Free Fall: Uniform Gravitational Acceleration

Several years ago another set of physics professors (for a similar high school teacher professional development workshop) prepared a videotape of many experiments that were suitable for presentation on television. The premise being that many high school teachers did not have sufficient equipment, material, or time to set up these sometimes complicated experiments.

These experiments are designed for students to make measurements directly on the television screen. The measurements are shown in slow motion when necessary, and calibration data are shown when needed. There was also a manual prepared to go along with the videotape. The manual is designed only for the instructor. It includes sample data read off the screen and the analysis of the data. We have recently retyped the manual as well as analyzed the data and prepared graphs using Excel. There are 16 different experiments available including many collision experiments. We will give each 2009 summer participant a copy of a CD that contains the videotape in Real Player and the manual at the end of today's session.

In today's experiment, we will determine the Earth's gravitational acceleration by dropping a ball under free fall. We will show the introduction of the tape to orient you to how the experiments are supposed to work. Then we will measure the data on a television screen or a computer screen. We have added Real Player to all computers.

In this demonstration we record the path of a ball dropped from rest: under the attraction of gravity $x = \frac{1}{2} g t^2$, where $g = 9.80$ m/s^2. By plotting x versus t we can see the parabolic nature of the path. By calculating the average velocity as in earlier demos we can measure the value of g from the slope of v versus time.

Your lab report should include the following:

1) Include your group transparency where you plotted your data from the screen.
2) Put your data into an Excel file. Produce graphs of distance vs. time and velocity vs. time. Fit data. Show fit on graph.
3) Do an error analysis. Make an estimate of your uncertainties. What errors are there in making your measurements? What errors are inherent in the video process? How should these affect your final result? If possible, include an uncertainty with your result for g.

4) Turn in your data table, both graphs, and this page for grading.