A tumor is injected with 0.5 grams of Iodine-125, which has a decay rate of 1.15% per day. To the nearest day, how long will it take for half of the Iodine-125 to decay?

Solution

The half-life is the time it takes a substance to decay to half of the amount that is present.
To find how long it will take for half of the Iodine-125 to decay, we can use the model for continuous exponential decay, $y = A_0 e^{kt}$. When the substance has decayed in half, the output will be half of the original amount, $y = 0.5A_0$. To find the half-life we can set up an equation and solve for t.

$$0.5(0.5) = 0.5e^{-0.0115t}$$
$$0.25 = 0.5e^{-0.0115t}$$
$$0.5 = e^{-0.0115t}$$
$$\ln(0.5) = \ln\left(e^{-0.0115t}\right)$$
$$\ln(0.5) = -0.0115t * \ln(e)$$
$$\ln(0.5) = -0.0115\,\text{t}$$
$$\frac{\ln(0.5)}{-0.0115} = t$$
$$60.27 \approx t$$

We could also use the formula for the relationship between k and the half-life t, $t = -\frac{\ln(2)}{k}$.

$$t = -\frac{\ln(2)}{-0.0115} \approx 60.27$$

The half-life of the iodine-125 is approximately 60 years.