

General chemistry

Chapter 1

Introduction

References for general chemistry course

- Chang, R. (1986). General chemistry. Fifth edition.
- Mortimer, Ch. Chemistry. Sixth edition.

Definition of chemistry

- It is the study of composition, structure, properties of the matter and the changes it undergoes.
 - *Composition:* What is it made of?
 - *Structure:* How is it put together?
 - *Properties:* What characteristics does it have? (physical and chemical properties).
 - *Reactions:* How does it behave with other substances?

Matter

- **Definition:**

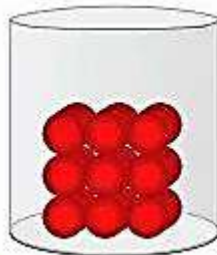
Matter is anything that occupies space and has a mass.

- **States of matter:**

Matter can exist in three states: solid, liquid, and gas. The three states of matter can be interconverted without changing the composition of the substance.

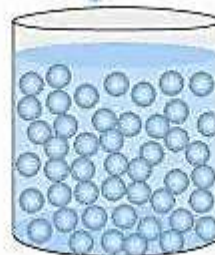
States of matter

solid



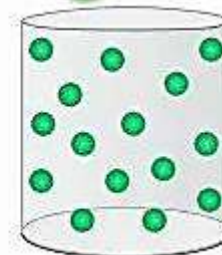
- rigid
- fixed shape
- fixed volume

liquid



- not rigid
- no fixed shape
- fixed volume

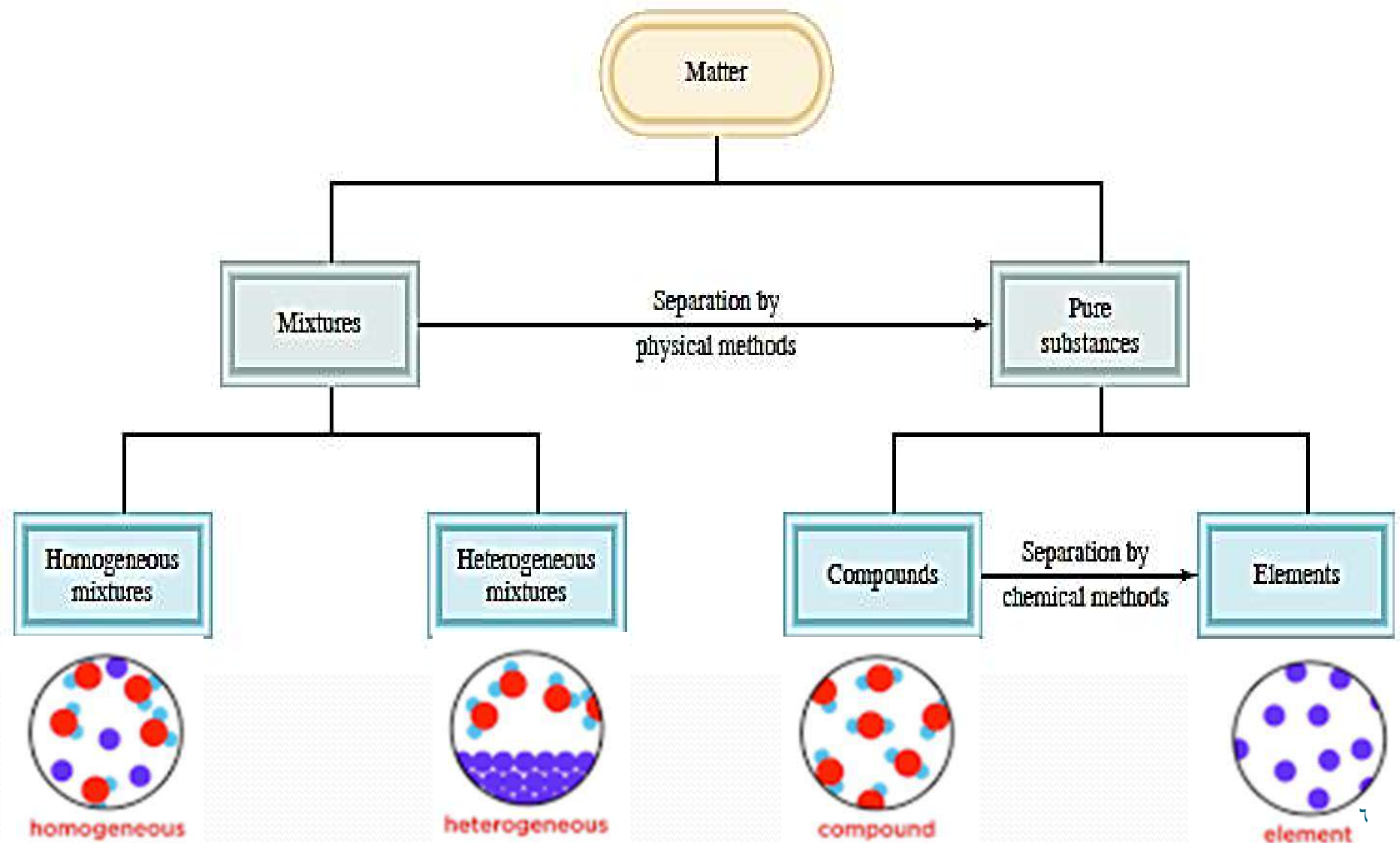
gas



- not rigid
- no fixed shape
- no fixed volume



Classification of matter

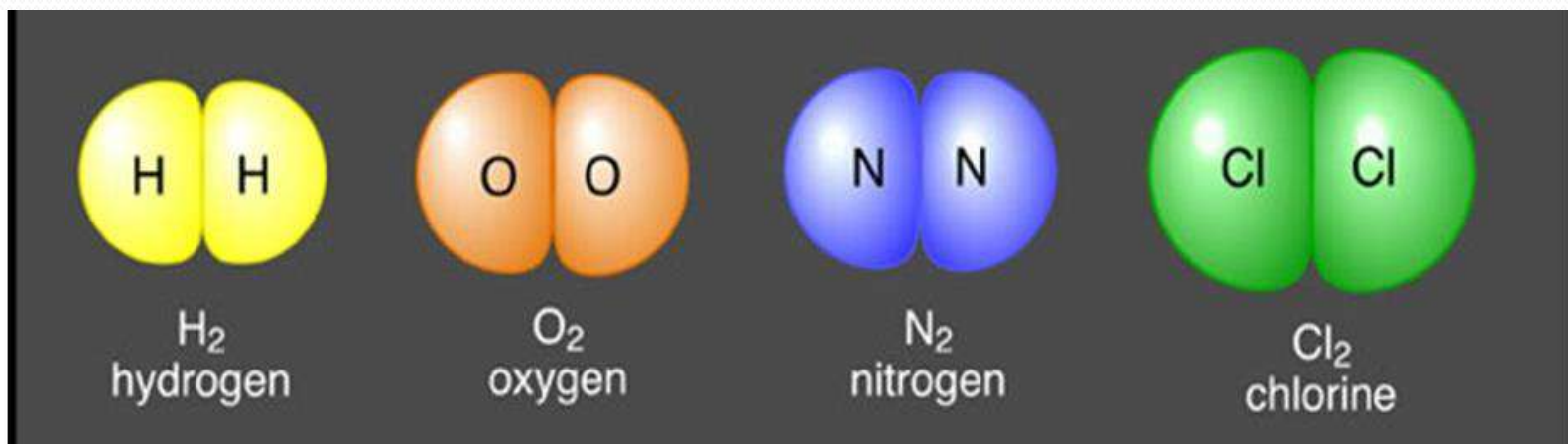


Substances

- **A substance:** is matter that has a definite or constant composition and distinct properties.
 - Examples are oxygen, water, table salt (sodium chloride) and carbon dioxide.
 - Substances differ from one another in composition and can be identified by their appearance, smell, taste, and other properties.
 - *A substance can be either an element or a compound.*

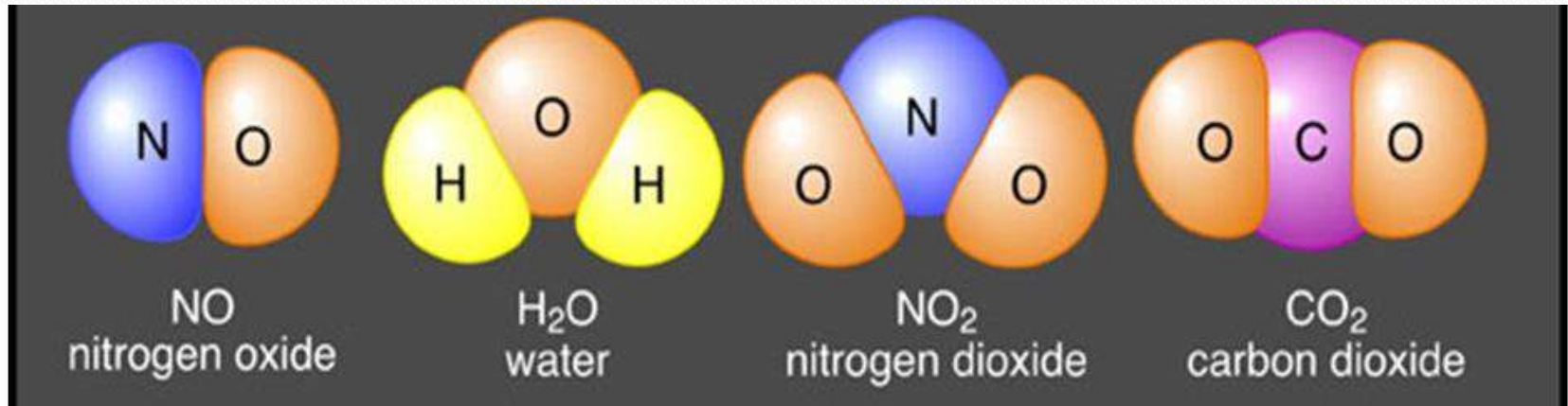
Elements

- **An element:** is a substance that cannot be separated into simpler substances by chemical means (one type of atoms).
 - Examples: oxygen, hydrogen, nitrogen and chlorine.



Compounds

- **A compound:** is a substance composed of two or more elements chemically united in fixed proportions. Compounds can be separated only by chemical means into their pure components.
- **Examples:** Hydrogen gas burns in oxygen gas to form water, a compound whose properties are distinctly different from those of the starting materials. Water is made up of two parts of hydrogen and one part of oxygen. This composition does not change, regardless of the source of water.



Mixtures

- **A mixture:** is a combination of two or more substances in which the substances retain their distinct identities. Mixtures do not have constant composition. They can be separated by physical means into their components.
- They are either *homogeneous or heterogeneous*.

Homogeneous mixtures

- In homogeneous mixtures: all portions of a material are in the same state, have no visible boundaries, and are uniform throughout.
- Homogeneous mixtures are also called solutions. Although most solutions we encounter are liquid, solutions can also be solid or gas.
- **Examples:**
 - A solution of salt and water.
 - Air is a solution of nitrogen, oxygen, water vapor, carbon dioxide, and several other gases.
 - Tap water is a solution of small amounts of several substances in water.
 - Alloys are solid solutions of two or more metals such as the gray substance still used by some dentists to fill teeth.



Heterogeneous mixtures

- If the composition of a material is not completely uniform, then it is heterogeneous.
- The components of heterogeneous mixtures can usually be separated by simple means.

- **Examples:**

- A mixture of water with sand.
- A mixture of oil and water.
- Mixtures that appear to be homogeneous are often found to be heterogeneous after microscopic examination. Milk, for example, appears to be homogeneous, but when examined under a microscope, it clearly consists of tiny globules of fat and protein dispersed in water.



Mixtures

1

Homogeneous mixtures



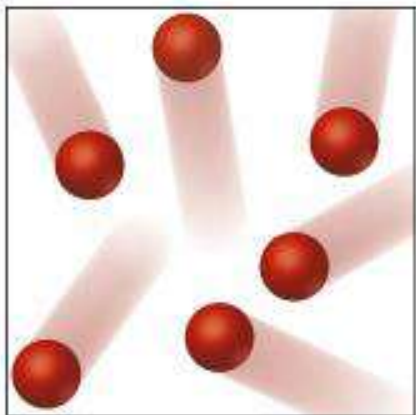
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Heterogeneous mixtures

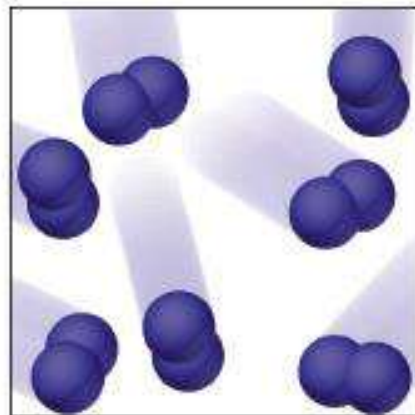


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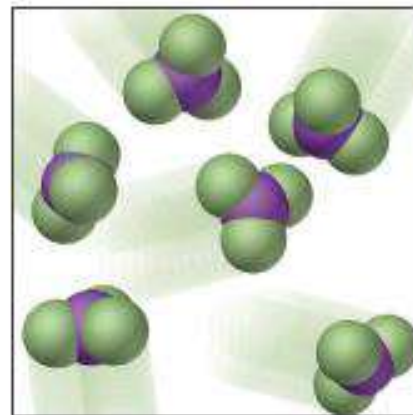
Classification of matter (summary)



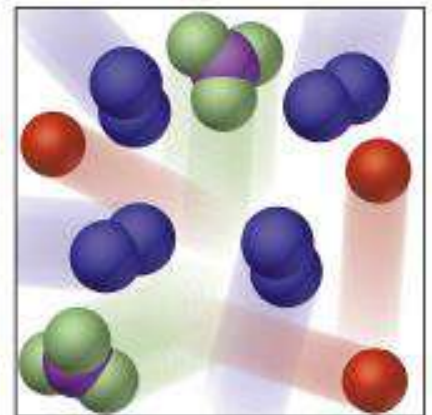
(a) Atoms of an element



(b) Molecules of an element



(c) Molecules of a compound



(d) Mixture of elements and a compound

Physical and chemical properties

- A **physical property** can be measured and observed without changing the composition or identity of a substance.
- Ex.: melting point, freezing points, mass.....etc.
- A **chemical property** a chemical change in which the original substances will have vanished and a chemically different substance will have taken their place.
- Possible indicators of chemical change include a change in color, odor, temperature, and the formation of a gas or solid from a liquid.
- Ex.: Hydrogen gas burns in oxygen gas to form water.