

EXPERIMENT 1: MOTION

In this semester we will be using the computer in the lab to record, store and analyze data. In some experiments the computer will also control apparatus. In this first experiment you are to study motion (position and velocity), and also get familiar with the computer, the particular interface we are using, and their controls. During the semester we will use additional equipment, but many of the controls and commands needed will be based on what you learn today.

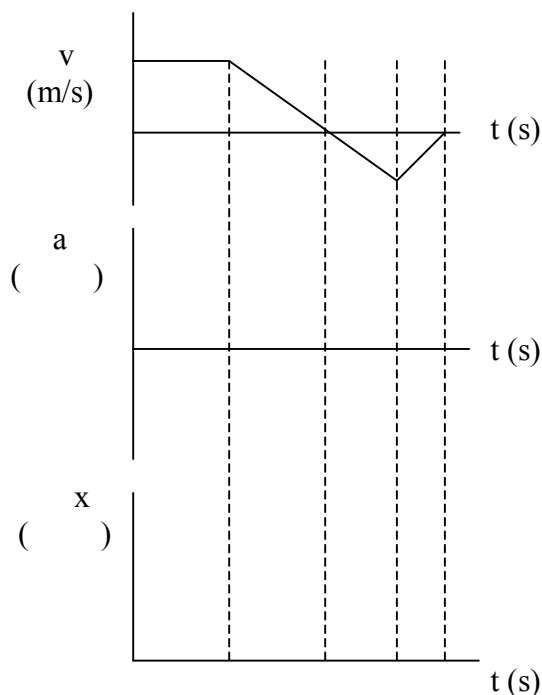
BACKGROUND

If you haven't already done so, you should read sections 2-1 to 2-4 from your textbook, BEFORE coming to lab the first lab day. In particular, pay attention to the graphs which show the relationship between time and position, and time and velocity. You will be generating and studying similar graphs in this first experiment.

ADVANCED STUDY ASSIGNMENT

The top graph at right is a velocity vs time graph for an object moving on the x-axis.

1. Fill in the acceleration vs time graph below the velocity vs time graph. Label the acceleration axis with suitable units.
2. Starting at $x = 0$ when $t = 0$, fill in the position vs time graph from the velocity vs time graph. Recall that area under the velocity curve gives displacement information. Calculate the area for each half second, and place dots on the position vs time graph each half second. Label the position axis with suitable units.



PROCEDURE A

Turn on the Pasco interface, connected to the computer. The switch is on the back at the left of the interface. AFTER the interface is turned on, turn on the computer and select Data Studio. From the menu, select Open Activity. Read the file name you are in. If it is not Data Studio, click on the small arrow to the right of the file name, click on C drive, double click on Program Files, then Data Studio, then double click on Library. Next go to Physics and go down and select P01_Position and Time. This should give you a position time graph to match, after you minimize the text window. IMPORTANT: WHEN YOU CHANGE WINDOWS, YOU MAY BE ASKED TO "SAVE" OR "DON'T SAVE". ALWAYS CHOOSE "DON'T SAVE" OPTION.

PROCEDURE B

Plug the motion sensor into Digital Channels 1 and 2 of the interface, yellow plug into Digital Channel 1. On the motion sensor, set sensor select button to wide pattern. On the Data Studio window, near the top left is a button which has "START" on it, to start collecting data. Notice also the "STOP" button is the same button as the start button (as the experiment records data). Practice starting and stopping the motion sensor by clicking on the Start and then STOP. You should hear a clicking indicating the motion sensor is working.

Now you are asked to duplicate with your body (or a book) the position-time graph supplied. Set the motion sensor on the center divider or on the edge of the table, with 2.0 m of open space available. Study the graph displayed and answer the following questions. Partners should discuss answers, and be sure all agree. Answers should be placed in the data and calculation section of your lab report, procedure B, labeled B1 to B4.

1. How close should you be to the motion sensor at the start?
2. How long (time) are you at this distance from the sensor?
3. When will you be at the farthest distance from motion sensor?
4. How long does your motion take from nearest position to farthest position?

When you are ready, one person (from now on, the target) should stand in front of the motion sensor. No one else should be within range (between the target and the sensor) or the sensor may detect more than one person. Make sure the area behind the target is clear (perhaps a partner can help by making sure no one else crosses behind the target). While the target watches the monitor, a partner should click on START, and the target should start attempting to match the position time graph displayed. Run # 1 will appear in the Data window. All partners should take a turn at running computer and being target.

Repeat the process, noting that multiple runs can be displayed in different colors. Practice using the DATA button on the graph to turn on and off different runs to be displayed. Go to the Data window, highlight the run(s) least like the given graph and delete it using the delete button on the keyboard. (You can use the enter on keyboard to confirm delete.) Do more runs until you have a fairly good match of the target's position with the given graph. Save your best graph by clicking on File, then "Save Activity As...", and then type in a name for your file. (Saving the graph with your name will cause your name to be printed on the graph, so you make sure you get your graph.) Now print one copy of the graph for each group member. When you have the graphs printed, return to "Save Activity As...", highlight the name you gave to your graph, and delete it with the delete button on the keyboard.

PROCEDURE C

Now for a more challenging graph to match. Clear the previous graphs, experiment notes, etc. by clicking close (X, on top right of each window) with the mouse. **REMEMBER TO ALWAYS CHOOSE "DO NOT SAVE" IN ANSWER TO PROMPT.** Go again to the File button on the Menu; go to Open, then Physics experiments and this time click on PO2 Velocity and Time. Note now this is a velocity vs time graph.

Again answer the 4 questions asked in PROCEDURE B above, but now some of the answers are not definite (or may not be possible to answer), but should give you ideas about how to proceed. (Hint: the distance traveled is proportional to the area under the velocity time curve.) Be sure all partners agree on what to do before you start. Answer questions as C1 to C4 on lab report, under Procedure C.

Now proceed as before, doing several runs, deleting unsatisfactory runs, and changing turns of partners to be target and to run the computer. It may be easier to hold a book in front of the sensor and move it, instead of walking yourself. In this case, make sure the sensor is turned onto narrow beam. Print copies of the one best graph for each group member.

QUESTIONS

1. How well were you able to make your graphs fit the given graphs?
2. For PROCEDURE B, describe the motion in words. (Example, moving toward sensor at start for 4 seconds at constant speed, then not moving for 2 seconds.)
3. For PROCEDURE C, describe the motion in words.
4. Do you feel you need more practice in using the Pasco interface and computer controls?