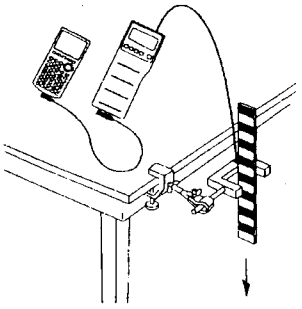
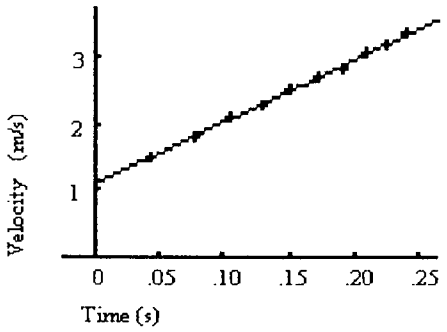
Lab Report - **Measuring g Using the TI-83 and the Picket Fence**
AP Physics B - J Dilsaver Sept, 1999

Procedure: Using the picket fence, the photogates that we assembled in lab, the CBL interface, and the program TIMER from the PHYSICST program group, we collected data on the time required for each leading edge of the picket fence to break the infrared beam of the photogate. See figure at the right for the set up used. We were EXTREMELY careful to catch the picket fence each time since we knew Mr. D had spent hundreds of hours carefully building it.



Data and Graph: The data below were collected on the TI-83, using the CBL interface and photogate. The graph at the right is v/t. The line (line of best fit) doesn't just simply connect the data points. This line, which was calculated using the linear regression feature of the TI-83, is the line which passes closest to all the data points. We have to pick, using our best judgment, whether we think the data are essentially linear, quadratic, inverse, or some other relationship. Note that a linear relationship is reasonable because we expect the acceleration on the picket fence to be constant. We can reasonably expect the acceleration to be about 9.8m/s², since air drag isn't a factor at low speed. The calculated regression equation was y=1.09 +9.272x. This corresponds to the kinematic equation $v=v_0 + at$. So, approximately, g = 9.272 m/s².

Time(s)	Dist (m)	Vel (m/s)
0.0000	0.0000	1.1186
0.0447	0.0500	1.4925
0.0782	0.1000	1.7921
0.1061	0.1500	2.0747
0.1302	0.2000	2.2936
0.1520	0.2500	2.5000
0.1720	0.3000	2.7027
0.1905	0.3500	2.8409
0.2081	0.4000	3.0303
0.2246	0.4500	3.1646
0.2404	0.5000	3.3350



Analysis: The graph we produced on the TI-83 is of velocity vs time. Since the rate of change of velocity equals acceleration, the slope of the v/t line is the acceleration of the picket fence. Since the picket fence is free-falling in earth's gravitational field, with insignificant air resistance, the acceleration of the picket fence should equal g. The y-intercept of the graph gives the non-zero initial velocity the picket fence had acquired before the photogate was blocked for the first time. It really isn't possible to have this line pass through the origin since the picket fence has to be held at least a small distance above the photogate prior to release.

Going Further: Another way to graph our data would be distance vs time. This graph is shown at the right and is clearly not linear. We expect a parabola with d/t and uniform acceleration. We can again use the regression capability of the TI-83 to calculate a curve of best fit. We want a quadratic (2nd degree equation) regression this time. Our regression equation was $y=4.894x^2 + .671x - 0.0001009$. The very small constant term tells us our quadratic regression is a good fit. This corresponds to the kinematic equation $d=v_0t + 0.5at^2$, and results in a g value of 9.788m/s².