Exercise 1.3

How many nanoseconds does it take light to travel 1.00 ft in vacuum? (This result is a useful quantity to remember.)

Solution

Much more useful is to remember the speed of light,

$$c = 299\,792\,458\ \frac{\text{m}}{\text{s}} \approx 3 \times 10^8\ \frac{\text{m}}{\text{s}}.$$

Start with 1.00 ft and arrange the appropriate conversion factors so that the desired units remain.

$$1.00\ \cancel{\text{ft}} \times \frac{12\ \cancel{\text{in}}}{1\ \cancel{\text{ft}}} \times \frac{2.54\ \cancel{\text{cm}}}{1\ \cancel{\text{in}}} \times \frac{1\ \cancel{\text{m}}}{100\ \cancel{\text{cm}}} \times \frac{1\ \cancel{\text{s}}}{299\,792\,458\ \cancel{\text{m}}} \times \frac{10^9\ \text{ns}}{1\ \cancel{\text{s}}} = \frac{(1.00)(12)(2.54)(1)(1)(10^9)\ \text{ns}}{(1)(1)(100)(299\,792\,458)(1)}$$
$$\approx 1.02\ \text{ns}$$