

Properties of Matter

Chemistry Bundle 1



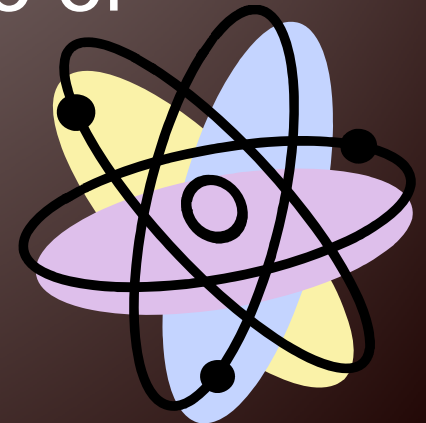
What is Chemistry?

- The study of matter – its composition, structure, properties & the changes it undergoes
- Matter is anything that has mass and takes up space.



Building Blocks of Matter:

- **Atom**– smallest particle of matter that retains the identity of the substance
- **Element** – made up of only 1 type of atom; can't be separated into simpler substances
- **Compound** – a combination of two or more different elements that are chemically combined



Properties of Matter:

All matter can be identified by its properties – its characteristics and behavior. Properties can be described as either chemical or physical, and intensive or extensive.





Chemical Properties:

- Ability or inability of a substance to combine with another substance or change into a new substance
- Can only be observed when there is a change in the composition of the substance
- Always relates to a chemical change, also called a chemical reaction.

Examples of Chemical Properties:

- **Reactivity** - “How does it react with acids?” ; “Does it react with water?”
- **Instability** - tendency of substance to breakdown into different substances
- **Toxicity** – how poisonous; chlorine, lead
- **pH** – measure of acidity
- **Flammability** – the ease with which it will burn



Physical Properties:

- Characteristics that can be observed or measured
- They describe the substance itself (alone)
- Don't involve changes in composition
 - Ex. Water is still H₂O whether it is liquid, ice or steam



Examples of Physical Properties

- **Color**



- **Texture** – how it feels: such as slimy, rough, fuzzy

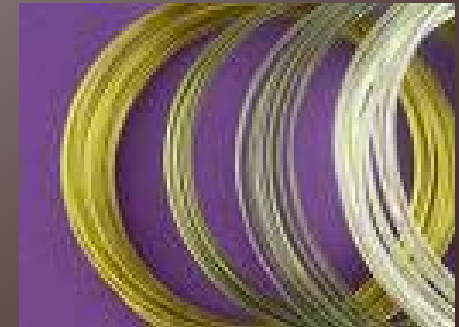
- **Malleability** – can be hammered or rolled into a sheet;



- Al foil

- **Ductility** – can be drawn into a wire

- copper electrical wire



- **Mass** - the amount of matter an object contains

- 5 grams of carbon

More Examples of Phys. Prop:

- **Volume** – the amount of space occupied by an object
 - a gal. of milk
- **Density** – mass per volume unit
 - compactness
- **Solubility** – the ability to dissolve
 - sugar in tea
- **Conductivity** – ability to transfer heat, electricity or sound

[2 Types of Physical Properties:]

- **Intensive properties:** do not change with amount; are used for identification

Example 1-1: List some intensive properties:

Density, color, texture, boiling point, freezing point, odor, etc

- **2. Extensive properties:** depend on the amount of matter present; these change constantly and therefore cannot be used for identification

Example 1-2: List extensive properties

Mass, length, heat or temperature, weight, etc.

Physical and chemical properties can be qualitative and quantitative descriptions of matter.

- **Example 1-3:** Give an example of a qualitative property.

The solution is *clear blue*; the solid is *hard*; or the liquid boils at a *low temperature*

- **Example 1-4:** Give an example of a quantitative property.

Density of iron is 7.86 g/mL ; ice melts at 0°C ; a mass of 35.7 g of sodium chloride dissolves in 100 mL of water

Observations of properties can vary depending on the conditions of the environment. Both physical and chemical properties depend on temperature and pressure. As a result, it is important to note the specific conditions in which observations of properties are made.

Example 1-5: Consider the three physical states of water – solid, liquid, gas. How do the properties of water change as the temperature changes?

- ✓ Liquid water has a density of 1.00 g/mL & is not very chemically reactive.
- ✓ Solid water (ice) has lower density.
- ✓ Gas water (steam), reacts chemically with several different substances.

Physical Changes:



- Change in physical state but not its composition; change in size, shape, or phase
- Most physical changes are reversible

Example 1-6: Name examples of physical changes.



grinding, bending,
dissolving, splitting,
crushing, melting, boiling

Chemical Changes:



- Involve a NEW substance being formed that has different properties
- Chemical changes are usually not reversible

Example 1-7: Name examples of chemical changes.



Indicators of Chemical Change:

- a color change
- a texture change
- a gas produced
- a precipitate formed (a solid product which forms from the reaction of two solutions)
- an obvious mass change
- temperature change



Classification of Matter:

The classification of matter is based on the uniformity of the components that make up the substance and the characteristic properties of the substance. As a result, all matter can be separated into two broad categories: pure substances or mixtures.

Pure substance:

- Every sample has the same properties & fixed composition
- Cannot be separated by simple physical means; separated chemically
- Can be either elements or compounds
 - Ex. Pure sucrose ($C_{12}H_{22}O_{11}$)
 - Pure water (H_2O)



Mixture:



- Combination of two or more substances in which the identity of each substance is not changed
- Do not have specific combinations & do not interact with each other
 - Ex. White sugar mixed with white sand; a tossed salad; vegetable soup



2 Kinds of Mixtures:



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1. **Homogeneous mixtures** are the same composition throughout. Always has a single phase.
 - Another name for homogeneous mixtures is solution. Solutions may contain solids, liquids, or gases.
 - Ex. Air, carbonated soda, stainless steel
2. **Heterogeneous mixtures** are not blended smoothly and individual substances remain distinct.
 - Ex. Granite, dirt, blood



Physical Separation:

- **Filtration** - a process of using a filter to physically separate mixtures. Ex. Using a screen to separate rocks from sand.
- **Distillation** - Using evaporation as a means of separating substances
- **Chromatography** - method of separating mixtures by adsorption
- **Magnetism** – attraction for iron associate with electric current and magnets
- **Solubility** – dissolving one substance in another

