Rate Constant from Integrated Rate Law Equation

$2N_2O_5 \rightarrow 4NO_2 + O_2$

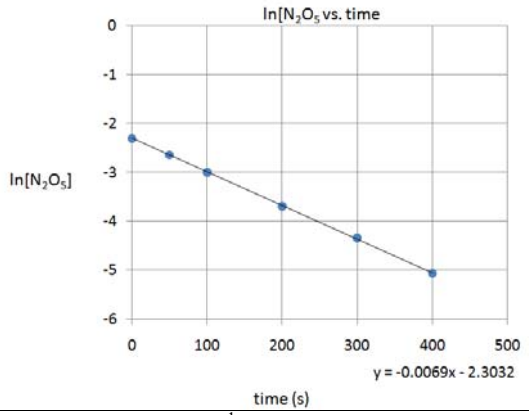
$$\text{Rate} = k[N_2O_5]^1$$

What is the rate constant for this reaction?

Data

Note that Rod Lederer had typo'd the first two concentration data points.

$[N_2O_5]$ (M)	Time (s)
0.100	0
0.071	50
0.050	100
0.025	200
0.013	300
0.0063	400



-slope = k = 0.0069 s^{-1}
based on the linear regression formula

You can use two points and the integrated rate constant to find the rate constant. You can use any times, but it is best to use time zero and the last time for greater accuracy.

$$\ln[N_2O_5]_t - \ln[N_2O_5]_o = -kt$$

$$\ln[0.0063]_{400} - \ln[0.100]_o = -k \times 400s$$

k= 0.0069 s^{-1}

A faster easier method of proving that this is a first order reaction is noting that every 100 seconds the concentration is halved. Only a first order reaction has a constant half life time. Always be on the lookout for half concentrations.

Dividing the half life into 0.693, you will get rate constant for the reaction.

$$k = \frac{0.693}{t_{½}}$$

k= 0.0069 s^{-1}