Section Review

Objectives
• Convert measurements to scientific notation
• Distinguish among the accuracy, precision, and error of a measurement
• Identify the number of significant figures in a measurement and in the result of a calculation

Vocabulary
• measurement
• scientific notation
• accuracy
• precision
• accepted value
• experimental value
• error
• percent error
• significant figures

Key Equations
• Error = experimental value / accepted value
• Percent error = |error| / accepted value × 100%

Part A Completion
Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The __1__ of a measurement describes how close the measurement comes to the true value. The __2__ of a measurement depends on its reproducibility. An __3__ is a value measured in the lab. __4__ is calculated by subtracting the __5__ from an experimental value. Percent error is calculated by dividing the __6__ of the error by the accepted value and then multiplying by __7__.

Large and small numbers are more easily handled when expressed in __8__. Significant figures in a measurement include all of the digits that are __9__ plus a last digit that is __10__.
Part B True-False
Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

11. Scientific notation is used to express large numbers in convenient form.
12. Significant figures include all the digits that can be known accurately plus a last digit that must be estimated.
13. An answer to calculations done with scientific measurements cannot be more precise than the least precise measurement.

Part C Matching
Match each description in Column B to the correct term in Column A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. accuracy</td>
<td>a. measure of how close a series of measurements are to one another</td>
</tr>
<tr>
<td>15. measurement</td>
<td>b. measure of how close a measurement comes to the actual value</td>
</tr>
<tr>
<td>16. precision</td>
<td>c. digits in a measurement that are known plus one that is estimated</td>
</tr>
<tr>
<td>17. scientific notation</td>
<td>d. a value determined in the laboratory</td>
</tr>
<tr>
<td>18. experimental value</td>
<td>e. a quantity that has both a number and a unit</td>
</tr>
<tr>
<td>19. significant figures</td>
<td>f. a method of expressing numbers as a product of a coefficient and a power of 10</td>
</tr>
</tbody>
</table>

Part D Questions and Problems
Answer the following questions or solve the following problems in the space provided.
Show your work.

20. Give the number of significant figures in the following measurements.
   - a. $3.85 \times 10^{-3}$ dm
   - b. 17.30 cm³
   - c. 0.0037 mm

21. Perform the following operations and give the answers in standard exponential form with the correct number of significant figures.
   - a. $37.2$ mL + $18.0$ mL + $380$ mL =
   - b. $0.57$ cm $\times 0.86$ cm $\times 17.1$ cm =
   - c. $(8.13 \times 10^4) \div (3.8 \times 10^2) =$
Section Review

Objectives

- List SI units of measurement and common SI prefixes
- Distinguish between the mass and weight of an object
- Convert between Celsius and Kelvin temperature scales

Vocabulary

- International System of Units (SI)
- kilogram (kg)
- meter (m)
- gram (g)
- liter (L)
- temperature
- Celsius scale
- Kelvin scale
- weight
- energy
- joule (J)
- calorie (cal)
- absolute zero
- space taken up by a cube
- one
temperature

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The International System of Units (SI) is a revision of the

1. ______ system. There are 2 SI base units. In SI, the base

2. ______ unit of length is the 3. ______.

3. ______

The space taken up by a cube that is 10 cm on each edge is

4. ______. A measure of the pull of gravity on an object of

5. ______. The mass of one cubic centimeter of

6. ______. Scientists commonly use two

equivalent units of temperature, the degree 7. ______ and the

8. ______. The 9. ______ and the 10. ______ are common units of energy.

9. ______

10. ______
Part B True-False
Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

11. The SI base unit of mass is the milliliter.
12. A decigram is 100 times smaller than a gram.
13. The SI unit of volume is derived from the unit of length.
14. There are six basic SI units of measurement.

Part C Matching
Match each description in Column B to the correct term in Column A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Kelvin scale</td>
<td>a. quantity of heat that raises the temperature of 1 g of pure water by 1°C.</td>
</tr>
<tr>
<td>16. International System of Units (SI)</td>
<td>b. the capacity to do work or to produce heat</td>
</tr>
<tr>
<td>17. temperature</td>
<td>c. the SI unit of energy</td>
</tr>
<tr>
<td>18. meter</td>
<td>d. non-SI unit of volume</td>
</tr>
<tr>
<td>19. calorie</td>
<td>e. standardized system of measurement based on the metric system</td>
</tr>
<tr>
<td>20. Celsius scale</td>
<td>f. mass unit commonly used in chemistry</td>
</tr>
<tr>
<td>21. liter</td>
<td>g. the SI unit of length</td>
</tr>
<tr>
<td>22. joule</td>
<td>h. force that measures the pull of gravity on a given mass</td>
</tr>
<tr>
<td>23. weight</td>
<td>i. zero point on the Kelvin scale equal to −273.15°C</td>
</tr>
<tr>
<td>24. absolute zero</td>
<td>j. SI base unit of mass</td>
</tr>
<tr>
<td>25. kilogram</td>
<td>k. temperature scale on which the freezing point of water is 273.15° and its boiling point is 373.15°</td>
</tr>
<tr>
<td>26. gram</td>
<td>l. freezing scale that sets the freezing point of water at 0° and its boiling point at 100°</td>
</tr>
<tr>
<td>27. energy</td>
<td>m. measure of how hot or cold an object is</td>
</tr>
</tbody>
</table>
Part D Questions and Problems

Answer the following in the space provided.

28. What is the volume of a board that measures 1.8 cm by 8.8 cm by 30.5 cm?

29. Hydrogen boils at 20K. What is the boiling point of hydrogen on the Celsius scale?

30. What is the symbol and meaning of each prefix?
   a. pico-
   b. kilo-
   c. micro-
   d. centi-
Section Review

Objectives

• Construct conversion factors from equivalent measurements
• Apply the techniques of dimensional analysis to a variety of conversion problems
• Solve problems by breaking the solution into steps
• Convert complex units, using dimensional analysis

Vocabulary

• conversion factor
• dimensional analysis

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Whenever two measurements are equal, or equivalent, a ratio of these two measurements will equal _____________.

A ratio of equivalent measurements is called a ____________. When a measurement is multiplied by a conversion factor, the value of the measurement ________.

In ________, the units that are a part of the measurements are used to help solve the problem. The form of the conversion factor that is used is the one in which the unit of the ________ is in the denominator.

Many complex word problems can be solved by breaking the solution into ________. When converting between units, it is often necessary to use more than one ________.

In doing multistep problems, it is important to check that the numerator and ________ of each conversion factor are equivalent.

When the ________ cancel, you should be left with the unit of the ________.

Name ___________________________ Date ___________________ Class __________________
Part B  True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

______ 11. The units of a conversion factor must cancel.

______ 12. The conversion factor for changing between grams and milligrams is \( \frac{1 \text{ g}}{1000 \text{ mg}} \).

______ 13. Multiple conversion factors can be used to solve complex conversion problems.

______ 14. If density = mass/volume, then mass = density/volume.

______ 15. When two measurements are equal, a ratio of these two measurements will equal unity.

Part C  Questions and Problems

Answer the following in the space provided.

16. Make the following conversions using Tables 3.1 and 3.2. Write your answers in scientific notation.
   a. 125 g to kilograms
   b. 0.12 L to mL

17. If 1500 white blood cells are lined up side by side, they would form a row 1.0 inch long. What is the average diameter in micrometers of a single white blood cell? (1 inch = 2.54 cm)

18. A radio wave travels 186,000 miles per second. How many kilometers will the wave travel in one microsecond? (1 mile = 1.61 km)
3.4 DENSITY

Section Review

Objectives
- Calculate the density of a material from experimental data
- Describe how density varies with temperature

Key Term
- density

Key Equation
- Density = \( \frac{\text{mass}}{\text{volume}} \)

Part A Completion
Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The ratio of the mass of an object to its volume is its density.  1. __________________________
Density is an property that depends only on the 2. __________________________ of a substance, not on the size of the sample.  3. __________________________

Part B True-False
Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

4. The density of a substance decreases as its temperature is increased.  
5. Density has units of grams per cubic centimeter.
Part D  Questions and Problems

Solve the following problems in the space provided. Show your work.

6. A rock has a mass of 127 g and displaces 32.1 mL of water. What is the density of the rock?

7. A 1.00-L sample of carbon tetrachloride has a mass of 1.58 kg. What is the density of this substance in g/cm³?
SECTION 3.1 MEASUREMENTS AND THEIR UNCERTAINTY

Using different rulers, Bruce and Pete each measure the length of the same object three times.

1. Bruce's three measurements are 19 cm, 20 cm, and 22 cm. Calculate the average value of his measurements and express the answer with the correct number of significant figures.

2. Pete's three measurements are 20.9 cm, 21.0 cm, and 21.0 cm. Calculate the average value of his measurements and express the answer with the correct number of significant figures.

3. Multiply the answer to problem 1 by the answer to problem 2. Express the answer in scientific notation with the correct number of significant figures.

4. Whose measurements are more precise?

5. The actual length of the object is 20 cm. Whose measurements are more accurate?

6. What is the error of Pete's average measurement?

7. What is the percent error of Pete's average measurement?

8. Four boards each measuring 1.5 m are laid end to end. Multiply to determine the combined length of the boards, expressed with the correct number of significant figures.

SECTION 3.2 THE INTERNATIONAL SYSTEM OF UNITS (SI)

A fish tank measures 0.40 meter long by 0.20 meter wide by 0.30 meter high.

1. What is the width of the tank in centimeters?

2. What is the length of the tank in millimeters?

3. What is the volume of the tank in liters?

4. What is the mass of water, in grams, that would fill the tank halfway?

5. An astronaut in her spacesuit weighs 300 lb on Earth. What would her weight be on the moon?

6. How many nanoseconds are there in one minute?

7. A chemical reaction takes place at 20°C. What is this temperature in kelvins?

8. A typical refrigerator keeps food at 277 K. What is this temperature in degrees Celsius?
SECTION 3.3 CONVERSION PROBLEMS

1. The population of San Francisco is 750,000 in an area of 49 square miles. What is the population density in San Francisco? Express your answer in people per acre. (1 mi² = 640 acres)

2. A sugar-free powdered drink mix sells for $2.99 per can. Each can of the mix contains 50.2 g of powder, which, when added to water, will make 8 quarts of drink. What is the cost of the powdered drink mix in dollars/lb? (454 g = 1 lb)

3. A car is travelling at 60 miles per hour. Express this speed in kilometers per hour (km/h). (1 mi = 1.609 km)

4. A whole chicken sells for $7.06 and has a mass of 1.5 kg. A beef shank sells for $10.00 with a mass of 2.5 kg. Compare the per pound cost for each item. (1 kg = 2.2 lb)

5. How many seconds are there in a day? (1 day = 24 h)

6. The speed limit on a certain highway is 72 km/h. What is this speed in cm/s?

7. Gold has a density of 19.3 g/cm³. What is the mass, in kilograms, of one cubic meter of gold?

8. An automobile can travel 40.0 miles on one gallon of gasoline. How many kilometers per liter is this? (1.61 km = 1 mi; 1 L = 0.264 gal)

9. Suppose that gold is selling at $375/ounce. How many milligrams of gold could you buy for one cent? (16 oz = 1 lb; 1 lb = 454 g)

SECTION 3.4 DENSITY

Use the data in Table 3.7 to solve problems 1–4.

1. What is the mass at 20°C of 5 liters of air?

2. A balloon filled with air is released in a room filled with carbon dioxide. Will the balloon float to the ceiling or sink to the floor?

3. What is the volume in liters of a kilogram of ice at 0°C?

4. What is the mass of a bar of aluminum measuring 1.0 cm by 1.0 cm by 10.0 cm?
Use Figure 1 to answer the following questions.

1. Cylinder A is used to measure liquids up to 4 mL. To what number of significant figures could liquids be measured using cylinder A?

2. Cylinder B is also used to measure liquids up to 4 mL. To what number of significant figures could liquids be measured using cylinder B?

3. A student is asked to measure out 2.55 mL of water. Which cylinder(s) would be suitable for this measurement?

4. A student is asked to measure out 3 mL of methanol. Which cylinder(s) would be suitable for this measurement?
Figure 2 shows a thermometer that is calibrated in both Celsius and Kelvin scales. Use Figure 2 to answer the following questions.

5. Which temperature scale is shown at the top of the drawing?

6. Which temperature scale is shown at the bottom of the drawing?

7. A student reported the temperature shown to be 20°C. Is this the correct number of significant figures? Why?

8. In what physical state does water exist at the temperature shown?
**Vocabulary Review**

Match the correct vocabulary term to each numbered statement. Write the letter of the correct term on the line.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. the ratio of the mass of an object to its volume</td>
<td>a. Celsius scale</td>
</tr>
<tr>
<td>2. closeness of a measurement to the true value</td>
<td>b. measurement</td>
</tr>
<tr>
<td>3. the mass of 1 L of water at $4{\degree}C$</td>
<td>c. scientific notation</td>
</tr>
<tr>
<td>4. difference between the experimental value and the accepted value</td>
<td>d. joule</td>
</tr>
<tr>
<td>5. the degree of hotness or coldness of an object</td>
<td>e. energy</td>
</tr>
<tr>
<td>6. the SI base unit of length</td>
<td>f. error</td>
</tr>
<tr>
<td>7. a ratio of equivalent measurements</td>
<td>g. density</td>
</tr>
<tr>
<td>8. a quantity that has both a number and a unit</td>
<td>h. kilogram</td>
</tr>
<tr>
<td>9. temperature scale on which water freezes at $0{\degree}C$ and boils at $100{\degree}C$</td>
<td>i. accuracy</td>
</tr>
<tr>
<td>10. a way to analyze and solve problems, using the units of the measurements</td>
<td>j. meter</td>
</tr>
<tr>
<td>11. a method of expressing numbers as a product of a coefficient and a power of 10</td>
<td>k. temperature</td>
</tr>
<tr>
<td>12. the SI unit of energy</td>
<td>l. conversion factor</td>
</tr>
<tr>
<td>13. the capacity to do work or to produce heat</td>
<td>m. dimensional analysis</td>
</tr>
</tbody>
</table>
Chapter Quiz

Answer the following questions and write the answers on the line.

1. If you measure a line three times with the same ruler, do your measurements become more accurate?

2. Which form of the conversion factor would you use to convert 75 g to kg?

3. How many significant figures does the measurement 0.4006 m have?

4. Round off the following measurements to two significant figures.
   a. 0.0828 m
   b. 19.75°C
   c. 6906 km

5. Write the answers to question 4 in scientific notation.
   a. 4a. 0.08 m
   b. 4b. 19.8°C
   c. 4c. 6906 km

Choose the best answer and write its letter on the line.

6. Which of these is the smallest?
   a. one liter
   b. one microliter
   c. one milliliter

7. The metric prefix kilo- means:
   a. one thousand times smaller.
   b. ten times smaller.
   c. one thousand times larger.

Solve the following problems in the space provided.

8. Convert −55°C to K. (Recall that °C = K − 273.)

9. The density of a substance, as measured by a student, is 4.80 g/cm³. The accepted value, as printed in a reliable handbook, is 5.10 g/cm³. Calculate the percent error.
Chapter Test A

A. Matching

Match each description in Column B with the correct term in Column A. Write the letter of the correct description on the line.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. error</td>
<td>a. a measure of the pull of gravity on a given mass</td>
</tr>
<tr>
<td>2. precision</td>
<td>b. concerned with the reproducibility of measurements</td>
</tr>
<tr>
<td>3. 1 liter</td>
<td>c. a ratio of equivalent measurements</td>
</tr>
<tr>
<td>4. temperature</td>
<td>d. originally defined as the mass of 1 L of water at 4°C</td>
</tr>
<tr>
<td>5. density</td>
<td>e. a way to analyze and solve problems, using the units of a measurement</td>
</tr>
<tr>
<td>6. conversion factor</td>
<td>f. the ratio of the mass of an object to its volume</td>
</tr>
<tr>
<td>7. dimensional analysis</td>
<td>g. the degree of hotness or coldness of an object</td>
</tr>
<tr>
<td>8. weight</td>
<td>h. closeness of a measurement to the true value</td>
</tr>
<tr>
<td>9. 1 kilogram</td>
<td>i. difference between the experimental value and the accepted value</td>
</tr>
<tr>
<td>10. accuracy</td>
<td>j. the volume of a cube 10 cm on each edge</td>
</tr>
</tbody>
</table>

B. Multiple Choice

Choose the best answer and write its letter on the line.

11. How many significant figures are in the measurement 2103.2 g?
   a. 2  
   b. 3  
   c. 4  
   d. 5

12. Which of these equalities is not correct?
   a. 100 cg = 1 g  
   b. 1000 mm = 1 m  
   c. 1 cm³ = 1 mL  
   d. 10 kg = 1 g

13. How many of the zeros in the measurement 0.000 040 200 m are significant?
   a. 2  
   b. 3  
   c. 7  
   d. 8
14. How many milligrams are in 2.5 kg?
   a. $2.5 \times 10^6$ mg  
   b. 25 mg  
   c. $2.5 \times 10^{-4}$ mg  
   d. $2.5 \times 10^2$ mg

15. The closeness of a measurement to its true value is a measure of its:
   a. usefulness.  
   b. precision.  
   c. accuracy.  
   d. reproducibility.

16. Which of these measurements is expressed to three significant figures?
   a. 0.070 mm  
   b. $7.30 \times 10^{-7}$ km  
   c. 7007 mg  
   d. 0.007 m

17. A metric unit of volume is the:
   a. L.  
   b. mg.  
   c. km.  
   d. K.

18. The number of seconds in a 40-hour work week can be calculated as follows:
   a. $60 s \times \frac{1 \text{ min}}{60 s} \times \frac{1 \text{ h}}{60 \text{ min}}$  
   b. $1 s \times \frac{1 \text{ min}}{60 s} \times \frac{40 \text{ h}}{60 \text{ min}}$  
   c. $40 h \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}}$  
   d. $40 h \times \frac{60 \text{ min}}{40 \text{ h}} \times \frac{60 \text{ s}}{60 \text{ min}}$

19. The metric prefix *kilo*- means:
   a. 100 times smaller.  
   b. 1000 times larger.  
   c. 1000 times smaller.  
   d. 100 times larger.

20. What is the volume of 60.0 g of ether if the density of ether is 0.70 g/mL?
   a. 86 mL  
   b. $1.2 \times 10^{-2}$ mL  
   c. $2.4 \times 10^{-2}$ mL  
   d. 42 mL

21. The temperature reading of $-14^\circ C$ corresponds to a Kelvin reading of:
   a. 297.6 K.  
   b. $-287$ K.  
   c. 287 K.  
   d. 259 K.

22. Concentrated hydrochloric acid has a density of 1.19 g/mL. What is the mass, in grams, of 2.00 liters of this acid?
   a. $2.38 \times 10^3$ g  
   b. 2.38 g  
   c. $4.20 \times 10^{-4}$ g  
   d. $4.20 \times 10^{-4}$ g

23. A conversion factor:
   a. is equal to 1.  
   b. is a ratio of equivalent measurements.  
   c. does not change the value of a measurement.  
   d. all of the above

24. Chlorine boils at 239 K. What is the boiling point of chlorine expressed in degrees Celsius?
   a. $93^\circ C$  
   b. $34^\circ C$  
   c. $-61^\circ C$  
   d. $-34^\circ C$

25. A student measures a volume as 25 mL, whereas the correct volume is 23 mL. What is the percent error?
   a. 0.087%  
   b. 8.7%  
   c. 0.92%  
   d. 8.0%
C. True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

26. Precise measurements are also accurate measurements. _______
27. Zeros in a measurement are significant. _______
28. In converting between units, it is necessary to use more than one conversion factor. _______
29. When converting complex units, you should check that the units cancel, the conversion factors are correct, and the answer has the correct units. _______
30. The weight of an object changes with its location. _______
31. A kilogram is the mass of 1 mL of water at 4°C. _______
32. The density of a substance decreases at its temperature increases. _______
33. Heat transfers from objects at high temperatures to objects at low temperatures. _______
34. To convert density from g/cm³ to kg/m³, one of the conversion factors you could use is mg³/kg. _______

D. Problems

Solve the problems in the space provided. Show your work.

35. A cube of gold-colored metal with a volume of 64 cm³ has a mass of 980 g. The density of pure gold is 19.3 g/cm³. Is the metal pure gold?

36. Perform the following operations. Make sure that your answers have the correct number of significant digits.
   a. 4.15 cm \( \times \) 1.8 cm

   b. 13.00 m \( - \) 0.54 m

   c. \( (1.7 \times 10^{-5} \text{ m}) \times (3.72 \times 10^{-4} \text{ m}) \)
37. Calculate the density of a liquid that has a mass of 14.0 g and a volume of 18.0 cm³.

E. Essay

Write a short essay for the following.

38. Explain how density differs from volume.
Chapter Test B

A. Matching

Match each term in Column B with the correct description in Column A. Write the letter of the correct term on the line.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. how close a single measurement comes to the actual value of whatever is being measured</td>
<td>a. density</td>
</tr>
<tr>
<td>2. a way to analyze and solve problems, using the units of a measurement</td>
<td>b. precision</td>
</tr>
<tr>
<td>3. the SI base unit of length</td>
<td>c. conversion factor</td>
</tr>
<tr>
<td>4. the mass of 1 L of water at 4°C.</td>
<td>d. temperature</td>
</tr>
<tr>
<td>5. a ratio of equivalent measures</td>
<td>e. accuracy</td>
</tr>
<tr>
<td>6. how close several measurements are to each other</td>
<td>f. 1 kilogram</td>
</tr>
<tr>
<td>7. a measure of the pull on a given mass by Earth's gravity</td>
<td>g. meter</td>
</tr>
<tr>
<td>8. the ratio of the mass of an object to its volume</td>
<td>h. 1 liter</td>
</tr>
<tr>
<td>9. the volume of a cube 10 cm on each edge</td>
<td>i. dimensional analysis</td>
</tr>
<tr>
<td>10. the degree of hotness or coldness of an object</td>
<td>j. weight</td>
</tr>
</tbody>
</table>

B. Multiple Choice

Choose the best answer and write its letter on the line.

11. The number of seconds in a 40-hour work week can be calculated as follows:
   a. \(60 \text{ s} \times \frac{1 \text{ min}}{60 \text{ s}} \times \frac{1 \text{ h}}{60 \text{ min}} =\)
   b. \(1 \text{ s} \times \frac{1 \text{ min}}{60 \text{ s}} \times \frac{40 \text{ h}}{60 \text{ min}} =\)
   c. \(40 \text{ h} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} =\)
   d. \(40 \text{ h} \times \frac{60 \text{ min}}{40 \text{ h}} \times \frac{60 \text{ s}}{60 \text{ min}} =\)

12. Which of the following is the correct scientific notation for 0.000 008 62?
   a. \(86.2 \times 10^7\)
   b. \(8.62 \times 10^6\)
   c. \(86.2 \times 10^{-7}\)
   d. \(8.62 \times 10^{-6}\)
13. The measurement $4.06 \times 10^{-5}$ g represents:
   a. $0.000 \, 040 \, 6$ g. 
   b. $0.000 \, 004 \, 06$ g. 
   c. $406 \, 000$ g. 
   d. $40 \, 600 \, 000$ g.

14. The largest number from among the following is:
   a. $1.80 \times 10^{-4}$. 
   b. $1.80 \times 10^{-6}$. 
   c. $1.80 \times 10^{-2}$. 
   d. $1.80 \times 10^{-8}$.

15. According to the rules of significant figures, the number of digits that are estimated in a measurement is:
   a. one. 
   b. two. 
   c. three. 
   d. none.

16. How many significant figures are in the measurement 603.040 g?
   a. 3 
   b. 4 
   c. 5 
   d. 6

17. How many of the zeros in the measurement 0.050 060 m are significant?
   a. 1 
   b. 2 
   c. 3 
   d. 4

18. Which of these measurements is expressed to four significant figures?
   a. $0.108$ m 
   b. $16.530$ m 
   c. $2.6 \times 10^6$ m 
   d. $5.300 \times 10^{-7}$ m

19. The thickness of a dime is approximately:
   a. 1 m. 
   b. 1 dm. 
   c. 1 cm. 
   d. 1 mm.

20. Which of these equalities is correct?
   a. 1 g = 1000 kg 
   b. 1 cm = 100 m 
   c. 1 L = 1000 mL 
   d. 1 mm = 10 cm

21. How many centimeters are in 25 kilometers?
   a. $2.5 \times 10^3$ cm 
   b. $2.5 \times 10^5$ cm 
   c. $2.5 \times 10^7$ cm 
   d. $2.5 \times 10^9$ cm

22. The metric prefix milli- means:
   a. 100 times smaller. 
   b. 1000 times smaller. 
   c. 1000 times larger. 
   d. 100 times larger.

23. The smallest volume from among the following is:
   a. 0.012 L. 
   b. 25 mL. 
   c. 18 cm$^3$. 
   d. $1.6 \times 10^{-2}$ L.

24. What volume of water at 4°C can be held in a cube whose edge is 3.0 cm long?
   a. 3.0 mL 
   b. 9.0 cm$^2$ 
   c. 27 mL. 
   d. 12 cm$^3$

25. What is the density of an object with a mass of 40.0 g and a volume of 80.0 cm$^3$?
   a. 0.500 g/cm$^3$ 
   b. 2.00 cm$^3$/g 
   c. $3.20 \times 10^3$ g/cm$^3$ 
   d. $1.20 \times 10^2$ g/cm$^3$
26. What is the volume of 25.0 g of copper if the density of copper is 8.9 g/cm³?
   a. 2.8 cm³  
   b. 0.36 cm³  
   c. 220 cm³  
   d. 34 cm³

27. What is the mass of 72 cm³ of silver if the density of silver is 10.5 g/cm³?
   a. 6.8 g  
   b. 760 g  
   c. 0.15 g  
   d. 83 g

28. A conversion factor:
   a. is equal to 1.  
   b. is a ratio of equivalent measurements.  
   c. does not change the value of a measurement.  
   d. all of the above

29. If water boils at 100°C, this is a Kelvin reading of:
   a. 100 K.  
   b. 273 K.  
   c. 373 K.  
   d. 173 K.

30. A Kelvin reading of 50 K is the same as a Celsius reading of:
   a. −223°C.  
   b. 323°C.  
   c. 223°C.  
   d. 50°C.

31. A student estimated a mass to be 250 g but, upon carefully measuring it, found the value to be 240 g. What is the percent error of the estimated mass if the measured value is the accepted one?
   a. 4.0%  
   b. −4.2%  
   c. −4.0%  
   d. 4.2%

C. True-False
Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

32. When converting complex units, you should check that the units cancel, the conversion factors are correct, and the answer has the correct units.

33. A reproducible measurement is an accurate one.

34. Zero digits in a measurement are significant.

35. One mL of water has a mass of 1 g at 4°C.

36. One milliliter occupies the same volume as one cubic centimeter.

37. The mass of an object changes with its location.

38. In converting between units, it is never necessary to use more than one conversion factor.

39. The density of a substance decreases as its volume decreases.
D. Problems
Solve the following problems in the space provided. Show your work.

40. Perform the following operations. Express your answers in the correct number of significant figures.
   a. \(36.47 + 2.721 \text{ cm} + 15.1 \text{ cm}\)
   b. \(148.576 \text{ g} - 35.41 \text{ g}\)
   c. \((5.6 \times 10^7 \text{ m}) \times (3.60 \times 10^{-2} \text{ m})\)
   d. \((8.74 \times 10^9 \text{ m}) / (4.2 \times 10^{-6})\)

41. a. Find the volume, in both \(\text{cm}^3\) and \(\text{L}\), of a metal box 0.60 m long, 10.0 cm wide, and 50.0 mm deep.
   b. If the box is filled with water, what would be the mass of the water inside?

42. A block of silver-colored metal with a volume of 65.0 \(\text{cm}^3\) has a mass of 750.0 g. The density of pure silver is 10.5 g/cm\(^3\). Is the metal pure silver?

E. Essay
Write a short essay for the following.

43. Using the following problem as an example, explain and illustrate, step by step, how the use of units can help you solve problems correctly. Example: Find the volume, in liters, of a rectangular box 25 cm long, 10 cm wide, and 8 cm deep.