

Chapter 8 Chemical Equations

Advanced Chemistry

8.1 The Chemical Equation

Learning Objective	
Describe the information present in a chemical equation.	<ul style="list-style-type: none">• A chemical equation is shorthand for expressing a chemical change or reaction.• In a chemical reaction atoms are neither created nor destroyed.• All atoms in the reactants must be present in the products.
Key Terms	
Reactants	A chemical substance entering into a reaction.
Products	A chemical substance produced from reactants by a chemical change.
Chemical equation	A shorthand expression showing the reactants and the products of a chemical change (e.g., $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$).
Law of conservation of mass	No change is observed in the total mass of the substances involved in a chemical reaction; that is, the mass of the products equals the mass of the reactants.

8.2 Writing and Balancing Chemical Equations

Learning Objective	
Write and balance chemical equations.	<ul style="list-style-type: none">• To balance a chemical equation:<ul style="list-style-type: none">○ Identify the reaction.○ Write the unbalanced (skeleton) equation.○ Balance the equation:<ul style="list-style-type: none">▪ Count the number of atoms of each element on each side and determine which need to be balanced.▪ Balance each element (one at a time) by placing whole numbers (coefficients) in front of the formulas containing the unbalanced element: Begin with metals, then nonmetals, and then H and O.▪ Check the other elements to see if they have become unbalanced in the process of balancing the chosen element. If so, rebalance as needed.▪ Do a final check to make sure all elements are balanced.
Key Term	
Balanced equation	A chemical equation having the same number of each kind of atom and the same electrical charge on each side of the equation.

8.3 Types of Chemical Equations

Learning Objective	
Give examples of a combination (or synthesis) reaction, decomposition reaction, single-displacement reaction, and double-displacement reaction.	<ul style="list-style-type: none">• Combination reaction = $A + B \rightarrow AB$ Examples:<ul style="list-style-type: none">○ Metal + oxygen \rightarrow metal oxide○ Nonmetal + oxygen \rightarrow nonmetal oxide○ Metal + nonmetal \rightarrow salt○ Metal oxide + water \rightarrow metal hydroxide○ Nonmetal oxide + water \rightarrow oxy-acid• Decomposition reaction = $AB \rightarrow A + B$ Examples:<ul style="list-style-type: none">○ Some metal oxides decompose to yield the free metal plus oxygen; others give another oxide, and some are very stable, resisting decomposition by heating○ Carbonates and hydrogen carbonates decompose to yield CO_2 when heated• Single-displacement reactions:<ul style="list-style-type: none">○ In which A is a metal = $A + BC \rightarrow B + AC$ Examples:<ul style="list-style-type: none">▪ Metal + acid \rightarrow hydrogen + salt▪ Metal + water \rightarrow hydrogen + metal hydroxide or metal oxide▪ Metal + salt \rightarrow metal + salt○ In which A is a halogen = $A + BC \rightarrow C + BA$ Example:<ul style="list-style-type: none">▪ Halogen + halide salt \rightarrow halogen + halide salt• Double-displacement reactions = $AB + CD \rightarrow AD + CB$ Examples:<ul style="list-style-type: none">○ Neutralizing of an acid and base acid + base \rightarrow salt + water + heat○ Metal oxide + acid \rightarrow salt + water + heat○ Formation of an insoluble precipitate○ Formation of a gas

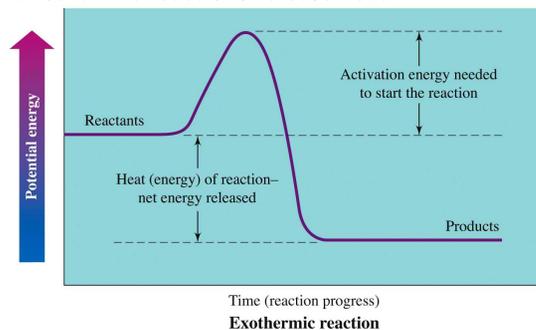
Key Terms	
Combination reaction	A direct union or combination of two substances to produce one new substance.
Decomposition reaction	A breaking down, or decomposition, of one substance into two or more different substances.
Single-displacement reaction	A reaction of an element and a compound that yields a different element and a different compound.
Double-displacement reaction	A reaction of two compounds to produce two different compounds by exchanging the components of the reacting compounds.

8.4 Heat in Chemical Reactions

Learning Objective

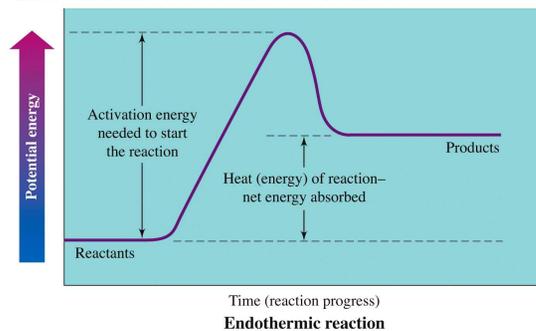
Explain the following terms and how they relate to a chemical reaction: exothermic reaction, endothermic reaction, heat of reaction, and activation energy.

- Exothermic reactions release heat.



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- Endothermic reactions absorb heat.



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- The amount of heat released or absorbed in a chemical reaction is called the heat of reaction:
 - It can be written as a reactant or product in the chemical equation.
 - Units are joules (J) or kilojoules (kJ).
- To initiate a chemical reaction, activation energy is required:
 - In exothermic reactions, this energy is returned and more is released, which allows

the reaction to continue on its own.

- In endothermic reactions, energy must be added to start and continue to be added to sustain the reaction.

Key Terms

Exothermic reaction	A chemical reaction in which heat is released as a product.
Endothermic reaction	A chemical reaction that absorbs heat.
Heat of reaction	The quantity of heat produced by a chemical reaction.
Hydrocarbons	Compounds composed entirely of carbon and hydrogen.
Activation energy	The amount of energy needed to start a chemical reaction.

8.5 Global Warming: The Greenhouse Effect

Learning Objective

Discuss the possible causes and results of the greenhouse effect.

- Carbon dioxide levels are now increasing on our planet every year.
- Carbon dioxide and other greenhouse gases warm the atmosphere by trapping heat near the surface of the Earth.