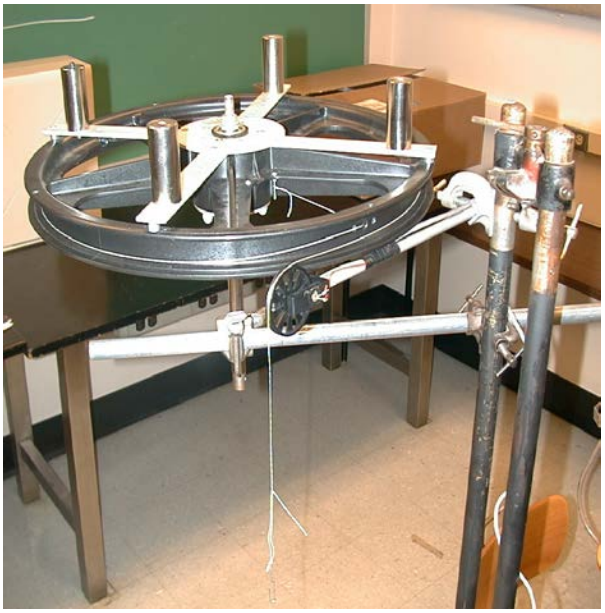
Lab #5 – RKE

The picture below shows the experimental setup for this experiment. Make sure that your wheel is reasonably level (what will the motion of the wheel be like if it is not level?).



Section D.1. Generating Simulated Data, Paragraph 1:

The equations given for the moments of inertia for a disk and a ring include a term '*M*'. You need to use the mass of the Roto-Dyne wheel, not the mass of the hanging weights.

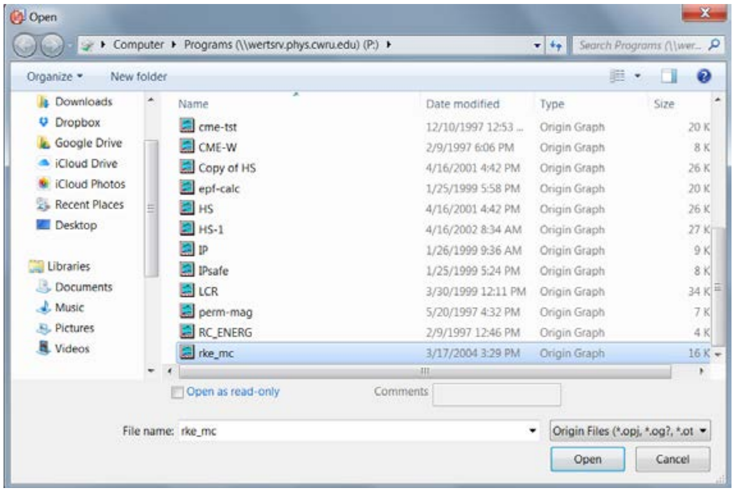
Lab 5 - RKE: Origin Guide

R(otational)K(inetic)E(nergy) is the most Origin-intensive lab in the mechanics section. Pictures for most of the very basic operations have been left out, as you should be quite competent at using Origin at this point.

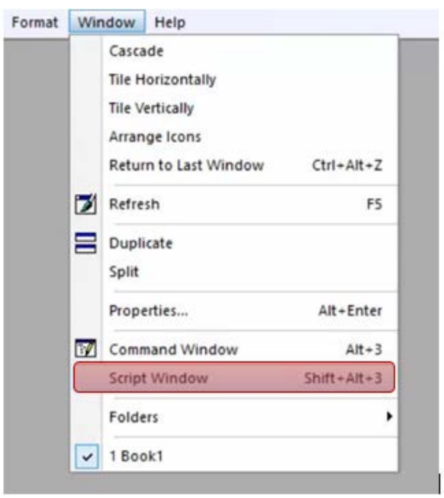
Part D: Monte Carlo Simulation

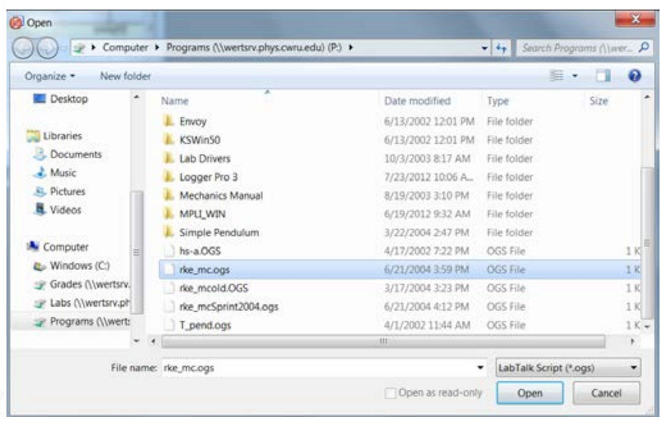
This is one of the biggest problems with this lab is getting the Monte Carlo Simulation to work correctly. If you follow the steps outlined below, you should have no problems testing it and applying your analysis to your experimental data.

1. In Origin, go to *File->Open* and navigate to *P:\rke_mc.obj* (if you can't find this, ask your TA.) If you did this correctly, Origin should open something interesting.



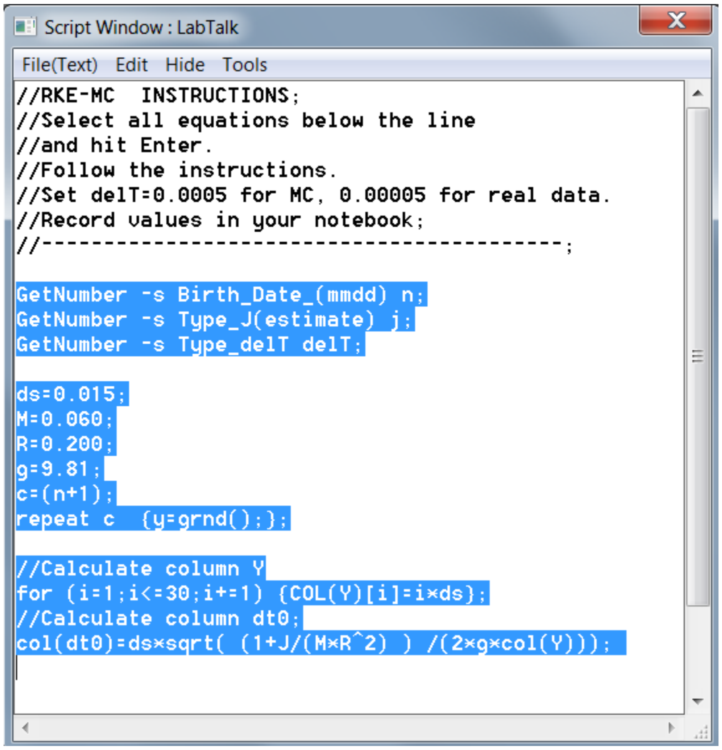
2. In the menu bar, go to *Window->Script Window* and this should open up a smaller dialogue box. **Inside the dialogue box**, go to *File->Open*, navigate to *P:\rke_mc.ogs*, and open it. If you can't find it, ask your TA for assistance.





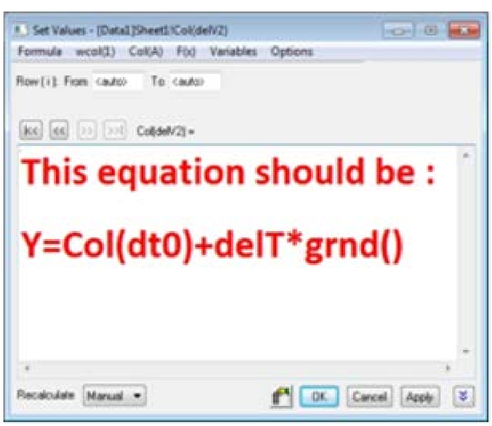
3. Follow the Lab Manual, and copy the equations you see to your notebook; you will need them later.

4. Select everything below the dashed line and press enter. The script should run now, and ask you for a few numbers. They are, in order, your date of birth (MMYY format), your estimate of the moment of inertia for your Roto-dyne wheel (J), and the error in time, which for this part is equal to .0002. Press OK or GO.



5. **Save your file**. Make sure that you *Save As* instead of just *Save* or else you may accidentally overwrite the template file. Place the file into your folder on the *L:* drive, so you can access it from other computers in the labs.

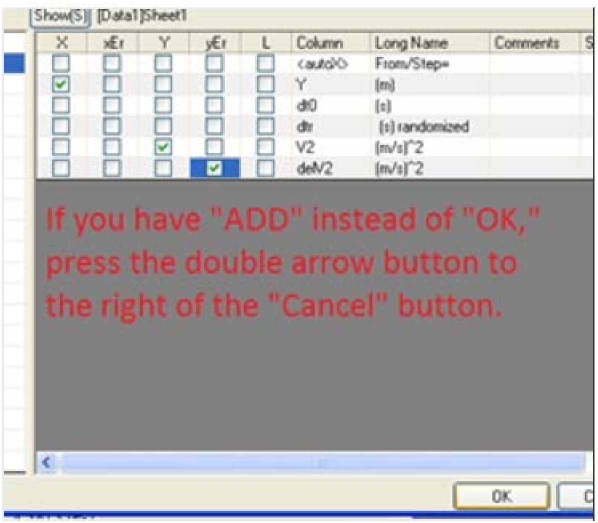
6. You should be back on the main Origin screen. Right-click on the "dtr(Y)" column and select *Set Column Values*. The formula you need should be already there, so just click OK. If you get only dashed lines or no values at all, ask your TA for assistance.



7. Record the first three values(or more, if your TA deems it necessary), and then repeat step 6 three more times, recording the first three values each time. They should be changing every time you click OK(or Apply.)

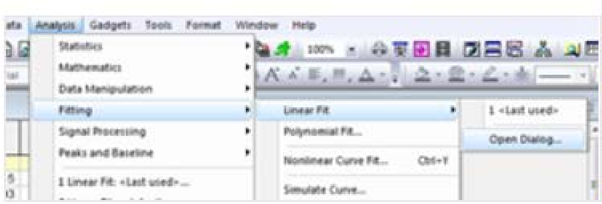
8. Next, *Set Column Values* on the columns for v^2 and dv^2 and input the correct formula into each. V^2 is in the lab manual, and the error in v^2 must be calculated by you.

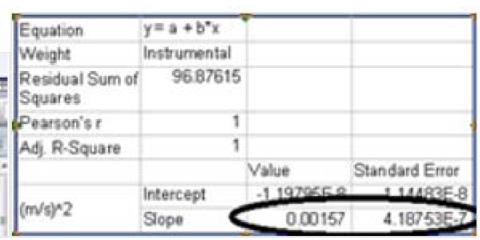
9. Plot v^2 versus y (*Plot->Symbol->Scatter* and you should be familiar with the rest by now) and fit a straight line (*Analysis->Fitting->Linear Fit*). Your finished graph should look something like the one in the lab manual, although maybe not as perfectly on the line. Clean it up and print it out (unless your TA says otherwise.)



10. Find the mathematical relationship between the slope of your graph (B) and the moment of inertia (I). Your calculated value for moment of Inertia should be very close to the value you input into the program initially. If it isn't (3 standard deviations or more) check your method and redo steps 4-10 (perhaps with step 2 first if you can't get the program working again).

11. Congratulations, your Monte Carlo simulation worked!

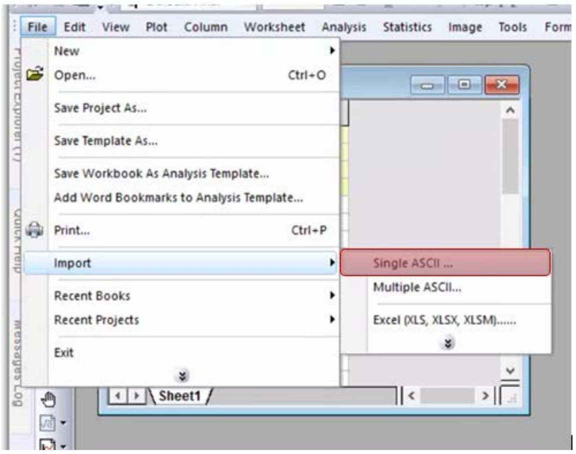




Part F: Actual Measurements

Once you get to this part, you need to use your analysis from part D on the data you took experimentally. This is much less tricky than part D.

1. In Origin (A new file) Import your time data from Logger Pro and remove a few values from the ends. If you find an error, it means you did not open the correct Logger Pro file before taking data, and will have to do it again.



2. *Add New Columns* for v^2 and dv^2 and *Set Column Values* to the appropriate equations that you should have written down during part D. If you only get dashed lines, ask your TA for assistance.
    a. Make sure that you change the value of delta t to .00005. Part D exaggerated the error to get a nice looking scatter.

3. Plot v^2 versus y, as you did in part D. *Analysis->Fitting->Linear Fit* as well. Your data will probably not look as nice as the simulated data, but a general trend is all you really need.

4. Calculate your moment of inertia (I) from the slope (B) for this graph, and do the same for all the other data you have taken.

5. Congratulations, you have finished using Origin for this lab (but still have math to do!)