7.4

Saturday, May 8, 2021 9:05 AM

36. Polonium-210 The half-life of polonium is 139 days, but your sample will not be useful to you after 95% of the radioactive nuclei present on the day the sample arrives has disintegrated. For about how many days after the sample arrives will you be able to use the polonium?

$\tau = 139 \Rightarrow k = \frac{\ln 2}{\tau} = \frac{\ln 2}{139}$

$y(\tau) = \frac{y_0}{2}$

$k \approx 0.285 \times 10^{-4}$

$y(t) = y_0 e^{-kt}$

y_0: initial amount $t=0$

k: decay rate

$y(t)$: amount available at time

Find time t^* s.t $y(t^*) = \frac{5}{100} y_0$

$y(t^*) = y_0 e^{-k t^*}$

$\frac{5}{100} y_0 = y_0 e^{-k t^*}$

$0.05 = e^{-k t^*} \Rightarrow \ln 0.05 = \ln e^{-k t^*} = -k t^* \ln e = -k t^*$

$t^* = \frac{\ln 0.05}{-k} = \frac{\ln 0.05}{-0.285 \times 10^{-4}} \approx 600$ days