Phys 135A Activity 2

Name_____

Class_____

Lab Partners _____

Investigation 1: Distance(Position)-Time Graphs of Your Motion

To find out How you can measure your motion with a motion detector

How your motion looks as a distance (position)-time graph

Introduction In this investigation, you will use a motion detector to plot a distance (position)-time graph of your motion. As you walk (or jump, or run), the graph on the computer screen displays how far away from the detector you are.

- *"Distance" is short for "distance from the motion detector."*
- The motion detector is the *origin* from which distances are measured.
- It detects the closest object directly in front of it (including your arms if you swing them as you walk).
- It will not correctly measure anything closer than 1/2 meter. When making your graphs don't go closer than 1/2 meter from the motion detector.

Activity 1 Making Distance-Time Graphs

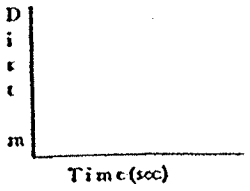
1. Connect the Logger Pro interface to your computer and a motion detector. Connect the power cord (you should hear melodious beeping which will indicate that the device is ready to run).

2. Turn on the Logger Pro software on the desktop.

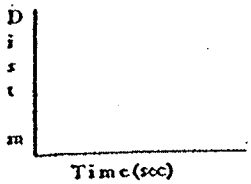
3. Open the program called "1 distance-time." Dr. Zorba will describe to you how you can do that.

4. Make distance-time graphs for different walking speeds and directions.

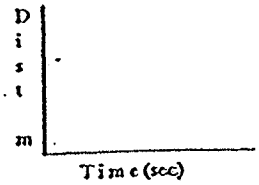
a. Start at the 1/2-meter mark and make a distance/time graph, walking away from the detector *slowly and steadily*. Sketch the graph on the right.



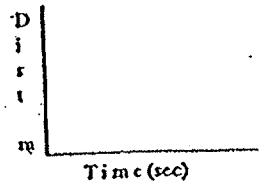
b. Make a distance/time graph, walking away from the detector *medium fast and steadily*. Sketch the graph.



c. Make a distance/time graph, walking toward the detector *slowly and steadily*. Sketch the graph.



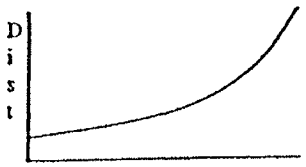
d. Make a distance/time graph, walking toward the detector *medium fast and steadily*. Sketch the graph.



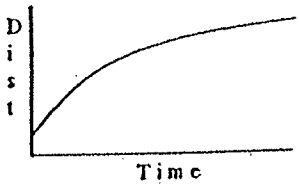
Questions 1- Describe the difference between the graph you made by walking away slowly and the one made by walking away more quickly. (Q1)

2- Describe the difference between the graph made by walking toward and the one made walking away from the motion detector. (Q2)

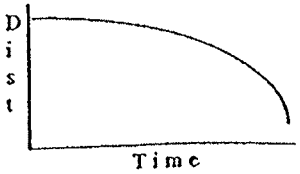
3 – Can you make a curved distance-time graph? Try to make each of the graphs shown below.



Graph 1



Graph 2



Graph 3

Describe how you must move to produce a distance-time graph with each of the shapes shown.

Graph 1 answer: _____

_____

_____

Graph 2 answer: _____

_____

_____

Graph 3 answer: _____

_____

_____

Investigation 2: Velocity-Time Graphs of Your Motion

To find out The connection between velocity and your actual motion
How your motion looks as a velocity-time graph

Introduction You have already plotted your distance (position) from the motion detector as a function of time. You can also plot how fast you are moving. How fast you move is your speed. It is the rate of change of distance with respect to time. *Velocity* takes into account your speed and the direction you are moving. When you measure motion along a line, velocity can be positive or negative.

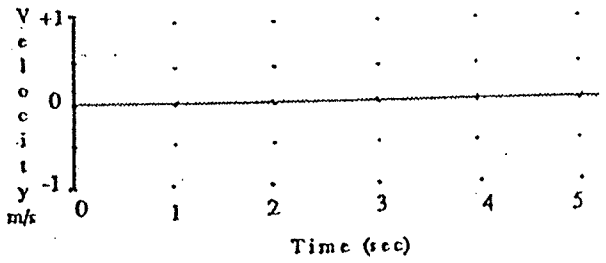
Activity 1 **Making Velocity Graphs**

Open "3 vel-time" LoggerPro program.

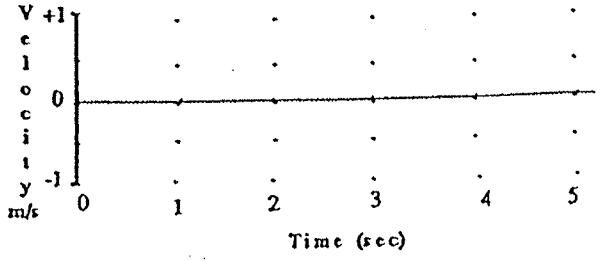
2. Graph your velocity for different walking speeds and directions.
   a. Make a velocity graph by walking *away* from the detector *slowly and steadily*. Try again until you get a graph you're satisfied with.

      You may want to change the velocity scale so that the graph fills more of the screen and is clearer. To do this, double click anywhere on the graph and change the velocity range.

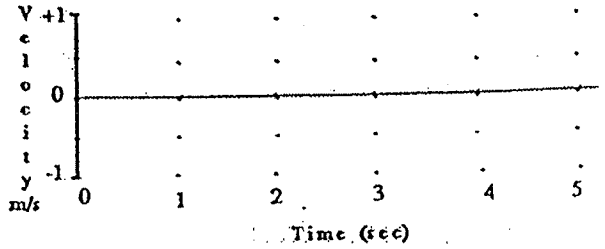
      Sketch your result below. (Just draw *smooth* patterns; leave out smaller bumps that are mostly due to your steps.)



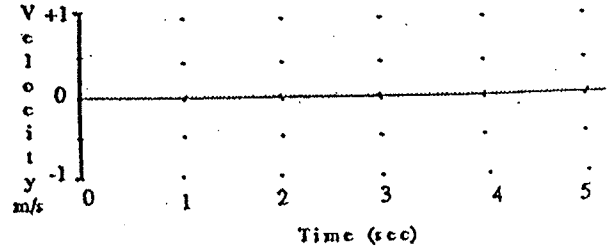
b. Make a velocity graph, walking *away* from the detector *medium fast and steadily*. Sketch your graph.



c. Make a velocity graph, walking *toward* the detector *slowly and steadily*. Sketch your graph.



d. Make a velocity graph, walking *toward* the detector *medium fast and steadily*. Sketch your graph.



Questions

What is the most important difference between the graph made by slowly walking away from the detector and the one made by walking away more quickly? (Q1)

_____

_____

How are the velocity-time graphs different for motion away and motion toward the detector? (Q2)

_____

_____

Investigation 3: Distance and Velocity Graphs

To find out The relationship between distance-time and velocity-time graphs.

Introduction You have looked at distance- and velocity-time graphs separately. Now you will see how they are related.

Activity 1 **Predicting Velocity Graphs from Distance Graphs**

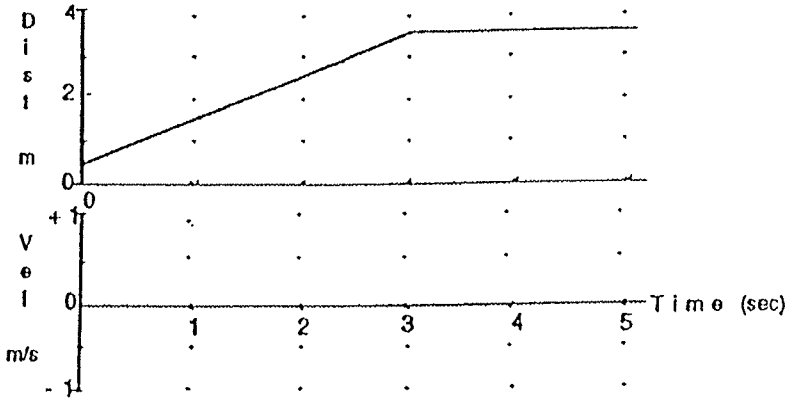
1. Open "5 vel and dist" LoggerPro program.

2. Predict a velocity graph from a distance graph. Carefully study the distance graph shown below and predict the velocity-time graph that would result from the motion. Using a *dotted line*, sketch your *prediction* of the corresponding velocity-time graph on the velocity axes.

3. Make the graphs. After each person has sketched a prediction, **Start**, and do your group's best to make a distance graph like the one shown below. Walk as smoothly as possible.

   When you have made a good duplicate of the distance graph, sketch your actual graph over the existing distance-time graph.

   Use a *solid line* to draw the actual velocity graph on the same graph with your prediction. (Do not erase your prediction).



Questions

How would the distance graph be different if you moved faster? Slower? (Q1)

_____

_____

How would the velocity graph be different if you moved faster? Slower? (Q2)

_____

_____

Activity 2 **Estimating and Calculating Velocity**

In this activity, you will estimate an average velocity from the velocity graph in Activity 1 and then calculate an average velocity using your distance graph .

1. Estimate your average velocity from your velocity graph in Activity 1. You are to estimate a single average velocity while you were walking steadily in Activity 1. Select **Analyze** in the Data Menu, read a number of values (say ten) from the velocity graph, and use them to calculate the average (mean) velocity.

   Velocity values read from graph (m/s): ____ ____ ____ ____ ____

   ____ ____ ____ ____ ____

   Average value of the velocity: _____m/s

Comment

Average velocity during a particular time interval is the change of distance divided by the change in time. By definition, this is also the (average) *slope* of the distance-time graph for that time period.

As you have observed, the faster you move, the more inclined is your distance-time graph. The *slope* of a distance-time graph is a quantitative measure of this incline, and therefore it tells you the velocity of the object.

2. Calculate your average velocity from your distance graph in Activity 1. Use **Analyze** to read the distance and time coordinates for two typical points while you were moving. For a more accurate answer, use two points as far apart as possible but still typical of the motion.

   Point 1 Distance _____ m Time _____ sec

   Point 2 Distance _____ m Time _____ sec

   Calculate the change in distance between points 1 and 2. Also calculate the corresponding change in time (time interval). Divide the change in distance by the change in time to calculate the *average* velocity. Show your calculations below.

   Change in distance:_____m Change in time:_____sec

   Average velocity :_____m/s

3. Draw in the average velocity you just calculated on the velocity graph in Activity 1.