

## Physical and Chemical Properties and Changes

### Intensive & Extensive Properties

**Extensive property:** a characteristic that depends on the amount of matter present (how much you have).

1. Mass
2. Volume
3. Length (width, height)

**Intensive property:** a characteristic that does NOT depend on the amount of matter present.

1. Color
2. Density
3. Malleability
4. Ductility
5. Luster
6. Odor
7. Melting Pt.
8. Boiling Pt.
9. Conductivity

### Physical Properties/Changes

**Physical property:** a characteristic that can be observed or measured without changing the identity of the substance.

1. Color
2. Melting point
3. Malleability
4. Ductility
5. Density
6. Solubility (ability to dissolve)
7. Mass
8. Volume
9. Viscosity

**Physical change:** a change when chemical bonds within compounds are NOT broken in the reactant and no new chemical bonds are formed in the products. The identity of the material does NOT change.

1. Changes of state. Example:  $\text{Fe(s)} \rightarrow \text{Fe(l)}$  or  $\text{CO}_2\text{(s)} \rightarrow \text{CO}_2\text{(g)}$
2. Changes in form.

### Chemical Properties/Changes

**Chemical property:** a characteristic that can ONLY be observed or measured by subjecting it to a process that might change the identity of the substance.

1. Reactivity
2. Flammability
3. Toxicity
4. pH (how acidic or basic it is)
5. Ability to Ferment
6. Ability to Oxidize, for example: rusting (Fe) or tarnishing (Ag)

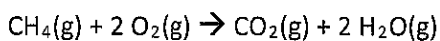
**Chemical change:** a change when chemical bonds within the compound ARE broken in the reactants and new chemical bonds are formed in the products. The identity of the material changes.

### Potential Indications of Chemical Change

1. Energy change (emission or absorption of heat or light)
2. Formation of a gas
3. Formation of a precipitate
4. Formation of an odor
5. Color change

**Chemical Reactions can be described in several ways:** you must be able to convert from any of these forms to another

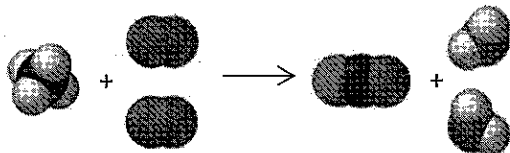
1. In a formula (equation)



2. In a sentence

Methane reacts with oxygen gas to form carbon dioxide and water vapor.

3. In a picture (particulate representation)



**Symbols used in chemical equations:**

$\longrightarrow$  forms, produces, yields

(s) solid state

(l) liquid state

(g) gaseous state

(aq) aqueous solution (dissolved in water).

$\xrightarrow{\text{heat}}$  or  $\xrightarrow{\Delta}$  Reactants are heated.

$\xrightarrow{\text{MnO}_2}$  Formula of catalyst used to speed up reaction. The catalyst does NOT undergo permanent chemical change itself.

**Steps in a Chemical Reaction:** Atoms are NOT created or destroyed! (Law of Conservation of Mass)

1. Reactant bonds broken
2. Atoms rearranged.
3. New bonds formed in products!
4. Mass of all Reactants = Mass of all Products

**Obeying the Law (of Conservation of Mass): Balancing Chemical Equations!**

1. Word equations must be translated into a formula equation.

Do not forget nomenclature:

- Covalent compounds: prefixes
- Ionic compounds: balance charges
- Diatomic elements: **Br<sub>2</sub>, I<sub>2</sub>, N<sub>2</sub>, Cl<sub>2</sub>, H<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>** ← But only when alone (i.e. not bonded to another element)

2. Balance 1 atom at a time by writing coefficient in front of compound.

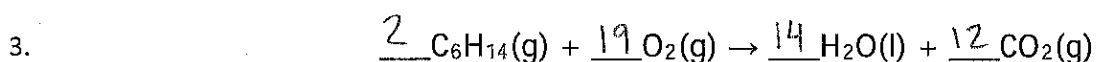
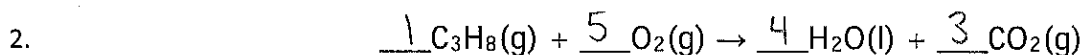
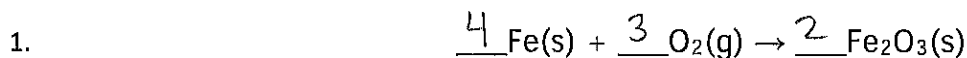
- Do NOT ever change subscripts!

3. Polyatomic ions treated as a single unit (iff they stay together on both sides)

4. If an equation has C, H, and O's balance them in that respective order.

5. Make sure the coefficients are in the Smallest whole number ratio (reduce).

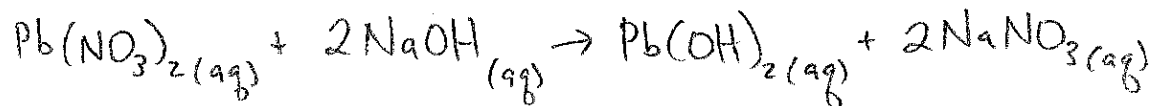
## Practice with Balancing Reactions!



4. Aluminum and  $\text{Cl}_2$  molecular chlorine undergo a synthesis reaction. Write and balance the equation for this reaction.



5. An impure sample containing lead (II) nitrate and an inert material is added to sodium hydroxide. The two aqueous reactants undergo a chemical change, producing aqueous lead (II) hydroxide and one other compound dissolved in the solution. Write and balance the equation for this reaction.
- ↙ doesn't react ⇒ not included in chemical rxn!*



6. An aqueous reaction of hydrochloric acid and potassium sulfite undergoes a gas evolution reaction to form liquid water, sulfur dioxide vapor, and aqueous potassium chloride. Write and balance the equation for this reaction.

