

15. (I) Express the following using the prefixes of Table 1-4: (a)  $3 \times 10^6$  volts, (b)  $2 \times 10^{-6}$  meters, (c)  $5 \times 10^3$  days, (d)  $18 \times 10^2$  bucks, and (e)  $9 \times 10^{-7}$  seconds.
16. (I) Determine your own height in meters, and your mass in kg.
- ★ 17. (II) To the correct number of significant figures, use the information inside the front cover of this book to determine the ratio of (a) the surface area of Earth compared to the surface area of the Moon, (b) the volume of Earth compared to the volume of the Moon. *copying makes the error 3x bigger than in the measurements!*
18. (II) Would a driver traveling at 15 m/s in a 35 mi/h zone be exceeding the speed limit? Why or why not?
19. (II) The age of the universe is thought to be about 14 billion years. Assuming two significant figures, write this in powers of 10 in (a) years, (b) seconds.
20. (II) The Sun, on average, is 93 million miles from Earth. How many meters is this? Express (a) using powers of 10, and (b) using a metric prefix (km).
21. (II) Express the following sum with the correct number of significant figures:  $1.90 \text{ m} + 142.5 \text{ cm} + 6.27 \times 10^5 \mu\text{m}$ .
22. (II) A typical atom has a diameter of about  $1.0 \times 10^{-10} \text{ m}$ . (a) What is this in inches? (b) Approximately how many atoms are along a 1.0-cm line, assuming they just touch?
23. (II) Determine the conversion factor between (a) km/h and mi/h, (b) m/s and ft/s, and (c) km/h and m/s.
24. (II) What is the conversion factor between (a)  $\text{ft}^2$  and  $\text{yd}^2$ , (b)  $\text{m}^2$  and  $\text{ft}^2$ ?
25. (II) A **light-year** is the distance light travels in one year (at speed =  $2.998 \times 10^8 \text{ m/s}$ ). (a) How many meters are there in 1.00 light-year? (b) An **astronomical unit** (AU) is the average distance from the Sun to Earth,  $1.50 \times 10^8 \text{ km}$ . How many AU are there in 1.00 light-year?
26. (II) How much longer (percentage) is a one-mile race than a 1500-m race ("the metric mile")?
27. (II) How many wavelengths of orange krypton-86 light (Section 1-4) would fit into the thickness of one page of this book? See Example 1-6.
28. (II) Using the French Academy of Sciences' original definition of the meter, calculate Earth's circumference and radius in *those* meters. Give % error relative to today's accepted values (inside front cover).
29. (II) A passenger jet uses about 12 liters of fuel per km of flight. What is that value expressed as miles per gallon?
30. (II) American football uses a *field* that is 100.0 yd long, whereas a *soccer field* is 100.0 m long. Which field is longer, and by how much (give yards, meters, and percent)?
31. (II) (a) How many seconds are there in 1.00 year? (b) How many nanoseconds are there in 1.00 year? (c) How many years are there in 1.00 second?
32. (II) Use Table 1-3 to estimate the total number of protons or neutrons in (a) a bacterium, (b) a DNA molecule, (c) the human body, (d) our Galaxy.
33. (II) The diameter of the planet Mercury is 4879 km. (a) What is the surface area of Mercury? (b) How many times larger is the surface area of the Earth?
34. (III) A standard baseball has a circumference of approximately 23 cm. If a baseball had the same mass per unit volume (see Tables in Section 1-4) as a neutron or a proton, about what would its mass be?

## 1-6 Order-of-Magnitude Estimating

(Note: Remember that for rough estimates, only round numbers are needed both as input to calculations and as final results.)

35. (I) Estimate the order of magnitude (power of 10) of: (a) 3200, (b)  $86.30 \times 10^3$ , (c) 0.076, and (d)  $15.0 \times 10^8$ .
36. (II) Estimate how many books can be shelved in a college library with  $6500 \text{ m}^2$  of floor space. Assume 8 shelves high, having books on both sides, with corridors 1.5 m wide. Assume books are about the size of this one, on average.
37. (II) Estimate how many hours it would take to run (at 10 km/h) across the U.S. from New York to California.
38. (II) Estimate the number of liters of water a human drinks in a lifetime.
39. (II) Estimate the number of *cells* in an adult human body, given that a typical cell has a diameter of about  $10 \mu\text{m}$ , and the human body has a density of about  $1000 \text{ kg/m}^3$ .
40. (II) Estimate how long it would take one person to mow a football field using an ordinary home lawn mower (Fig. 1-12). (State your assumptions, such as the mower moves with a 1-km/h speed, and has a 0.5-m width.)



FIGURE 1-12  
Problem 40.

41. (II) Estimate the number of gallons of gasoline consumed by the total of all automobile drivers in the U.S., per year.
42. (II) Estimate the number of dentists (a) in San Francisco and (b) in your town or city.
43. (II) Estimate how many kilograms of laundry soap are used in the U.S. in one year (and therefore pumped out of washing machines with the dirty water). Assume each load of laundry takes 0.1 kg of soap.
44. (II) How big is a *ton* (1000 kg)? That is, what is the volume of something that weighs a ton? To be specific, estimate the diameter of a 1-ton rock, but first make a wild guess: will it be 1 ft across, 3 ft, or the size of a car? [Hint: Rock has mass per volume about 3 times that of water, which is  $1 \text{ kg per liter}$  ( $10^3 \text{ cm}^3$ ) or 62 lb per cubic foot.]
45. (II) A hiking trail is 270 km long through varying terrain. A group of hikers cover the first 49 km in two and a half days. Estimate how much time they should allow for the rest of the trip.
46. (II) Estimate how many days it would take to walk around the circumference of the Earth, assuming 12 h walking per day at 4 km/h.
47. (II) Estimate the number of jelly beans in the jar of Fig. 1-13.

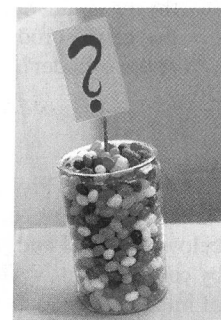


FIGURE 1-13  
Problem 47. Estimate the number of jelly beans in the jar.

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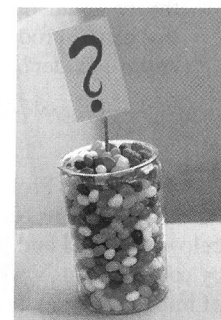


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