Matter, Atoms and Molecules

Unit 1: Some Basic Concepts of Chemistry

Topics: Matter and its nature; Dalton's atomic theory; Concept of atom, molecule, element, and compound

As we know, **anything which occupies space and has mass is called matter.**

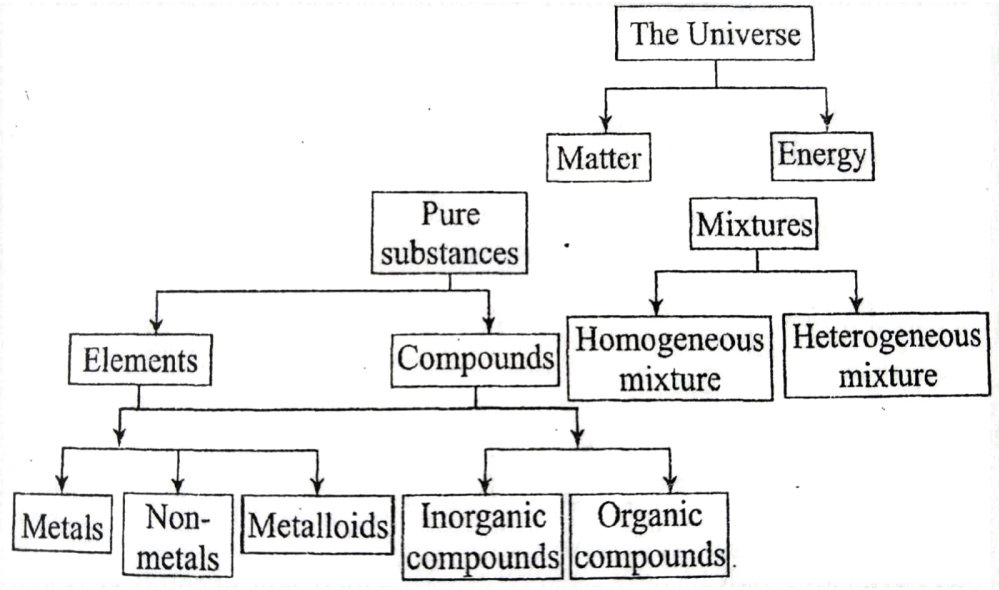
- All matter is made up of atoms.

States of Matter

State	Definite Volume	Definite Shape
Solid	Yes	Yes
Liquid	Yes	No
Gas	No	No

$$\text{Solid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Liquid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Gas}$$

Classification of Matter



Element

An **Element** is a pure substance which is made up of only one type of atom. It cannot be decomposed or built from simpler substances.
Eg: Gold, Hydrogen

- Metals are further classified as Metals, Non Metals and Metalloids.

Compound

A **Compound** is obtained by the reaction of two or more elements in a fixed mass ratio.

- The property of the compound does not depend on its constituent elements.
- Its constituent elements cannot be extracted by physical means.
  Eg: Water, Carbon Dioxide

Types of Compounds:

- **Organic Compounds:** These compounds are obtained from living sources such as plants and animals. All these compounds contain carbon.
- **Inorganic Compounds:** These compounds are obtained fom non-living sources such as rocks and minerals.

Mixture

A **Mixture** is the product obtainend by mixing two or more substances.

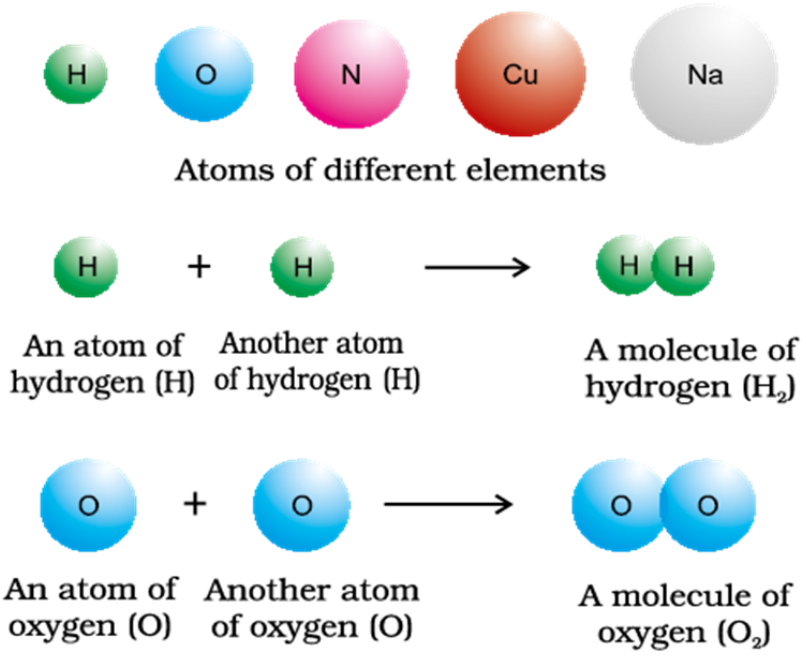
- The proportion is not fixed and the properties of constituent substances are retained.
- Physical methods can be used to extract the constituents.
- Mixtures can be homogenous or heterogenous.
  Eg: Air, Tea, Sugar Solution

Types of Mixtures:

- A mixture is said to be **homogeneous** if it has an uniform composition throughout. (Air)
- A mixture is said to be **heterogeneous** if its composition is not unique throughout. (Mixture of Iron fillings and Sulphur)

Atoms and Molecules

An atom is the smallest unit of matter. Molecules are made up of atoms.



- All substances are made up of molecules.
  Eg: Hydrogen Molecule (H_2*), Water Molecule (*H_2O*), etc.*

Compounds	Mixtures
1. In a compound, two are more elements are combined chemically.	1. In a mixture, two or more elements or compounds just mix together.
2. The compounds contains two or more elements in a fixed ratio by mass. Its composition is always fixed.	2. The components of a mixture may be present in any ratio. Its composition is variable.
3. A compound has a definite formula.	3. A mixture does not have a definite formula.
4. A compound is always homogeneous i.e., has the same composition throughout.	4. A mixture may be homogeneous or heterogeneous.
5. A chemical reaction takes place and therefore, the formation of a compound takes place with absorption or evolution of energy.	5. No chemical reaction takes place and therefore, the formation of mixture is not accompained by any energy change.
6. The properties of a compound are entirely different from those of its constituents.	6. A mixture shows the properties of its constituents.
7. A compound cannot be separated into its constituents by ordinary physical methods. These can be separated by chemical or electrochemical reactions.	7. A mixture can be separated into its constituents by physical methods (like filtration, evaporation, distillation, sublimation, mechanical separation etc.)

Figure 1: Difference between Compounds and Mixtures

Dalton's Atomic Theory

John Dalton proposed the first Atomic Theory in 1808.

- Matter consists of indivisible atoms.
- All atoms of a given element have identical properties, including mass. Atoms of different elements differ in mass.
- Compounds are formed by the combination of different elements in a fixed ratio.
- Atoms are neither created nor destroyed in a chemical reaction. Chemical reactions involve reorganisation of atoms.