40. [II] We are advised to keep our total blood cholesterol level at less than 200. What that actually means is 200 mg of cholesterol per deciliter of blood. Physicists usually shun the *deci* prefix and often avoid the liter as well, so convert this quantity to SI units.

SECTION 1.6: SIGNIFICANT FIGURES

SECTION 1.9: APPROXIMATIONS AND CHECKS

41. [I] It's been estimated that the mass of junk mail delivered each and every second in the United States is 4.4×10^1 kg. How much arrives in an hour?

42. [I] The potato spindle virus with a diameter of 2×10^{-8} m is among the smallest viruses. If we place three million of them end-to-end, how far will the column reach?

43. [I] Can the quantity 100.0 kg be expressed in grams in decimal form with the correct number of significant figures? Explain.

44. [I] Express each of the following in grams in decimal form with the correct number of significant figures: (a) 1.00 μg; (b) 0.001 ng; (c) 100.0 mg; (d) 10 000 μg; and (e) 10.000 kg.

SOLUTION: Keep in mind that we can write each answer in many different ways. (a) 1.00 μg has three significant figures, and 1 μg = 10^{-6} g; therefore 1.00 μg = 1.00×10^{-6} g. (b) 0.001ng has one significant figure, and 1 ng = 10^{-9} g; therefore 0.001 ng = 0.001×10^{-9} g or 1×10^{-12} g. (c) 100.0 mg has four significant figure, and 1 mg = 10^{-3} g; therefore 100.0 mg = 100.0×10^{-3} g or 0.100 0 g. (d) 10 000 μg has five significant figures, and 1 μg = 10^{-6} g; therefore 10 000 μg = $10\,000 \times 10^{-6}$ g or $1.000\,0 \times 10^{-2}$ g. (e) 10.000 kg has five significant figures, and 1 kg = 10^3 g; therefore 10.000 kg = 10.000×10^3 g or $1.000\,0 \times 10^4$ g.

45. [I] Determine the number of significant figures for each of the following: (a) 0.002 0; (b) 0.99; (c) 1.75 ± 0.02; (d) 1.001; (e) 4.44×10^4; and (f) 0.01×10^{34}.

46. [I] Write the speed of light in vacuum (299 792 458 m/s) to one, three, four, and eight significant figures.

47. [I] State the number π = 3.141 592 65... to one, three, four, and five significant figures.

48. [I] To four significant figures, how many square meters correspond to a square foot?

SOLUTION: A foot is 12 inches and each inch is 2.54 cm, so each foot is 30.48 cm. One square foot corresponds to (30.48 cm)(30.48 cm) = $9.290\,3 \times 10^2$ cm^2. Moreover, 1.000 m^2 = (100 cm)(100 cm) = 1.000×10^4 cm^2. Thus

$$1.000 \text{ ft}^2 = 9.290\,3 \times 10^2 \text{ cm}^2 = \frac{9.290\,3 \times 10^2 \text{ cm}^2}{1.000 \times 10^4 \text{ cm}^2/\text{m}^2}$$

$$1.000 \text{ ft}^2 = 9.290 \times 10^{-2} \text{ m}^2$$

49. [I] Liters are sometimes used for liquid and gas measurement, although the preferred unit is the cubic meter. How much is 1.000 liter in cubic meters?

50. [I] The radius of a hydrogen atom is $5.291\,77 \times 10^{-11}$ m. How many of them, lined up one "touching" the next, would stretch a length of 1.0 m?

51. [I] The radius of the Moon ($R_\leftmoon$) is 1.738×10^3 km. Assume the Moon is a sphere and determine its volume to two significant figures. [*Hint: The volume of a sphere is* $V = \frac{4}{3}\pi R^3$. *Compute with four figures and round down to two.*]

52. [I] A spherical tank contains 4.19 m^3 of water. What's the diameter of the tank?

53. [I] A solid sphere having a volume of 1.00 m^3 fits tightly in a cubical box. What's the volume contained within the box?

54. [II] Compute the circumferences of circles having diameters of (a) 5.42 μm, (b) 0.542 0 nm, (c) 5.420 000 mm, (d) 542.0 m, and (e) 0.542 km.

55. [II] Compute the sum of the following quantities: 0.066 m, 1.132 m, 200.1 m, 5.3 m, and 1600.22 m. [*Hint: Here all the numbers have the same units (including prefixes), so this is a straight addition. Watch out for significant figures.*]

56. [II] Add the following quantities: 0.10 ms, 20.2 s, 6.33 s, 18 μs, and 200.55 ms.

57. [II] Determine the sum of the following: 1.00 g, 1.00 mg, 1.00 kg, and 1.00 μg.

58. [II] What is the product of the following quantities: 0.002 1 g, 655.1 kg, and 4.41 μg?

59. [II] THIS PROBLEM DEALS WITH MAKING APROXIMATIONS. We want to find out roughly how many grains of sand would form a sphere the size of the Earth? a) Approximately how big is a grain of sand, assuming first that it's a cube; and then that it's a sphere? b) What are the two volumes one might compute for such a grain of sand? c) The planet's diameter is about 1.3×10^7 m; what's the volume of the Earth? d) Roughly how many grains of sand would fit inside a sphere the size of the Earth? Don't worry about empty spaces between grains.

60. [II] We wish to uniformly paint a house having an area A. Write an expression approximating the thickness, τ, of the resulting layer of paint when one gallon is used. There are 3785 cubic centimeters per gallon. Determine τ when the area is a reasonable 8×10^2 m^2.

61. [II] Write expressions that crudely estimate the area and volume of a human body by representing it as a cylinder of radius r and height h. (Take the person to be a rather large 2-m tall.) Approximate a cell to be a sphere 30 μm in diameter; roughly how many cells are in a human body?

62. [III] A *pipe* is 2 *hogsheads,* and a hogshead is 63 gallons (or 2 barrels). Given that 1 U.S. gallon is 231 in.^{3}, what's the SI equivalent of a pipe to three significant figures?

63. [III] It has been estimated that a drop (0.1 cm^3) of light oil spreads out, on the calm surface of a pond, into a film with an area of about 40 m^2. Assuming this to be a single molecule thick, approximate the size of the molecule.