(8.1) A detector has a 1 cm^2 efficient area perpendicular to a γ-particle flux produced by a source 7 m away. The sensitivity for the 0.73 MeV γ-radiation is 8.2%. (a) What must the source strength be for the detector to register 1000 cpm? (b) What fraction of the radiation is adsorbed in the air space between source and detector?

Assume $\mu_a/\rho_a = \mu_m(Al)/\rho_{Al}$, and read data for Al from Figure 6.17.

$Bq := sec^{-1}$ $\quad$ $cpm := min^{-1}$ $\quad$ $\rho := 1.293 \cdot 10^{-3} \cdot gm \cdot cm^{-3}$

$\mu_o := 0.071 \cdot cm^2 \cdot gm^{-1}$ $\quad$ $\mu_a := 0.028 \cdot cm^2 \cdot gm^{-1}$

$r := 7 \cdot m$ $\quad$ $d := r$ $\quad$ Because the absorber thickness, *d*, is equal to the distance, *r*.

(a) Begin with: $\quad$ $\Phi = R_0 \cdot \dfrac{1 \cdot cm^2}{4 \cdot \pi \cdot r^2} \cdot exp\left(-\mu_o \cdot \rho \cdot d\right)$ $\quad$ Eqn. (6.26)

$$\psi := \frac{8.2}{100}$$

$A = \psi \cdot \Phi$ $\quad$ Eqn. (4.45)

$$A := 1000 \cdot cpm$$

Combine these three equations and solve for R_0:

$R_0 := 153.248 \cdot \dfrac{A}{cm^2} \cdot \dfrac{r^2}{exp\left(-1. \cdot \mu_o \cdot \rho \cdot d\right)}$ $\quad$ $R_0 = 1.33 \cdot 10^9 \cdot Bq$

(b) $\quad$ $\Delta\Phi := \left(1 - exp\left(-\mu_a \cdot \rho \cdot d\right)\right)$ $\quad$ $\Delta\Phi = 0.025$ $\quad$ absorbed

or

$\Delta\Phi = 2.5 \cdot \%$ $\quad$ absorbed