

## PHYSICS LAB - MEASURING MOTION

In this lab you will examine a student's motion using a motion detector that is interfaced to a computer. As the student moves, plots of position and velocity versus time are generated. Part of the purpose of the lab is to give you experience with creating and interpreting these plots. **Be sure to include all graphs, clearly labeled, and your responses to all questions (in complete sentences) in your final report.**

*Procedure -*

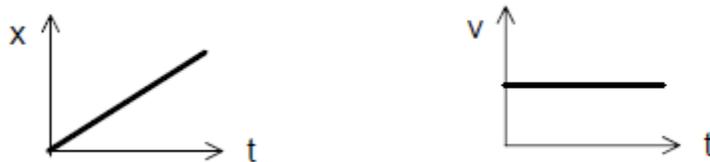
### I. Generating Motion

*Materials and equipment:* motion detector and white board

**Step 1** - Follow the instructions provided to open the data acquisition program on your computer. (The motion detector should already be attached to the computer.)

To collect data, one student should hold the motion detector as steady as possible while another student holding the white board moves in front of the detector. The signal emitted by the motion detector is reflected off of the board back to the probe. As a consequence, any objects that intervene between the detector and the moving student will adversely affect data collection. Make sure that the space between the detector and the student is clear of furniture, backpacks, other students, etc. The student's motion also needs to be as smooth as possible, and slower motion works better than fast motion.

**Step 2** - In this step you will try to optimize the data collection. Use the motion where a student walks toward the detector at constant speed to do this. Determine the best values for the sampling time and experiment duration and realize that you may have to auto-scale (or change the vertical scale) to see the detail of the motion. Your graphs should look like this:



Once you have succeeded in reproducing this motion, *print the position and velocity graphs and label them.*

**Step 3** - Now that you have mastered the motion in Step 2, try to reproduce the motions listed below. For each motion complete the following:

**(a)** *Acquire the position and velocity graphs. Make sure that you auto-scale (or change the vertical scale) so that you can clearly see how position and velocity vary with time.*

(b) *Print the position and velocity graphs.*

**Motions:**

(1) Move the board away from the detector at a constant speed, and then continue to move away at a higher constant speed.

(2) Move the board away from the detector at constant speed, stop briefly, and then move towards the detector at a lower constant speed.

(3) Move the board away from the detector with increasing speed (at constant acceleration).

(4) Move the board towards the detector with increasing speed (at constant acceleration).

**Further questions**

1. For each motion that you collected using the motion detectors:

(a) Identify and label the parts of the motion on the position and velocity graphs.

(b) Use a pencil or colored (blue, red...) pen to sketch what the position, velocity and acceleration graphs should look like, ideally, on top of your printed results.

2. Discuss the experimental limitations (both equipment and human) of using the motion detector for measuring motion. What could be done to improve the results? Be specific.

3. Two position versus time graphs are shown. For each graph, **explain in detail** how you would generate the velocity and acceleration graphs using just the position graph. Sketch these graphs, identify and label each region on the graphs, and describe the motion.

