Covalent bonding

➢ Definition:

Covalent bonds involve the sharing of electrons, often between two non-metals. Covalent bonds can occur between atoms of the same element (e.g. Cl_2) or atoms of different elements (e.g. NO).

➢ Characteristics of Covalent Bonds

- **Why atoms needs to form covalent bonds?** Atoms share electrons to gain a **full outer shell** of electrons. they want to gain a full outer shell as this is when the atom is most **stable** and inert.
- **Single covalent bond : it contains a shared pair of electrons.** Each single covalent bond involves two electrons which makes up the **shared pair of electrons** between **two** atoms. Each atom donates one electron to the covalent bond, forming an electron pair.
- **Covalent bond forms between non-metals.** The main form of bonding between **non-metals** is covalent bonds, whereby non-metals share electrons in a bond. Non-metals want to gain electrons to make a full outer shell, so covalent bonding enables them to share electrons and reach a full outer shell.
- **Strong Bond.** In the covalent bond, there is a **strong electrostatic attraction** between the positive nuclei of each atom, and the negative shared pair of electrons. The electrostatic attraction holds the two atoms in the covalent bond together.

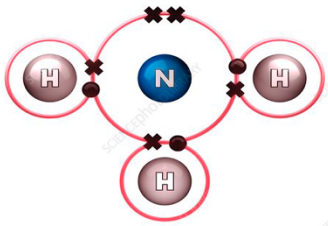
➢ Dot and cross models

I. Dot and cross models show how a pair of electrons form a covalent bond. Only the electrons in the outer shell of each atom are shown

II. They don't show the relative size Of atoms

III. Example :

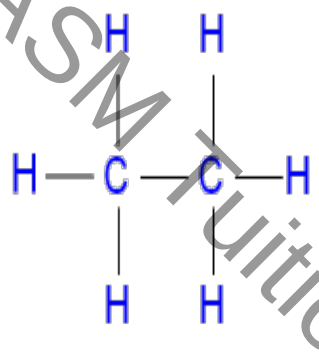
In a molecule of ammonia, one nitrogen atom shares one electron each with 3 hydrogen atoms and form 3 single covalent bond



➢ Molecular formula:

I) we can find the Molecular Formula by the diagram of covalent bond.

II) Example: Here is the diagram of Ethane write the formula of ethane



III) count the number of atoms and write it in the right corner of atom like here is 2 atoms of carbon and 4 atoms of hydrogen so the molecular formula is C2H4

➢ Types of Covalent Bonds

Depending upon the number of shared electron pairs, the covalent bond can be classified into:

- Single covalent bond
- Double covalent bond
- Triple covalent bond

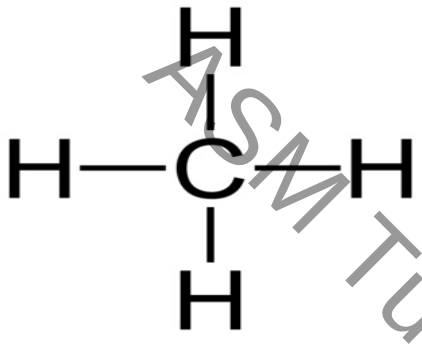
Single Covalent bond:

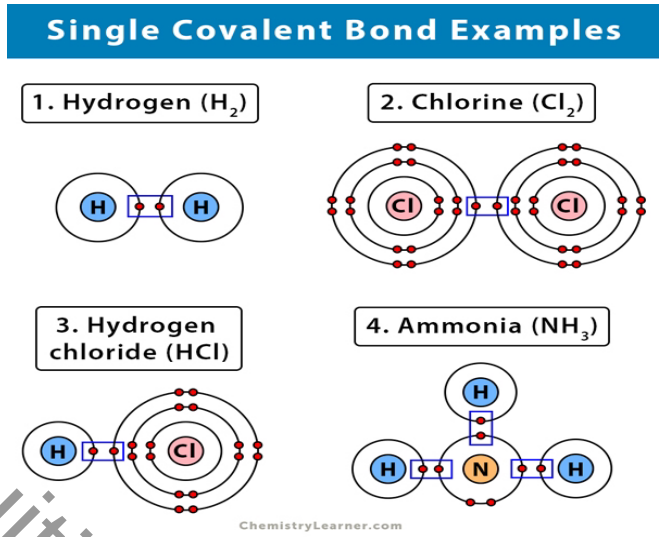
a) A single bond is formed when only one pair of electrons is shared between the two participating atoms.

b) It is represented by one dash (-).

c) This form of covalent bond has a smaller density and is weaker than a double and triple bond, it is the most stable.

d) Example as shown in picture





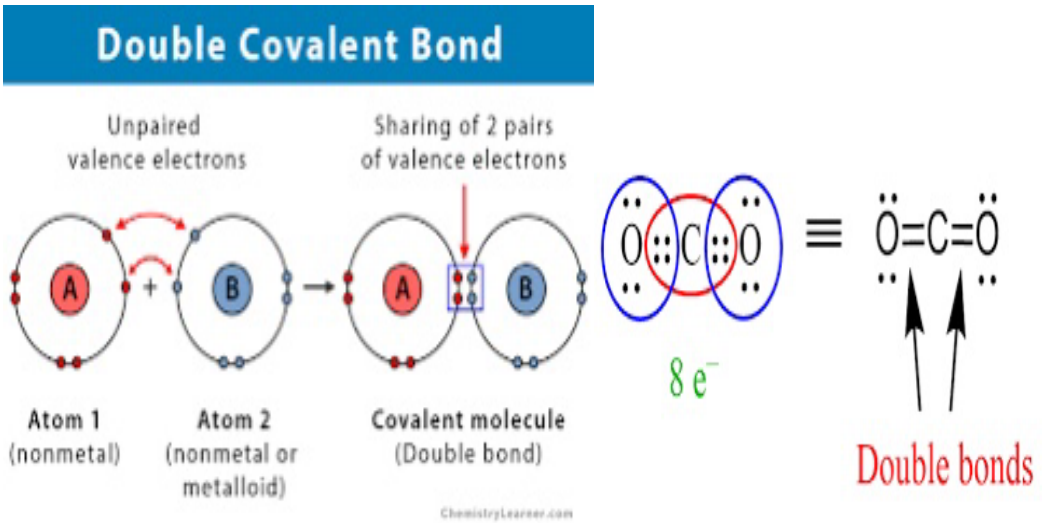
Double Covalent Bonds

a) A double bond is formed when two pairs of electrons are shared between the two participating atoms.

b) It is represented by two dashes (=).

c) Double covalent bonds are much stronger than single bonds, but they are less stable.

d) **For example**, a carbon dioxide molecule has one carbon atom with six valence electrons and two oxygen atoms with four valence electrons.



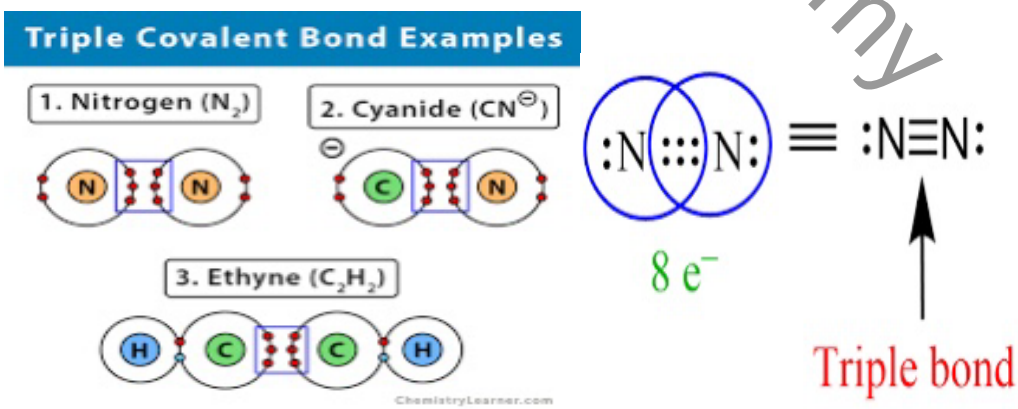
Triple covalent bond

a) A triple bond is formed when three pairs of electrons are shared between the two participating atoms.

b) Triple covalent bonds are represented by three dashes (≡)

c) They are the least stable type of covalent bonds.

d) **For example,** in the formation of a nitrogen molecule, each nitrogen atom having five valence electrons provides three electrons to form three electron pairs for sharing. Thus, a triple bond is formed between the two nitrogen atoms.



➤ **Properties of simple molecular substances**

- **Low melting and boiling points** – this is because little energy is needed to break the weak intermolecular forces.
- **Do not** conduct **electricity** – this is because they do not have any free electrons or an overall electric charge in any state of matter.
- **Intermolecular forces:** Hydrogen, ammonia, methane and pure water are also simple molecules. All have **strong covalent bonds between their atoms**, but much **weaker intermolecular forces between molecules**.
- At **room temperature**, simple molecular substances are gases, or liquids or solids with low melting and boiling points.
- **Physical properties:** They are also soft, again due to the weak intermolecular forces that can be broken easily.