(4.6) From the specific activity of potassium (1850 dpm/g K) and the fact that it all originates in the rare isotope ^{40}K (0.0117%), calculate the half-life of ^{40}K.

First the usual definitions:

$N_A := 6.0221367 \cdot 10^{23} \cdot mole^{-1}$ $\quad Bq := sec^{-1}$

Then the data given: $\quad R_{40K} := \frac{1850}{60} \cdot Bq \quad m_{40K} := 1 \cdot gm \quad x_{40K} := 0.0117 \cdot \%$

Data from Appendix I: $\quad M_K := 39.10 \cdot \frac{gm}{mole}$

$N_{40K} := \frac{m_{40K}}{M_K} \cdot N_A \cdot x_{40K}$ $\quad$ atoms ^{40}K /g K $\quad N_{40K} = 1.802 \cdot 10^{18}$

$\lambda_{40K} := \frac{R_{40K}}{N_{40K}}$ $\quad$ eqn (4.40a)

$t := \frac{ln(2)}{\lambda_{40K}}$ $\quad$ eqn (4.43): $\quad t = 4.051 \cdot 10^{16} \cdot sec$ $\quad$ or $\quad t = 1.284 \cdot 10^{9} \cdot yr$