Pre-Lab 2
Due: 10/8

Print your full LAST name: ________________________________

Print your full first name: ________________________________

Print your Lab TA's name: ________________________________

What is your Lab TA's box # (located outside of Wngr 234)? ______

Print your Lab SECTION # here: -----------------> 

Sign your name (full signature): ________________________________

Print today's date: ________________________________
Measuring and Describing One-Dimensional Motion

Read in the textbook all of Chapter 1 and Chapter 2.1-2.5. Then read all of this lab.

Pre-lab: Complete these questions before lab, and turn them into the lab instructor as you enter the lab room.

A. Define the following terms:
   1. Displacement
   2. Velocity
   3. Acceleration

B. Does a car speedometer measure speed, velocity, or both?

C. If one object has a greater speed than the second object, does the first necessarily have a greater acceleration? Explain, using examples.

D. What must your car's average speed be in order to travel 280 km in 3.2 h?

E. A sports car accelerates from rest to 95 km/hr in 6.2 s. What is its average acceleration in m/s^2?

F. A car has constant acceleration from 12 m/s to 21 m/s in 6.0 s. What was its acceleration? How far did it travel in this time? (Be sure to read as indicated above—we may not yet have covered this in class at the time of your lab!)

G. When using a motion detector, what is the minimum distance from the detector an object can be to get accurate results? (You’ll need to read the lab to learn this.)
Lab 2: Measuring and Describing 1-Dimensional Motion

An effective method of describing motion is to plot graphs of distance, velocity, and acceleration versus time. From such graphs, it is possible to determine in which direction an object is moving, how fast it is moving, how far it traveled, and whether it is speeding up or slowing down. In this lab, you will use a sonic motion detector to create graphs of your motion as you move across the floor.

The motion detector measures the time it takes for a high-frequency sound pulse to travel from the detector to an object and back. Using the measured time and the speed of sound, the software can determine the object’s position, velocity and acceleration for you.

The motion detector does not properly detect objects closer than 0.5 m. All of the collected and computed information can be displayed either in a table or as a graph. A qualitative analysis of the graphs of your motion will help you develop an understanding of kinematics.

OBJECTIVES

- Analyze the motion of a student walking across the room.
- Predict, sketch, and test position vs. time graphs.
- Predict, sketch, and test velocity vs. time graphs.
- Analyze graphs of position, velocity, and acceleration vs. time.
**ACTIVITY 1**

**Part 1 Creating Position vs. Time Graphs**

1. Assume the motion detector is at the origin and moving away from the detector means moving in the positive direction. Imagine walking away from the motion detector slowly at a constant speed. Draw a dashed line of your prediction of how the position vs. time graph would look on graph 1.

2. Repeat your prediction for someone walking away at a faster speed. Sketch position vs. time with a dashed line on graph 2.

3. Repeat, but this time for someone starting about 3 m from the detector, and walking toward the detector. Sketch your prediction of the position vs. time graph for this case with a dashed line on graph 3.

4. If there are any disagreements in your lab group, then resolve them before testing the predictions.

5. Connect the Motion Detector to DIG/SONIC 2 of the LabPro. Place the Motion Detector so that it points toward an open space at least 4 m long.

6. Open the Lab2A file (in the Lab 2 folder on the desktop). One graph will appear. (Make sure there’s only one window open.) The vertical axis has position scaled from 0 to 5 meters. The horizontal axis has time scaled from 0 to 10 seconds.

7. Using the Motion Detector and Logger Pro, produce a graph of your motion when you walk away from the detector with constant velocity. To do this, stand about 1 m from the Motion Detector and have your lab partner click **Collect**. Walk slowly away from the Motion Detector when you hear it begin to click. Draw the position vs. time curve on graph 1 with a solid line.

8. Repeat, walking a little faster. Sketch the resulting curve on graph 2 with a solid line.

9. Repeat again, but start about 3 m away and slowly walk toward the detector. Sketch the resulting curve with a solid line on graph 3.

10. How did your predictions and results compare?

11. What is it about the position vs. time graph that tells you the magnitude of the velocity (speed) and what tells you the direction?
Part II  Position vs. Time Graph Matching

1. Open the experiment file Exp 02b Distance Match One. A position vs. time graph similar to this one will appear. **Describe** how you would walk to produce each segment of the graph you see on your computer (it may be slightly different than this sample):

![Graph Image]

Description (segment by segment):

2. To test your prediction, choose a starting position and stand at that point. Start data collection by clicking **DONE**. When you hear the Motion Detector begin to click, walk in such a way that the graph of your motion matches the target graph on the computer screen.

3. If you were not successful, then repeat the process until your motion closely matches the graph on the screen. Be sure all team members try.

4. Open the experiment file Exp 02c Distance Match Two and repeat Steps 1 through 3 using that new target graph. Again, describe how you would walk to produce each segment of the graph you see on your computer (it may be slightly different than this sample. Then try to walk to produce that target graph.

![Graph Image]
5. What type of motion is occurring when the slope of a position vs. time graph is zero?

6. What type of motion is occurring when the slope of a position vs. time graph is constant?

7. What type of motion is occurring when the slope of a position vs. time graph is changing? Test your answer to this question using the Motion Detector.

______ Lab Instructor Check Point

Part III  Velocity vs. Time Graph Matching

1. Open the experiment file Exp 02d Velocity Match One. You will see something similar to this velocity vs. time graph (yours may be a little different).

![Graph]

2. Describe how you would walk to produce each segment of the graph on your computer screen.

3. To test your prediction, choose a starting position and stand at that point. Start Logger Pro by clicking In Collect. When you hear the Motion Detector begin to click, walk in such a way that the graph of your motion matches the target graph on the screen. It will be more difficult to match the velocity graph than it was for the position graph. It is hard to create a smooth graph since the trunk of your body undergoes accelerations during each step. The best results occur with small, shuffling steps. You may want to hold a book in front of your body to smooth out the motion. It will take some practice. Be sure all team members try.
4. Now sketch the position vs. time graph for the graph you just made.

5. In Logger Pro, switch to a position vs. time graph to check your answer. Do this by clicking on the y-axis label, un-checking Velocity and checking Distance. Click ok to see the position graph. Explain any differences to your prediction.

6. What does the area under the velocity vs. time graph represent? Test your answer to this question using the Motion Detector.

7. What type of motion is occurring when the slope of a velocity vs. time graph is zero?

8. What type of motion is occurring when the slope of a velocity vs. time graph is not zero? Test your answer using the Motion Detector.
9. Open the experiment file Exp 02e Velocity Match Two. **Describe** how you will walk to match each segment of the graph you see (below is a similar sample, but it may not be identical—as usual, use the one on your computer screen).

   Description (segment by segment):

   ![Graph](image)

10. Now test your prediction—try to walk your description. Explain any differences.

11. Now sketch the position vs. time graph for the graph you just made.

   ![Graph](image)

12. In Logger Pro, switch to a position vs. time graph to check your answer. Do this by clicking on the y-axis label, un-checking Velocity and checking Distance. Click **OK** to see the position graph. Explain any differences to your prediction.
13. a. Perform the appropriate motion to create a plot of the velocity as a function of time that is a linear, non-zero, function. Draw the plot below and be sure to scale and label each axis.

b. What is the slope of the plot?

c. Describe the motion you had to perform to create this plot.

d. Write an equation, with appropriate units, describing the above velocity as a function of time.

\[ v(t) = \]

e. Draw a physical representation of the motion. A physical representation is a sketch that takes use of identifying icons, i.e. cartoons, and vectors to represent the position, velocity, and acceleration at various points in the motion (usually just the initial and final states of the system).
ACTIVITY 2 GRAPHICAL ANALYSIS

Use the motion graphs A through I to answer the following questions. 
Pick the graph or graphs which show:

a) velocity always negative: 1. ______

b) an object with constant velocity:
   2. ______  3. ______  4. ______  5. ______

c) an object that has changed the direction of its motion:
   6. ______

d) an object whose acceleration is changing:
   7. ______  8. ______

e) Pick a pair of velocity and acceleration graphs that could be describing the same motion.
   9. ________
   10. ________
   11. ________

_____ Lab Instructor Check Point

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Physics 201