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PH – 1110 CX16

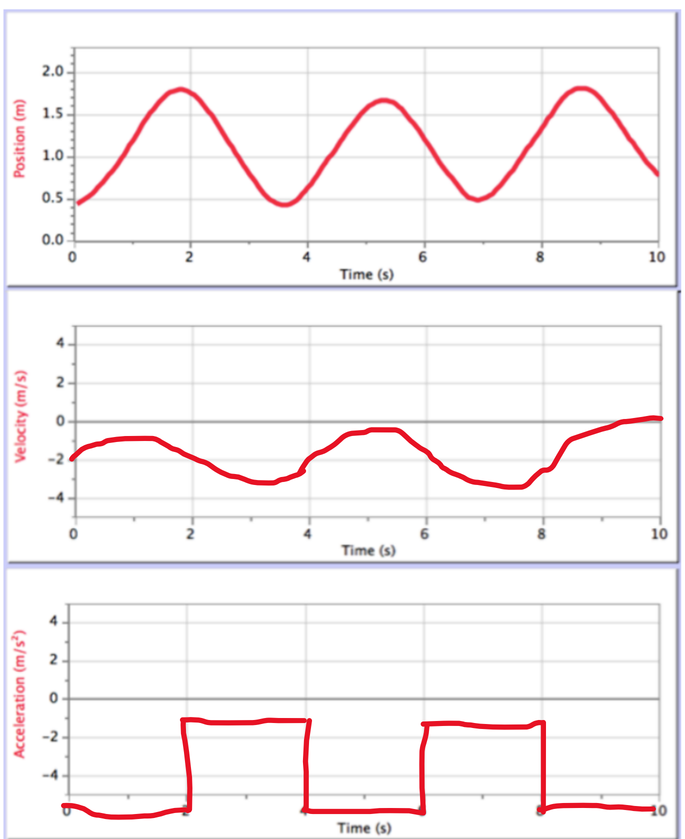
Graphing Motion – 111X Lab 2

Question – 1:

1. Describe the kind of motion that produced the position versus time graph.

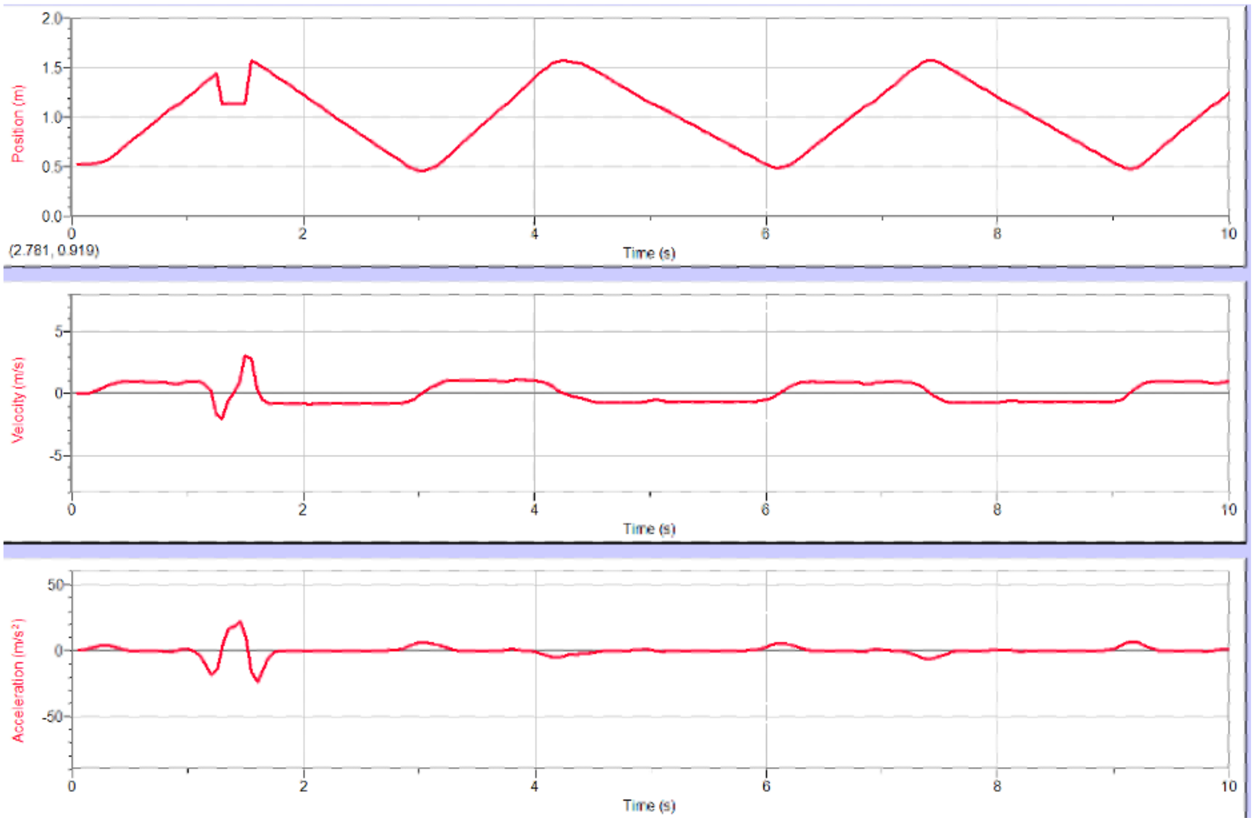
Multiple factors can influence the kind of motion produced by the position versus time graph, for example, the velocity or even the accelerated movement. A constant slope can represent a straight line on the graph as the object moves over a constant velocity. Similarly, an object undergoing accelerated motion or deceleration motion represents a curved line on the graph. And the graph creates a sinusoidal curve representing a harmonic motion when the object goes through an oscillatory motion.

2. Sketch the v(t) and a(t) graphs you would expect to get for this motion. You can either draw this by hand and take a picture for your Word document or draw it in word.



(Figure – 1: Graphs that I expect to get from the motion)

3. Try to recreate this motion in real life, collect the data with Logger Pro, and qualitatively compare your predicted graphs with the graphs calculated in Logger Pro.



(Figure – 2: Recreating the graphs that I expect to get from the motion through Logger Pro)

Question – 2: The Three Motions and their Prompts

Will the position, velocity, and acceleration be zero, positive, negative, or more complex?

What will the graphs of x(t), v(t), and a(t) look like? (i.e. a straight line slanted up or slanted down, a constant, curving up, curving down, etc.)

Motions:

1. Moving towards the motion detector at a constant velocity

The object's position and velocity increase at a constant rate and are positive, whereas the acceleration is zero. Therefore the x(t) will be a straight line slanted upward, v(t) will be a horizontal straight line, and the a(t) will be zero.

2. Moving away from, then towards, the motion detector (looking only at the turning point).

The object's position and velocity would be zero, whereas the acceleration would be a maximum positive value. Therefore the graph of x(t) and v(t) has a vertical line at zero, whereas a(t) is at it's maximum positive value at the turning point.

3. Moving away from the motion detector with a continuously decreasing speed

The position would be positively increasing at a decreasing rate; the velocity would be positive and decreasing and the acceleration would be negative. Whereas the graphical representation would be like x(t) forming a parabolic shape with a downward slope, and v(t) and a(t) forming a linearly slanted graph.

Question – 3: For each of your graphs (a total of nine), answer the following questions for each motion on your worksheet. Reference the statistics or slopes applied to the graphs in this discussion.

How do your position, velocity and acceleration graphs compare with your prediction? Was it exactly zero at all times if you predicted ZERO for velocity or acceleration? If you predicted non-zero velocity or acceleration, was the sign what you predicted?

Compare the numerical values for the velocity and acceleration obtained by more than one method from your graphs, and comment on whether those differences are significant. Be as quantitative as you can (i.e., include uncertainties).

As for velocity, I was expecting to get more of a mildly oscillating graph; as a result, I was getting a zero at all times. That was the first difference I instantly noticed while collecting my data. From the experiment, I deduced that the further the object is from the sensor, the more the distance increases, resulting in an inclined slope or vice versa with respect to time, where I hypothesised the graph to be oscillating and either the number of oscillations to increase or the wavelength or the amplitude to increase, which is the other primary contradiction which is different from my graph. As for acceleration, I expected the graph to remain constant for a particular amount of time and gradually decrease, and my hypothesis matched with the experiment conducted graph.

Question – 4: Experimental Method

For today's experiment, write down with bullet points the three most important steps for your data collection, including why you think the particular step is important. Use complete sentences (one per bullet point) not just a copy and paste of the instructions above.

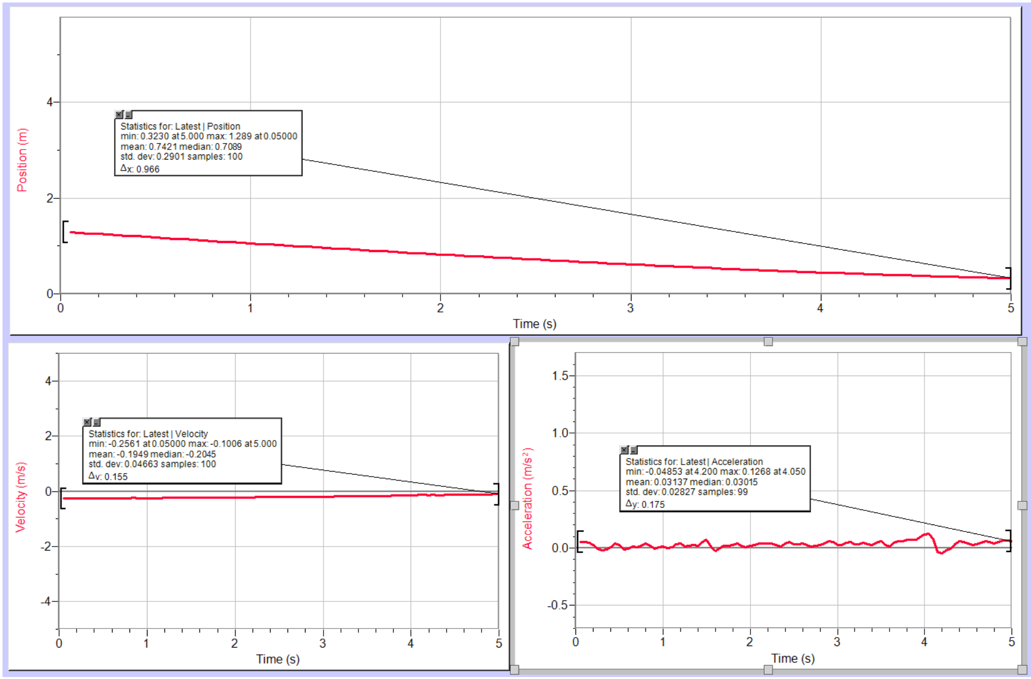
- Make sure to start the timer at the same distance to make sure the car to not hit the sensor; I would mark a place (around 7 cm away from the sensor) and make sure to take the vehicle out when the car reaches that mark to make the experiment consistent throughout for the other trials as well.
- Marking the error bars accordingly to calculate the uncertainty would be something to be considered at all times. For example, when the vehicle is released at a specific initial acceleration, we can see that the graph goes a bit higher and then comes down, following a linear graph after that. In that case, taking the error bars from the beginning would not make sense and would give us a higher uncertainty value. An example of it has been given in the Acceleration graph of Figure 5 for reference. Therefore marking the error bars as soon as the linear line start until the end would be ideal for calculating the uncertainty.
- In order to make the speed measurement consistent throughout the lab, it would be well suggested to have an inclined surface to release from; therefore, regardless of where the car is released from, with a single touch, we know that the vehicle is going to reach the mark and removing it ass soon as it reaches the mark would give us more consistent results in terms of time and in terms of acceleration.

Question – 5: Graph and Data Checklist

You should have two hand-drawn graphs and nine LoggerPro graphs with the appropriate axis label, a complete caption and answered all of the questions highlighted by the grey boxes.

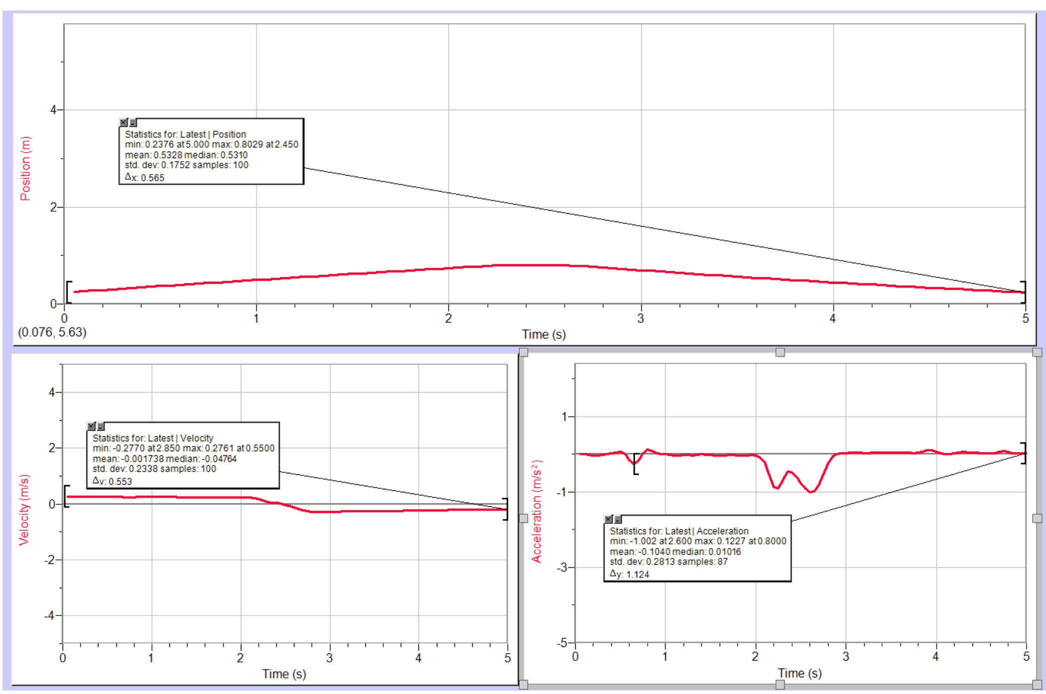
To reiterate, please have a position, velocity and acceleration graph for

1. Moving towards the motion detector at a constant velocity.



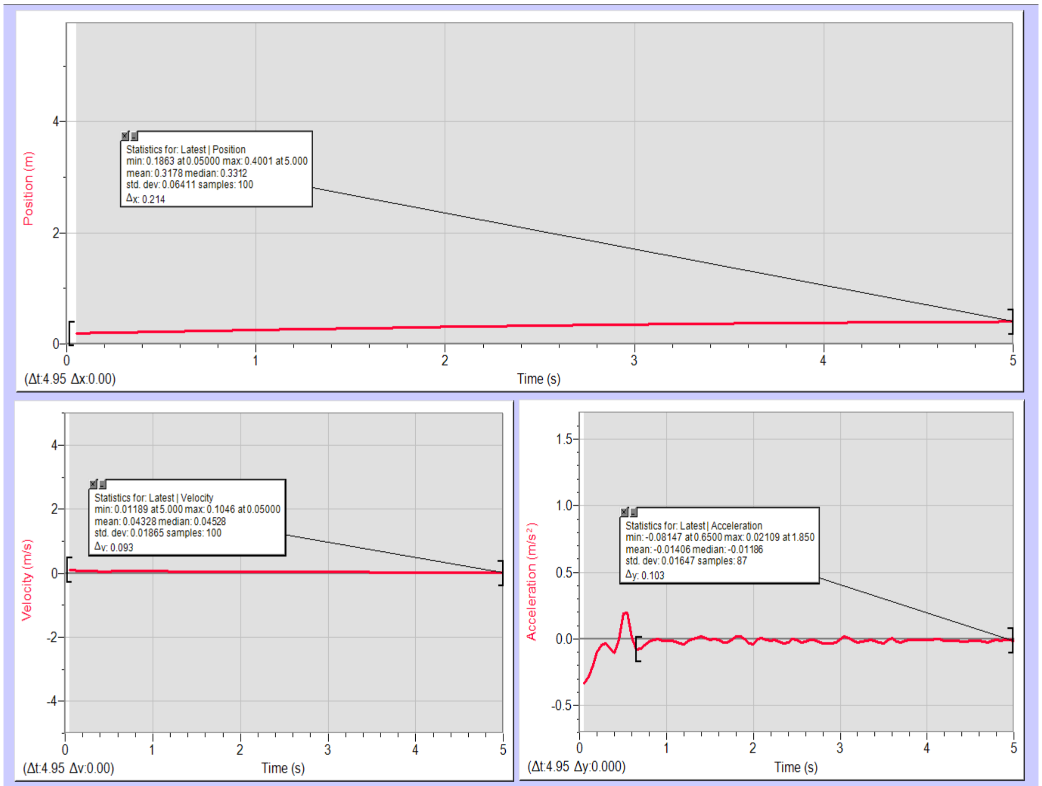
(Figure – 3: As the object is moving towards the sensor)

2. Moving away from, then towards, the motion detector (looking only at the turning point).



(Figure – 4: As the object is moving away from the sensor then towards the sensor)

3. Moving away from the motion detector with continuously decreasing speed.



(Figure – 5: As the object is moving away from the sensor)