

**❑ Matter:**

The matter is anything in the universe that has mass and takes up space. As for example, air, all liquids, and all solids. The matter is made of tiny particles called atoms. Atoms also have mass and take up space.

**State of matter:**

- i) Solid: In a solid, constituent particles (ions, atoms, or molecules) are closely packed together. The forces between particles are so strong that the particles cannot move freely but can only vibrate. As a result, a solid has a stable, definite shape, and a definite volume. Solids can only change their shape by an outside force, as when broken or cut.
- ii) Liquid: A liquid is a nearly incompressible fluid that conforms to the shape of its container but retains a (nearly) constant volume independent of pressure. The volume is definite if the temperature and pressure are constant. When a solid is heated above its melting point, it becomes liquid.
- iii) Gas: A gas is a compressible fluid. It has no definite shape or volume, but occupies the entire container in which it is confined.

**Types of matter:**

Matter can either be a pure substance or a mixed. Pure substances can either be elements or compounds. Mixture can either be homogeneous or heterogeneous.

**Elements:**

An element is matter made of only one kind of atom. There are 118 known elements. Ninety elements are naturally occurring. The elements are organized according to their properties in the Periodic table.

Example: Hydrogen, Carbon, Nitrogen, Calcium, Sodium, Oxygen, Iron, Silver, Gold etc.

**Compounds:**

Compounds are two or more elements that are chemically combined and cannot be easily separated into their elements.

Example:  $\text{H}_2\text{O} \rightarrow$  water,  $\text{NaCl} \rightarrow$  salt,  $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow$  glucose.

The gases of hydrogen ( $\text{H}_2$ ), nitrogen ( $\text{N}_2$ ), and oxygen ( $\text{O}_2$ ) naturally exist as compounds of two atoms of their element.

**Mixtures:**

Mixtures are made of different compounds that are mixed together and can be easily separated into original compounds.

Homogeneous: Substances are evenly mixed.

Heterogeneous: Substances are not evenly mixed.

**Classification of elements:**

The elements are classified into two main groups: (i) Metal and (ii) Non-metal.

**Physical properties of metal:**

- i) They are shiny, reflect light brightly.
- ii) Heat and electricity move through metals easily.
- iii) They can be hammered into shape.
- iv) They can be drawn into wire.
- v) They have high density i.e., heavy for their size.

**Physical properties of non-metal:**

- i) They are not shiny.
- ii) They do not conduct heat or electricity.
- iii) They are brittle, i.e., break or shatter easily.
- iv) They have low density.

**Intramolecular** force is any force that binds together the atoms making up a molecule or compound.

**Intermolecular** forces, which are the forces present between molecules.

**□ Bonds in solids:**

Solids are made of atoms which are held together by **intramolecular** bonds to form molecules. The **lattices** of molecules are held together by **intermolecular** bonds and are arranged in certain structures to form the solid.

There are four types of bonds holding lattices of molecules together:

- i) Covalent bond (chemical bond)
- ii) Ionic bond (chemical bond)
- iii) Metallic bond (chemical bond)
- iv) Weak bonds (hydrogen bond, Van der Waals bond etc.)

Weak bonds are not permanent. They are merely brief attachments which can be broken down readily by a molecular collision. Strong bonds (covalent, ionic, and metallic bonds) are almost never broken simply by molecular collision. They require a chemical action to break down.

**i) Covalent bond:**

It occurs between atoms and molecules. It involves the sharing of electrons, usually with those shared electrons localized between two atoms. A bond can only be formed when the spins of

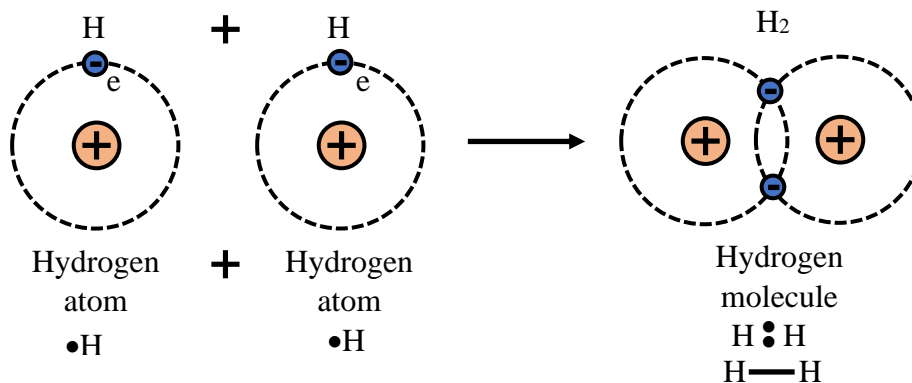


Fig. Covalent bond

the electrons are opposite. [If the two electrons have parallel or same spins, they would have the same quantum number, which violates the Pauli exclusion principle.]

With opposite spins, the two electrons are in different quantum number states and hence they can come together **spatially**. The region in which the electrons spend the most of their time in is between the two positively charged nuclei. Hence the nuclei are attracted to the negatively charged **electron cloud**. This attraction holds the atoms together forming a covalent bond in the molecule.