

Physics Lab 4: Analyzing Motion I

Goals: Improve your ability to use LoggerPro software to analyze kinematics data; Gain more experience with graphical representations of motion; Use slopes of (linear regions of) position vs. time graphs to determine velocity for constant velocity situations; Use slopes of (linear regions of) velocity vs. time graphs to determine acceleration for constant acceleration situations; Use the area under a velocity vs. time graph to determine the corresponding change in position.

Equipment: Your primary tool today will be the computer. You should have access to all your previously produced LoggerPro files in the folders in the program share Workspace.

Groups: For today's activity, you will work by yourself on a computer. Feel free to consult with a neighbor or instructor but you should be completing this analysis by yourself.

References:

- LoggerPro tutorials 09 Curve Fitting, available under LoggerPro, File: Open: Tutorials.

Lab Notebook

- Update your Table of Contents. Write in page numbers as needed.
- Leave some room at the end of the previous lab. Start the new lab entry on a new page. Start the entry with the title of the investigation and the date. Include the names and contact information of any lab partners.
- Leave some room at the end of each lab entry in case you need to add something later. For this lab, you should leave sufficient space at the end to tape in the graphs which you will print out later after you have completed the analysis, have access to a printer, and then tape directly into your lab notebook.

Part 1: Reviewing

- a) As a class, we will look at past physics labs and identify gaps to complete, either in obtaining data or bringing your lab notes up to date.

Part 2: Analyzing Motion Detector Data

- a) As a class, we will go over how to prepare useful position vs. time and velocity vs. time graphs from Motion Detector data. This will include showing individual data points that are not connected and zooming in on regions of interest. We will do this for one Tumble Buggy data run and for Ball Bounce data.
- b) For the four Tumble Buggy runs from Physics Lab 3, verify that the slope of the position vs. time graph gives the velocity by doing a Linear Fit to the linear region of the position vs. time graph and comparing that to the mean velocity found using Statistics.
- c) For one of the Tumble Buggy runs (your choice), verify that that area under the velocity vs. time graph found using the Integral tool is consistent with the change in position (also called the displacement).
- d) For the Ball Bounce data, do Linear Fits to the linear regions of the velocity vs. time graphs for while the ball is in the air (so the negative slope regions) for several bounces. What physical quantity does the slope of a velocity vs. time graph give you? Record the acceleration (with units) for the ball while it is in the air for at least different bounces (this means Linear Fits to three different parts of the velocity vs. time graph). Are these accelerations consistent?
- e) Zoom in on one single bounce. Highlight a portion of the velocity vs. time data and use the Integral tool to determine the area under the velocity vs. time graph. Verify that this area is consistent with the corresponding displacement. Do this for several different portions of the same bounce.

Part 3: Extensions

- a) Open the LoggerPro file Motion Story, available in the program share Handouts folder, under Week 2 Lab. In words, describe the motion shown. This data was obtained with a Motion Detector similar to the one you used in lab. Be as quantitative as possible.
- b) Use the time to work on getting caught up with Physics Labs.
- c) Complete When Will They Pass from Physics Lab 2 and Math/Physics Lab 2b.
- d) Continue working on Will They Collide from Math/Physics Lab 2b.