

INTRODUCTION TO MAKING GRAPHS USING EXCEL®

Background

Excel is constantly changing so use this tutorial as basic guidelines. Excel may switch location of some items or rename items but the basic concept remains unchanged. Whether graphing by hand or using a spreadsheet program, a graph should contain the following:

- i) A descriptive title (such as: “Boyle’s Law”, the Inverse Relationship between Pressure and Volume of a Gas at Constant Temperature”).
- ii) Clearly scaled and labeled axes, including units. For example: Volume (mL), Pressure (torr).
- iii) A curve or straight line drawn through the set of plotted points such that the points straddle the line equally.
- iv) A method by which the slope of a straight line is found.

What is a spreadsheet? Excel is a spreadsheet program equivalent to a data table with a built-in calculator and graph generator. Enter: **Start > Programs > Excel > New**
The “**New**” button opens a new file and the screen will look like this:

	A	B	C	D	etc
1	(cell A1)				
2					
3					
4			cell (C 4)		

The boxes are called *cells*.

Cells can be selected by using the white cross cursor, which is moved with the arrow keys or mouse.

A selected cell will be framed with a bold border.

A whole column or more than one column can be selected with the white cross cursor.

Making a Data Table.

Type in your data, preferably in ascending or descending order of magnitude. If data was typed in random order, or you need to change from ascending to descending order or vice versa, use the menu: **Data > Sort > column A** (and/or other columns can be selected) **> ascending** (or descending) button. For example:

A		A	
1. 9.8		6.6	↓ ascending order of magnitude (or you can select descending order)
2. 6.6		9.8	
3. 39.4	has now been converted to: →	15.8	
4. 26.3		26.3	
5. 15.8		39.4	

It is critical that the data be organized in ascending or descending order!

EXAMPLE:

Given below is a table of data showing the relationship between pressure and volume for a hypothetical experiment: Enter this data into excel for you to use as practice.

Actual Volume	Gauge Pressure
(mL)	(psi)
60.0	6.6
40.0	9.8
25.0	15.8
15.0	26.3
10.0	39.4

(1) You might ask yourself: “How do I do calculations in a table?”

- Converting entered data in one column to new values in another column.

For example, if the data in column **B** represents “gauge pressure” in psi units, and you may want to convert the values to torr units then place those values in column C,

- 1) Move the white cross cursor to cell C1 and click on it.
- 2) Type the following: = (that’s the equal sign on the keyboard)
- 3) Move the cursor to cell B1 and click on it
- 4) Continue typing: / 14.69*(shift 8) 760 (* is multiplication)
- 5) Hit the *Enter* button
- 6) Move the cursor away from column B and C to somewhere else
- 7) Click on an empty area.
- 8) Move the cursor back to cell C1 and click on it. The cell will be framed and there is a small dark square in the bottom right corner of the frame.



- 9) Carefully move the white cross cursor onto the small square until the cursor becomes a black cross. Left click with the mouse and hold the left button down, while you drag the cursor down to the cell adjacent to the last cell in column B that has data. All the data in column B has now been converted to torr units in column C.

If you have several columns of data like this you may wish to label the columns, as in this sample, with text. Be sure you don’t highlight any of these text cells in further applications, along with the data cells. If you used text in cell C1, then highlight C3 (instruction 9 above).

	A	B	C	D
1	Volume	Pressure	Pressure	
2	mL	psi	Torr	
3	60	6.6	341.4568	
4	40	9.8	507.0116	
5	25	15.8	817.4268	
6	15	26.3	1360.654	
7	10	39.4	2038.393	



Check your answers, did you get the same values as to the left?

(2) How do I plot data on a graph?

Each edition varies to some degree, look for the general concepts mentioned below.

1. The easiest way is to hit the “chart icon” button, on the upper menu. Start by selecting the data with the white cross cursor, starting with cell A-3 and dragging the mouse to the opposite corner (for example cell B-7 or C-7. The first cell you clicked on will remain white, but the rest of the block will appear as white numbers on a black background.

2. Find the Chart Icon button at the top of the spreadsheet; it looks like a little bar chart, with vertical blue, red and yellow bars. Click once on the button, and the chart box should appear somewhere in your screen. Choose **XY scatter** and click on it. Then choose the chart sub-type (large square button with only points showing). Don't select line yet. Click **next**.

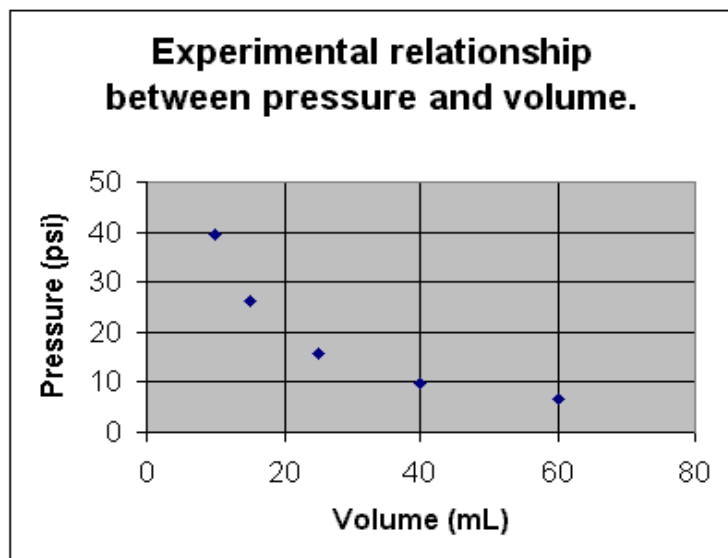
3. Click on **series**, then **remove** if there are any series present in the box.

4. Click on **add**, then move the cursor to the right and choose the colored icon at the lower right (this refers to the y-axis).

5. Now the data will appear. Select column C data boxes with the white cross cursor and click on the y-axis icon in the lone rectangular bar appearing on the table

6. Repeat steps 4 and 5, choosing the middle icon in step 4 for the x-axis, and selecting column A data boxes. A small sample graph will appear, and some boxes – fill these in to label the graph and the axes. For example: Title: *Boyle's Law: the Relationship between Pressure and Volume*. Axes: Pressure (torr), Volume (mL). You may select the gridlines tab and check it. Selecting a legend is probably unnecessary. Click **next**.

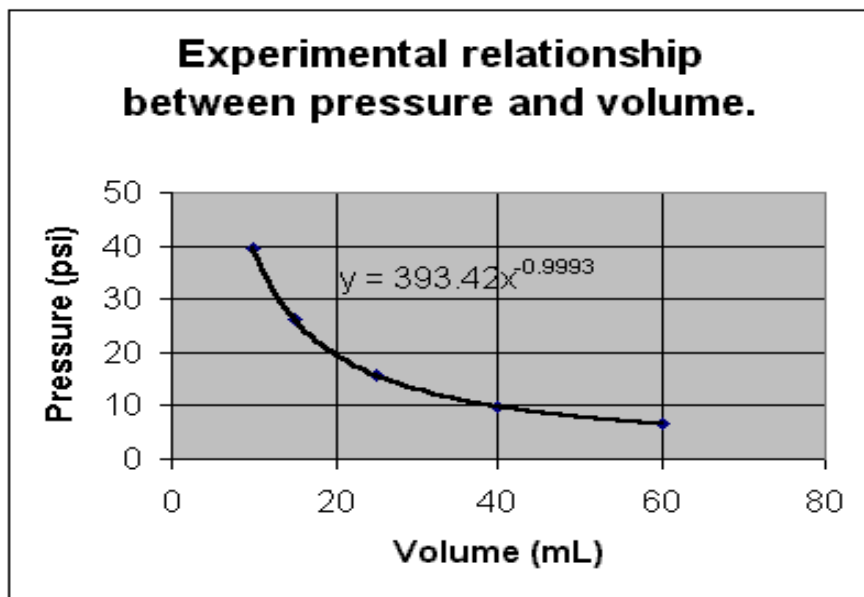
7. If you wish to display your graph along with the data in the cells, select “as object in” option. The graph's size may be adjusted by moving the cursor to a corner of the box with the graph, and dragging it along the page while holding down the left button on the mouse. Your graph will look something like this, with only the points showing.



(3) Data Analysis: Drawing a Line through the Plotted Graph

Excel allows us to get a graph that is a best-fit curve or straight line through the set of data points.

1. Click with the cursor anywhere on the graph, on the gray field. Then go to the top of the screen and find the **Chart** tab. Click on it. A pull down menu will appear. Select **Add trend line**. For type, choose **power** (if your graph is a curve) or **linear** if your graph should be a straight line.
2. Click on **Options**, choose **Display equation on chart** then **OK**. You may wish to print (hit printer icon or file – then print – then ok.)

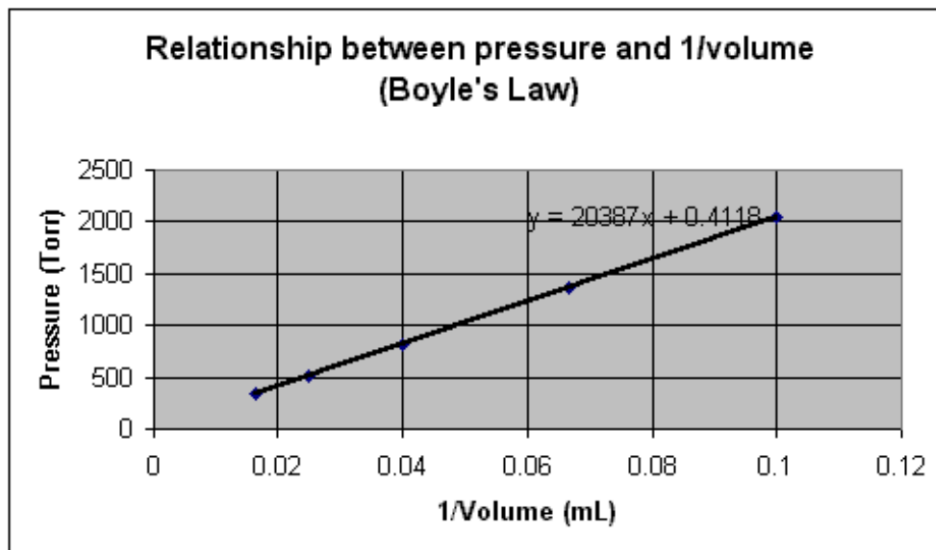


(4) Further data analysis

More analysis and graphing possibilities. For example, if you have text in cell A1, the data in column A of the cells, can be converted from volume to inverse volume (1/V) by typing in column D the following: =1/(click on A3), removing the cursor, reselecting box D3 and moving the cursor to the lower right corner of D3 until the white cross becomes a black cross, then carefully holding the mouse button drag the black cross cursor down until it is flush with the last cell in A that contains data.

	A	B	C	D
1	Volume	Pressure	Pressure	1/V
2	mL	psi	Torr	mL ⁻¹
3	60	6.6	341.4568	0.016667
4	40	9.8	507.0116	0.025
5	25	15.8	817.4268	0.04
6	15	26.3	1360.654	0.066667
7	10	39.4	2038.393	0.1

This data may now be graphed, and analyzed by plotting P (torr) vs. $1/V$ (mL^{-1}). You repeat instruction 4, selecting column C after instruction 4, then proceed with instruction 5. Do this again for the x-axis with the data in D. Complete instructions 7-9. You will now have a graph that has an equation of a straight line, with a slope and y-intercept.



- (5) **Extrapolation:** The line equation in the form: $y = mx + b$ can be used to extrapolate values that lie outside the range of data gathered. Excel allows you to actually graph a set of extended points that are prepared by selecting and highlighting one or more columns of data with the white cross cursor, then placing the cursor on the lower right corner of the frame with the small dark square. Use the black cross cursor to drag down. Values will appear in the column(s) and you just need to drag as long as you want until you get the desired range of extended values. These can be plotted as before. Just make sure you use the **Data > sort > ascending or descending** options if you need to prior to extending your set of data. On the above graph for instance, you may want the data in descending order so you can extend to 0 or a little past 0 to negative values. This way, you can graphically see the y or x intercepts.
- (6) **How to prepare a quality presentation:** To prepare your graph for publication, you may wish to clear the gridlines on the worksheet and put your name and data at the bottom of the paper. Eliminate the gridlines by pointing to one of the lines with the mouse cursor and click with the right button, then select **Clear** from the pop-up menu. Put your name on the page by going to **File** then **Page setup**. Delete the default header (stuff at the top of the page) by selecting the **Header/Footer** tab and selecting **none**. Now you may enter info about the project or lab in the header. Select **custom header** and type in your project title etc. A sample title is: "Graphing Assignment Problem 1". Delete the contents of the footer box and replace with your contents in the same way; select **custom footer** and type in your name in the left section and the date in the right section. Select **OK** and the page is ready to print. Save your file by selecting **File** and **Save** as and you may want to save it on floppy disc A.