

80. (a) Assuming a “target” area of one square meter, we establish a ratio:

$$\frac{\text{rate through you}}{\text{total rate upward}} = \frac{1 \text{ m}^2}{(2.6 \times 10^5 \text{ km}^2)(1000 \text{ m/km})^2} = 3.8 \times 10^{-12} .$$

The SI unit becquerel is equivalent to a disintegration per second. With half the beta-decay electrons moving upward, we find

$$\text{rate through you} = \frac{1}{2} (1 \times 10^{16} / \text{s}) (3.8 \times 10^{-12}) = 1.9 \times 10^4 / \text{s}$$

which implies (converting s \rightarrow h) the rate of electrons you would intercept is $R_0 = 7 \times 10^7 / \text{h}$.

- (b) Let D indicate the current year (2000, 2001, etc) Combining Eq. 43-15 and Eq. 43-17, we find

$$R = R_0 e^{-t \ln 2 / T_{1/2}} = (7 \times 10^7 / \text{h}) e^{-(D-1996) \ln 2 / (30.2 \text{ y})} .$$