# Answer on the question #68065, Chemistry / Physical Chemistry

**Question:**
b) How long would it take for a sample of 222Rn that weighs 0.750 g to decay to 0.100 g? Assume a half-life for 222Rn of 3.823 days.

**Solution:**
Radioactive decay kinetics is explained with first-order equations:

$$\ln\frac{[A]}{[A_0]} = -kt,$$

where $[A_0]$ and $[A]$ are the concentrations of $^{222}$Rn: initial and at time t, respectively, and $k$ is the rate constant of the process. The concentration is proportional to the mass of $^{222}$Rn, so we can take the ratio of masses in our calculation.
Rate constant can be calculated from the half-life time as follows:

$$k = \frac{\ln(2)}{t_{1/2}} = \frac{0.69315}{3.823(days)} = 0.1814\ (days^{-1})$$

Then, we can find the time that it would take for a sample of $^{222}$Rn that weights 0.750g to decay to 0.100g :

$$t = -\frac{1}{k}\ln\frac{[A]}{[A_0]} = \frac{1}{k}\ln\frac{[A_0]}{[A]} = \frac{1}{0.1814\ (days^{-1})}\ln\frac{0.750(g)}{0.100(g)}$$
$$= 11.11\ days, or\ 11\ days\ 2\ hours\ and\ 43\ minutes$$

**Answer :** 11 days 2 hours and 43 minutes