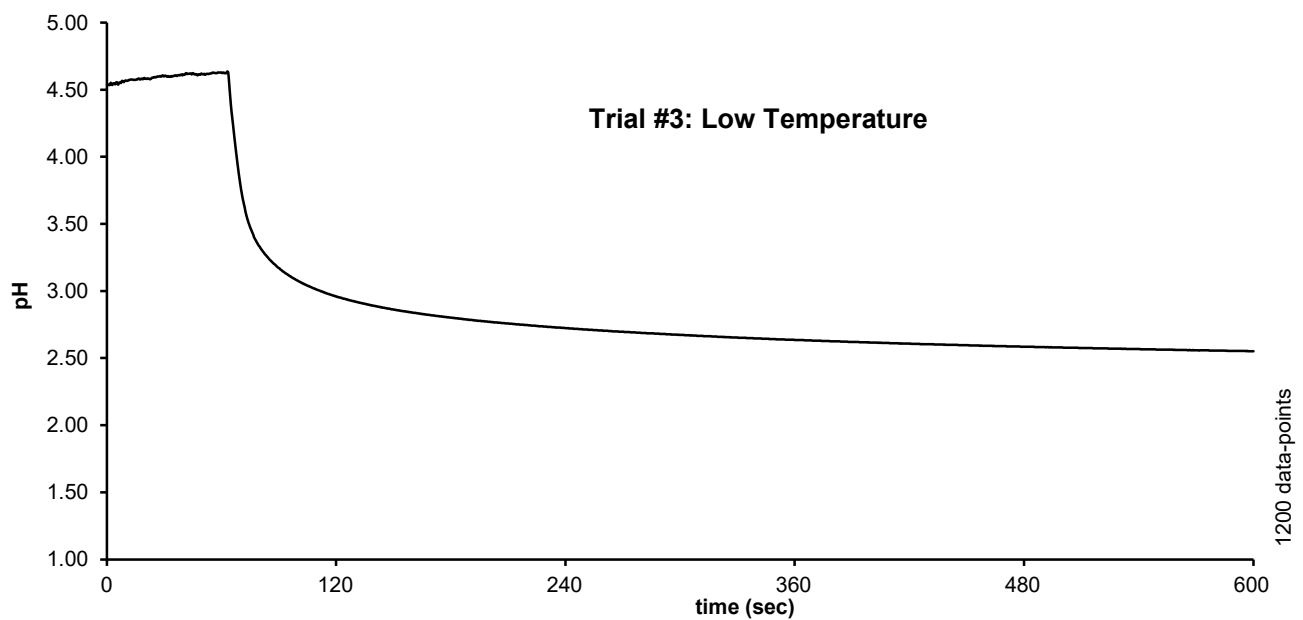
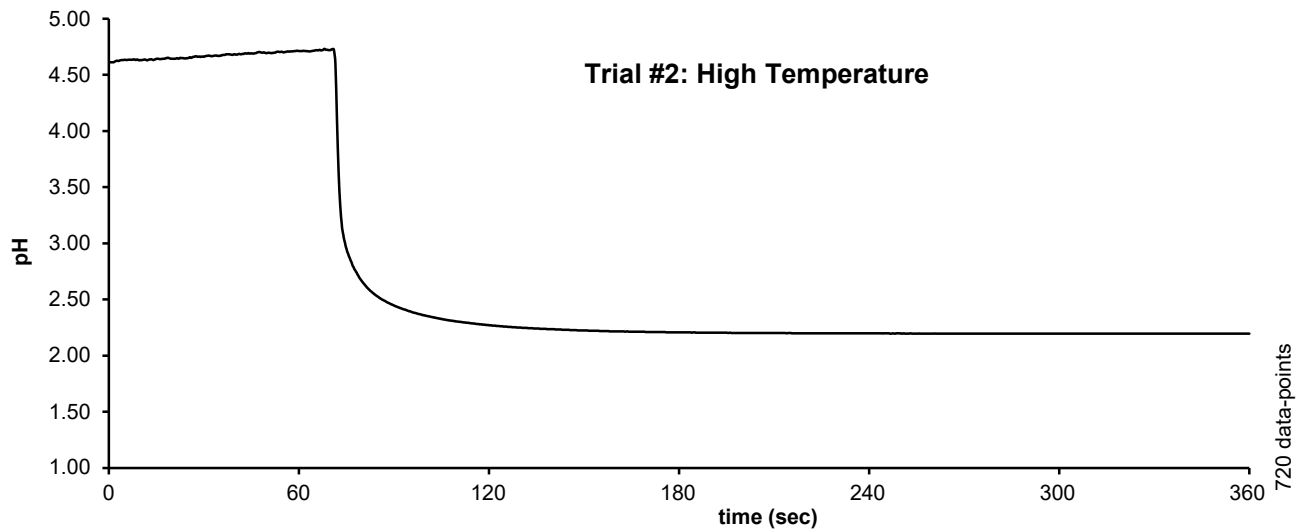
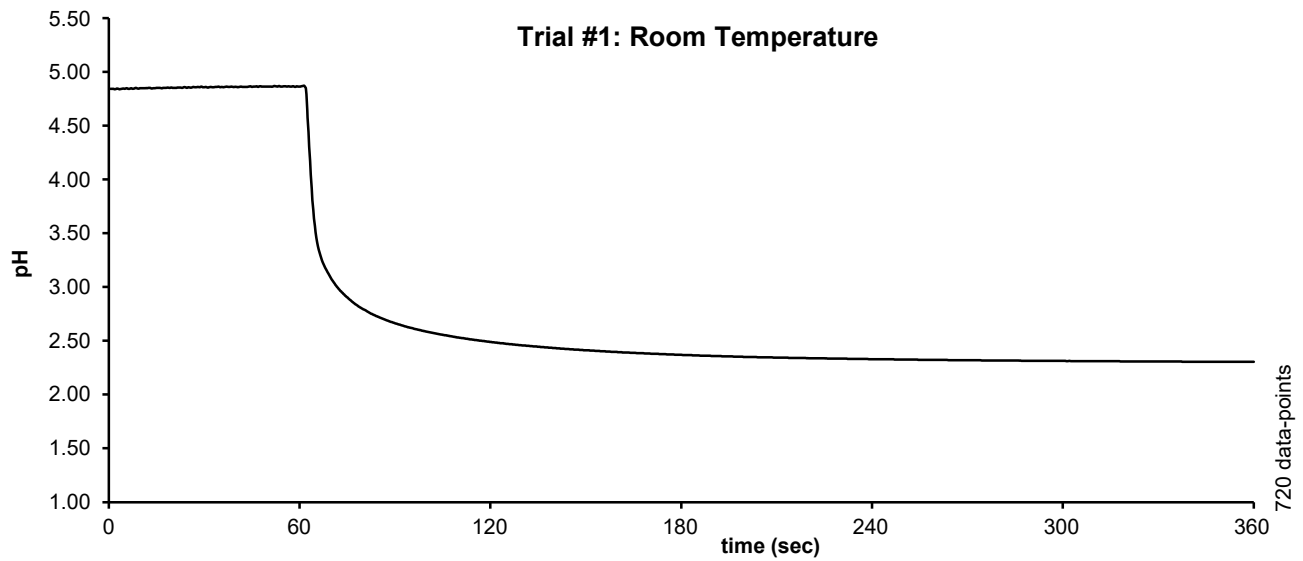
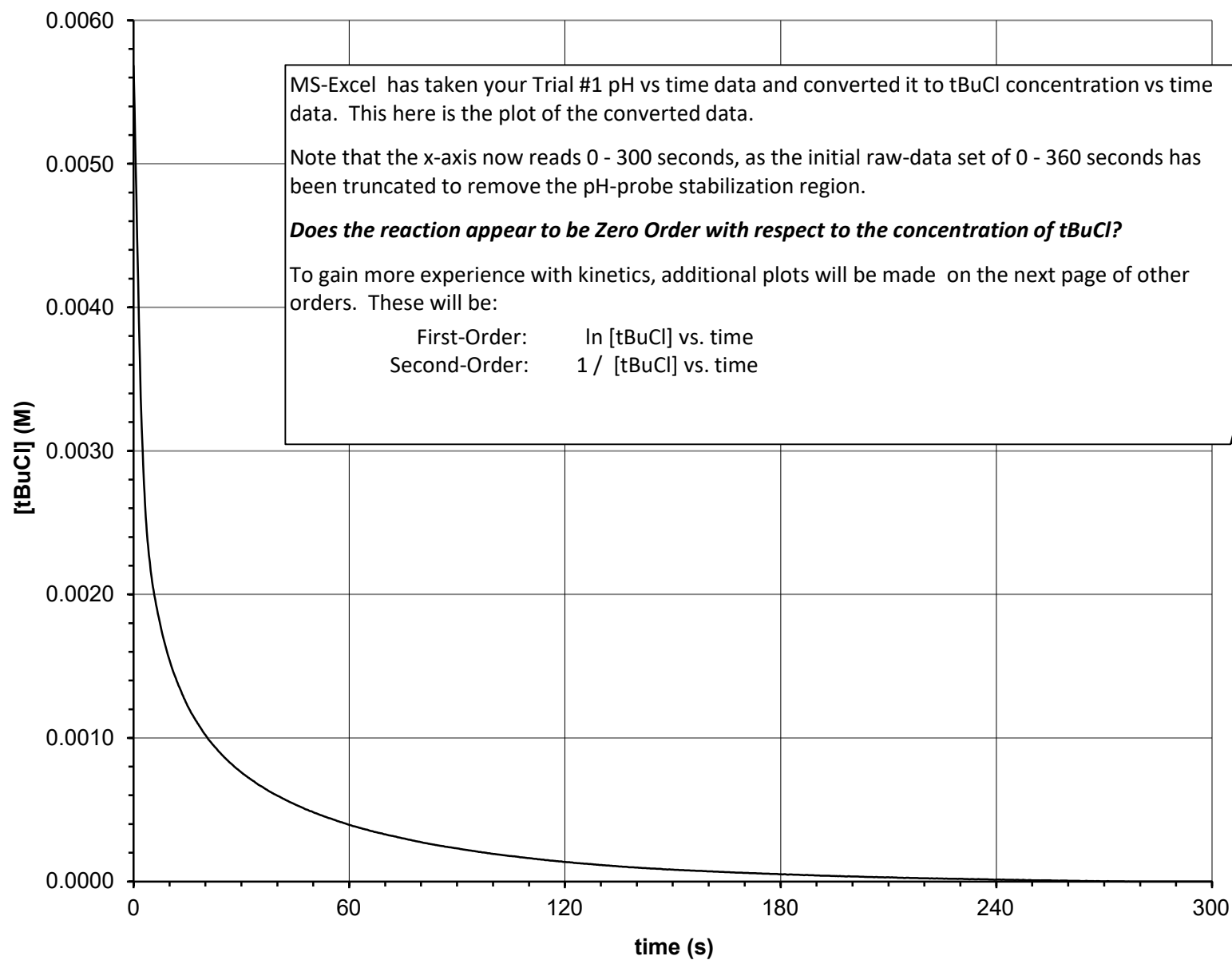
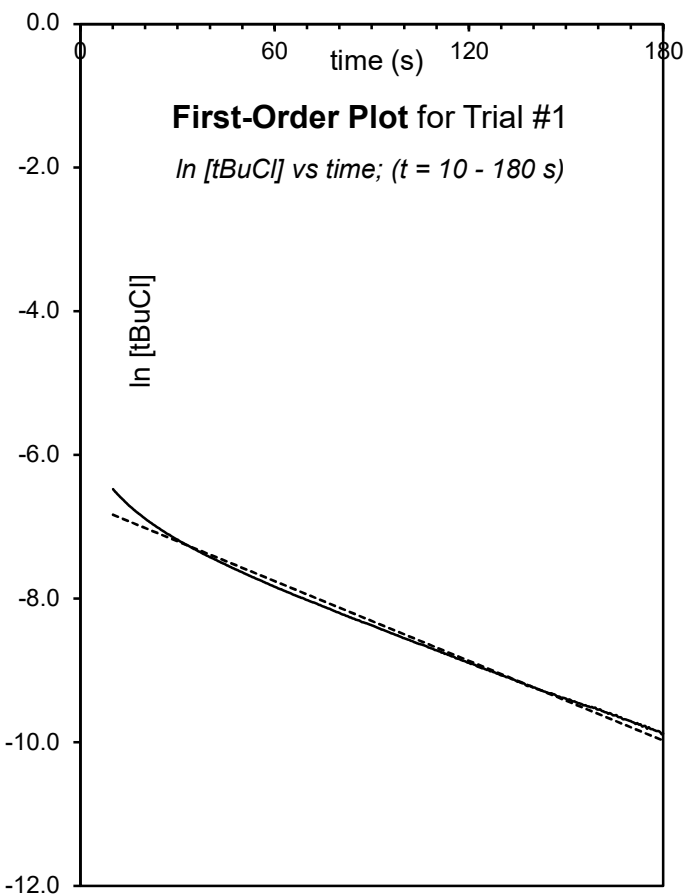




Trial 1: Hydrolysis of tBuCl at Room Temperature
[tBuCl] vs time; (t = 0 - 300 s)

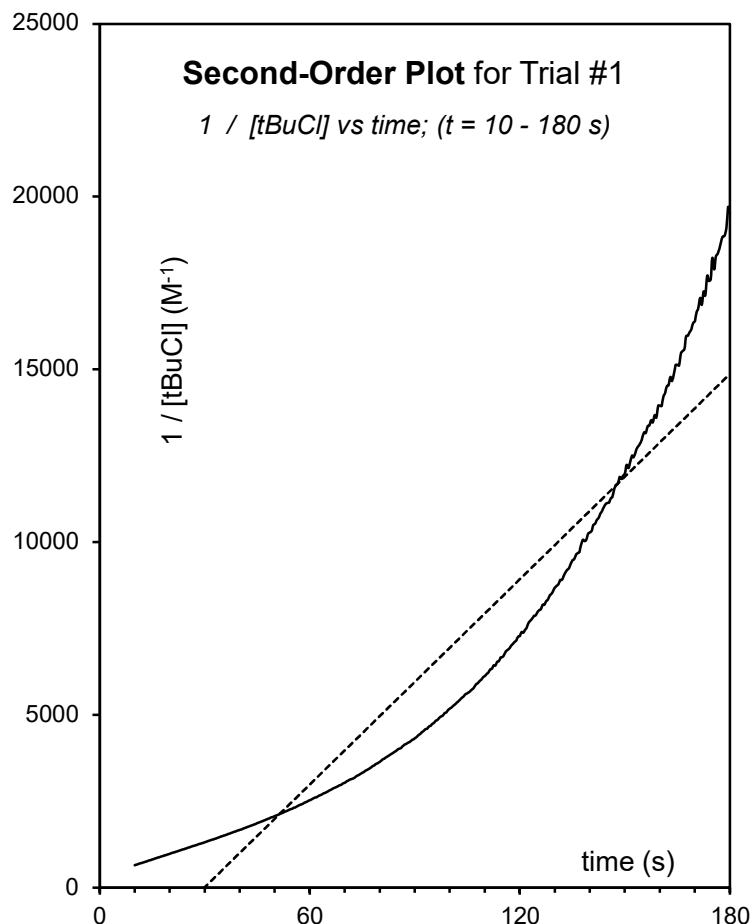


600 data-points



$$R^2 = 0.9920$$

$$y = -0.01850 x - 6.65$$



$$R^2 = 0.9034$$

$$y = 73.58809 x - 2955$$

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.

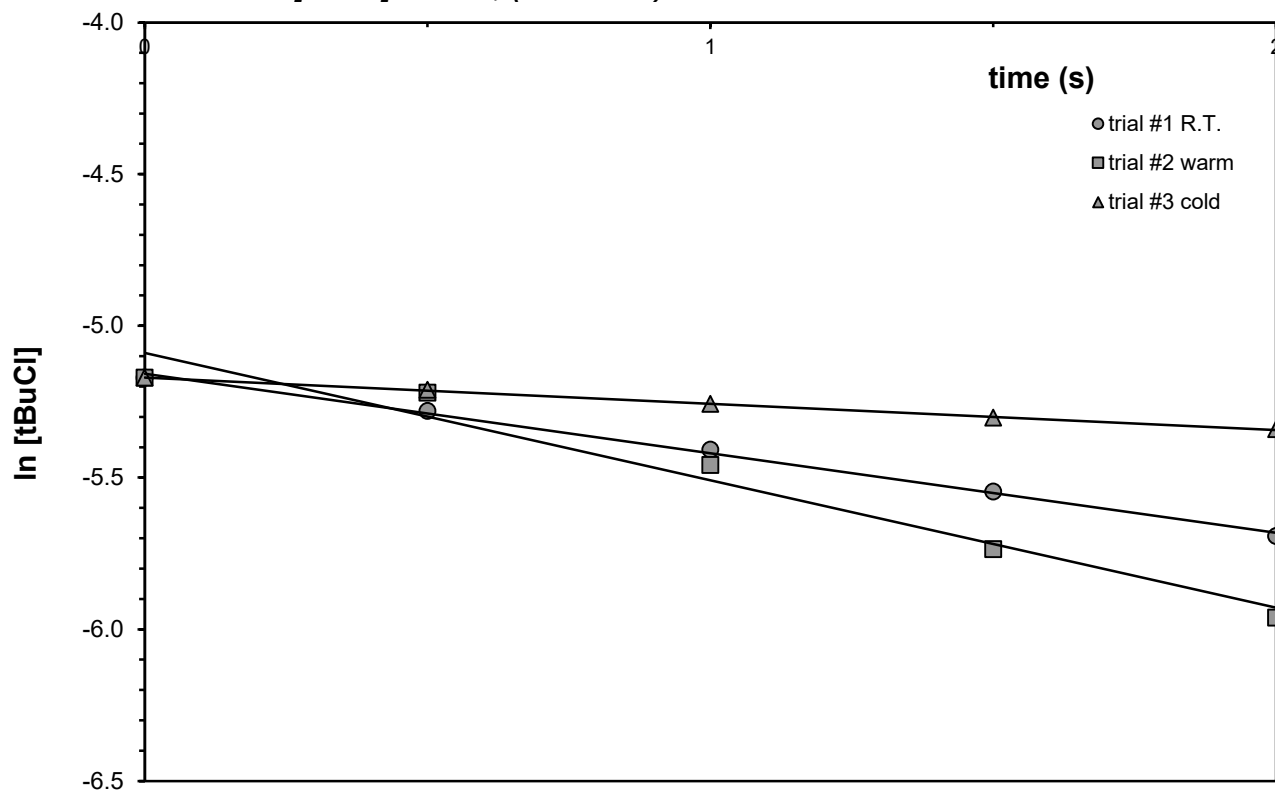
For both graphs, the dashed-line is the Excel-generated 'line-of-best-fit'. The equations shown are of the form ' $y = mx + b$ ', and the R^2 value is a measure of how well the data fits the line, where an R^2 of 1.0 indicates a perfect fit.

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

First-order: $k = -\text{slope}$ units of s^{-1}

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

First-Order Plot for Trials #1-#3 (various temperatures)
ln [tBuCl] vs time; (t = 0 - 2 s)



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:	$y = -0.262x - 5.16$	$R^2 = 0.9970$
trial #2:	$y = -0.42x - 5.09$	$R^2 = 0.9633$
trial #3:	$y = -0.0866x - 5.17$	$R^2 = 0.9989$

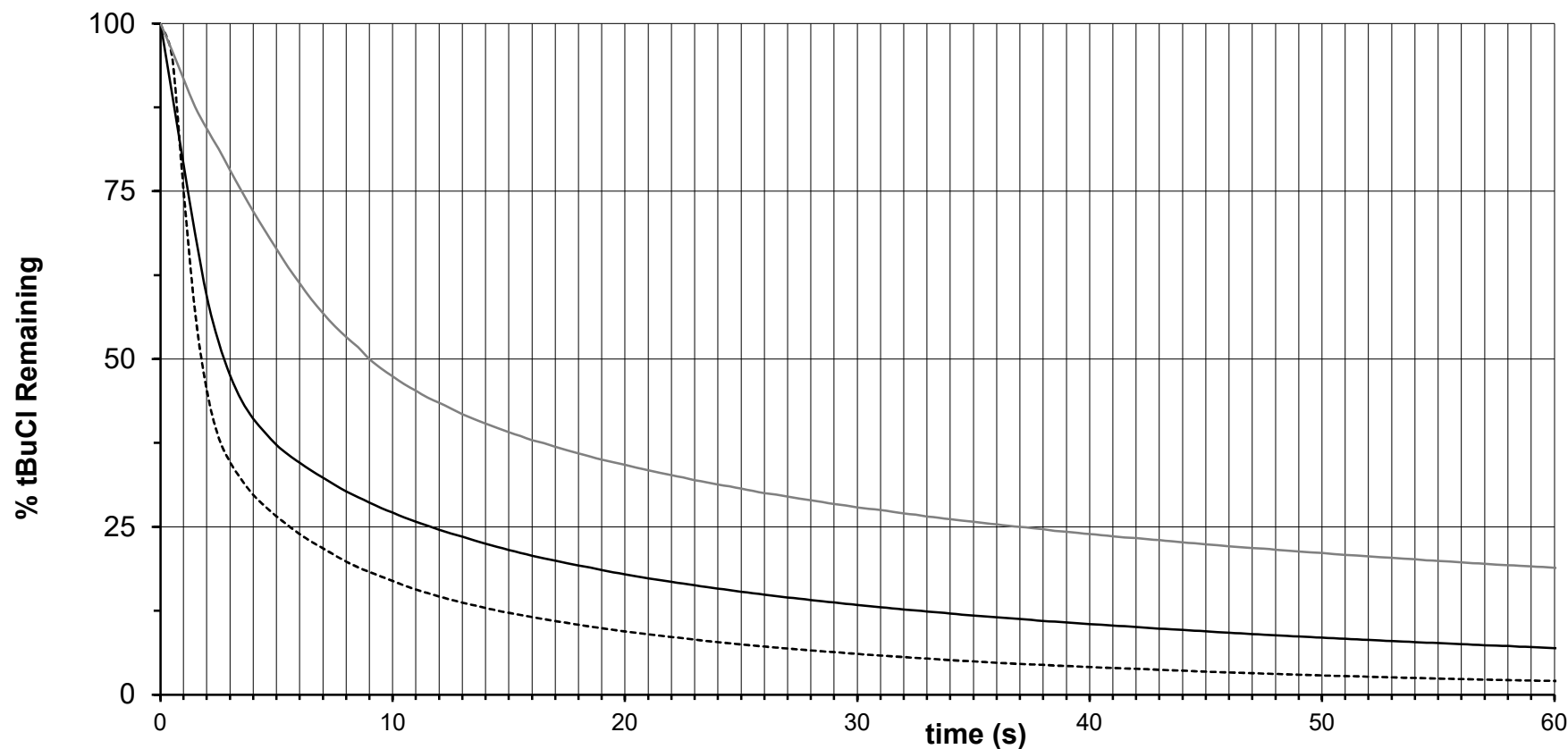
As discussed on Graph #3, the rate-constant, k , is the negative of the slope of the best-fit line.

- 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 appropriate equation from the lab manual to calculate the theoretical first half-lives.

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.

Hydrolysis of tBuCl at Three Temperatures **% tBuCl Remaining vs time; ($t = 0 - 60$ s)**

— trial #1 R.T.
 - - - - - trial #2 warm
 — trial #3 cold



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.