Patterning the World – Spring 2014

Physics Lab 8: Force and Motion

Goals: Improve communication and teamwork capacities**;** Improve ability to make careful measurements; Use a motion detector to investigate the connection between acceleration, mass, and force.

Equipment: You will be oriented to the location and proper use of the equipment for this lab. At the end of the session, return the equipment to its original configuration and location.

Groups & Lab Notebook: For today's investigation, you will work in groups of 3; your instructor will facilitate pair formation. Update your Table of Contents. General Lab Notes guidelines apply. You will return to this data in a future session, so make sure you have documented your results from this lab well.

Part 0: Getting Started

a) You will be oriented to equipment and today's investigation in the opening remarks.
b) Gather your equipment and assemble it as described. Take care to level the track. Set up the motion detector with a protective stop so that the cart doesn't crash into the detector or fall off the other end of the track.
c) Determine the detector's usable range and adjust as needed to get the most useful range.
d) Draw a sketch of your experimental set-up in your lab notebook.
e) Make sure to use tape to identify each of your 2 black masses as A or B.

Part 1: Constant Velocity Measurements (Fan turned off)

a) Obtain a good position vs. time graph for motion of the cart for constant velocity motion (the fan should be turned off) for motion **towards** the motion detector. Save your best run as Constant Velocity Towards.
b) Determine and record the velocity (include sign and units) for this run.
c) Repeat, but this time for constant velocity motion away from the motion detector. Save your best run as Constant Velocity Away.
d) Determine and record the velocity for this run.

Part 2: Full Strength Force Measurements I (Fan turned on, all batteries)

a) As described in the equipment orientation, obtain position vs. time graphs for motion where the cart is initially moving towards the motion detector, turns around, and moves away from the motion detector. As before, your goal is to obtain good position vs. time graphs for each of the following scenarios.
b) Pick good names for each scenario. When you have obtained, saved, and named your best run for each scenario, fit a quadratic to the position vs. time graph and a line to the velocity vs. time graph for regions centered around the turn-around point. For the velocity vs. time graph, record the slope (with units) of the best linear fit(s). For the position vs. time graph, record the value of A (with units) for the best quadratic fit(s).
   - Scenario I: all batteries, no extra mass.
   - Scenario II: all batteries, silver mass.
   - Scenario III: all batteries, black mass A.
   - Scenario IV: all batteries, silver mass and black mass A.
   - Scenario V: all batteries, black mass A and black mass B.

Part 3: Partial Strength Force Measurements II (Fan turned on, 2 or 3 batteries)

a) Repeat Part 2, but using only 2 or 3 batteries as described in the equipment orientation.

Part 4: Measure Mass

a) Use the balance in the back of the room. Measure each piece of equipment separately (you can't measure more than one piece at a time anyway). Record the masses to the nearest 5 grams for the cart, the fan + batteries + slugs, the silver mass, black mass A, and black mass B.

Data organization

a) Organize your results into a table, with columns for fan force ("full" or "partial"), mass, acceleration from velocity vs. time graphs, and acceleration from position vs. time graphs. You may also need to distinguish between towards and away parts of a trip.