(7.16) In a sample of 10.4 TBq of old fission products, the average γ-ray energy is 0.5 MeV and on the average 0.4 γ's are emitted per β-decay. (a) What is the lead shielding required to reduce the γ-flux to 10^2 γ $cm^{-2}s^{-1}$ at 1.5 m from the source assuming only exponential absorption? (b) What is the relaxation length? (c) What is the build-up factor?

$Bq := sec^{-1}$ $A := 10.4 \cdot 10^{12} \cdot Bq$ $n := 0.4$ γ/β

$\rho := 11.3 \cdot gm \cdot cm^{-3}$ $\mu_a := 0.19 \cdot cm^2 \cdot gm^{-1}$ $\mu := \mu_a \cdot \rho$

$r := 1.5 \cdot 100 \cdot cm$ $\phi := 10^2 \cdot cm^{-2} \cdot sec^{-1}$ γ/$cm^{-2}s^{-1}$

$$x := \frac{ln\left(\frac{n \cdot A}{4 \cdot \pi \cdot r^2 \cdot \phi}\right)}{\mu}$$ Derived from eqn. (7.27)

(a) Shield thickness, x, is $x = 0.055 \cdot m$ or $x = 5.542 \cdot cm$

(b) Relaxation length = $\mu \cdot x = 11.899$

(c) From Fig. 7.20; build-up factor = 2.5