Human Motion

Purpose: 1. To gain experience in interpreting motion graphs.
2. To become familiar with the motion detector and the Logger Pro software.

Equipment Needed: windows based computer, lab pro, motion detector, rectangular piece of cardboard

Introduction: Your instructor will explain briefly how the motion detector and computer work together to make position versus time measurements of moving objects. In this laboratory you will make some rough graphs of the motion of a person as they move (in one dimension) in a carefully prescribed way. First you will predict what you think the graphs should look like from a written description of the motion. Next a person in your group will move according to the written description while the computer measures and graphs their position. A comparison will be made between your prediction graphs and the experimental graphs.

Procedure:

1. Use the Prediction sheet provided to construct a graph for the motion described in each activity. Each student should do their own prediction graph and then discuss their predicted graph with their lab partners before taking any data with the computer. Modifications to the graphs can be made after these discussions. Next, do the actual experiment as described in part 2 below and complete the result sheet with the graph that the computer displays. Complete each activity--prediction and results—before going on to the next activity. Connect the lab pro to computer. Connect the motion detector to DIG/SONIC2 port on lab pro.

2. Turn on the computer and open the **Physics Apps** folder by double clicking on its icon. Load the **Logger Pro** software by double clicking on its icon. If you need help with this first step, ask your instructor. A file named motion detector will be used to set up the computer for collecting the data needed for this experiment. To open this file click on **FILE** on the menu bar at the top of the left of the screen and choose **OPEN**. Double click on **Mechanics** folder and then double click on the filename **Motion Detector**.

3. Place the motion detector on a chair facing the open space between lab tables. The chair should be at one end of this open space in order to provide a long open area to move in when taking data. Use a piece of tape to hold the motion detector wire against the chair to keep the detector facing in the desired direction. Hold the piece of cardboard comfortably in front of your chest and perform the indicated motions given from the prediction sheet in Activity 1. Click on **Collect** (at the top of the screen) and the computer will begin taking data. Observe the graphs of position vs time and sketch these (the computer graphs) on your Results sheet. Compare the Results graphs (what actually happened) with your Prediction graphs. Try to explain any differences between the two. Confront your misconceptions!

4. Repeat steps 1-3 but follow the motions given in Activity 2. <u>Complete and discuss your Prediction graphs before taking any data with the computer</u>. Notice that this activity involves a velocity versus time graphs instead of position vs time. Display this graph on the computer by double clicking on the y-axis label (Position) and then select velocity and deselect position.

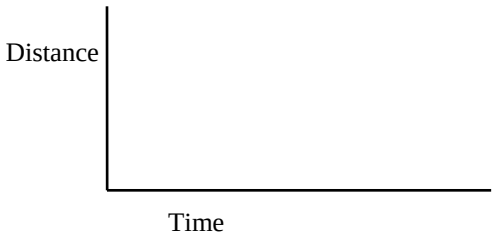
5. Repeat steps 1-3 for Activity 3 and also for Activity 4. Complete and discuss your Prediction graphs before taking any data with the computer. You can display both a position and velocity graph on the computer by opening a new window for the second graph. Choose **Insert** in the upper menu bar and click on **Graph. C**lick on the y-axis label to choose velocity or position for each graph.

6. Finally, open the file **Match Motion** and observe the graph of position vs time which is given as sort of an ideal motion that you will try to match with your body. Discuss with your lab partners how you will need to move to match this graph as closely as possible. Each person in the group should then try to move according to the ideal motion. Make several tries if you like. If possible obtain a printout of the graph and compare your motion with the ideal motion. Give your comments.

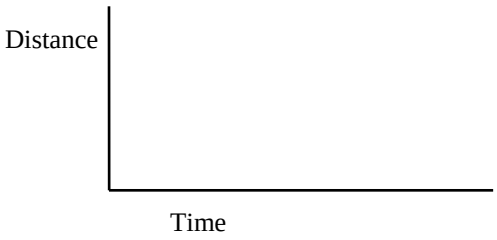
7. Make a sketch of the apparatus and give a brief explanation of how the motion detector works. What are its limitations? Include in your lab report the data collection rate.

Human Motion--Prediction Sheet

Activity 1: Sketch below on the left axes your prediction of the distance (position) vs time graph for a person moving away from the origin (motion detector) at a steady (constant) velocity. On the other axes sketch your prediction for a person moving toward the origin at a steady (constant) velocity.

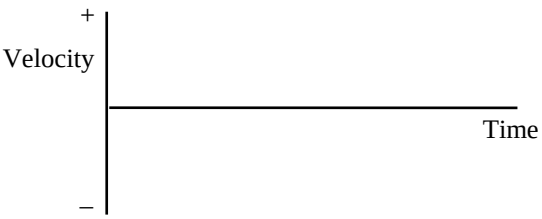


Moving away

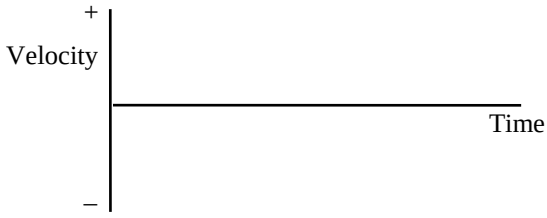


Moving toward

Activity 2: Sketch on the left axes below your prediction of the velocity vs time graph for a person moving away from the origin at a steady velocity. On the other axes sketch your prediction for a person moving toward the origin at a steady velocity.

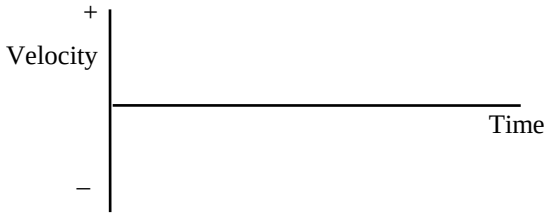


Moving away



Moving toward

Activity 3: Sketch on the axes below your prediction for the distance vs time and velocity vs time graphs of a person moving away from the motion detector at approximately twice the velocity of activity 1 and activity 2.



Moving away at twice the velocity

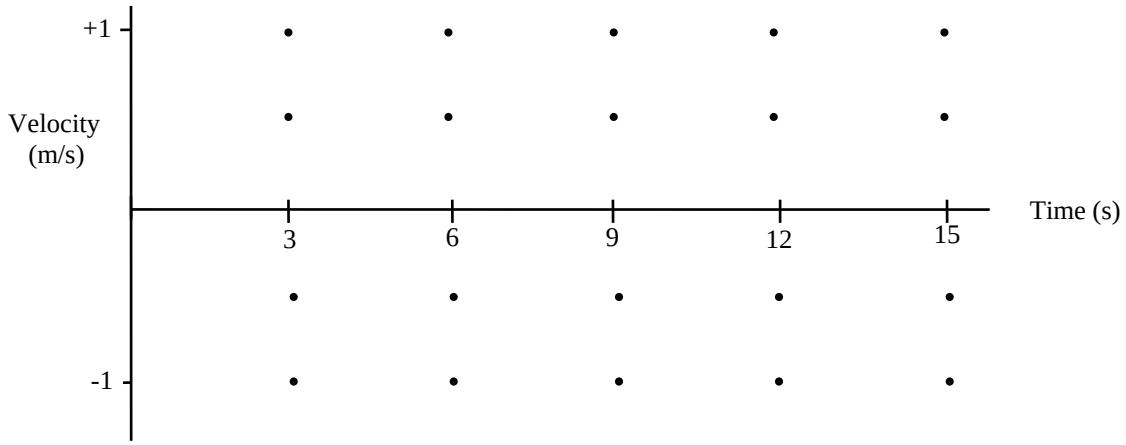
Describe in words how the distance vs time graph changes when the velocity is twice as fast.

Activity 4:

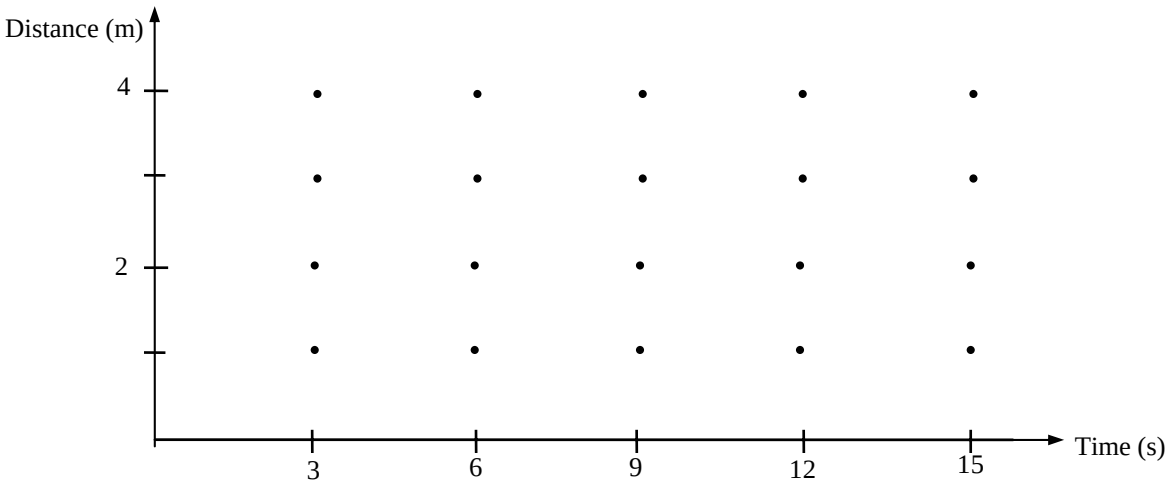
Predict a velocity vs time graph for a more complicated motion: A person

- walks away from the detector slowly and steadily for 6 seconds
- then stands still for 6 seconds
- and then walks toward the detector steadily about twice as fast as before

Compare your prediction with the other people in your group and see if you can all agree.



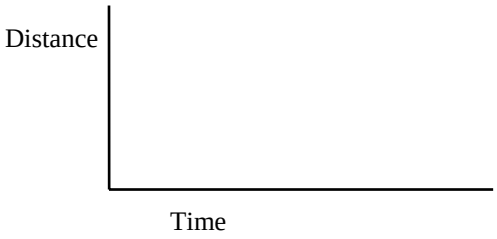
Predict the distance vs time graph for the motion described above. Follow the same procedure described above and do an individual and then a group prediction.



Human Motion--Results Sheet

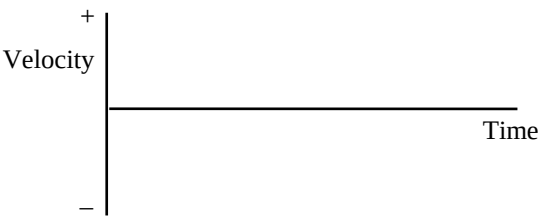
Activity 1: Sketch below on the left axes the results from the computer of the distance (position) vs time graph for a person moving away from the origin (motion detector) at a steady (constant) velocity. On the other axes sketch the results from the computer for a person moving toward the origin at a steady (constant) velocity.

Moving away

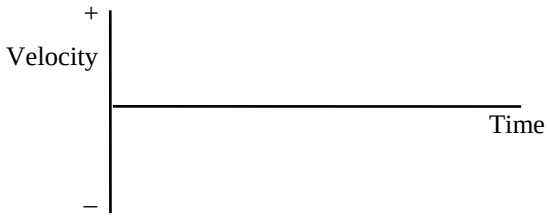


Moving toward

Activity 2: Sketch on the left axes below the results from the computer of the velocity vs time graph for a person moving away from the origin at a steady velocity. On the other axes sketch the results from the computer for a person moving toward the origin at a steady velocity.

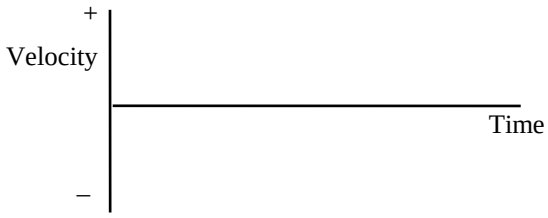


Moving away



Moving toward

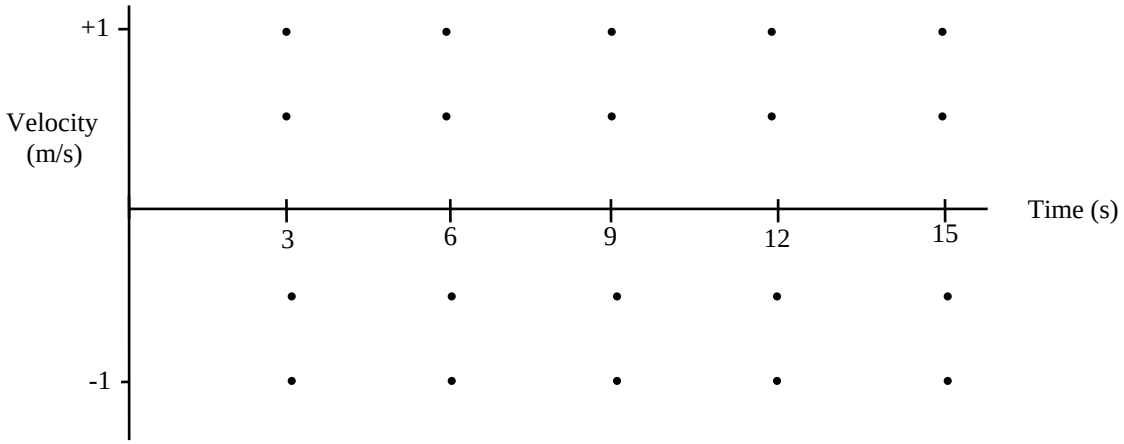
Activity 3: Sketch on the axes below the results from the computer for the distance vs time and velocity vs time graphs of a person moving away from the motion detector at approximately twice the velocity of activity 1 and activity 2.



Moving away at twice the velocity

Describe in words how the distance vs time graph changes when the velocity is twice as fast.

Results for Activity 4: Sketch below the results from the computer of the velocity vs time graph for the motion of activity 4 as described on the prediction sheet.



Sketch below the results from the computer for the distance vs time for the motion of activity 4.