

Bohr Model of Atom

- Atom is very small spherical particle composed of protons, neutrons and electrons
- The centre of atom is called nucleus, consist of p and n
- The negatively charged electrons are revolving around nucleus called **orbits**. Denoted as 1,2,3,4..... Or K,L,M,O.
- The electrostatic force of attraction b/n the nucleus and electron is exactly balanced by the centrifugal force of moving electone.
- Each orbit is associated by definite amount of energy ,so they called **stationary states**.

- An electron does not absorb or emit energy as long as the electron remain in the same orbit
- The angular momentum of an orbit can be calculated by
- The emission and absorption of energy occur only when the electron jump from one orbit to another

$$mvr = nh/2\pi$$

$$\Delta E = E_2 - E_1 = h\nu$$

Merits of Bohr model

1. It can give a satisfactory explanation about the structure of atom
2. It helped to calculate the energy of electron and radius of orbit
3. It can explain the emission and absorption spectra of hydrogen atom

Demerits of Bohr model

1. Failed to explain the spectrum of complicated atoms
2. It could not explain the Zeeman effect(Splitting of spectral line in magnetic field), Stark effect(Splitting of spectral line in electric field)\
3. Does not tell about chemical bonding of atom
4. Does not explain Heizenberg's uncertinitry principle

deBroglie concept

All microscopic particle like electron exhibit wave nature and particle nature during its motion. It is called **Dual nature of matter.**

$$\lambda = h/mv \text{ or } \lambda = h/p$$

h = plank's constant, m = mass of particle, v = velocity, p = momentum

λ = wavelength of matter

Heisenberg's uncertainty principle

It is impossible to determine simultaneously the exact position and of momentum Of small moving particle like electron.

$$(\Delta x) (\Delta p) \geq h/4\pi$$

Δx = uncertainty in position

Δp = uncertainty in momentum.

ORBITAL

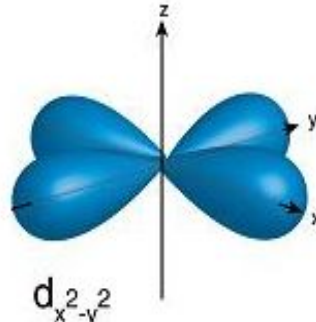
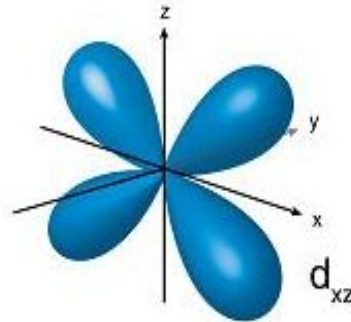
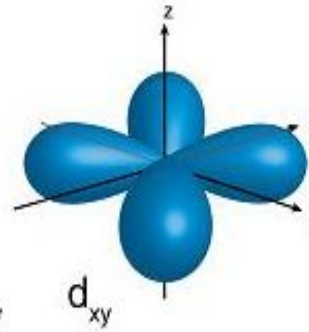
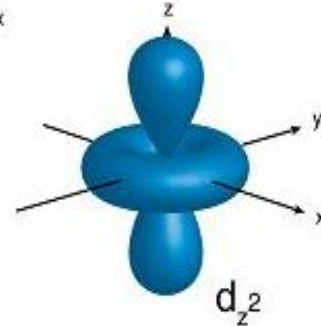
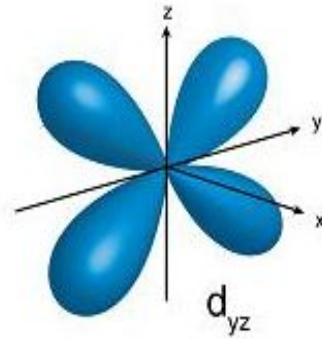
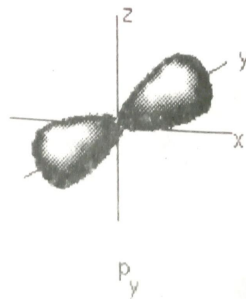
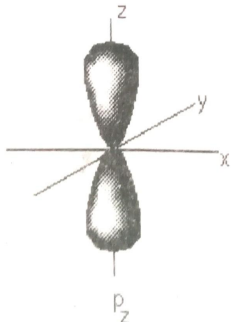
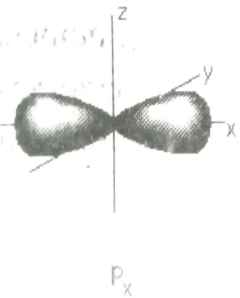
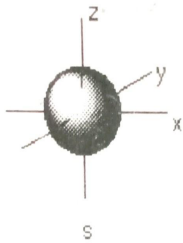
Region in space in an atom where there is maximum probability to finding electrons

<https://www.youtube.com/watch?v=Q0UEMXM5MTI>

Shapes of orbitals

Shapes of orbitals

The shape of s and p orbitals



Difference b/n Orbit and Orbital

Orbit

- It is the circular path around the nucleus, where the electron is revolving.
- It represents a planar motion of electron.
- It represents circular shape
- The maximum number of electrons in an orbit is $2n^2$

Orbital

- It is the space around the nucleus where there is maximum probability of finding electron
- It represents three-dimensional motion of electron
- It has different shapes like s-spherical, p-dumbbell etc
- The maximum number of electrons in each orbital is 2

Quantum Numbers

It is the set of four numbers to designate the main energy level, sub energy level, the orbital and spin of electron in an atom

- ❑ They are-Principal Q.no, Subsidiary Q.no, Magnetic Q.no and Spin Q.no

$2P_x^1$

Principal quantum Number(n)

- It represent the main energy level of the atom
- n take the values 1,2,3... or K,L,M,N....
- The maximum number of electron in the orbit is $2n^2$

Value of n	1	2	3	4
Name of shell (orbit)	K	L	M	N
Max no.of electrons($2n^2$)	2	8	18	32

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Subsidiary Or Azimuthal Quantum Number(l)

- It represent the Sub Energy level of electron in the atom
- It take the values 0 to $n-1$
- Ex-when $n=1, l=0$ to $(1-1)$ ie 0, so $l=0$ that is 1s subshell
- When $n=2$ then $l=0$ to $(2-1)$ ie 0 to 1 ie 0,1 values they are 2s and 2p sub shells

Value of l	0	1	2	3
Name of subshell	s	p	d	f
Max no.of electrons $2(2l+1)$	2	6	10	14

Magnetic Quantum number (m)

- It represent the orbital in a subshell
- There can be $2l+1$ integral values between $-l$ to 0 to $+l$
- If $l=0$, $m=0$ ie only one orbital in s subshell
- If $l=1$ then $m= -1,0,+1$: three orbital in p subshells
- If $l=2$ then $m=-2,-1,0,+1,+2$: five orbital in d sub shells.

Spin Quantum Number(s)

- ❑ It represent the spin of electron in the orbital
- ❑ For each value of m there are two values for s that is $=+1/2$ and $-1/2$
- ❑ The electron may be in clockwise or anticlockwise spin in the orbital

Rules for filling electron in the shells of an atom

1. **Pauli's exclusion principle**
2. **Hund's rules of maximum multiplicity**
3. **Aufbau principle**

Pauli's Exclusion Principle

- ★ It is impossible for two electron in an atom to have the same value for the all the four quantum numbers.
- ★ An orbital cannot have more than two electron
- ★ If an orbital have two electron then at least their spin must be opposite signs .

$$1s^{+1/2}$$

$$1s^{-1/2}$$

Hund's rules of maximum Multiplicity

- Pairing of electrons does not take place until all the orbitals are singly occupied by the electrons
- All the singly occupied electrons have the same spins

P_x

P_y

P_z



case 1 — Correct

P_x

P_y

P_z

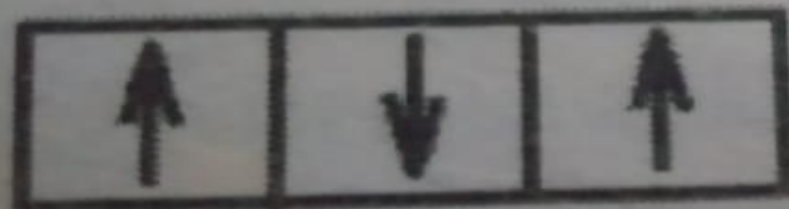


case 2 — Wrong

P_x

P_y

P_z



case 3 Wrong

P_x

P_y

P_z

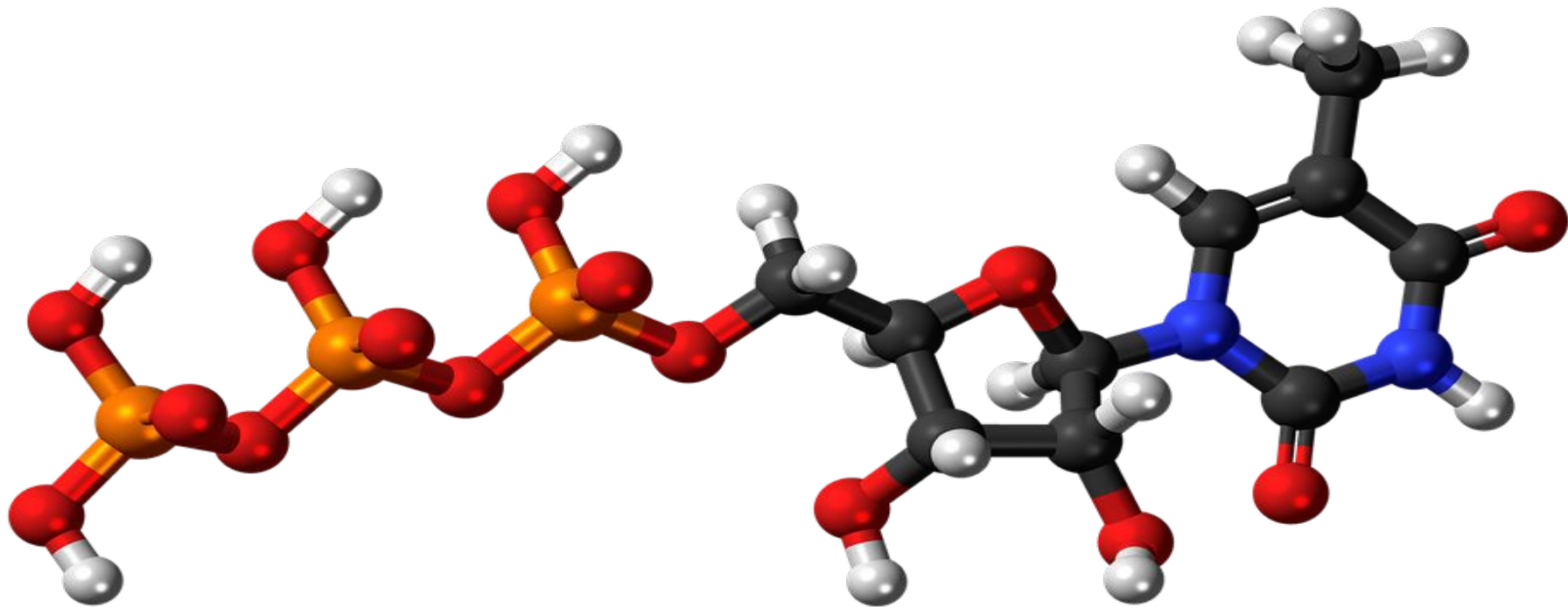


case 4 Wrong

Aufbau Principle

- ❖ Electrons in an atom are occupied in the orbital in the increasing order of the energy level.
- ❖ $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s < 5f < 6d < 7p$

CHEMICAL BONDING



CHEMICAL BONDING-

The attractive force which holds the atoms together in molecules.

- **By chemical bonding ,any system can attain stability and lowering energy.**

Types of Chemical Bonding

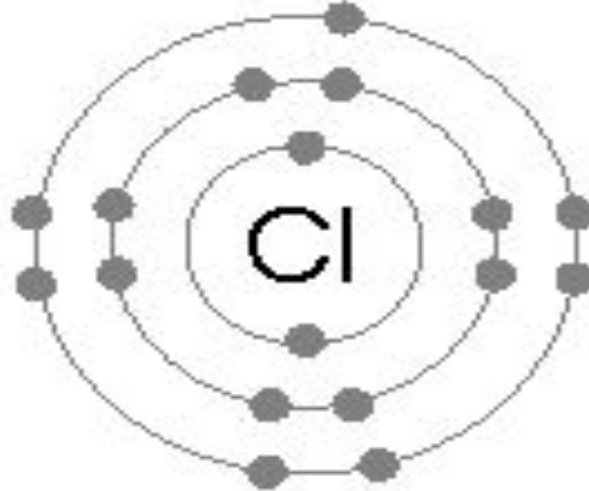
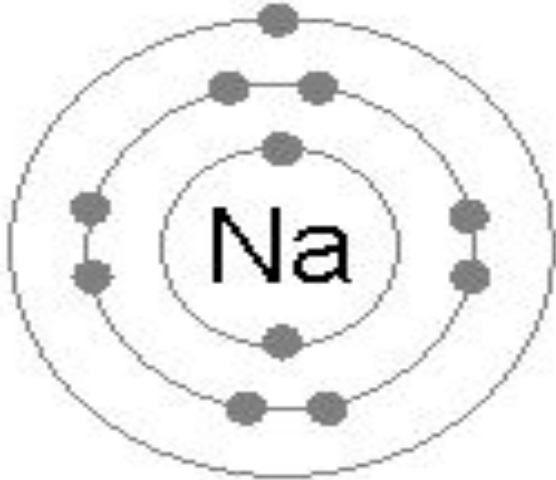
- 1. Ionic Bond**
- 2. Covalent Bond**
- 3. Coordinate Bond**
- 4. Hydrogen Bond**

Ionic Bond-/ Electrovalent bond

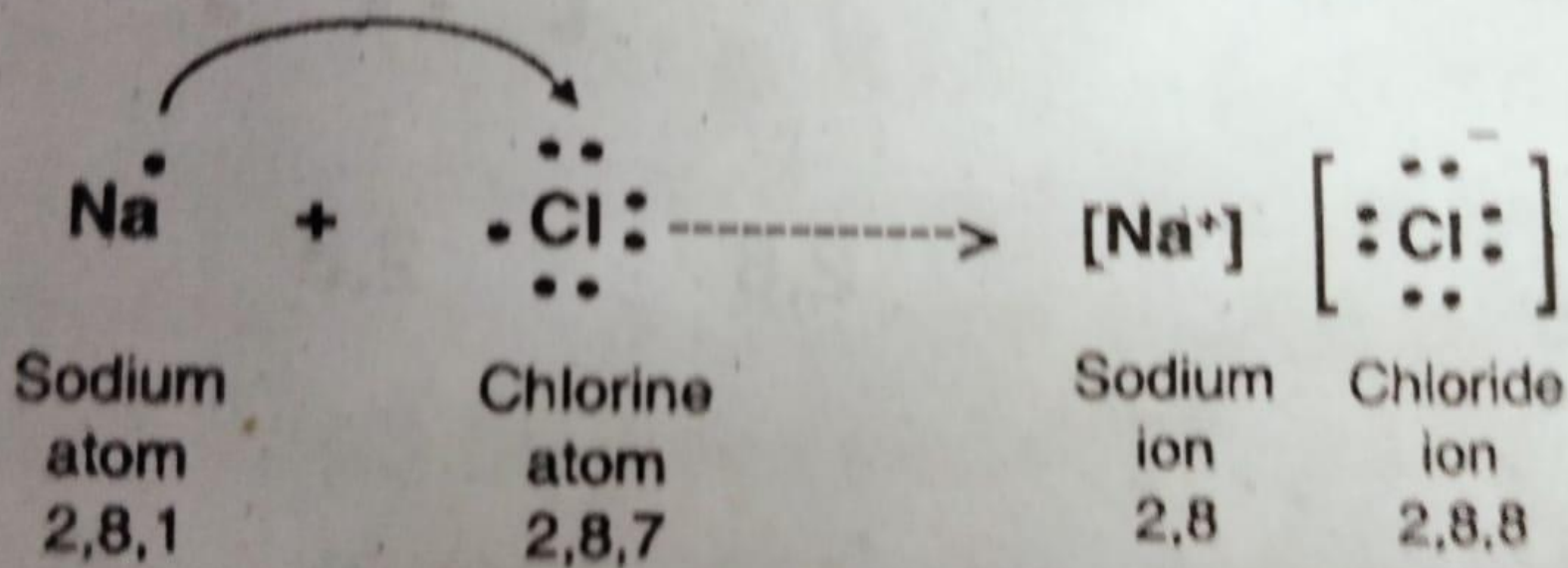
Complete transfer of one or more electrons from one atoms to another.

- **The atoms which lose electrons called Cations.**
- **The atoms which accept electrons called anions.**
- **Ionic bond between positive and negative charge ions**

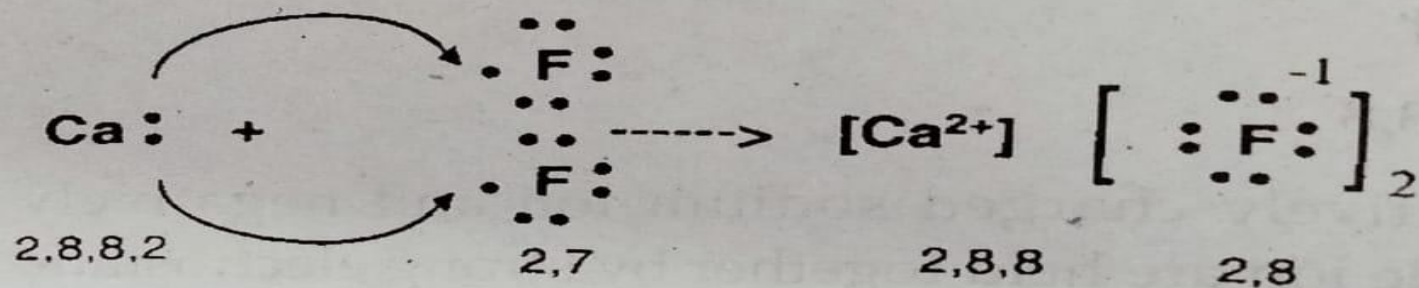
Formation of sodium chloride:-



Formation of NaCl

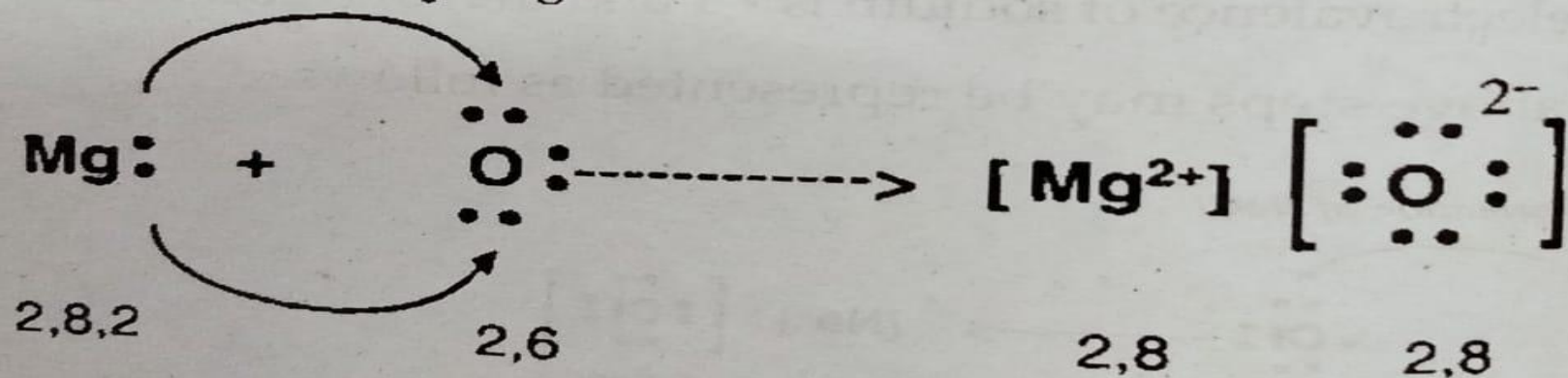


Formation of Ca F_2



3. Formation of Magnesium Oxide

Formation of MgO



The number of electrons liberated or accepted by the atom during the ionic bonding called **electrovalency.**

For sodium-1

Chlorine-1

Mg-2

Oxygen-2

calcium-2

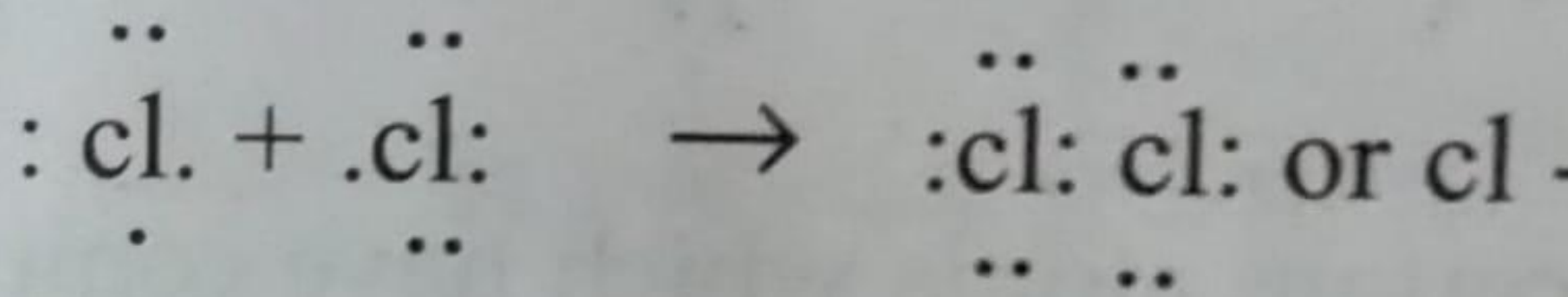
Covalent Bond

1. This bond formed by the sharing of electrons between the atoms .

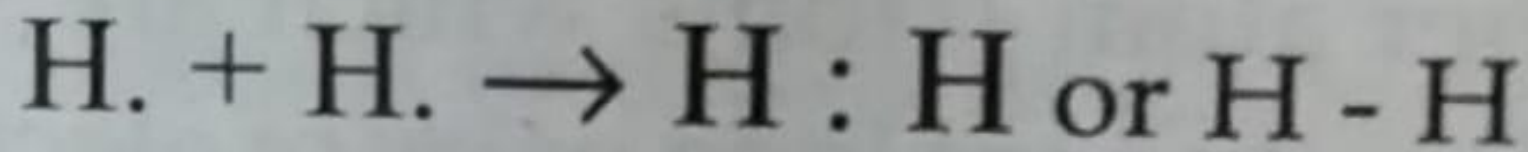
2. Equal number of electrons are shared by the atoms.

If one electrons are shared the atoms -single bond

- **If two electrons are shared by the atoms -double bond**
- **If three electrons are shared by atoms-triple bond.**

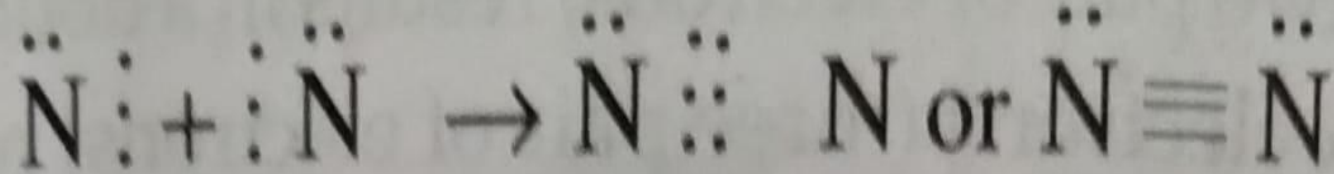


2) Formation of hydrogen molecule



3) Formation of hydrogen Chloride

FORMATION OF NITROGEN MOLECULE (N_2)

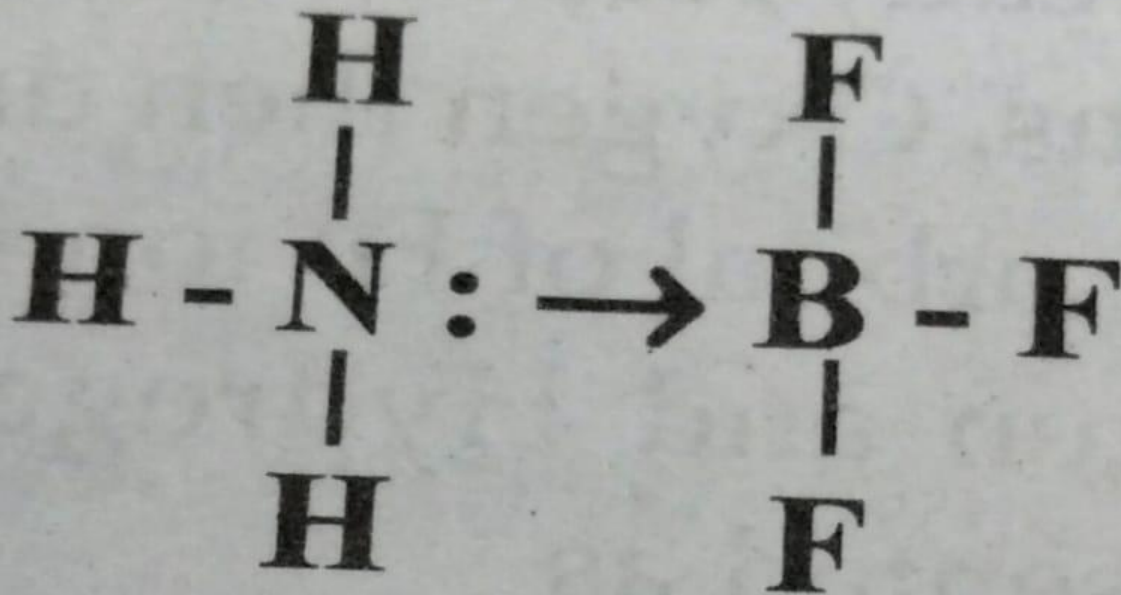


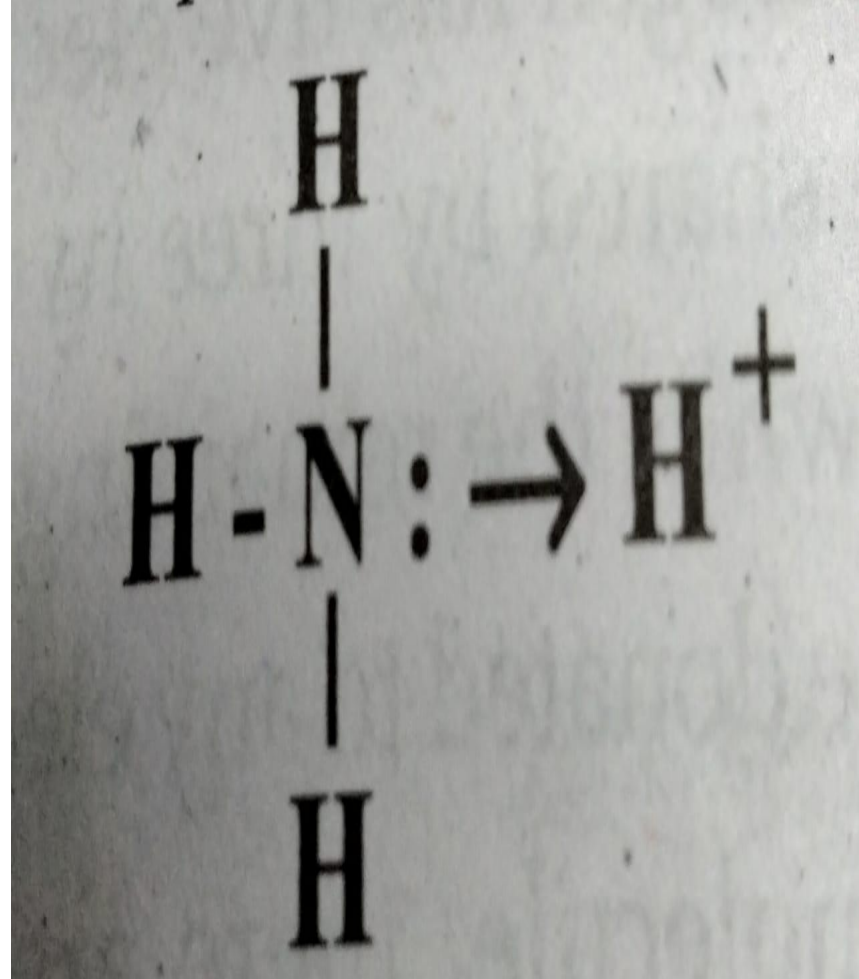
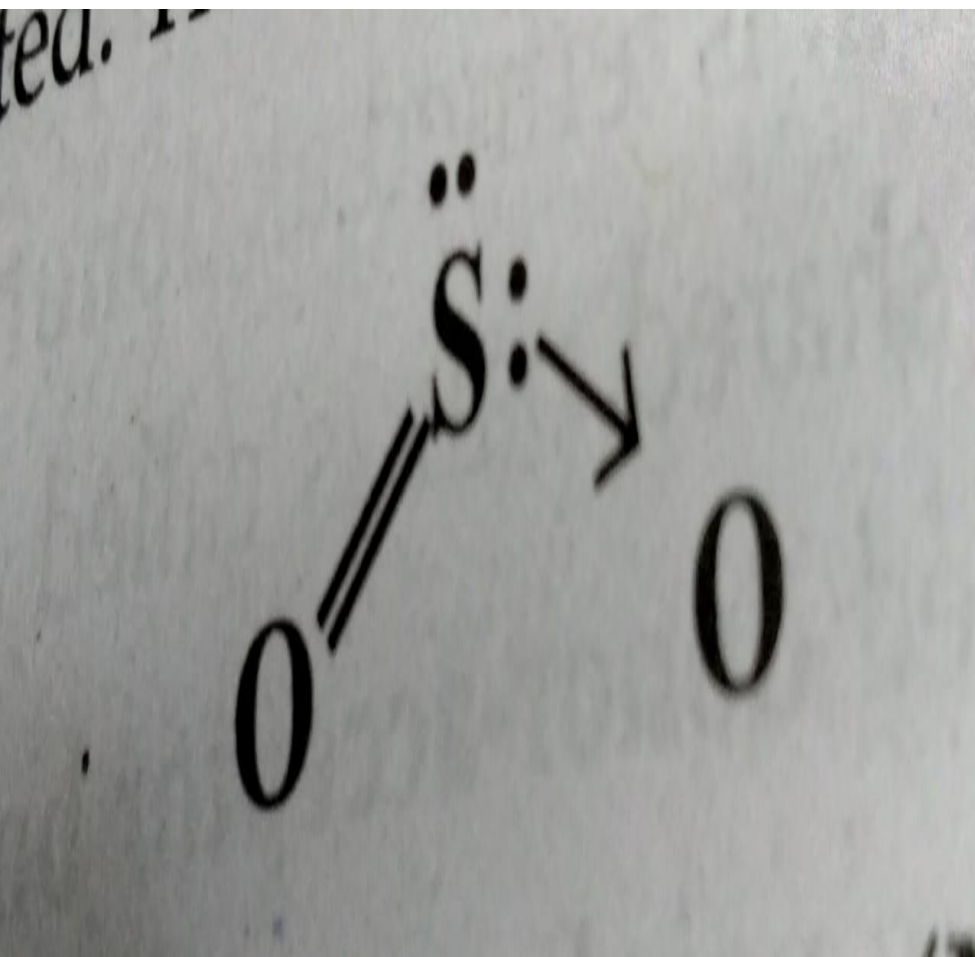
COVALENT BONDING

3. CO-ORDINATE OR DATIVE BOND

- Electron pair is donated by only one atom but shared by both atoms , the bond formed is called coordinate bond.
- The electron giving atom is called **Donor** and other atom is called **acceptor**.
- Bond is represented by arrow pointing donor to acceptor.

EX:-NH₃ and BF₃





Hydrogen Bond

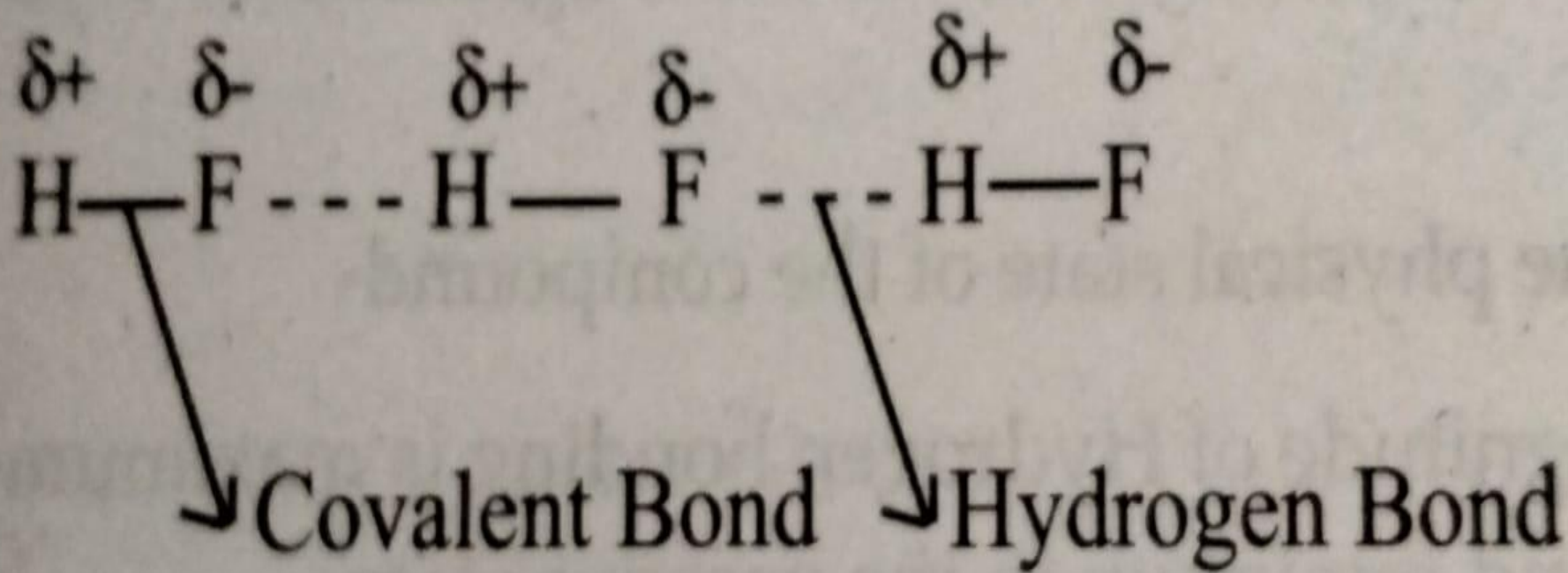
- When the electronegative atoms like N,F,O etc attached to hydrogen atom by a covalent bond, the electrons of the covalent bond are shifted to electronegative atom.
- Then the electronegative atom becomes slightly negative and hydrogen atom becomes Slightly positive.

- This partially positive charge hydrogen atom of one molecule form a bond with electronegative atom of other molecule.
- This bond is called hydrogen bond.

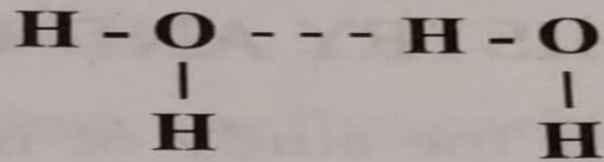
Hydrogen bond is attractive force between hydrogen atom of one molecule with electronegative atom of another molecule.

<https://www.youtube.com/watch?v=3N8aCwu4RbA>

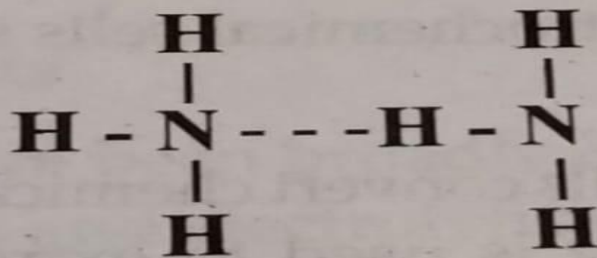
EX-



Water (H_2O) molecules: H_2O molecule contains hydrogen bonds.



Ammonia (NH_3) molecule: NH_3 molecule contains hydrogen bonds



The magnitude of hydrogen bond depends on:-

- 1. The electronegativity of linked atom-higher the electronegativity greater the hydrogen bond.**
- 2. Size of electronegative atom-the smaller the size greater the hydrogen bond**
- 3. Physical state of the compound -hydrogen bond is maximum in solid state and minimum in gaseous state.**

Q. Hydrogen bond in HF is greater than HI why?

A. F have smaller size than I, F have greater electronegativity than I ,so F have greater hydrogen bond than I

Q. H_2O is in liquid state while H_2S is gas why?

A; O have higher electronegativity and smaller size compared to S. so oxygen form strong bond with H ,ie it is in liquid state.