

## Analysis of Motion

In this lab, you'll experiment with the Pasco Cars and design your own experiments using a laser gate. The laser gate is interfaced with a computer and can give you very accurate measurements of speeds and times! You also have an incline available to let the cars run down.

### Setting up the Equipment

#### *Hardware:*

Each lab bench has a laser gate, and each gate is connected to a computer. The laser gate consists of a laser and a detector. The laser should be set up so that its beam shines directly on the detector. Each group of 2 students will be given a car, an incline, some bar weights, and tabs that can be used to block the laser gate. Note: **The cars are expensive. Do not let the cars fall off the table and hit the ground!!!**

#### *Software:*

You can use the program "gdrop". Click once on the icon to start the program. The menu should be self-explanatory. The interface measures the time that the laser gate is blocked. Then the tab thickness is divided by this time, and the resulting speed displayed on the screen.

1. To check if the laser gate is working, type "t". The program samples the detector once every second and displays if the gate is blocked (the laser beam doesn't hit the detector) or unblocked (the laser shines on the detector).
2. To set the number of data points that will be collected, type "n".
3. To calibrate the gate, press "z". The software will prompt you to enter the distance between the middle of the first and the middle of the "n'th" tab.
4. To take data, press "d".

## Designing and carrying out the Experiment

### *Car rolling down the ramp*

1. Check that the equipment is working properly and calibrate the laser gate.
2. Your task is to determine what type of motion a car performs when it rolls down the incline. Using the program gdrop determine the Velocity as a function of time as the car rolls down the ramp. Hint: for the best results **you want a large difference between the slowest and fastest speeds.**
3. Make a graph (by hand) of Velocity vs. time
4. From your graph examine the plot. Is the acceleration changing as the car rolls down the ramp? Explain.
5. Press g to see a computer graph of the results and discuss.

### *Car rolling up the ramp*

Your task is to determine what type of motion a car performs when it rolls up the incline.

1. Make a prediction: How will the acceleration of the car when it goes up the incline compare with the acceleration of the car when it goes down the incline?
2. Roll the car up, check the  $v$  versus  $t$  graph and comment. Is the acceleration constant? If so, is the acceleration the same as before? Discuss your results.

### **Other Experiments to try**

1. How will the acceleration of a heavier car compare with the acceleration of a lighter car when it rolls down the ramp? Do the experiment and discuss.
2. Vary the angle of the incline, describe the motion now.
3. There is a ladder available in the lab. Let it fall freely, and determine whether the acceleration is constant when it freely falls. If the acceleration is constant, what value do you obtain?