Chemical Bonding

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Introduction

A chemical bond is defined as the attractive force that holds two (or) more atoms together in a molecule.

In the formation of a chemical bond, atoms interacts with each other by losing, gaining (or) sharing of electrons so as to acquire a stable outer shell of 8 electrons.

Octet rule

In the formation of a covalent bond, the atom attains an inert gas configuration with an octet of electrons (i.e., $ns^2\ p^6$ configuration).

This is known as octet rule (or) rule of eight. Since He atom has only two electrons, this rule is called doublet rule (or) rule of two.

The main point of this theory is an atom with eight electrons in the outermost shell (2 in case of He) are chemically stable and hence are in capture of chemical combination.

Limitations of octet rule (or) failure of octet rule

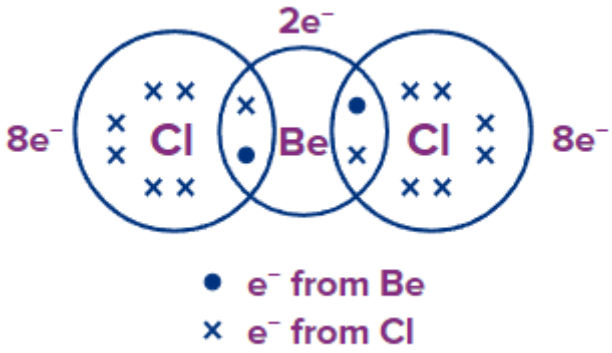
Some atoms bonded to others by covalent bond do not complete their octet.

i.e., in such molecule octet rule breaks down. This is due to either an in complete octet (i.e., 8 electrons) (or) expansion of octet (i.e., the atoms is surrounded by more than 8 electrons)

Incomplete octet

Consider $BeCl_2$, the central Be atoms has only 4 electrons in its outermost shell two of its own (shown by cross) the covalently bonded atoms.

Be^4-$1s^2$, $2s^2$



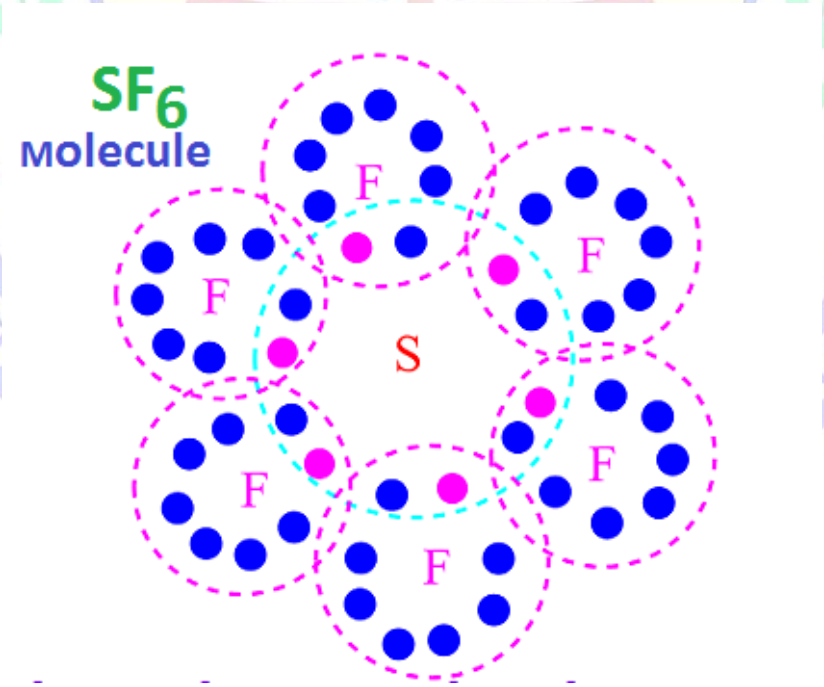
Expansion of octet

Consider SF_6 molecule

$S^{16}= 1s^2,2s^2p^6,3s^2p^4$

$F^9=1s^2,2s^2,p^5$

In SF_6 molecule the number of electrons in the outermost shell of sulphur atom.(central atom) is 12 i.e., 6 electron from its own (S $3s^2p^4$) and 6 electrons gained by S in forming 6 covalent bonds with 6F atoms.



The octet concept is not able to explain the structure of covalent molecules whose central atom has either less(or) more than 8 electrons in the outermost shell.

Types of bonds

Ionic bond (or) electrovalent bond

Ionic bond is formed by the complete transfer of one (or) more electrons from valence shell of one atom to the other atom.

Example: Na-Cl, Cl-Ca-Cl

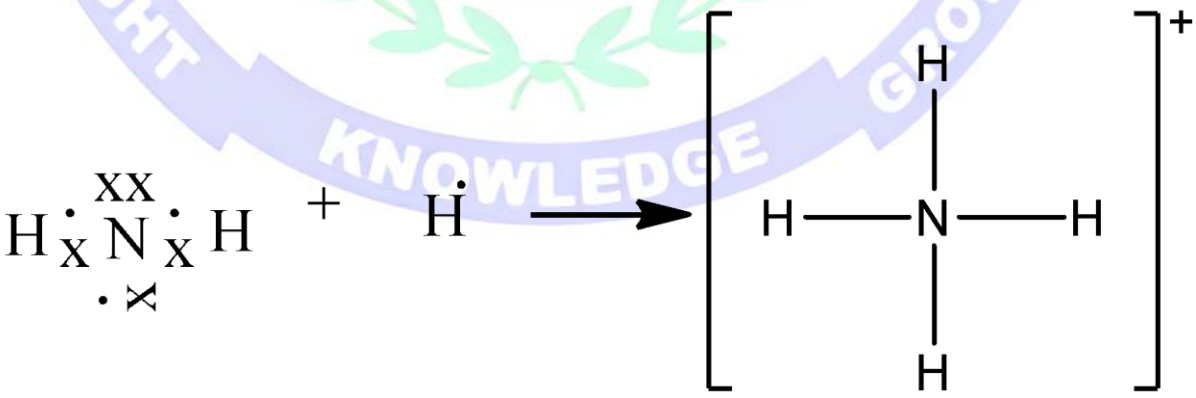
Covalent bond

A covalent bond is formed by mutual sharing of electrons between two atoms in their valence shell.

Example: H-H

Coordination bond

- This bond is formed between two atoms by sharing of electrons (one pair of electrons) like covalent bond but the pair of electrons required for sharing is contributed by only one atom.
- Thus it is a special type of covalent bond called a co-ordination bond.
- Example:
- Consider the formation of NH^{4+} ions from ammonia and H^{+} ion.



The long pair of electron of nitrogen in ammonia donate to the H^+ ion from co- ordinate bonds.

Metallic bond

The bond formed between metallic atoms in metals is called metallic bond. In metals electropositive metal ions are embedded in cloud of electrons.