

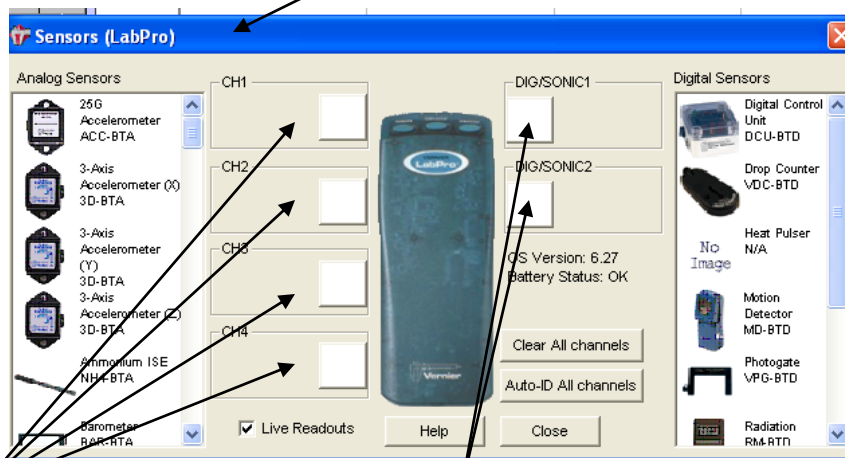
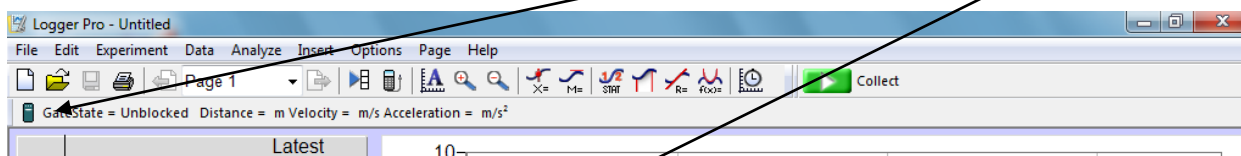
Accelerated Motion Lab

Purpose: The purpose of this lab is to investigate the nature of accelerated motion and become familiar with the Vernier LabPro computer lab.

Materials: computer Vernier LabPro Picket fence

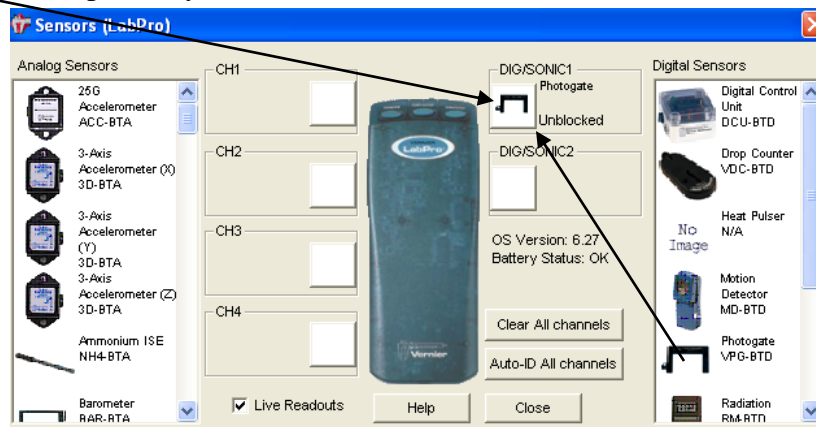
Procedure: (show all your work when questions are asked- each person does own work)

1. Make sure the computer is on. Da!
2. Either from the desktop, or under *Programs* in the start menu under *Vernier Software*, select *Logger Pro 3.8.7.....not Logger Pro 2.2.1 or 2.1*. (If it shows up, cancel out of “Tip of the Day” and if a menu comes up looking for the interface you have to choose the computer port to connect to- usually USB or Com 1.)
3. At the top left part of the screen click on the *LabPro* icon and the *Sensors menu* will appear.

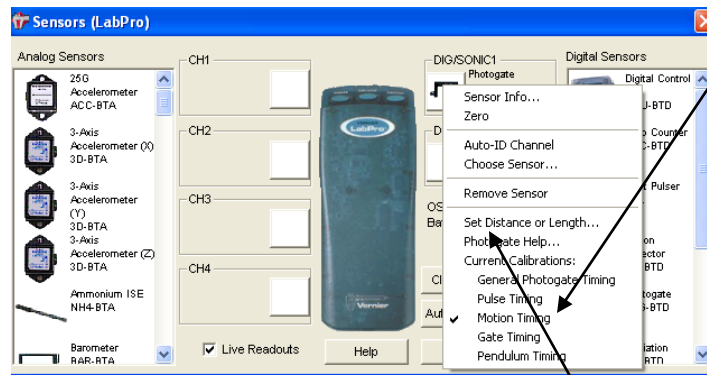


Notice that the four channels on the left and the two channels on the right are blank. The left channels are analog and the right channels are digital or sonic. Each probe we use is either analog or digital.

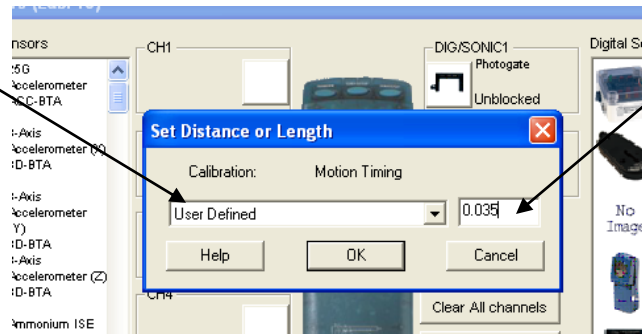
For this lab we will click and drag the picture of the photogate from the right digital sensors menu to the DIGSONIC1 port. You will probably have to scroll down the menu/



Right click on the picture of the photogate and a set-up menu will come up telling the computer how you want to use the photogate. We want to measure the change in time for several blockings of the picket fence so we can see how the velocity changes as the fence fall through the photogate- that is the *Motion Timing* function, so be sure it is checked.



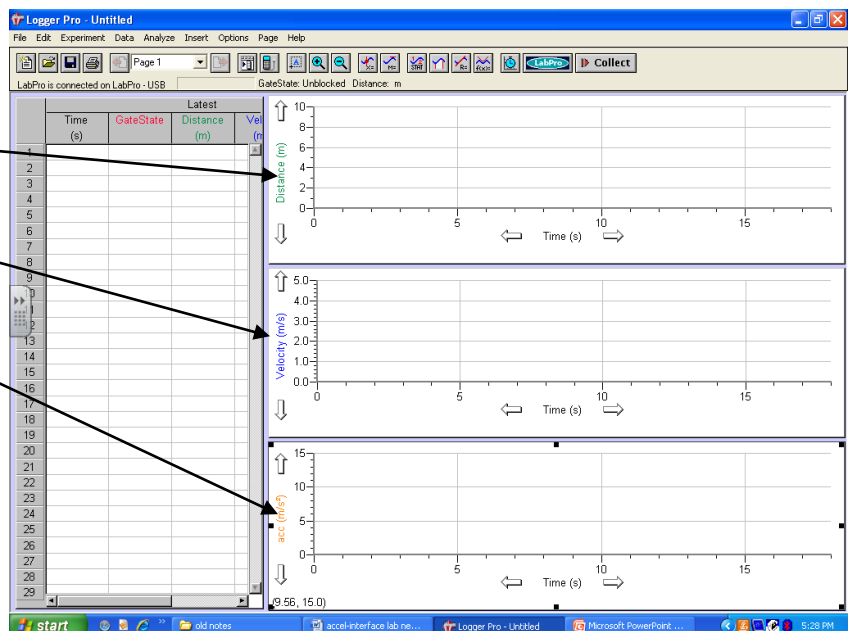
Now that we've told the computer how to count we have to tell it what the distance is between the leading edges of the opaque areas of the picket fence. To do this we have to click on *Set Distance or Length* and choose *user defined* and set the distance to the proper distance as shown below. My distance was 3.5 cm so I inputted 0.035m. Click "OK" and then "X" out of the *Sensor Menu*.



1) Your "d" = _____ m

Notice how three graph showed up;
distance vs time,
velocity vs time, and
accel vs time.

For this lab we are mostly concerned with the velocity vs time graph because the slope of it will yield us acceleration.

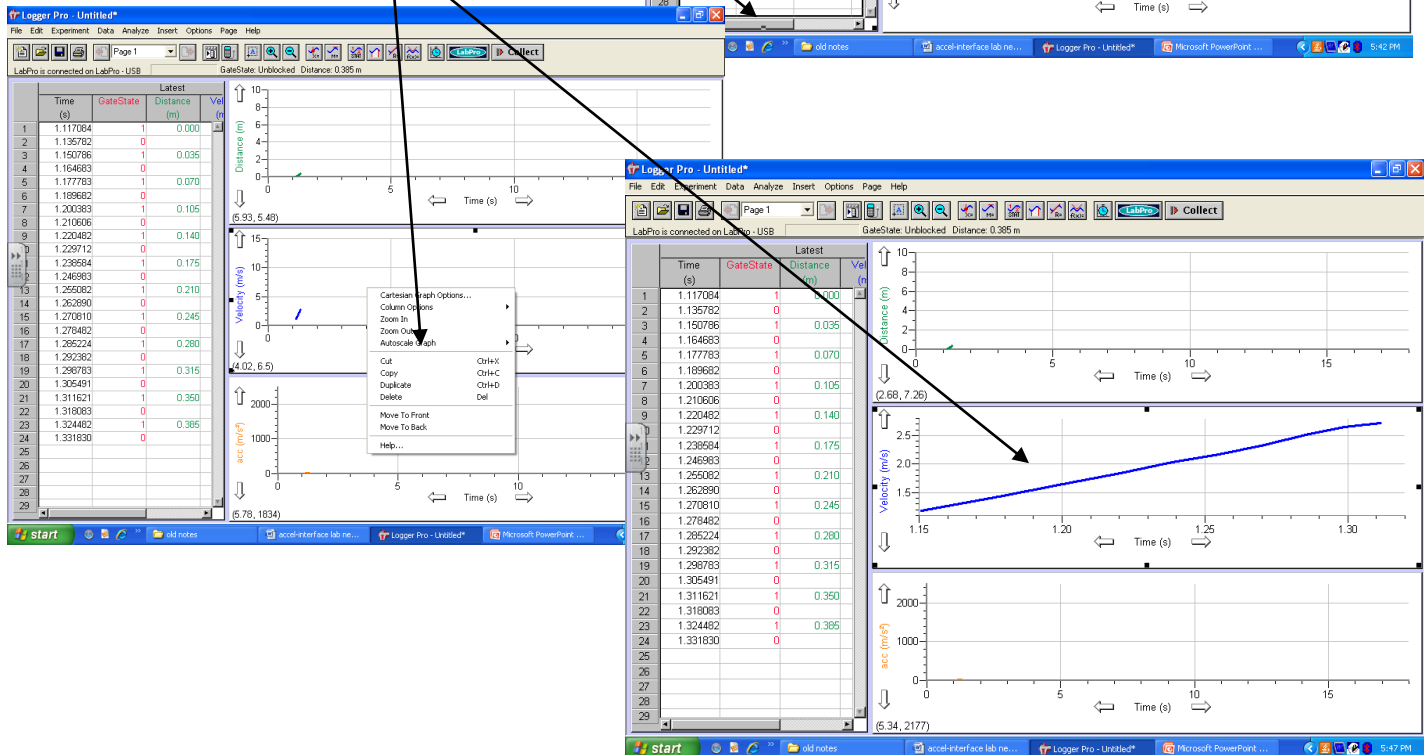
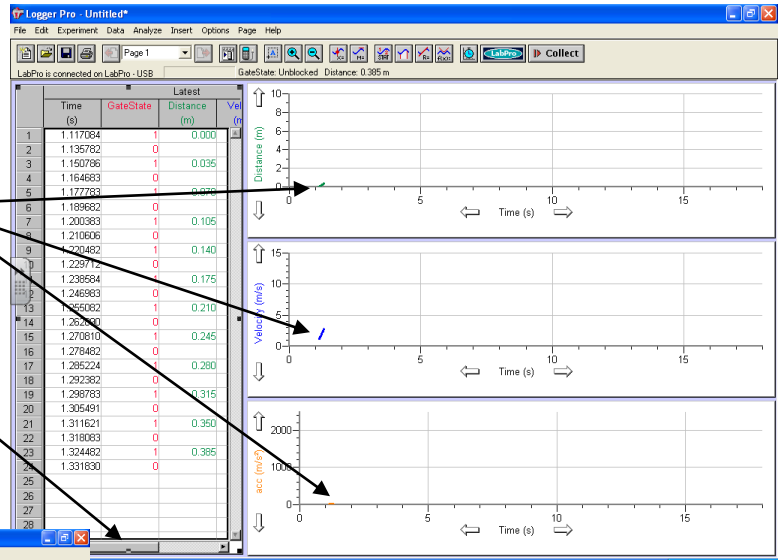


4. Plug the photogate connector into the *DIG/SONIC1* port on the left-front side (as facing it) of the LabPro (the connector on the end of the photogate cord only fits into the port one way- look carefully at the configuration and don't force it when you slide it into the port).

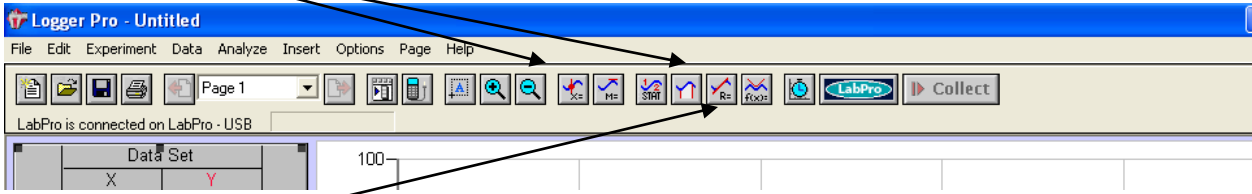
5. Line up the picket fence just above the photogate and prepare to let go of it and catch it with the other hand (have a notebook on the floor below the photogate so the picket fence doesn't hit the hard floor!). Click *Collect* and let go of the picket fence and catch it. See if you collected 10+ points (from distance) of data from the table at the left of the graphs, if not redo. When you drop the picket fence through the photogate the program should automatically collect data. Notice that when you press *Collect* it turns to *Stop*, after you drop the picket fence click *Stop* and the computer will return to the ready state. Note that after you click *Stop* the computer automatically reverts to *Collect* (ready for another trial)

If you want to see all your collected data you will have to scroll over.

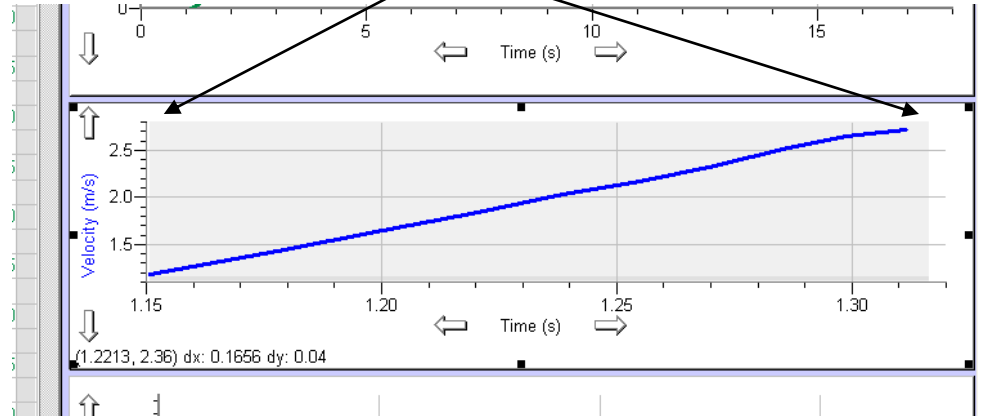
Note that the collected data is only a very small part of the graph (you can hardly see it). To enlarge it you can click on the desired graph so it's highlighted and then right click and choose *Auto Scale*. Note the difference in the size !



6) Use the analysis buttons located across the top of the screen to study the various characteristics of our accelerated motion.

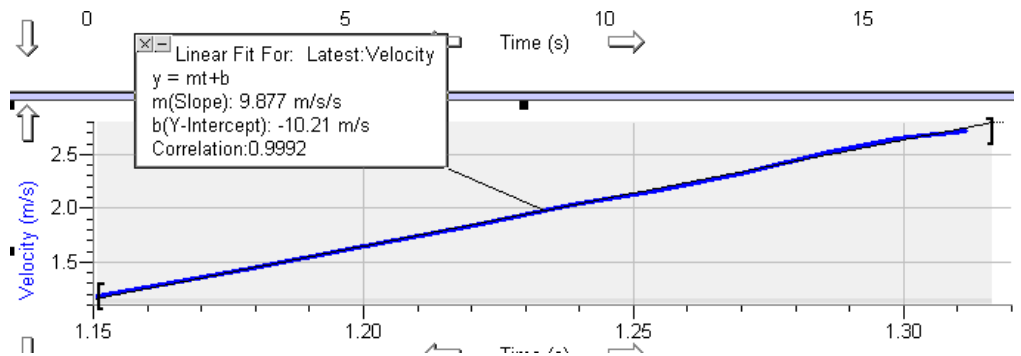


We want to use the “R” button (regression line) to find the slope of the velocity vs time graph. Before you click the “R” button highlight the area of the graph by clicking and horizontally dragging your cursor across the part of the slope you want to analyze.

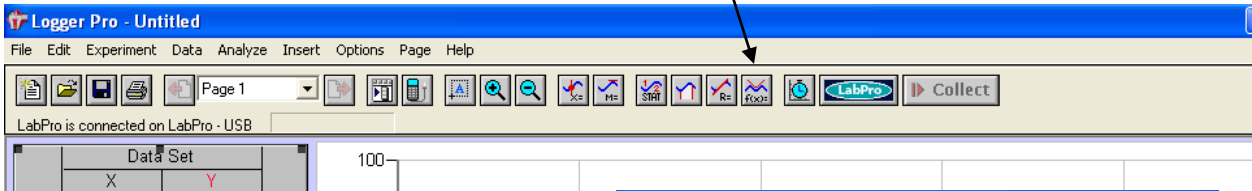


- 2) Your “m” = _____ m/s/s
- 3) Your Correlation: _____ (straightness of line)

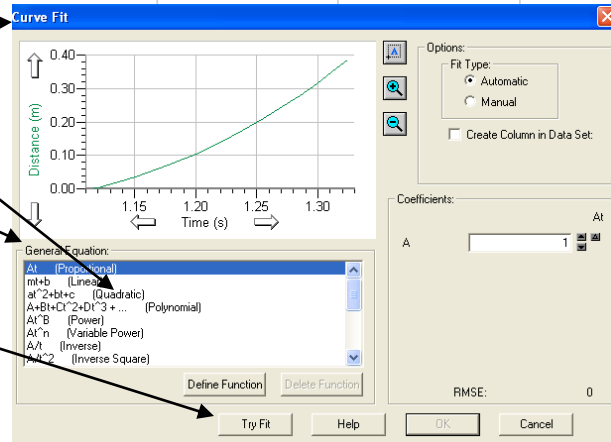
Now, click the “R” button. Notice how a text box comes up showing all the data about our regression (best fit) line. We are most interested in the “m” (slope) value. Note that “m” is the acceleration ($\Delta v/\Delta t$) of the picket fence. My slope is 9.877 m/s/s.



7) Now, click on the top graph (dist. vs time) and click on the “f(x)” button.



Notice how a “Curve Fit” menu comes up allow a multitude of “General Formulas” to match our curve. Our curve for acceleration of the picket fence is a parabola and hence a “quadratic” fit. Select Quadratic And click Try Fit



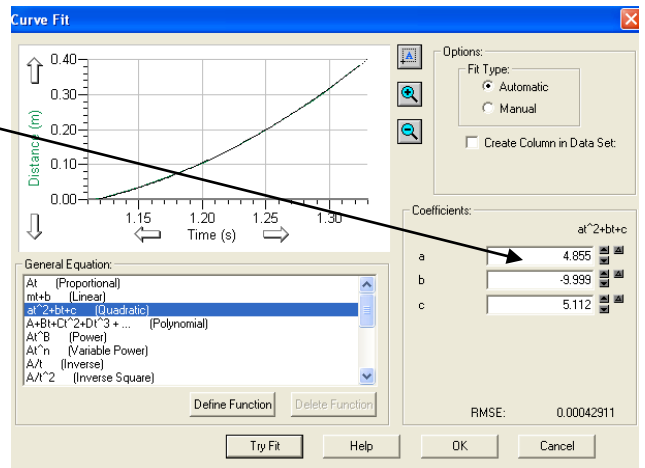
Note how the “a”, “b”, and “c” values come up for our equation values.

4) Your “a” value is _____
 “b” value is _____
 “c” value is _____

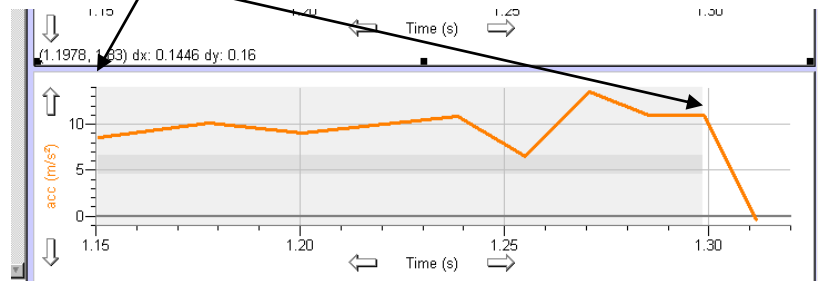
Our “dat” equation is actually $\Delta d = v_1t + \frac{1}{2}at^2$
 or, $d_2 - d_1 = v_1t + \frac{1}{2}at^2$
 or, $d_2 = d_1 + v_1t + \frac{1}{2}at^2$
 this is the: $\longrightarrow c \quad b \quad a$
 values of the
 quadratic equation

So, in the “dat” equation the “a” value is “1/2 at²”, or “2a”
 would be the acceleration.

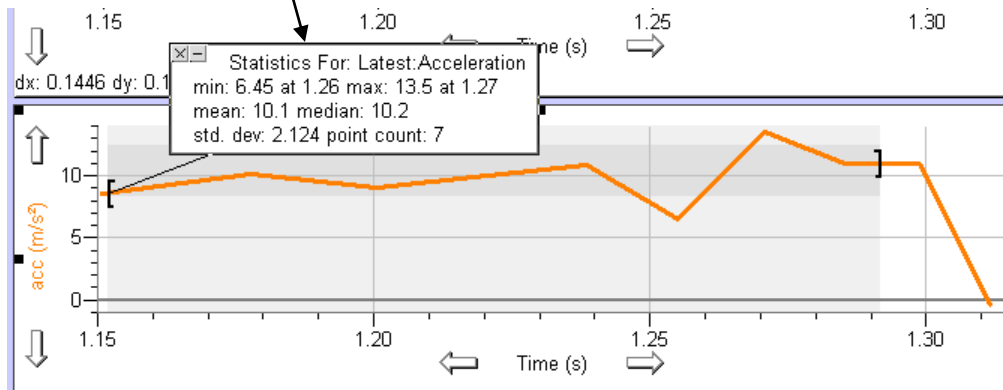
8. Now highlight the third graph (accel vs time) and click and drag over the data you want to analyze.



5) How close is it?
 6) What would “b” and “c” represent from the equation?



Click the “STAT” button and note the basic characteristics of this graph (accelerated motion)



7) Your “min.” value is _____
 “max.” value is _____
 “mean” value is _____
 “median.” value is _____
 “std. dev.” value is _____

8) How close is the “mean”
 value to your “m” (slope) value?