# Velocity Lab

Purpose: In this lab you will investigate the nature of constant and varying velocity by using graphing techniques to analyze your observations of distance and time.

Procedure: *Constant Velocity*
1) Set up the dot timer using masking tape to adhere the timer to the counter(table surface).
2) Make sure the round carbon paper is good, and face down on the timer surface slot.
3) Rip off about 50 cm of timer tape and tape it to the back of the constant velocity cart and thread it through the lineup staples on the timer surface- being sure the tape in under the carbon paper.
4) Gather your data:
    a. Make sure the cart in about 5 cm from the timer and the tape is lined up with the slots.
    b. Turn on the cart switch (have one person in charge of the cart so it doesn't crash and burn) and then turn on the dot timer.
    c. Check your timer tape to verify that the dots are visible.
5) Analyze your data:
a. Measure your time and distance (cumulative) variables and record their values on an inserted Excel sheets) data table. Create the spread sheet at the end of this document, later you will also screen dump a graph at this same location. To create an Excel spreadsheet in a Word document place your cursor at the location you want the table and then click on the "Insert" tab in the ribbon and select "Table" from the menu (4th from the left) and then expand the "table" tab and select "Excel Spreadsheet. Label your columns in the Spread sheet: dot #, time, distance, and velocity. We will be using "Sheets", but the commands are very similar- we need to learn both. Remember that one dot is equal to $1/60^{th}$ (0.0167) of a second. Measure the first 20 dots and record the data on the *Constant Velocity* Excel Spreadsheet.
b. Calculate the velocity in the spreadsheet by using the formula of $\Delta d/t$ in the velocity column.
    i. Click on the cell in the velocity column for the first data point. Note how it is outlined. Now, click on the formula bar to the right of the "f_x" just at the bottom of the ribbon and above the document and press "=". This activates the formula function for Excel. Click the adjacent cell for your 1st non zero distance measurement, now, press "/" and then click the next adjacent cell for time. This tells the program to divide distance by time (that's velocity). Click return, and your velocity should appear.
    ii. To copy the action to the rest of your action click on the first velocity cell so it's highlighted, now right click and hit "copy", this copies the formula. Now highlight the rest of the velocity cells by left clicking and holding and then dragging across the remaining velocity cells. When highlighted, right click

and hit "paste". You may want to select the "f$_x$" paste function. Hit "Enter" and your velocities should appear.

c. Open up the *Graphical Analysis* program under the program menu in the *Vernier Software* folder. Note the data table in on the left and the graph on the right.

d. Double click on the "X" and "Y" titles at the top of the data table and change "X to time and the "Y" to distance. Fill in the units and also go to the "Options" tab and choose point protectors.

e. Insert your data by copying it from the columns of your Excel Spreadsheet and pasting it into the "Graphical Analysis" data table. If your data doesn't cover over half the graph right click on the graph and select autoscale. If you need to correct the Sig. Figs. of your measurements select the cell or column and go to "Data" and then "Column Options" and select the axis to correct. Now, go to to "Options" tab on the "Manual Column Options" window and set the correct # of decimal places.

f. Press the "R =" button at the top to draw a regression line and view the slope values.

g.
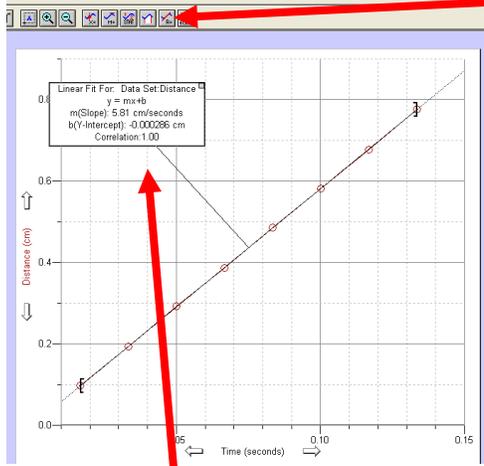
Formula:
M(slope):
B(Y intercept):
Correlation:

h. List the regression line data in the text box to the right of the graph.

i. Press the "STAT" button (three to the left of the "R=" button) and record the data statistics for your data set.

j. Press the "x=" button (four to the left of the "R=" button and run your cursor over the slope and note the data values

k. Screen dump (control +Print Screen) the graph from "j" and insert it into this document at the end. Be sure to label the graph.

Min.:
Max.:
Mean:
Median:
Std dev.:

dot #	time(s)	dist(cm)	vel.(cm/s)
0	0.0000	0.00	
1	0.0167	0.35	20.96
2	0.0334	0.76	22.75
3	0.0501	1.10	21.96
4	0.0668	1.45	21.71
5	0.0835	1.80	21.56
6	0.1002	2.17	21.66
7	0.1169	2.51	21.47
8	0.1336	2.93	21.93

Varying Velocity

1) Set up the photogate on edge of the counter

2) Open "Logger Pro 3.1" under the program files in the Vernier folder. Click the "Lab Pro" at the top of the screen and click and drag the photogate symbol to the "Dig/Sonic 1" box in the "Sensors" tab.
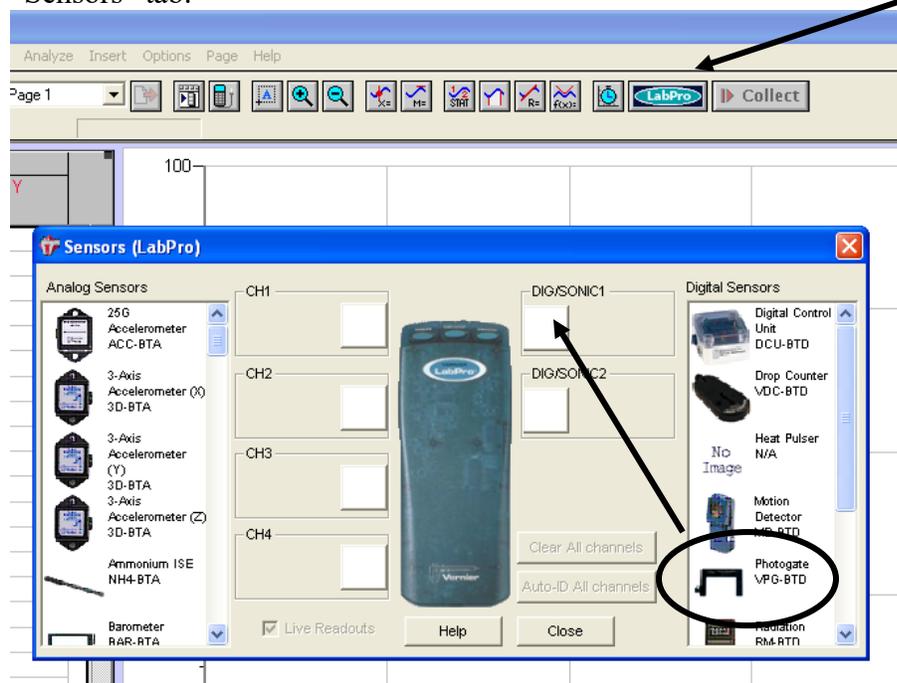
3) Right click on the "Photogate" icon in the "Dig/Sonic1" box and choose :"Set Distance or Length". Measure the leading edges of the picked fence and insert the distance in the data box

4) Hit "Collect" and drop the fence through the photogate. Record the first 10+ times and distances in an second Excel document.

time   distance

5) This time choose the "f(x)" botton at the top right of the graph to analyze your curve. Within this option choose "Quadratic" under *General Equations* and then hit "Try Fit" and record the "a,b, and c" values

a:
b:
c:

6) Screen dump (Control + Print Screen and then paste) this graph to the end of your lab report.

7) Select the "M=" button and move your cursor along the curve. Note how it constructs a tangent at each location. This is the *instantaneous* velocity. List 5 different instantaneous velocities and record them below. Try some of the other analysis functions and note their values

Time   velocity
1.
2.
3.
4.
5.