Review of Gillespie Laws, its applications and limitations

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Abstract : In order to predict the geometry of covalent molecules, Valence Shell Electron Pair Repulsion Theory is used. This theory was given by Gillespie and Nyholm. According to this theory the geometry of a molecule depends upon the number of bonding and non-bonding electron pairs in the central atom. These arrange themselves in such a way that there is a minimum repulsion between them so that the molecule has minimum energy (i.e. maximum stability).



Gillespie Laws

The following rules have been reported by Gillespie to explain the shape of some covalent molecules:

1. If the central atom of a molecule is surrounded only by bonding electron pairs and not by non-bonding electron pairs (lone pairs), the geometry of the molecule will be regular.

In other words we can say that the shape of covalent molecule will be linear for 2 bonding electron pairs, triangular for 3 bonding electron pairs. Tetrahedral for 4 bonding electron pairs, trigonal bipyramidal for 5 bonding electron pairs:

Name of Compound	Bonding Electron Pairs	Shape
BeCl ₂	2	Linear
BeCl ₃	3	Triangular Planar
SnCl ₄	4	Regular Tetrahedral
PCl ₅	5	Trigonal bipyramidal
SF ₆	6	Regular Octahedral

2. When the central atom in a molecule is surrounded by both, bonding electron pairs as well as by lone pairs, then molecule will not have a regular shape. The geometry of the molecule will be disturbed. This alteration or distortion in shape is due to the alteration in bond angles which arises due to the presence of lone pairs on the central atom. How the presence of lone pairs causes an alteration in bond angles can be explained as follows:

At a fixed angle the closer the electric-pairs to the central atom, the greater is the repulsion between them. Since the lone-pair electrons are under the influence of only one positive centre (i.e. nucleus), they are expected to have a greater electron density than the bond-pair electrons which are under the influence of two positive centres. Thus lone pair is much closer to the central atom than the bond pair. Hence it is believed that lone pair will exert more repulsion on any adjacent electron pair than a bond pair will do on the same adjacent electron pair.

$$(lp - lp) > (lp - bp) \quad \dots\dots\dots(i)$$

(lp = lone pair and bp = bond pair)

If the adjacent electron pair is a bond pair, then repulsive force between lone pair and bond pair will be greater than repulsive force between two bond pairs.