Find the associated exponential growth or decay model.

a) \( Q = 2000 \) when \( t = 0 \); Half-life = 5.

Solution: This part says “half-life,” so we are dealing with exponential decay. Therefore we use the formula

\[ Q(t) = Q_0 e^{-kt}, \text{ where } k = \frac{\ln 2}{\text{half-life}} = \frac{\ln 2}{5}. \]

Also, \( Q_0 \) is defined to be the quantity at time \( t = 0 \), so for this problem \( Q_0 = 2000 \). The decay model is

\[ Q(t) = 2000 e^{-\left(\frac{\ln(2)}{5}\right)t} = 2000 e^{-t \ln(2)/5}. \]

If you see a problem similar to this on WebAssign, be sure you check if the problem tells you to round \( k \) to some number of decimal places. If it doesn’t, then you need to leave your answer like the one shown here. If it asks you to round this to three decimal places (for example), you would write your solution as

\[ Q(t) = 2000 e^{-0.139t}. \]

b) \( Q = 2000 \) when \( t = 0 \); Doubling-time = 4.

Solution: This part says “doubling-time,” so we are dealing with exponential growth. Therefore we use the formula

\[ Q(t) = Q_0 e^{kt}, \text{ where } k = \frac{\ln 2}{\text{doubling-time}} = \frac{\ln 2}{4}. \]

Also, \( Q_0 \) is defined to be the quantity at time \( t = 0 \), so for this problem \( Q_0 = 2000 \). The decay model is

\[ Q(t) = 2000 e^{\left(\frac{\ln(2)}{4}\right)t} = 2000 e^{t \ln(2)/4}. \]