Answer on Question #67201 - Chemistry - Physical Chemistry

Question:

The half-life for the first-order decomposition of N2O5 is 2.05 x 104 s. How long will it take for a sample of this compound to decay to 80% of its initial value?

Solution:

For a first-order reaction, the half-life is defined as: $t_{1/2} = \frac{ln2}{k}$.

The kinetic equation for the first-order reaction has the form: $k = \frac{1}{t} \cdot ln\frac{[X]_0}{[X]}$.

$$t = \frac{ln\frac{[X]_0}{[X]}}{k} = \frac{ln\frac{[X]_0}{[X]} \cdot t_{1/2}}{ln2} = \frac{ln\frac{1}{0.8} \cdot 2.05 \cdot 10^4}{ln2} = \frac{4574.44}{0.69} = 6600.87\ s = 1.83\ h = \\ = 1\ h\ 50\ min\ 0.87\ s$$

Answer: 6600.87 s = 1.83 h = 1 h 50 min 0.87 s.