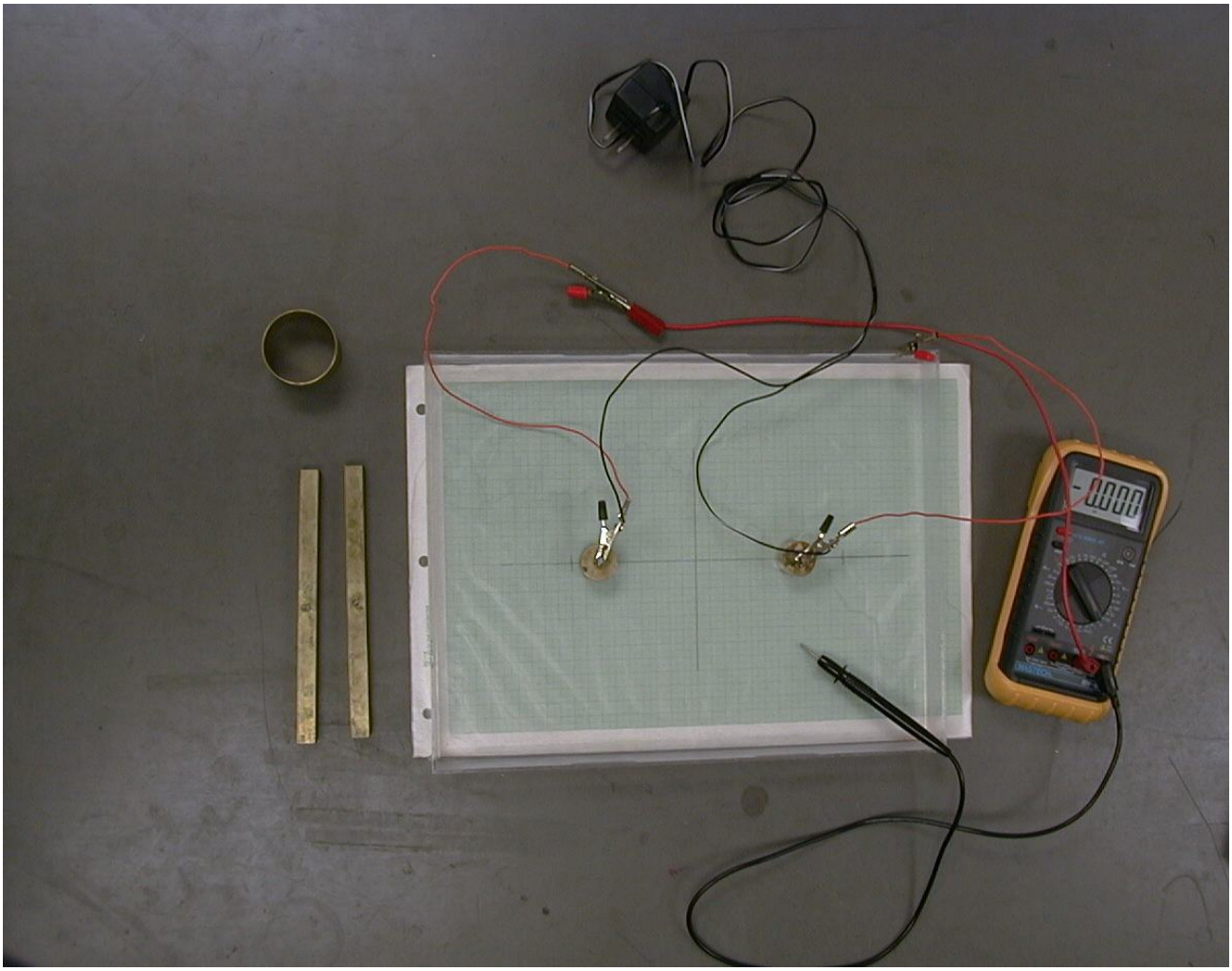
Lab #2 - EPF

This lab requires that you submit the typed *Abstract* and *Conclusions* sections to Canvas along with scans of your Introduction, Analysis, and Error Analysis sections that you do in your notebook, and your graphs. Also attach a Cover Sheet to the front of your work and your signed bottom portion of the FAQ about Plagiarism.

Be sure to set your DMM to read AC volts, this is the scale with the sine wave symbol (looks like ~) rather than the flat-line DC symbol.

Your setup for the electric field should resemble the following picture. The graph paper is **metric**! It says so right on the edge of the paper. The major divisions on the paper mark *cm* and the smallest divisions are *mm*.



Section D.3

Don't be fooled by the marks you may see on the graph paper under the water tray. These may NOT be at the ± 7.0 cm spacing that you need to use.

For the symmetry check, measure along the *entire x-axis*, including the space on the far side of each of the electrodes. Things may get confusing when you try to measure near the cylinders. If you can't record certain values because they are too close to one of the cylinders, skip these values and continue on the other side of the cylinder.

When you enter your data into Origin to make a plot of potential vs. position along the x-axis, be certain to enter the data from the smallest value of x (most negative number) to largest. Various Origin routines will malfunction if the x-axis data is entered in an arbitrary order.

Section D.5

You may have to skip some numbers very close to the hollow cylinder. It is difficult to measure near the edges of the cylinder without bumping it and moving it, which will cause all of the readings to shift.

Section E.2

For your plot of the electric field for the parallel plate setup, be careful about your choice of a scale for the y-axis. The electric field is roughly constant along the y-axis between the plates. If you let Origin choose a scale for you, it may use a scale that overly emphasizes the 'noise' in your data. You should pick a scale that encompasses the smallest to the largest field that might be found anywhere in the water tray for this experiment. A rough guess at these values should suffice.

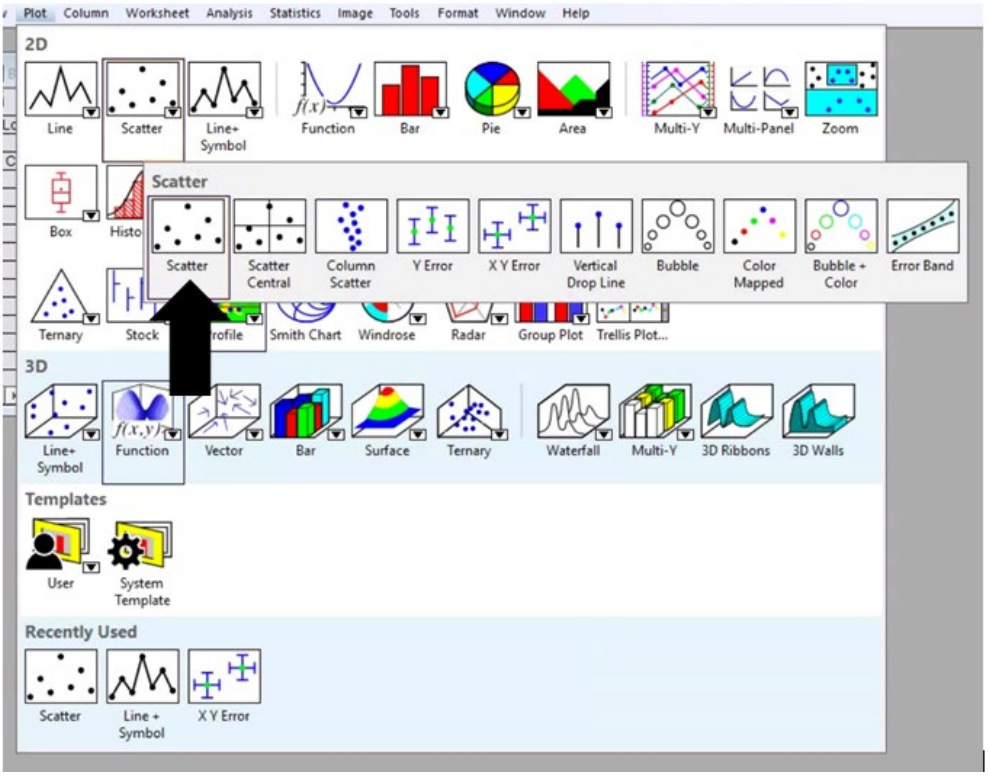
Lab 2: EPF - Origin Guide

Origin is a fickle thing, updates rather more often than is easy to keep track of. As such, with our current version, here is a visual aid to help make sense of the instructions given in the lab manual.

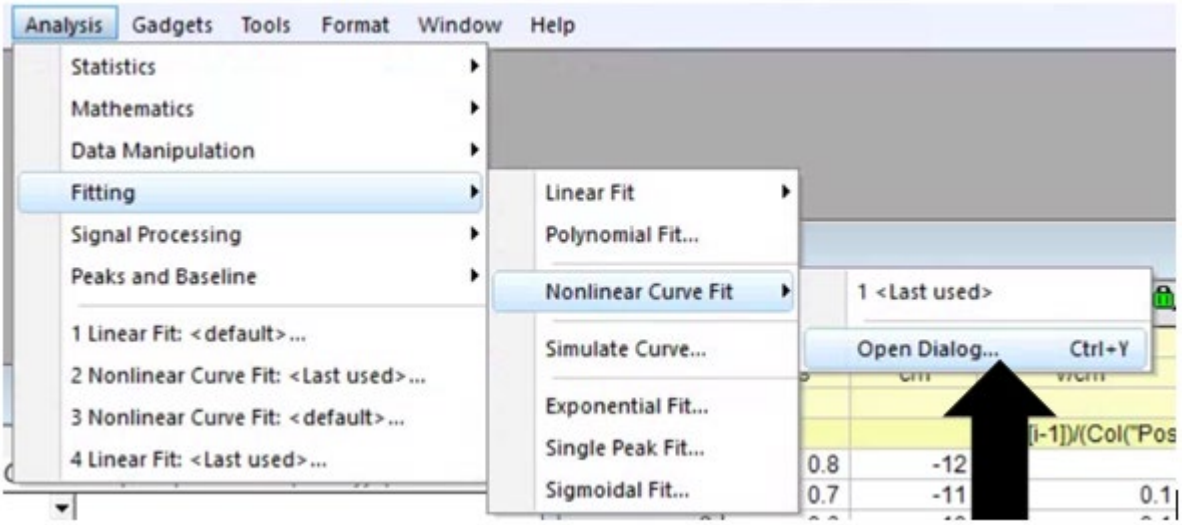
Section D3:

After taking your data, follow these steps to plot and analyze it within Origin.

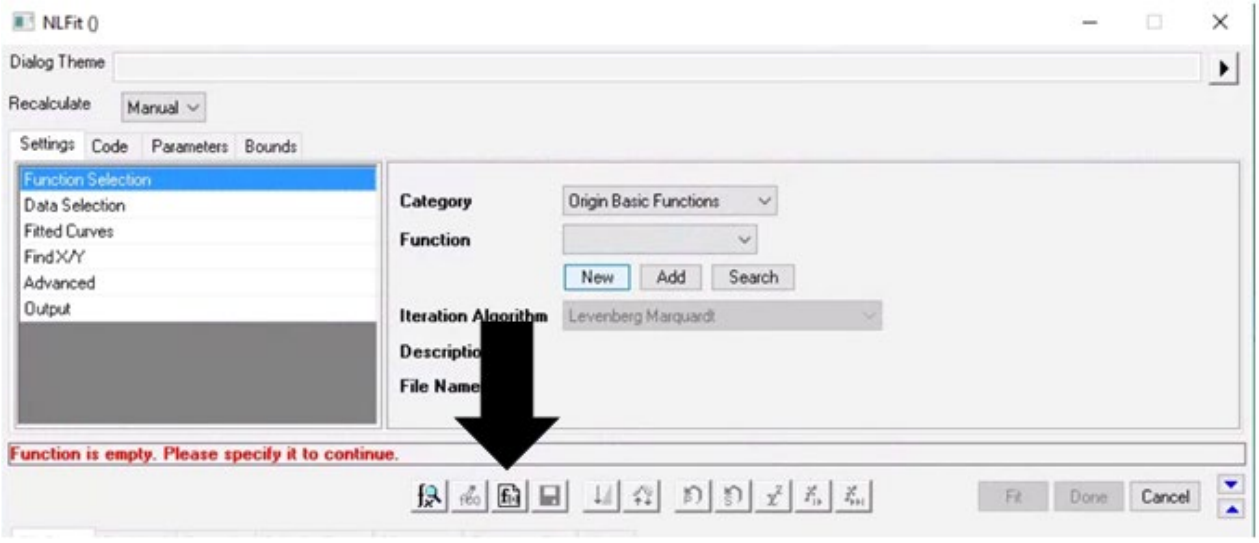
1. Plot Voltage(*V*) vs. *x*



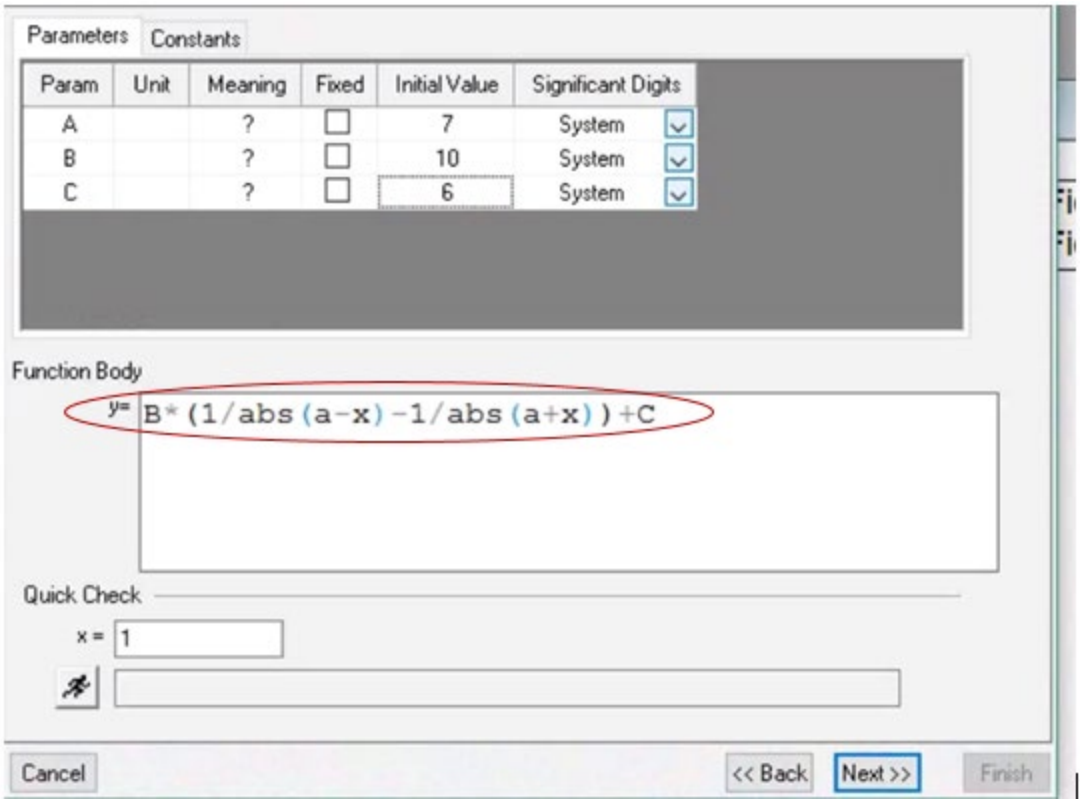
2. Select ANALYSIS from the menu bar. Go to FITTING --> NON-LINEAR CURVE FIT --> OPEN DIALOGUE. (Do not choose "Last used" as it will rarely do what you actually want.)



3. Click CREATE NEW FITTING FUNCTION button, which looks like a white page with a "f(x)" on it. Name your function something, honestly it won't matter all that much, but choose something that makes sense.
    a. Press NEXT and put the following information into their respective spaces (capitalization is important here):
        i. Indep(endant) Var(iable): x
        ii. Dep(endant) Var(iable): y
        iii. Parameters: a,B,C



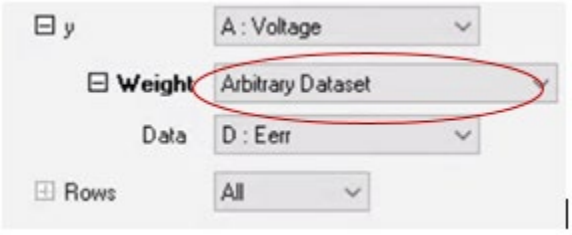
b. Press NEXT again, and under INITIAL VALUES in the small table, input 7 for a, 10 for B, and 6 for C (if you did centimeters; If you did meters, use instead .07, .1, and .6 respectively).



c. In the space labeled FUNCTION BODY, input the following formula: (DO NOT COPY DIRECTLY FROM THE LAB MANUAL! The formula there has a symbol which will copy over incorrectly and create an error.)

B*(1/abs(a-x)-1/abs(a+x))+C

d. Press NEXT one more time, and then press FINISH. If you did it correctly, moving the dialogue box should allow you to see a red line on your graph.



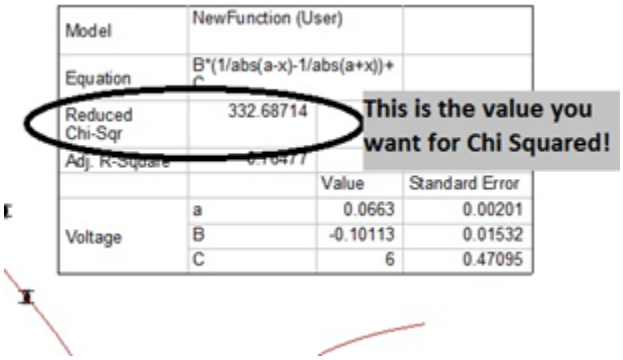
4. Near the top-left of the box should be a few spaces you can click on; choose DATA SELECTION.

a. Find IMPUT DATA and press the small plus to the left, if it hasn't already been expanded.
b. Continue to expand RANGE 1 and "y".
c. There should be a drop-down menu for WEIGHTING METHOD. Choose ARBITRARY DATASET.
d. Another drop-down list should appear. Choose your y-error column. If you do not have a y-error column, stop what you are doing and make one!(Then start back at Stage 4, no need to do Stage 3 again.)

5. There are two buttons here that you should press, one is 1-ITER(ation) and ITERATE UNTIL CONVERGED.

a. Press the 1-ITER button first, and look at what shows up below in the white space. If you see any red text there, call your TA over to see if they can help you spot the error. Otherwise, press the button to the right of 1-ITER and then press DONE.

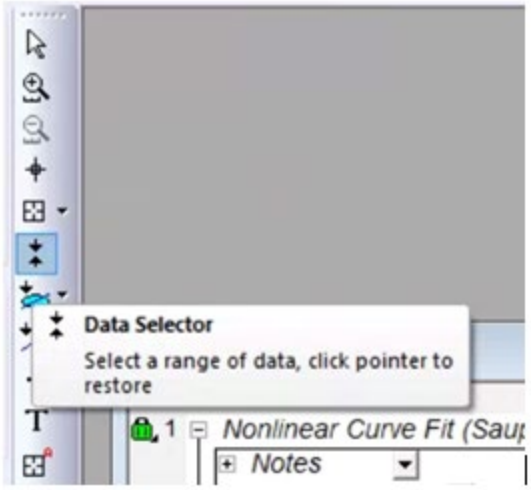
6. You now have a Fit line! A text box should appear along with your line on top of your graph. Move that box somewhere nice, and look for where it asks for Chi-Squared. This is the value that you will need to put on your worksheet (along with "a," of course!)



Section D4:

In this section, it asks you to plot over a limited set of your data. To do that, you need to press the DATA SELECTION button, which looks like two arrows pointing

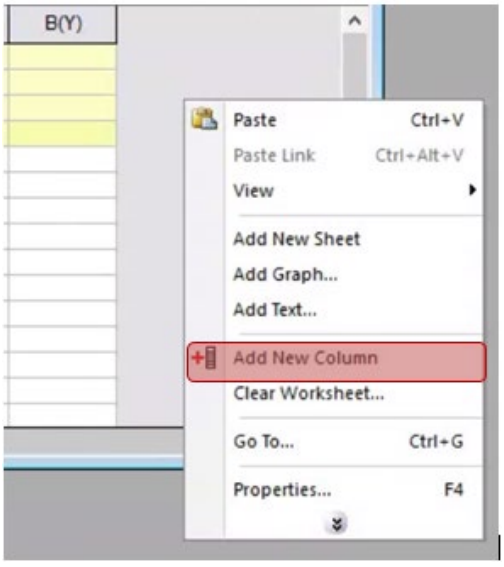
at each other, and is usually on the **LEFT SIDE OF THE SCREEN**. After you press that, click and drag to the starting and ending points of the selection that you want, in that order. If you mess it up, click the DATA SELECTION button twice and try again. You should see a few vertical lines follow your cursor as you move the selection. These help tell you which point you are selecting, so pay attention to them!



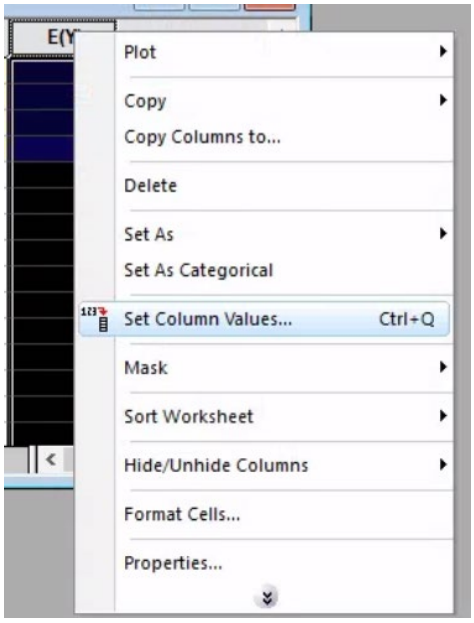
Section E2:

In the last section of the Analysis, you will be asked to plot Electric Field vs. *x*. Two origin-related things with be asked of you: filling a column with a special formula, and plotting another nonlinear fit line. For the special formula, follow the following instructions:

1. Make two more columns by right clicking on the grey space in the table and pressing CREATE NEW COLUMN (or, if you feel adventurous, find and press the button which does the same).

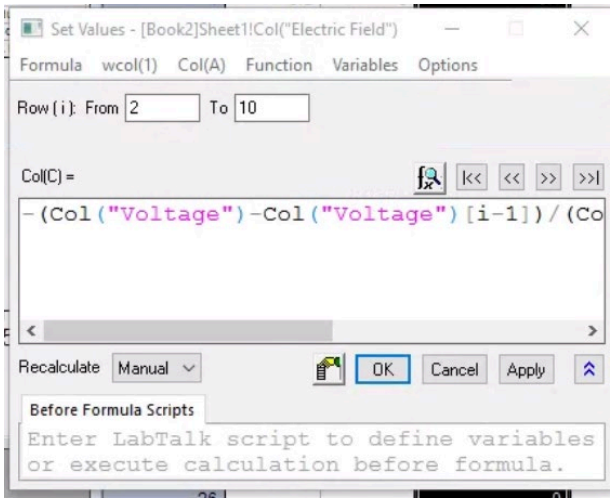


2. Right-click on the first of the new columns and select SET COLUMN VALUES. A new screen will appear.

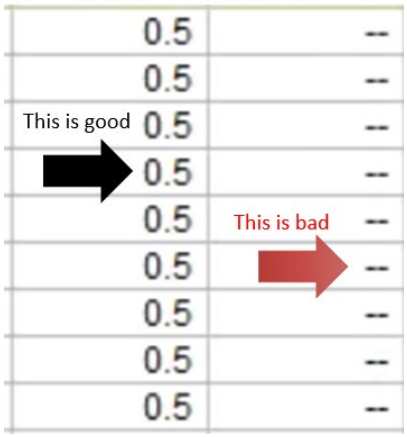


3. Near the top will be a set of boxes for the range. You must change them from <auto> to "2" and the row of your last value. If you don't do this, you will not get any numbers.

4. In the large middle box will be where you put your formulas. You must use a proper syntax when dealing with this. For the Electric Field, your formula should be `(COL(B)-COL(B)[I-1])/(COL(A)-COL(A)[I-1])`. The `I`'s are what tell origin to deal with the values point-by-point, and give you your field. Position will be an average of two points, do you think you can figure it out? *HINT* the answer is in the lab manual.



5. When you finish with a specific column, press apply, and see if you can see numbers in the new columns. If you only see dashed lines, you have an error somewhere in your formula or range.



Plotting and Fitting are the same as in Section D2, except that your fit formula is based on Equation 9 instead of Equation 8. You will need to figure that equation out on your own, but your TA can help you if you get stuck.

RC-CIR and LCR

In the LCR and RC-CIR labs, there are points at which you will need to do a non-linear fit. You can follow the same directions given here for section **D3.** The only differences are that in RC-CIR, the equation you need is an easier exponential (plus a linear fit for the residuals) and in LCR, you need only use a pre-written formula that Origin already has, so you don't need to do half the steps!