

Physical Properties –

Properties of an element or a compound that can be observed without a chemical reaction. These include:

mass
volume
density
color
odor
shape
melting point
boiling point
state (solid, liquid, gas)

The state can be changed, but the substance will still be the same when you return to the original state.

Example – We think of water as only being the liquid state. Actually water can be a solid which we call ice. Water can also be a gas, which we call steam. Steam can be condensed to form liquid water and ice can be melted to form liquid water. Water in any state is still water, specifically H₂O.

hardness
softness

Chemical Properties –

Properties of an element or compound can will be observed when a chemical reaction occurs. Examples of chemical properties could be:

1. **how** sulfuric acid reacts with sugar
2. **how** electricity reacts with water to form hydrogen and oxygen
3. **how** magnesium reacts with water to form magnesium oxide

Physical Change –

The substance(s) involved in physical changes are not changed chemically in physical changes. They may change state (solid to liquid to gas) or they may be separated or mixed. However, they can always be separated or changed back to their original state. Examples are:

1. water is frozen or evaporated (changed to ice or to steam)
2. a piece of paper is torn in two
3. a diamond is used to cut a ruby
4. salt dissolves in water, when the salt water is evaporated the salt is left behind
5. two different colored paints are mixed to form a new color that is different from either of the original colors
6. acetone evaporates rapidly at room temperature

Chemical Change –

Two substances (reactants) react with each other and one or more new substance(s) (products) are created that is/are different from the original substance(s). Products and reactants have different physical properties. Examples are:

1. when sulfuric acid (H_2SO_4) reacts with sugar ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) and forms carbon (C) and water (H_2O) reactants and products are very different in both chemical and physical properties
2. when magnesium (Mg) and oxygen (O_2) react they form magnesium oxide (MgO)
3. when electricity is passed through water (H_2O) two new substances are formed, hydrogen (H_2) and oxygen (O_2)