Topic : ..... Date. : ..... Page No. : 1.

Covalent Bonding

Covalent Bond :- According to Lewis a covalent bond is formed when two neighbouring atoms share an electron pair.

eg. Cl_2 

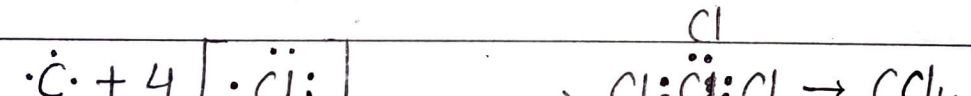
Single Bond	A shared electron pair
Double Bond	Two shared electron pairs
Triple Bond	Three shared pairs of electrons

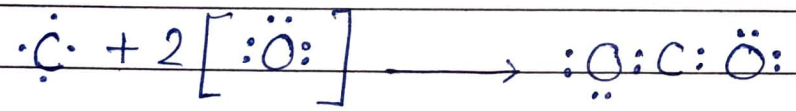
Lone Pair :- An unshared pair of valence electrons on an atom is called a lone pair.

→ Lone pairs do not contribute directly to the bonding.

→ Lone pairs do influence the shape of the molecule and play an important role in its properties.

Octet Rule :- Each atom shares electrons with neighbouring atoms to achieve a total of eight valence electrons.



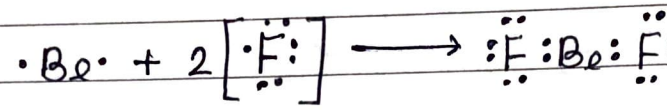


Exceptions to Octet Rule :-

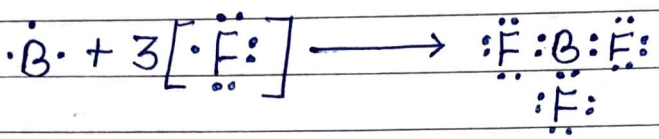
The octet rule is broken in a significant number of cases:

For atoms such as Be and B which have less than four outer electrons. Even if all the outer electrons are used to form bonds an octet cannot be attained.

$_4Be \rightarrow 1s^2\ 2s^2$



$_5B \quad 1s^2\ 2s^2\ 2p^1$



2. The octet rule is also broken where atoms have an extra energy level which is close in energy to p level, and may accept electrons and be used for bonding. e.g. PF_3 obey octet rule but PF_5 does not.

3. The octet rule does not work in molecules which have an odd number of electrons, such as NO and ClO_2, nor does it explain why O_2 is paramagnetic and has two unpaired electrons.

4. It gives no indication of the shape adopted by the molecule.

Sidgwick-Powell Theory :-
According to Sidgwick-Powell

No. of Pairs	electron in outer shell	Shape of Molecule	Bond Angles
2		Linear	180°
3		Plane triangle	120°
4		Tetrahedron	109°28'
5		Trigonal Bipyramid	120° and 90°
6		Octahedron	90°
7		Pentagonal Bipyramid	72° and 90°

VSEPR Theory (Valence shell electron pair repulsion Theory) :-

Rule 1 :- Electrons pairs tend to minimize repulsions. Ideal geometries are.

a) For two electron pairs, linear
b) For three electron pairs, trigonal
c) For four electron pairs, tetrahedral
d) For five electron pairs, trigonal bipyramidal
e) For six electron pairs, octahedral.

Rule 2 :- Repulsions are of the order LP-LP > LP-BP > BP-BP.

a) When lone pairs are present, the bond angles are smaller than predicted by rule 1.
b) Lone pairs choose the largest site e.g. equatorial in trigonal bipyramid.
c) If all sites are equal, lone pairs will be trans to each other.

Rule 3 :- Double bonds occupy more space than the single bonds.

Rule 4 :- Bonding pairs to electronegative substituents occupy less space than those to more electropositive substituents.

Rule 5 :- If the central atom is in the third row or below in the periodic table, the lone pair will occupy a stereochemically inactive s orbital and the bonding will be through p orbitals and near 90° bond angles if the substituents electronegativity is $\leq \sim 2.5$

Rule 6 :- Isoelectronic species usually have the same structure. This may be extended to species with the same number of valence electrons. e.g BF_4^-, CH_4 & NH_4^+ all are tetrahedral, CO_3^{2-}, NO_3^- and SO_3 are are planar