

Entering data and doing repetitive calculations with Excel

(Excel 2016 version)

Entering Data and Using Formulas in Excel

Start by entering preliminary data in columns. Label each column.

If you need to do repetitive calculations on your data before you make a graph, you can have Excel do the repetitive work for you. For example, in the blue food coloring and bleach demo, our raw data consisted of times and absorbances. However, the graphs we will be making will be concentration vs. time, the natural log of concentration vs. time, and the inverse of the concentration vs. time. You'll need to get the data into the correct form before making the graphs. You could do each calculation separately on your calculator, or you could enter formulas so that Excel does these calculations. (This is much easier!)

Each formula must start with = (the equals sign).

Some symbols used in excel:

+ addition

- subtraction

* multiplication

/ division

ln() take the natural logarithm of the number in parentheses

For scientific notation: to input the number 6.022×10^{23} , enter 6.022e23.

If you wanted to input something with a negative exponent, such as 1.3×10^{-4} , enter 1.3e-4.

Using exponents: to raise a number to a power, use the ^ key. 4^2 would be entered as 4^2.

For example, let's assume you entered the following data: (You should enter your data for experiment 1. It will be different than this.)

time (min)	Absorbance
0	0.589
0.25	0.566
0.5	0.544
0.75	0.523
1	0.503
1.25	0.483
1.5	0.464

To have Excel calculate concentrations for you so that you don't have to do it by hand, we'll apply a formula. Since graphs are easiest to make if the x and y data are next to each other with the x values on the left, we'll make another table. (Follow the steps listed on the next page.)

Data for Graph 1

1. Select and copy the set of times to another location in the Excel workbook.
2. Set up the heading of the column next to it to read “conc BFC, M” (concentration of blue food coloring in units of molarity).
3. The handout states that the concentration of BFC (in M) is equal to the absorbance multiplied by 5.0×10^{-5} . To set up the formula, click in the first cell of the new column. Enter “=”, then click on the cell that contains the absorbance at the corresponding time. Type “*5.0e-5” and hit the “return” or “enter” key. If the steps were followed correctly, the result in the cell should be the absorbance multiplied by 5.0×10^{-5} .
4. To repeat this same calculation for the rest of the absorbances, click on the cell you just set up with the formula, and copy it. Drag it down to cover the rest of the cells in the column, and paste. Now you should have a new table with times on the left and concentrations on the right.

Data for Graph 2

1. To set up another table for the next graph, copy and paste the times in a new section of the workbook.
2. Label the next heading “ln [BFC]”. In the first cell, enter “=ln(” and then click on the first **concentration** that corresponds to the first time. Hit “return” or “enter.” Excel should have calculated the natural log of the concentration.
3. Copy this formula from the first cell and paste it to the rest of the cells. Now you have the next data table for the next graph.

Data for Graph 3

1. To set up the table for the inverse concentration vs. time graph, copy and paste the list of times in another section of the worksheet.
2. Label the heading for the next column “1/[BFC]”. In the first cell, enter “=1/”, click on the first **concentration** in the list, and press “return” or “enter”. This should take the inverse of the concentration.
3. Copy this formula and paste it in the rest of the cells in the column, and you’ve got your third data table.

Data for Graph 4

This should be a graph of **concentration** of blue food coloring vs. time for Experiment 2.

1. Enter the times and absorbance readings for Experiment 2.
2. Copy the set of times to a new location in the Excel worksheet.
3. Set up the heading of the column next to it to read “conc BFC, M” (concentration of blue food coloring in units of molarity).

4. To set up the formula, click in the first cell of the new column. Enter "=", then click on the cell that contains the absorbance at the corresponding time. Type "*5.0e-5" and hit the return/enter key. If the steps were followed correctly, the result in the cell should be the absorbance multiplied by 5.0×10^{-5} .
5. Copy and paste this formula in the remaining cells in this column. Now you should have a new table with times on the left and concentrations on the right.

Making Graphs Using Microsoft Excel 2016 (for Windows)

1. Open/Start Excel, and start a new blank workbook.
2. Enter the data for the graph in two adjacent columns. You can start the columns anywhere on the workbook. Include headings at the top of the table. Make sure you list the data for the x-axis on the left and the data for the y-axis on the right. Follow directions on pp. 1-2 of this handout to use Excel to do repetitive calculations.
3. Once all of the data has been listed, select the data (only data, not headings) and from the **Insert** menu, choose **scatter chart**. (The symbol looks like a graph with points, and it is between the pie chart symbol and the spiderweb symbol.) Then, choose the option that shows points but no lines drawn between the points. We will be adding our line later. (If you choose one of the options with lines drawn, Excel will just connect the dots instead of drawing the best-fit straight line. This is definitely not what we want!) A small graph will appear on your workbook.
4. We want all of our graphs to be full-page graphs. In the top right corner, there should be an option to "**move chart**". Click on this, and then choose "**new sheet**". Your graph should then appear full-sized on one of the pages of the workbook, labeled as "chart 1" or "chart 2" or something similar.
5. Using the "**Add Chart Element**" button (the button on the top left side of the page) enter a **chart title** for your graph. Make sure it is very descriptive.
6. Using the "**Add Chart Element**" button, enter **axis titles** (quantities and units) for the x and y axes.
7. Click on "**Add Chart Element**" and then on "**Gridlines**". Choose to display both **major AND minor gridlines** for both the horizontal and vertical axes.
8. Using the "**Add Chart Element**" button, under "**Axes**", choose "**more axis options**". A dialog box will pop up on the right side of the page. Under "Format axis" choose "Axis options" (with a little picture of a bar graph). From this screen, you can manually set the minimum and maximum value of the numbers along the axis. (Sometimes we want to be able to adjust the scales so that the points are spread out more on the page.) You can also set the size of the major and minor

units. Check to make sure that the minor units fit the 1, 2, 5 rule, and if not, change the minor units to something that does.

9. To get the best-fit straight line, under the “**Add Chart Element**” menu, choose “**trendline**” and then “**linear**” (or other, if appropriate). Note that some graphs are not expected to be linear. Do not add a linear trendline to a graph that isn’t supposed to be linear.

Things to double-check:

- Make sure the graph is a full page.
- If you’re plotting only one set of data at a time, remove the legend on the side of the graph. (If we had more than one line on the graph, the legend would be useful, but we don’t.)
- Make sure your graph has a very descriptive title (such as “natural log of the rate constant vs. inverse temperature in the reaction of iodide with peroxydisulfate”).
- Both axes must be labeled with quantities and units.
- The axes should be chosen to spread out the plotted points on the page. If the points are not spread out, you can change the minimum and maximum values for the x and y axes.
- Both major and minor gridlines should be used.
- Major and minor gridlines must follow the 1, 2, 5 rule. Sometimes Excel won’t follow this rule, and you will need to manually change the minor gridline divisions. For example, if the minor gridline divisions are every 0.04, this doesn’t follow the 1, 2, 5 rule. You would change it to either 0.05 or 0.02 instead. Similarly, if the minor divisions are every 0.25, you would need to manually change it to either 0.2 or 0.5 instead.
- The y axis and numbers should appear on the left side of the page. The x axis and numbers should appear at the bottom of the page. If they appear anywhere else (top or right), there is a way to fix it. For example, if your x-axis appears on the top of the page instead of the bottom, format the y-axis with these steps: with the “**Add Chart Element**” button, under “**Axes**”, choose “**more axis options**”. A dialog box will pop up on the right side of the page. Under “**Format axis**” choose “**Axis options**” (with a little picture of a bar graph). On the dialog box, find “**horizontal axis crosses at**” and set it to the lowest number along the y axis of your graph. This will move the x-axis to the bottom of the page.

Checklist for Graphs

Make sure to read and follow the directions in the graphing handout.

- The graph is a full page.
- The graph has a descriptive title. It lists the y vs. x quantities and includes the reaction or situation. For example: "Absorbance at 630 nm vs. concentration of blue food coloring in the reaction of blue food coloring with bleach" or "mass of beaker and liquid vs. volume of liquid". The vertical axis is the y axis and is stated first, and the horizontal axis is the x axis.
- The axes are labeled with quantity and units.
- The numbers along axes are evenly spaced "round" numbers.
- The numbers shown along axes are not too close together.
- The scale along each axis is chosen to spread out the plotted points on the page.
- The 1, 2, 5 rule is followed (each square should be equal to some version of 1, 2, or 5: for example 1, 2, 5, 10, 20, 50, 0.1, 0.2, 0.5, etc. This means that it will be easy to estimate between the lines.)
- If the graph is done on a computer, both major and minor gridlines are shown for both axes. Double check to make sure that the minor gridlines follow the 1, 2, 5 rule.
- The plotted points are clearly shown.
- No plotted points are outside the boundaries of the graph.
- The labels (title, axes, etc.) are not cramped and are easy to read.
- If the graph is a linear relationship, a single straight line is drawn (using a ruler) that averages out all of the data. (Single points that don't fit the trend can be ignored.) If you are using a graphing computer program, have it draw the best-fit straight line.
- If the graph is a curve, a smooth curve is drawn among the points.

Calculating the slope of the line

Please show this process and calculation even if you create the graph on a computer.

- The points chosen for the calculation of the slope are far apart on the graph. (Why?)
- The points chosen for the calculation of the slope are indicated clearly.
- The points chosen for the calculation of the slope are NOT data points. (Why?)
- The x and y values of each point are estimated correctly.
- The x and y values of each point have the correct precision. (Estimate to one-tenth of the smallest division. If each division = 0.1, then estimate to ± 0.01 . If each division = 2, then estimate to ± 0.2 . In this case, values from the graph should end in an even digit and have one decimal place. If the smallest division is 0.5, then estimate to ± 0.05 , and make sure the values estimated from this graph end in a 0 or a 5 and have two decimal places.)
- The slope calculation is shown clearly, with the correct **units** and the correct number of significant figures.
- All work is clear and easy to understand or follow.
- If needed, the y-intercept is calculated correctly.
- If needed, the equation of the line is expressed correctly, including appropriate numbers and units for the slope and the y-intercept.