Time Concentration Data: Plots

The reaction

$$C_2H_4\ (g) + O_3\ (g) \rightarrow C_2H_4O\ (g) + O_2\ (g)$$

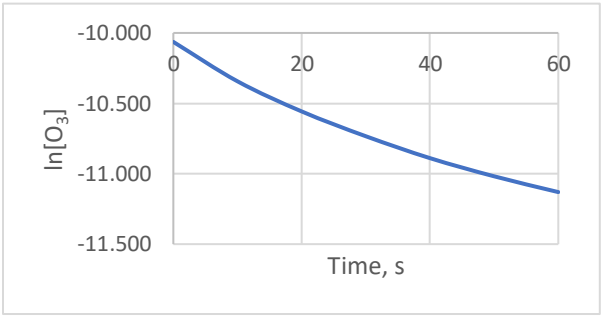
has the following concentration-time data.

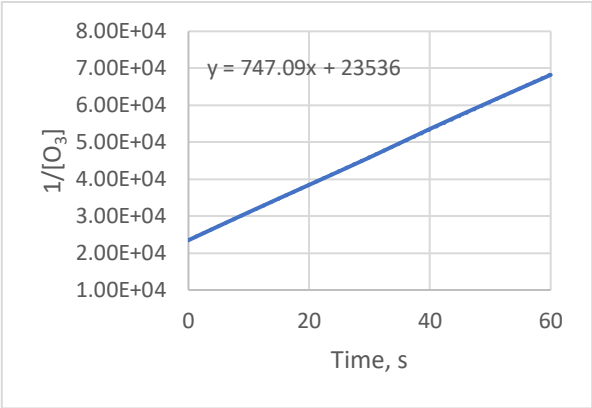
Time, s	$[O_3]$, M
0	4.26×10^{-5}
10	3.22×10^{-5}
20	2.60×10^{-5}
30	2.18×10^{-5}
40	1.87×10^{-5}
50	1.64×10^{-5}
60	1.47×10^{-5}

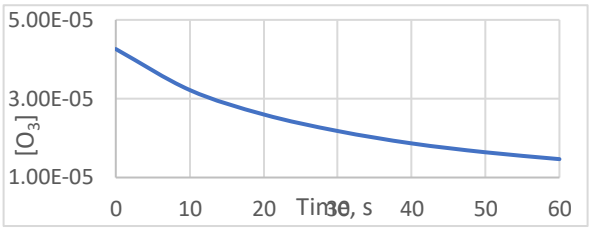
1) Determine the order with respect to $[O_3]$.
Plot the data (see table below).

Time, s	$[O_3]$, M	$1/[O_3]$	$\ln[O_3]$
0	4.26E-05	2.35E+04	-10.064
10	3.22E-05	3.11E+04	-10.344
20	2.60E-05	3.85E+04	-10.557
30	2.18E-05	4.59E+04	-10.734
40	1.87E-05	5.36E+04	-10.889
50	1.64E-05	6.10E+04	-11.018
60	1.47E-05	6.82E+04	-11.130

From the plots we see with respect to $[O_3]$ reaction is second order







2) What is the value of the rate constant with units?

m = k = **747**

3) What is the half-life of $[O_3]$?

Half-life for second order reaction is:

$$t_{1/2} = \frac{1}{k[A]_o} = \frac{1}{747 M^{-1}s^{-1} \times (4.26\times10^{-5}\ M)} = \mathbf{31.4\ s}$$

4) How long will it take for $[O_3]$ to decrease from 4.26 x 10^{-5} M to 1.55 x 10^{-5} M?

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_o}$$ solve equation for t

$$\frac{t = \frac{1}{[A]_t} - \frac{1}{[A]_o}}{k} = \frac{\frac{1}{1.55\times10^{-5}\ M} - \frac{1}{4.26\times10^{-5}\ M}}{747\ M^{-1}s^{-1}} = \mathbf{54.9\ s}$$