Section 1.4. Units

Note. Table 1.1 gives common prefixes for various multiples of SI units:

Prefix	Abbreviation	Multiple
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
kilo	k	10^{3}
mego	M	10^{6}
giga	G	10^{9}

Note. As calculated on page 9, the weight of a 1 slug mass at sea level is 32.2 lb.

Note. We measure angles in degrees.

Note. Table 1.2 gives some conversions between SI and US customary units.

Example 1.19. If the Earth is modeled as a homogeneous sphere, the velocity of a satellite in a circular orbit is $v = \sqrt{\dfrac{rR_E^2}{r}}$ where R_E is the radius of the Earth and r is the radius of the orbit.

(a) If g is in $\mathrm{m/s^2}$ and R_E and r are in meters, what are the units of v?

Solution. An analysis of units tells us

$$v = \sqrt{\frac{(\mathrm{m/s^2})(\mathrm{m})^2}{\mathrm{m}}} = \sqrt{\mathrm{m^2/s^2}} = \mathrm{m/s}.$$

So v is m/s.

(b) If $R_E = 6370$ km and $r = 6670$ km what is the value of v to three significant digits?

Solution. We have

$$v = \sqrt{\frac{gR_E^2}{r}} = \sqrt{\frac{(9.81\ \mathrm{m/s^2})(6370\ \mathrm{km})^2}{(1000\ \mathrm{m/km})(6670\ \mathrm{km})}} = 7.73\ \mathrm{km/s} = .00773\ \mathrm{m/s}.$$

So $v = 7.73$ km/s.

(c) For the orbit described in (b), what is the value of v in mi/s to three significant digits?

Solution. We need to convert 7.73 km/s to mi/s. We need the conversion factors (from Table 1.2) of 1 ft = 0.3048 m. Therefore,

$$(7.73\ \mathrm{km/s})\left(\frac{1\ \mathrm{ft}}{0.3048\ \mathrm{m}}\right)\left(\frac{1000\ \mathrm{m}}{\mathrm{km}}\right)\left(\frac{\mathrm{mi}}{5280\mathrm{ft}}\right) = 4.80\ \mathrm{mi/s}.$$

The answer is $v = 4.80$ mi/s.