Name____________________________________

Date__________**Pd**____

Sliding on Slippery Roads Lab

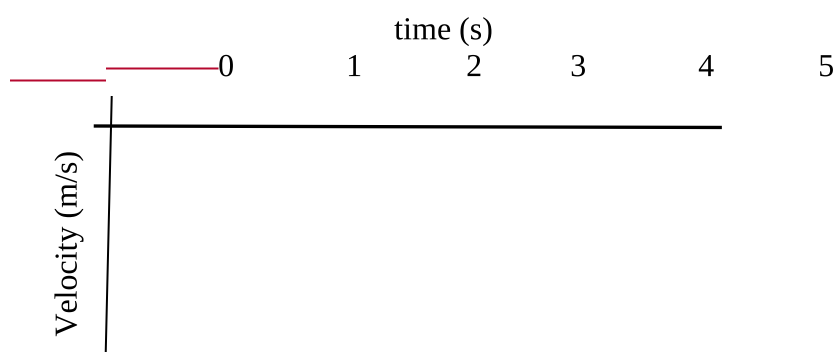
Grandma and Grandpa always reminded me to be extra careful when driving the truck on slippery (gravel or icy) roads.

Grandma's rule was, "Only go 2/3 as fast and the truck will stop in half the distance."

Grandpa's safety precaution was to throw a couple of 50 pound sacks of sand into the bed of the pickup. He always told me that, "Even though the mileage will go down, more weight means less stopping distance." Who do you think is correct? Why?

Use a motion detector and a coffee can and lab masses to simulate the pickup truck and sand bags to test each of these theories. Your analysis will require you to both position vs. time graph and a velocity vs. time graph.

Set up:



Predict the shape of the velocity *vs.* time curve for the time from when you pushed the can until it came to rest. (Remember that motion <u>towards</u> the sensor will have a <u>negative velocity</u>!

Compare your prediction of the graph to others in your lab team and discuss until you reach consensus about the shape of the graph.

Procedure

1. Consider the relative masses of a pickup truck and the bags of sand Grandpa suggests you add to the bed. With this information in mind, add some mass to the coffee can at the start to represent the mass of the truck and driver. Secure it to the bottom so it doesn't slide around. Then decide how much mass is reasonable to add to test Grandpa's theory.

2. Set the data collection rate to 50 Hz; the default duration of 5 s is suitable. The minimum distance a motion detector can sense an object is 0.20 m. Practice giving the can a push towards the motion detector so that it comes to a stop before it reaches this limit. Start the data collection, then push the can. Examine the velocity-time graph. If it appears to be satisfactory (no spikes once the can begins to slow) save the run. Repeat until you have two satisfactory runs.

3. Put the additional mass into the coffee can to check Grandpa's rule. Secure the mass inside the can as you did in step 1.

4. Before you collect data, predict how the extra mass will affect the stopping distance.

5. Start data collection, then push the can as you did in step 2.

Evaluation of data

1. Sketch or print the velocity-time graph from one of your runs from step 1. Circle that part of the graph where you were pushing on the cart. Label this "Push". (If you are using Logger *Pro*, you can insert text annotation to label the graph.)

2. Did the can have a steady acceleration while slowing ? How do you know? If yes, then show your calculation for the acceleration.

   a = ________

3. Was the sliding friction on the can constant as the velocity was changing? Defend your answer.

4. Group the position-time and velocity-time graphs by selecting both graphs, and choosing Page ⇒ Group Graphs (X-Axis). Turn on the Interpolate function from the Analysis menu. Find and record the position when the speed was nearly 1.0 m/s, 0.67 m/s and 0. From these values determine the stopping distance at these two speeds. Repeat for your 2^{nd} run

Run 1		Run 2	
v (m/s)	**x (m)**	**v (m/s)**	**x (m)**
-1.00	______	-1.00	______
-0.67	______	-0.67	______
0	______	0	______

Was Grandma right? Defend your answer.

5. Repeat this analysis for the runs with the heavier can.

Run 3		Run 4	
v (m/s)	**x (m)**	**v (m/s)**	**x (m)**
-1.00	______	-1.00	______
-0.67	______	-0.67	______
0	______	0	______

6. Determine the acceleration from one of the runs with a heavier can. Was Grandpa right? Defend your answer.

   a= _______

7. Use the value of the acceleration from one of your runs and the equation relating displacement, initial velocity, acceleration and time to calculate the stopping distance for both initial velocities. How do these compare to the values you obtained graphically?

Application:

A car with excellent brakes has a stopping acceleration of -7.0 m/s each second on flat, dry pavement. Make a graph, a data table (time and velocity, and calculate the stopping distance when the car hits the brakes moving at 21 m/s.