Chapter 1

1. (a) Expressing the radius of the Earth as

$$R = \left(6.37 \times 10^6 \text{ m}\right)\left(10^{-3} \text{ km/m}\right) = 6.37 \times 10^3 \text{ km},$$

its circumference is $s = 2\pi R = 2\pi(6.37 \times 10^3 \text{ km}) = 4.00 \times 10^4$ km.

(b) The surface area of Earth is $A = 4\pi R^2 = 4\pi\left(6.37 \times 10^3 \text{ km}\right)^2 = 5.10 \times 10^8 \text{ km}^2$.

(c) The volume of Earth is $V = \dfrac{4\pi}{3} R^3 = \dfrac{4\pi}{3}\left(6.37 \times 10^3 \text{ km}\right)^3 = 1.08 \times 10^{12} \text{ km}^3$.

4. (a) Using the conversion factors 1 inch = 2.54 cm exactly and 6 picas = 1 inch, we obtain

$$0.80 \text{ cm} = (0.80 \text{ cm})\left(\frac{1 \text{ inch}}{2.54 \text{ cm}}\right)\left(\frac{6 \text{ picas}}{1 \text{ inch}}\right) \approx 1.9 \text{ picas}.$$

(b) With 12 points = 1 pica, we have

$$0.80 \text{ cm} = (0.80 \text{ cm})\left(\frac{1 \text{ inch}}{2.54 \text{ cm}}\right)\left(\frac{6 \text{ picas}}{1 \text{ inch}}\right)\left(\frac{12 \text{ points}}{1 \text{ pica}}\right) \approx 23 \text{ points}.$$

9. The volume of ice is given by the product of the semicircular surface area and the thickness. The area of the semicircle is $A = \pi r^2/2$, where r is the radius. Therefore, the volume is

$$V = \frac{\pi}{2} r^2 z$$

where z is the ice thickness. Since there are 10^3 m in 1 km and 10^2 cm in 1 m, we have

$$r = (2000 \text{ km})\left(\frac{10^3 \text{ m}}{1 \text{ km}}\right)\left(\frac{10^2 \text{ cm}}{1 \text{ m}}\right) = 2000 \times 10^5 \text{ cm}.$$

In these units, the thickness becomes

$$z = 3000 \text{ m} = (3000 \text{ m})\left(\frac{10^2 \text{ cm}}{1 \text{ m}}\right) = 3000 \times 10^2 \text{ cm}$$

which yields $V = \dfrac{\pi}{2}\left(2000 \times 10^5 \text{ cm}\right)^2\left(3000 \times 10^2 \text{ cm}\right) = 1.9 \times 10^{22} \text{ cm}^3$.

21. If M_E is the mass of Earth, m is the average mass of an atom in Earth, and N is the number of atoms, then $M_E = Nm$ or $N = M_E/m$. We convert mass m to kilograms using Appendix D (1 u = 1.661×10^{-27} kg). Thus,

$$N = \frac{M_E}{m} = \frac{5.98 \times 10^{24}\ \text{kg}}{(40\ \text{u})\left(1.661 \times 10^{-27}\ \text{kg/u}\right)} = 9.0 \times 10^{49}.$$

28. If we estimate the "typical" large domestic cat mass as 10 kg, and the "typical" atom (in the cat) as 10 u $\approx 2 \times 10^{-26}$ kg, then there are roughly (10 kg)/(2×10^{-26} kg) $\approx 5 \times 10^{26}$ atoms. This is close to being a factor of a thousand greater than Avogadro's number. Thus this is roughly a kilomole of atoms.

41. Using the (exact) conversion 1 in = 2.54 cm = 0.0254 m, we find that

$$1\ \text{ft} = 12\ \text{in.} = (12\ \text{in.}) \times \left(\frac{0.0254\ \text{m}}{1\ \text{in.}}\right) = 0.3048\ \text{m}$$

and $1\ \text{ft}^3 = (0.3048\ \text{m})^3 \doteq 0.0283\ \text{m}^3$ for volume (these results also can be found in Appendix D). Thus, the volume of a cord of wood is $V = (8\ \text{ft}) \times (4\ \text{ft}) \times (4\ \text{ft}) = 128\ \text{ft}^3$. Using the conversion factor found above, we obtain

$$V = 1\ \text{cord} = 128\ \text{ft}^3 = (128\ \text{ft}^3) \times \left(\frac{0.0283\ \text{m}^3}{1\ \text{ft}^3}\right) = 3.625\ \text{m}^3$$

which implies that $1\ \text{m}^3 = \left(\frac{1}{3.625}\right) \text{cord} = 0.276\ \text{cord} \approx 0.3\ \text{cord}$.

47. We convert meters to astronomical units, and seconds to minutes, using

$$\begin{aligned} 1000\ \text{m} &= 1\ \text{km} \\ 1\ \text{AU} &= 1.50 \times 10^8\ \text{km} \\ 60\ \text{s} &= 1\ \text{min}. \end{aligned}$$

Thus, 3.0×10^8 m/s becomes

$$\left(\frac{3.0 \times 10^8\ \text{m}}{\text{s}}\right)\left(\frac{1\ \text{km}}{1000\ \text{m}}\right)\left(\frac{\text{AU}}{1.50 \times 10^8\ \text{km}}\right)\left(\frac{60\ \text{s}}{\text{min}}\right) = 0.12\ \text{AU/min}.$$