Answer on Question #49455-Physics-Nuclear Physics

(a) The 210Po source used in a physics laboratory is labeled as having an activity of 1.0μCi on the date it was prepared. A student measures the radioactivity of this source with a Geiger counter and observes 1500 counts per minute. She notices that the source was prepared 120 days before her lab. What fraction of the decays is she observing with her apparatus? (b) Identify some of the reasons that only a fraction of the α s emitted are observed by the detector.

Solution

(a) $R_0 = (1.00 \cdot 10^6 Ci)\left(3.70 \cdot 10^{10} \frac{Bq}{Ci}\right) = 3.70 \cdot 10^4 Bq.$

$$R' = \frac{1500}{60.0s} = 25.0 \ Bq = observed.$$

$$R = R_0 e^{-\lambda t} = (3.70 \cdot 10^4 Bq)e^{-\frac{(0.693)(120d)}{138.4d}} = 2.03 \cdot 10^4 Bq.$$

$$\frac{R'}{R} = \frac{25.0 \ Bq}{2.03 \cdot 10^4 Bq} = 1.23 \cdot 10^{-3} \ .$$

(b) Only part of the emitted radiation goes in the direction of the detector. Only a fraction of that causes a response in the detector. Some of the emitted radiation (mostly α-particles) is observed within the source. Some is absorbed within the source, some is absorbed by the detector, and some does not penetrate the detector.