(5.2.) In Greenland ice the $^{10}$Be radioactivity has been measured to be 0.0184 dpm m$^{-3}$. How old is this ice if it was formed out of water in equilibrium with cosmic-ray $^{10}$Be (see previous question)?

First we define the densities of ice and water, dpm and the Bq:

$\rho_{ice} := 0.9168 \cdot gm \cdot cm^{-3}$ $\rho_{water} := 1.0000 \cdot gm \cdot cm^{-3}$ $dpm := min^{-1}$ $Bq := sec^{-1}$

The specific activity of $^{10}$Be in seawater was obtained as answer from (5.1).

$R_{0water} := 0.131 \cdot Bq \cdot m^{-3}$

The specific activity of $^{10}$Be in Greenland ice is given in the text as:

$R_{ice} := 0.0184 \cdot dpm \cdot m^{-3}$

Calculate the decay constant from the half-life (data from Table 5.1.a on p. 95)

$t_{halv} := 1.52 \cdot 10^6 \cdot 365 \cdot 24 \cdot 60 \cdot 60 \cdot sec$ $\lambda := \frac{ln(2)}{t_{halv}}$ $\lambda = 1.446 \cdot 10^{-14} \cdot \sec^{-1}$

Recalculate the rate from water to ice:

$$R_{water} := R_{ice} \cdot \frac{\rho_{water}}{\rho_{ice}}$$

By using eqn. (4.41b) we can calculate the age of the ice as follows:

$$t := \frac{ln\left(\frac{R_{0water}}{R_{water}}\right)}{\lambda} \qquad t = 4.129 \cdot 10^{14} \cdot \sec \quad \text{or} \quad t = 1.308 \cdot 10^{7} \cdot yr$$