

Chapter 4 Properties of Matter

Advanced Chemistry

4.1 Properties of Substances

Learning Objective	
Compare the physical and chemical properties of a substance.	<ul style="list-style-type: none">Physical properties are inherent in the substance and can be determined without altering the composition of the substance: color, odor, state of matter, density, melting point, and boiling point.Chemical properties describe the ability of a substance to interact with other substances to form different substances.
Key Terms	
Properties	The characteristics, or traits, of substances that give them their unique identities. Properties are classified as physical or chemical.
Physical properties	Inherent physical characteristics of a substance that can be determined without altering its composition: color, odor, state of matter, density, melting point, boiling point.
Chemical properties	The ability of a substance to form new substances either by reaction with other substances or by decomposition.

4.2 Physical and Chemical Changes

Learning Objective	
Compare the physical and chemical changes in a substance.	<ul style="list-style-type: none">A physical change is a change in the physical properties or a change in the state of matter for a substance without altering the composition of the substance.In a chemical change different substances are formed that have different properties and composition from the original material. Chemical changes can be represented by chemical equations: word equation, molecular equation, and symbol (formula) equation.
Key Terms	
Physical change	A change in form (such as size, shape, or physical state) without a change in composition.
Chemical change	A change producing products that differ in composition from the original substances.
Chemical equation	A shorthand expression showing the reactants and the products of a chemical change (e.g., $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$).
Reactants	A chemical substance entering into a reaction.
Products	A chemical substance produced from reactants by a chemical change.

4.3 Learning to Solve Problems

Learning Objective	
List the basic steps in solving chemistry problems.	<ul style="list-style-type: none">Read. Read the problem carefully, determining what is known and what is to be solved for.Plan. Determine what is required to solve the problem and set up the problem in a neat, organized manner using the examples as guides.Calculate. Complete the necessary calculations making sure your answer contains the proper units and significant figures.Check to see if your answer is reasonable.

4.4 Energy

Learning Objective	
List the various forms of energy, explain the role of energy in chemical changes, and state the law of conservation of energy.	<ul style="list-style-type: none"> • About Energy (the capacity to do work): <ul style="list-style-type: none"> ○ Potential energy is energy that results from position or is stored within a substance. ○ Kinetic energy is the energy matter possesses as a result of its motion. ○ Energy can be converted from one form to another. ○ Common forms of energy are mechanical, chemical, electrical, heat, nuclear, and light. • Energy in Chemistry: <ul style="list-style-type: none"> ○ Energy is most frequently expressed as heat. ○ All chemical changes in are often used to produce energy rather than new substances. • Energy can neither be created nor destroyed. It can be transformed from one form to another.
Key Terms	
Energy	The capacity of matter to do work.
Potential energy (PE)	Stored energy, or the energy of an object due to its relative position.
Kinetic energy (KE)	The energy that matter possesses due to its motion; $KE = \frac{1}{2}mv^2$.
Law of conservation of energy	Energy can be neither created nor destroyed, through it can be transferred from one form to another

4.5 Heat

Learning Objective	
Calculate the amount of heat lost or gained in a give system.	$4.184 \text{ J} = 1 \text{ cal}$ $change \text{ in heat} = m \times c \times \Delta t$ (m is mass, c is specific heat, Δt is change in temperature)

Key Terms	
Joule (J)	The SI unit of energy.
calorie (cal)	A commonly used unit of heat energy; 1 calorie is a quantity of heat energy that will raise the temperature of 1 g of water 1°C (e.g., from 14.5 to 15.5°C). Also, 4.184 joules = 1 calorie exactly.
Specific heat (c)	The quantity of heat required to change the temperature of 1 g of any substances by 1°C. Every substance has a characteristic heat capacity.