LAB 3: MOTION: ACCELERATION VS. TIME GRAPHS

INTRODUCTION

With this lab we will study the concepts of position, velocity, and acceleration, and how these change through time. The instrument we will be using is a motion detector capable of measuring your position at any given time and calculating your velocity and acceleration. We will use position, velocity, and acceleration vs. time graphs to analyze and better understand these quantitates and how they change through time given different motions. We will also learn how to use a graph to present data as well as interpret the information in a graph.

An acceleration vs. time graph is a graph that plots the acceleration of an object or person over the course of a time period. Acceleration is plotted on the y-axis (the vertical axis) and time is on the x-axis (the horizontal axis).

OBJECTIVES

This lab has the following objectives:

- Become familiar with Motion Sensor and its use
- To explore the concepts of position, velocity, and acceleration and their relationship to different kinds of motion
- To develop graphing skills in presenting and interpreting data

EQUIPMENT

Computer with LoggerPro software with LabQuest or LabPro interface
Motion sensor
Track with cart

FORM A TEAM

Form 5 teams of 4 and assign the following positions:
Person 1: Team Leader / Oral Presenter
Person 2: Lab Tech 1 (Computer / Sensor Ops)
Person 3: Data Recorder / Grapher
Person 4: Lab Tech 2 (Carry out required motions)

GETTING STARTED

- Log into computer using the login taped on the front of the computer
- If LabPro unit is not plugged in already, plug it in
- If motion detector is not already plugged in, plug it in
- Open the desktop file PHYS100_Hosmer

Contributed by Dr. Hosmer

GENERAL INSTRUCTIONS

- Do not let the Cart hit the motion detector
- Always keep the cart at least 6 inches away from the motion detector since it cannot accurately detect position close than this distance
- Note that there is a slight time lag between your actions and what is graphed on the screen
- To start and stop the motion sensor, clock the green "collect button." You can start and stop as many times as you want

EXPERIMENT 1

- Set the cart about 6 inches from the motion detector
- Start collecting data
- With your hand, move the cart to the right, along the track all the way to the end and then back to the motion detector, in about 6 or 7 short, crisp steps each way, pausing about a second in between each step
- If necessary, do this several times until you get nice, clean graphs

What physical object is serving as the origin of your coordinate system?

Which direction is the positive (+) direction? Away from, or towards the detector?

Which direction is the negative (-) direction? Away from, or towards the detector?

When the cart is making steps in the positive direction, lis the velocity graph positive or negative?

When the cart is making steps in the negative direction, is the velocity graph positive or negative?

On the acceleration vs. time graph, you should notice that there are two peaks associated with each step
that the cart tales, one positive peak and one negative peak. What is different about these peaks from when the cart is moving away from the detector and when the cart is moving toward the detector?

When moving in the positive direction, which acceleration peak comes first: + or - ?

When moving in the negative direction, which acceleration peak comes first: + or - ?
Explain why there is one positive acceleration peak and one negative acceleration peak associated with each step the cart makes and why they are in different orders depending on if the cart is moving in the positive or negative direction.

EXPERIMENT II

- Start collecting data
- With your hand continuously on the cart, roll the cart from the detector to the other end of the track at the most constant velocity you can, stop the cart at the end for a second, then roll it back to the detector at constant velocity. Repeat until the end of the collection time.

When the cart is moving in the positive direction describe the slope of the position graph. When the cart is moving in the positive direction, is the velocity graph positive or negative?
You may not that the acceleration peaks come in pairs, 2 negative, 2 positive, corresponding to when you stop the cart from moving in one direction and start it moving in the other direction. Why do both of these motions have the same direction or acceleration?

EXPERIMENT III

- Start collecting data
- Starting with the cart close to the detector, give it a short, crisp nudge toward the other end of the track and let it coast to the end on its own, gently stopping it with your finger jus before it hits the end of the track. Wait a second, them nudge it back toward the motion detector, gently stopping it with your finger before it hits the motion detector.

In what ways does the graph look different from when you were rolling the cart the entire time with your hand at constant velocity?
What kind of acceleration (+ or -) was require to START the cart to move in the + direction?
What kind of acceleration (+ or -) was require to STOP the cart to move in the + direction?
What kind of acceleration was required to START the cart moving in the – direction?
What kind of acceleration was required to STOP the cart moving in the – direction?

MOTION CHALLENGE

If time permits, the teams will participate in the motion challenge.