

SAMPLE PROBLEM 1.2

Scientific Notation

- Write the following measurements in scientific notation:
 - 0.000 16 L
 - 5 220 000 m
- Write the following as standard numbers:
 - 7.2×10^{-3} m
 - 2.4×10^5 g

SOLUTION

- 1.6×10^{-4} L
 - 5.22×10^6 m
- 0.0072 m
 - 240 000 g

STUDY CHECK

Write the following measurements in scientific notation:

- 425 000 m
- 0.000 000 8 g

QUESTIONS AND PROBLEMS

Scientific Notation

- Write the following measurements in scientific notation:
 - 55 000 m
 - 480 g
 - 0.000 005 cm
 - 0.000 14 s
 - 0.007 85 L
 - 670 000 kg
- Write the following measurements in scientific notation:
 - 180 000 000 g
 - 0.000 06 m
 - 750 000 kg
 - 0.15 m
 - 0.024 s
 - 1500 m^3
- Which number in each pair is larger?
 - 7.2×10^3 or 8.2×10^2
 - 4.5×10^{-4} or 3.2×10^{-2}
 - 1×10^4 or 1×10^{-4}
 - 0.000 52 or 6.8×10^{-2}

- Which number in each pair is smaller?
 - 4.9×10^{-3} or 5.5×10^{-9}
 - 1250 or 3.4×10^2
 - 0.000 000 4 or 5×10^{-8}
 - 4×10^{-8} or 4×10^{-10}

- 1250 or 3.4×10^2
- 0.000 000 4 or 5×10^{-8}
- 4×10^{-8} or 4×10^{-10}

- Write the following as standard numbers:

- 1.2×10^4
- 8.25×10^{-2}
- 4×10^6
- 5×10^{-3}

- Write the following as standard numbers:

- 3.6×10^{-5}
- 8.75×10^4
- 3×10^{-2}
- 2.12×10^5

STUDY CHECK

State the number of significant figures in each of the following measured numbers:

- a. 0.000 35 g b. 2000 m c. 2.0045 L

QUESTIONS AND PROBLEMS

Measured Numbers and Significant Figures

1.11 Identify the numbers in each of the following statements as measured or exact:

- A person weighs 155 lb.
- The basket holds eight apples.
- In the metric system, 1 kg is equal to 1000 g.
- The distance from Denver, Colorado, to Houston, Texas, is 1720 km.

1.12 Identify the numbers in each of the following statements as measured or exact:

- There are 31 students in the laboratory.
- The oldest known flower lived 1.2×10^8 years ago.
- The largest gem ever found, an aquamarine, has a mass of 10^4 kg.
- A laboratory test shows a blood cholesterol level of 184 mg/100 mL.

1.13 In each set of the following numbers, identify the measured number(s), if any:

- 3 hamburgers and 6 oz of meat
- one table and four chairs

c. 0.75 lb of grapes and 350 g of butter

d. 60 seconds equals 1 minute

1.14 In each set of the following numbers, identify the exact number(s), if any:

- 5 pizzas and 50.0 g of cheese
- 6 nickels and 16 g of nickel
- 3 onions and 3 lb of potatoes
- 5 miles and 5 cars

1.15 For each of the following measurements, indicate if the zeros are significant:

- 0.0038 m
- 5.04 cm
800. L
- 3.0×10^{-3} kg
- 85 000 g

1.16 For each of the following measurements, indicate if the zeros are significant:

- 20.05 g
- 5.00 m
- 0.000 02 L
- 120 000 years
- 8.05×10^2 g

QUESTIONS AND PROBLEMS

Significant Figures in Calculations

1.23 Why do we usually need to round off calculations that use measured numbers?

1.24 Why do we sometimes add a zero to a number in a calculator display?

1.25 Round off each of the following numbers to three significant figures:

- a. 1.854 b. 184.2038
c. 0.004 738 265 d. 8807
e. 1.832×10^5

1.26 Round off each of the numbers in problem 1.25 to two significant figures.

1.27 For the following problems, give answers with the correct number of significant figures:

- a. 45.7×0.034 b. $0.002\ 78 \times 5$
c. $\frac{34.56}{1.25}$ d. $\frac{(0.2465)(25)}{1.78}$

1.28 For the following problems, give answers with the correct number of significant figures:

- a. 400×185 b. $\frac{2.40}{(4)(125)}$
c. $0.825 \times 3.6 \times 5.1$ d. $\frac{3.5 \times 0.261}{8.24 \times 20.0}$

1.29 For the following problems, give answers with the correct number of decimal places:

- a. $45.48\text{ cm} + 8.057\text{ cm}$
b. $23.45\text{ g} + 104.1\text{ g} + 0.025\text{ g}$
c. $145.675\text{ mL} - 24.2\text{ mL}$
d. $1.08\text{ L} - 0.585\text{ L}$

1.30 For the following problems, give answers with the correct number of decimal places:

- a. $5.08\text{ g} + 25.1\text{ g}$
b. $85.66\text{ cm} + 104.10\text{ cm} + 0.025\text{ cm}$
c. $24.568\text{ mL} - 14.25\text{ mL}$
d. $0.2654\text{ L} - 0.2585\text{ L}$

1.5 Prefixes and Equalities

The special feature of the metric system of units is that a **prefix** can be attached to any unit to increase or decrease its size by some factor of 10. For example, the prefixes *milli* and *micro* are used to make the smaller units, milligram (mg) and microgram (μg). Table 1.6 lists some of the metric prefixes, their symbols, and their decimal values.

The prefix *centi* is like cents in a dollar. One cent would be a centidollar, or $\frac{1}{100}$ of a dollar. That also means that one dollar is the same as 100 cents. The prefix *deci* is like dimes in a dollar. One dime would be a decidollar, or $\frac{1}{10}$ of a dollar. That also means that one dollar is the same as 10 dimes.

The U.S. Food and Drug Administration (FDA) has determined the daily values (DVs) of nutrients for adults and children age 4 or older. Some of these recommended daily val-

LEARNING GOAL

Use the numerical values of prefixes to write a metric equality.

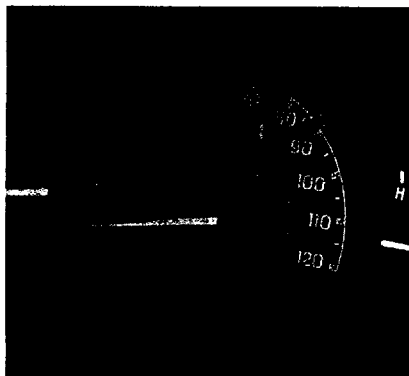


SELF STUDY ACTIVITY
Metric System

QUESTIONS AND PROBLEMS

Prefixes and Equalities

1.31 The speedometer is marked in both km/h and mph. What is the meaning of each abbreviation?



1.32 In a French car, the odometer reads 2250. What units would this be? What units would it be if this were an odometer in a car made for the United States?

1.33 How does the prefix *kilo* affect the gram unit in kilogram?

1.34 How does the prefix *centi* affect the meter unit in centimeter?

1.35 Write the abbreviation for each of the following units:

- | | |
|---------------|--------------|
| a. milligram | b. deciliter |
| c. kilometer | d. kilogram |
| e. microliter | f. nanogram |

1.36 Write the complete name for each of the following units:

- | | |
|------------------|-------|
| a. cm | b. kg |
| c. dL | d. Gm |
| e. μg | f. mg |

1.37 Write the numerical values for each of the following prefixes:

- | | |
|----------|---------|
| a. centi | b. kilo |
| c. milli | d. deci |
| e. mega | f. pico |

1.38 Write the complete name (prefix + unit) for each of the following numerical values:

- | | |
|------------|-------------------------|
| a. 0.10 g | b. 1×10^{-6} g |
| c. 1000 g | d. 0.01 g |
| e. 0.001 g | f. 1×10^{12} g |

1.39 Complete the following metric relationships:

- | | |
|-------------------|-------------------|
| a. 1 m = _____ cm | b. 1 km = _____ m |
| c. 1 mm = _____ m | d. 1 L = _____ mL |

1.40 Complete the following metric relationships:

- | | |
|-------------------|-------------------|
| a. 1 kg = _____ g | b. 1 mL = _____ L |
| c. 1 g = _____ kg | d. 1 g = _____ mg |

1.41 For each of the following pairs, which is the larger unit?

- | | |
|---------------------------|-----------------------------|
| a. milligram or kilogram | b. milliliter or microliter |
| c. cm or km | d. kL or dL |
| e. nanometer or picometer | |

1.42 For each of the following pairs, which is the smaller unit?

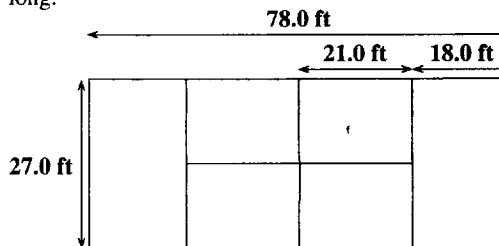
- | | |
|------------------------|-----------------------------|
| a. mg or g | b. centimeter or millimeter |
| c. mm or μm | d. mL or dL |
| e. mg or Mg | |

QUESTIONS AND PROBLEMS

Problem Solving

- 1.51 When you convert one unit to another, how do you know which unit of the conversion factor to place in the denominator?
- 1.52 When you convert one unit to another, how do you know which unit of the conversion factor to place in the numerator?
- 1.53 Use metric conversion factors to solve the following problems:
- The height of a student is 175 cm. How tall is the student in meters?
 - A cooler has a volume of 5500 mL. What is the capacity of the cooler in liters?
 - A hummingbird has a mass of 0.0055 kg. What is the mass of the hummingbird in grams?
- 1.54 Use metric conversion factors to solve the following problems:
- The daily requirement of phosphorus is 800 mg. How many grams of phosphorus are recommended?
 - A glass of orange juice contains 0.85 dL of juice. How many milliliters of orange juice is that?
 - A package of chocolate instant pudding contains 2840 mg of sodium. How many grams of sodium is that?
- 1.55 Solve the following problems using one or more conversion factors:
- A container holds 0.750 qt of liquid. How many milliliters of lemonade will it hold?
 - In England, a person is weighed in stones. If one stone has a weight of 14.0 lb, what is the mass, in kilograms, of a person who weighs 11.8 stones?
 - The femur, or thighbone, is the longest bone in the body. In a 6-ft-tall person, the femur is 19.5 in. long. What is the length of that femur in millimeters?
 - How many inches thick is an arterial wall that measures $0.50 \mu\text{m}$?
- 1.56 Solve the following problems using one or more conversion factors:
- You need 4.0 ounces of a steroid ointment. If there are 16 oz in 1 lb, how many grams of ointment does the pharmacist need to prepare?
 - During surgery, a person receives 5.0 pints of plasma. How many milliliters of plasma were given?
 - Solar flares containing hot gases can rise to 120 000 miles above the surface of the sun. What is that distance in kilometers?
 - A filled gas tank contains 18.5 gallons of unleaded fuel. If a car uses 46 L, how many gallons of fuel remain in the tank?

- 1.57 The singles portion of a tennis court is 27.0 ft wide and 78.0 ft long.



- What is the length of the court in meters?
 - What is the area of the court in square meters (m^2)?
 - If a serve is measured at 185 km per hour, how many seconds does it take for the tennis ball to travel the length of the court?
- 1.58 A football field is 300 feet long between goal lines.
-
- The diagram shows a simple rectangle representing a football field. The left and right sides are labeled "goal line".
- How many meters does a player run if he catches the ball on his own goal line and scores a touchdown?
 - If a player catches the football and runs 45 yards, how many meters did he gain?
 - If a player runs at a speed of 36 km/h, how many seconds does it take to run from the 50-yard line to the 20-yard line?
- 1.59 Using conversion factors, solve the following clinical problems:
- You have used 250 L of distilled water for a dialysis patient. How many gallons of water is that?
 - A patient needs 0.024 g of a sulfa drug. There are 8-mg tablets in stock. How many tablets should be given?
 - The daily dose of ampicillin for the treatment of an ear infection is 115 mg/kg of body weight. What is the daily dose, in mg, for a 34-lb child?
- 1.60 Using conversion factors, solve the following clinical problems:
- The physician has ordered 1.0 g of tetracycline to be given every 6 hours to a patient. If your stock on hand is 500-mg tablets, how many will you need for 1 day's treatment?
 - An intramuscular medication is given at 5.00 mg/kg of body weight. If you give 425 mg of medication to a patient, what is the patient's weight in pounds?



Then the mass and volume of the person are used to calculate body density. For example, suppose a 70.0-kg person has a body volume of 66.7 L.

The body density is calculated as

$$\begin{aligned}\frac{\text{Body mass}}{\text{Body volume}} &= \frac{70.0 \text{ kg}}{66.7 \text{ L}} \\ &= 1.05 \text{ kg/L or } 1.05 \text{ g/mL}\end{aligned}$$

When the body density is determined, it is compared with a chart that correlates the percentage of adipose tissue with body density. A



QUESTIONS AND PROBLEMS

Density

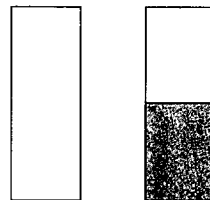
1.63 In an old trunk, you find a piece of metal that you think may be aluminum, silver, or lead. In lab you find it has a mass of 217 g and a volume of 19.2 cm³. Using Table 1.11, what is the metal you found?

1.64 Suppose you have two 100-mL graduated cylinders. In each cylinder there is 40.0 mL of water. You also have two cubes: One is lead, and the other is aluminum. Each cube measures 2.0 cm on each side. After you carefully lower each cube into the water of its own cylinder, what will the new water level be in each of the cylinders?

1.65 Determine the density (g/mL) for each of the following:

- A 20.0 mL sample of a salt solution has a mass of 24.0 g.
- A cube of butter weighs 0.250 lb and has a volume of 130. mL.
- A gem has a mass of 45.0 g. When the gem is placed in a graduated cylinder containing 20.0 mL of water, the water level rises to 34.5 mL.

d. A syrup is added to an empty container with a mass of 115.25 g. When 0.100 pint of syrup is added, the total mass of the container and syrup is 182.48 g.



115.25 g 182.48 g

1.66 Determine the density (g/mL) for each of the following:

- A plastic material weighs 2.68 lb and has a volume of 3.5 L.
- The fluid in a car battery if it has a volume of 125 mL and a mass of 155 g.
- A 5.00-mL urine sample from a patient suffering from diabetes mellitus has a mass of 5.025 g.
- A 10.00 L sample of oxygen gas has a mass of 0.014 kg.

- b. The density of water is 1.0 g/cm^3 . What is the mass, in kilograms, of the water in the pool?
- 1.109 A package of aluminum foil is 66.7 yd long, 12 in. wide, and 0.000 30 in. thick. If aluminum has a density of 2.7 g/cm^3 , what is the mass, in grams, of the foil?
- 1.110 An 18-karat gold necklace is 75% gold by mass, 16% silver, and 9.0% copper.
- a. What is the mass, in grams, of the necklace if it contains 0.24 oz silver?
- b. How many grams of copper are in the necklace?
- c. If 18-karat gold has a density of 15.5 g/cm^3 , what is the volume in cubic centimeters?

ANSWERS

ANSWERS TO STUDY CHECKS

- 1.1 a. meter; m b. degree Celsius; °C c. gram; g
- 1.2 a. $4.25 \times 10^5 \text{ m}$ b. $8 \times 10^{-7} \text{ g}$
- 1.3 a. two b. one c. five
- 1.4 a. 36 m b. 0.0026 L
c. $3.8 \times 10^3 \text{ g}$ d. 1.3 kg
- 1.5 a. 0.4924 b. 0.0080 or 8.0×10^{-3} c. 2.0
- 1.6 a. 83.70 mg b. 0.5 L
- 1.7 a. giga b. centi
- 1.8 a. 1000 g ($1 \times 10^3 \text{ g}$) b. 0.001 mL ($1 \times 10^{-3} \text{ mL}$)
- 1.9 Conversion factors: $\frac{1 \text{ zs}}{1 \times 10^{-23} \text{ s}}$ and $\frac{1 \times 10^{-23} \text{ s}}{1 \text{ zs}}$
- 1.10 a. $\frac{62.2 \text{ km}}{1 \text{ hr}}$ and $\frac{1 \text{ hr}}{62.2 \text{ km}}$
b. $\frac{10 \text{ g arsenic}}{1 \times 10^9 \text{ g water}}$ and $\frac{1 \times 10^9 \text{ g water}}{10 \text{ g arsenic}}$
- 1.11 1.89 L
- 1.12 0.44 oz
- 1.13 10 mL
- 1.14 25 g of fat
- 1.15 10.5 g/cm^3
- 1.16 2.20 g/mL
- 1.17 1.50 mL of mercury
- 1.18 207 mL

ANSWERS TO SELECTED QUESTIONS AND PROBLEMS

- 1.1 In the United States, a. weight is measured in pounds (lb), b. height in feet and inches, c. gasoline in gallons, and d. temperature in Fahrenheit (°F). In Mexico, a. mass is measured in kilograms, b. height in meters, c. gasoline in liters, and d. temperature in Celsius (°C).
- 1.3 a. meter; length b. gram; mass c. liter; volume
d. second; time e. degree Celsius; temperature
- 1.5 a. $5.5 \times 10^4 \text{ m}$ b. $4.8 \times 10^2 \text{ g}$ c. $5 \times 10^{-6} \text{ cm}$
d. $1.4 \times 10^{-4} \text{ s}$ e. $7.85 \times 10^{-3} \text{ L}$ f. $6.7 \times 10^5 \text{ kg}$
- 1.7 a. 7.2×10^3 b. 3.2×10^{-2}
c. 1×10^4 d. 6.8×10^{-2}
- 1.9 a. 12 000 b. 0.0825 c. 4 000 000 d. 0.005
- 1.11 a. measured b. exact c. exact d. measured
- 1.13 a. 6 oz of meat b. none
c. 0.75 lb; 350 g d. none (definitions are exact)
- 1.15 a. not significant b. significant

- 1.17 a. 5 b. 2 c. 2 d. 3 e. 4 f. 3
- 1.19 Both measurements in part c have two significant figures, and both measurements in part d have four significant figures.
- 1.21 a. $5.0 \times 10^3 \text{ L}$ b. $3.0 \times 10^4 \text{ g}$
c. $1.0 \times 10^5 \text{ m}$ d. $2.5 \times 10^{-4} \text{ cm}$
- 1.23 A calculator often gives more digits than the number of significant figures allowed in the answer.
- 1.25 a. 1.85 b. 184 c. 0.004 74
d. 8810 e. 1.83×10^5
- 1.27 a. 1.6 b. 0.01 c. 27.6 d. 3.5
- 1.29 a. 53.54 cm b. 127.6 g c. 121.5 mL d. 0.50 L
- 1.31 km/h is kilometers per hour; mi/h (mph) is miles per hour.
- 1.33 The prefix *kilo* means to multiply by 1000. One kg is the same mass as 1000 g.
- 1.35 a. mg b. dL c. km d. kg e. μL f. ng
- 1.37 a. 0.01 b. 1000 c. 0.001 (1×10^{-3})
d. 0.1 e. 1 000 000 (1×10^6) f. 1×10^{-12}
- 1.39 a. 100 cm b. 1000 m c. 0.001 m d. 1000 mL
- 1.41 a. kilogram b. milliliter c. km
d. kL e. nanometer
- 1.43 A conversion factor can be inverted to give a second conversion factor.
- 1.45 a. $100 \text{ cm} = 1 \text{ m}; \frac{100 \text{ cm}}{1 \text{ m}}$ and $\frac{1 \text{ m}}{100 \text{ cm}}$
b. $1000 \text{ mg} = 1 \text{ g}; \frac{1000 \text{ mg}}{1 \text{ g}}$ and $\frac{1 \text{ g}}{1000 \text{ mg}}$
c. $1 \text{ L} = 1000 \text{ mL}; \frac{1000 \text{ mL}}{1 \text{ L}}$ and $\frac{1 \text{ L}}{1000 \text{ mL}}$
d. $1 \text{ dL} = 100 \text{ mL}; \frac{100 \text{ mL}}{1 \text{ dL}}$ and $\frac{1 \text{ dL}}{100 \text{ mL}}$
- 1.47 a. $3 \text{ ft} = 1 \text{ yd}; \frac{3 \text{ ft}}{1 \text{ yd}}$ and $\frac{1 \text{ yd}}{3 \text{ ft}}$
b. $1 \text{ mile} = 5280 \text{ feet}; \frac{5280 \text{ ft}}{1 \text{ mi}}$ and $\frac{1 \text{ mi}}{5280 \text{ ft}}$
c. $1 \text{ min} = 60 \text{ sec}; \frac{60 \text{ sec}}{1 \text{ min}}$ and $\frac{1 \text{ min}}{60 \text{ sec}}$
d. $1 \text{ gal} = 27 \text{ mi}; \frac{1 \text{ gal}}{27 \text{ mi}}$ and $\frac{27 \text{ mi}}{1 \text{ gal}}$
e. $93 \text{ g silver} = 100 \text{ g sterling}; \frac{93 \text{ g silver}}{100 \text{ g sterling}}$ and $\frac{100 \text{ g sterling}}{93 \text{ g silver}}$
- 1.49 a. $\frac{3.5 \text{ m}}{1 \text{ s}}$ and $\frac{1 \text{ s}}{3.5 \text{ m}}$
b. $\frac{3500 \text{ mg potassium}}{1 \text{ day}}$ and $\frac{1 \text{ day}}{3500 \text{ mg potassium}}$

- 1.82 A fish company delivers 22 kg of salmon, 5.5 kg of crab, and 3.48 kg of oysters to your seafood restaurant.
- What is the total mass, in kilograms, of the seafood?
 - What is the total number of pounds?
- 1.83 Bill's recipe for onion soup calls for 4.0 lb of thinly sliced onions. If an onion has an average mass of 115 g, how many onions does Bill need?
- 1.84 The price of 1 pound (lb) of potatoes is \$1.75. If all the potatoes sold today at the store bring in \$1420, how many kilograms (kg) of potatoes did grocery shoppers buy?
- 1.85 The following nutrition information is listed on a box of crackers:
- Serving size 0.50 oz (6 crackers)
Fat 4 g per serving
Sodium 140 mg per serving
- If the box has a net weight (contents only) of 8.0 oz, about how many crackers are in the box?
 - If you ate 10 crackers, how many ounces of fat are you consuming?
 - How many grams of sodium are used to prepare 50 boxes of crackers?
- 1.86 An aquarium store unit requires 75 000 mL of water. How many gallons of water are needed? (1 gal = 4 qt)
- 1.87 In Mexico, avocados are 48 pesos per kilogram. What is the cost in cents of an avocado that weighs 0.45 lb if the exchange rate is 10.8 pesos to the dollar?
- 1.88 Celeste's diet restricts her intake of protein to 24 g per day. If she eats an 8.0-oz burger that is 15.0% protein, has she exceeded her protein limit for the day? How many ounces of a burger would be allowed for Celeste?
- 1.89 A sunscreen preparation contains 2.50% by mass benzyl salicylate. If a tube contains 4.0 ounces of sunscreen, how many kilograms of benzyl salicylate are needed to manufacture 325 tubes of sunscreen?
- 1.90 An object has a mass of 3.15 oz. When it is submerged in a graduated cylinder initially containing 325.2 mL of water, the water level rises to 442.5 mL. What is the density (g/mL) of the object?
- 1.91 What is a cholesterol level of 1.85 g/L in units of mg/dL?
- 1.92 If a recycling center collects 1254 aluminum cans and there are 22 aluminum cans in 1 pound, what volume, in liters, of aluminum was collected? (See Table 1.11.)
- 1.93 The water level in a graduated cylinder initially at 215 mL rises to 285 mL after a piece of lead is submerged. What is the mass in grams of the lead? (See Table 1.11.)
- 1.94 A graduated cylinder contains 155 mL of water. A 15.0-g piece of iron (density = 7.86 g/cm³) and a 20.0-g piece of lead are added. What is the new water level in the cylinder? (See Table 1.11.)
- 1.95 How many cubic centimeters (cm³) of olive oil have the same mass as 1.00 L of gasoline? (See Table 1.11.)
- 1.96 What is the volume, in quarts, of 1.50 kg of ethyl alcohol? (See Table 1.11.)
- 1.97
- Some athletes have as little as 3.0% body fat. If such a person has a body mass of 45 kg, how many lb of body fat does that person have?
 - In a process called *liposuction*, a doctor removes fat deposits from a person's body. If body fat has a density of 0.94 g/mL and 3.0 liters of fat are removed, how many pounds of fat were removed from the patient?
- 1.98 A mouthwash is 21.6% by mass alcohol. If each bottle contains 0.358 pint of mouthwash with a density of 0.876 g/mL, how many kilograms of alcohol are in 180 bottles of the mouthwash?
- 1.99 Sterling silver is 92.5% silver by mass with a density of 10.3 g/cm³. If a cube of sterling silver has a volume of 27.0 cm³, how many ounces of pure silver are present?
- 1.100 A typical adult body contains 55% water. If a person has a mass of 65 kg, how many pounds of water does she have in her body?
- 1.101 For a 180-lb person, calculate the quantities of each of the following that must be ingested to provide the LD₅₀ for caffeine given in Table 1.10:
- cups of coffee if one cup is 12 fluid ounces and there are 100. mg of caffeine per 6 fl oz of drip-brewed coffee
 - cans of cola if one can contains 50. mg of caffeine
 - tablets of No-Doz if one tablet contains 100. mg of caffeine
- 1.102 The label on a 1-pint bottle of water lists the following components. If the density is the same as pure water and you drink three bottles of water in one day, how many milligrams of each component will you obtain?
- Calcium 28 ppm
Fluoride 0.08 ppm
Magnesium 12 ppm
Potassium 3.2 ppm
Sodium 15 ppm

CHALLENGE QUESTIONS

The following groups of questions and problems are related to the topics in this chapter. However, they do not all follow the chapter order, and they require you to combine concepts and skills from several sections. These problems will help you increase your critical thinking skills and prepare for your next exam.

- 1.103 A balance measures mass to 0.001 g. If you determine the mass of an object that weighs about 30 g, would you record the mass as 30 g, 32 g, 32.1 g, or 32.075 g? Explain your choice by writing two to three complete sentences that describe your thinking.
- 1.104 When three students use the same meterstick to measure the length of a paper clip, they obtain results of 5.8 cm, 5.75 cm, and 5.76 cm. If the meterstick has millimeter markings, what are some reasons for the different values?
- 1.105 A car travels at 55 miles per hour and gets 11 kilometers per liter of gasoline. How many gallons of gasoline are needed for a 3.0-hour trip?
- 1.106 A 50.0-g silver object and a 50.0-g gold object are both added to 75.5 mL of water contained in a graduated cylinder. What is the new water level in the cylinder?
- 1.107 In the manufacturing of computer chips, cylinders of silicon are cut into thin wafers that are 3.00 inches in diameter and have a mass of 1.50 g of silicon. How thick (mm) is each wafer if silicon has a density of 2.33 g/cm³? (The volume of a cylinder is $V = \pi r^2 h$.)
- 1.108 A circular pool with a diameter of 27 ft is filled to a depth of 50. in. Assume the pool is a cylinder ($V = \pi r^2 h$).
- What is the volume of water in the pool in cubic meters?

c. $\frac{46.0 \text{ km}}{1.0 \text{ gal}}$ and $\frac{1.0 \text{ gal}}{46.0 \text{ km}}$

d. $\frac{50 \text{ mg Atenolol}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{50 \text{ mg Atenolol}}$

e. $\frac{29 \mu\text{g}}{1 \text{ kg}}$ and $\frac{1 \text{ kg}}{29 \mu\text{g}}$

1.51 The unit in the denominator must cancel with the preceding unit.

1.53 a. 1.75 m b. 5.5 L c. 5.5 g

1.55 a. 710. mL b. 75.1 kg c. 495 mm d. 2.0×10^{-5} in.

1.57 a. 23.8 m b. 196 m² c. 0.463 s

1.59 a. 66 gal b. 3 tablets
c. 1800 mg (1.8×10^3 mg)

1.61 a. 152 g of oxygen b. 0.026 g of magnesium
c. 43 g of N d. 50. lb of chocolate bars

1.63 lead; 11.3 g/mL

1.65 a. 1.20 g/mL b. 0.873 g/mL
c. 3.10 g/mL d. 1.42 g/mL

1.67 a. 1.9 L b. 88 g c. 62 oz d. 30. kg

1.69 a. 1.030 b. 1.13 c. 0.85 g/mL

1.71 c. 0.000 75 s and 75 000 s
d. 255.0 L and 6.240×10^{-2} L

1.73 a. exact b. measured c. exact d. measured

1.75 a. length = 6.96 cm; width = 4.75 cm
b. length = 69.6 mm; width = 47.5 mm
c. 3 significant figures

d. 3 significant figures

e. 33.1 cm²

f. 3 significant figures

1.77 1.8 g/mL

1.79 a. 0.000 0126 L b. 3.53×10^2 kg

c. 125 000 m d. 58.7 g

e. 3.00×10^{-3} s f. 0.0108 g

1.81 42 min

1.83 16 onions

1.85 a. 96 crackers b. 0.2 oz of fat c. 110 g of sodium

1.87 91 cents

1.89 0.92 kg

1.91 185 mg/dL

1.93 790 g

1.95 720 cm³

1.97 a. 3.0 lb of body fat b. 6.2 lb

1.99 9.07 oz of pure silver

1.101 a. 80 cups b. 310 cans c. 160 tablets

1.103 You should record the mass as 32.075 g. Because your balance will weigh to the nearest 0.001 g, the mass values should be reported to 0.001 g.

1.105 6.4 gal

1.107 0.141 mm

1.109 3.8×10^2 g of aluminum foil