

③ Q:- Define Chemical bond. Explain with examples the formation of Ionic, Co-valent & Co-ordinate bond. (NaCl, H₂O, CH₄, NH₄⁺, CO₂)

Ans: Defⁿ:- A Chemical bond is defined as a force of attraction which holds together the Constituent atoms ^{or ions} in a molecule.

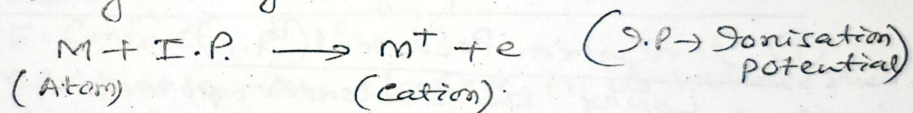
There are mainly three types of Chemical bonds

(A) Ionic bond or Electrovalent bond:-

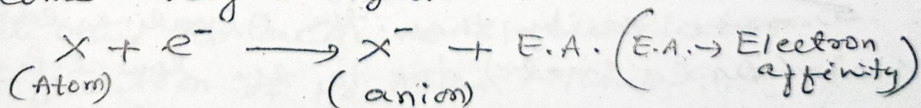
Defⁿ:- The bond which is formed by the transfer of one or more electrons between dissimilar atoms is called Electrovalent bond or Ionic-bond.

Condition:- For Ionic bond formation, the most necessary condition is that one atom must be electropositive and another atom must be electronegative.

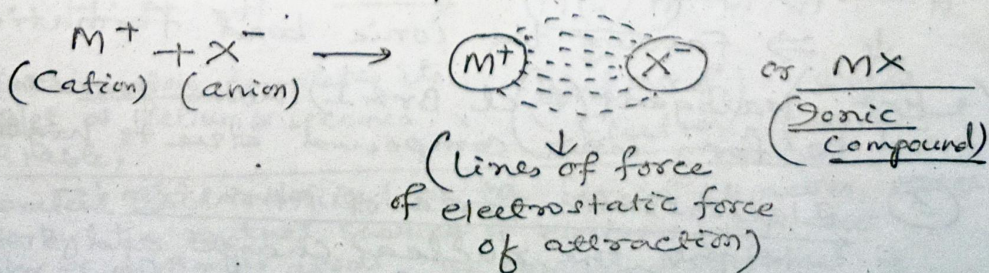
Explanation:- The electropositive atom (M) loses electron(s) and acquire stable electronic Confⁿ of nearest inert gas element and become positively charged.



The electronegative atom (X) gain the electron(s) and acquire the stable electronic Configuration of nearest inert gas element & become -vely charged.

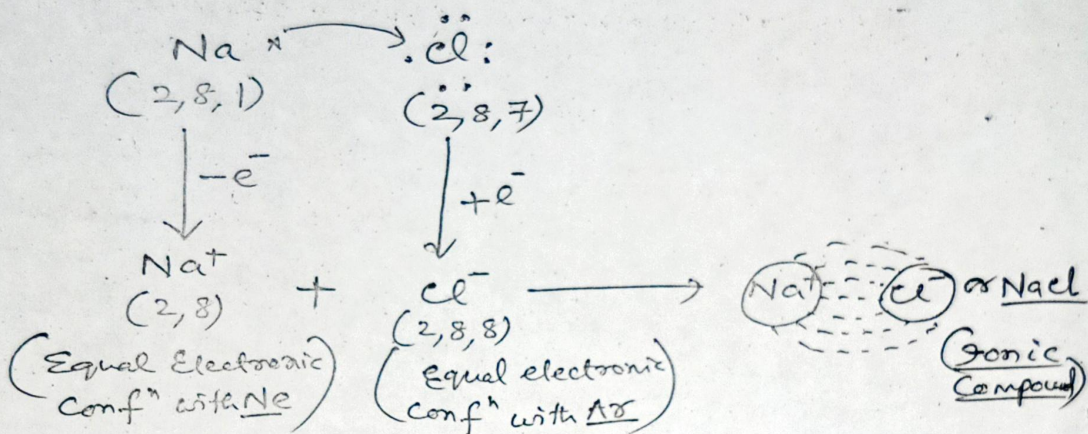


The Cation (M⁺) and the anion (X⁻) attract each other by electrostatic force of attraction to form ionic compound MX.



The force of attraction existing in betwⁿ M^+ & X^- in MX - molecule is called electrovalent or Ionic bond.

Ex: NaCl, KCl, CaCl₂, CaF₂, MgS etc.
formation of NaCl Compound:



Factors influencing the formation of Ionic Compound.

① Ionisation Potential (I.P.) →

Lower the Ionisation potential value
⇒ easier is the cation formation
⇒ Favours the formation of ionic bond

Ex: Alkali metals (Li, Na, K etc) form ionic compounds more easily than the Alkaline earth metals (Mg, Ca, Sr etc) due to the low I.P. values.

② Electron Affinity (E.A.) →

Higher the electron affinity value
⇒ easier is the anion formation
⇒ Favours the ionic bond formation

Ex: Halogens (F, Cl, Br & I) have greater tendency to form ionic compound due to high E.A. value

③ Electrostatic force of Attraction:

Higher, the nuclear charge and smaller, the size of an atom
⇒ Higher is the electrostatic force of attraction between the oppositely charged ions.

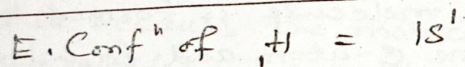
Properties of Ionic Compounds

- ① Ionic Compounds are hard & rigid due to strong electrostatic force of attraction.
- ② They have high density, high melting point, and boiling point.
- ③ Ionic Compounds are good conductors of electricity in molten and solution state.
- ④ These exist in crystalline state.
- ⑤ Ionic Compounds are non-directional in nature and have no definite bond angle.
- ⑥ These are soluble in polar solvents like H_2O .

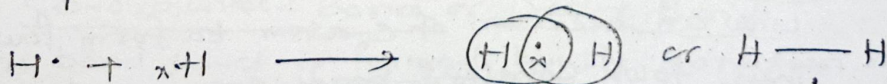
(B) Covalent bond:-

Defⁿ:- The bond which is formed by the mutual sharing of electrons between two similar or dissimilar atoms, is called co-valent bond and the compound so formed is called Covalent Compound. (or) *

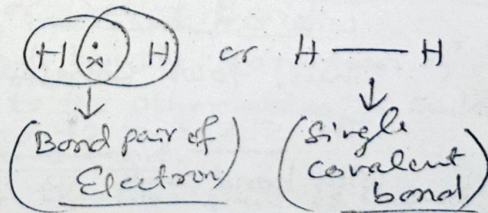
Ex: 1 Between Similar atoms:-



H-atom has one electron in its valence shell. Thus, it requires one more electron to acquire the stable electronic configuration of nearest inert gas element i.e; He-atom. Thus two H-atoms share one electron each with each other to acquire stable electronic configuration of He-atom. Thus, a covalent bond is formed which is a single bond as one pair of electron is shared.



Each H-atom completes its duplet as Helium & becomes stable,



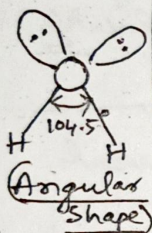
* Covalent bond is defined as the force of attraction which arises by the mutual sharing of electrons between two similar or dissimilar atoms. The compound so formed is called Covalent Compound.

Covalent Bond formed betwⁿ dissimilar atoms :-

Ex-2 Formation of water (H₂O) molecule :- (It is formed by the combination of one O-atom & two H-atoms.)

Electronic configuration of $O \rightarrow 1s^2 2s^2 2p^4$
 " of $H \rightarrow 1s^1$ Six electrons in the valence shell.
 (one electron)

An oxygen atom (At. No. 8) has six electrons in its valence shell. A Hydrogen atom has one electron. Thus, each hydrogen atom mutually shares its electron with an electron of oxygen to form two covalent bonds as shown below:

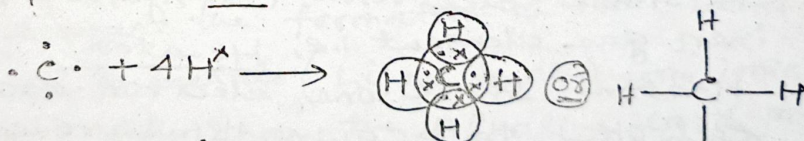


The structure of water is V-shaped or angular. & the bond angle (H-O-H) is 104.5°.

Ex-3 Formation of Methane (CH₄) molecule.

A methane molecule is formed by the combination of one C-atom and four H-atoms.

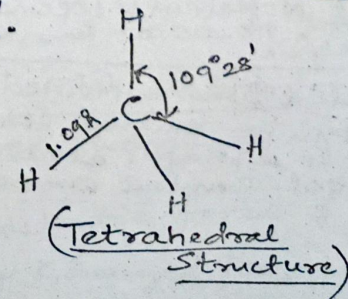
Electronic Confⁿ of $C \rightarrow 1s^2 2s^2 2p^2$ (four electrons in the valence shell)
 E.C. of $H \rightarrow 1s^1$



A C-atom (At. No. 6) has four electrons in its valence shell and a H-atom (At. No. 1) has one electron.

Thus, each H-atom mutually shares its electron with an electron of C-atom to form four bondpairs. Thus, four covalent bonds are formed.

The shape or structure of methane is tetrahedral. with bond angle to 109°28'.

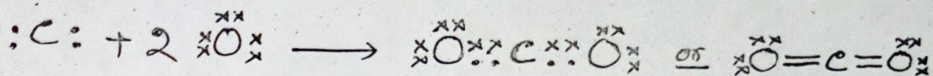


Ex- Formation of Carbon dioxide (CO₂) molecule:-

CO₂ is formed by the combination of one C-atom & two O-atoms.

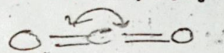
E.C. of C → 1s² 2s² 2p² (four electrons in the valence shell)

E.C. of O → 1s² 2s² 2p⁴ (six electrons in the valence shell)



A C-atom has four electrons in its valence shell whereas an O-atom has six electrons.

Thus, each O-atom mutually shares its one electron with the electron of C-atom to form four bond pairs or four covalent bonds.



The Shape or Structure of CO₂ is Linear with 100° bond angle equal to 180°.

Properties of Covalent Compounds :-

- ① Covalent Compounds have low melting & boiling points. This is because the molecules are held by weak forces which can be easily overcome by heat.
- ② Covalent compounds are bad conductors of electricity even in fused or liquid state. This is because these compounds do not form ions.
- ③ These compounds are insoluble in polar solvents like water. However, they dissolve in non-polar solvents like benzene, toluene, Carbon tetrachloride etc.
- ④ These compounds show molecular reactions which are generally slow in nature.

⑤ Co-ordinate Bond or Dative Bond

Defⁿ:- The bond which is formed by the donation of a lone pair of electrons ^{from one atom} to the other atom is called co-ordinate bond or dative bond.

The atom which donates the lone pair is called as donor & the atom which accepts the lone pair is called as acceptor.

The co-ordinate bond is represented by an arrow (→) mark from the donor atom to the acceptor atom.

Conditions: (i) This type of bond is formed between two dissimilar atoms A and B.

(ii) Atom A has ^{with complete octet} one or more lone pairs of electrons, whereas Atom B is short of a pair of electrons than the nearest inert gas element.

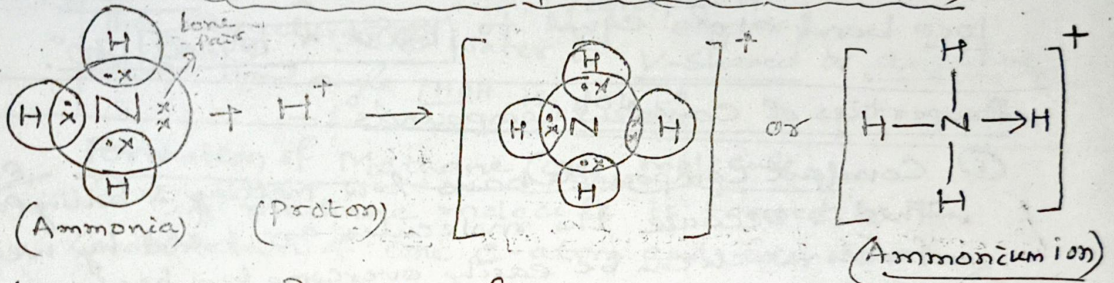
(iii) Atom A donates its lone pair of electrons to atom B. As a result, both atoms get inert gas configuration.

(iv) Atom A is called donor atom & Atom B is called acceptor atom.

(v) A co-ordinate bond is formed between atom A & B which can be shown by $(A \rightarrow B)$.

(vi) The dative bond is a directional bond.

Example: - Formation of NH_4^+ ion (Ammonium ion)



Characteristic Properties of Co-ordinate Compounds: -

(i) Co-ordinate compounds are molecular & do not ionise in fusion state or in solⁿ state.

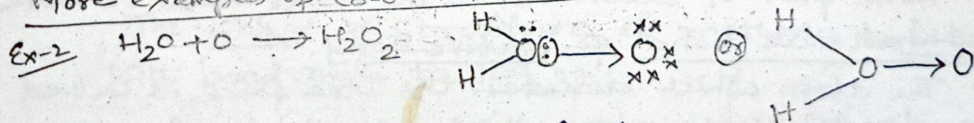
(ii) These compounds are usually insoluble in water but soluble in non-polar organic solvents.

(iii) The M.P. and B.P. are higher than covalent compounds but lower than ionic compounds.

(iv) They are semipolar i.e., more polar than covalent but less polar than ionic compounds.

(v) They show isomerism.

More examples of Co-ordinate bond: -



Ex-3 Formation of Hydronium ion (H_3O^+ ion)

