

Unit 1

Matter

What is Matter?

1. Matter is the “stuff” that makes up everything in the universe.

Definition

Matter - Anything that has mass and takes up space. [matter]

2. Properties of Matter

- (a) Each specific substance has its own combination of properties that can be used to identify the substance.

- (b) Matter can Δ its properties.

Δ means "Change"

- i. Ex. Water is a

- A. Liquid at room temperature
- B. Solid at cold temperatures
- C. Gas at high temperatures

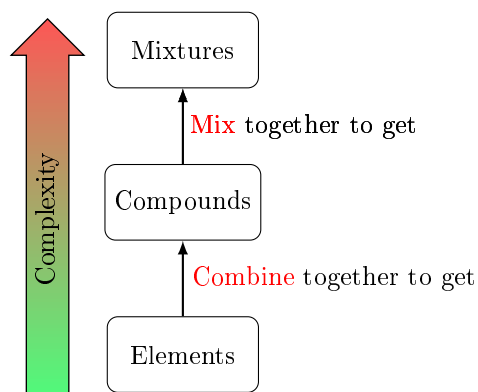
- (c) Examples:

- i. Hardness
- ii. Texture
- iii. Flammability
- iv. Color
- v. Shape
- vi. Temperature

Definition

Chemistry - The science that studies what everything is made of and how it changes.
[chemistry]

Kinds of Matter



3. Elements

Definition

Element - A substance that is made up of only one type of atom.
[chemical_elements]

- (a) If you break down an element any more, then it just becomes generic *protons*, *neutrons* and *electrons*.
 - i. It stops behaving like that element
 - Ex: If you break down Gold into protons, neutrons and electrons, it is no longer a shiny metal that conducts electricity.
- (b) Each element has its own symbol
 - i. Usually the first 1 - 2 letters in the name
 - ii. Always CAPITAL lowercase if two letters long
 - iii. Examples
 - O → Oxygen

- He → Helium
- C → Carbon
- H → Hydrogen
- Al → Aluminum
- Au → Gold

The latin word for Gold is "Aurum", so it still follows the rule, just in a different language.

4. Compounds

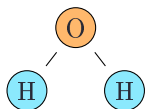
Definition

Compound - A chemical compound is a substance made of two or more different elements joined together by chemical bonds in a fixed ratio. [chemical_compounds]

Ex: Carbon Dioxide (CO_2)



Ex: Water (H_2O)



Definition

Chemical Formula - A combination of symbols that show the ratio of elements in a compound. [chemical_formula]

(a) Examples

- $C_6H_{12}O_6$
- $NaCl$
- CH_4

- CO_2
- $CaCO_3$
- $Al(OH)_3$

5. Mixtures

Definition

Mixture - A substance that is made up of two or more simpler substances. These substances can be chemical elements or compounds. A mixture can be made of liquids, solids, or gases. [mixture]

(a) Ex: Well Water

- i. Well water is a mixture because it has minerals, salts, and even dissolved oxygen within it

Changes in Matter

6. Physical Changes

Definition

Physical Change - A type of change in which the form of matter is altered but one substance is not transformed into another. The size or shape of matter may be changed, but no chemical reaction occurs. [physical_change]



Figure 1.1: Ripping Paper

- (a) Before it is ripped, it is paper
- (b) After it is ripped, it is still paper
 - i. Thus, this is an example of a *physical change*.
- (c) Other examples
 - i. Melting Ice
 - ii. Smashing a rock

7. Chemical Changes

Definition

Chemical Change - A chemical change, a.k.a. a chemical reaction is a change of materials into other materials with different properties. [chemical _ change]

(a) Chemical changes occur when

i. A substance combines with another to form a new substance.

OR

ii. Chemical decomposition into two or more different substances.

(b) Examples

- Burning Wood
- Iron Rusting
- Mixing Baking Soda and Vinegar

Measuring Matter

8. Mass

9. Weight

10. Volume

11. Density

Matter Formulas

Density Formulas

When **Density** is unknown

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Density is measured in

$$\frac{\text{g}}{\text{cm}^3} \quad | \quad \frac{\text{g}}{\text{mL}}$$

When **Mass** is unknown

$$\text{mass} = \text{density} \cdot \text{volume}$$

Mass is measured in

$$\text{g} \quad | \quad \text{kg} \quad | \quad \text{mg}$$

When **Volume** is unknown

$$\text{volume} = \frac{\text{mass}}{\text{density}}$$

Volume is measured in

$$\text{L} \quad | \quad \text{mL} \quad | \quad \text{cm}^3$$

Pressure Formulas

When **Pressure** is unknown

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Pressure is measured in

$$\text{atm}$$

When **Force** is unknown

$$force = pressure \cdot area$$

Force is measured in

N

When **Area** is unknown

$$area = \frac{force}{pressure}$$

Area is measured in

cm² | m²

1.5.1 Gas Laws

Boyle's Law Formulas

When **Pressure** is unknown

$$pressure = \frac{force}{area}$$

Pressure is measured in

atm

When **Force** is unknown

$$force = pressure \cdot area$$

Force is measured in

N

When **Area** is unknown

$$area = \frac{force}{pressure}$$

Area is measured in

cm² | m²

Charles's Law Formulas

When **Pressure** is unknown

$$pressure = \frac{force}{area}$$

Pressure is measured in

atm

When **Force** is unknown

$$force = pressure \cdot area$$

Force is measured in

N

When **Area** is unknown

$$area = \frac{force}{pressure}$$

Area is measured in

cm² | m²

Gay-Lussac's Law Formulas

When **Pressure** is unknown

$$pressure = \frac{force}{area}$$

Pressure is measured in

atm

When **Force** is unknown

$$force = pressure \cdot area$$

Force is measured in

N

When **Area** is unknown

$$area = \frac{force}{pressure}$$

Area is measured in

$$\text{cm}^2 \mid \text{m}^2$$