

## Key Concepts

## 1.1 Chemistry

- Because living and nonliving things are made of matter, chemistry affects all aspects of life and most natural events.
- Chemistry can be divided into five traditional areas of study: organic chemistry, inorganic chemistry, biochemistry, analytical chemistry, and physical chemistry.
- Pure research can lead directly to an application, but an application can exist before research is done to explain how it works.
- Chemistry can be useful in explaining the natural world, preparing people for career opportunities, and producing informed citizens.

## 1.2 Chemistry Far and Wide

- Chemists design materials to fit specific needs. Chemists play an essential role in finding ways to conserve energy, produce energy, and store energy.
- Chemists supply the medicines, materials, and technology that doctors use to treat patients. Chemists help to develop more productive crops and safer, more effective ways to protect crops.

- Chemists help to identify pollutants and prevent pollution.
- To study the universe, chemists gather data from afar and analyze matter that is brought back to Earth.

## 1.3 Thinking Like a Scientist

- Alchemists developed tools and techniques for working with chemicals.
- Lavoisier helped to transform chemistry from a science of observation to the science of measurement that it is today.
- Steps in the scientific method include making observations, testing hypotheses, and developing theories.
- When scientists collaborate and communicate, they increase the likelihood of a successful outcome.

## 1.4 Problem Solving in Chemistry

- Effective problem solving always involves developing a plan and then implementing the plan.
- The steps for solving a numeric word problem are analyze, calculate, and evaluate. The steps for solving a conceptual problem are analyze and solve.

## Vocabulary

- |                               |                                |                               |
|-------------------------------|--------------------------------|-------------------------------|
| • analytical chemistry (p. 8) | • hypothesis (p. 22)           | • physical chemistry (p. 8)   |
| • applied chemistry (p. 9)    | • inorganic chemistry (p. 8)   | • pollutant (p. 16)           |
| • biochemistry (p. 8)         | • macroscopic (p. 12)          | • pure chemistry (p. 9)       |
| • biotechnology (p. 14)       | • matter (p. 7)                | • responding variable (p. 22) |
| • chemistry (p. 7)            | • microscopic (p. 12)          | • scientific law (p. 23)      |
| • experiment (p. 22)          | • manipulated variable (p. 22) | • scientific method (p. 22)   |
|                               | • observation (p. 22)          | • technology (p. 9)           |
|                               | • organic chemistry (p. 8)     | • theory (p. 23)              |

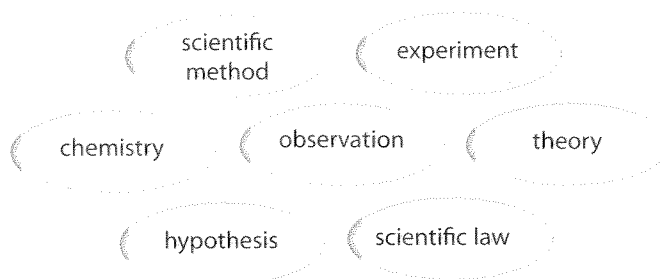
## Organizing Information

Use these terms to construct a concept map that organizes the major ideas of this chapter.



**Concept Map 1** Solve the Concept Map with the help of an interactive guided tutorial.

with ChemASAP



## Reviewing Content

## 1.1 Chemistry

34. Explain why air is classified as matter.
35. The Japanese characters for chemistry literally mean “change study.” Why are these appropriate characters to represent chemistry?

36. Describe the main difference between inorganic chemistry and organic chemistry.
37. Was Wallace Carothers doing pure chemistry or applied chemistry when he discovered nylon? Explain your answer.
38. Explain how chemists were able to connect the ability of aspirin to relieve pain to its ability to reduce the risk of a heart attack.
39. Why would a firefighter or a reporter need to understand chemistry?

## 1.2 Chemistry Far and Wide

40. George de Mestral used burrs as a model for his hook-and-loop tapes. Using burrs as an example, explain the difference between a macroscopic and a microscopic view of matter.
41. How does the use of insulation help to conserve energy?
42. What is the overall goal of scientists who work with biotechnology?
43. Describe two ways that biotechnology can be used to treat diseases.
44. How can testing soil help to increase the productivity of farmland?
45. What is a pollutant?
46. Why is it important that young children not be exposed to lead-based paint?
47. How can scientists study the composition of distant stars?

## 1.3 Thinking Like a Scientist

48. What did the scientists who founded the Royal Society of London share with Lavoisier?
49. What is the most powerful tool that any scientist can have?
50. What is the purpose of an experiment?
51. Which of the following is not a part of the scientific method?  
 a. hypothesis      b. experiment  
 c. guess             d. theory
52. How do a manipulated variable and a responding variable differ?
53. You perform an experiment and get unexpected results. According to the scientific method, what should you do next?
54. Explain how the results of many experiments can lead to both a scientific law and a theory.
55. List two general reasons why scientists are likely to collaborate.

## 1.4 Problem Solving in Chemistry

56. Identify the statements that correctly describe good problem solvers.  
 a. Read a problem only once.  
 b. Check their work.  
 c. Look up missing facts.  
 d. Look for relationships among the data.
57. What do effective problem-solving strategies have in common?
58. In which step of the three-step problem-solving approach for numeric problems is a problem-solving strategy developed?
59. On the average, a baseball team wins two out of every three games it plays. How many games will this team lose in a 162-game season?
60. If your heart beats at an average rate of 72 times per minute, how many times will your heart beat in an hour? In a day?
61. How many days would it take you to count a million pennies if you could count one penny each second?

## Understanding Concepts

62. Match each area of chemistry with a numbered statement.
- |                         |                        |
|-------------------------|------------------------|
| a. physical chemistry   | b. organic chemistry   |
| c. analytical chemistry | d. inorganic chemistry |
| e. biochemistry         |                        |

- (1) Measure the level of lead in blood.
- (2) Study non-carbon-based chemicals in rocks.
- (3) Investigate changes that occur as food is digested in the stomach.
- (4) Study carbon-based chemicals in coal.
- (5) Explain the energy transfer that occurs when ice melts.

63. Explain why chemistry might be useful in a career you are thinking of pursuing.

Use this photograph of a javelin thrower to answer Questions 64 and 65.



64. Explain how chemistry has affected the ability of this athlete to compete.
65. What type of chemist might study how an athlete uses energy during a competition? Give a reason for your answer.

66. A doctor examines a patient's sore throat and suggests that the patient has strep throat. She takes a sample to test for the bacteria that cause strep throat. What parts of the scientific method is the doctor applying?

67. You perform an experiment and find that the results do not agree with an accepted theory. Should you conclude that you made an error in your procedure? Explain.

68. A student is planning a science fair project called Does Temperature Affect How High a Basketball Can Bounce?

- a. Based on the project title, identify the manipulated variable and the responding variable.
- b. Name at least two factors that would need to be kept constant during the experiment.

69. Describe a situation in which you used at least two steps in the scientific method to solve a problem.

70. Pure water freezes at  $0^{\circ}\text{C}$ . A student wanted to test the effect of adding salt to the water. The table shows the data that was collected.

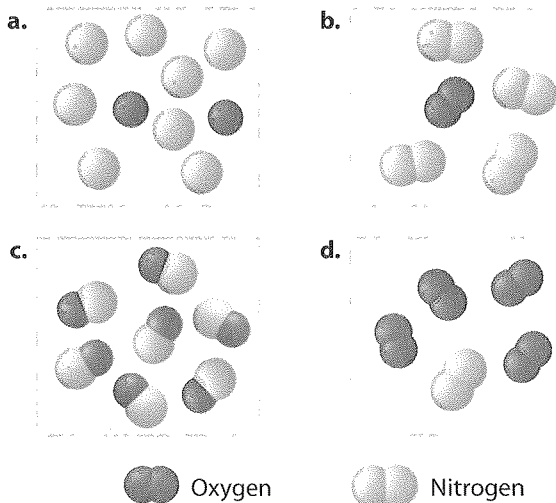
Salt Added	Freezing Point
5 g	$-4.8^{\circ}\text{C}$
10 g	$-9.7^{\circ}\text{C}$
15 g	$-15.1^{\circ}\text{C}$
20 g	$-15.0^{\circ}\text{C}$

- a. What was the manipulated variable?
- b. What was the responding variable?
- c. Why must the volume of water be the same for each test?
- d. Based on the data, the student hypothesized, "As more salt is added to water, the temperature of the water decreases." Is this hypothesis supported by the data? Explain.

71. In the time a person on a bicycle travels 4 miles, a person in a car travels 30 miles. Assuming a constant speed, how far will the car travel while the bicycle travels 40 miles?

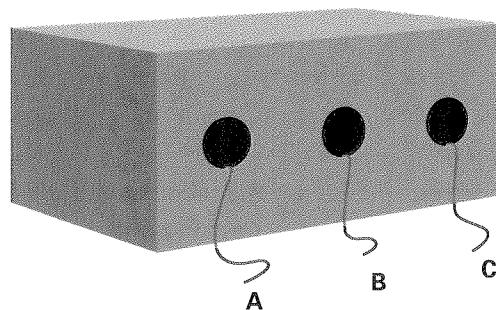
## Critical Thinking

72. Compare and contrast the study of chemistry with the study of a language.
73. Comment on the idea that science accepts what works and rejects what does not work.
74. You are asked to design an experiment to answer the question: "Which paper towel is the best?"
- What is the manipulated variable in your experiment?
  - List three possible responding variables that could be used to define "best"?
  - Pick one of the responding variables and rewrite the question as a hypothesis.
  - List at least five factors that must be kept constant when you test the hypothesis.
75. Important discoveries in science are sometimes the result of an accident. Louis Pasteur said, "Chance favors the prepared mind." Explain how both of these statements can be true.
76. Four beakers have a total weight of 2.0 lb. Each beaker when full holds 0.5 lb of water. Describe two different methods you could use to calculate the weight of two full beakers of water. Then try both methods and compare the answers.
77. Explain what is wrong with the statement, "Theories are proven by experiments."
78. The air you breathe is composed of about 20% oxygen and 80% nitrogen. Use your problem solving skills to decide which drawing best represents a sample of air. Explain your choice.



## Concept Challenge

79. You find a sealed box with strings protruding from three holes, as shown in the diagram. When you tug string A, it becomes longer and string C becomes shorter. When you tug string B, it becomes longer, but strings A and C are not affected. Make a diagram showing the arrangement of the strings inside the box.



80. A certain ball when dropped from any height, bounces one-half the original height. If the ball was dropped from a height of 60 in. and allowed to bounce freely, what is the total distance the ball has traveled when it hits the ground for the third time? Assume the ball bounces straight up and down.
81. Eggs are shipped from the farm to market by truck. They are packed 12 eggs to a carton and 20 cartons to a box. Four boxes are placed in each crate. Crates are stacked on a truck 5 crates wide, 6 crates deep, and 5 crates high. How many eggs are on a truck?
82. An oil tanker containing 4,000,000 barrels is emptied at the rate of 5000 gallons per minute. What information do you need to figure out how long it would take to empty the tanker?
83. A crate of envelopes sells for \$576.00. A package of envelopes contains 250 envelopes. Six packages are packed inside a carton. Twelve cartons are packed in a box. Eight boxes are packed in a crate.
- What does a package of envelopes cost?
  - What fact given in the problem was not needed to calculate the answer?

# Standardized Test Prep

## Test-Taking Tip

**True-False Questions** When the word *because* is placed between two statements that may or may not be true, you need to decide two things. First, are the statements both true, are they both false, or is one statement true and the other false. If both statements are true, you must then decide if the second statement is a correct explanation for the first statement.

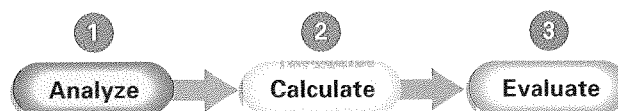
Select the choice that best answers each question or completes each statement.

- The branch of chemistry that studies chemicals containing carbon is \_\_\_\_ chemistry.
  - physical
  - inorganic
  - analytical
  - organic
- An analytical chemist is most likely to
  - explain why paint is stirred before it is used.
  - explain what keeps paint attached to the steel frame of an automobile.
  - identify the type of paint chips found at the scene of a hit-and-run accident.
  - investigate the effect of leaded paint on the development of a young child.
- Chemists who work in the biotechnology field are most likely to work with
  - X-ray technicians.
  - geologists.
  - physicians.
  - physicists.

Respond to each statement in Questions 4–6.

- Someone who wears contact lenses does not have to wear safety goggles in the lab.
- Eating food that is left over from an experiment is an alternative to discarding the food.
- For a student who has read the procedure, the teacher's pre-lab instructions are unnecessary.

Use the flowchart to answer Question 7.



- What should you do before you calculate an answer to a numeric problem and what should you do after you calculate the answer?

Use this paragraph to answer Questions 8–10.

- (1) On a cold morning, your car does not start. (2) You say, "Oh no! The battery is dead!". (3) Your friend who works on cars uses a battery tester and finds that the battery has a full charge. (4) Your friend notices a lot of corrosion on the battery terminals. (5) Your friend says, "Maybe corrosion is causing a bad connection in the electrical circuit, preventing the car from starting." (6) Your friend cleans the terminals and the car starts.
- Which statements are observations?
  - Which statements are hypotheses?
  - Which statement describes an experiment?

For each question there are two statements. Decide whether each statement is true or false. Then decide whether Statement II is a correct explanation for Statement I.

Statement I	Statement II
11. A hypothesis may be rejected after an experiment.	BECAUSE Experiments are used to test hypotheses.
12. The supply of fossil fuels is limited.	BECAUSE Scientists are always looking for new sources of energy.
13. Theories help you make mental models of objects that cannot be seen.	BECAUSE Theories summarize the results of many observations and experiments.
14. Ideally, chemicals used to attack insect pests should be nonspecific.	BECAUSE Scientists are looking for safer, more effective ways to protect crops.
15. All Internet sites that provide scientific information are equally reliable.	BECAUSE All information on these sites is reviewed by qualified scientists.