(11.13) Calculate the half-life for α-decay of ^{147}Sm assuming that Q_α is 2.314 MeV. Compare the result with the measured half-life and compute the hindrance factor.

$Q := 2.314$ $A := 147$ $Z := 62$

$q_e := 1.60211773 \cdot 10^{-19} \cdot coul$ $Q_\alpha := Q \cdot 10^6 \cdot 1.60211773 \cdot 10^{-19} \cdot joule$

$\varepsilon_0 := 8.8541878 \cdot 10^{-12} \cdot \frac{coul}{volt \cdot m}$ $h := 6.626076 \cdot 10^{-34} \cdot joule \cdot sec$

$Z_\alpha := 2$ $A_\alpha := 4$ $Z_1 := Z - Z_\alpha$

$r_0 := 1.30 \cdot 10^{-15} \cdot m$ $r_\alpha := 1.20 \cdot 10^{-15} \cdot m$ $A_1 := A - A_\alpha$

$R_{nucl} := r_0 \cdot A_1^{\frac{1}{3}} + r_\alpha$ $R_{nucl} = 7.998 \cdot 10^{-15} \cdot \mathrm{m}$ $u_n := 1.660540 \cdot 10^{-27} \cdot kg$

$u := \sqrt{\frac{4 \cdot \pi \cdot \varepsilon_0 \cdot Q_\alpha \cdot R_{nucl}}{Z_1 \cdot Z_\alpha \cdot q_e^2}}$ $u = 0.327$ $\mu := \frac{A_\alpha \cdot A_1}{A_\alpha + A_1} \cdot u_n$ $\mu = 6.461 \cdot 10^{-27} \cdot \mathrm{kg}$

$$\lambda := \frac{h}{2 \cdot \mu \cdot R_{nucl}^2} \cdot exp\left[\frac{-\sqrt{2 \cdot \mu} \cdot Z_1 \cdot Z_\alpha \cdot q_e^2}{\varepsilon_0 \cdot h \cdot \sqrt{Q_\alpha}} \cdot \left(acos(u) - u \cdot \sqrt{1 - u^2} \right) \right]$$ eqn. (11.42)

$\lambda = 2.479 \cdot 10^{-19} \cdot \mathrm{sec}^{-1}$ $t_{half} := \frac{ln(2)}{\lambda}$ $t_{half} = 8.86 \cdot 10^{10} \cdot yr$

$t_{half.exp} := 1.06 \cdot 10^{11} \cdot yr$

$f_{hindrance} := \frac{t_{half.exp}}{t_{half}}$ See p. 329. $f_{hindrance} = 1.2$