

Balancing Chemical Equations



What goes in must
come out!

- A **chemical equation** is a representation of a chemical reaction; the formulas of the reactants (on the left) are connected by an arrow with the formulas of the products (on the right).
- The arrow is the “yields sign”. Other synonyms for yield:: produce, make, create, form, result, etc.

Table 11.1**Symbols Used in Chemical Equations**

Symbol	Explanation
+	Used to separate two reactants or two products
\longrightarrow	"Yields," separates reactants from products
\rightleftharpoons	Used in place of \longrightarrow for reversible reactions
(s)	Designates a reactant or product in the solid state; placed after the formula
(l)	Designates a reactant or product in the liquid state; placed after the formula
(g)	Designates a reactant or product in the gaseous state; placed after the formula
(aq)	Designates an aqueous solution; the substance is dissolved in water; placed after the formula
$\xrightarrow[\text{heat}]{\Delta}$	Indicates that heat is supplied to the reaction
$\xrightarrow{\text{Pt}}$	A formula written above or below the yield sign indicates its use as a catalyst (in this example, platinum).

- A **catalyst** is a substance that speeds up the reaction but is not used up in the reaction.
- **Without Catalyst** **With Catalyst**



Law of Conservation of Mass

You need to remember this law!

- The Law of Conservation of Mass states:
that mass is neither created nor destroyed in any chemical reaction.
Therefore balancing of equations requires the same number of atoms on both sides of a chemical reaction.
- The number of atoms in the Reactants must equal the Number of atoms in the Products

Chemical Equations

Because of the principle of the
Conservation of Matter,
an *equation must be
balanced*.

It must have the same
number of atoms of the
same kind on both sides.



Lavoisier, 1788

Balancing Equations

■ Hydrogen + oxygen \rightarrow water



- Hydrogen and oxygen are diatomic elements.
- Their subscripts cannot be changed.
- The subscripts on water cannot be changed.

Balancing Equations



- If the subscripts cannot be altered, how can the atoms be made equal?
- Adjust the number of molecules by changing the ***coefficients***.

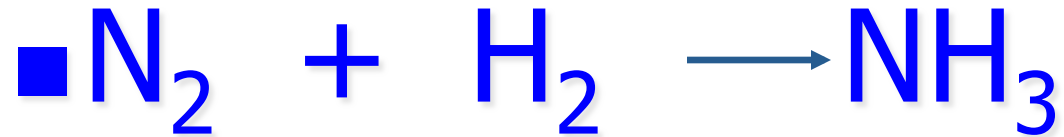
Balancing Equations



- Coefficients multiply all the atoms of the substance they are next to.

(Just like a math equation)

Balancing Equations



■ Nitrogen + hydrogen \longrightarrow ammonia

Balancing Equations



- Polyatomic ions that stay intact can be counted as a unit

Balancing Equations



Balancing Equations

- Balancing hints:
 - Start at the left, and go back & forth changing coefficients as necessary
 - Balance the metals in compounds first.
 - Balance the ion groups next. Leave unchanged polyatomics as a unit (don't count individual atoms)
 - Save single elements for last (i.e. metals, diatomics, etc).

Balancing Equations

- This method of balancing equations is the inspection method.
- The method is trial and error.
- Practice.

