

Valence Shell Electron Pair repulsion Theory
(VSEPR) Theory

This theory was developed by Gillespie and Nyholm in 1957. According to this theory, The geometry of a molecule depends upon the no of bonding and non-bonding electron pairs in the central atom which arranges them in a such a way that there should be minimum repulsion between them so that the molecule has minimum energy and maximum stability, Since there can only be one orientation of orbitals Corresponding to minimum energy, the molecule has a definite shape.

The following rules have been proposed by Gillespie to explain the shapes of molecules and ion.

Rule-1. When the central atom of a molecule is surrounded only by the bonding electron pairs (bp's) but not by lone pairs (lp's) the geometry or shape of molecules will be regular. The geometry depends upon the no of bonding electron pairs as given in the following Table

No of bonding electron	Geometry	Bond angle	Examples
2	Linear	180°	BeCl ₂ , HgCl ₂
3	Trigonal Planar	120°	BF ₃ , SF ₃
4	Tetrahedral	109°28'	CH ₄ , SiH ₄
5	Trigonal bipyramidal/50° and 120°	90°	CrO ₄ ²⁻ , SnCl ₅
6	Octahedral	90°	PtCl ₆ , [SCN] ⁻
7	Pentagonal bipyramidal	72° 90°	SF ₆ , (SiF ₆) ²⁻ , IF ₇

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Rule: - 2MP BIRLA
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when the central atom in a molecule is surrounded by both bonding electron Pairs and lone Pairs the molecule does not have a regular geometry. lone Pairs of electrons repel adjacent electron Pairs more strongly than do bonding electron pairs. The repulsion is in the following order.

$$(LP-LP) > (LP-bp) > (bp-bp)$$

The bond angle decreases as the no of LP's on the central atom increases e.g.

Molecule	CH_4	NH_3	H_2O
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no of LP's	0	1	2
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Bond angle	109.5°	107.3°	104.3°
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Rule 3. The repulsion of the bond Pair decreases with Increases electronegativity of the atom B in AB_n molecules and hence the bond angle $B-A-B$ decreases. This is due to the fact that the average position of bonding electron Pairs Moves farther from the central atom A. Therefore the repulsive force of the bp on the LP on atom decreases. This decreases the bond angl. For example

$$\text{AsI}_3 (101^\circ) > \text{AsBr}_3 (100.5^\circ) > \text{AsCl}_3 (98.4^\circ)$$

Rule: 04

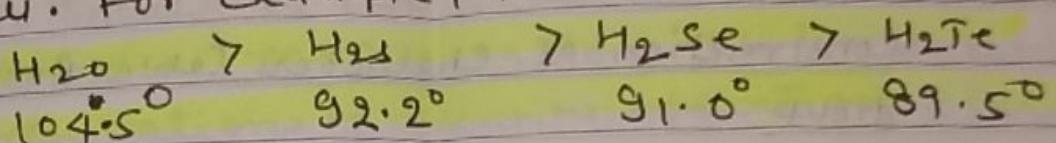
Bond angles involving multiple bonds are generally Larger than those involving only Single bonds. However, the multiple

A man who was completely innocent, offered himself as a sacrifice for the good of others, including his enemies, and became the ransom of the world. It was a perfect act.

bonds are generally ²⁴⁴⁻¹²² | MONDAY

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single bonds. However the multiple bonds
do not effect the geometry of a molecule.
between electron Pairs in

Rule 5:- Repulsion between electron Pairs in filled shells are larger than the repulsion between electron pairs in incompletely filled shell. For example, the bond angle decreases



Limitation of VSEPR Theory

- ① This theory does not explain the shapes of Molecules having very Polar bonds e.g Li_2O Should have the same structure as H_2O but it is linear.

② This Theory does not explain the shape of Molecules having extensive delocalised π -electron system.

③ VSEPR Theory does not explain the shape of certain Compounds which have Inert Pair of electrons

④ This theory fails to explain the shape of certain Compounds of transition elements