HT Kinematics Lab

PSI Physics

Name_____

Problem: The goal of this lab is to determine and confirm:

1. the velocity (v) of a dynamics cart by measuring the slope of a position graph, and
2. the acceleration (a) of a dynamics cart by measuring the slope of a velocity graph
3. examine standard motion patterns through graphs

Materials:

- One dynamics rail and cart
- PASCO interface
- Motion sensor (if possible, set to wide beam)
- Computer with PASCO capstone software

Preparing the PASCO Capstone Software:

1. Connect the motion sensor to the PASCO interface (the yellow plug goes into digital input port 1, and the black plug goes into port 2). Turn on the interface.
2. Open the Capstone software on the computer. On the left sidebar, click “Hardware Setup.” Then, click the yellow circle that represents the first digital port (where the yellow plug is), and select “Motion Sensor II.”
3. On the right sidebar, double click the “Graph” icon. Then, add two more graphs by clicking the “Add Display” button.
4. Make the first graph measure position, the second graph measure velocity and the third graph measure acceleration.

Procedure: Gather your data using the following procedure:

1. Slide the motion sensor onto one end of the dynamics rail. Put that end of the dynamics rail on an incline by placing it on top of books. Put the other end of the dynamics rail against a wall so that the cart can bounce.
2. Place the dynamics cart in front of the motion sensor. In the Capstone software, start the data recording and let go of the cart.
3. Once the cart stops moving, stop recording of the data.
4. Select three points on the position graph before the first peak. Using the slope tool in the Capstone software, record the slope of the position graph at that time. Do the same for the velocity and acceleration graphs, but use the Capstone software to fully smooth the acceleration graph before taking its slope. Record your results in the chart below.

Data:

Variable	Slope at t_1 (t = s)	Slope at t_2 (t = s)	Slope at t_3 (t = s)
Position			
Velocity			
Acceleration			

Equations:

$$\boldsymbol{v} = \frac{\Delta \boldsymbol{x}}{\boldsymbol{t}}$$

$$\boldsymbol{a} = \frac{\Delta \boldsymbol{v}}{\boldsymbol{t}}$$

Analysis:

1. Do the peaks / sudden changes for position, velocity, and acceleration occur at the same time? Why or why not?

2. Compare the slope for position at t_1 to the value of velocity at t_1. Repeat for t_2 and t_3.What does this tell you about the relationship between position and velocity?

3. Compare the slope for velocity at t_1 to the value of acceleration at t_1. Repeat for t_2 and t_3. What does this tell you about the relationship between velocity and acceleration?

4. What is the slope of acceleration at t_1? What does this tell you about acceleration? Repeat for t_2 and t_3.

Interpretation and Application Questions:

1. A jogger accelerates uniformly for 5 seconds to cover a distance of 40 meters

    a. What is her average velocity?

b. What is her acceleration?

c. What is her velocity after 5 seconds, assuming she starts from rest?