PHY 120 Lab 1: Kinematic Graphs I[1]

Name ______________________________ Date ______________

A. Position vs. Time Graphs of Your Motion

What does a position vs. time graph look like when you move slowly? When you move quickly? What happens when you move in different directions?

In the following activity, use the motion sensor with PASCO Capstone software to record your own motion as you walk towards and/or away from the sensor.

Making Position vs. Time Graphs

Launch the PASCO Capstone software and open experiment kin_1. (Ask your instructor where to find the files for the Kinematics Lab.)

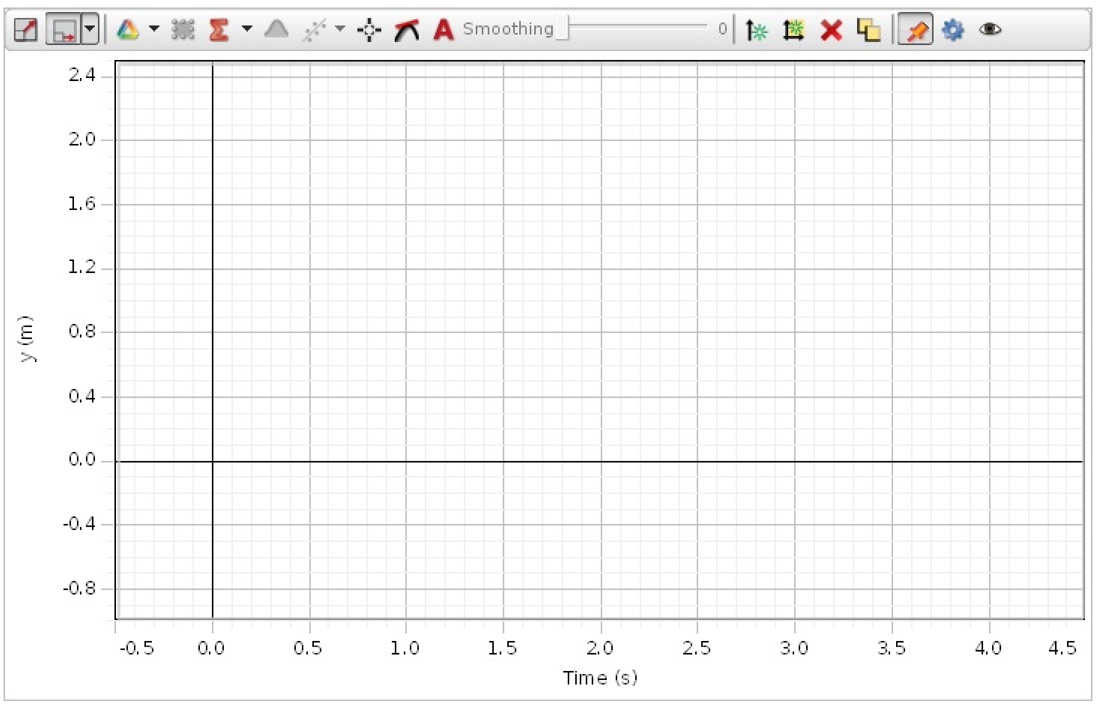
1. Make a position vs. time graph for different walking speeds and directions. As you perform each kind of motion, sketch the resulting position vs. time graph on the axes provided below. Your final graph should have three lines.

a. Start at x = -0.5 m and walk slowly and steadily in the positive direction.

b. Start at x = -0.5 m and walk somewhat faster in the positive direction.

c. Start at x = +2.0 m and walk slowly and steadily in the negative direction.

Label the three lines a, b, and c.

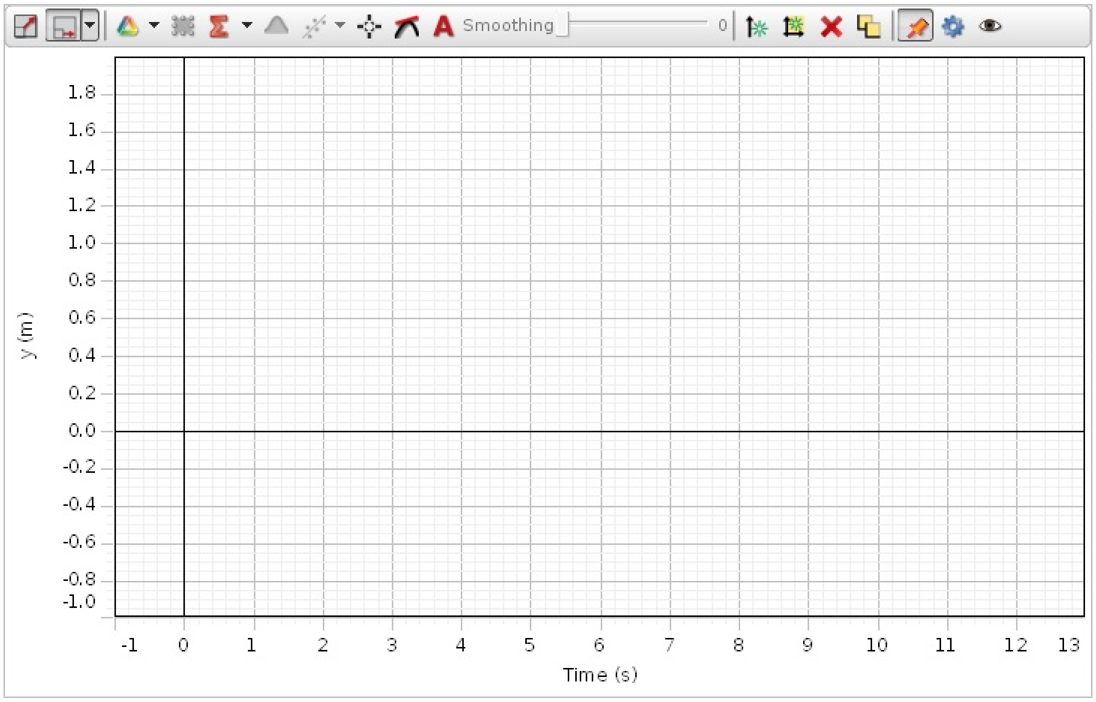


Open experiment kin_2.

2. **Predict** the shape of the position vs. time graph that results when a person starts at the origin, walks in the positive direction slowly and steadily for 4 seconds, stops for 4 seconds, and then walks in the negative direction more quickly. **Sketch your prediction** on the axis provided below using a *dashed line*.

Test your prediction by generating a graph for the motion described above. Sketch your observation on the same graph as your prediction using a *solid line*.

[1] 1993-94 P. Laws, D. Sokoloff, R. Thornton. Supported by the National Science Foundation and U.S. Department of Education (FIPSE). These materials have been modified for use at Union College.



Matching a Position Graph

Open experiment kin_3.

By now you should be pretty good at predicting the shape of a graph of your movements. Can you do this the other way around by reading a position vs. time graph and figuring out how to move to reproduce it?

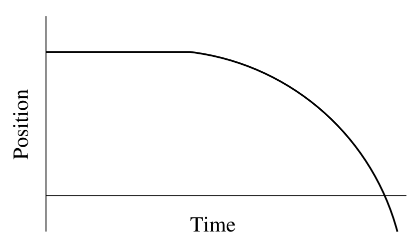
3. Try to move so as to match the graph you see on the computer screen. You may try a number of times. It helps to work as a team. Get the times right. Get the positions right.

In the space below, describe the motion required to reproduce the given position vs. time graph.

Other Position vs. Time Graphs

Open experiment kin_4.

4. Can you make a curved position-time graph? Try to move so as to produce something similar to the graph shown below.



a. Describe how you must move to produce a position vs. time graph with the shape shown.

b. What is the main difference between motions which result in a straight line position vs. time graph and those that result in a curved line graph.

B. Velocity vs. Time Graphs

Another way to represent your motion during an interval of time is with a velocity vs. time graph. Remember that velocity can be positive or negative. You will probably find that velocity vs. time graphs are more challenging to create and interpret than position vs. time graphs.

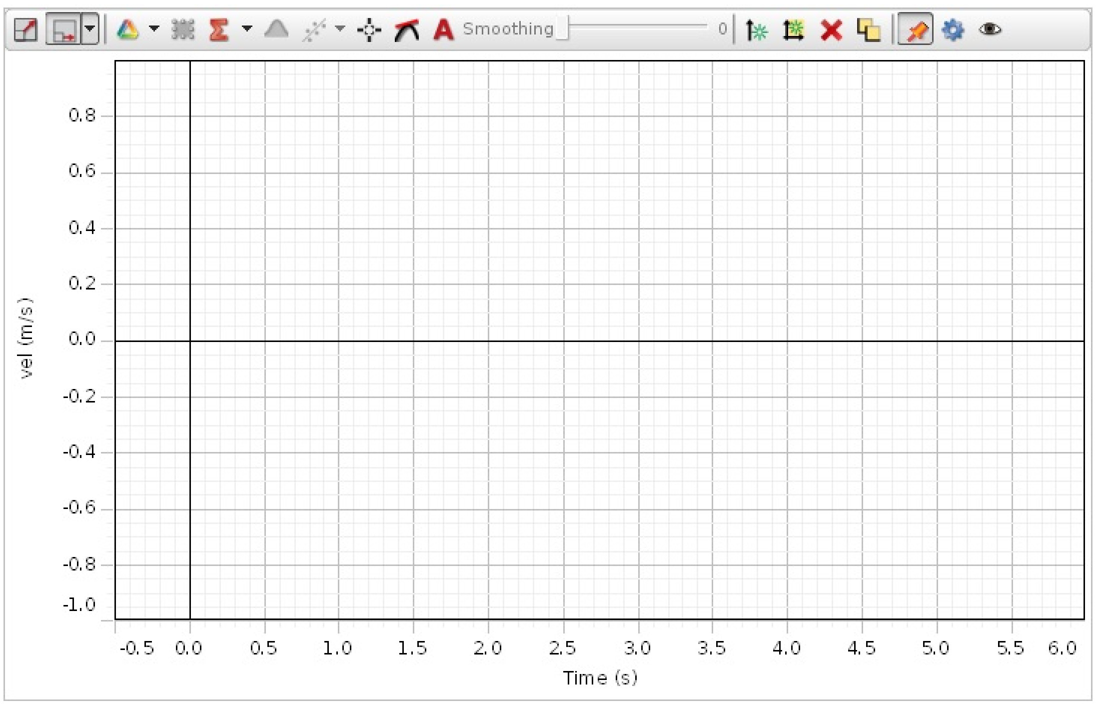
Making Velocity Graphs

Open experiment Activity kin_5.

5. Make graphs of your velocity for different walking speeds and directions.

a. Make a velocity graph by walking quite slowly and steadily in the positive direction. Try again until you get a graph you are satisfied with. Sketch your graph on the axes below and label it a.

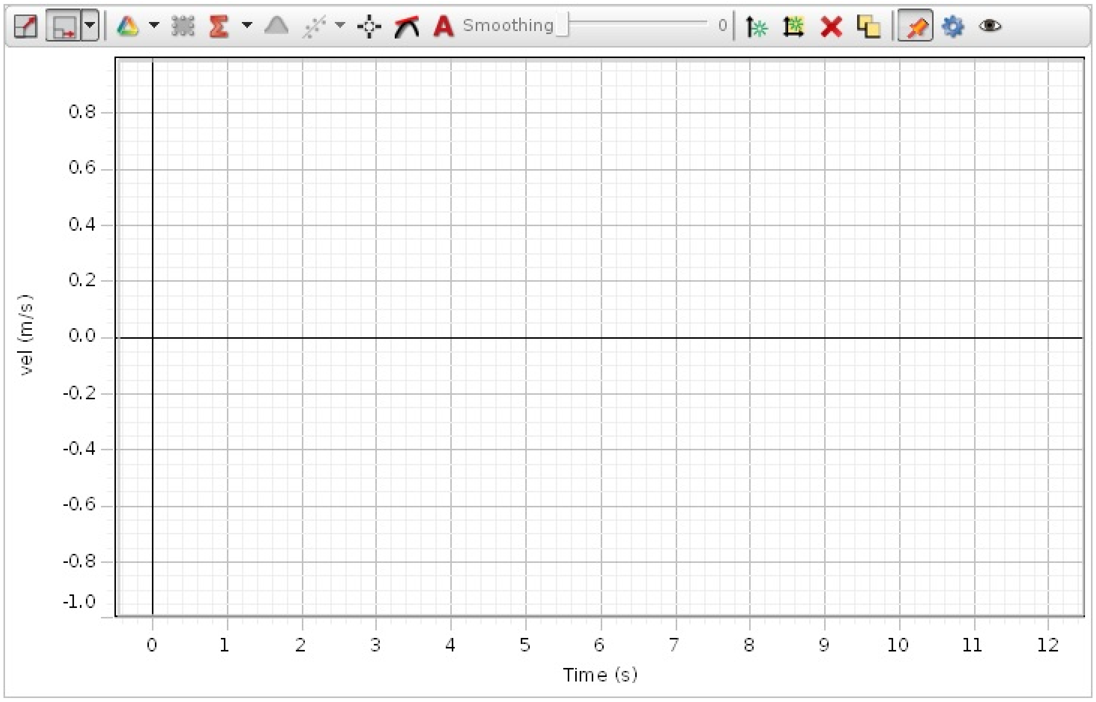
b. On the same axes, make a velocity graph by walking in the positive direction somewhat faster. Label this line b.



Open experiment kin_6.

6. Using a *dashed line* on the axes provided, sketch the velocity graph that you would predict for: walking away from the detector slowly and steadily for 4 seconds, then standing still for 4 seconds, then walking toward the detector steadily somewhat faster than before.

Test your prediction by moving in the way described and making a graph of the motion. Try again until you think your motion matches the description. Be sure the 4-second stop shows clearly. Sketch your observation on the graph with your prediction using a *solid line*.



C. Relating Position and Velocity Graphs

Since position vs. time and velocity vs. time graphs are different ways to represent the same motion, you should be able to figure out the velocity at which an object is moving by examining its position vs. time graph. Conversely, you should be able to figure out by how much an object's position has changed (the displacement) from a velocity vs. time graph.

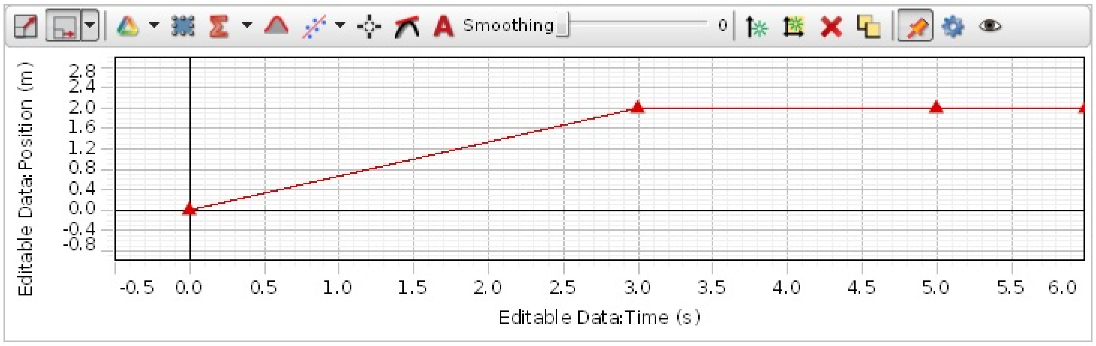
Predicting Velocity Graphs from Position Graphs

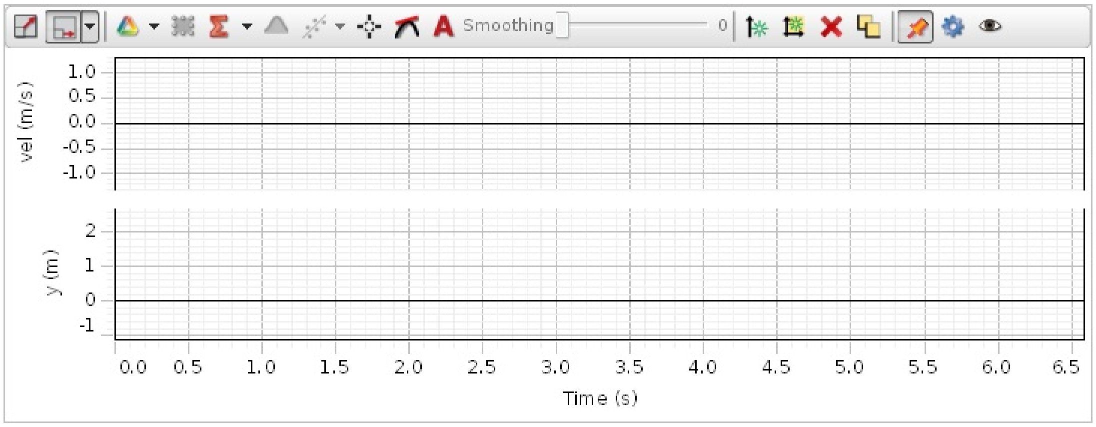
Open experiment kin_7.

7. Carefully study the position vs. time graph shown on the computer screen.

a. Predict the velocity vs. time graph that would result from that motion. Sketch it on the velocity axes below using a *dashed line*.

Then try to move so as to match the position vs. time graph. Walk as smoothly as possible. Sketch your observations on the position and velocity graphs using *solid lines*.





b. How would the position graph be different if you moved faster? Slower?

c. How would the velocity graph be different if you moved faster? Slower?

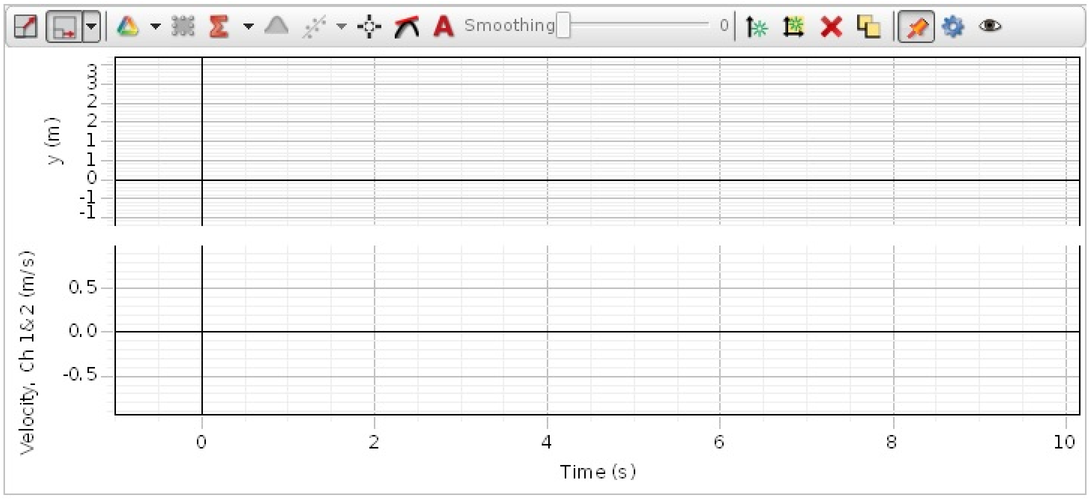
Predicting Position Graphs from Velocity Graphs

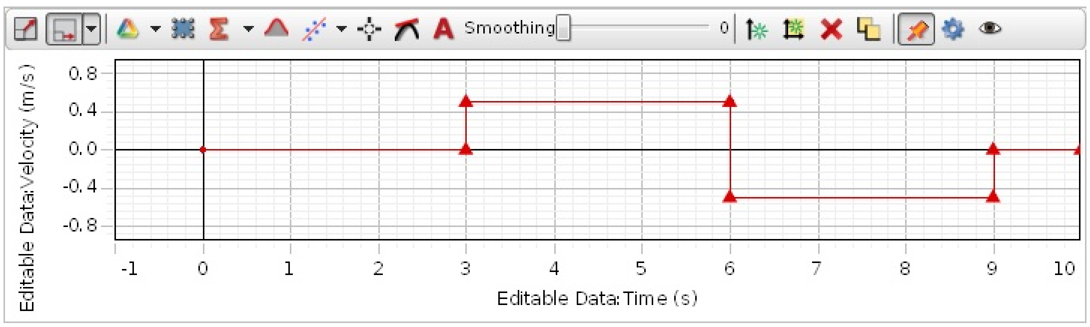
Open experiment kin_8.

8. Carefully study the velocity graph shown on the computer screen.

a. Using a *dashed line*, sketch your prediction for the corresponding position graph, on the axes provided. (Assume that you started at the origin.)

Now do your best to duplicate the velocity vs. time graph by walking. When you have a good match of the velocity graph, sketch your observations on the position and velocity graphs using *solid lines*.





b. How can you tell from a velocity vs. time graph that the moving object has changed direction?

c. How can you tell from a position vs. time graph that your motion is steady (motion at constant velocity)?

d. How can you tell from a velocity vs. time graph that your motion is steady (constant velocity)?