# Physics 230
# Relating Position and Velocity
# An Introduction to Computer Based Data Collection

## Introduction

In this lab you will learn to use a motion detector and computer based data collection system to study motion. You should also come to understand how the shape of position vs. time graphs and velocity vs. time graphs are related to motions and each other.

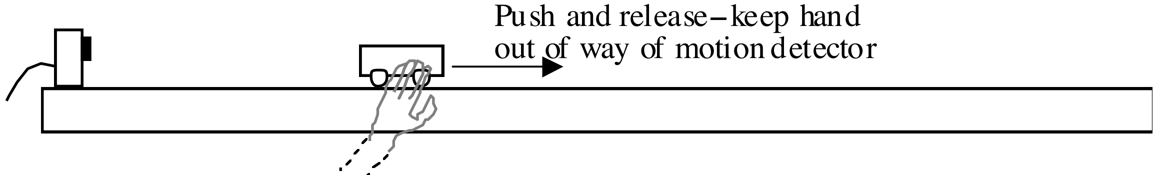
## Materials

Low friction track, cart, fan, motion sensor, LabPro analog to digital converter and a computer. In addition, you need the following cords: power cord for LabPro, cord to connect motion sensor to LabPro, cord to connect LabPro to computer

## Procedure

Open the file called **"pos-vel.mbl"** that is in the PHY230 folder on your computer desktop. You open the file by double clicking on it.

1. **Constant Velocity Motion Away from the Detector**. Start the cart ½ meter from the motion detector and give the cart a quick, hard push away from the detector. After the push ends, the cart will move with (approximately) constant velocity.




For motion #1 described below, do the following:

A) <u>On your own, sketch two prediction graphs.</u> Take 1 or 2 minutes to sketch an **individual prediction** of *position versus time* and *velocity versus time graphs for the motion described*. **After** you have made your own predictions, talk to your group about your ideas and questions. Prediction graphs are not graded for correctness but must be done BEFORE collecting data. Be sure to label the horizontal and vertical axes of your graphs with words (numbers are not needed). Also give the set of graphs an overall title that describes the motion like "Constant velocity motion away from the detector".

**Important!!**

<u>**Friction is so small that it can be ignored.**</u>

<u>**Do not include any data in the graph you record other than that associated with the motion described. The push and stop of the cart should not be recorded.**</u>

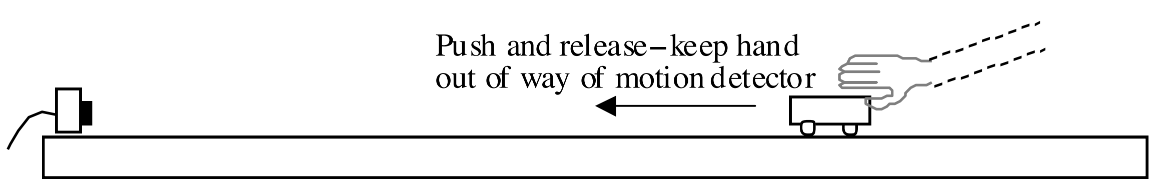
B) Collect data and sketch the correct graphs. Set up the equipment as shown and discussed. Practice the motion until you are comfortable with it. Then, point to and click on the "collect" icon at the top of the page. Wait until you hear the clicking noise. Then, start the motion. Remember to keep the nearest part of the cart at least ½ meter away from the motion detector and keep your hand and other things out of the line between the detector and cart. The data collection will stop automatically. Do not stop the data collection manually. **Record the RELEVENT PARTS of the actual data** as *position versus time* and *velocity versus time graphs*. Data is automatically erased when you click the "collect" icon again. You do not need to erase it manually. These graphs may be graded for correctness. Be sure to label the horizontal and vertical axes of your graphs with words (numbers are not needed). Also give the set of graphs an overall title that describes the motion like "Constant velocity motion away from the detector".

C) Compare your predictions and the actual data. Answer the following question: Do the relevant aspects of your prediction graphs and actual graphs agree? If not, one of them is wrong. If you question the actual data, repeat the measurement. You do not need to correct your prediction if that was wrong.

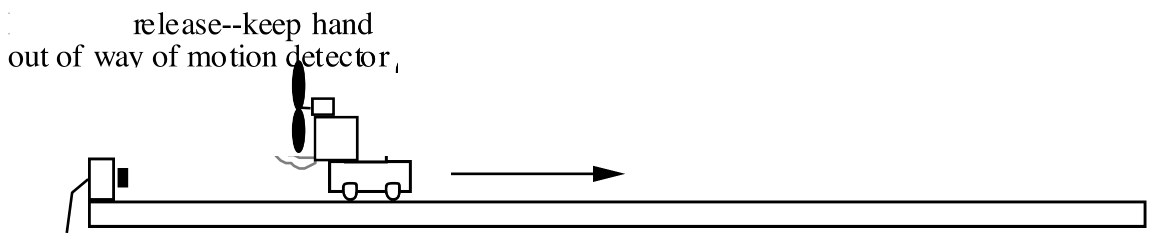
D) State in words what the graphs indicate. Write two sentences, one for each graph in Part B, that describe the position and velocity graphs. Use words like horizontal line, upward sloping line, downward sloping line or curve to describe the general shape of the graph. Also state whether the values of position and velocity are positive, negative or zero. For example, you might write "The velocity vs. time graph is an upward sloping line with negative values."

**Repeat all four of these steps for each of the motions below.**

2. **Constant Velocity Toward the Detector**. Start the cart at the end of the track. Give the cart a quick, hard push toward the detector but stop the cart before it gets within ½ meter of the detector. The cart will move with (approximately) constant velocity.



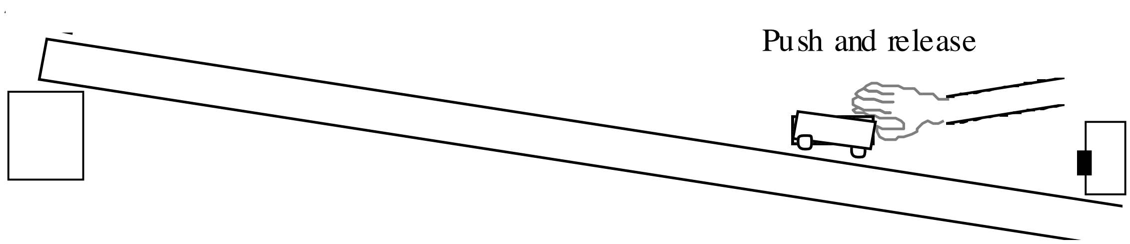
3. **Speeding up at a steady rate Away from the Detector**. Put the fan onto the cart and place the cart on the track so that the fan pushes the cart away from the detector. Start the cart ½ meter from the motion detector. Turn on the fan, start collecting data and release the cart from rest. It will move away from the motion detector and speed up at a steady rate.




4. **Speeding up at steady rate Toward the Detector**. Start the cart at the far end of the track. Orient the fan so that it pushes the cart toward the detector. Start collecting data and then let the cart go-starting from rest. The cart should move toward the motion detector speeding up at a steady rate**. <u>Stop the cart before it gets closer than ½ meter from the motion detector!!! Don't allow it to turn back around!</u>**


5. **Reversing Directions at a Steady rate**. Start the cart at the far end of the track. Orient the fan so that it pushes the cart away from the detector. Give the cart a quick hard push toward the motion detector. It will move toward the detector and slow down at a steady rate as it goes**. <u>DO NOT Stop</u>** the cart before it turns around. The cart will come momentarily to a stop as it reverses direction. It will then move away from the motion detector, speeding up at a steady rate. **DO NOT push so hard that the cart gets closer than ½ meter to the motion detector!!! Practice this motion before taking data.**

6. **Reversing Directions at a steady rate.** Remove the fan from the cart. Incline the track by placing 3-5 inches of textbooks, or something else, under the far end of the track. Place the motion sensor that the bottom of the track and start the cart ½ meter from the motion detector. Give the cart a quick push up the incline. Be sure to keep your hand out of the way of the motion detector. The cart moves up the incline, slowing down at a steady rate, comes momentarily to a stop and then begins moving back down the incline speeding up at a steady rate. Stop the cart before it gets closer than ½ meter from the detector.




## Questions

7. Is the velocity of the cart zero at the turn around point?

8. What does the sign on velocity mean?

9. What has to be true of the velocity for an object to speed up?

10. What has to be true of the velocity for an object to slow down?

11. What feature of a velocity vs. time graph tells you that a cart has reversed direction?