Measurements in Chemistry — Chapter 2

Problem-Set Solutions

2.1 It is easier to use because it is a decimal unit system.

2.2 Common measurements include mass, volume, length, time, temperature, pressure, and concentration.

2.3 a. The metric prefix *giga*, abbreviated as G, has a value of 10^9. b. The metric prefix *nano*, abbreviated as n, has a value of 10^{-9}. c. The metric prefix *mega*, abbreviated as M, has a value of 10^6. d. The metric prefix *micro*, abbreviated as μ, has a value of 10^{-6}.

2.4 a. kilo-, 10^3 b. M, 10^6 c. pico-, p d. d, 10^{-1}

2.5 a. A kilogram, abbreviated as kg, measures mass.
b. A megameter, abbreviated as Mm, measures length.
c. A nanogram, abbreviated as ng, measures mass.
d. A milliliter, abbreviated as mL, measures volume.

2.6 a. centimeter, length b. volume, dL c. picometer, length d. mass, kg

2.7 a. A milliliter is 10^3 times smaller than a liter.
b. A kiloliter is 10^9 times larger than a microliter. c. A nanoliter is 10^8 times smaller than a deciliter. d. A centiliter is 10^8 times smaller than a megaliter.

2.8 a. larger, 10^6 b. smaller, 10^3 c. smaller, 10^{10} d. smaller, 10^{15}

2.9 The meaning of a metric system prefix is independent of the base unit it modifies. The lists, arranged from smallest to largest are:
a. nanogram, milligram, centigram
b. kilometer, megameter, gigameter
c. picoliter, microliter, deciliter
d. microgram, milligram, kilogram

2.10 a. microliter, milliliter, gigaliter
b. centigram, decigram, megagram
c. picometer, micrometer, kilometer
d. nanoliter, milliliter, centiliter

2.11 60 minutes is a counted (exact number), and 60 feet is a measured (inexact) number.

2.12 27 people is a counted (exact number), and 27 miles per hour is a measured (inexact) number.

2.13 An exact number has no uncertainty associated with it; an inexact number has a degree of uncertainty. Whenever defining a quantity or counting, the resulting number is exact. Whenever a measurement is made, the resulting number is inexact.
a. 32 is an exact number of chairs.
b. 60 is an exact number of seconds.
c. 3.2 pounds is an inexact measure of weight.
d. 323 is an exact number of words.

2.14 a. exact b. inexact c. inexact d. exact

2.15 Measurement results in an inexact number; counting and definition result in exact numbers.
a. The length of a swimming pool is an inexact number because it is measured.
b. The number of gummi bears in a bag is an exact number; gummi bears are counted.
c. The number of quarts in a gallon is exact because it is a defined number.
d. The surface area of a living room rug is an inexact number because it is calculated from two inexact measurements of length.

2.16 a. exact b. exact c. inexact d. inexact

2.17 The last digit of a measurement is estimated.
a. The estimated digit is 1.
b. The estimated digit is 5.
c. The estimated digit is the last 2.
d. The estimated digit is 0.

2.18 a. 2 b. 1 c. 1 d. 0

2.19 The magnitude of the uncertainty is indicated by a 1 in the last measured digit.
a. The magnitude of the uncertainty is 0.001
b. The magnitude of the uncertainty is 1.
c. The magnitude of the uncertainty is 0.0001
d. The magnitude of the uncertainty is 0.1

2.20 a. 0.001 b. 1 c. 0.01 d. 0.01

2.21 Only one estimated digit is recorded as part of a measurement.
a. Temperature recorded using a thermometer marked in degrees should be recorded to 0.1 degree.
b. The volume from a graduated cylinder with markings of tenths of milliliters should be recorded to 0.01 mL.
c. Volume using a volumetric device with markings every 10 mL should be recorded to 1 mL.
d. Length using a ruler with a smallest scale marking of 1 mm should be recorded to 0.1 mm.

2.22 a. 0.1 cm b. 0.1° c. 0.01°F d. 1 mL

2.23 a. 0.1 cm; since the ruler is marked in ones units, the estimated digit is tenths
b. 0.1 cm; since the ruler is marked in ones units, the estimated digit is tenths

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2.24 a. 0.01 cm; since the ruler is marked in tenths units, the estimated digit is hundredths
b. 1 cm; since the ruler is marked in tens units, the estimated digit is ones

2.25 a. 2.70 cm; the value is very close to 2.7, with the estimated value being 2.70
b. 27 cm; the value is definitely between 20 and 30, with the estimated value being 27

2.26 a. 2.7 cm; the value is definitely between 2 and 3, with the estimated value being 2.7
b. 27.0 cm; the value is very close to 27, with the estimated value being 27.0

2.27 a. ruler 4; since the ruler is marked in ones units it can be read to tenths
b. ruler 1 or 4; since both rulers are marked in ones units they can be read to tenths
c. ruler 2; since the ruler is marked in tenths units it can be read to hundredths
d. ruler 3; since the ruler is marked in tens units it can be read to ones

2.28 a. ruler 1 or 4; since both rulers are marked in ones units they can be read to tenths
b. ruler 2; since the ruler is marked in tenths units it can be read to hundredths
c. ruler 3; since the ruler is marked in tens units it can be read to ones
d. ruler 3; since the ruler is marked in tens units it can be read to ones

2.29 a. The zeros are not significant because they are trailing zeros with no decimal point.
b. The zeros are significant; trailing zeros are significant when a decimal point is present.
c. The zeros are not significant; leading zeros are never significant.
d. The zeros are significant; confined zeros (between nonzero digits) are significant.

2.30 a. significant b. significant
c. not significant d. not significant

2.31 Significant figures are the digits in a measurement that are known with certainty plus one digit that is uncertain. In a measurement all nonzero numbers, and some zeros, are significant.
a. 6.000 has four significant figures. Trailing zeros are significant when a decimal point is present.
b. 0.0032 has two significant figures. Leading zeros are never significant.
c. 0.01001 has four significant figures. Confined zeros (between nonzero digits) are significant, but leading zeros are not.
d. 65,400 has three significant figures. Trailing zeros are not significant if the number lacks an explicit decimal point.
e. 76.010 has five significant figures. Trailing zeros are significant when a decimal point is present.
f. 0.03050 has four significant figures. Confined zeros are significant; leading zeros are not.

2.32 a. 5 b. 3 c. 4 d. 2 e. 5 f. 5

2.33 a. 11.01 and 11.00 have the same number (four) of significant figures. All of the zeros are significant because they are either confined or trailing with an explicit decimal point.
b. 2002 has four significant figures, and 2020 has three. The last zero in 2020 is not significant because there is no explicit decimal point.
c. 0.000066 and 660,000 have the same number (two) of significant figures. None of the zeros in either number are significant because they are either leading zeros or trailing zeros with no explicit decimal point.

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d. 0.05700 and 0.05070 have the same number (four) of significant figures. The trailing zeros are significant because there is an explicit decimal point.

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2.34 a. different b. different c. different d. same

2.35 The estimated digit is the last significant figure in each measured value, and is underlined in the numbers below:
a. $6.00\underline{0}$ b. $0.003\underline{2}$ c. $0.0100\underline{1}$ d. $65,\underline{4}00$ e. $76.01\underline{0}$ f. $0.0305\underline{0}$

2.36 a. the 9 b. the 1 c. last zero d. the 3 e. last zero f. last zero

2.37 The magnitude of uncertainty is ±1 in the last significant digit of a measurement.
a. ±0.001 b. ±0.0001 c. ±0.00001
d. ±100 e. ±0.001 f. ±0.00001

2.38 a. ±1 b. ±0.00001 c. ±0.0001
d. ±1000 e. ±0.001 f. ±0.00001

2.39 The estimated number of people is 50,000.
a. If the uncertainty is 10,000, the low and high estimates are 40,000 to 60,000.
b. If the uncertainty is 1000, the low and high estimates are 49,000 to 51,000.
c. If the uncertainty is 100, the low and high estimates are 49,900 to 50,100.
d. If the uncertainty is 10, the low and high estimates are 49,990 to 50,010.

2.40 a. 30,000-50,000 b. 39,000-41,000 c. 39,900-40,100 d. 39,990-40,010

2.41 When rounding numbers, if the first digit to be deleted is 4 or less, drop it and the following digits; if it is 5 or greater, drop that digit and all of the following digits and increase the last retained digit by one.
a. 45.3455 rounded to the tenths decimal place is 45.3
b. 375.14 rounded to the tenths decimal place is 375.1
c. 0.7567 rounded to the tenths decimal place is 0.8
d. 3.0500 rounded to the tenths decimal place is 3.1

2.42 a. 42.33 b. 231.45 c. 0.07 d. 7.10

2.43 a. 456.455 rounded to three significant figures is 456 b.
4.56455 rounded to three significant figures is 4.56 c.
0.31111 rounded to three significant figures is 0.311 d.
0.31151 rounded to three significant figures is 0.312

2.44 a. 327 b. 3.60 c. 0.457 d. 0.456

2.45 To obtain a number with three significant figures:
a. 3567 becomes 3570 b. 323,200 becomes 323,000
c. 18 becomes 18.0 d. 2,345,346 becomes 2,350,000

2.46 a. 1230 b. 25,700 c. 7.20 d. 3,670,000

2.47 In multiplication and division, the number of significant figures in the answer is the same as the number of significant figures in the measurement that contains the fewest significant figures. (s.f. stands for significant figures)
a. 10,300 (three s.f.) ↖ 0.30 (two s.f.) ↖ 0.300 (three s.f.) Since the least number of significant figures is two, the answer will have two significant figures.

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b. 3300 (two s.f.) → 3330 (three s.f.) → 333.0 (four s.f.) The lowest number of significant figures is two, so the answer will have two significant figures.

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c. 6.0 (two s.f.) ÷ 33.0 (three s.f.) The answer will have two significant figures.
d. 6.000 (four s.f.) ÷ 33 (two s.f.) The answer will have two significant figures.

2.48 a. 1 b. 1 c. 2 d. 1

2.49 In multiplication and division of measured numbers, the answer has the same number of significant figures as the measurement with the fewest significant figures. (s.f. stands for significant figures.)
a. 2.0000 (five s.f.) × 2.00 (three s.f.) × 0.0020 (two s.f.) = 0.0080 (two s.f.)
b. 4.1567 (five s.f.) × 0.00345 (three s.f.) = 0.0143 (three s.f.)
c. 0.0037 (two s.f.) × 3700 (two s.f.) × 1.001 (four s.f.) = 14 (two s.f.)
d. 6.00 (three s.f.) ÷ 33.0 (three s.f.) = 0.182 (three s.f.)
e. 530,000 (two s.f.) ÷ 465,300 (four s.f.) = 1.1 (two s.f.)
f. 4670 (four s.f.) × 3.00 (three s.f.) ÷ 2.450 (four s.f.) = 5720 (three s.f.)

2.50 a. 0.080 b. 0.1655 c. 0.0048 d. 0.1818 e. 36,000 f. 1.44

2.51 In addition and subtraction of measured numbers, the answer has no more digits to the right of the decimal point than are found in the measurement with the fewest digits to the right of the decimal point.
a. 12 + 23 + 127 = 162 (no digits to the right of the inferred decimal point)
b. 3.111 + 3.11 + 3.1 = 9.3 (one digit to the right of the decimal point)
c. 1237.6 + 23 + 0.12 = 1261 (no digits to the right of the inferred decimal point)
d. 43.65 – 23.7 = 20.0 (one digit to the right of the decimal point)

2.52 a. 281 b. 12.20 c. 309 d. 1.04

2.53 a. The uncertainty of 12.37050 rounded to 6 significant figures is 0.0001
b. The uncertainty of 12.37050 rounded to 4 significant figures is 0.01
c. The uncertainty of 12.37050 rounded to 3 significant figures is 0.1
d. The uncertainty of 12.37050 rounded to 2 significant figures is 1

2.54 a. 0.0001 b. 0.001 c. 0.01 d. 1

2.55 Scientific notation is a numerical system in which a decimal number is expressed as the product of a number between 1 and 10 (the coefficient) and 10 raised to a power (the exponential term). To convert a number from decimal notation to scientific notation, move the decimal point to a position behind the first nonzero digit. The exponent in the exponential term is equal to the number of places the decimal point was moved.

a. $120.7 = 1.207 \times 10^2$ The decimal point was moved two places to the left, so the exponent is 2. Note that all significant figures become part of the coefficient.
b. $0.0034 = 3.4 \times 10^{-3}$ The decimal point was moved three places to the right, so the exponent is –3.
c. $231.00 = 2.3100 \times 10^2$ The decimal point was moved two places to the left, so the exponent is 2.
d. $23,100 = 2.31 \times 10^4$ The decimal point was moved four places to the left, so the exponent is 4.

2.56 a. 3.722×10^1 b. 1.02×10^{-3} c. 3.4000×10^1 d. 2.34×10^5

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2.57 To convert a number from scientific notation to decimal notation, move the decimal point in the coefficient to the right for a positive exponent or to the left for a negative exponent. The

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number of places the decimal point is moved is specified by the exponent. The number of significant figures remains constant in changing from one notation to the other.

a. $2.34 \times 10^2 = 234$ b. $2.3400 \times 10^2 = 234.00$
c. $2.34 \times 10^{-3} = 0.00234$ d. $2.3400 \times 10^{-3} = 0.0023400$

2.58 a. 3721 b. 3721.0 c. 0.0676 d. 0.067600

2.59 When you compare exponential numbers, notice that the larger (the more positive) the exponent is, the larger the number is. The more negative the exponent is, the smaller the number is.
a. 1.0×10^{-3} is larger than 1.0×10^{-6}
b. 1.0×10^{3} is larger than 1.0×10^{-2}
c. 6.3×10^{4} is larger than 2.3×10^{4} (The exponents are the same, so we need to look at the coefficients to determine which number is larger.)
d. 6.3×10^{-4} is larger than 1.2×10^{-4}

2.60 a. 2.0×10^{2} b. 3.0×10^{6} c. 4.4×10^{-4} d. 9.7×10^{3}

2.61 In scientific notation, only significant figures become part of the coefficient.
a. 1.0×10^{2} (two significant figures)
b. 5.34×10^{6} (three significant figures)
c. 5.34×10^{-4} (three significant figures)
d. 6.000×10^{3} (four significant figures)

2.62 a. 3 b. 3 c. 5 d. 4

2.63 To multiply numbers expressed in scientific notation, multiply the coefficients and add the exponents in the exponential terms. To divide numbers expressed in scientific notation, divide the coefficients and subtract the exponents.

a. $(3.20 \times 10^{7}) \times (1.720 \times 10^{5}) = 5.504 \times 10^{12} = 5.50 \times 10^{12}$ The coefficient in the answer is expressed to three significant figures because one of the numbers being multiplied has only three significant figures.
b. $(1.00 \times 10^{3}) \times (5.00 \times 10^{3}) \times (3.0 \times 10^{-3}) = 15 \times 10^{3} = 1.5 \times 10^{4}$ To express the answer in correct scientific notation, the decimal point in the coefficient was moved one place to the left, and the exponent was increased by 1.
c. $(3.0 \times 10^{-5}) \div (1.5 \times 10^{2}) = 2.0 \times 10^{-7}$
d. $(2.2 \times 10^{6}) \times (2.3 \times 10^{-6}) \div (1.2 \times 10^{-3}) \div (3.5 \times 10^{-3}) = 1.2 \times 10^{6}$

2.64 a. 5.3×10^{12} b. 8.1×10^{-2} c. 2.0×10^{-8} d. 1.3×10^{5}

2.65 a. 10^2; the uncertainty in the coefficient is 10^{-2} and multiplying this by the power of ten gives $10^{-2} \times 10^{4} = 10^{2}$
b. 10^4; $10^{-2} \times 10^{6} = 10^{4}$
c. 10^4; $10^{-1} \times 10^{5} = 10^{4}$
d. 10^{-4}; $10^{-1} \times 10^{-3} = 10^{-4}$

2.66 a. 10^{-4}; the uncertainty in the coefficient is 10^{-2} and multiplying this by the power of ten gives $10^{-2} \times 10^{-2} = 10^{-4}$
b. 10^{-4}; $10^{-3} \times 10^{-1} = 10^{-4}$
c. 10^{2}; $10^{-1} \times 10^{3} = 10^{2}$

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d. 10^{2}; $10^{-3} \times 10^{5} = 10^{2}$

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2.67 To convert a number from decimal notation to scientific notation, move the decimal point to a position behind the first nonzero digit. The exponent in the exponential term is equal to the number of places the decimal point was moved.

a. 0.00300300 to three significant figures becomes 3.00×10^{-3}
b. 936,000 to two significant figures becomes 9.4×10^{5}
c. 23.5003 to three significant figures becomes 2.35×10^{1}
d. 450,000,001 to six significant figures becomes 4.50000×10^{8}

2.68 a. 3.030×10^{-1} b. 1.51×10^{1} c. 3.26×10^{6} d. 3.200×10^{7}

2.69 Conversion factors are derived from equations (equalities) that relate units. They always come in pairs, one member of the pair being the reciprocal of the other.

a. 1 day = 24 hours The conversion factors derived from this equality are:

$$\frac{1\text{ day}}{24\text{ hours}} \quad \text{or} \quad \frac{24\text{ hours}}{1\text{ day}}$$

b. 1 century = 10 decades The conversion factors derived from this equality are:

$$\frac{1\text{ century}}{10\text{ decades}} \quad \text{or} \quad \frac{10\text{ decades}}{1\text{ century}}$$

c. 1 yard = 3 feet The conversion factors derived from this equality are:

$$\frac{1\text{ yard}}{3\text{ feet}} \quad \text{or} \quad \frac{3\text{ feet}}{1\text{ yard}}$$

d. 1 gallon = 4 quarts The conversion factors derived from this equality are:

$$\frac{1\text{ gallon}}{4\text{ quarts}} \quad \text{or} \quad \frac{4\text{ quarts}}{1\text{ gallon}}$$

2.70 a. $\frac{1\text{ week}}{7\text{ days}}$ or $\frac{7\text{ days}}{1\text{ week}}$ b. $\frac{1\text{ century}}{100\text{ years}}$ or $\frac{100\text{ years}}{1\text{ century}}$

c. $\frac{1\text{ foot}}{12\text{ inches}}$ or $\frac{12\text{ inches}}{1\text{ foot}}$ d. $\frac{2\text{ pints}}{1\text{ quart}}$ or $\frac{1\text{ quart}}{2\text{ pints}}$

2.71 The conversion factors are derived from the definitions of the metric system prefixes.

a. $1\text{ kL} = 10^{3}\text{ L}$ The conversion factors are: $\frac{1\text{ kL}}{10^{3}\text{ L}}$ or $\frac{10^{3}\text{ L}}{1\text{ kL}}$

b. $1\text{ mg} = 10^{-3}\text{ g}$ The conversion factors are: $\frac{1\text{ mg}}{10^{-3}\text{ g}}$ or $\frac{10^{-3}\text{ g}}{1\text{ mg}}$

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c. 1 cm = 10^{-2} m The conversion factors are: $\dfrac{1\text{ cm}}{10^{-2}\text{ m}}$ or $\dfrac{10^{-2}\text{ m}}{1\text{ cm}}$

d. 1μsec = 10^{-6} sec The conversion factors are: $\dfrac{1\ \mu\text{sec}}{10^{-6}\text{ sec}}$ or $\dfrac{10^{-6}\text{ sec}}{1\ \mu\text{sec}}$

2.72 a. $\dfrac{1\text{ ng}}{10^{-9}\text{ g}}$ or $\dfrac{10^{-9}\text{ g}}{1\text{ ng}}$ b. $\dfrac{10^{-1}\text{ L}}{1\text{ dL}}$ or $\dfrac{1\text{ dL}}{10^{-1}\text{ L}}$

c. $\dfrac{10^{6}\text{ m}}{1\text{ Mm}}$ or $\dfrac{1\text{ Mm}}{10^{6}\text{ m}}$ d. $\dfrac{10^{-12}\text{ sec}}{1\text{ psec}}$ or $\dfrac{1\text{ psec}}{10^{-12}\text{ sec}}$

2.73 Exact numbers occur in definitions, counting and simple fractions. Inexact numbers result when a measurement is made.
a. 1 dozen = 12 objects This is a definition, so the conversion factors are exact numbers.
b. 1 kilogram = 2.20 pounds This equality is measured, so the conversion factors are inexact numbers.
c. 1 minute = 60 seconds The equality is derived from a definition; the conversion factors are exact numbers.
d. 1 millimeter = 10^{-3} meters The equality is derived from a definition; the conversion factors are exact numbers.

2.74 a. exact b. exact c. inexact d. exact

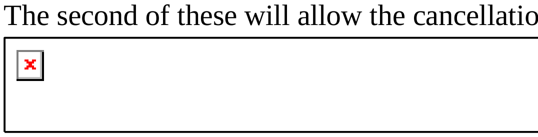
2.75 Exact numbers occur in definitions (c. and d.); inexact numbers result when a measurement is made (a. and b.). The numbers below are expressed to three significant figures.
a. 4.54×10^{2} g b. 2.54×10^{0} cm
c. 1×10^{-12} g d. 3.60×10^{1} in

2.76 a. 9.46×10^{-1} b. 1×10^{-6} c. 1×10^{-3} d. 4×10^{0}

2.77 Using dimensional analysis: (1) identify the given quantity and its unit, and the unknown quantity and its unit and (2) multiply the given quantity by a conversion factor that allows cancellation of any units not desired in the answer.
a. 1.6×10^{3} dm is the given quantity. The unknown quantity will be in meters. The equality is 1 dm = 10^{-1} m, and the conversion factors are:

$\dfrac{1\text{ dm}}{10^{-1}\text{ m}}$ or $\dfrac{10^{-1}\text{ m}}{1\text{ dm}}$

The second of these will allow the cancellation of decimeters and leave meters.



b. Convert 24 nm to meters. The equality is 1 nm = 10^{-9} m.

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c. Convert 0.003 km to meters. The equality is 1 km = 10^3 m.

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d. Convert 3.0×10^8 mm to meters. The equality is 1 mm = 10^{-3} m.

2.78

2.79 Convert 2500 mL to liters. The equality is 1 mL = 10^{-3} L.

2.80

2.81 Convert 1550 g to pounds. Some conversion factors relating the English and Metric Systems of measurement can be found in Table 2.2 of your textbook.

2.82

2.83 Convert 25 mL to gallons. For this conversion, use two conversion factors, one derived from the defined relationship of mL and L, and the other, relating gallons and liters, from Table 2.2.

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2.84

2.85 Convert 83.2 kg to pounds. See Table 2.2 in your textbook for the conversion factor relating kilograms and pounds.

Convert 1.92 m to feet. Use two conversion factors: the relationship between inches and meters from Table 2.2, and the defined relationship between feet and inches.

2.86

5 ft 4 in. = 64 in.

2.87 Exact numbers occur in definitions (1 foot = 12 inches). Therefore the answer will have the same number of significant figures as the measurement.

a. 4.3 feet – two significant figures
b. 3.09 feet – three significant figures
c. 0.33030 feet – five significant figures
d. 5.12310 feet – six significant figures

2.88 a. 2 b. 5 c. 6 d. 3

2.89 The conversion factor is obtained from a measurement (1 inch = 2.540 cm). Therefore, the answer will have the same number of significant figures as the number in the measurement or the conversion factor with the least number of significant figures.

a. 4.3 cm – two significant figures
b. 3.09 cm – three significant figures
c. 0.33030 cm – four significant figures
d. 5.12310 cm – four significant figures

2.90 a. 2 b. 4 c. 4 d. 3

2.91 Density is the ratio of the mass of an object to the volume occupied by that object. To calculate the density of mercury, substitute the given mass and volume values into the defining formula for density.

$$\text{Density} = \text{mass/volume} = \frac{524.5\text{ g}}{38.72\text{ cm}^3} = 13.55\ \frac{\text{g}}{\text{cm}^3}$$

2.92 $$\frac{12.0\text{ g}}{2.69\text{ cm}^3} = 4.46\ \frac{\text{g}}{\text{cm}^3}$$

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2.93 Use the reciprocal of the density of acetone, 0.791 g/mL, as a conversion factor to convert 20.0 g of acetone to milliliters.

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2.94 

2.95 Use the density of homogenized milk, 1.03 g/mL, as a conversion factor to convert 236 mL of homogenized milk to grams.

2.96 

2.97 An object or a water-insoluble substance will float in water if its density is less than that of water, 1.0 g/cm^3.

a. Paraffin wax will float in water because its density, 0.90 g/cm^3, is less than that of water.

b. Limestone will sink in water because its density, 2.8 g/cm^3, is greater than that of water.

2.98 a. rise b. sink

2.99 Density = mass/volume The answer will have the same number of significant figures as the measurement with the least number of significant figures.

a. Density = 1.0 g ÷ 2.0 cm^3 = 5.0×10^{-1} g/cm^3

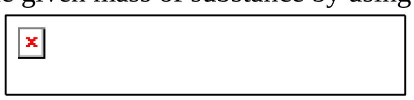
b. Density = 1.000 g ÷ 2.00 cm^3 = 5.00×10^{-1} g/cm^3

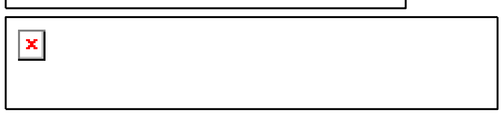
c. Density = 1.0000 g ÷ 2.0000 cm^3 = 5.0000×10^{-1} g/cm^3

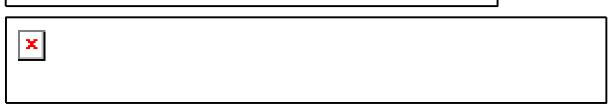
d. Density = 1.000 g ÷ 2.0000 cm^3 = 5.000×10^{-1} g/cm^3

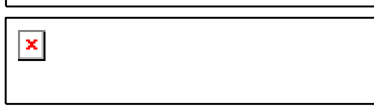
2.100 a. 5.00×10^{-1} b. 5.0×10^{-1} c. 5.000×10^{-1} d. 5.000×10^{-1}

2.101 Calculate the volume of the given mass of substance by using density as a conversion factor.

a. Gasoline: 

b. Sodium metal: 

c. Ammonia gas: 

d. Mercury: 

2.102 a. 64.3 mL b. 51,200 mL c. 5.84 mL d. 64.1 mL

2.103 a. True. The density of body fat is less than average body density.

b. False. Fat cells are less dense than water.

c. False. Lean individuals have less fat so their average body densities are higher.

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d. False. A per cent body fat of 20 is considered average for men and good for women.

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2.104 a. true b. true c. false d. true

2.105 The relationship between the Fahrenheit and Celsius temperature scales can be stated in the form of an equation:

To find the temperature for baking pizza in degrees Celsius, substitute the degrees Fahrenheit in the appropriate form of the equation and solve for ºC.

2.106

2.107 Convert the freezing point of mercury, –38.9ºC, to degrees Fahrenheit using the appropriate equation.

2.108 $\frac{9}{5}\left(29.1^{\circ}\right) + 32.0^{\circ} = 84.4^{\circ}\text{F}$

2.109 Convert one of the temperatures to the other temperature scale.

2.110 $\frac{9}{5}\left(-15^{\circ}\right) + 32.0^{\circ} = 5^{\circ}\text{F};\ -15^{\circ}\text{C is higher}$

2.111 a. False. Recent studies indicate that the average body temperature is 98.2 ºF.
b. False. Body temperature is typically lowest in the very early morning.
c. True. Women have a slightly higher average body temperature than men.
d. True. A rapid fall in body temperature is associated with “shivering.

2.112 a. true b. false c. false d. false

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