

Answer on Question #59675 – Math – Calculus

Question

Plutonium-240 decays according to the function ...

where Q represents the quantity remaining after t years and k is the decay constant, 0.00011...
How long will it take 36 grams of plutonium-240 to decay to 12 grams?

Solution

Formula of exponential decay is given by

$$N(t) = N_0 e^{-kt},$$

where $N(t)$ is the quantity at time t , and $N_0 = N(0)$ is the initial quantity, i.e. the quantity at time $t = 0$; k is the decay constant.

Next,

$$e^{-kt} = \frac{N(t)}{N_0},$$

Taking the natural logarithms of both sides of the equation

$$-kt = \ln \frac{N(t)}{N_0},$$

hence

$$t = -\frac{\ln \frac{N(t)}{N_0}}{k} = -\frac{\ln \frac{12}{36}}{0.00011} = 9987.38 \text{ years.}$$

Answer: $t = -\frac{\ln \frac{N(t)}{N_0}}{k} = 9987.38 \text{ years.}$