(6.3) For an irradiation experiment it is necessary to extract a beam of deuterons from an accelerator. The projectile energy is 22 MeV D^+. For this purpose the beam is deflected and permitted to pass through a thin titanium foil (density 4.5 g cm^{-3}). Assuming that $R_1\rho_1 M_1^{-1/2} = R_2\rho_2 M_2^{-1/2}$ (Bragg-Kleman rule), what is the maximum thickness of the foil? Give answer in millimeters.

First the known data (the range in Al is read from Fig. 6.6):

$R_{Al} := 400$ mg Al/cm^2 $\rho_{Al} := 2.7$ g/cm^3 $\rho_{Ti} := 4.5$ g/cm^3

$M_{Al} := 26.98$ $M_{Ti} := 47.90$

Now the solution based on eqn. (6.11). Calculate the ranges in aluminum and titanium.

$$R_{Ti} := \frac{R_{Al} \cdot \rho_{Al} \cdot M_{Al}^{-\frac{1}{2}}}{\rho_{Ti} \cdot M_{Ti}^{-\frac{1}{2}}}$$ Application of eqn. (6.11) two times $R_{Ti} = 319.785$ mg Ti/cm^2

$$Thickness := \frac{R_{Ti}}{\rho_{Ti}} \cdot 10^{-3} \cdot 10$$ $Thickness = 0.711$ mm of Ti