INSTRUCTIONS AND HINTS FOR COMPLETING THE KINETICS PRELAB

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WHAT SPREADSHEET TO USE

Generation of the required graphs is much easier if you use a spreadsheet. The most common ones used are either Excel or Google Sheets. Each have their own advantages, but both can perform all of the tasks that you need, so choose whichever one is more convenient for you.

HINTS FOR COMPLETING THE PRELAB

0. In step 14 of the experimental procedure it tells you the volume and molarity for each solute. Use these to calculate the moles of each. Next use the information (molar mass, density, molarity) given in the Reagents Provided section of the experiment to relate the calculated number of moles to mL or g, as needed.

1. (a) This is a simple dilution calculation for the solution prepared in procedure step 2.
   (b) Use Beer's law.

2. Use Excel or Google Sheets to construct graphs of ln conc vs. time and 1/conc vs. time.
   A. Enter your time data in column A and your absorbance data in Column B of a spreadsheet. Put the column labels (time and absorbance) in row 1 and your data in rows 2-9.
   B. Enter the label **conc** in cell C1. In cell C2, enter the formula: **=B2/xxxx** (where xxxx is the answer that you obtained to question 1(b). For example =B2/1350).
   C. Enter the label **ln conc** in cell D1. In cell D2, enter the formula: **=ln(C2)**.
   D. Enter the label **1/conc** in cell E1. In cell E2, enter the formula: **=1/C2**.
   E. Select cells C2-E2 and copy them (ctrl-C) and then paste it into cells C3-E9 (ctrl-V).

   F. If you are using Excel to generate the graphs:
      a. Select all of your data (A1-E9) and then select the ***INSERT*** menu found in the upper left.
      b. Choose the chart icon which just shows individual points (this is an ***X Y Scatter* chart**). It will give you options for how to connect the points, choose the simplest version with the points unconnected. [If this does not give you a plot with the times on the x-axis, delete the chart and then repeat steps a & b, but choose ***More Scatter Charts...*** and then choose (double-click) on the chart with the time values on the x-axis.]
      c. Choose ***Add Chart Element*** (found in the upper left corner of the screen).
      d. Move the cursor down to the bottom element, **Trendline**. This will cause a new box to appear. Select ***More Trendline Options…*** .
      e. A new box will pop up asking to which plot you want to add the trendline. Select **ln conc**.

f. The **Format Trendline** box will appear on the right. Make sure ***Trendline Options*** tab is selected.
g. It should have **Linear** selected (by default). Select the box in front of **Display Equation on Chart**. You should see the best fit line and equation appear on your graph. Note how linear it is and record the slope and y-intercept.
h. Close the **Format Trendline** box.
i. Repeat steps c-h. But, this time, in step e, choose **1/conc** instead of **ln conc**.
j. You should be able to see whether or not the 1/conc vs time graph is linear. However, to see each graph separately, click anywhere on the graph and then choose ***Select Data*** (top right of the screen). Click in the boxes with the check marks to unselect or select the different series only only the series you want to view is checked.

G. If you are using Google Sheets to generate the graphs:
a. Select all of your data (A2-E9, but NOT the first row) and then select the ***INSERT*** menu found in the upper left.
b. Choose ***Chart***. A bar graph will now appear and the Chart editor will open.
c. Within the Chart editor, select the ***Chart type*** and then scroll down and select ***Scatter chart***. The graph should change to show the points.
d. The Chart Editor should open on the right side of the screen. Make sure that "**Use Row 1 as Headers**" and "**Use Column A as labels**" are both checked.
e. The Chart editor box should show 4 series. Select ⋮ for the absorbance series and then select Remove.
f. Repeat step e to also remove the conc series.
g. Select ***CUSTOMIZE*** (at the top of the Chart Editor). Select ***Horizontal axis***. Make sure that "**Treat labels as text**" is NOT checked.
h. Next, select ***Series***. Then select ***Trendline***.
i. More options will appear. Move down to the **Label** scroll box and change it from **None** to ***Use Equation***. The best fit lines should appear on the graph and the equations will appear in the graph's legend. Record both equations.
j. Given the scaling of the graph, you should be able to see whether or not the 1/conc vs. time graph is linear. To see the linearity of the ln conc vs. time graph, the easiest way to proceed is to reselect ***Setup*** (at the top of the Chart Editor). Then follow step e to remove the 1/conc series. You should now be able to see if the ln conc vs. time graph is linear.

3. No new calculation should be required here. Simply use the slope of your linear graph, as discussed in the Background section of the experiment.

4. (a) Based on the appropriate linear equation, the initial concentration can be determined from the y-intercept:

First-order: $e^{y\text{-int}}$

Second-order: 1/y-int

(b) Refer to equation (5) or (6) of the Background section, as appropriate.