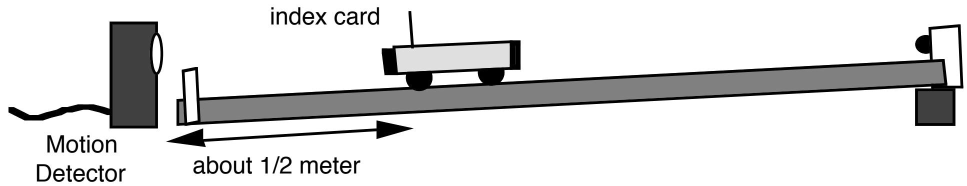
Lab 2-5: Up and Down

Purpose: 1. To make D vs. t, V vs. t, and A vs. t graphs for the following motions:
   a. A cart given an initial push up a ramp.
   b. A ball tossed up in the air.
2. To show that an object can have zero velocity, yet be constantly accelerating.

Procedure:

Part I: Cart pushed up a ramp

1. Raise one end of the ramp by placing a book or something under it.
2. Place the Motion Detector at the base of the ramp so that it is pointing up the ramp.
3. Put an index card at one end of the cart, and then put the cart on the ramp. Make sure that the wheels of the cart are in the grooves on the ramp. *See diagram.*



4. Open up LoggerPro. Start timing. After you hear the Motion Detector clicking, push the cart and let it go. Give the cart enough initial velocity so that it gets to within 10 cm of the raised end. Don't let the cart slam into the bottom of the ramp! (This may take a few trials.)
5. Make sure your graph shows the cart going up and down the ramp.
6. Show all three motion graphs at once (distance, velocity, and acceleration.) (Under Insert, choose Graph. Then under Page, choose Auto Arrange.) You may have to change some axes by clicking on them.
7. If you want, adjust the scale on any vertical axis so that you have "nice" graphs that show the position, velocity and acceleration of the cart throughout the trial.
8. On the velocity graph, determine the acceleration of the cart by highlighting the straight portion and clicking on the button with the "R=."
9. Give your graph a title that includes your group number and a description of the data. After checking with your teacher, print copies for everyone.
10. Click on the button with the "x=?" to see data values. If the little windows cover portions of your graph, move them out of the way. Answer question 1 before going on to Part II

Part II: Tossing a ball in the air

1. Place the Motion Detector in on a stool pointing straight up.
2. Hold the ball directly above the Motion Detector.
3. Start timing. After you hear the Motion Detector clicking, toss the ball straight up in the air a few times. Obviously, make sure you catch it and don't let it crash into the Motion Detector. (Try a few times in a row – this may be difficult. Call your teacher if you are not having any luck.)
4. Make sure you have good data. As in Part I above (#6 to 8), make three graphs that nicely show the position, velocity and acceleration of a ball tossed up in the air. Include the regression line of the velocity graph.
5. After checking with the teacher, title the graphs and print them.
6. Look at the data values by clicking on the button with the "x=?" and answer question 5.

Questions:

Part I: Cart pushed up a ramp

1. Draw a line through all three graphs that is perpendicular to the time axis and passes through the point on the graph where V=0.
   a. When the velocity is zero, what are the position and the acceleration?

   b. Why does the maximum position have to be when the velocity is zero?

Lab 2-5: **Up and Down**

2. Is the acceleration of the cart constant? Explain.

3. The acceleration is always negative, yet the cart both slows down and speeds up. Explain.

Part II: Tossing a ball in the air

4. How does this set of graphs for the ball toss relate to the set of graphs for the cart? What is the same and what is different?

5. At the ball's highest point, what is the velocity and acceleration?

6. As best you can, compare the velocities of the ball when it was at the same height, but going in different directions. (Make a general statement.)

Conclusion:

1. Looking at your results from all three parts of this lab, is it possible to have a constant acceleration, yet have zero velocity? Explain your answer.