Name: _____ Date: _____

Real Kinetics

Want a little taste of real kinetics data? This activity will cement your understanding of how kinetics is done. You will need to make several graphs using Google Sheets, Microsoft Excel, SparkVue or Numbers.

Data Set 1.

Time (s) 300K	[C] 300K	2nd Order 1/[C]	1st Order ln[C]	0th Order [C]	Time (s) 310 K	[C] 310K	2nd Order 1/[C]	1st Order ln[C]	0th Order [C]
0	Unknown C_o				0	Unknown C_o			
1	0.12				1	0.074			
2	0.074				2	0.027			
3	0.044				3	0.009			
4	0.027				4	0.0036			
5	0.016				5	0.0013			
6	0.009				6	0.0005			
8	0.0036				8	0.000067			
10	0.0013				10	0.0000091			

Find rates, C_0, k, $t_{1/2}$, E_a and reaction order at each temperature.

1. Solve for the instantaneous rate at 2 seconds. (Plot the concentration-time data for **one of the temperatures**. Draw a tangent line to the curve at 2 seconds and obtain the rate from the slope.) **Do this only for Data Set #1.** Your teacher may just provide you with a value for the slope to continue with your calculations.
2. Find the order of the reaction. (Complete the empty columns in the table above. The column that generates a **straight line** corresponds to the order of the reaction.) SAVE THIS GRAPH.
3. Solve for the rate constant and the initial concentration. (From the data that produces a straight line, the **slope** yields the rate constant and the **y-intercept** yields the initial concentration.)
4. Solve for the half life. (Choose a concentration and half that concentration; the half life is the time associated with that concentration time.) **Do this only for Data Set #1.**
5. Solve for the activation energy. (Use the **two values of k at different temperatures** to extract the activation energy from the slope of the combined Arrhenius equation.) **This is the Arrhenius equation. The R stands for the Gas Constant (8.314 J M^{-1} K^{-1}).**

$$\ln\frac{k_1}{k_2}=\frac{E_a}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$$

Data Set 2 - Complete 2, 3 and 5

Time (s) 300 K	[C]	2nd Order 1/[C]	1st Order ln[C]	0th Order [C]	Time (s) 313 K	[C]	2nd Order 1/[C]	1st Order ln[C]	0th Order [C]
0	Unknown C_0				0	Unknown C_0			
1	0.182				1	0.166			
2	0.166				2	0.142			
3	0.153				3	0.125			
4	0.142				4	0.111			
5	0.133				5	0.100			
6	0.125				6	0.090			
8	0.110				8	0.076			
10	0.100				10	0.066			

Data Set 3 - Complete 2, 3 and 5

Time (s) 300 K	[C]	2nd Order 1/[C]	1st Order ln[C]	0th Order [C]	Time (s) 305 K	[C]	2nd Order 1/ [C]	1st Order ln[C]	0th Order [C]
0	Unknown C_0				0	Unknown C_0			
0.05	0.1875				0.05	0.175			
0.1	0.175				0.1	0.15			
0.15	0.1625				0.15	0.125			
0.2	0.150				0.2	0.1			
0.25	0.1375				0.25	0.075			
0.3	0.125				0.3	0.05			
0.35	0.1125				0.35	0.025			