

SI units of measurement are based on multiples of 10, making them much easier to work with mathematically than the unrelated units of the U.S. standard measurements, such as ounces, pounds, feet, and gallons. Most calculations with SI

units can be converted from one unit to another simply by moving the decimal point.

For example, look at the illustration below.

10^3 m	10^2 m	10^1 m	10^0 m	10^{-1} m	10^{-2} m	10^{-3} m
kilo	hecto	deka	<u>Base Unit</u>	deci	centi	milli
king	harry	drools	ugly	dark	chocolate	milk

To convert the SI base unit for distance, meters, to centimeters, the decimal point is simply moved 2 spaces to

the right. One meter is equal to 100 centimeters.

Problem-Solving TIPS

- Make note of the unit that is given at the beginning of the problem, and check to see if the answer you are seeking is given in the same or a different unit.
- Is the unit given at the beginning an SI base unit?
- If you are converting from a smaller unit to a larger unit, the decimal point will move to the left.
- If you are converting from a larger unit to a smaller unit, the decimal point will move to the right.
- The number of places you move the decimal point is equal to the power of 10 that is indicated by the prefix.
- If you are converting from a unit with a prefix back to a base unit, start with the prefix unit. Make note of the power of 10 of that prefix in the table in your text.
- Check your final unit to see if it makes sense in terms of the answer sought. For example, if you are measuring the length of a tablet, an answer in tens of kilometers would not be appropriate.

Sample

How many liters are there in 9.844 mL?

The prefix *milli* has a power of 10 of -3 . It is therefore smaller than the base unit of liters. Because you are converting from a smaller unit (mL) to a larger unit (L), move the decimal point 3 places to the left:
 $9.844 \text{ mL} = 0.009844 \text{ L}$

Convert 0.35543 km into meters.

The power of 10 for the prefix *kilo* is 3. It is therefore a larger value than the base unit of meters. To convert from a larger unit (km) to a smaller unit (m), move the decimal point 3 places to the right:
 $0.35543 \text{ km} = 355.43 \text{ m}$

CHAPTER 1 Summary

BIG IDEA Chemistry is the study of the properties and structure of matter, how matter changes, and how both affect our lives.

SECTION 1 Chemistry Is a Physical Science

KEY TERMS

- Science is the knowledge obtained by observing natural events and conditions in order to discover facts and formulate laws or principles that can be verified or tested.
- Chemistry is the study of the composition, structure, and properties of matter and the changes that matter undergoes.
- A chemical is any substance that has a definite composition or is used or produced in a chemical process.
- Basic research is carried out simply to increase knowledge. Applied research is carried out to solve practical problems.
- A knowledge of chemistry can help you make wiser decisions.

science
chemistry
chemical

SECTION 2 Matter and Its Properties

KEY TERMS

- All matter has mass and takes up space. Mass is one measure of the amount of matter.
- Chemical properties refer to a substance's ability to undergo changes that alter its composition and identity.
- An element is composed of one kind of atom. Compounds are made from two or more elements in fixed proportions.
- All substances have characteristic properties that chemists use to distinguish and separate them.
- Physical changes do not change the identity of a substance.
- The three major states of matter are solid, liquid, and gas. Changes of state are physical changes.
- In a chemical change—or a chemical reaction—the identity of the substance changes.
- Energy changes accompany physical and chemical changes. Energy may be released or absorbed, but it is neither created nor destroyed.
- Matter can be classified into mixtures and pure substances.

mass
matter
atom
element
compound
extensive property
intensive property
physical property
physical change
change of state
solid
liquid

gas
plasma
chemical property
chemical change
chemical reaction
reactant
product
mixture
homogeneous solution
heterogeneous pure substance

SECTION 3 Elements

KEY TERMS

- Each element has a unique symbol. The periodic table shows the elements organized by their chemical properties. Columns on the table represent groups or families of elements that have similar chemical properties. Properties vary across periods.
- The elements can be classified as metals, nonmetals, and metalloids. These classes occupy different areas of the periodic table. Metals tend to be shiny, malleable, and ductile and tend to be good conductors. Nonmetals tend to be brittle and tend to be poor conductors.
- Metalloids are intermediate in properties between metals and nonmetals. The noble gases are generally unreactive.

group
family
period
metal
nonmetal
metalloid



SECTION 1

Chemistry Is a Physical Science

REVIEWING MAIN IDEAS

1. What is the definition of science?
2. What branch of chemistry is most concerned with the study of carbon compounds?
3. Identify each of the following as an example of either basic research, applied research, or technological development:
 - a. A new type of refrigerant that is less damaging to the environment is developed.
 - b. A new element is synthesized in a particle accelerator.
 - c. A computer chip is redesigned to increase the speed of the computer.
4. What is said to be the origin of chemistry?
5. Should you believe any “scientific claim” you hear? Why?

SECTION 2

Matter and Its Properties

REVIEWING MAIN IDEAS

6.
 - a. What is mass?
 - b. What is volume?
7. How does the composition of a pure compound differ from that of a mixture?
8.
 - a. Define *property*.
 - b. How are properties useful in classifying materials?
9. What is the difference between extensive properties and intensive properties?

10.
 - a. Define *chemical property*.
 - b. List two examples of chemical properties.
11. Distinguish between a physical change and a chemical change.
12.
 - a. How does a solid differ from a liquid?
 - b. How does a liquid differ from a gas?
 - c. How is a liquid similar to a gas?
 - d. What is a plasma?
13. What is meant by a change in state?
14. Identify the reactants and products in the following reaction:
potassium + water \longrightarrow
potassium hydroxide + hydrogen
15. Suppose different parts of a sample material have different compositions. What can you conclude about the material?

SECTION 3

Elements

REVIEWING MAIN IDEAS

16. What is the significance of the vertical columns of the periodic table? What is the significance of the horizontal rows?
17. Compare the physical properties of metals, nonmetals, metalloids, and noble gases, and describe where in the periodic table each of these kinds of elements is located.
18. Suppose element X is a poor conductor of electricity and breaks when hit with a hammer. Element Z is a good conductor of electricity and heat. In what area of the periodic table does each element most likely belong?
19. Use the periodic table to write the names of the elements that have the following symbols, and identify each as a metal, nonmetal, metalloid, or noble gas.
 - a. K
 - b. Ag
 - c. Si
 - d. Na
 - e. Hg
 - f. He

20. An unknown element is shiny and is found to be a good conductor of electricity. What other properties would you predict for it?
21. Use the periodic table to identify the group numbers and period numbers of the following elements:
- carbon, C
 - argon, Ar
 - chromium, Cr
 - barium, Ba

Mixed Review

REVIEWING MAIN IDEAS

22. a. Define *physical property*.
b. List two examples of physical properties.
23. How can you tell the difference between an element and a compound?
24. Identify each of the following as either a physical change or a chemical change. Explain your answers.
- A piece of wood is sawed in half.
 - Milk turns sour.
 - Melted butter solidifies in the refrigerator.
25. Write a paragraph that shows that you understand the following terms and the relationships between them: *atom*, *molecule*, *compound*, and *element*.
26. Pick an object you can see right now. List three of the object's physical properties that you can observe. Can you also observe a chemical property of the object? Explain your answer.

CRITICAL THINKING

27. **Interpreting Concepts** One way to make lemonade is to start by combining lemon juice and water, then adding sugar to suit your specific desire for sweetness. Is this combination classified as a compound or a mixture? Explain your answer.
28. **Analyzing Results** A pure white, solid material that looks like table salt releases gas when heated under certain conditions. There is no change in the appearance of the solid, but the reactivity of the material changes.
- Did a chemical or physical change occur? How do you know?
 - Was the original material an element or a compound?

29. Interpreting Concepts

- Is breaking an egg an example of a physical or chemical change? Explain your answer.
- Is cooking an egg an example of a physical or chemical change? Explain your answer.

USING THE HANDBOOK

30. Review the information on trace elements in the *Elements Handbook* (Appendix A).
- What are the functions of trace elements in the body?
 - What transition metal plays an important role in oxygen transport throughout the body?
 - What two Group 1 elements are part of the electrolyte balance in the body?

RESEARCH AND WRITING

31. Research any current technological product of your choosing. Find out about its manufacture and uses. Also find out about the basic research and applied research that made its development possible.
32. Investigate current and proposed technological applications of superconductors. Find out which of these applications have been successfully tested or are already in use.

ALTERNATIVE ASSESSMENT

33. During a 1 h period, make a list of all the changes that you see around you and that involve matter. Note whether each change seems to be a physical change or a chemical change. Give reasons for your answers.
34. Make a concept map using at least 15 terms from the vocabulary lists. An introduction to concept mapping is found in the *Study Skills Handbook* of this book.