(9.1) 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 from Figure 7.17b.

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

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

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

(a) Begin with:

$$\Phi = R_0\cdot\frac{1\cdot cm^2}{4\cdot\pi\cdot r^2}\cdot exp(-\mu_o\cdot\rho\cdot d)$$ Eqn. (7.27)

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

$$A = \psi\cdot\Phi$$ Eqn. (5.64)

$$A := 1000\cdot cpm$$

Combine these three equations and solve for R_0:

$$R_0 := 153.248\cdot\frac{A}{cm^2}\cdot\frac{r^2}{exp(-1.\cdot\mu_o\cdot\rho\cdot d)}$$ $$R_0 = 1.335\cdot 10^9 \cdot Bq$$

(b) $$\Delta\Phi := 100\cdot(1 - exp(-\mu_a\cdot\rho\cdot d))$$ $$\Delta\Phi = 2.502$$ % absorbed