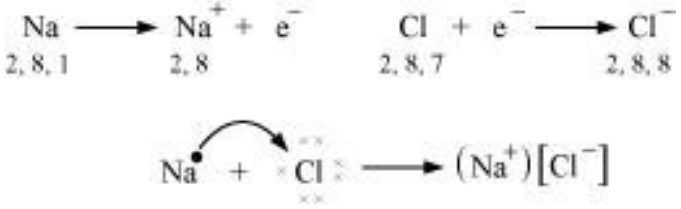
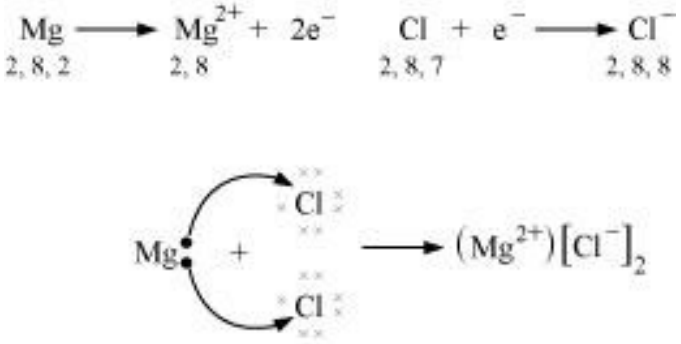
Chemical Bonding

- **Metals + Non-metals**
  - **1)**



  - **2)**



- **Physical Properties of Ionic compounds**

1. Solid
2. Hard [because of strong attraction force]
3. Brittle
4. High melting and boiling points
5. Soluble in H_2O; insoluble in kerosene, petrol
6. Conduct electricity in H_2O solution

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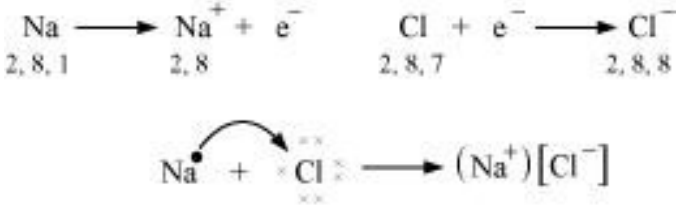
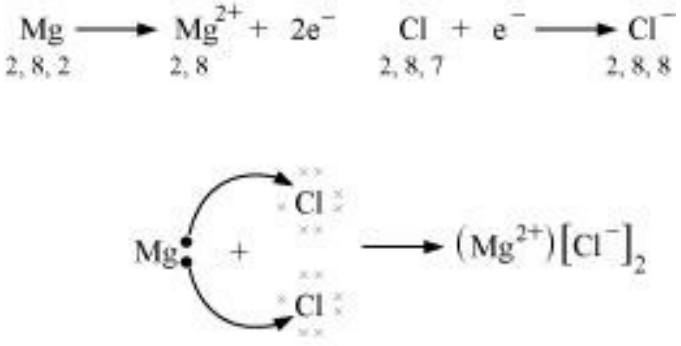


- **2)**



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Chemical bond:

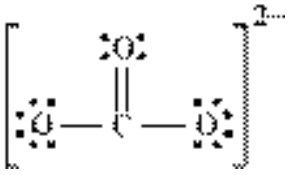
Chemical bond is the attractive force, which holds various constituents (such as atoms, ions) together in different chemical species.

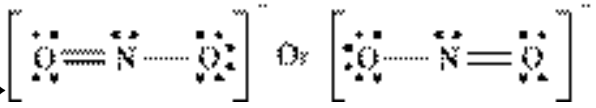
Octet rule:

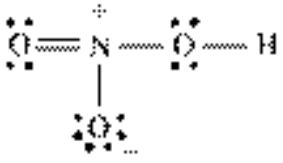
Atoms tend to gain, lose, or share electrons so as to have eight electrons in their valence shells.

Lewis dot Structure:

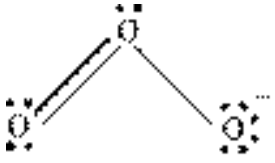
Representation of molecules and ions in terms of the shared pairs of electrons and the octet rule

$CO_3^{2-}\rightarrow$ 

$NO_2^{-}\rightarrow$ 

$HNO_3\rightarrow$ 

Formal charge:

Lewis structure of $O_3\rightarrow$ 

$$\begin{bmatrix}\text{Formal charge (F.C)}\\ \text{on an atom in a}\\ \text{Lewis structure}\end{bmatrix} = \begin{bmatrix}\text{Total number of}\\ \text{valence electrons}\\ \text{in the free atom}\end{bmatrix} - \begin{bmatrix}\text{Total number of}\\ \text{nonbonding (lone}\\ \text{pair electrons)}\end{bmatrix} - \frac{1}{2}\begin{bmatrix}\text{Total number of}\\ \text{bonding (shared}\\ \text{electrons)}\end{bmatrix}$$

F.C. on the $O^{-1} = 6 - 2 - \frac{1}{2}(6) = +1$

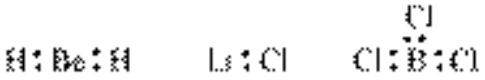
F.C. on the $O^{-2} = 6 - 4 - \frac{1}{2}(4) = 0$

F.C. on the $O^{-3} = 6 - 6 - \frac{1}{2}(2) = -1$

Limitations of the octet rule:

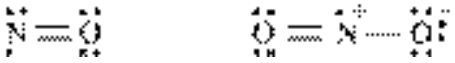
- Incomplete octet of the central atom

E.g. BeH_2, LiCl, BCl_3



- Odd electron molecules

E.g. NO, NO_2



- Expanded octet

E.g. PF_5, SF_6, H_2SO_4

- Some other drawbacks:

1. It is based upon chemical inertness of noble gases. However, some noble gases can combine to form compounds such as XeF_2, KrF_2, $XeOF_2$, etc.
2. Does not account for the shape of molecules
3. Does not explain the relative stability of molecules

Conditions for Formation of Covalent Bond

- Presence of four or more electrons in the outermost shell of an atom (exception H, Be, B and Al)
- High electronegativity of both the atoms
- High electron affinity for both the atoms
- High ionisation energy of both the atoms
- Electronegativity difference between combining atoms should be zero or very low

- The bonds that are formed by sharing electrons are known as **covalent bonds**. Covalently bonded molecules have strong intermolecular forces, but intramolecular forces are weak.
- Carbon has four valence electrons and requires four more electrons to complete its octet. Therefore, it is capable of bonding with four other atoms of carbon or atoms of other elements having a valency of 1.
- Some properties of covalent compounds are:
    - Covalent compounds are non- conductors of electricity.
    - They also have low melting and boiling points.
    - These compounds mostly exist as liquids or gases at room temperature.
- Polar covalent compounds: A covalent bond formed between two different atoms, with different electronegativities is known as **polar covalent bond.** For example, hydrogen chloride molecule
- $\mathbf{H^{\delta+}}$**----**$\mathbf{Cl^{\delta-}}$
- Non-polar covalent compounds: A covalent bond formed between two like atoms, is known as **Non-polar bond**. For example, hydrogen molecule
- **H------H**
- **Cordinate bond**: It is formed when the shared pair of electrons is provided by one of the two atoms and shared by both.
- Conditions for formation of cordinate bond:
    - Presence of at least one lone pair of electrons on any of the two atoms. This atom acts like a donor.

- Shortage of a lone pair of electron on the second atom. This atom acts like an acceptor.