CHEMICAL BONDING

① Chemical Bonding (Definition).

② Types of chemical bonding with Egs.
   ① Ionic / polar / Electrovalent bond
   ② Covalent / Non-polar bond.

③ Electrovalent & Covalent compound.

④ Duplet & Octet

⑤ Valency (Electrovalency & covalency) with Egs.

⑥ formation of Ionic & Covalent Bonds with Egs.

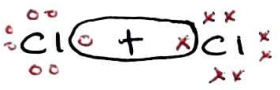
CHEMICAL BONDING (DEFINITION)

" The force of attraction which keeps two atoms, two molecules & two ions together in a molecule is called chemical bonding "

OR

" When atoms of the elements combine to form molecules, a force of attraction is developed between the atoms which holds them together. This force is called chemical bond. "

Eg:- ① In Cl_2 molecule, the two chlorine atoms are held together by a chemical bond.



$\longrightarrow$ Cl — Cl (Cl_2) molecule.

Cl_2 molecule has less energy than Cl atoms.

TYPES OF CHEMICAL BOND

(1) IONIC / ELECTROVALENT / POLAR BOND.

* DEFINITION:- " The chemical bond formed by the mutual transfer of electrons from one atom to another is known as Ionic bond ".

* Electrovalent bond is also known as Ionic bond because it is a chemical bond between oppositely charged ions.

* Eg:- ① combination of Na & Cl atoms.

Na,

Z = 11 (2,8,1)

Valence e^- = 1

$$[Na^\bullet] \xrightarrow{-1e^-} [Na^+]$$

(2,8,1) (2,8) = Ne

Cl

Z = 17 (2,8,7)

Valence e^- = 7

$:\ddot{\underset{\cdot\cdot}{Cl}}\cdot + 1e^- \longrightarrow Cl^-$ (Chlorine-ion)

(2,8,7) (2,8,8) = Ar

$[Na^+] + [Cl^-] \longrightarrow NaCl$

COVALENT / NON POLAR BOND

DEFINITION :- "The chemical bond formed by the sharing of e's between two atoms is known as Covalent bond".

OR

"The attractive force between atoms created by sharing of an e^- pair".

TYPES OF COVALENT BOND

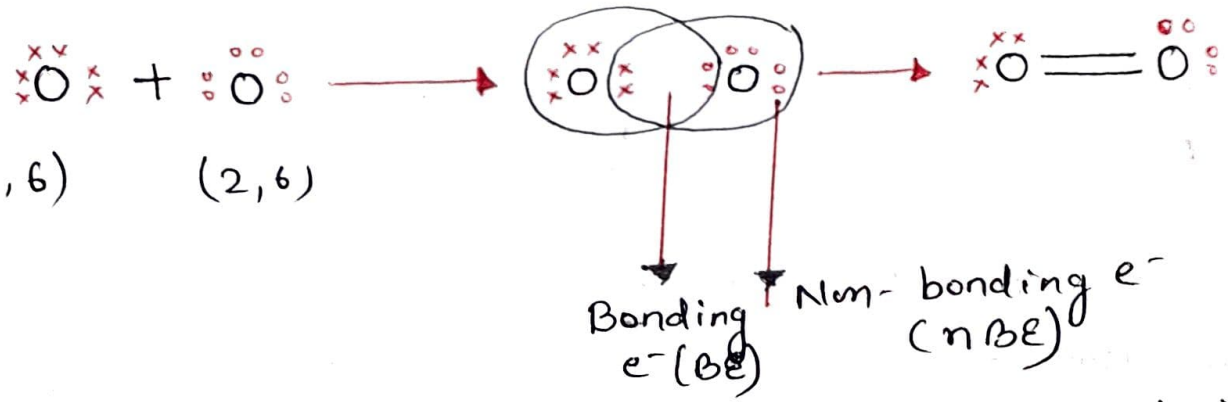
1. Single Covalent bond
2. Double " "
3. Triple " "

1. SINGLE COVALENT BOND :- " A Single Covalent bond is formed when one pair of e's is shared between two atoms".

Eg :- ① H_2 molecule :-

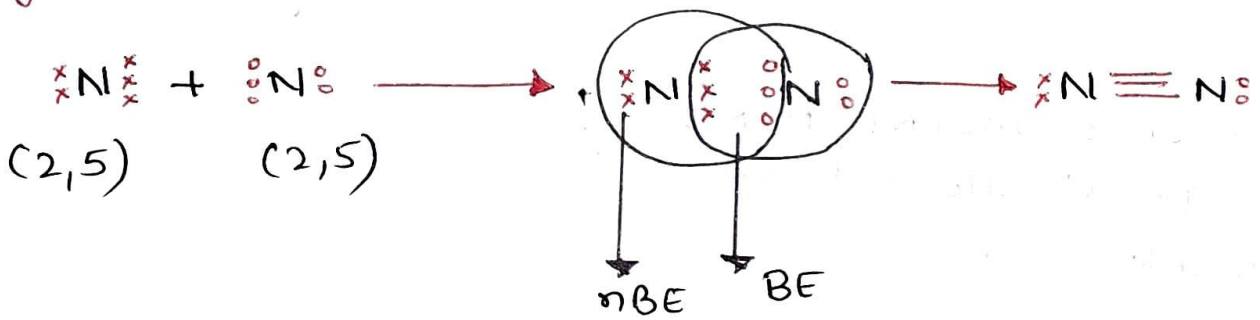
DOUBLE COVALENT BOND "A double covalent bond is formed when two pair of e⁻s is shared between two atoms".

Eg:- O_2 molecule.



TRIPLE COVALENT BOND " A triple covalent bond is formed when three pair of e⁻s is shared between two atoms".

Eg:- N_2 molecule.



VALENCE e⁻ (VE) The e⁻s present in the outermost/ Valence shell of an atom.

BONDING e⁻ (BE) The e⁻s which takes part in bond formation.

NON- BONDING e⁻ (nBE) The e⁻s which does not takes part in bond formation.

DIFFERENCE BETWEEN IONIC & COVALENT COMPOUNDS

IONIC COMPOUND	COVALENT COMPOUND.
① Crystalline solids at room temperature.	① Gases, Liquids or soft solids under ordinary conditions.
② High m.p & b.p.	② Low m.p & b.p with the exception of giant molecules such as diamond, SiC, SiO_2.
③ Hard & brittle	③ Soft & waxy with the exception of giant molecules
④ Freely soluble in water & in polar solvents. Insoluble in non-polar solvents eg:- CCl_4, benzene	④ Usually insoluble in water & in polar solvents. Soluble in non-polar solvents.
⑤ In solid state, bad conductors of electricity. Good conductor in molten state & in solutions.	⑤ Bad conductors of electricity with few exceptions having Layer Lattice structure.
⑥ Undergo ionic reactions. Rates of reactions are very high. Reactions are fast.	⑥ Undergo molecular reactions. Rates of reaction are low. Reactions are slow.

DIFFERENCE BETWEEN IONIC & COVALENT BOND

IONIC BOND	COVALENT BOND
(1) Formed by the transference of e^- or e^-s from electro +Ve (metal) to electro -Ve (non-metal) atoms.	(1) Formed by the sharing of e^-s between two non-metal atoms. when the e^-s are equally contributed by both the atoms.
(2) Such a bond is possible between dissimilar atoms.	(2) Such a bond is possible between similar & dissimilar atoms.
(3) Consists of electrostatic force between atoms.	(3) Consists of shared pair or pairs of e^-s which are attracted by both the nuclei.
(4) It is a weak bond, since the electrostatic force between the ions can be broken easily.	(4) It is a strong bond, since the paired e^-s cannot be separated easily.
(5) It is polar in nature.	(5) It is non polar in nature
(6) Eg:- $NaCl$, $CaCl_2$, $AlCl_3$, MgO etc.	(6) Eg:- H_2, Cl_2, O_2, CH_4, NH_3, C_2H_2, C_2H_4, CO_2 etc.

OCTET & DUPLET RULE"

OCTET RULE :-

DEFINITION :- "The tendency of an atom to have 8 e's in its valence shell either by loosing, gaining or sharing the e's is called Octet rule.

OCTET :- "The atoms having 8 e's in the outermost shell called octet.

Egs :- ① Noble gases :- Ne, Ar, kr, Xe, Rn.

Noble gases	At. No (Z)	Electronic Conf^n	Valence - e$^-$
Ne	10	2,8	8 (octet)
Ar	18	2,8,8	8 "
kr	36	2,8,18,8	8 "
Xe	54	2,8,18,18,8	8 "
Rn	86	2,8,18,32,18,8	8 "

② IONS :-

a) $Na \xrightarrow{-1e^-} [Na^+]$
(2,8,1) 2,8 (octet)

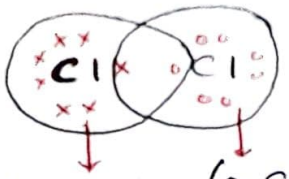
b) $F \xrightarrow{+1e^-} [F^-]$
(2,7) 2,8 (octet).

c) $N \xrightarrow{+3e^-} [N^{3-}]$
(2,5) (2,8) (octet).

(8) Molecules

① Cl_2

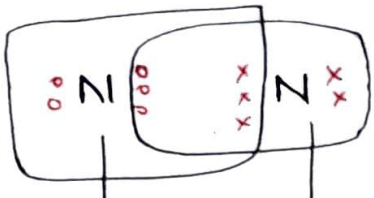
Cl = 17 (2,8,7)



(2,8,8) (octet) (2,8,8) (octet)

② N_2

N = 7 (2,5)

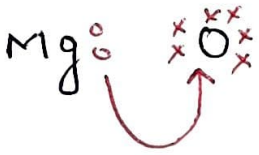


(2,8) (octet) (2,8) (octet)

③ MgO

Mg = 12 (2,8,2)

O = 8 (2,6)



Mg^{2+} (2,8) (octet) O^{2-} (2,8) (octet).

DUPLET RULE :-

DEFINITION :- "It states that when an element gets 2 e^-s in its valence or last shell so as to achieve a stable electronic configuration."

OR

" Atoms with low atomic Number try to have 2 Valence e^-s in its outermost shell."

Duplet :- The atoms having two e^-s in its valence shell called Duplet.

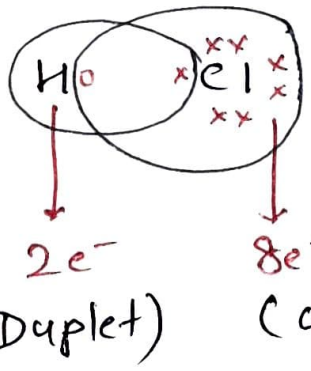
Eg :- (1) Noble Gas ⟶ He, Z = 2,
Valence e^- = 2 (Duplet).

(2) · Hydrogen (H),
Z = 1.

$H^{\bullet} \xrightarrow{+1e^-} H^-$

(1) (2) Duplet.

(3) HCl molecule.



(Duplet) (octet).

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VALENCY (ELECTROVALENCY & COVALENCY).

VALENCY :-

* **DEFINITION :-** "The Valency of an element may be defined as the number of electrons gained, lost or shared so as to complete its octet & become stable".

Valence e⁻s		Valency
1	Lose e⁻s	+1 (1)
2		+2 (2)
3		+3 (3)
5	Gain e⁻s	-3 (3)
6		-2 (2)
7		-1 (1)
4	Share e⁻s	4.

* "The Combining Capacity of an element is known as Valence".

ELECTROVALENCY

DEFINITION :- "The no of e's which an atom loses or Gains while forming an Ionic bond is called electro-valency"

* **Electropositive Atom :-** The atom which loses e's

Electronegative Atom The atom which gains e's

* **Examples :-** ① Na-atom.

$$Na \longrightarrow Na^+ + e^-$$
$$(2,8,1) \qquad (2,8)$$

electrovalency of Na-atom = +1 or 1

② Cl-atom.

$$Cl \xrightarrow{+1e^-} Cl^-$$
$$(2,8,7) \qquad (2,8,8)$$

electrovalency of Cl-atom = −1 or 1.

③ Mg-atom.

$$Mg \longrightarrow Mg^{2+} + 2e^-$$
$$(2,8,2) \qquad (2,8)$$

electrovalency of Mg atom = +2 or 2.

④ S-atom

$$S + 2e^- \longrightarrow S^{2-}$$
$$(2,8,6) \qquad (2,8,8)$$

electrovalency = −2 or 2

(12)

COVALENCY :-

(1) DEFINITION :- "It is defined as the no. of covalent bonds formed by the atom of the element with other atoms".

(2) Covalency of an element except hydrogen is equal to (8 − no. of groups to which an element belongs)

Element	Group	8 − Group No.	Covalency.
C	IV (14)	8 − 4 = 4	4
Si	IV (14)	8 − 4 = 4	4
N	V (15)	8 − 5 = 3	3
P	V (15)	8 − 5 = 3	3
O	VI (16)	8 − 6 = 2	2
S	VI (16)	8 − 6 = 2	2
F	VII (17)	8 − 7 = 1	1
Cl	VII (17)	8 − 7 = 1	1

(3) Eg :- (1) $N \equiv N$ Covalency = 3 (no. of covalent bonds).

(2) $O = O$ Covalency = 2

(3) $H - H$ Covalency = 1

(4) $F - F$ Covalency = 1

Covalency :- Defi:- Covalency of an element is equal to the no. of unpaired e's in s- and p- orbitals of the valence shell !!

Examples :- ① ~~Hydrogen (H)~~

Elements	Electronic Configuration	No. of Unpaired e's	Covalency.
H (1)	$1s^1$ ↑	1	1 (one)
F (9)	$1s^2 2s^2 2p^5$ ↑↓ ↑↓ ↑	~~5~~ 1	~~5~~ 1 (one)
O (8)	$1s^2 2s^2 2p^4$ ↑↓ ↑ ↑	2	Two (2)
P (15) (Ground state)	$1s^2 2s^2 2p^6 3s^2 3p^3$ ↑ ↑ ↑	3	Three (3)
P atom in excited state	3s 3p 3d ↑↓ ↑ ↑ ↑ ⟶ ↑ ↑ ↑ ↑ ⟶ ↑ ↑ ↑ ↑ ↑ (excited state)	5	5
S (16) (Ground state).	$1s^2 2s^2 2p^6 3s^2 3p^4$ ↑↓ ↑↓ ↑ ↑ ⟶ ↑↓ ↑ ↑ ↑ ↑	2	2
S (16) 1st excited state	3s 3p 3d ↑↓ ↑ ↑ ↑ ⟶ ↑ ↑ ↑ ↑ ↑	4	4
S (16) 2nd excited state	3s 3p 3d ↑ ↑ ↑ ↑ ⟶ ↑ ↑ ↑ ↑ ↑	6	6