Velocity and Acceleration

Introduction

In this lab, you will continue to use the ultrasonic range finder and the MacMotion software as in last week's lab. However, we will now investigate the motion of a cart in a variety of situations: rolling freely on a smooth surface and on a rough surface, accelerating from a cord attached to the cart and to a falling weight, and accelerating up and down an inclined surface. As usual, this handout suggests a number of possibilities for study, but you should not limit yourself to these situations.

Helpful Hints

You should work in pairs since one person will have difficulty starting the software and the cart simultaneously.

Use double graphs, distance vs time and velocity vs time, each with the same time scale. Then, use the Analysis menu to investigate slopes and areas for interpreting the graphs.

Although you can ask the computer to graph an acceleration curve, you will find (try it and see) that the acceleration curve is likely not to be very smooth. Why is this the case? It's usually easier to determine the acceleration using the Tangent option in the Analysis menu.

In this lab, you will often wish to make comparisons of different distance/velocity graphs. You can do this on the computer by moving Data A into Data B and then accumulating the next set of data and graph. The graphs for the two data sets will be superimposed on the screen! You can also save the graphs and recall them later for comparison.

The mass of the metal bar is equal to the mass of the cart.

Distance and Velocity Graphs

At a minimum you should investigate the following situations and ask questions such as what do you expect if you double the mass of the cart or the mass of the weight on the string pulling the cart. You should compare your measurements with your calculations. Does the shape of the distance and the velocity graphs make sense? What are the values of the acceleration during the motion? Is the acceleration constant over the path of the cart? If so, what is the value of the acceleration? Does the measured value of the acceleration agree with your calculated value? If the measurements disagree with the calculations, you should explain these differences in as much detail as possible. These and similar questions are appropriate in these investigations.

- A string attached to a falling weight pulls the cart on a level, smooth surface
- The cart rolls freely on a level, smooth surface
- The cart rolls freely on a level, rough (felt) surface

- The cart rolls freely down a smooth incline (and rolls freely up a smooth incline, of course with a non-zero initial velocity)