Name:_____ Date:_____

Dr. Croom's Physics Lab 02-1

What's my Motion [NOTEBOOK LAB]

Purpose:

The purpose of this experiment is to learn how displacement, velocity and acceleration graphs are related.

Theory (synopsis):

- Position, velocity, and acceleration can be graphed versus time.
- The equation of a line is equal to y=mx+b
- Slope is determined by $\Delta Y / \Delta X$
- The slope of a position time graph is velocity.
- The slope of a velocity time graph is acceleration.
- The area under an acceleration time graph is final velocity.
- The area under a velocity time graph is final displacement.

Hypothesis:

The slope of the displacement graph will be average velocity over the same time interval. The area under the velocity graph will be total displacement over the same time interval.

Equipment:

1. Computer
2. Computer Interface
3. Motion Sensor
4. Capstone Software

General Procedure:

For this activity, you will be the object in motion. The Motion Sensor will measure your position and velocity as you move in a straight line at different speeds. The capstone program will plot your motion on a graph of position and time and velocity and time. The challenge in this activity is to move in such a way that a plot of your motion on the same graph will "match" the line that is already there.

1. Make sure computer and computer interface are properly connected to power sources and to each other and then start computer
2. Plug Motion Sensor into interface, Yellow cord into 1, Black into 2
3. Open: Pub Drive/HSC/Croom, J/Your Period/Capstone Files/Lab 02-1 Motion Lab
4. Click on Hardware setup
5. Connect your interface. (See your teacher for details)
6. Still in the setup window click on the digital input 1 port and select the motion sensor.
7. Click hardware setup to close the setup window.
8. Make sure the independent variable in the top left graph is position
9. Make sure the independent variable in the bottom left graph is velocity
10. Make sure the independent variable in the bottom right graph is acceleration
11. For the textbox on the top right put your lab group number
12. For each graph you print change the experiment to the appropriate number.

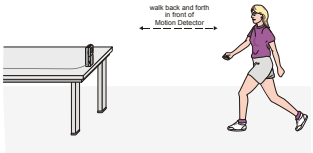
*For this lab each lab partner will be responsible for a portion of the write up. You will hand in a hard copy of this lab as a group. It is very important that each person completes their portion of the lab.

To Collect Data:

13. Make sure switch on top of the sensor is on the human setting
14. Stand about 20cm in front of the center.
15. Click "Record" in the bottom in the left hand corner of capstone.
16. Move away from the sensor and then back towards it as described in the data collection section.
17. Click "Stop" to stop experiment
18. If Graph does not appear raise your hand and patiently wait for assistance.
19. Scale axes to show all data
20. If the graph is present, analyze it with the tools described in the specific procedures below
21. When done print your graph.

22. DO NOT Delete the data sets you keep
23. DELETE any data sets that have bad data by clicking delete last run on the bottom right of Capstone
24. Make sure to save your Capstone file in your group's pub drive file.
25. When you are done with a data run, click "Record" again and your graph will be cleared and the new run will appear on the screen.
    a. You can go back to previous run by clicking on

Specific Procedure PART A: (You will preform enough experiments for part A as you have lab partners)



Experiment 1a – Performed and Analyzed by Partner 1

1. Have the walker walk in a straight line at the same speed away from the sensor for about 10 feet, Stop for 2 second and then return to the initial spot. Remember you must start no closer then 40cm away from sensor.
    a. What does the position time graph look like?
    b. What is the significance of the sign of the slope of the position time graph?
    c. What is the slope of the position time graph away from the sensor?
    d. What does the acceleration graph look like? Why does it look like this?
    e. Is there a similarity between the height of the acceleration graph and the slope of the position graph?
    f. The 20 cm is because the computer cannot recognize the different ticks at this time. If 20 cm is minimum distance and sound is traveling at 343 m/s, how quick can the computer process a single tick?

Experiment 2a – Performed and Analyzed by Partner 2

2. Have the walker walk away from the sensor again, but this time have them change there speed by speeding up while they are walking. When they have traveled about 10 feet, have them stop for about 2 second and then stop your run.
    a. What does the slope of the position graph look like this time?
    b. What does the slope of the velocity graph look like this time?
    c. What is the slope of the velocity graph?
    d. What is the slope of the acceleration graph?
    e. What is the relationship between the height of the acceleration graph and the slope of the velocity graph?
    f. If you are standing 120 cm from the motion sensor, how long does it take the sound to travel from the sensor to you and back to the sensor? Sound is traveling at 343 m/s.

Experiment 3a – Performed and Analyzed by Partner 3

3. Have the walker walk away from the sensor again, but this time have them change there speed by slowing down while they are walking. When they have traveled about 10 feet, have them stop for about 2 second and then stop your run.
    a. What does the slope of the position graph look like this time?
    b. What does the slope of the velocity graph look like this time?
    c. What is the difference in the velocity graph in the last run and this run? What does this mean?
    d. What is the slope of the velocity-time graph?
    e. Now look at the acceleration graph and explain why the acceleration is in the positive or negative region.
    f. If you are standing 220 cm from the motion sensor, how long does it take the sound to travel from the sensor to you and back to the sensor? Sound is traveling at 343 m/s.

Experiment 4a – Performed and Analyzed by Partner 4

4. Have the walker stand about 10 fee from the sensor. Turn on the senor and have the walker, walk toward the sensor at a constant rate. Stop when you are about 40cm from the motion sensor. Pause for 2 seconds. Then return to where you came from at an increasing rate.
    a. **What does the slope of the first half of the position graph look like this time?**
    b. **What does the slope of the first half of the velocity graph look like this time?**
    c. **What is the slope of the position time graph for the first half of the lab?**
    d. **What is the difference in the velocity graph in the last run and this run? What does this mean?**
    e. **Now look at the acceleration graph and explain why the acceleration is in the positive or negative during the second half.**
    f. **If you are standing 170 cm from the motion sensor, how long does it take the sound to travel from the sensor to you and back to the sensor? Sound is traveling at 343 m/s.**

Specific Procedure PART B: (You will preform enough experiments for part A as you have lab partners)

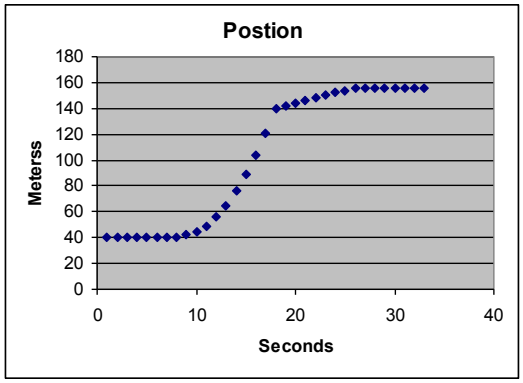
For this part of the lab you are going to try to create the graphs show below. Click on page 2 of the capstone file before collecting data. Collect data. Once you have done this find the slope of your position time graph with the capstone software. Then find the area of the velocity graph with the capstone file.

1. To find slope, by clicking on the slope tool from the top menu bar of the graph you want to analyze and then choosing linear equation.
2. Move the data box so that it isn't covering the entire graph.
3. Find the area by clicking on the area tool from the top menu bar of the graph you want to analyze.
4. Move the data box so that it isn't covering the entire graph.

Experiment 1b – Performed and Analyzed by Partner 1

Create a graph to match the graphs below. Don't worry about matching the value; match the shape!

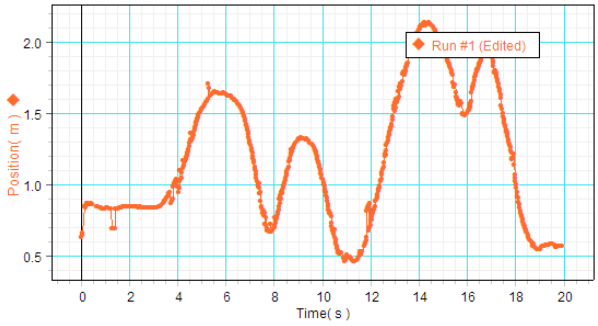
Position



Experiment 2b – Performed and Analyzed by Partner 2

Create a graph to match the graphs below. Don't worry about matching the value; match the shape!

Position



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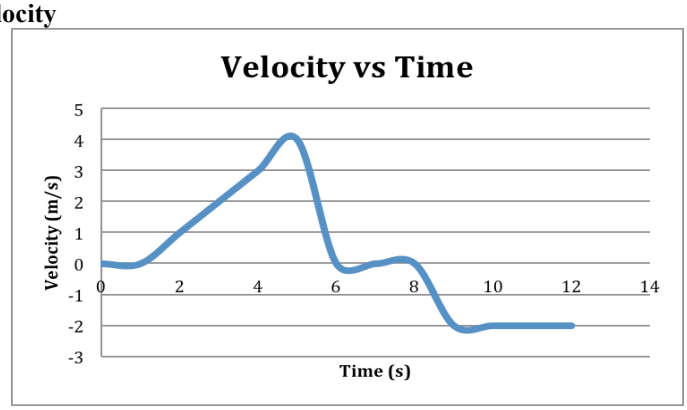
Experiment 3b – Performed and Analyzed by Partner 3

Create a graph to match the graphs below. Don't worry about matching the value; match the shape!

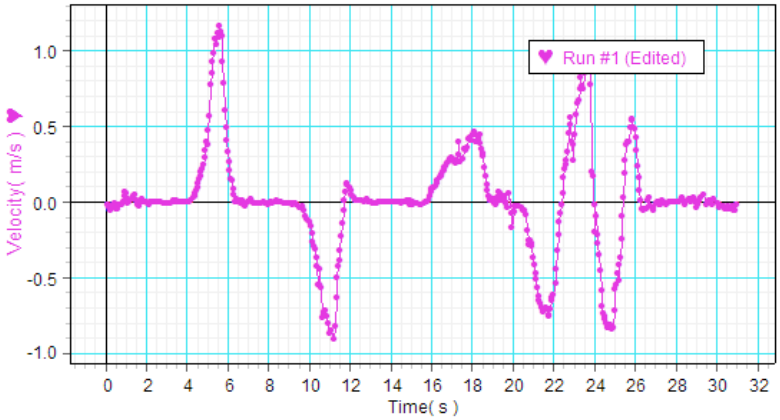
Velocity



Experiment 4b – Performed and Analyzed by Partner 4

Create a graph to match the graphs below. Don't worry about matching the value; match the shape!

Velocity



Questions/Things you need to do individually:

Follow separate rubric for Grades. Include the sections below.

Purpose

Hypothesis

Data / Results

Conclusions