SNC 2P

Balancing Chemical Equations

Word Equations

REACTANTS ⟶ **PRODUCTS**

(left side) (right side)

- A way of representing a chemical reaction.
- Reactants are the substances that are present initially.
- Products are the substances that are produced.
- An arrow is used to indicate the direction of the chemical reaction.
- A plus sign is used to separate each reactant and each product.

Example:

hydrogen + oxygen → water

Skeleton Equations

A word equation shows the reactants and products of a reaction, but it does not provide information about the chemical composition of the substances. Replacing the words with chemical formulas produces a skeleton equation.

Example:

$$H_2 + O_2 \rightarrow H_2O$$

The **state** of any substance in a chemical equation can be described using one of the following symbols placed after the formula of the substance:

State	Symbol
Solid	(s)
Liquid	(l)
Gas	(g)
Aqueous (dissolved in water)	(aq)

Example: $H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)}$

Balanced Chemical Equations

Although the skeleton equation shows the composition of each substance, it does not show the number of reactants or products. A balanced chemical equation demonstrates the law of conservation of mass, which requires the same number of atoms of each element on both sides of the chemical equation.

Law of Conservation of Mass:

In any given chemical reaction,

Example:

$$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$$

How to Balance a Chemical Equation

Example 1 Write the balanced chemical equation for the reaction between aluminum and oxygen gas to produce aluminum oxide.

Step 1: Write the word equation (if necessary)

Aluminum + Oxygen → Aluminum oxide

Step 2: Write a skeleton equation

$$Al_{(s)} + O_{2(g)} \rightarrow Al_2O_{3(s)}$$

Step 3: *a) Draw symbols below each formula to represent the exact number of atoms that are present.*

b) If the number of atoms of one element is not equal on both sides, add another entire reactant or product until the numbers of atoms are equal on both sides. (Repeat Step for all atoms)

$$Al_{(s)} + O_{2(g)} \rightarrow Al_2O_{3(s)}$$

$$Al_{(s)} + O_{2(g)} \rightarrow Al_2O_{3(s)}$$

*Step 4: Count how many of each reactant and product you have used to balance the atoms and put the appropriate **coefficients** in front of the formulas to balance the number of atoms. Make sure to check when finished.*

$$\_\_\_ Al_{(s)} + \_\_\_ O_{2(g)} \rightarrow \_\_\_ Al_2O_{3(s)}$$

Example 2

Aluminum oxide + Calcium → Calcium oxide + Aluminum

Helpful Tips

1. Remember, when trying to balance equations, you can only change the value of the coefficient in front of the compound or element, **not** the subscripts.

1. Balance the element, other than hydrogen and oxygen, which has the *greatest number of atoms* in any reactant or product.

2. Balance other elements, other than hydrogen and oxygen.

3. Balance oxygen or hydrogen, whichever one is present in the combined state (with something else i.e. H_2S). **Leave until last** whichever one is present in the uncombined state (by itself i.e. H_2).

4. Check that the equation is balanced by counting the number of atoms of each element on each side of the equation.

5. When the equation is balanced, the coefficients should be in their **lowest** terms. For example, the balanced equation for the reaction between hydrogen and oxygen is:

Correct $\underline{2}H_2 + O_2 \rightarrow \underline{2}H_20$

NOT Correct! $\underline{4}H_2 + \underline{2}O_2 \rightarrow \underline{4}H_2O$