24. 100 cm

To determine how many centimeters are in a meter, recall that the prefix *centi-* represents 1/100. You can use 1 cm/0.01 m or 100 cm/1 m as your conversion factor. Generally, it's easier to avoid the conversions that use decimals. Multiply 1 m by 100 cm/1 m. The meters cancel, giving you 100 cm:

$$\frac{1\,\cancel{m}}{1} \times \frac{100\text{ cm}}{1\,\cancel{m}} = 100\text{ cm}$$

25. 100 g

To find out how many grams are in a hectogram, recall that the prefix *hecto-* represents 100. Multiply 1 hg by 100 g/1 hg. The hectograms cancel, giving you 100 g:

$$\frac{1\,\cancel{hg}}{1} \times \frac{100\text{ g}}{1\,\cancel{hg}} = 100\text{ g}$$

26. 25,000 mL

You can determine how many milliliters are in a dekaliter in two steps. Convert dekaliters to liters (1 daL = 10 L) and then convert liters to milliliters (1 L = 1,000 mL): daL → L → mL. Here's the answer:

$$\frac{2.5\,\cancel{daL}}{1} \times \frac{10\,\cancel{L}}{1\,\cancel{daL}} \times \frac{1{,}000\text{ mL}}{1\,\cancel{L}} = 25{,}000\text{ mL}$$

In scientific notation, the answer is 2.5×10^4 mL.

27. 4,900,000 cg

You can find the number of centigrams that are in 49 kg in two steps. Convert kilograms to grams (1 kg = 1,000 g) and then convert grams to centigrams (1 g = 100 cg): kg → g → cg:

$$\frac{49\,\cancel{kg}}{1} \times \frac{1{,}000\,\cancel{g}}{1\,\cancel{kg}} \times \frac{100\text{ cg}}{1\,\cancel{g}} = 4{,}900{,}000\text{ cg}$$

In scientific notation, the answer is 4.9×10^6 cg.

28. 0.00037 GW

To get from watts to gigawatts, you need to know that *giga-* means 1×10^9, or 1,000,000,000, of something. Multiply 370,000 W by 1 GW/1,000,000,000 W. The watts cancel, giving you the answer in gigawatts:

$$\frac{370{,}000\ \cancel{W}}{1} \times \frac{1\text{ GW}}{1{,}000{,}000{,}000\ \cancel{W}} = 0.00037\text{ GW}$$

Alternatively, you can move the decimal point in 370,000 W nine places to the left to convert to watts. In scientific notation, the answer is 3.7×10^{-4} GW.

29. **126,000,000,000 µg** 1.26×10^{11} mg

Going from very large units to very small units can be challenging. Be sure to double-check your conversions and the number of zeros. Convert megagrams to grams (1 Mg = 1,000,000 g) and convert grams to micrograms (1 g = 1,000,000 µg): Mg → g → µg:

$$\frac{0.126\ \text{Mg}}{1} \times \frac{1{,}000{,}000\ \text{g}}{1\ \text{Mg}} \times \frac{1{,}000{,}000\ \mu\text{g}}{1\ \text{g}}$$

$$= 126{,}000{,}000{,}000\ \mu\text{g}$$

$$= 1.26 \times 10^{11}\ \mu\text{g}$$

30. **0.000000000000080 km**

Converting from very small units to very large units can be challenging. Think of the steps, picometers to meters (1×10^{12} pm = 1 m) and then meters to kilometers (1,000 m = 1 km): pm → m → km:

$$\frac{80\ \text{pm}}{1} \times \frac{1\ \text{m}}{1{,}000{,}000{,}000{,}000\ \text{pm}} \times \frac{1\ \text{km}}{1{,}000\ \text{m}}$$

$$= 0.000000000000080\ \text{km}$$

$$= 8.0 \times 10^{-14}\ \text{km}$$

31. **0.002 m^3**

Conversions that involve cubic units are often challenging because people aren't used to thinking of conversion factors in three dimensions.

To get from units used for measuring liquids (liters) to units used to measure solids (cubic meters), remember that 1 mL = 1 cm^3. Your plan to get from liters to cubic meters may look like this: L → mL → cm^3 → m^3:

$$\frac{2\ \text{L}}{1} \times \frac{1{,}000\ \text{mL}}{1\ \text{L}} \times \frac{1\ \text{cm}^3}{1\ \text{mL}} \times \frac{(1\ \text{m})^3}{(100\ \text{cm})^3}$$

$$= \frac{2\ \text{L}}{1} \times \frac{1{,}000\ \text{mL}}{1\ \text{L}} \times \frac{1\ \text{cm}^3}{1\ \text{mL}} \times \frac{1\ \text{m}^3}{(100 \times 100 \times 100)\ \text{cm}^3}$$

$$= 0.002\ \text{m}^3$$

In scientific notation, the answer is 2×10^{-3} m^3.

32. **640,000 mL**

Conversions that involve cubic units are often challenging because people aren't used to thinking of conversion factors in three dimensions.

To convert from cubic meters to milliliters, you may choose to use the relationship 1 mL = 1 cm^3 as follows: m^3 → cm^3 → mL:

$$\frac{0.64\ \text{m}^3}{1} \times \frac{(100\ \text{cm})^3}{(1\ \text{m})^3} \times \frac{1\ \text{mL}}{1\ \text{cm}^3}$$

$$= \frac{0.64\ \cancel{\text{m}^3}}{1} \times \frac{(100 \times 100 \times 100)\ \cancel{\text{cm}^3}}{1\ \cancel{\text{m}^3}} \times \frac{1\ \text{mL}}{1\ \cancel{\text{cm}^3}}$$

$$= 640{,}000\ \text{mL}$$

In scientific notation, the answer is 6.4×10^5 mL.

33. 22 mi.

Converting between metric units and English units mainly requires using the right conversion factor. To go from kilometers to miles, you can use the conversion factor 1 mi./1.61 km. If you set up the problem correctly, the kilometers cancel out, leaving you with miles:

$$\frac{35\ \cancel{\text{km}}}{1} \times \frac{1\ \text{mi.}}{1.61\ \cancel{\text{km}}} \approx 22\ \text{mi.}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

34. 0.079 in.

To convert between centimeters and inches, use the conversion factor 1 in./2.54 cm. The centimeters cancel out, giving you the answer in inches:

$$\frac{0.20\ \cancel{\text{cm}}}{1} \times \frac{1\ \text{in.}}{2.54\ \cancel{\text{cm}}} \approx 0.079\ \text{in.}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

35. 221 yd.

When converting between meters and yards, start with the given (202 m) and use the conversion factor 1 yd./0.914 m. The meters cancel out, giving you the answer in yards:

$$\frac{202\ \cancel{\text{m}}}{1} \times \frac{1\ \text{yd.}}{0.914\ \cancel{\text{m}}} \approx 221\ \text{yd.}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

36. 130 lb.

To convert from kilograms to pounds, you can use the conversion factors 1,000 g/1 kg and 1 lb./454 g:

$$\left(\frac{58\ \cancel{\text{kg}}}{1}\right)\left(\frac{1{,}000\ \cancel{\text{g}}}{1\ \cancel{\text{kg}}}\right)\left(\frac{1\ \text{lb.}}{454\ \cancel{\text{g}}}\right) \approx 130\ \text{lb.}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

Note: You have to make some assumptions to do this conversion, because the kilogram is a unit of mass and the pound is a unit of weight (force). Dividing a weight by the acceleration due to gravity yields a mass. On Earth, the force of gravity is nearly constant, allowing the pound to function as a unit of mass. For clarity, if *pound* is a mass, the designation should be *pound-mass;* when *pound* is a weight, the designation is *pound-force.*

37. **7.97 qt.**

Liters and quarts are similar in size, so be careful with the conversion. Use the conversion factor 1 qt./0.946 L. The liters cancel out, giving you the answer in quarts:

$$\frac{7.54\,\text{L}}{1} \times \frac{1\text{ qt.}}{0.946\,\text{L}} \approx 7.97\text{ qt.}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

38. **0.22 cm**

To convert from inches to centimeters, multiply the inches by 2.54 cm/1 in.:

$$\frac{0.087\,\text{in.}}{1} \times \frac{2.54\text{ cm}}{1\,\text{in.}} \approx 0.22\text{ cm}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

39. **745 km**

To find how many kilometers are in a certain number of miles, simply multiply the miles by 1.61 km/1 mi.:

$$\frac{463\,\text{mi.}}{1} \times \frac{1.61\text{ km}}{1\,\text{mi.}} \approx 745\text{ km}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

40. **41,000 g**

To convert from pounds to grams, take the number of pounds and multiply it by 454 g/1 lb.:

$$\frac{91\,\text{lb.}}{1} \times \frac{454\text{ g}}{1\,\text{lb.}} \approx 41{,}000\text{ g}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well. In scientific notation, the answer is 4.1×10^4 g.

41. **1,980 L**

There are 3.78 L in a gallon, so simply multiply the number of gallons, 525 gal., by 3.78 L/1 gal.:

$$\frac{525 \text{ gal.}}{1} \times \frac{3.78 \text{ L}}{1 \text{ gal.}} \approx 1{,}980 \text{ L}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well. In scientific notation, the answer is 1.98×10^3 L.

42. **3.0 atm**

To find the number of atmospheres in 44 psi (pounds per square inch), use the appropriate pressure conversion. There are 14.7 psi in 1 atm, so multiply 44 psi by 1 atm/14.7 psi:

$$\frac{44 \text{ psi}}{1} \times \frac{1 \text{ atm}}{14.7 \text{ psi}} \approx 3.0 \text{ atm}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

43. **8.46 c.**

Writing a short plan for the conversions may be helpful. Converting from liters to quarts and then from quarts to cups gets you through this problem: L → qt. → c. Always write the units to make sure they cancel correctly; then do the math:

$$\frac{2.00 \text{ L}}{1} \times \frac{1 \text{ qt.}}{0.946 \text{ L}} \times \frac{4 \text{ c.}}{1 \text{ qt.}} \approx 8.46 \text{ c.}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

44. **36.1 lb.**

To convert from hectograms to pounds, you can either go from hectograms to grams to pounds or from hectograms to kilograms to pounds. Here's the hg → g → lb. conversion:

$$\frac{164 \text{ hg}}{1} \times \frac{100 \text{ g}}{1 \text{ hg}} \times \frac{1 \text{ lb.}}{454 \text{ g}} \approx 36.1 \text{ lb.}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

45. **0.155 gal.**

When converting from milliliters to gallons, I find it easiest to convert milliliters to liters and then convert liters to gallons: mL → L → gal.:

$$\frac{587 \text{ mL}}{1} \times \frac{1 \text{ L}}{1{,}000 \text{ mL}} \times \frac{1 \text{ gal.}}{3.78 \text{ L}} \approx 0.155 \text{ gal.}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

46. **969,000 cm**

A slightly longer problem like this requires a plan. Changing miles to kilometers and then kilometers to centimeters is the shorter way to do this. Or you can change the kilometers to meters and then the meters to centimeters, as follows: mi. → km → m → cm:

$$\frac{6.02\ \text{mi.}}{1} \times \frac{1.61\ \text{km}}{1\ \text{mi.}} \times \frac{1{,}000\ \text{m}}{1\ \text{km}} \times \frac{100\ \text{cm}}{1\ \text{m}} \approx 969{,}000\ \text{cm}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well. In scientific notation, the answer is 9.69×10^5 cm.

47. **1,020,000 dg**

You can do this conversion by converting pounds to grams and grams to decigrams: lb. → g → dg. Multiply the number of pounds by 454 g/lb. and then convert the grams to decigrams by multiplying by 10 dg/1 g:

$$\frac{225\ \text{lb.}}{1} \times \frac{454\ \text{g}}{1\ \text{lb.}} \times \frac{10\ \text{dg}}{1\ \text{g}} \approx 1{,}020{,}000\ \text{dg}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well. In scientific notation, the answer is 1.02×10^6 dg.

48. **6,400 mL**

Convert quarts to liters and liters to milliliters: qt. → L → mL. Multiply the number of quarts by 0.946 L/1 qt.; then convert the liters to milliliters by multiplying by 1,000 mL/1 L:

$$\frac{6.8\ \text{qt.}}{1} \times \frac{0.946\ \text{L}}{1\ \text{qt.}} \times \frac{1{,}000\ \text{mL}}{1\ \text{L}} \approx 6{,}400\ \text{mL}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well. In scientific notation, the answer is 6.4×10^3 mL.

49. **466 cm**

Convert feet into inches and then convert inches into centimeters: ft. → in. → cm. Multiply the 15.3 ft. by 12 in./1 ft. to convert to inches; then multiply by 2.54 cm/1 in. to convert to centimeters:

$$\frac{15.3\ \text{ft.}}{1} \times \frac{12\ \text{in.}}{1\ \text{ft.}} \times \frac{2.54\ \text{cm}}{1\ \text{in.}} \approx 466\ \text{cm}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

50. **47 L**

Convert pints to quarts and then convert quarts to liters: pt. → qt. → L. Multiply 99 pt. by 1 qt./2 pt. to convert to quarts; then multiply the quarts by 0.946 L/1 qt. to convert to liters. The pints and quarts cancel out, giving you the answer in liters:

$$\frac{99\ \text{pt.}}{1} \times \frac{1\ \text{qt.}}{2\ \text{pt.}} \times \frac{0.946\ \text{L}}{1\ \text{qt.}} \approx 47\ \text{L}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

51. **908 kg**

To convert short tons to pounds, multiply the number of tons by 2,000 lb./1 ton. To get from pounds to kilograms (kg), multiply by 0.454 kg/1 lb.:

$$\frac{1.00\ \text{ton}}{1} \times \frac{2{,}000\ \text{lb.}}{1\ \text{ton}} \times \frac{0.454\ \text{kg}}{1\ \text{lb.}} \approx 908\ \text{kg}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

52. **552 cm**

You may be able to find a conversion factor that goes straight from yards to centimeters. If so, this conversion takes only one step. Otherwise, you may remember that 3 ft. = 1 yd., 12 in. = 1 ft., and 2.54 cm = 1 in. Set up the problem, starting with 6.04 yd. over 1, and then line up the conversions so that the units cancel correctly. Here's the overall plan: yd. → ft. → in. → cm. And here are the calculations:

$$\frac{6.04\ \text{yd.}}{1} \times \frac{3\ \text{ft.}}{1\ \text{yd.}} \times \frac{12\ \text{in.}}{1\ \text{ft.}} \times \frac{2.54\ \text{cm}}{1\ \text{in.}} \approx 552\ \text{cm}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

53. **0.063 c.**

First, remember that cc represents cubic centimeters (cm^3). Cubic centimeters easily convert to milliliters because they're in a 1:1 ratio. Then you can convert milliliters to fluid ounces and fluid ounces to cups: cc → mL → fl. oz. → c.:

$$\frac{15\ \text{cc}}{1} \times \frac{1\ \text{mL}}{1\ \text{cc}} \times \frac{1\ \text{fl. oz.}}{29.6\ \text{mL}} \times \frac{1\ \text{c.}}{8\ \text{fl. oz.}} \approx 0.063\ \text{c.}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well.

54. **1,610,000 mm**

You can approach this conversion in many ways. One option is to convert yards to inches, inches to centimeters, and centimeters to millimeters: yd. → in. → cm → mm:

$$\frac{1{,}760\ \text{yd.}}{1} \times \frac{36\ \text{in.}}{1\ \text{yd.}} \times \frac{2.54\ \text{cm}}{1\ \text{in.}} \times \frac{10\ \text{mm}}{1\ \text{cm}} \approx 1{,}610{,}000\ \text{mm}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well. In scientific notation, the answer is 1.61×10^6 mm.

55. **53,000 pt.**

Converting hectoliters to pints involves many steps, so put together a plan. You can go from hectoliters to liters to gallons to quarts to pints: hL → L → gal. → qt. → pt. The only division in the plan occurs when you convert liters to gallons, so you can multiply all the values in the numerator ($250 \times 100 \times 4 \times 2$) and then divide by 3.78. The units cancel, giving you the answer in pints:

$$\frac{250\ \text{hL}}{1} \times \frac{100\ \text{L}}{1\ \text{hL}} \times \frac{1\ \text{gal.}}{3.78\ \text{L}} \times \frac{4\ \text{qt.}}{1\ \text{gal.}} \times \frac{2\ \text{pt.}}{1\ \text{qt.}} \approx 53{,}000\ \text{pt.}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well. In scientific notation, the answer is 5.3×10^4 pt.

56. **5,100 g**

A slug is an English mass unit that you may not encounter except when working conversion problems. First convert slugs to pounds and then convert to grams: slugs → lb. → g. Converting to grams isn't difficult if you remember that there are 454 g in 1 lb. Here's the conversion:

$$\frac{0.35\ \text{slugs}}{1} \times \frac{32.2\ \text{lb.}}{1\ \text{slug}} \times \frac{454\ \text{g}}{1\ \text{lb.}} \approx 5{,}100\ \text{g}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well. In scientific notation, the answer is 5.1×10^3 g.

The conversion takes an extra step if you convert pounds to kilograms and then convert the kilograms to grams, but you should get the same answer either way.

57. **0.2540 km**

You can find the number of kilometers in 9,999 in. by converting inches to centimeters (by multiplying by 2.54 cm/1 in.) and then changing centimeters to meters (multiplying by 1 m/100 cm) and meters to kilometers (multiplying by 1 km/1,000 m): in. → cm → m → km.

$$\frac{9{,}999\ \text{in.}}{1} \times \frac{2.54\ \text{cm}}{1\ \text{in.}} \times \frac{1\ \text{m}}{100\ \text{cm}} \times \frac{1\ \text{km}}{1{,}000\ \text{m}} \approx 0.2540\ \text{km}$$

The given measurement has four significant figures, so you round the answer to four significant figures as well.

58. **25.9 oz.**

Converting from kilograms to ounces requires one metric conversion (kilograms to grams), one metric-English conversion (grams to pounds), and one English conversion (pounds to ounces): kg → g → lb. → oz. The units cancel out, leaving you with ounces:

$$\frac{0.734\ \text{kg}}{1} \times \frac{1{,}000\ g}{1\ \text{kg}} \times \frac{1\ \text{lb.}}{454\ g} \times \frac{16\ \text{oz.}}{1\ \text{lb.}} \approx 25.9\ \text{oz.}$$

The given measurement has three significant figures, so you round the answer to three significant figures as well.

59. **1,600,000 μL**

Converting from ounces to microliters requires one English conversion (ounces to quarts), one English-metric conversion (quarts to liters), and one metric conversion (liters to microliters): oz. → qt. → L → μL:

$$\frac{55\ \text{oz.}}{1} \times \frac{1\ \text{qt.}}{32\ \text{oz.}} \times \frac{0.946\ L}{1\ \text{qt.}} \times \frac{1{,}000{,}000\ \mu\text{L}}{1\ L} \approx 1{,}600{,}000\ \mu\text{L}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well. In scientific notation, the answer is 1.6×10^6 μL.

60. **1,498.4 dozen**

Finding the number of dozen eggs in 17,981 eggs uses the conversion factor 1 dozen/12 eggs:

$$\frac{17{,}981\ \text{eggs}}{1} \times \frac{1\ \text{dozen}}{12\ \text{eggs}} \approx 1{,}498.4\ \text{dozen}$$

The given egg count has five significant figures, so you round the answer to five significant figures as well.

61. **17.1 yr.**

When dealing with a number of days that would exceed four years (1,461 days), account for the extra day in a leap year by using the relationship 365.25 days = 1 yr. Take the number of days and multiply by 1 yr./365.25 days. The days cancel out, leaving you with years:

$$\frac{6{,}250\ \text{days}}{1} \times \frac{1\ \text{yr.}}{365.25\ \text{days}} \approx 17.1\ \text{yr.}$$

The given length of time has three significant figures, so you round the answer to three significant figures as well.

62. **13,000 weeks**

To do this conversion, you need to know that a century is 100 years. Multiply the 2.5 centuries by the number of years in a century (100); then multiply the years by the number of weeks in a year (52) to get the number of weeks: centuries → years → weeks:

$$\frac{2.5\ \text{centuries}}{1} \times \frac{100\ \text{yr.}}{1\ \text{century}} \times \frac{52\ \text{weeks}}{1\ \text{yr.}} = 13{,}000\ \text{weeks}$$

The given measurement has two significant figures, so the answer has two significant figures as well.

63. **$2,870**

First, recognize that 1 penny = 3.16 g is a conversion factor that you'll use in your calculations. The question asks you to find the mass of 1.00 ton of pennies, so 1.00 ton is your starting point. Convert tons to pounds, pounds to grams, grams to pennies, and pennies to dollars: tons → lb. → g → pennies → $:

$$\frac{1.00\ \text{ton}}{1} \times \frac{2{,}000\ \text{lb.}}{1\ \text{ton}} \times \frac{454\ \text{g}}{1\ \text{lb.}} \times \frac{1\ \text{penny}}{3.16\ \text{g}} \times \frac{\$1}{100\ \text{pennies}} \approx \$2{,}870$$

The given average mass has three significant figures, so you round the answer to three significant figures as well.

64. **43.8 s**

The tricky part is sorting out which of the given numbers to use where. Starting with the total distance in meters, you can multiply by 1 yd./0.914 m and then use 100 yd. = 10.0 s to get to the time unit in the numerator: m → yd. → s:

$$\frac{400\ \text{m}}{1} \times \frac{1\ \text{yd.}}{0.914\ \text{m}} \times \frac{10.0\ \text{s}}{100\ \text{yd.}} \approx 43.8\ \text{s}$$

The race distances (400 m and 100 yd.) are considered exact measures, so you can ignore those numbers when looking at significant figures. The given time has three significant figures, so the answer does as well.

65. **18 L**

This problem is a bit like a conversion from fluid ounces to liters, but you have to take into consideration that 60 guests are each drinking 10. fl. oz. of soda. The first step is to figure out how many ounces of soda that is; then you can convert from ounces to milliliters by multiplying by 29.6 mL/1 fl. oz. Last, you convert from milliliters to liters by multiplying by 1 L/1,000 mL. Here's the conversion plan: guests → fl. oz. → mL → L:

$$\frac{60\ \text{guests}}{1} \times \frac{10.\ \text{fl. oz.}}{1\ \text{guest}} \times \frac{29.6\ \text{mL}}{1\ \text{fl. oz.}} \times \frac{1\ \text{L}}{1{,}000\ \text{mL}} \approx 18\ \text{L}$$

The given volume measurement has two significant figures, so you round the answer to two significant figures as well.

66. **8.3 sandwiches**

The question gives you two relationships to use: 1 guest eats 25.4 cm of sandwich, and 1 sandwich is 6.0 ft. long. Take the amount of sandwich that each person will eat and multiply it by 60 guests to find out how many centimeters of sandwich you need. Next, you can convert centimeters to inches (by multiplying by 1 in./2.54 cm), inches to feet (by multiplying by 1 ft./12 in.), and feet to sandwiches (by multiplying by 1 sandwich/6.0 ft.): guests → cm → in. → ft. → sandwiches:

$$\frac{60\ \text{guests}}{1} \times \frac{25.4\ \text{cm}}{1\ \text{guest}} \times \frac{1\ \text{in.}}{2.54\ \text{cm}} \times \frac{1\ \text{ft.}}{12\ \text{in.}} \times \frac{1\ \text{sandwich}}{6.0\ \text{ft.}} \approx 8.3\ \text{sandwiches}$$

The given sub measurement has two significant figures, so you round the answer to two significant figures as well.

Answers 1–100

67. **3,780 cm³**

You find the volume of a rectangular solid by multiplying the length times the width times the height. You can convert measurements before multiplying:

$$l = \frac{230.\ \cancel{\text{mm}}}{1} \times \frac{1\ \text{cm}}{10\ \cancel{\text{mm}}} = 23.0\ \text{cm}$$

$$w = \frac{274\ \cancel{\text{mm}}}{1} \times \frac{1\ \text{cm}}{10\ \cancel{\text{mm}}} = 27.4\ \text{cm}$$

$$h = \frac{60.0\ \cancel{\text{mm}}}{1} \times \frac{1\ \text{cm}}{10\ \cancel{\text{mm}}} = 6.00\ \text{cm}$$

$$V = lwh = 23.0\ \text{cm} \times 27.4\ \text{cm} \times 6.00\ \text{cm} \approx 3{,}780\ \text{cm}^3$$

The given measurements have three significant figures, so you round the answer to three significant figures as well.

You can also find the volume in cubic millimeters and then do the conversion:

$$\frac{230.\ \text{mm} \times 274\ \text{mm} \times 60.0\ \text{mm}}{1} \times \frac{(1\ \text{cm})^3}{(10\ \text{mm})^3}$$

$$= \frac{(230. \times 274 \times 60.0)\ \cancel{\text{mm}^3}}{1} \times \frac{1\ \text{cm}^3}{(10 \times 10 \times 10)\ \cancel{\text{mm}^3}}$$

$$\approx 3{,}780\ \text{cm}^3$$

68. **0.0630 m²**

The surface area of the front cover of the textbook equals to the length of the book times the width of the book: $A = lw$. You can convert from millimeters to meters before multiplying them together:

$$l = \frac{230.\ \cancel{\text{mm}}}{1} \times \frac{1\ \text{m}}{1{,}000\ \cancel{\text{mm}}} = 0.230\ \text{m}$$

$$w = \frac{274\ \cancel{\text{mm}}}{1} \times \frac{1\ \text{m}}{1{,}000\ \cancel{\text{mm}}} = 0.274\ \text{m}$$

$$A = lw = 0.230\ \text{m} \times 0.274\ \text{m} \approx 0.0630\ \text{m}^2$$

The given measurements have three significant figures, so you round the answer to three significant figures as well.

Another option is to find the surface area before converting the measurements:

$$\frac{230.\ \text{mm} \times 274\ \text{mm}}{1} \times \frac{(1\ \text{m})^2}{(1{,}000\ \text{mm})^2}$$

$$= \frac{(230. \times 274)\ \cancel{\text{mm}^2}}{1} \times \frac{1\ \text{m}^2}{(1{,}000 \times 1{,}000)\ \cancel{\text{mm}^2}}$$

$$\approx 0.0630\ \text{m}^2$$

69. **72 tiles**

One approach is to first find the area of the hallway in square feet. Then convert the square feet to square inches and divide by the area of one tile.

$$\frac{(10.0\text{ ft.}\times 5.0\text{ ft.})}{1}\times\frac{(12\text{ in.})^2}{(1\text{ ft.})^2}\times\frac{1\text{ tile}}{(10.0\text{ in.})^2}$$

$$=\frac{(10.0\times 5.0)\,\cancel{\text{ft.}^2}}{1}\times\frac{(12\times 12)\,\cancel{\text{in.}^2}}{1\,\cancel{\text{ft.}^2}}\times\frac{1\text{ tile}}{(10.0\times 10.0)\,\cancel{\text{in.}^2}}$$

$$=72\text{ tiles}$$

The given 5.0-ft. measurement has only two significant figures, so the answer has two significant figures as well.

Another option is to find the area of the hallway in square inches and divide by the area of a tile, also in square inches.

Or you can determine the number of tiles that fit across the 5.0-ft. hallway (by dividing the width of the hallway by the width of a tile) and multiply that number by the number of tiles that fit down the 10.0-ft. hallway:

$$\text{Across: } \frac{5.0\,\cancel{\text{ft.}}}{1}\times\frac{12\,\cancel{\text{in.}}}{1\,\cancel{\text{ft.}}}\times\frac{1\text{ tile}}{10\,\cancel{\text{in.}}}=6\text{ tiles}$$

$$\text{Down: } \frac{10.0\,\cancel{\text{ft.}}}{1}\times\frac{12\,\cancel{\text{in.}}}{1\,\cancel{\text{ft.}}}\times\frac{1\text{ tile}}{10\,\cancel{\text{in.}}}=12\text{ tiles}$$

$$\text{Total: } 6\times 12=72\text{ tiles}$$

70. 54,000 cm/min.

This problem is challenging because you have to convert both the numerator and the denominator. Keeping track of the units is really important in this kind of problem. You can convert the numerator or the denominator first — the order doesn't matter. The following equation converts hours to minutes first by multiplying by 1 hr./60 min. Then it converts miles to kilometers (by multiplying by 1.61 km/1 mi.), kilometers to meters (by multiplying by 1,000 m/1 km), and then meters to centimeters (by multiplying by 100 cm/1 m). Here's the conversion plan: mi./hr. → mi./min. → km/min. → m/min. → cm/min.:

$$\frac{20.\,\cancel{\text{mi.}}}{1\,\cancel{\text{hr.}}}\times\frac{1\,\cancel{\text{hr.}}}{60\text{ min.}}\times\frac{1.61\,\cancel{\text{km}}}{1\,\cancel{\text{mi.}}}\times\frac{1{,}000\,\cancel{\text{m}}}{1\,\cancel{\text{km}}}\times\frac{100\text{ cm}}{1\,\cancel{\text{m}}}\approx 54{,}000\text{ cm/min.}$$

The given measurement has two significant figures, so you round the answer to two significant figures as well. In scientific notation, the answer is 5.4×10^4 cm/min.

As you go through a problem like this, make sure you cross out the units that cancel. If you end up with the correct units in your answer — in this case, cm/min. — you know you've probably set up the problem correctly.

71. 85 lb.

In this problem, you're given a volume and a conversion factor of 1.00 cm^3 = 19.3 g. So to start, this is a conversion problem from liters to cubic centimeters. You can convert liters to milliliters by multiplying by 1,000 mL/1 L. Milliliters and cubic centimeters are equivalent, so you can multiply by 1 cm^3/1 mL. Next, multiply by 19.3 g/1.00 cm^3 to get to mass. Last, convert grams pounds by multiplying by 1 lb./454 g. Here's the overall plan: L → mL → cm^3 → g → lb.:

$$\frac{2.0\,\cancel{L}}{1}\times\frac{1{,}000\,\cancel{mL}}{1\,\cancel{L}}\times\frac{1\,\cancel{cm^3}}{1\,\cancel{mL}}\times\frac{19.3\,\cancel{g}}{1.00\,\cancel{cm^3}}\times\frac{1\text{ lb.}}{454\,\cancel{g}}=85\text{ lb.}$$

The given volume measurement has only two significant figures, so you round the answer to two significant figures as well.

72. 2.5 min.

To find the number of minutes the horse takes to run a distance of 12 furlongs, first convert the distance to miles in order to use the given speed of 385.3 mph. Then convert the time from hours to minutes: furlongs → rods → yd. → mi. → hr. → min.:

$$\frac{12\,\cancel{\text{furlongs}}}{1}\times\frac{40\,\cancel{\text{rods}}}{1\,\cancel{\text{furlong}}}\times\frac{5.5\,\cancel{\text{yd.}}}{1\,\cancel{\text{rod}}}\times\frac{1\,\cancel{\text{mi.}}}{1{,}760\,\cancel{\text{yd.}}}\times\frac{1\,\cancel{\text{hr.}}}{35.3\,\cancel{\text{mi.}}}\times\frac{60\text{ min.}}{1\,\cancel{\text{hr.}}}=2.5\text{ min.}$$

The given length measurement has only two significant figures, so you round the answer to two significant figures as well.

If you don't know how many yards are in a mile (1 mi. = 1,760 yd.), you may need to take the extra step of converting yards to feet (3 yd. = 1 ft.) and then converting feet to miles (5,280 ft. = 1 mi.), but you should get the same answer.

73. 0.43 s

Finding the number of seconds the pitch will take to travel from the pitcher to the batter requires using the distance between the two locations and the speed of the ball. Convert the distance from feet to miles by multiplying by 1 mi./5,280 ft. Next, divide by the speed (96 mi./1 hr.) and then convert the hours to minutes (by multiplying by 60 min./1 hr.) and the minutes to seconds (by multiplying by 60 s/1 min.): ft. → mi. → hr. → min. → s:

$$\frac{60.5\,\cancel{\text{ft.}}}{1}\times\frac{1\,\cancel{\text{mi.}}}{5{,}280\,\cancel{\text{ft.}}}\times\frac{1\,\cancel{\text{hr.}}}{96\,\cancel{\text{mi.}}}\times\frac{60\,\cancel{\text{min.}}}{1\,\cancel{\text{hr.}}}\times\frac{60\text{ s}}{1\,\cancel{\text{min.}}}\approx 0.43\text{ s}$$

The given speed measurement has only two significant figures, so you round the answer to two significant figures as well.

74. 0.00072 mm

This problem requires that you think in three dimensions. You're given a mass (grams), a conversion between mass and volume (grams per cubic centimeter), and a surface area (cubic meters). Volume equals length × width × height, and surface area = length × width, so you can find the height by dividing volume by surface area:

$$\frac{\text{Volume}}{\text{Surface Area}}=\frac{\cancel{l}\times\cancel{w}\times h}{\cancel{l}\times\cancel{w}}$$

Now for the unit conversions. Change kilograms to grams by multiplying by 1,000 g/1 kg. Multiply by 1 cm^3/19.3 g to get cubic centimeters. Next, convert the cubic centimeters to cubic millimeters. That takes care of the numerator. You have to convert the square meters in the denominator to square millimeters before you can divide. Here's the conversion plan: (kg → g → cm^3 → mm^3) ÷ (m^2 → mm^2) = mm^3/mm^2 = mm: