

Chapter 1

What Is Chemistry?

Section 1: Some Basic Definitions

Skill-Building Exercises

- Example 1.**
 - matter
 - not matter
- Example 2.**
 - chemical change
 - physical change
- Example 3.**
 - heterogeneous mixture
 - homogeneous mixture

Concept Review Exercises

- Chemistry is the study of matter and how it interacts with other matter and with energy.

Exercises

- matter
 - not matter
 - not matter
 - matter
 - matter
- solid: a book; liquid: water; gas: air
- physical property
 - chemical property
 - physical property
- chemical property
 - chemical property
 - physical property
- physical property
 - chemical property
 - physical property
- chemical property
 - physical property
 - chemical property

7. An element is a fundamental chemical part of a substance; there are about 115 known elements. A compound is a combination of elements that acts as a different substance; there are over 50 million known substances.
8. A heterogeneous mixture is obviously a combination of two or more substances, and usually can be identified just by looking (even if very closely). A homogeneous mixture actually looks like a single substance and can be difficult to know that it is a mixture.
9.
 - a. heterogeneous mixture
 - b. homogeneous mixture
 - c. heterogeneous mixture
10.
 - a. homogeneous mixture
 - b. heterogeneous mixture
 - c. heterogeneous mixture
11. 9b is a solution.
12. 10a is a solution.
13. Iron is a metal because it is solid, is shiny, and conducts electricity and heat well.
14. Oxygen is a nonmetal because it is a gas, and does not conduct electricity or heat well.
15. Metals are typically shiny, conduct electricity and heat well, and are malleable and ductile; nonmetals are a variety of colors and phases, are brittle in the solid phase, and do not conduct heat or electricity well.
16. Semimetals have properties intermediate between metals and nonmetals. Some are shiny and conduct heat well, while others have a variety of colors and do not conduct electricity or heat well.
17. Carbon behaves as a metal because it conducts heat and electricity well. It is a nonmetal because it is dull, black, and brittle and cannot be made into sheets or wires.
18. Silicon behaves as a metal because it is shiny and silvery. It is a nonmetal because it does not conduct heat or electricity well.

Section 2: Chemistry as a Science

Skill-Building Exercises

4. **Example 4.**
 1. science
 2. not science
5. **Example 5.**
 1. qualitative
 2. quantitative

Concept Review Exercises

1. First, a hypothesis, or a reasonable guess, is proposed. Then, experiments are performed to try to support or oppose the hypothesis. If the hypothesis is supported, scientists try to work it into a theory of how the natural universe behaves.

Exercises

1. Simply stated, the scientific method includes three steps: (1) stating a hypothesis, (2) testing the hypothesis, and (3) refining the hypothesis.
2. A hypothesis is a guess about how an aspect of the natural universe works. But it's not "just a guess" because it is based on previous understandings of how the universe works; "educated guess" might be a better way to define hypothesis.
3. Scientists perform experiments to test their hypotheses because sometimes the nature of natural universe is not obvious.
4. A theory is a general statement that explains a large number of observations. In general conversation, people tend to use the term to mean "hypothesis" instead, which can be misleading.
5. A scientific law is a specific statement that is thought to be never violated by the entire natural universe. Everyday laws are arbitrary limits that society puts on its members.
6. Music is a field that is not considered a science. (There are other possible answers.)
7.
 - a. yes
 - b. no
 - c. no
8.
 - a. no
 - b. yes
 - c. yes
9.
 - a. qualitative
 - b. not qualitative
 - c. not qualitative
10.
 - a. not qualitative
 - b. qualitative
 - c. qualitative
11. Statements b and c are quantitative.
12. Statement a is quantitative.

Section 3: End-of-Chapter Material

Additional Exercises

1. Yes, it is matter, because it has mass and takes up space. This is true whether you are using a physical copy of the book or if you are viewing it on a computer or other device.
2. Air is usually too easy to forget because we are so used to it being around. Except in a strong wind, of course!
3.
 - a. The quantitative information is the number of home runs.
 - b. No, the quantitative information does not refer to a piece of matter. Rather, it refers to a number of actions (e.g. home runs).
 - c. The fact that Babe Ruth is described as "famous" is qualitative information.

- d. The qualitative information is referring to Babe Ruth, who certainly was a piece of matter!
4. Water (ice and steam are the words we use to describe water in the solid and gas phases, respectively).
 5. Air is a solution that exists in the gas phase. Salt water is a solution that exists in the liquid phase. (Answers may vary.)
 6. Metals are solid, shiny, good conductors of heat and electricity, and can be pulled into wires or beaten into sheets.
 7. Nonmetals have various phases at room temperature, they are poor conductors of heat and electricity, they have a variety of colors.
 8. It is a hypothesis.
 9. It is a theory.
 10. It means that it is a general statement that is thought to never be violated. (Of course, we recognize now that the theory of general relativity is a better description of the natural universe, but in virtually all circumstances Newton's law of gravity works fine.)
 11. Murphy's law isn't really a scientific law. It is more of a humorous statement of what might happen in life.
 12. Quantitative: how busy the bank is, how neat and clean the money and checks are.
Qualitative: how much money comes in and goes out of the bank, the number of customers and transactions that occur.