Study Guide

Study Tip

Gather Materials

Tell students to gather the materials they will need before they begin to study. Explain that students should also have available a few sheets of blank paper. As students study, they can write or sketch key ideas. Tell students that putting key ideas on paper can help them understand and remember the ideas later.

Thinking Visually

a. A fundamental unit of measurement
b. Meter
c. A unit of measurement that is formed by combining base units
d. Cubic meter (m^3)

Assessment

Interactive Textbook If your class subscribes to the Interactive Textbook, your students can go online to access an interactive version of the Student Edition and a self-test.

Reviewing Content

1. c **2.** d **3.** b
4. b **5.** c **6.** b
7. c **8.** b **9.** c
10. c

Understanding Concepts

11. Example: The study of Mars falls under the branch of space science. However, studying Mars might also involve analyzing the chemistry of substances found on Mars, which falls under physical science. If scientists search for evidence of life on Mars, then their studies might also fall under life science.
12. The goal of any scientific method is to solve a problem or to better understand an observed event.
13. Controlled experiments are useful in that they can show how one variable (the responding variable) changes with respect to another variable (the manipulated variable), while the remaining variables are controlled.
14. You might modify your hypothesis or formulate a new hypothesis based on your experimental results.

CHAPTER 1

Study Guide

1.1 What is Science?

Key Concepts

- Science begins with curiosity and often ends with discovery.
- Science and technology are interdependent. Advances in one lead to advances in the other.
- Natural science is generally divided into three branches: physical science, Earth and space science, and life science.

Vocabulary

science, *p. 3*
technology, *p. 3*
chemistry, *p. 4*
physics, *p. 4*
geology, *p. 4*
astronomy, *p. 4*
biology, *p. 4*

1.2 Using a Scientific Approach

Key Concepts

- The goal of a scientific method is to solve a problem or to better understand an observed event.
- A scientific law describes an observed pattern in nature without attempting to explain it. The explanation of such a pattern is provided by a scientific theory.
- Scientific models make it easier to understand things that might be too difficult to observe directly.

Vocabulary

scientific method, *p. 7*
observation, *p. 8*
hypothesis, *p. 8*
manipulated variable, *p. 8*
responding variable, *p. 8*
controlled experiment, *p. 8*
scientific theory, *p. 9*
scientific law, *p. 9*
model, *p. 10*

1.3 Measurement

Key Concepts

- Scientific notation makes very large or very small numbers easier to work with.
- Scientists use a set of measuring units called SI.
- The precision of a calculation is limited by the least precise measurement used in the calculation.

Vocabulary

scientific notation, *p. 14*
length, *p. 16*
mass, *p. 16*
volume, *p. 16*
density, *p. 17*
conversion factor, *p. 18*
precision, *p. 19*
significant figures, *p. 19*
accuracy, *p. 19*
thermometer, *p. 20*

1.4 Presenting Scientific Data

Key Concepts

- Scientists can organize their data by using data tables and graphs.
- Scientists can communicate results by writing in journals or speaking at conferences.

Vocabulary

slope, *p. 23*
direct proportion, *p. 23*
inverse proportion, *p. 23*

Thinking Visually

Using Tables Use information from the chapter to complete the table below.

Type of Unit	Description	Example
Base	a. ?	b. ?
Derived	c. ?	d. ?

Chapter Resources

Print

- ***Chapter and Unit Tests,*** Chapter 1 Test A and Test B
- ***Test Prep Resources,*** Chapter 1

Technology

- ***Computer Test Bank,*** Chapter Test 1
- ***Interactive Textbook,*** Chapter 1
- ***Go Online,*** PHSchool.com, Chapter 1

CHAPTER 1

Assessment

Interactive Textbook with assessment at PHSchool.com

Reviewing Content

Choose the letter that best answers the question or completes the statement.

1. The application of knowledge to solve practical problems is known as
a. science. **b.** curiosity.
c. technology. **d.** experimentation.

2. Which is not a branch of natural science?
a. physical science **b.** life science
c. Earth science **d.** social science

3. What is the purpose of an experiment?
a. to communicate data
b. to test a hypothesis
c. to prove a scientific law
d. none of the above

4. A representation of an object or event is called
a. a scientific law. **b.** a model.
c. a hypothesis. **d.** a variable.

5. Which value is equivalent to 5×10^6?
a. five thousand **b.** fifty thousand
c. five million **d.** fifty million

6. What is the SI base unit of mass?
a. gram **b.** kilogram
c. milligram **d.** pound

7. An electric generator produces 10 megawatts. This amount is equivalent to
a. 10,000 watts. **b.** 1,000,000 watts.
c. 10,000,000 watts. **d.** 0.010 watt.

8. Which of the following is a ratio of equivalent measurements that is used to convert a quantity expressed in one unit to another unit?
a. slope **b.** conversion factor
c. derived unit **d.** density

9. When the ratio of two variables is constant, their relationship can be described as
a. inversely proportional.
b. interdependent.
c. directly proportional.
d. parallel.

10. Which of the following would best suit data that describe how a part relates to the whole?
a. line graph **b.** bar graph
c. circle graph **d.** scientific notation

Understanding Concepts

11. Give an example of a case where the branches of natural science appear to overlap.

12. What is the goal of a scientific method?

13. How are controlled experiments useful?

14. Suppose you perform an experiment, and the resulting data do not support your hypothesis. What is the next step you might take?

15. What are some safety precautions that you should follow when working in the laboratory?

16. What is scientific notation?

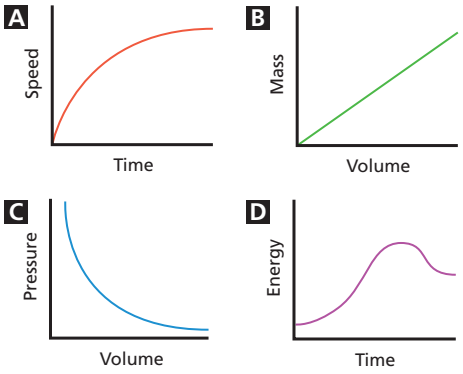
17. What are the SI base units for length and temperature?

18. How do derived units differ from base units?

19. How is the precision of a calculated result related to the precision of the measurements used in the calculation?

20. How can you convert a temperature expressed in degrees Celsius to kelvins?

21. Which of the following graphs describes a direct proportion?



22. Why is it important for scientists to communicate their results?

Homework Guide

Section	Questions
1.1	1–2, 11, 33
1.2	3–4, 12–15, 23–24, 26, 31–32
1.3	5–7, 16–19, 25, 28, 30
1.4	8–10, 20–22, 27, 29

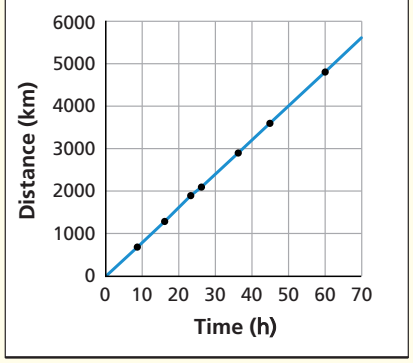
Assessment (continued)

15. Some safety precautions you should follow when working in the laboratory include reading through all the steps of any activity, making sure you understand the entire procedure, following directions exactly, and asking your teacher if you're not sure about how to proceed.
16. Scientific notation is a way of expressing a value as the product of a number between 1 and 10 and a power of 10.
17. The SI base unit for length is the meter. The SI base unit for temperature is the kelvin.
18. Derived units are combinations of base units. A base unit is a fundamental unit of measurement.
19. The precision of a calculated answer is limited by the precision of the measurements used in the calculation. For example, if the least precise measurement in a calculation has three significant figures, then the calculated answer can have at most three significant figures.
20. To convert from degrees Celsius to kelvins, you can use the following formula: $K = °C + 273$
21. B
22. It is important for scientists to communicate their results so that they can share the knowledge they have gained with others, and also get feedback from other scientists.

Critical Thinking

23. Some students may hypothesize that objects of greater mass fall to the ground faster than objects of lesser mass. Others may hypothesize that mass does not affect the rate at which objects fall.
24. In designing their experiments, students might suggest dropping a heavy object and a light object from the same height and measuring how long each takes to fall to the ground. (A more qualitative design might suggest releasing both objects simultaneously and observing if one reaches the ground before the other, without taking any measurements.) Height is controlled. The manipulated variable is the mass of the object. The responding variable is time.
25. 13.5 km
26. Everything drawn on a map represents a thing or place that is scaled down. For example, solid lines on the map might represent streets and highways; a green polygon on the map might represent a park; a gray square on the map might represent a building. If you plan a trip to an unfamiliar place, a map can help you by showing you how the streets are oriented. If a road forks on the map, you will see it fork as you travel on the road. If you navigate two rights and then a left on the map, you should be able to match that route to the environment you travel in.
27. Average speed = 80 km/h

Driving Distance vs. Time



Math Skills

28. 16°C; 289 K
29. The mass of the pennies is directly proportional to the number of pennies. Measuring the mass of one penny yields a ratio (i.e., grams per penny) that is constant. You can then measure the mass of all the pennies. Dividing the total mass by the mass of one penny yields the total number of pennies.
30. Between 6×10^{12} and 1.2×10^{13} stars

Assessment *(continued)*

Critical Thinking

23. Formulating Hypotheses Suppose you want to know if objects with different masses fall to the ground at different rates. State a hypothesis about falling objects.

24. Designing Experiments Explain how you can test the hypothesis in Question 23. What will be the manipulated variable in your experiment? What will be the responding variable?

25. Calculating A triathlete enters a race in which he swims 500 meters, runs 3000 meters, and cycles 10.0 kilometers. What is the total distance of the race in kilometers?

26. Using Models Explain how a map of your town is an example of a model. How does this model help you plan a trip to an unfamiliar place?

27. Using Graphs Use the data in the table below to create a line graph. Plot distance on the vertical axis. Plot driving time on the horizontal axis. Calculate the slope of the line. If speed is the ratio of distance to time, what is the average driving speed of the trip?

Driving Distance and Time

City	Distance From Start (km)	Driving Time From Start (h)
New York City, N.Y.	750	9.5
Cleveland, Ohio	1300	16.25
Chicago, Ill.	1900	23.25
Omaha, Nebr.	2100	26.25
Cheyenne, Wyo.	2900	36.25
Salt Lake City, Utah	3600	45
San Francisco, Calif.	4800	60

Math Skills

28. Calculating If a thermometer outside your classroom indicates a temperature of 61 degrees Fahrenheit, what is the temperature in degrees Celsius? In kelvins?

29. Problem Solving Suppose you have a large coffee can full of pennies. How can you estimate how much money the can contains without counting all the coins? (*Hint:* What is the relationship between the mass of pennies and the number of pennies?)

30. Calculating The Milky Way galaxy contains between 200 and 400 billion stars. Estimate the number of stars in a cluster of 30 galaxies similar in size to the Milky Way. Your answer should consist of a low estimate and a high estimate, both expressed in scientific notation.

Concepts in Action

31. Designing Experiments A zookeeper notices that elephants become restless shortly before an earthquake. The zookeeper forms a hypothesis that, just before an earthquake occurs, an elephant detects a sound that humans are unable to hear. How could this hypothesis be tested?

32. Making Judgments You see an advertisement on television for an over-the-counter medication that has been "scientifically proven to work." How could you find out if this claim is true?

33. Writing in Science Write a paragraph describing how advances in technology have affected your life. (*Hint:* The first sentence should state the paragraph's main idea.)

Performance-Based Assessment

Designing Experiments Grocery stores carry many brands of household detergents. Design an experiment to compare a more expensive brand of detergent with a less expensive one. Is one brand better for some purposes than the other?

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Concepts in Action

31. The zookeeper could test his hypothesis by installing an instrument that can detect sounds that are too low or too high in frequency for humans to hear. Sounds detected by the instrument could then be compared to the elephant's behavior and the timing of earthquakes.
32. You could test the claim by finding out what has been reported or written about the medication advertised. You could do an Internet search, query the manufacturer, or query a doctor.
33. Students may describe how certain advances in technology have made their lives more convenient. For example, advances in computer technology (such as faster processors and modems) have made it easier for people to communicate, access information, study, shop, and entertain.

Standardized Test Prep

Test-Taking Tip

Calculating

Checking units is a very important part of problem solving. Keep these tips in mind when solving problems involving unit conversions:

- A conversion factor is a ratio of equivalent measurements.
- Write horizontal fractions to help keep track of conversion factors. For example, write $\frac{32\ g}{cm^3}$ as opposed to 32 g/cm^3.
- Line up conversion factors so that the unit you are converting cancels.
- If you have to square or cube a unit, make sure you square or cube the entire conversion factor.
- Make a reality check of your answer. If the units are wrong, your calculations are probably wrong. Also, verify that the numerical answer is reasonable.

Practice using these tips in Questions 2 and 4.

Choose the letter that best answers the question or completes the statement.

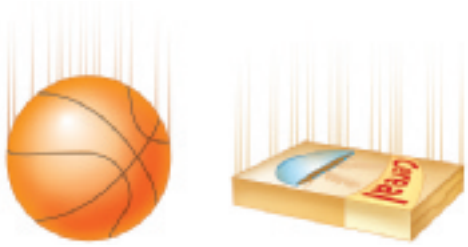
1. In a controlled experiment,
(A) there are multiple responding variables.
(B) the responding variable is kept constant.
(C) the manipulated variable is kept constant.
(D) the responding variable is deliberately changed.
(E) only one variable at a time is deliberately changed.

2. The speed of an object indicates how far it travels in a given amount of time. If an electron travels 2.42×10^8 meters in 2.00 seconds, what is the speed of this electron in cm/s?
(A) 1.21×10^8 cm/s
(B) 4.84×10^8 cm/s
(C) 1.21×10^{10} cm/s
(D) 2.42×10^{10} cm/s
(E) 4.84×10^{10} cm/s

3. A doctor measures the temperature of a patient to be 101°F. What is this temperature in kelvins?
(A) 38.3 K (B) 73.8 K
(C) 214 K (D) 311 K
(E) 346 K

4. The density of seawater is 1.024×10^3 kg/m^3. What is the density of seawater in g/cm^3?
(A) 102.4 g/cm^3
(B) 1.024×10^{-6} g/cm^3
(C) 1.024 g/cm^3
(D) 3.072×10^3 g/cm^3
(E) 1.024×10^9 g/cm^3

5. A student conducts an experiment by dropping a basketball and a box of cereal of the same weight from the top of a building. The student measures the time it takes for each object to strike the ground. What was the student's hypothesis?



(A) A basketball weighs more than cereal.
(B) Curved objects travel through the air faster than flat objects.
(C) Heavier objects travel through the air faster than lighter objects.
(D) Gravity pulls on objects of the same weight with the same force.
(E) Heavier objects strike the ground with a greater force than lighter objects.

6. If two variables are directly proportional, then
(A) an increase in one variable causes a decrease in the other variable.
(B) the product of the two variables is constant.
(C) the ratio of the two variables is constant.
(D) neither variable is the controlled variable.
(E) both variables are constant.

Standardized Test Prep

1. E **2.** C **3.** D
4. C **5.** B **6.** C

Performance-Based Assessment

Students may think of different ways to evaluate/measure the responding variable (how effectively a detergent cleans) in their experiments. Another important aspect of the experimental design is how to make the stains a controlled variable, for in order for a comparison of two cleaning agents to be exact, they must be tested on uniformly stained surfaces.