Unit 2 Homework: Text Problems

8. Since a change of longitude equal to 360° corresponds to a 24 hour change, then one expects to change longitude by 360°/(24 hr) or 15° before resetting one's watch by 1.0 h.

12. The customer expects 20×7056 in^3 and receives 20×5826 in^3, the difference being 24600 cubic inches, or

$$(24600 \text{ in}^3)\left(\frac{2.54\text{cm}}{1 \text{ inch}}\right)^3 \left(\frac{1 \text{ L}}{1000 \text{ cm}^3}\right) = 403 \text{ L}$$

where Appendix D or the table inside the back cover has been used.

20. To organize the calculation, we introduce the notion of density (which the students have probably seen in other courses):

$$\rho = \frac{m}{V}.$$

(a) We take the volume of the leaf to be its area A multiplied by its thickness z. With density $\rho = 19.32$ g/cm^3 and mass $m = 27.63$ g, the volume of the leaf is found to be

$$V = \frac{m}{\rho} = \left(\frac{27.63 \text{ g}}{19.32 \text{ g/cm}^3}\right) = 1.430 \text{ cm}^3.$$

We convert the volume to SI units:

$$(1.430 \text{ cm}^3)\left(\frac{1 \text{ m}}{100 \text{ cm}}\right)^3 = 1.430 \times 10^{-6} \text{ m}^3.$$

And since $V = Az$ where $z = 1 \times 10^{-6}$ m (metric prefixes can be found in Table 1–2 or inside the front cover), we obtain

$$A = \frac{1.430 \times 10^{-6} \text{ m}^3}{1 \times 10^{-6} \text{ m}} = 1.430 \text{ m}^2.$$

(b) The volume of a cylinder of length ℓ is $V = A\ell$ where the cross-section area is that of a circle: $A = \pi r^2$. Therefore, with $r = 2.500 \times 10^{-6}$ m and $V = 1.430 \times 10^{-6}$ m^3, we obtain

$$\ell = \frac{V}{\pi r^2} = 7.284 \times 10^4 \text{ m}.$$

26. 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 very 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 Avogradro's number. Thus there are roughly 10^3 moles (a kilomole) of atoms in the cat.