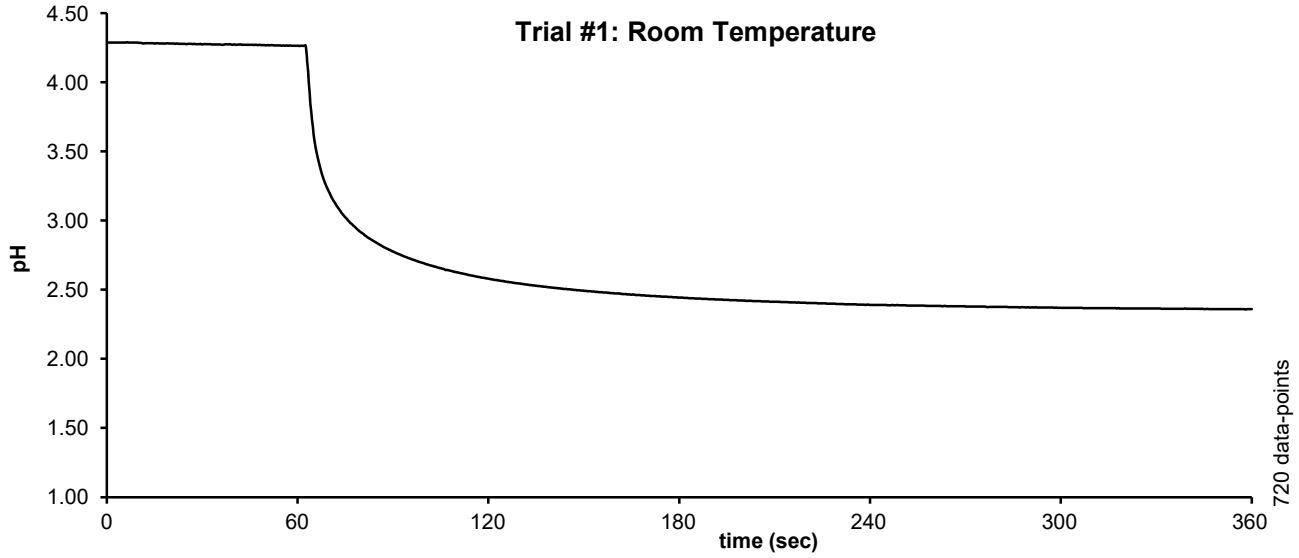
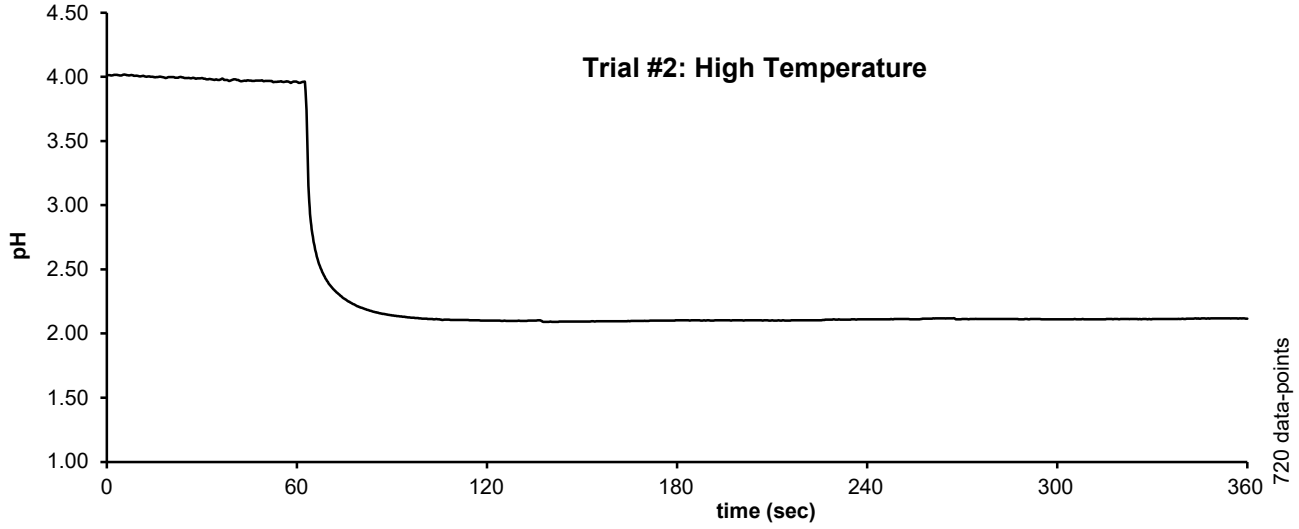
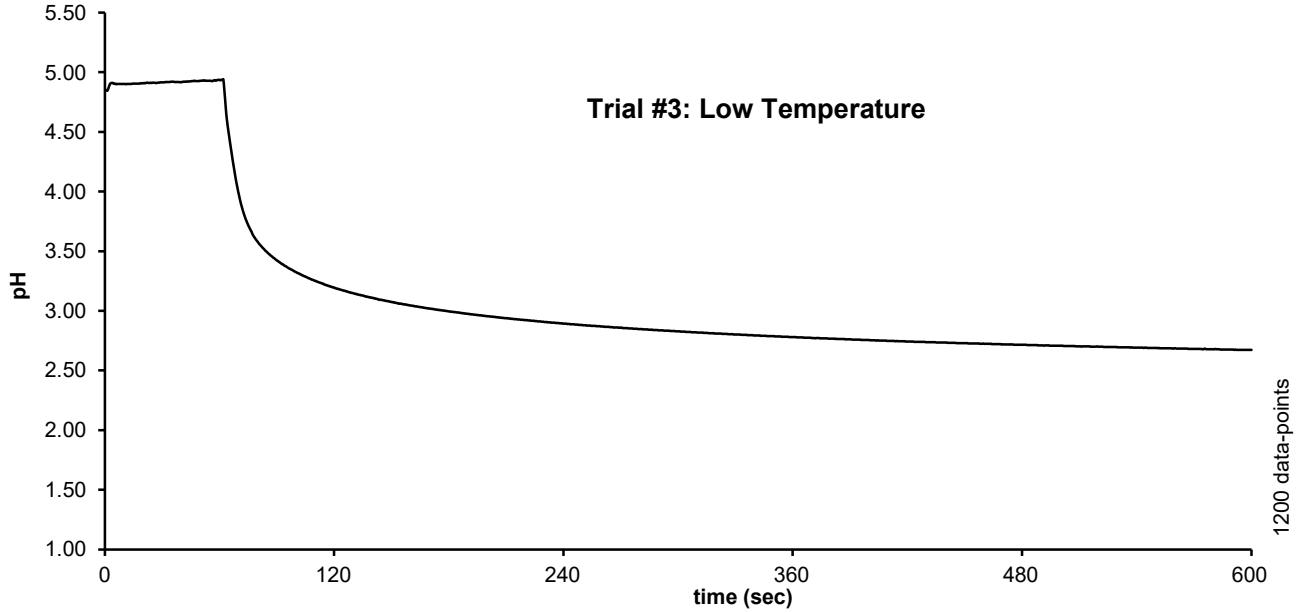
for students at locker # 14

pH Curves for Trials 1 - 3 2.9707 **MN Station # 2**

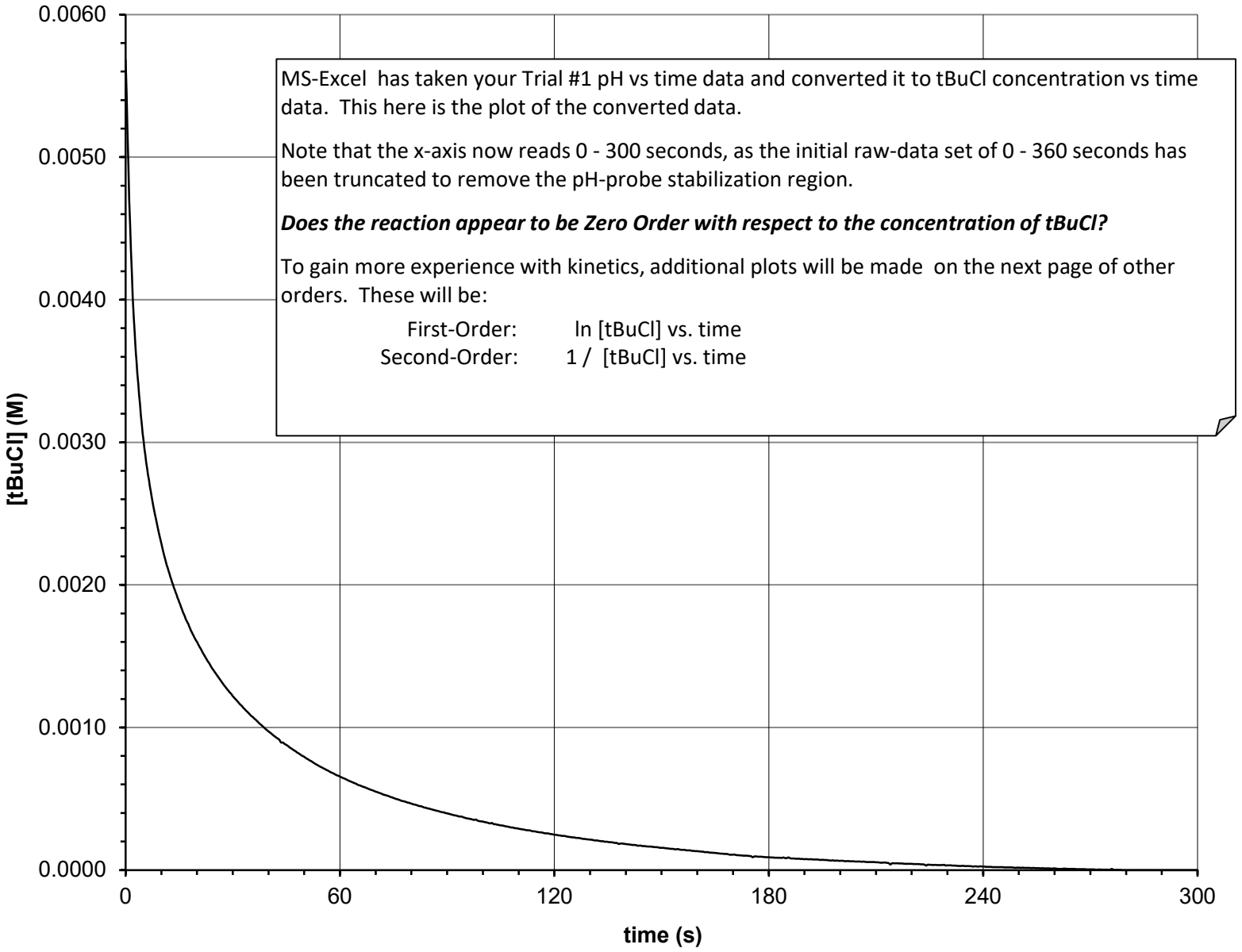






MeasureNet Serial ID: MNDS-006-1-11-J42.9.38.95SanRosa

Trial 1: Hydrolysis of tBuCl at Room Temperature
[tBuCl] vs time; (t = 0 - 300 s)



MS-Excel has taken your Trial #1 pH vs time data and converted it to tBuCl concentration vs time data. This here is the plot of the converted data.

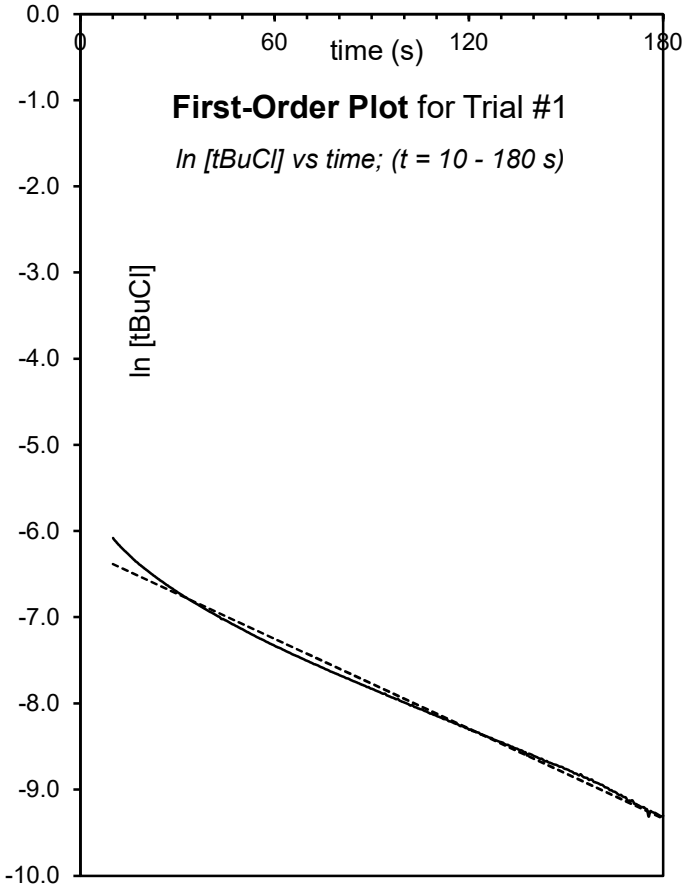
Note that the x-axis now reads 0 - 300 seconds, as the initial raw-data set of 0 - 360 seconds has been truncated to remove the pH-probe stabilization region.

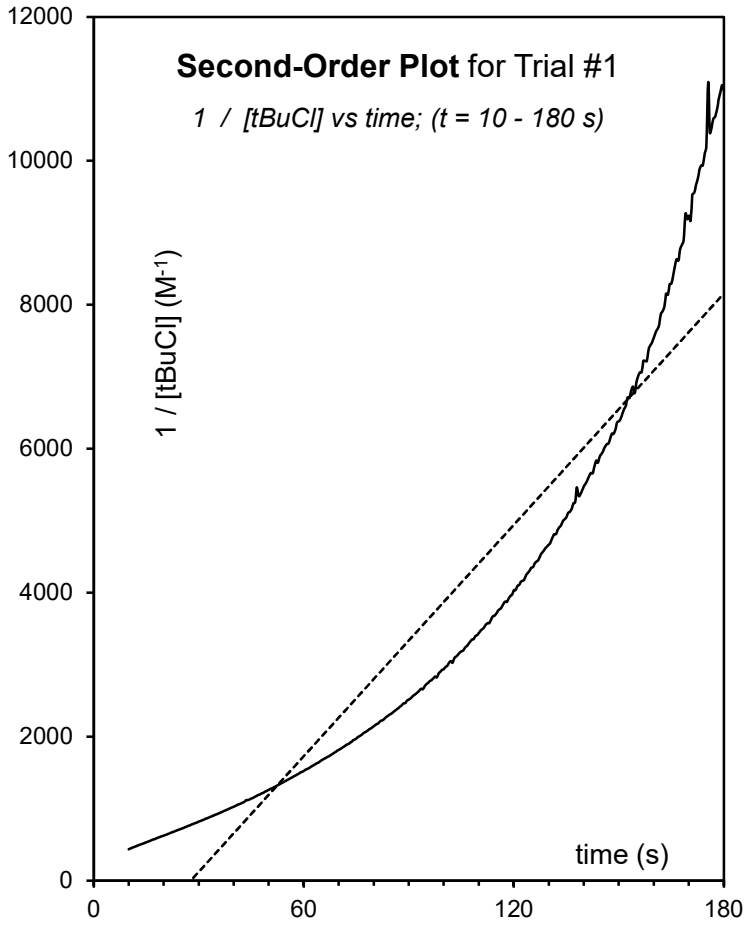
Does the reaction appear to be Zero Order with respect to the concentration of tBuCl?

To gain more experience with kinetics, additional plots will be made on the next page of other orders. These will be:

First-Order:	ln [tBuCl] vs. time
Second-Order:	1 / [tBuCl] vs. time

600 data-points





$R^2 = 0.9931$

$y = -0.01737\ x\ -6.21$

$R^2 = 0.8902$

$y = 73.58809\ x\ -1484$

These are the First and Second-Order plots for Trial #1.

Note that data is not being evaluated over the entire 300 seconds because as we approach t = 300 seconds, [tBuCl] approaches 0.0 M. The first-order operation 'ln(0)' is undefined, while the second-order operation '1 / 0' yields infinity. Plotting such results would yield useless graphs.

These graphs might look slightly different to what you are accustomed to seeing in a textbook, as those graphs usually only show 5 or 6 data-points, and then a line-of-best-fit drawn through them. With our MeasureNet monitored experiments, we have gathered hundreds of data-points, as a pH-reading was taken every 0.5 seconds. The solid line on each graph arises from all of these data-points.

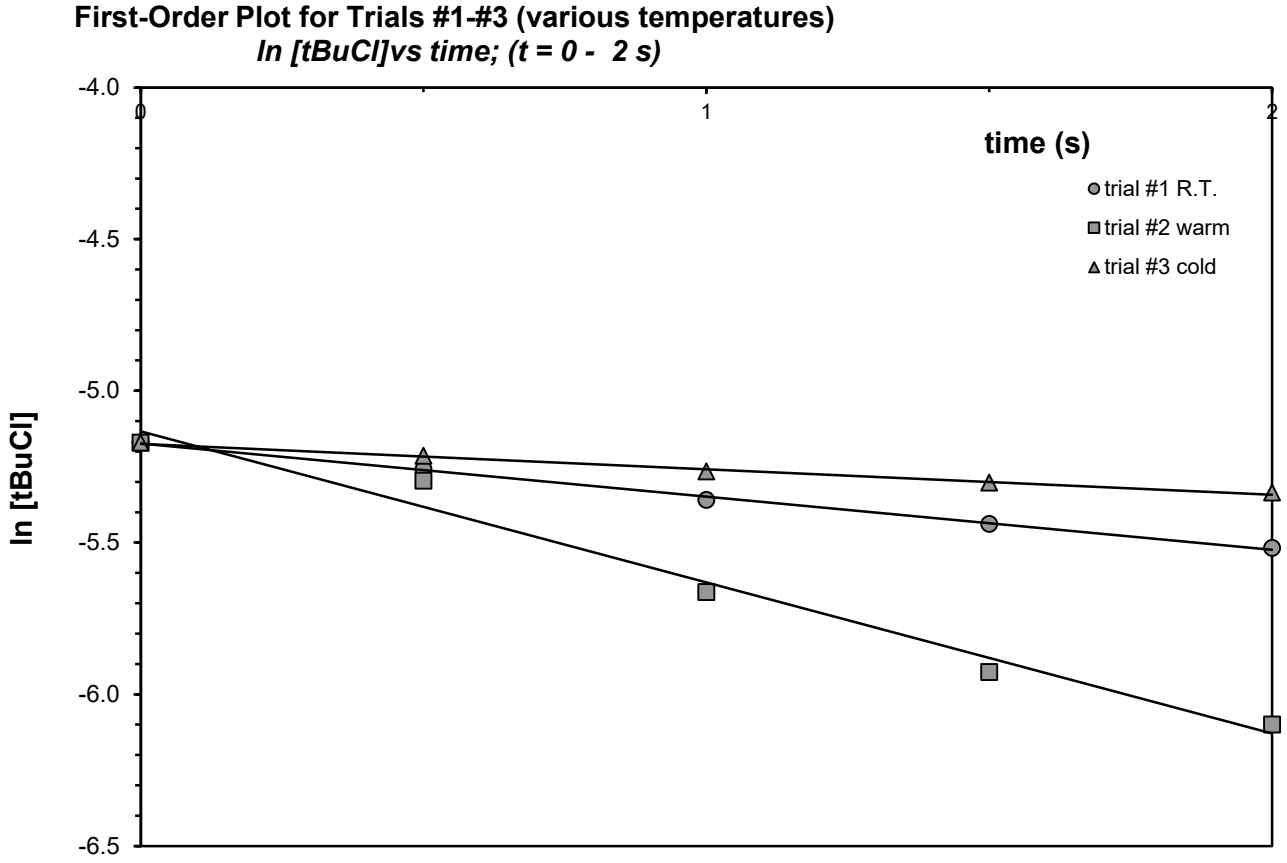
The order of the reaction with respect to tBuCl can be determined by whichever of these two graphs yields a straight solid-line.

For both graphs, the dashed-line is the Excel-generated 'line-of-best-fit'. The equations shown are of the form 'y = mx + b', and the R^2 value is a measure of how well the data fits the line, where an R^2 of 1.0 indicates a perfect fit.

From the integrated rate-laws, the **rate-constant**, **k**, can be calculated from the slope (m) of the graphs:

First-order: k = - slope *units of s^{-1}*

Second-order: k = slope *units of $M^{-1}\ s^{-1}$*



This graph shows the first-order plot for Trials #1 - #3, but only over the time-domain of 0 - 2 seconds so that the very initial rate can be calculated, when the reaction is at it's fastest.

The line-of-best-fit is shown for all three trials, and the table shows the slope and R^2 values for each line.

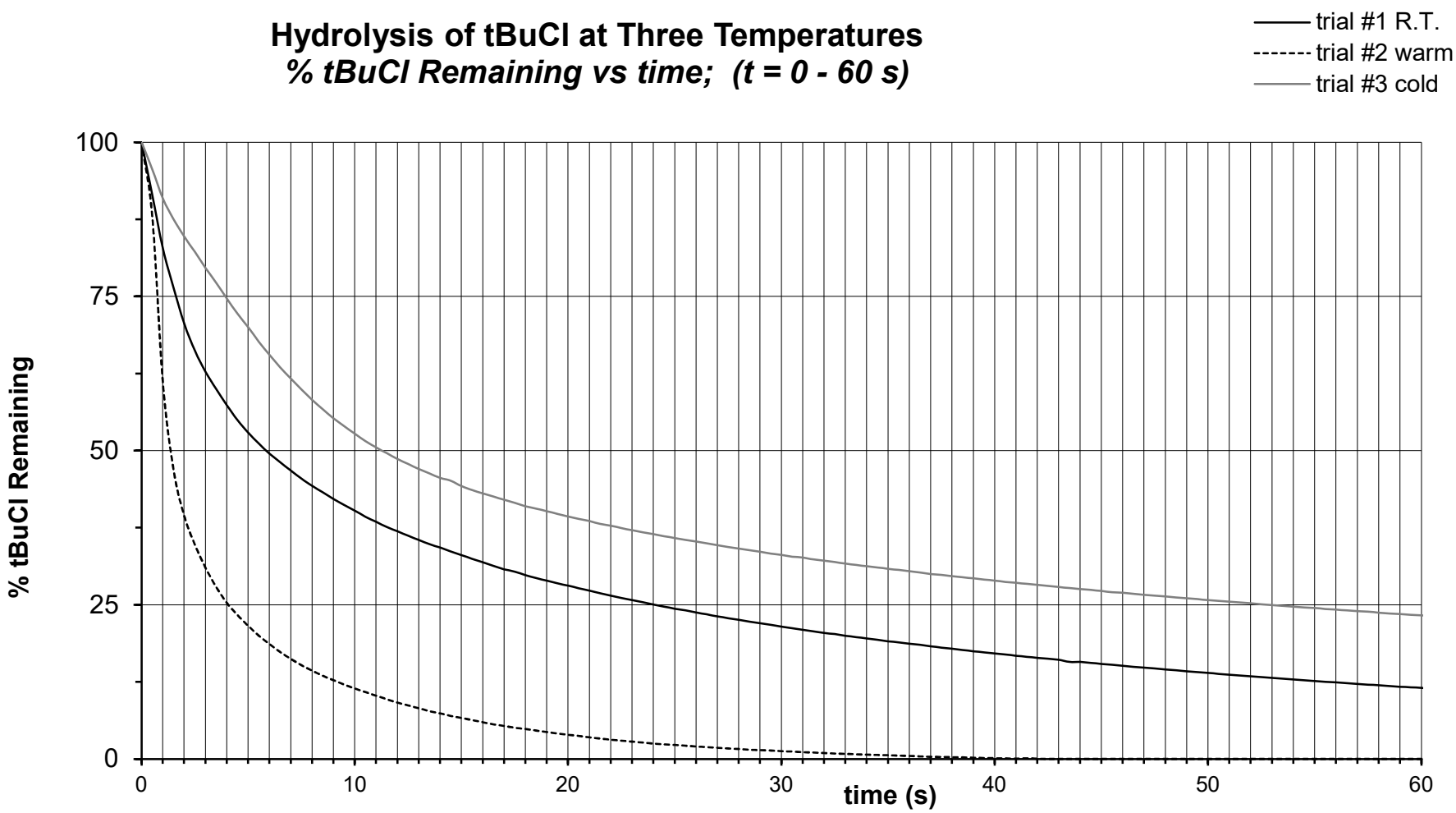
	$y = mx + b$	
trial #1:	**y = - 0.175 x - 5.17**	**R^2 = 0.9978**
trial #2:	**y = - 0.498 x - 5.13**	**R^2 = 0.9798**
trial #3:	**y = - 0.0838 x - 5.17**	**R^2 = 0.9931**

As discussed on Graph #3, the rate-constant, *k*, is the negative of the slope of the best-fit line.

- **Convert the slope-values to initial rate-constants, *k*, for all three trials and record these on your Lab Report Sheet (in units of s^{-1}).**
- **Use the appopriate equation from the lab manual to calculate the theoretical first half-lifes.**

You will now need to use the MS-Excel workbook called **KIN2_Arrhenius_Plotter** to generate an Arrhenius Plot. Your instructor will have already sent this Excel file to your Capilano University e-mail account. Once you have obtained the file, open it using MS-Excel and follow the on-screen instructions.

MN Station # 2



This graph is similar to Graph #2, except that here, the y-axis is a measure of what percent of unreacted tBuCl remains in the beaker. The conversion from a [tBuCl] y-axis to a % tBuCl remaining y-axis is simple. Each data-point (in units of tBuCl M) was simply divided by the initial concentration of tBuCl at t = 0 seconds, and then multiplied by 100. Note that only the first 60 seconds of data have been plotted, so as to magnify the first portion of the x-axis.

Perform on this page the Graphical Determination of Half-Lives:

- find the point on each curve where it intersects with the 50% tBuCl Remaining line.
- drop a vertical-line down from each point to the x-axis.
- estimate, to the nearest 1 s, the time where each dropped-line intersects the x-axis and then record these on your Report Sheet as the First Half-Life.

Be sure to show all of this work directly on this graph page.