Answer on Question 60786, Physics, Atomic and Nuclear Physics

Question:

The half-life of radon is 3.82 days. How long will it take for 60 percent of a sample of radon to decay?

Solution:

Let's use the famous equation for the radioactive decay:

$$N = N_0 e^{-\lambda t},$$

here, N_0 is the amount of radon at time $t = 0$ (100%), N is the amount of radon when 60% of it is decayed ($N = 40\%$), $\lambda = 0.693/T_{1/2}$ is the radioactive decay constant, $T_{1/2} = 3.82\ days$ is the half-life of radon, t is the elapsed time which we are searching for.

Then, we get:

$$\frac{N}{N_0} = e^{-\lambda t},$$

$$\ln\left(\frac{N}{N_0}\right) = \ln\left(e^{-\lambda t}\right),$$

$$\ln\left(\frac{N}{N_0}\right) = -\frac{0.693}{T_{1/2}} t.$$

From the last formula we can find the time needed for 60 percent of a sample of radon to decay:

$$t = \left[\frac{\ln\left(\frac{N}{N_0}\right)}{(-0.693)}\right] T_{1/2} = \left[\frac{\ln(0.4)}{(-0.693)}\right] \cdot 3.82\ days = 5.05\ days.$$

Answer:

$t = 5.05\ days.$