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Chemistry in Our Lives

Learning Goals

- Define the term chemistry and identify substances as chemicals.
- Describe the activities that are part of the scientific method.
- Develop a study plan for learning chemistry.
- Review math concepts used in chemistry: place values, positive and negative numbers, percentages, solving equations, interpreting graphs, and writing numbers in scientific notation.

Chapter Outline

Chapter Opener: Forensic Scientist

1.1 Chemistry and Chemicals

1.2 Scientific Method: Thinking Like a Scientist

Explore Your World: Nobel Prize Winners in Chemistry

Chemistry Link to Health: Early Chemist: Paracelsus

1.3 Learning Chemistry: A Study Plan

1.4 Key Math Skills for Chemistry

Clinical Update: Forensic Evidence Solves the Murder

Key Math Skills

- Identifying Place Values (1.4A)
- Using Positive and Negative Numbers in Calculations (1.4B)
- Calculating Percentages (1.4C)
- Solving Equations (1.4D)
- Interpreting Graphs (1.4E)
- Writing Numbers in Scientific Notation (1.4F)

Answers and Solutions to Text Problems

- 1.1 a. Chemistry is the study of the composition, structure, properties, and reactions of matter.
b. A chemical is a substance that has the same composition and properties wherever it is found.
- 1.2 Your friends may give a variety of definitions, most of which will probably not agree with the dictionary definitions.
- 1.3 Many chemicals are listed on a vitamin bottle such as vitamin A, vitamin B₃, vitamin B₁₂, vitamin C, and folic acid.
- 1.4 Many chemicals are listed on a cereal box such as vitamin A, vitamin B₆, vitamin B₁₂, vitamin C, folic acid, sugar, salt, and iron.
- 1.5 Typical items found in a medicine cabinet and some of the chemicals they contain are as follows:
Antacid tablets: calcium carbonate, cellulose, starch, stearic acid, silicon dioxide
Mouthwash: water, alcohol, thymol, glycerol, sodium benzoate, benzoic acid
Cough suppressant: menthol, beta-carotene, sucrose, glucose

Chapter 1

- 1.6** Typical chemicals found in dishwashing products are: water, sodium lauryl sulfate, sodium laureth sulfate, dimethyl amine oxide, sodium chloride, phenoxyethanol, triclosan.
- 1.7**
- An observation (O) is a description or measurement of a natural phenomenon.
 - A hypothesis (H) proposes a possible explanation for a natural phenomenon.
 - An experiment (E) is a procedure that tests the validity of a hypothesis.
 - An observation (O) is a description or measurement of a natural phenomenon.
 - An observation (O) is a description or measurement of a natural phenomenon.
 - A conclusion (C) is an explanation of an observation that has been validated by repeated experiments that support a hypothesis.
- 1.8**
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 - An experiment (E) is a procedure that tests the validity of a hypothesis.
 - An observation (O) is a description or measurement of a natural phenomenon.
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- 1.9**
- An observation (O) is a description or measurement of a natural phenomenon.
 - A hypothesis (H) proposes a possible explanation for a natural phenomenon.
 - An experiment (E) is a procedure that tests the validity of a hypothesis.
 - An experiment (E) is a procedure that tests the validity of a hypothesis.
- 1.10**
- A hypothesis (H) proposes a possible explanation for a natural phenomenon.
 - An observation (O) is a description or measurement of a natural phenomenon.
 - An experiment (E) is a procedure that tests the validity of a hypothesis.
 - A conclusion (C) is an explanation of an observation that has been validated by repeated experiments that support a hypothesis.
- 1.11** There are several things you can do that will help you successfully learn chemistry, including forming a study group, going to lecture, working *Sample Problems* and *Study Checks*, working *Questions and Problems* and checking answers, reading the assignment ahead of class, going to the instructor's office hours, and keeping a problem notebook.
- 1.12** Many things make it difficult to learn chemistry, including not going to lecture regularly, not working *Sample Problems* and *Study Checks*, not reading the assignment ahead of class, not going to the instructor's office hours, and waiting until the night before an exam to study.
- 1.13** Ways you can enhance your learning of chemistry include:
- forming a study group.
 - visiting the professor during office hours.
 - being an active learner.
- 1.14** Ways you can enhance your learning of chemistry include:
- doing the assigned problems.
 - attending review sessions.
 - reading the assignment before a lecture.
 - keeping a problem notebook.
- 1.15**
- The bolded 8 is in the thousandths place.
 - The bolded 6 is in the ones place.
 - The bolded 6 is in the hundreds place.
- 1.16**
- The bolded 5 is in the tenths place.
 - The bolded 7 is in the tens place.
 - The bolded 0 is in the hundredths place.

- 1.17** a. $15 - (-8) = 15 + 8 = 23$
 b. $-8 + (-22) = -30$
 c. $4 \times (-2) + 6 = -8 + 6 = -2$
- 1.18** a. $-11 - (-9) = -11 + 9 = -2$
 b. $34 + (-55) = -21$
 c. $\frac{-56}{8} = -7$
- 1.19** a. $\frac{21 \text{ flu shots}}{25 \text{ patients}} \times 100\% = 84\% \text{ received flu shots}$
 b. total grams of alloy = 56 g silver + 22 g copper = 78 g of alloy
 $\frac{56 \text{ g silver}}{78 \text{ g alloy}} \times 100\% = 72\% \text{ silver}$
 c. total number of coins = 11 nickels + 5 quarters + 7 dimes = 23 coins
 $\frac{7 \text{ dimes}}{23 \text{ coins}} \times 100\% = 30\% \text{ dimes}$
- 1.20** a. $\frac{22 \text{ boys}}{35 \text{ babies}} \times 100\% = 63\% \text{ boys}$
 b. total grams of alloy = 67 g gold + 35 g zinc = 102 g of alloy
 $\frac{35 \text{ g zinc}}{102 \text{ g alloy}} \times 100\% = 34\% \text{ zinc}$
 c. total number of coins = 15 pennies + 14 dimes + 6 quarters = 35 coins
 $\frac{15 \text{ pennies}}{35 \text{ coins}} \times 100\% = 43\% \text{ pennies}$
- 1.21** a. $4a + 4 = 40$
 $4a + \cancel{4} - \cancel{4} = 40 - 4$
 $4a = 36$
 $\frac{\cancel{4}a}{\cancel{4}} = \frac{36}{4}$
 $a = 9$
- b. $\frac{a}{6} = 7$
 $\cancel{6}\left(\frac{a}{\cancel{6}}\right) = 6(7)$
 $a = 42$
- 1.22** a. $2b + 7 = b + 10$
 $2b + \cancel{7} - \cancel{7} = b + 10 - 7$
 $2b = b + 3$
 $2b - b = \cancel{b} - \cancel{b} + 3$
 $b = 3$
- b. $3b - 4 = 24 - b$
 $3b - \cancel{4} + \cancel{4} = 24 - b + 4$
 $3b = 28 - b$
 $3b + b = 28 - \cancel{b} + \cancel{b}$
 $4b = 28$
 $\frac{\cancel{4}b}{\cancel{4}} = \frac{28}{4}$
 $b = 7$

Chapter 1

- 1.23** a. The graph shows the relationship between the temperature of a cup of tea and time.
 b. The vertical axis measures temperature, in °C.
 c. The values on the vertical axis range from 20 °C to 80 °C.
 d. As time increases, the temperature decreases.
- 1.24** a. The horizontal axis measures time, in minutes.
 b. The values on the horizontal axis range from 0 min to 100 min.
 c. After 20 min, the temperature of the tea is about 56 °C.
 d. About 38 min were required for the tea to reach a temperature of 45 °C.
- 1.25** a. Move the decimal point four places to the left to give 5.5×10^4 .
 b. Move the decimal point two places to the left to give 4.8×10^2 .
 c. Move the decimal point six places to the right to give 5×10^{-6} .
 d. Move the decimal point four places to the right to give 1.4×10^{-4} .
 e. Move the decimal point three places to the right to give 7.2×10^{-3} .
 f. Move the decimal point five places to the left to give 6.7×10^5 .
- 1.26** a. Move the decimal point eight places to the left to give 1.8×10^8 .
 b. Move the decimal point five places to the right to give 6×10^{-5} .
 c. Move the decimal point two places to the left to give 7.5×10^2 .
 d. Move the decimal point one place to the right to give 1.5×10^{-1} .
 e. Move the decimal point two places to the right to give 2.4×10^{-2} .
 f. Move the decimal point three places to the left to give 1.5×10^3 .
- 1.27** a. 7.2×10^3 , which is also 72×10^2 , is larger than 8.2×10^2 .
 b. 3.2×10^{-2} , which is also 320×10^{-4} , is larger than 4.5×10^{-4} .
 c. 1×10^4 or 10 000 is larger than 1×10^{-4} or 0.0001.
 d. 6.8×10^{-2} or 0.068 is larger than 0.000 52.
- 1.28** a. 5.5×10^{-9} , which is also $0.000\ 005\ 5 \times 10^{-3}$, is smaller than 4.9×10^{-3} .
 b. 3.4×10^2 , which is also 340, is smaller than 1250.
 c. $0.000\ 000\ 4$, which is also 4×10^{-7} , is smaller than 5.0×10^2 .
 d. 2.50×10^2 , which is also 250, is smaller than 4×10^5 or 400 000.
- 1.29** $\frac{120\text{ g ethylene glycol}}{450\text{ g liquid}} \times 100\% = 27\% \text{ ethylene glycol}$
- 1.30** $50\text{ kg body mass} \times \frac{1.5\text{ g ethylene glycol}}{1\text{ kg body mass}} \times \frac{450\text{ g liquid}}{120\text{ g ethylene glycol}} \times \frac{1\text{ drink}}{100\text{ g liquid}} = 3\text{ drinks}$
- 1.31** No. All of these ingredients are chemicals.
- 1.32** No. All of these ingredients are chemicals.
- 1.33** Yes. Sherlock's investigation includes making observations (gathering data), formulating a hypothesis, testing the hypothesis, and modifying it until one of the hypotheses is validated.
- 1.34** Sherlock meant that you should not propose a theory until you have data from experiments and observations.
- 1.35** a. Describing the appearance of a patient is an observation (O).
 b. Formulating a reason for the extinction of dinosaurs is a hypothesis (H).
 c. Measuring the completion time of a race is an observation (O).
- 1.36** a. Measuring the composition of a sample is an observation (O).
 b. Recording a change in a sample is an observation (O).
 c. Formulating a reason as to why a phenomenon has happened is a hypothesis (H).
- 1.37** a. When two negative numbers are multiplied, the answer is positive (+ve).
 b. When a larger positive number is added to a smaller negative number, the answer has a positive sign.

- 1.38** a. When a negative number is divided by a positive number, the answer has a negative sign.
b. When two negative numbers are added, the answer has a negative sign.
- 1.39** a. An observation (O) is a description or measurement of a natural phenomenon.
b. A hypothesis (H) proposes a possible explanation for a natural phenomenon.
c. A conclusion (C) is an explanation of an observation that has been validated by repeated experiments that support a hypothesis.
- 1.40** a. An observation (O) is a description or measurement of a natural phenomenon.
b. A hypothesis (H) proposes a possible explanation for a natural phenomenon.
c. An experiment (E) is a procedure that tests the validity of a hypothesis.
- 1.41** If experimental results do not support your hypothesis, you should:
b. modify your hypothesis.
- 1.42** A conclusion confirms a hypothesis when:
b. many experiments validate the hypothesis.
- 1.43** A successful study plan would include:
b. working the *Sample Problems* as you go through a chapter.
c. going to your professor's office hours.
- 1.44** A successful study plan would include:
b. forming a study group and discussing the problems together.
c. working problems in a notebook for easy reference.
- 1.45** a. $-65 + 7 = -58$
b. $\frac{165}{-15} = -11$
c. $8 - 36 = -28$
- 1.46** a. $8 \times (-19) = -152$
b. $7 - 68 = -61$
c. $\frac{-160}{-40} = 4$
- 1.47** total number of gumdrops = 16 orange + 8 yellow + 16 black = 40 gumdrops
a. $\frac{8 \text{ yellow gumdrops}}{40 \text{ total gumdrops}} \times 100\% = 20\% \text{ yellow gumdrops}$
b. $\frac{16 \text{ black gumdrops}}{40 \text{ total gumdrops}} \times 100\% = 40\% \text{ black gumdrops}$
- 1.48** total number of students = 12 As + 18 Bs + 20 Cs = 50 students
a. $\frac{18 \text{ Bs}}{50 \text{ total students}} \times 100\% = 36\% \text{ Bs}$
b. $\frac{20 \text{ Cs}}{50 \text{ total students}} \times 100\% = 40\% \text{ Cs}$
- 1.49** a. Move the decimal point four places to the left to give 4.3×10^4 .
b. Move the decimal point two places to the left to give 6.2×10^2 .
c. Move the decimal point six places to the right to give 8.9×10^{-6} .
d. Move the decimal point four places to the right to give 3.7×10^{-4} .
- 1.50** a. Move the decimal point three places to the right to give 6.4×10^{-3} .
b. Move the decimal point five places to the left to give 2.9×10^5 .
c. Move the decimal point eight places to the left to give 6.5×10^8 .
d. Move the decimal point nine places to the right to give 4.2×10^{-9} .

Chapter 1

- 1.51** a. An observation (O) is a description or measurement of a natural phenomenon.
b. A hypothesis (H) proposes a possible explanation for a natural phenomenon.
c. An experiment (E) is a procedure that tests the validity of a hypothesis.
d. A hypothesis (H) proposes a possible explanation for a natural phenomenon.

- 1.52** a. An observation (O) is a description or measurement of a natural phenomenon.
b. A hypothesis (H) proposes a possible explanation for a natural phenomenon.
c. An observation (O) is a description or measurement of a natural phenomenon.
d. An observation (O) is a description or measurement of a natural phenomenon.

- 1.53** a. $4a - 5 = 35$
 $4a - 5 + 5 = 35 + 5$
 $4a = 40$

$$a = \frac{40}{4} = 10$$

- b. $3a/6 = -18$

$$3a \times \frac{6}{6} = -18 \times 6$$

$$3a = -108$$

$$a = -\frac{108}{3} = -36$$

- 1.54** a. $7z - (-11) = 39$
 $7z + 11 = 39$
 $7z + 11 - 11 = 39 - 11$
 $7z = 28$

$$z = \frac{28}{7} = 4$$

- b. $-8z \times 5 = -80$

$$-8z \times \frac{5}{5} = \frac{-80}{5}$$

$$-8z = -16$$

$$z = \frac{-16}{-8} = 2$$

- 1.55** a. The graph shows the relationship between the solubility of carbon dioxide in water and temperature.
b. The vertical axis measures the solubility of carbon dioxide in water (g CO₂/100 g water).
c. The values on the vertical axis range from 0 to 0.35 g CO₂/100 g water.
d. As temperature increases, the solubility of carbon dioxide in water decreases.
- 1.56** a. The horizontal axis measures temperature, in °C.
b. The values on the horizontal axis range from 0 °C to 60 °C.
c. At 25 °C, the solubility of carbon dioxide in water is about 0.17 g CO₂/100 g water.
d. Carbon dioxide has a solubility of 0.20 g CO₂/100 g water at a temperature of about 16 °C.

2

Chemistry and Measurements

Learning Goals

- Write the names and abbreviations for the metric or SI units used in measurements of length, volume, mass, temperature, and time.
- Identify a number as measured or exact; determine the number of significant figures in a measured number.
- Adjust calculated answers to give the correct number of significant figures.
- Use the numerical values of prefixes to write a metric equality.
- Write a conversion factor for two units that describe the same quantity.
- Use conversion factors to change from one unit to another.
- Calculate the density of a substance; use the density to calculate the mass or volume of a substance.

Chapter Outline

Chapter Opener: Registered Nurse

2.1 Units of Measurement

Explore Your World: Units Listed on Labels

2.2 Measured Numbers and Significant Figures

2.3 Significant Figures in Calculations

2.4 Prefixes and Equalities

2.5 Writing Conversion Factors

Explore Your World: SI and Metric Equalities on Product Labels

2.6 Problem Solving Using Unit Conversion

Chemistry Link to Health: Toxicology and Risk–Benefit Assessment

2.7 Density

Explore Your World: Sink or Float

Chemistry Link to Health: Bone Density

Clinical Update: Greg's Follow-Up Visit with His Doctor

Key Math Skill

- Rounding Off (2.3)

Core Chemistry Skills

- Counting Significant Figures (2.2)
- Using Significant Figures in Calculations (2.3)
- Using Prefixes (2.4)
- Writing Conversion Factors from Equalities (2.5)
- Using Conversion Factors (2.6)
- Using Density as a Conversion Factor (2.7)

Chapter 2

Answers and Solutions to Text Problems

- 2.1**
- a. A liter is a unit of volume.
 - b. A centimeter is a unit of length.
 - c. A kilometer is a unit of length.
 - d. A second is a unit of time.
- 2.2**
- a. A kilometer is a unit of length.
 - b. A kilogram is a unit of mass.
 - c. A degree Celsius is a unit of temperature.
 - d. A liter is a unit of volume.
- 2.3**
- a. The unit is a meter, which is a unit of length.
 - b. The unit is a gram, which is a unit of mass.
 - c. The unit is a milliliter, which is a unit of volume.
 - d. The unit is a second, which is a unit of time.
 - e. The unit is a degree Celsius, which is a unit of temperature.
- 2.4**
- a. The unit is a liter, which is a unit of volume.
 - b. The unit is a centimeter, which is a unit of length.
 - c. The unit is a kilogram, which is a unit of mass.
 - d. The unit is an hour, which is a unit of time.
 - e. The unit is a kelvin, which is a unit of temperature.
- 2.5**
- a. A second is a unit of time.
 - b. A kilogram is a unit of mass.
 - c. A gram is a unit of mass.
 - d. A degree Celsius is a unit of temperature.
- 2.6**
- a. A degree Celsius is a unit of temperature.
 - b. A second is a unit of time.
 - c. A milliliter is a unit of volume.
 - d. A gram is a unit of mass.
- 2.7** Measured numbers are obtained using some type of measuring device. Exact numbers are numbers obtained by counting items or using a definition that compares two units in the same measuring system.
- a. The value 67.5 kg is a measured number; measurement of mass requires a measuring device.
 - b. The value 2 tablets is obtained by counting, making it an exact number.
 - c. The values in the metric definition $1\text{ L} = 1000\text{ mL}$ are exact numbers.
 - d. The value 1720 km is a measured number; measurement of distance requires a measuring device.
- 2.8** Measured numbers are obtained using some type of measuring device. Exact numbers are numbers obtained by counting items or using a definition that compares two units in the same measuring system.
- a. The value 31 students is obtained by counting, making it an exact number.
 - b. The value $1.20 \times 10^8\text{ yr}$ is a measured number; measurement of time requires a measuring device.
 - c. The value 104 kg is a measured number; measurement of mass requires a measuring device.
 - d. The value 184 mg/dL is a measured number; measurement of mass and volume requires measuring devices.

- 2.9** Measured numbers are obtained using some type of measuring device. Exact numbers are numbers obtained by counting items or using a definition that compares two units in the same measuring system.
- 6 oz of hamburger meat is a measured number (3 hamburgers is a counted/exact number).
 - Neither are measured numbers (both 1 table and 4 chairs are counted/exact numbers).
 - Both 0.75 lb of grapes and 350 g of butter are measured numbers.
 - Neither are measured numbers (the values in a definition are exact numbers).
- 2.10** Measured numbers are obtained using some type of measuring device. Exact numbers are numbers obtained by counting items or using a definition that compares two units in the same measuring system.
- 5 pizzas is a counted/exact number (50.0 g of cheese is a measured number).
 - 6 nickels is a counted/exact number (16 g of nickel is a measured number).
 - 3 onions is a counted/exact number (3 lb of onions is a measured number).
 - 5 cars is a counted/exact number (5 miles is obtained by measurement).
- 2.11**
- Zeros at the beginning of a decimal number are not significant.
 - Zeros between nonzero digits are significant.
 - Zeros at the end of a decimal number are significant.
 - Zeros in the coefficient of a number written in scientific notation are significant.
 - Zeros used as placeholders in a large number without a decimal point are not significant.
- 2.12**
- Zeros between nonzero digits are significant.
 - Zeros at the end of a decimal number are significant.
 - Zeros at the beginning of a decimal number are not significant.
 - Zeros used as placeholders in a large number without a decimal point are not significant.
 - Zeros in the coefficient of a number written in scientific notation are significant.
- 2.13**
- All five numbers are significant figures (5 SFs).
 - Only the two nonzero numbers are significant (2 SFs); the preceding zeros are placeholders.
 - Only the two nonzero numbers are significant (2 SFs); the zeros that follow are placeholders.
 - All three numbers in the coefficient of a number written in scientific notation are significant (3 SFs).
 - All four numbers to the right of the decimal point, including the last zero, in a decimal number are significant (4 SFs).
 - All three numbers, including the zeros at the end of a decimal number, are significant (3 SFs).
- 2.14**
- All four numbers, including the last zero, in a decimal number are significant (4 SFs).
 - All six numbers are significant figures (6 SFs).
 - All three numbers, including the zeros at the end of a decimal number, are significant (3 SFs).
 - All three numbers are significant figures (3 SFs).
 - There are three significant figures (3 SFs), since the zero between the two nonzero numbers is significant; the zeros that follow are placeholders only.
 - Both of the numbers in the coefficient of a number written in scientific notation are significant (2 SFs).
- 2.15** Both measurements in part **b** have three significant figures, and both measurements in part **c** have two significant figures.
- 2.16** Both measurements in part **a** have three significant figures, and both measurements in part **d** have two significant figures.
- 2.17**
- 1.607 kg has four significant figures.
 - 130 mcg has two significant figures.
 - 4.02×10^6 red blood cells has three significant figures.

Chapter 2

- 2.18**
- 103.5 °F has four significant figures.
 - 1.20×10^{10} neurons has three significant figures.
 - 0.46 s has two significant figures.
- 2.19** A calculator often gives more digits than the number of significant figures allowed in the answer.
- 2.20** The whole number would not reflect the precision (significant figures) allowed by the original data without the additional zero.
- 2.21**
- 1.85 kg; the last digit is dropped since it is 4 or less.
 - 88.2 L; since the fourth digit is 4 or less, the last three digits are dropped.
 - 0.004 74 cm; since the fourth significant digit (the first digit to be dropped) is 5 or greater, the last retained digit is increased by 1 when the last four digits are dropped.
 - 8810 m; since the fourth significant digit (the first digit to be dropped) is 5 or greater, the last retained digit is increased by 1 when the last digit is dropped (a nonsignificant zero is added at the end as a placeholder).
 - 1.83×10^5 s; since the fourth digit is 4 or less, the last digit is dropped. The $\times 10^5$ is retained so that the magnitude of the answer is not changed.
- 2.22**
- 1.9 kg; since the third significant digit (the first digit to be dropped) is 5 or greater, the last retained digit is increased by 1 when the last two digits are dropped.
 - 88 L; since the third significant digit is 4 or less, the last four digits are dropped.
 - 0.0047 cm; since the third significant digit is 4 or less, the last five digits are dropped.
 - 8800 m; since the third digit is 4 or less, the last digit is changed to a zero as a placeholder.
 - 1.8×10^5 s; since the third digit is 4 or less, the last two digits are dropped. The $\times 10^5$ is retained so that the magnitude of the answer is not changed.
- 2.23**
- As written, 5080 L only has three significant figures; this can be shown in scientific notation as 5.08×10^3 L.
 - As written, 37 400 g only has three significant figures; this can be shown in scientific notation as 3.74×10^4 g.
 - To round off 104 720 m to three significant figures, drop the final digits 720 and increase the last retained digit by 1 and add placeholder zeros to give 105 000 m or 1.05×10^5 m.
 - To round off 0.000 250 82 s to three significant figures, drop the final digits 82 and increase the last retained digit by 1 to give 0.000 251 s or 2.51×10^{-4} s.
- 2.24**
- 5 100 000 L can be shown in scientific notation with three significant figures as 5.10×10^6 L.
 - To round off 26 711 s to three significant figures, drop the final digits 11 and add placeholder zeros to give 26 700 s or 2.67×10^4 s.
 - To round off 0.003 378 m to three significant figures, drop the final digit 8 and increase the last retained digit by 1 to give 0.003 38 m or 3.38×10^{-3} m.
 - To round off 56.982 g to three significant figures, drop the final digits 82 and increase the last retained digit by 1 to give 57.0 g or 5.70×10^1 g.
- 2.25**
- $45.7 \times 0.034 = 1.6$ Two significant figures are allowed since 0.034 has 2 SFs.
 - $0.002\,78 \times 5 = 0.01$ One significant figure is allowed since 5 has 1 SF.
 - $\frac{34.56}{1.25} = 27.6$ Three significant figures are allowed since 1.25 has 3 SFs.
 - $\frac{(0.2465)(25)}{1.78} = 3.5$ Two significant figures are allowed since 25 has 2 SFs.

- 2.26** a. $400 \times 185 = 7 \times 10^4$ One significant figure is allowed since 400 has 1 SF.
b. $\frac{2.40}{(4)(125)} = 0.005$ or 5×10^{-3} One significant figure is allowed since 4 has 1 SF.
c. $0.825 \times 3.6 \times 5.1 = 15$ Two significant figures are allowed since 3.6 and 5.1 both have 2 SFs.
d. $\frac{3.5 \times 0.261}{8.24 \times 20.0} = 0.0055$ or 5.5×10^{-3} Two significant figures are allowed since 3.5 has 2 SFs.
- 2.27** a. $45.48 \text{ cm} + 8.057 \text{ cm} = 53.54 \text{ cm}$ Two decimal places are allowed since 45.48 cm has two decimal places.
b. $23.45 \text{ g} + 104.1 \text{ g} + 0.025 \text{ g} = 127.6 \text{ g}$ One decimal place is allowed since 104.1 g has one decimal place.
c. $145.675 \text{ mL} - 24.2 \text{ mL} = 121.5 \text{ mL}$ One decimal place is allowed since 24.2 mL has one decimal place.
d. $1.08 \text{ L} - 0.585 \text{ L} = 0.50 \text{ L}$ Two decimal places are allowed since 1.08 L has two decimal places.
- 2.28** a. $5.08 \text{ g} + 25.1 \text{ g} = 30.2 \text{ g}$ One decimal place is allowed since 25.1 g has one decimal place.
b. $85.66 \text{ cm} + 104.10 \text{ cm} + 0.025 \text{ cm} = 189.79 \text{ cm}$ Two decimal places are allowed since 85.66 cm and 104.10 cm have two decimal places.
c. $24.568 \text{ mL} - 14.25 \text{ mL} = 10.32 \text{ mL}$ Two decimal places are allowed since 14.25 mL has two decimal places.
d. $0.2654 \text{ L} - 0.2585 \text{ L} = 0.0069 \text{ L}$ Four decimal places are allowed since both numbers have four decimal places.
- 2.29** The km/h markings indicate how many kilometers (how much distance) will be traversed in 1 hour's time if the speed is held constant. The mph (mi/h) markings indicate the same distance traversed *but measured in miles* during the 1 hour of travel.
- 2.30** In France, the units on the odometer would be in the metric system and so the reading would be in kilometers (km). In the United States, odometer readings are in miles (mi).
- 2.31** a. mg b. dL c. km d. fg
- 2.32** a. Gg b. Mm c. μL or mL d. ns
- 2.33** a. centiliter b. kilogram c. millisecond d. gigameter
- 2.34** a. deciliter b. terasecond c. microgram d. picometer
- 2.35** a. 0.01 b. 1 000 000 000 000 (or 1×10^{12})
c. 0.001 (or 1×10^{-3}) d. 0.1
- 2.36** a. 1 000 000 000 (or 1×10^9) b. 0.000 001 (or 1×10^{-6})
c. 1 000 000 (or 1×10^6) d. 0.000 000 001 (or 1×10^{-9})
- 2.37** a. 1 decigram b. 1 microgram
c. 1 kilogram d. 1 centigram
- 2.38** a. 1 gigameter b. 1 megameter
c. 1 millimeter d. 1 femtometer
- 2.39** a. 1 m = 100 cm b. 1 m = 1×10^9 nm
c. 1 mm = 0.001 m d. 1 L = 1000 mL
- 2.40** a. 1 Mg = 1×10^6 g b. 1 mL = 1000 μL
c. 1 g = 0.001 kg d. 1 g = 1000 mg

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- 2.41** a. kilogram, since 10^3 g is greater than 10^{-3} g
 b. milliliter, since 10^{-3} L is greater than 10^{-6} L
 c. km, since 10^3 m is greater than 10^0 m
 d. kL, since 10^3 L is greater than 10^{-1} L
 e. nanometer, since 10^{-9} m is greater than 10^{-12} m
- 2.42** a. mg, since 10^{-3} g is smaller than 10^0 g
 b. nanometer, since 10^{-9} m is smaller than 10^{-2} m
 c. micrometer, since 10^{-6} m is smaller than 10^{-3} m
 d. mL, since 10^{-3} L is smaller than 10^{-1} L
 e. centigram, since 10^{-2} g is smaller than 10^0 g
- 2.43** a. $100 \text{ cm} = 1 \text{ m}; \frac{100 \text{ cm}}{1 \text{ m}} \text{ and } \frac{1 \text{ m}}{100 \text{ cm}}$
 b. $1000 \text{ mg} = 1 \text{ g}; \frac{1000 \text{ mg}}{1 \text{ g}} \text{ and } \frac{1 \text{ g}}{1000 \text{ mg}}$
 c. $1 \text{ L} = 1000 \text{ mL}; \frac{1 \text{ L}}{1000 \text{ mL}} \text{ and } \frac{1000 \text{ mL}}{1 \text{ L}}$
 d. $1 \text{ dL} = 100 \text{ mL}; \frac{1 \text{ dL}}{100 \text{ mL}} \text{ and } \frac{100 \text{ mL}}{1 \text{ dL}}$
- 2.44** a. $2.54 \text{ cm} = 1 \text{ in.}; \frac{2.54 \text{ cm}}{1 \text{ in.}} \text{ and } \frac{1 \text{ in.}}{2.54 \text{ cm}}$
 b. $2.20 \text{ lb} = 1 \text{ kg}; \frac{2.20 \text{ lb}}{1 \text{ kg}} \text{ and } \frac{1 \text{ kg}}{2.20 \text{ lb}}$
 c. $1 \text{ lb} = 454 \text{ g}; \frac{1 \text{ lb}}{454 \text{ g}} \text{ and } \frac{454 \text{ g}}{1 \text{ lb}}$
 d. $1.06 \text{ qt} = 1 \text{ L}; \frac{1.06 \text{ qt}}{1 \text{ L}} \text{ and } \frac{1 \text{ L}}{1.06 \text{ qt}}$
- 2.45** a. $1 \text{ yd} = 3 \text{ ft}; \frac{3 \text{ ft}}{1 \text{ yd}} \text{ and } \frac{1 \text{ yd}}{3 \text{ ft}}$; the 1 yd and 3 ft are both exact (U.S. definition).
 b. $1 \text{ kg} = 2.20 \text{ lb}; \frac{2.20 \text{ lb}}{1 \text{ kg}} \text{ and } \frac{1 \text{ kg}}{2.20 \text{ lb}}$; the 2.20 lb is measured: it has 3 SFs; the 1 kg is exact.
 c. $1 \text{ min} = 60 \text{ s}; \frac{60 \text{ s}}{1 \text{ min}} \text{ and } \frac{1 \text{ min}}{60 \text{ s}}$; the 1 min and 60 s are both exact.
 d. $1 \text{ gal of gasoline} = 27 \text{ mi}; \frac{27 \text{ mi}}{1 \text{ gal gasoline}} \text{ and } \frac{1 \text{ gal gasoline}}{27 \text{ mi}}$; the 27 mi is measured: it has 2 SFs; the 1 gal is exact.
 e. $100 \text{ g of sterling} = 93 \text{ g of silver}; \frac{93 \text{ g silver}}{100 \text{ g sterling}} \text{ and } \frac{100 \text{ g sterling}}{93 \text{ g silver}}$; the 93 g is measured: it has 2 SFs; the 100 g is exact.
- 2.46** a. $1 \text{ L} = 1.06 \text{ qt}; \frac{1.06 \text{ qt}}{1 \text{ L}} \text{ and } \frac{1 \text{ L}}{1.06 \text{ qt}}$; the 1.06 qt is measured: it has 3 SFs; the 1 L is exact.
 b. $1 \text{ lb of oranges} = \$1.29; \frac{\$1.29}{1 \text{ lb oranges}} \text{ and } \frac{1 \text{ lb oranges}}{\$1.29}$; the \$1.29 is measured: it has 3 SFs; the 1 lb is exact.
 c. $1 \text{ week} = 7 \text{ days}; \frac{7 \text{ days}}{1 \text{ week}} \text{ and } \frac{1 \text{ week}}{7 \text{ days}}$; the 1 week and 7 days are both exact (U.S. definition).

- d. $1 \text{ dL} = 100 \text{ mL}$; $\frac{100 \text{ mL}}{1 \text{ dL}}$ and $\frac{1 \text{ dL}}{100 \text{ mL}}$; the 1 dL and 100 mL are both exact (metric definition).
- e. $100 \text{ g of gold ring} = 75 \text{ g of gold}$; $\frac{75 \text{ g gold}}{100 \text{ g gold ring}}$ and $\frac{100 \text{ g gold ring}}{75 \text{ g gold}}$; the 75 g is measured: it has 2 SFs; the 100 g is exact.
- 2.47** a. $1 \text{ s} = 3.5 \text{ m}$; $\frac{1 \text{ s}}{3.5 \text{ m}}$ and $\frac{3.5 \text{ m}}{1 \text{ s}}$; the 3.5 m is measured: it has 2 SFs; the 1 s is exact.
- b. $4700 \text{ mg of potassium} = 1 \text{ day}$; $\frac{4700 \text{ mg potassium}}{1 \text{ day}}$ and $\frac{1 \text{ day}}{4700 \text{ mg potassium}}$; the 4700 mg is measured: it has 2 SFs; the 1 day is exact.
- c. $1 \text{ gal of gasoline} = 46.0 \text{ km}$; $\frac{1 \text{ gal gasoline}}{46.0 \text{ km}}$ and $\frac{46.0 \text{ km}}{1 \text{ gal gasoline}}$; the 46.0 km is measured: it has 3 SFs; the 1 gal is exact.
- d. $1 \text{ kg of plums} = 29 \text{ mcg of pesticide}$; $\frac{1 \text{ kg plums}}{29 \text{ mcg pesticide}}$ and $\frac{29 \text{ mcg pesticide}}{1 \text{ kg plums}}$; the 29 mcg is measured: it has 2 SFs; the 1 kg is exact.
- 2.48** a. $150 \text{ mcg of iodine} = 1 \text{ day}$; $\frac{150 \text{ mcg iodine}}{1 \text{ day}}$ and $\frac{1 \text{ day}}{150 \text{ mcg iodine}}$; the 150 mcg is measured: it has 2 SFs; the 1 day is exact.
- b. $1 \text{ kg of water} = 32 \text{ mg of nitrate}$; $\frac{1 \text{ kg water}}{32 \text{ mg nitrate}}$ and $\frac{32 \text{ mg nitrate}}{1 \text{ kg water}}$; the 32 mg is measured: it has 2 SFs; the 1 kg is exact.
- c. $100 \text{ g of jewelry} = 58 \text{ g of gold}$; $\frac{58 \text{ g gold}}{100 \text{ g jewelry}}$ and $\frac{100 \text{ g jewelry}}{58 \text{ g gold}}$; the 58 g is measured: it has 2 SFs; the 100 g is exact.
- d. $1 \text{ L of milk} = \$1.65$; $\frac{\$1.65}{1 \text{ L milk}}$ and $\frac{1 \text{ L milk}}{\$1.65}$; the \$1.65 is measured: it has 3 SFs; the 1 L is exact.
- 2.49** a. $1 \text{ tablet} = 630 \text{ mg of calcium}$; $\frac{630 \text{ mg calcium}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{630 \text{ mg calcium}}$; the 630 mg is measured: it has 2 SFs; the 1 tablet is exact.
- b. $60 \text{ mg of vitamin C} = 1 \text{ day}$; $\frac{60 \text{ mg vitamin C}}{1 \text{ day}}$ and $\frac{1 \text{ day}}{60 \text{ mg vitamin C}}$; the 60 mg is measured: it has 1 SF; the 1 day is exact.
- c. $1 \text{ tablet} = 50 \text{ mg of atenolol}$; $\frac{50 \text{ mg atenolol}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{50 \text{ mg atenolol}}$; the 50 mg is measured: it has 1 SF; the 1 tablet is exact.
- d. $1 \text{ tablet} = 81 \text{ mg of aspirin}$; $\frac{81 \text{ mg aspirin}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{81 \text{ mg aspirin}}$; the 81 mg is measured: it has 2 SFs; the 1 tablet is exact.
- 2.50** a. $10 \text{ mg of furosemide} = 1 \text{ mL}$; $\frac{10 \text{ mg furosemide}}{1 \text{ mL}}$ and $\frac{1 \text{ mL}}{10 \text{ mg furosemide}}$; the 10 mg is measured: it has 1 SF; the 1 mL is exact.
- b. $70. \text{ mcg of selenium} = 1 \text{ day}$; $\frac{70. \text{ mcg selenium}}{1 \text{ day}}$ and $\frac{1 \text{ day}}{70. \text{ mcg selenium}}$; the 70. mg is measured: it has 2 SFs; the 1 day is exact.

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- c. 85 mL of saline solution = 1 hour; $\frac{85 \text{ mL saline solution}}{1 \text{ hour}}$ and $\frac{1 \text{ hour}}{85 \text{ mL saline solution}}$;
 the 85 mL is measured: it has 2 SFs; the 1 hour is exact.
- d. 1 capsule = 360 mg of omega-3 fatty acids; $\frac{360 \text{ mg omega-3 fatty acids}}{1 \text{ capsule}}$ and $\frac{1 \text{ capsule}}{360 \text{ mg omega-3 fatty acids}}$; the 360 mg is measured: it has 2 SFs; the 1 capsule is exact.
- 2.51** a. 5 mL of syrup = 10 mg of Atarax; $\frac{10 \text{ mg Atarax}}{5 \text{ mL syrup}}$ and $\frac{5 \text{ mL syrup}}{10 \text{ mg Atarax}}$
 b. 1 tablet = 0.25 g of Lanoxin; $\frac{0.25 \text{ g Lanoxin}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{0.25 \text{ g Lanoxin}}$
 c. 1 tablet = 300 mg of Motrin; $\frac{300 \text{ mg Motrin}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{300 \text{ mg Motrin}}$
- 2.52** a. 1 tablet = 2.5 mg of Coumadin; $\frac{2.5 \text{ mg Coumadin}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{2.5 \text{ mg Coumadin}}$
 b. 1 tablet = 100 mg of Clozapine; $\frac{100 \text{ mg Clozapine}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{100 \text{ mg Clozapine}}$
 c. 1 mL of solution = 1.5 g of Cefuroxime; $\frac{1.5 \text{ g Cefuroxime}}{1 \text{ mL solution}}$ and $\frac{1 \text{ mL solution}}{1.5 \text{ g Cefuroxime}}$
- 2.53** a. **Given** 175 cm **Need** meters
Plan cm \rightarrow m $\frac{1 \text{ m}}{100 \text{ cm}}$
Set-up $175 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = 1.75 \text{ m}$ (3 SFs)
- b. **Given** 5500 mL **Need** liters
Plan mL \rightarrow L $\frac{1 \text{ L}}{1000 \text{ mL}}$
Set-up $5500 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 5.5 \text{ L}$ (2 SFs)
- c. **Given** 0.0018 kg **Need** grams
Plan kg \rightarrow g $\frac{1000 \text{ g}}{1 \text{ kg}}$
Set-up $0.0018 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} = 1.8 \text{ g}$ (2 SFs)
- 2.54** a. **Given** 800 mg **Need** grams
Plan mg \rightarrow g $\frac{1 \text{ g}}{1000 \text{ mg}}$
Set-up $800 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} = 0.8 \text{ g}$ (1 SF)
- b. **Given** 0.85 dL **Need** milliliters
Plan dL \rightarrow mL $\frac{100 \text{ mL}}{1 \text{ dL}}$
Set-up $0.85 \text{ dL} \times \frac{100 \text{ mL}}{1 \text{ dL}} = 85 \text{ mL}$ (2 SFs)

c. **Given** 2840 mg **Need** grams

Plan mg → g $\frac{1 \text{ g}}{1000 \text{ mg}}$

Set-up $2840 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} = 2.84 \text{ g (3 SFs)}$

2.55 a. **Given** 0.500 qt **Need** milliliters

Plan qt → mL $\frac{946 \text{ mL}}{1 \text{ qt}}$

Set-up $0.500 \text{ qt} \times \frac{946 \text{ mL}}{1 \text{ qt}} = 473 \text{ mL (3 SFs)}$

b. **Given** 175 lb **Need** kilograms

Plan lb → kg $\frac{1 \text{ kg}}{2.20 \text{ lb}}$

Set-up $175 \text{ lb} \times \frac{1 \text{ kg}}{2.20 \text{ lb}} = 79.5 \text{ kg (3 SFs)}$

c. **Given** 74 kg body mass, 15% body fat **Need** pounds of body fat

Plan kg of body mass → kg of body fat → lb of body fat
 $\frac{15 \text{ kg body fat}}{100 \text{ kg body mass}} \quad \frac{2.20 \text{ lb body fat}}{1 \text{ kg body fat}}$

Set-up $74 \text{ kg body mass} \times \frac{15 \text{ kg body fat}}{100 \text{ kg body mass}} \times \frac{2.20 \text{ lb body fat}}{1 \text{ kg body fat}} = 24 \text{ lb of body fat (2 SFs)}$

d. **Given** 10.0 oz of fertilizer, 15% nitrogen **Need** grams of nitrogen

Plan oz of fertilizer → lb of fertilizer → g of fertilizer → g of nitrogen
 (percent equality: 100 g of fertilizer = 15 g of nitrogen)
 $\frac{1 \text{ lb}}{16 \text{ oz}} \quad \frac{454 \text{ g}}{1 \text{ lb}} \quad \frac{15 \text{ g nitrogen}}{100 \text{ g fertilizer}}$

Set-up $10.0 \text{ oz fertilizer} \times \frac{1 \text{ lb}}{16 \text{ oz}} \times \frac{454 \text{ g}}{1 \text{ lb}} \times \frac{15 \text{ g nitrogen}}{100 \text{ g fertilizer}} = 43 \text{ g of nitrogen (2 SFs)}$

2.56 a. **Given** 0.750 L of wine, 12% alcohol **Need** milliliters of alcohol

Plan L of wine → mL of wine → mL of alcohol $\frac{1000 \text{ mL wine}}{1 \text{ L wine}} \quad \frac{12 \text{ mL alcohol}}{100 \text{ mL wine}}$

Set-up $0.750 \text{ L wine} \times \frac{1000 \text{ mL wine}}{1 \text{ L wine}} \times \frac{12 \text{ mL alcohol}}{100 \text{ mL wine}} = 90. \text{ mL of alcohol (2 SFs)}$

b. **Given** 1 high-fiber muffin **Need** grams of fiber

Plan number of muffins → oz → lb → g of muffin → g of fiber
 (percent equality: 100 g of fiber muffin = 51 g of fiber)
 $\frac{12 \text{ oz}}{6 \text{ muffins}} \quad \frac{1 \text{ lb}}{16 \text{ oz}} \quad \frac{454 \text{ g}}{1 \text{ lb}} \quad \frac{51 \text{ g fiber}}{100 \text{ g muffin}}$

Set-up $1 \text{ muffin} \times \frac{12 \text{ oz}}{6 \text{ muffins}} \times \frac{1 \text{ lb}}{16 \text{ oz}} \times \frac{454 \text{ g}}{1 \text{ lb}} \times \frac{51 \text{ g fiber}}{100 \text{ g muffin}} = 29 \text{ g of fiber (2 SFs)}$

c. **Given** 1.43 kg of peanut butter **Need** ounces of peanut butter/sandwich

Plan kg of peanut butter (pb) → lb of pb → oz of pb → oz of pb/sandwich
 (percent equality: 100 oz of peanut butter = 8.0 oz pb/sandwich)
 $\frac{2.20 \text{ lb}}{1 \text{ kg}} \quad \frac{16 \text{ oz}}{1 \text{ lb}} \quad \frac{8.0 \text{ oz pb/sandwich}}{100 \text{ oz pb}}$

Set-up $1.43 \text{ kg peanut butter} \times \frac{2.20 \text{ lb pb}}{1 \text{ kg pb}} \times \frac{16 \text{ oz pb}}{1 \text{ lb pb}} \times \frac{8.0 \text{ oz pb/sandwich}}{100 \text{ oz pb}} = 4.0 \text{ oz of peanut butter/sandwich (2 SFs)}$

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d. **Given** 5.0 kg of pecans, 22.0% pecans **Need** pounds of chocolate bars

Plan kg of pecans → kg of bars → lb of bars

$$(\text{percent equality: } 100 \text{ kg of bars} = 22.0 \text{ kg of pecans}) \quad \frac{100 \text{ kg choc. bars}}{22.0 \text{ kg pecans}} \quad \frac{2.20 \text{ lb}}{1 \text{ kg}}$$

Set-up $5.0 \text{ kg pecans} \times \frac{100 \text{ kg choc. bars}}{22.0 \text{ kg pecans}} \times \frac{2.20 \text{ lb}}{1 \text{ kg}} = 50. \text{ lb of chocolate bars (2 SFs)}$

2.57 a. **Given** 250 L of water **Need** gallons of water

Plan L → qt → gal $\frac{1.06 \text{ qt}}{1 \text{ L}} \quad \frac{1 \text{ gal}}{4 \text{ qt}}$

Set-up $250 \text{ L} \times \frac{1.06 \text{ qt}}{1 \text{ L}} \times \frac{1 \text{ gal}}{4 \text{ qt}} = 66 \text{ gal (2 SFs)}$

b. **Given** 0.024 g of sulfa drug, 8-mg tablets **Need** number of tablets

Plan g of sulfa drug → mg of sulfa drug → number of tablets

$$\frac{1000 \text{ mg}}{1 \text{ g}} \quad \frac{1 \text{ tablet}}{8 \text{ mg sulfa drug}}$$

Set-up $0.024 \text{ g sulfa drug} \times \frac{1000 \text{ mg}}{1 \text{ g}} \times \frac{1 \text{ tablet}}{8 \text{ mg sulfa drug}} = 3 \text{ tablets (1 SF)}$

c. **Given** 34-lb child, 115 mg of ampicillin/kg of body mass **Need** milligrams of ampicillin

Plan lb of body mass → kg of body mass → mg of ampicillin

$$\frac{1 \text{ kg}}{2.20 \text{ lb}} \quad \frac{115 \text{ mg ampicillin}}{1 \text{ kg body mass}}$$

Set-up $34 \text{ lb body mass} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body mass}} \times \frac{115 \text{ mg ampicillin}}{1 \text{ kg body mass}} = 1800 \text{ mg of ampicillin (2 SFs)}$

d. **Given** 4.0 oz of ointment **Need** grams of ointment

Plan oz → lb → g $\frac{1 \text{ lb}}{16 \text{ oz}} \quad \frac{454 \text{ g}}{1 \text{ lb}}$

Set-up $4.0 \text{ oz} \times \frac{1 \text{ lb}}{16 \text{ oz}} \times \frac{454 \text{ g}}{1 \text{ lb}} = 110 \text{ g of ointment (2 SFs)}$

2.58 a. **Given** 1 day, 1.0 g of tetracycline/6 h, 500-mg tablets **Need** number of tablets

Plan days → hours → g of tetracycline → mg of tetracycline → number of tablets

$$\frac{24 \text{ h}}{1 \text{ day}} \quad \frac{1.0 \text{ g tetracycline}}{6 \text{ h}} \quad \frac{1000 \text{ mg}}{1 \text{ g}} \quad \frac{1 \text{ tablet}}{500 \text{ mg tetracycline}}$$

Set-up

$1 \text{ day} \times \frac{24 \text{ h}}{1 \text{ day}} \times \frac{1.0 \text{ g tetracycline}}{6 \text{ h}} \times \frac{1000 \text{ mg}}{1 \text{ g}} \times \frac{1 \text{ tablet}}{500 \text{ mg tetracycline}} = 8 \text{ tablets (1 SF)}$

b. **Given** 180-lb patient, 5.00 mg of medication/kg of body mass

Need milligrams of medication

Plan lb of body mass → kg of body mass → mg of medication

$$\frac{1 \text{ kg}}{2.20 \text{ lb}} \quad \frac{5.00 \text{ mg medication}}{1 \text{ kg body mass}}$$

Set-up $180 \text{ lb body mass} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body mass}} \times \frac{5.00 \text{ mg medication}}{1 \text{ kg body mass}} = 410 \text{ mg of medication (2 SFs)}$

- c. **Given** 0.50 mg of atropine, 0.10 mg of atropine/mL of solution
Need milliliters of solution

Plan mg of atropine \rightarrow mL of solution $\frac{1 \text{ mL solution}}{0.10 \text{ mg atropine}}$

Set-up $0.50 \text{ mg atropine} \times \frac{1 \text{ mL solution}}{0.10 \text{ mg atropine}} = 5.0 \text{ mL of solution (2 SFs)}$

- d. **Given** 5.0 pt of plasma **Need** milliliters of plasma

Plan pt \rightarrow qt \rightarrow mL $\frac{1 \text{ qt}}{2 \text{ pt}} \frac{946 \text{ mL}}{1 \text{ qt}}$

Set-up $5.0 \text{ pt} \times \frac{1 \text{ qt}}{2 \text{ pt}} \times \frac{946 \text{ mL}}{1 \text{ qt}} = 2400 \text{ mL of plasma (2 SFs)}$

- 2.59 a. **Given** 500. mL of IV saline solution, 80. mL/h **Need** infusion time in hours

Plan mL of IV saline solution \rightarrow hours $\frac{1 \text{ h}}{80. \text{ mL saline solution}}$

Set-up $500. \text{ mL saline solution} \times \frac{1 \text{ h}}{80. \text{ mL saline solution}} = 6.3 \text{ h (2 SFs)}$

- b. **Given** 72.6-lb child, 1.5. mg of Medrol/kg of body mass, 20. mg of Medrol/mL of solution **Need** milliliters of Medrol solution

Plan lb of body mass \rightarrow kg of body mass \rightarrow mg of Medrol \rightarrow mL of solution

$\frac{1 \text{ kg}}{2.20 \text{ lb}} \frac{1.5 \text{ mg Medrol}}{1 \text{ kg body mass}} \frac{1 \text{ mL solution}}{20. \text{ mg Medrol}}$

Set-up $72.6 \text{ lb body mass} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body mass}} \times \frac{1.5 \text{ mg Medrol}}{1 \text{ kg body mass}} \times \frac{1 \text{ mL solution}}{20. \text{ mg Medrol}}$
 $= 2.5 \text{ mL of Medrol solution (2 SFs)}$

- 2.60 a. **Given** ordered dose 12.5 mg of promethazine, stock 25 mg of promethazine/mL of solution **Need** milliliters of promethazine solution

Plan mg of promethazine \rightarrow mL of stock solution $\frac{1 \text{ mL solution}}{25 \text{ mg promethazine}}$

Set-up

$12.5 \text{ mg promethazine} \times \frac{1 \text{ mL solution}}{25 \text{ mg promethazine}} = 0.50 \text{ mL of stock solution (2 SFs)}$

- b. **Given** 28-kg child, 25 mg of ampicillin/kg of body mass, 250 mg of ampicillin/capsule **Need** number of capsules

Plan kg of body mass \rightarrow mg of ampicillin \rightarrow number of capsules

$\frac{25 \text{ mg ampicillin}}{1 \text{ kg body mass}} \frac{1 \text{ capsule}}{250 \text{ mg ampicillin}}$

Set-up $28 \text{ kg body mass} \times \frac{25 \text{ mg ampicillin}}{1 \text{ kg body mass}} \times \frac{1 \text{ capsule}}{250 \text{ mg ampicillin}}$
 $= 2.8 \text{ capsules of ampicillin (2 SFs)}$

- 2.61 a. **Given** 175 lb of body weight, LD₅₀ = 3300 mg/kg **Need** grams of table salt

Plan lb of body weight \rightarrow kg of body mass \rightarrow mg of table salt \rightarrow g of table salt

$\frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \frac{3300 \text{ mg table salt}}{1 \text{ kg body mass}} \frac{1 \text{ g table salt}}{1000 \text{ mg table salt}}$

Set-up

$175 \text{ lb body weight} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{3300 \text{ mg table salt}}{1 \text{ kg body mass}} \times \frac{1 \text{ g table salt}}{1000 \text{ mg table salt}}$
 $= 260 \text{ g of table salt (2 SFs)}$

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- b. **Given** 175 lb of body weight, $LD_{50} = 6 \text{ mg/kg}$ **Need** grams of sodium cyanide

Plan

lb of body weight \rightarrow kg of body mass \rightarrow mg of sodium cyanide \rightarrow g of sodium cyanide

$$\frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{6 \text{ mg sodium cyanide}}{1 \text{ kg body mass}} \times \frac{1 \text{ g sodium cyanide}}{1000 \text{ mg sodium cyanide}}$$

Set-up

$$175 \text{ lb body weight} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{6 \text{ mg sodium cyanide}}{1 \text{ kg body mass}} \times \frac{1 \text{ g sodium cyanide}}{1000 \text{ mg sodium cyanide}}$$

= 0.5 g of sodium cyanide (1 SF)

- c. **Given** 175 lb of body weight, $LD_{50} = 1100 \text{ mg/kg}$ **Need** grams of aspirin

Plan lb of body weight \rightarrow kg of body mass \rightarrow mg of aspirin \rightarrow g of aspirin

$$\frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{1100 \text{ mg aspirin}}{1 \text{ kg body mass}} \times \frac{1 \text{ g aspirin}}{1000 \text{ mg aspirin}}$$

$$\text{Set-up } 175 \text{ lb body weight} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{1100 \text{ mg aspirin}}{1 \text{ kg body mass}} \times \frac{1 \text{ g aspirin}}{1000 \text{ mg aspirin}}$$

= 88 g of aspirin (2 SFs)

- 2.62 a. **Given** 148 lb of body weight, $LD_{50} = 2080 \text{ mg/kg}$ **Need** grams of ethanol

Plan lb of body weight \rightarrow kg of body mass \rightarrow mg of ethanol \rightarrow g of ethanol

$$\frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{2080 \text{ mg ethanol}}{1 \text{ kg body mass}} \times \frac{1 \text{ g ethanol}}{1000 \text{ mg ethanol}}$$

$$\text{Set-up } 148 \text{ lb body weight} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{2080 \text{ mg ethanol}}{1 \text{ kg body mass}} \times \frac{1 \text{ g ethanol}}{1000 \text{ mg ethanol}}$$

= 140. g of ethanol (3 SFs)

- b. **Given** 148 lb of body weight, $LD_{50} = 30 \text{ mg/kg}$ **Need** grams of ricin

Plan lb of body weight \rightarrow kg of body mass \rightarrow mg of ricin \rightarrow g of ricin

$$\frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{30 \text{ mg ricin}}{1 \text{ kg body mass}} \times \frac{1 \text{ g ricin}}{1000 \text{ mg ricin}}$$

$$\text{Set-up } 148 \text{ lb body weight} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{30 \text{ mg ricin}}{1 \text{ kg body mass}} \times \frac{1 \text{ g ricin}}{1000 \text{ mg ricin}}$$

= 2 g of ricin (1 SF)

- c. **Given** 148 lb of body weight, $LD_{50} = 4220 \text{ mg/kg}$ **Need** grams of baking soda

Plan lb of body weight \rightarrow kg of body mass \rightarrow mg of baking soda \rightarrow g of baking soda

$$\frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{4220 \text{ mg baking soda}}{1 \text{ kg body mass}} \times \frac{1 \text{ g baking soda}}{1000 \text{ mg baking soda}}$$

$$\text{Set-up } 148 \text{ lb body weight} \times \frac{1 \text{ kg body mass}}{2.20 \text{ lb body weight}} \times \frac{4220 \text{ mg baking soda}}{1 \text{ kg body mass}} \times \frac{1 \text{ g baking soda}}{1000 \text{ mg baking soda}}$$

= 284 g of baking soda (3 SFs)

- 2.63 Density is the mass of a substance divided by its volume. $\text{Density} = \frac{\text{mass (grams)}}{\text{volume (mL)}}$

The densities of solids and liquids are usually stated in g/mL or g/cm³, so in some problems the units will need to be converted.

- a. **Given** 1.65 lb, 170 mL **Need** density (g/mL)

Plan lb \rightarrow g then calculate density $\frac{454 \text{ g}}{1 \text{ lb}}$

$$\text{Set-up } 1.65 \text{ lb} \times \frac{454 \text{ g}}{1 \text{ lb}} = 749 \text{ g (3 SFs)}$$

$$\therefore \text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{749 \text{ g}}{170 \text{ mL}} = 4.4 \text{ g/mL (2 SFs)}$$

b. Given 20.0 mL initial volume, 21.45 mL final volume, 4.50 g **Need** density (g/mL)

Plan calculate volume by difference, then calculate density

Set-up volume of gem: 21.45 mL total – 20.0 mL water = 1.45 mL

$$\therefore \text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{4.50 \text{ g}}{1.45 \text{ mL}} = 3.10 \text{ g/mL (3 SFs)}$$

c. Given 514.1 g, 114 cm³ **Need** density (g/mL)

Plan convert volume cm³ → mL then calculate the density $\frac{1 \text{ mL}}{1 \text{ cm}^3}$

$$\text{Set-up } 114 \text{ cm}^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3} = 114 \text{ mL}$$

$$\therefore \text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{514.1 \text{ g}}{114 \text{ mL}} = 4.51 \text{ g/mL (3 SFs)}$$

2.64 a. $\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{3.85 \text{ g}}{3.00 \text{ mL}} = 1.28 \text{ g/mL (3 SFs)}$

b. $\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{155 \text{ g}}{125 \text{ mL}} = 1.24 \text{ g/mL (3 SFs)}$

c. Given 0.100 qt, 115.25 g initial, 182.48 g final **Need** density (g/mL)

Plan qt → L → mL then calculate mass by difference

$$\frac{1 \text{ qt}}{2 \text{ pt}} \times \frac{1 \text{ L}}{1.06 \text{ qt}} \times \frac{1000 \text{ mL}}{1 \text{ L}} \text{ then calculate the density}$$

$$\text{Set-up } 0.100 \text{ qt} \times \frac{1 \text{ qt}}{2 \text{ pt}} \times \frac{1 \text{ L}}{1.06 \text{ qt}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 47.2 \text{ mL (3 SFs)}$$

$$\text{mass of syrup} = 182.48 \text{ g} - 115.25 \text{ g} = 67.23 \text{ g}$$

$$\therefore \text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{67.23 \text{ g}}{47.3 \text{ mL}} = 1.42 \text{ g/mL (3 SFs)}$$

2.65 In these problems, the density is used as a conversion factor.

a. Given 150 mL of liquid, density 1.4 g/mL **Need** grams of liquid

Plan mL → g $\frac{1.4 \text{ g}}{1 \text{ mL}}$

$$\text{Set-up } 150 \text{ mL} \times \frac{1.4 \text{ g}}{1 \text{ mL}} = 210 \text{ g of liquid (2 SFs)}$$

b. Given 0.500 L of glucose solution, density 1.15 g/mL **Need** grams of solution

Plan L → mL → g $\frac{1000 \text{ mL}}{1 \text{ L}} \times \frac{1.15 \text{ g}}{1 \text{ mL solution}}$

$$\text{Set-up } 0.500 \text{ L solution} \times \frac{1000 \text{ mL}}{1 \text{ L}} \times \frac{1.15 \text{ g}}{1 \text{ mL solution}} = 575 \text{ g of solution (3 SFs)}$$

c. Given 225 mL of bronze, density 7.8 g/mL **Need** ounces of bronze

Plan mL → g → lb → oz $\frac{7.8 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ lb}}{454 \text{ g}} \times \frac{16 \text{ oz}}{1 \text{ lb}}$

$$\text{Set-up } 225 \text{ mL} \times \frac{7.8 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ lb}}{454 \text{ g}} \times \frac{16 \text{ oz}}{1 \text{ lb}} = 62 \text{ oz of bronze (2 SFs)}$$

2.66 In these problems, the density is used as a conversion factor.

a. Given 18.0 mL of water, 35.6 g of silver, density 10.5 g/mL **Need** final volume (mL)

Plan g → mL then calculate the final volume using addition $\frac{1 \text{ mL}}{10.5 \text{ g}}$

$$\text{Set-up } 35.6 \text{ g} \times \frac{1 \text{ mL}}{10.5 \text{ g}} = 3.39 \text{ mL of silver (3 SFs)}$$

$$18.0 \text{ mL water} + 3.39 \text{ mL silver} = 21.4 \text{ mL total volume (rounded to tenths)}$$

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b. Given 8.3 g of mercury, density 13.6 g/mL **Need** milliliters of mercury

Plan $\text{g} \rightarrow \text{mL}$ $\frac{1 \text{ mL}}{13.6 \text{ g}}$

Set-up $8.3 \text{ g} \times \frac{1 \text{ mL}}{13.6 \text{ g}} = 0.61 \text{ mL of mercury (2 SFs)}$

c. Given 35 gal of water, density 1.00 g/mL **Need** pounds of water

Plan $\text{gal} \rightarrow \text{qt} \rightarrow \text{mL} \rightarrow \text{g} \rightarrow \text{lb}$ $\frac{4 \text{ qt}}{1 \text{ gal}} \frac{946 \text{ mL}}{1 \text{ qt}} \frac{1.00 \text{ g}}{1 \text{ mL}} \frac{1 \text{ lb}}{454 \text{ g}}$

Set-up $35 \text{ gal} \times \frac{4 \text{ qt}}{1 \text{ gal}} \times \frac{946 \text{ mL}}{1 \text{ qt}} \times \frac{1.00 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ lb}}{454 \text{ g}} = 290 \text{ lb of water (2 SFs)}$

2.67 a. Specific gravity = $\frac{\text{density of substance}}{\text{density of water}} = \frac{1.030 \text{ g/mL}}{1.00 \text{ g/mL}} = 1.03 \text{ (3 SFs)}$

b. Density = $\frac{\text{mass of glucose solution}}{\text{volume of glucose solution}} = \frac{20.6 \text{ g}}{20.0 \text{ mL}} = 1.03 \text{ g/mL (3 SFs)}$

c. Specific gravity = $\frac{\text{density of substance}}{\text{density of water}}$

$\therefore \text{Density of substance} = \text{specific gravity} \times \text{density of water}$
 $= 0.85 \times 1.00 \text{ g/mL} = 0.85 \text{ g/mL (2 SFs)}$

d. Density = $\frac{\text{mass of HDL}}{\text{volume of HDL}} = \frac{0.230 \text{ g}}{0.200 \text{ mL}} = 1.15 \text{ g/mL (3 SFs)}$

2.68 a. Specific gravity = $\frac{\text{density of substance}}{\text{density of water}} = \frac{1.02 \text{ g/mL}}{1.00 \text{ g/mL}} = 1.02 \text{ (3 SFs)}$

b. Specific gravity = $\frac{\text{density of substance}}{\text{density of water}}$

$\therefore \text{Density of substance} = \text{specific gravity} \times \text{density of water}$
 $= 0.850 \times 1.00 \text{ g/mL} = 0.850 \text{ g/mL}$

$\therefore \text{Volume of solution} = \frac{\text{mass of solution}}{\text{density of solution}} = \frac{325 \text{ g}}{0.850 \text{ g/mL}} = 382 \text{ mL (3 SFs)}$

c. Specific gravity = $\frac{\text{density of substance}}{\text{density of water}}$

$\therefore \text{Density of substance} = \text{specific gravity} \times \text{density of water}$
 $= 0.86 \times 1.00 \text{ g/mL} = 0.86 \text{ g/mL}$

Mass of substance = density of substance \times volume of substance
 $= 0.86 \text{ g/mL} \times 2.15 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 1800 \text{ g (2 SFs)}$

d. Density = $\frac{\text{mass of urine sample}}{\text{volume of urine sample}} = \frac{5.025 \text{ g}}{5.000 \text{ mL}} = 1.005 \text{ g/mL}$

Specific gravity = $\frac{\text{density of sample}}{\text{density of water}} = \frac{1.005 \text{ g/mL}}{1.00 \text{ g/mL}} = 1.005 \text{ (4 SFs)}$

Since the specific gravity of the urine sample is less than the normal range for urine (1.012 to 1.030), this could be an indicator of type 2 diabetes.

2.69 a. 42 mcg of iron = 1 dL of blood; $\frac{42 \text{ mcg iron}}{1 \text{ dL blood}}$ and $\frac{1 \text{ dL blood}}{42 \text{ mcg iron}}$

b. Given 8.0 mL blood sample, 42 mcg of iron/dL **Need** micrograms of iron

Plan mL of blood \rightarrow dL of blood \rightarrow mcg of iron $\frac{1 \text{ dL blood}}{100 \text{ mL blood}} \frac{42 \text{ mcg iron}}{1 \text{ dL blood}}$

Set-up $8.0 \text{ mL blood} \times \frac{1 \text{ dL blood}}{100 \text{ mL blood}} \times \frac{42 \text{ mcg iron}}{1 \text{ dL blood}} = 3.4 \text{ mcg of iron (2 SFs)}$

- 2.70 a.** 1 tablet = 65 mg of iron; $\frac{65 \text{ mg iron}}{1 \text{ tablet}}$ and $\frac{1 \text{ tablet}}{65 \text{ mg iron}}$
- b. Given** 1 tablet twice daily, 65 mg of iron/tablet **Need** grams of iron per week
- Plan** days \rightarrow tablets \rightarrow mg of iron \rightarrow g of iron
- $$\frac{7 \text{ days}}{1 \text{ week}} \times \frac{2 \text{ tablets}}{1 \text{ day}} \times \frac{65 \text{ mg iron}}{1 \text{ tablet}} \times \frac{1 \text{ g iron}}{1000 \text{ mg iron}} = 0.91 \text{ g of iron/week (2 SFs)}$$
- Set-up**
- 2.71** Both measurements in part **a** have two significant figures. Both measurements in part **c** have two significant figures and both measurements in part **d** have three significant figures.
- 2.72** Both measurements in part **a** have three significant figures. Both measurements in part **b** have two significant figures.
- 2.73 a.** The number of legs is a counted number; it is exact.
b. The height is measured with a ruler or tape measure; it is a measured number.
c. The number of chairs is a counted number; it is exact.
d. The area is measured with a ruler or tape measure; it is a measured number.
- 2.74 a.** Length is 3.7 cm (2 SFs); the 7 is the estimated digit.
b. Length is 2.50 cm (3 SFs); the 0 is the estimated digit.
c. Length is 4.10 cm (3 SFs); the 0 is the estimated digit.
- 2.75 a.** length = $38.4 \text{ in.} \times \frac{2.54 \text{ cm}}{1 \text{ in.}} = 97.5 \text{ cm (3 SFs)}$
b. length = $24.2 \text{ in.} \times \frac{2.54 \text{ cm}}{1 \text{ in.}} = 61.5 \text{ cm (3 SFs)}$
c. There are three significant figures in the length measurement.
d. Area = length \times width = $97.5 \text{ cm} \times 61.5 \text{ cm} = 6.00 \times 10^3 \text{ cm}^2$ (3 SFs)
- 2.76 a.** Diagram 3; a cube that has a greater density than the water will sink to the bottom.
b. Diagram 4; a cube with a density of 0.80 g/mL will be about two-thirds submerged in the water.
c. Diagram 1; a cube with a density that is one-half the density of water will be one-half submerged in the water.
d. Diagram 2; a cube with the same density as water will float just at the surface of the water.
- 2.77 Given** 18.5 mL initial volume, 23.1 mL final volume, 8.24 g mass **Need** density (g/mL)
Plan calculate volume by difference, then calculate density
Set-up The volume of the object is $23.1 \text{ mL} - 18.5 \text{ mL} = 4.6 \text{ mL}$
- $$\therefore \text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{8.24 \text{ g}}{4.6 \text{ mL}} = 1.8 \text{ g/mL (2 SFs)}$$
- 2.78** Since all three solids have a mass of 10.0 g, the one with the smallest volume must have the highest density; the one with the largest volume will have the lowest density.
- A** would be gold; it has the highest density (19.3 g/mL) and the smallest volume.
B would be silver; its density is intermediate (10.5 g/mL) and the volume is intermediate.
C would be aluminum; it has the lowest density (2.70 g/mL) and the largest volume.
- 2.79** The liquid with the highest density will be at the bottom of the cylinder, while the liquid with the lowest density will be at the top of the cylinder:
- A** is milk ($D = 1.04 \text{ g/mL}$), **B** is olive oil ($D = 0.92 \text{ g/mL}$), **C** is gasoline ($D = 0.74 \text{ g/mL}$)

Chapter 2

2.80 The volume of a cube, 2.0 cm on each edge, is calculated as follows:

$$\text{Volume} = (\text{length})^3 = (2.0 \text{ cm})^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3} = 8.0 \text{ mL (2 SFs)}$$

(Both cubes have the same volume, but their masses differ.)

A cube will displace its volume when submerged in water, so the final volume reading in each graduated cylinder is:

$$40.0 \text{ mL water} + 8.0 \text{ mL metal} = 48.0 \text{ mL total volume}$$

- 2.81**
- To round off 2.784 kg to three significant figures, drop the final digit 4 to give 2.78 kg.
 - To round off 76.016 to three significant figures, drop the final digits 16 to give 76.0 L.
 - To round off 0.006212 cm to three significant figures, drop the final digit 2 to give 6.21×10^{-3} cm.

- 2.82**
- To round off 6113 m to three significant figures, drop the final digit 3 to give 6.11×10^3 m.
 - To round off 3.079×10^3 s to three significant figures, drop the final digit 9 and increase the last retained digit by 1 to give 3.08×10^3 s.
 - To round off 0.00050917 g to three significant figures, drop the final digits 17 to give 5.09×10^{-4} g.

- 2.83**
- The total mass is the sum of the individual components of the dessert.
 $137.25 \text{ g} + 84 \text{ g} + 43.7 \text{ g} = 265 \text{ g}$. No places to the right of the decimal point are allowed since the mass of the fudge sauce (84 g) has no digits to the right of the decimal point.

b. Given grams of dessert from part **a** **Need** pounds of dessert

Plan $\text{g} \rightarrow \text{lb}$ $\frac{1 \text{ lb}}{454 \text{ g}}$

Set-up $265 \text{ g dessert (total)} \times \frac{1 \text{ lb}}{454 \text{ g}} = 0.584 \text{ lb of dessert (3 SFs)}$

- 2.84**
- The total mass is the sum of the individual components of the order.
 $22 \text{ kg salmon} + 5.5 \text{ kg crab} + 3.48 \text{ kg oysters} = 31 \text{ kg of seafood}$. No places to the right of the decimal point are allowed since the mass of the salmon (22 kg) has no digits to the right of the decimal point.

b. Given kilograms of seafood from part **a** **Need** pounds of seafood

Plan $\text{kg} \rightarrow \text{lb}$ $\frac{2.20 \text{ lb}}{1 \text{ kg}}$

Set-up $31 \text{ kg seafood (total)} \times \frac{2.20 \text{ lb}}{1 \text{ kg}} = 68 \text{ lb of seafood (2 SFs)}$

- 2.85** **Given** 1.75 Euros/kg of grapes, \$1.36/Euro **Need** cost in dollars per pound

Plan $\text{Euros/kg} \rightarrow \text{Euros/lb} \rightarrow \text{\$/lb}$ $\frac{1.75 \text{ Euros}}{1 \text{ kg grapes}} \times \frac{1 \text{ kg}}{2.20 \text{ lb}} \times \frac{\$1.36}{1 \text{ Euro}}$

Set-up $\frac{1.75 \text{ Euros}}{1 \text{ kg grapes}} \times \frac{1 \text{ kg}}{2.20 \text{ lb}} \times \frac{\$1.36}{1 \text{ Euro}} = \$1.08/\text{lb of grapes (3 SFs)}$

- 2.86** **Given** 0.45 lb of avocado, 48 pesos/kg, 13 pesos/dollar **Need** cost in cents

Plan $\text{lb} \rightarrow \text{kg} \rightarrow \text{pesos} \rightarrow \text{dollars} \rightarrow \text{cents}$ $\frac{1 \text{ kg}}{2.20 \text{ lb}} \times \frac{48 \text{ pesos}}{1 \text{ kg}} \times \frac{1 \text{ dollar}}{13 \text{ pesos}} \times \frac{100 \text{ cents}}{1 \text{ dollar}}$

Set-up $0.45 \text{ lb} \times \frac{1 \text{ kg}}{2.20 \text{ lb}} \times \frac{48 \text{ pesos}}{1 \text{ kg}} \times \frac{1 \text{ dollar}}{13 \text{ pesos}} \times \frac{100 \text{ cents}}{1 \text{ dollar}} = 76 \text{ cents (2 SFs)}$

- 2.87 Given** 4.0 lb of onions **Need** number of onions
Plan lb \rightarrow g \rightarrow number of onions $\frac{454 \text{ g}}{1 \text{ lb}} \frac{1 \text{ onion}}{115 \text{ g}}$
Set-up $4.0 \text{ lb onions} \times \frac{454 \text{ g}}{1 \text{ lb}} \times \frac{1 \text{ onion}}{115 \text{ g}} = 16 \text{ onions (2 SFs)}$
- 2.88 Given** \$1420, \$1.75/lb **Need** kilograms of potatoes
Plan \$ \rightarrow lb of potatoes \rightarrow kg of potatoes $\frac{1 \text{ lb}}{\$1.75} \frac{1 \text{ kg}}{2.20 \text{ lb}}$
Set-up $\$1420 \times \frac{1 \text{ lb}}{\$1.75} \times \frac{1 \text{ kg}}{2.20 \text{ lb}} = 369 \text{ kg of potatoes (3 SFs)}$
- 2.89 Given** 215 mL initial, 285 mL final volume, density of lead 11.3 g/mL **Need** grams of lead
Plan calculate the volume by difference and mL \rightarrow g $\frac{11.3 \text{ g}}{1 \text{ mL}}$
Set-up The difference between the initial volume of the water and its volume with the lead object will give us the volume of the lead object: 285 mL total – 215 mL water = 70. mL of lead, then
 $70. \text{ mL lead} \times \frac{11.3 \text{ g lead}}{1 \text{ mL lead}} = 790 \text{ g of lead (2 SFs)}$
- 2.90 Given** 160 mL initially, 17.0 g of copper, 25.0 g of silver **Need** final volume (mL)
Plan for both copper and silver g \rightarrow mL then calculate the final volume using addition
 $\frac{1 \text{ mL copper}}{8.92 \text{ g copper}} \frac{1 \text{ mL silver}}{10.5 \text{ g silver}}$
Set-up $17.0 \text{ g copper} \times \frac{1 \text{ mL copper}}{8.92 \text{ g copper}} = 1.90 \text{ mL of copper (3 SFs)}$
 $25.0 \text{ g silver} \times \frac{1 \text{ mL silver}}{10.5 \text{ g silver}} = 2.38 \text{ mL of silver (3 SFs)}$
 $\therefore \text{ final volume} = 160 \text{ mL} + 1.90 \text{ mL copper} + 2.38 \text{ mL silver} = 164.3 \text{ mL}$
 (no places to the right of the decimal point are allowed)
- 2.91 Given** 2.0 L of ethanol **Need** cm³ of mercury
Plan L of ethanol \rightarrow mL of ethanol \rightarrow g of ethanol \rightarrow g of mercury \rightarrow cm³ of mercury
 (equality from question: 1 g ethanol = 1 g of mercury)
 $\frac{1000 \text{ mL ethanol}}{1 \text{ L ethanol}} \frac{0.79 \text{ g ethanol}}{1 \text{ mL ethanol}} \frac{1 \text{ cm}^3 \text{ mercury}}{13.6 \text{ g mercury}}$
Set-up $2.0 \text{ L ethanol} \times \frac{1000 \text{ mL}}{1 \text{ L}} \times \frac{0.79 \text{ g ethanol}}{1 \text{ mL ethanol}} = 1580 \text{ g of ethanol}$
 $1580 \text{ g mercury} \times \frac{1 \text{ cm}^3 \text{ mercury}}{13.6 \text{ g mercury}} = 116 \text{ cm}^3 \text{ of mercury}$
- 2.92 Given** 2.50 kg of gasoline **Need** quarts of gasoline
Plan kg \rightarrow g \rightarrow mL \rightarrow L \rightarrow qt $\frac{1000 \text{ g}}{1 \text{ kg}} \frac{1 \text{ mL}}{0.74 \text{ g}} \frac{1 \text{ L}}{1000 \text{ mL}} \frac{1.06 \text{ qt}}{1 \text{ L}}$
Set-up $2.50 \text{ kg} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mL}}{0.74 \text{ g}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1.06 \text{ qt}}{1 \text{ L}} = 3.58 \text{ qt of gasoline}$
- 2.93 a. Given** 8.0 oz **Need** number of crackers
Plan oz \rightarrow number of crackers $\frac{6 \text{ crackers}}{0.50 \text{ oz}}$
Set-up $8.0 \text{ oz} \times \frac{6 \text{ crackers}}{0.5 \text{ oz}} = 96 \text{ crackers (2 SFs)}$