Lab 9: Acceleration

1. On your table you have a "frictionless" track, a cart, and a fan. The fan will provide a constant acceleration to push the cart along the track. Start by having your cart stationary near the motion detector and have the fan pointing whichever direction moves the cart AWAY from the motion detector. Start the fan and observe what happens. On your handout, predict what the graphs of position and velocity will look like when you take data on the computer.

2. Open **SPARKVue** application in the **PASCO SPARK LXi** interface. Open **PASCO** Experiment. Select **PHYS101L**. Open **Acceleration** file to collect data. Sketch the graphs you generated on your handout.

   (a) How do the computer graphs compare to your predictions?

   (b) Recall from last week your position vs time graph for motion with a constant speed (it should have been a straight line with a slope equal to the speed of the object). How does the position vs time graph you just generated compare to the ones from last week?

   (c) Recall from last week your velocity vs time graph for motion with a constant speed (it should have been a straight horizontal line at the speed of the object). How does the velocity vs time graph you just generated compare to the ones from last week?

   (d) You should have a rectangular mass on your table. Place this on the cart and repeat your data collection (you don't need to sketch this one on your handout). You should find that the cart speeds up more slowly than before. How does the velocity vs time graph for the cart with the mass compare to the graph for the cart without the mass? Note the similarities as well as the differences.

   (e) What aspect of the velocity vs time graph shows the rate at which an objects velocity is changing? Explain.

   (f) What feature of the velocity vs time graph is related to the quantity $\frac{\Delta v}{\Delta t}$ that your instructor mentioned at the beginning of lab? Explain.

(g) Given a velocity vs time graph, how can you tell if the object is speeding up at a constant rate?

(h) Given an acceleration vs time graph, what feature of the graph tells you the magnitude of the acceleration?

3. *Speeding up toward the motion detector*: Set up your cart so that it is at rest and the fan will move it toward the motion detector. Sketch a prediction on your handout of what you think will happen when the fan is turned on. Then start data collection, perform the experiment, and sketch the results on your handout.

4. *Slowing down and moving away from the motion detector*: Set up your cart so that it is at rest and the fan will move it toward the motion detector. For this run, you will turn on the fan while holding it and give it a quick push AWAY from the motion detector. The cart will initially move away from the detector but slow down. Sketch a prediction on your handout of what you think the graphs on the computer will look like. Then start data collection, perform the experiment, and sketch the results on your handout. (Ignore everything after the cart turns around)

5. *Slowing down and moving toward the motion detector*: Set up your cart so that it is at rest and the fan will move it away from the motion detector. For this run, you will turn on the fan while holding it and give it a quick push TOWARDS the motion detector. The cart will initially move towards the detector but slow down. Sketch a prediction on your handout of what you think the graphs on the computer will look like. Then start data collection, perform the experiment, and sketch the results on your handout. (Ignore everything after the cart turns around)

6. Examine the results from your experiments. If an object that has positive velocity and positive acceleration is moving away from the motion detector and speeding up, fill in the blanks for the following statements:

   (a) An object that has positive velocity and negative acceleration is moving ________________ the motion detector and ________________.

   (b) An object that has negative velocity and negative acceleration is moving ________________ the motion detector and ________________.

   (c) An object that has negative velocity and positive acceleration is moving ________________ the motion detector and ________________.

   (d) An object that has positive velocity and zero acceleration is moving ________________ the motion detector and ________________.

   (e) Is it possible to move with positive acceleration and slow down? Explain.

(f) Is it possible to move with negative acceleration and speed up? Explain.

7. *Turning around*: Set up the cart like you did for either of the "Slowing down" experiments, but this time DON'T ignore the part after it turns around. Sketch your prediction on your handout, do the experiment and sketch the results. On your sketches, mark the instant the cart turned around.

   (a) What is the velocity of the cart at the turnaround point? How can you tell?

   (b) Is the acceleration of the cart zero at the turnaround point? How can you tell?

   (c) Is it possible for an object to have zero velocity and nonzero acceleration at a given instant? Find an example on one of your graphs.