The number of seconds in a year is $3.156 \times 10^7$. This is listed in Appendix D and results from the product 

$$(365.25 \text{ day/y})(24 \text{ h/day})(60 \text{ min/h})(60 \text{ s/min}) .$$

(a) The number of shakes in a second is $10^8$; therefore, there are indeed more shakes per second than there are seconds per year.

(b) Denoting the age of the universe as 1 u-day (or 86400 u-sec), then the time during which humans have existed is given by

$$\frac{10^6}{10^{10}} = 10^{-4} \text{ u-day ,}$$

which we may also express as

$$\left(10^{-4} \text{ u-day}\right)\left(\frac{86400 \text{ u-sec}}{1 \text{ u-day}}\right) = 8.6 \text{ u-sec .}$$
25. From the Figure we see that, regarding differences in positions $\Delta x$, 212 S is equivalent to 258 W and 180 S is equivalent to 156 Z. Whether or not the origin of the Zelda path coincides with the origins of the other paths is immaterial to consideration of $\Delta x$.

(a) 

$$\Delta x = (50.0 \text{ S}) \left( \frac{258 \text{ W}}{212 \text{ S}} \right) = 60.8 \text{ W}$$

(b) 

$$\Delta x = (50.0 \text{ S}) \left( \frac{156 \text{ Z}}{180 \text{ S}} \right) = 43.3 \text{ Z}$$
34. (a) We find the volume in cubic centimeters

\[(193 \text{ gal}) \left( \frac{231 \text{ in}^3}{1 \text{ gal}} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right)^3 = 7.31 \times 10^5 \text{ cm}^3\]

and subtract this from \(1 \times 10^6 \text{ cm}^3\) to obtain \(2.69 \times 10^5 \text{ cm}^3\). The conversion \text{gal} \rightarrow \text{in}^3\) is given in Appendix D (immediately below the table of Volume conversions).

(b) The volume found in part (a) is converted (by dividing by \((100 \text{ cm/m})^3\)) to \(0.731 \text{ m}^3\), which corresponds to a mass of

\[(1000 \text{ kg/m}^3) (0.731 \text{ m}^2) = 731 \text{ kg}\]

using the density given in the problem statement. At a rate of 0.0018 kg/min, this can be filled in

\[
\frac{731 \text{ kg}}{0.0018 \text{ kg/min}} = 4.06 \times 10^5 \text{ min}
\]

which we convert to 0.77 y, by dividing by the number of minutes in a year (365 days)(24 h/day)(60 min/h).