

UNIT NINE: CHEMICAL REACTIONS

Learning Targets	Textbook Section:
Describe how to write a skeleton equation.	11.1
Describe the steps of writing and balancing a chemical equation.	11.1
Describe the five general types of reactions.	11.2

Suggested Reading:

Chapter 11:

Section 11.1 (pages 346-353)

Section 11.2 (pages 356-366)

End of Chapter Practice:

34, 35, 36, 37, 38, 39, 41, 42, 43, 44

To determine what type of reaction is present, study the reactants!

Synthesis - 2 elements



Decomposition - 1 compound



Single Replacement - 1 element + 1 compound



Double Replacement - 2 compounds



Combustion - oxygen + hydrocarbon

Chemical reactions occur around us all of the time! After a meal, a series of chemical reactions take place as your body digests food. Similarly, plants use a series of chemical reactions to convert sunlight into a usable form of energy! (photosynthesis)

In a chemical reaction, one or more reactants change into one or more products.

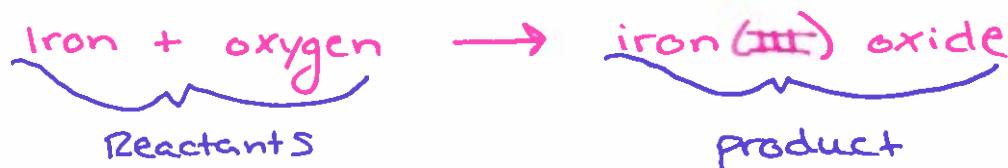
Chemists use a quick, shorthand notation to convey as much information as possible about what happens in a chemical reaction. This is known as a Chemical equation.

Word Equations

In this method, the reactants are written on the left and the products on the right.

Reactants \longrightarrow Products

The arrow represents the direction of the reaction. Read as "yields", "gives", or "produces".



Chemical Equations

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).



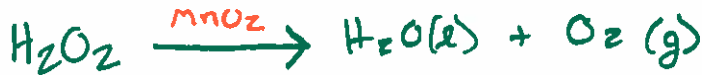
Skeleton Equations

a chemical equation that does not indicate the relative amounts of the reactants and products.

To write a skeleton equation:

- 1) write the chemical formulas for the reactants to the left of the arrow.
- 2) write the formulas for the products to the right of the arrow.

• we can also indicate the physical states of substances by putting symbols after the formulas.
 (s) = solid (l) = liquid (g) = gas (aq) = aqueous solution



Catalyst A substance that speeds up the reaction but is not used up in the reaction.

- * neither a reactant nor a product
- * Formula is written above the arrow.

Symbols Used in Chemical Equations	
+	Separates 2 reactants or 2 products
→	"yields" (separates reactants + products)
⇌	used in place of → for reversible reactions.
(s), (l), (g)	Designates the state a product or reactant is in.
(aq)	Designates an aqueous solution ↳ substance is dissolved in water
Δ →	Indicates heat is supplied to the reaction.
heat →	indicates heat is supplied to the reaction
Pt →	A formula written above the arrow indicates the use of a catalyst.

Practice Writing a Skeleton Equation

1. Hydrochloric acid reacts with solid sodium hydrogen carbonate. The products formed are aqueous sodium chloride, water, and carbon dioxide gas. Write a skeleton equation for this equation.

Reactants:

Hydrochloric acid (aq)
Sodium hydrogen carbonate (s)

Products:

Sodium chloride (aq)
water (l)
Carbon dioxide (g)

Reactants:

HCl (aq)
NaHCO₃ (s)

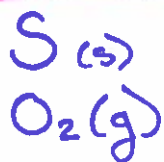
Products:

NaCl (aq)
H₂O (l)
CO₂ (g)



2. Sulfur burns in oxygen to form sulfur dioxide. Write a skeleton equation for this chemical reaction.

Reactants:



Products:



Balancing Chemical Equations

Recall: What are coefficients?

Small whole numbers that are placed in front of the formulas in an equation in order to balance it.

↳ indicates how many of each molecule/compound you have.



In a balanced equation, each side of the equation has the same number of atoms of each element and mass is conserved.

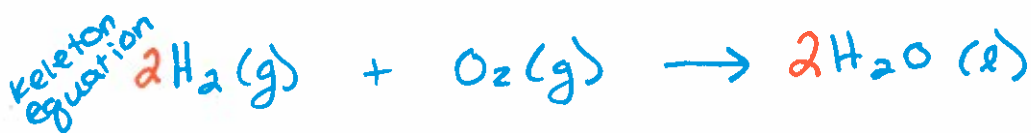
Steps to Balancing a Chemical Equation

1) First, write the skeleton equation.

2) use coefficients to balance the equation.

↳ each side of the equation has the same number of atoms of each element.

Hydrogen and oxygen react to form liquid water.



Reactants

$$\text{H} = \cancel{2} \times 4$$

$$\text{O} = 2$$

Products

$$\text{H} = \cancel{2} \times 4$$

$$\text{O} = \cancel{1} \times 2$$

Practice Balancing Equations $\text{Cu}(s)$ (aq) AgNO_3

1. Students suspended copper wire in an aqueous solution of silver nitrate. They noticed a deposit of silver crystals on the copper wire when the copper reacted with the silver nitrate. Write the skeleton equation for this reaction and then balance the equation.



Reactants:

$$\text{Ag} = \cancel{1} \times 2$$

$$\text{NO}_3 = \cancel{1} \times 2$$

$$\text{Cu} = \cancel{1} \times 1$$

$$\text{O} = \cancel{3} \times 2 = 6$$

Products:

$$\text{Ag} = \cancel{1} \times 2$$

$$\text{NO}_3 = 2$$

$$\text{Cu} = 1$$

$$\text{O} = \cancel{3} \times 2 = 6$$

2. Aluminum is a good choice for outdoor furniture because it reacts with oxygen in the air to form a thin protective coat of aluminum oxide. Balance the following equation.



Reactants:

$$\text{Al} = \cancel{1} \times 4 \checkmark$$

$$\text{O} = \cancel{2} \times 3 \checkmark$$

Products:

$$\text{Al} = \cancel{2} \times 2 \checkmark$$

$$\text{O} = \cancel{3} \times 2 \checkmark$$

Types of Chemical Reactions

By classifying chemical reactions, you can easily predict what products are likely to form. One classification system identifies five general types.

- 1) combination (synthesis)
- 2) decomposition
- 3) single-replacement
- 4) double-replacement
- 5) combustion

Combination Reactions (Synthesis Reactions)

A chemical change in which two or more substances react to form a single new substance.

usually
elements



Decomposition Reaction

A chemical change in which a single compound breaks down into two or more simpler products.

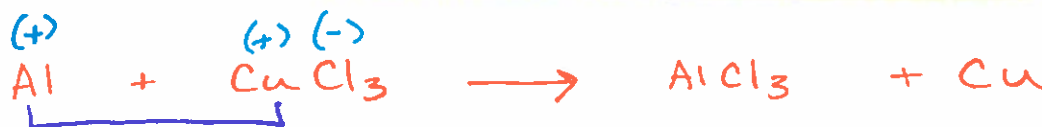
usually
elements



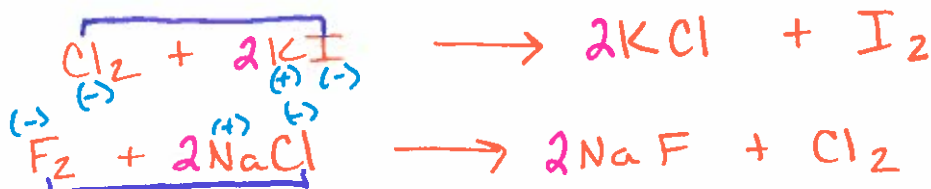
Single-Replacement Reaction

A chemical change in which one element replaces a second element in a compound.

similar



(+) = cation
(-) = anion



Double-Replacement Reaction

A chemical change involving an exchange of positive ions between two compounds.

* 2 ionic compounds \rightarrow ions "switch dance partners"

**Combustion Reaction**

A chemical change in which an element or a compound reacts with oxygen, often producing energy in the form of heat and light.

* O_2 is always in the reactants

* CO_2 and H_2O are always produced!

* A hydrocarbon (compound containing C & H and O sometimes) will be a reactant.

