

Answer Question #56440 - Chemistry - General Chemistry

Question:

A first order reaction, where $[A]_0 = 1.00 \text{ M}$, is 69.9% complete in 341 s. How long does it take for the same reaction to go from 1.00 M to 87.7 % completion?

Solution:

The first order reaction obeys the following kinetic expression:

$$[A] = [A_0]e^{-kt}$$

The rate constant of the reaction is:

$$k = -\frac{1}{t} \ln \frac{[A]}{[A_0]}$$

The 69.9% completion means, that 30.1% remains:

$$= -\frac{1}{341} \ln(0.301) = 3.52 \cdot 10^{-3} \text{ s}^{-1}$$

Then, as we have the rate constant of reaction, we can find the time that we need to get the certain percentage of completion (87.7 %of completion means that 12.3% remains):

$$t = -\frac{1}{k} \ln \frac{[A]}{[A_0]} = -\frac{1}{3.52 \cdot 10^{-3}} \ln(0.123) = 595 \text{ s}$$

Answer: 595 s