

## Constant Velocity (Speed)

**Objective:** Measure distance and time during constant velocity (speed) movement.  
Calculate average velocity (speed) as the slope of a "Position vs. Time" graph.

**Equipment:** battery operated vehicles, stopwatch, meter stick or measuring tape

**Procedure:**

1. Complete the table by timing each vehicle as it travels the indicated distance.
2. Perform two time trials for each distance and take the average value as your accepted time.
3. Use the distances traveled and average times to make a "Distance vs. Time" graph (always named as "y vs. x") using MS Excel. Label this and all graphs as directed in class.
4. Use the MS Excel "Add Trendline" function to draw the best straight lines through your data points and to compute the "best fit" equations for the lines.
5. Record the equation for each line on the graph. The slope of each line, given with the units associated with the y- and x-axes, is the average velocity (speed) of each vehicle. Use this information to write the speed of each vehicle on the graphs next to each line.
6. Print your graph or graphs.

Distance, meters	Vehicle I			Vehicle II		
	Time Trials, seconds			Time Trials, seconds		
	1	2	AVG.	1	2	AVG.
0	0	0	0	0	0	0
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						

**Questions:**

1. Did each vehicle appear to maintain a constant velocity (speed)? \_\_\_\_\_  
How can you tell by looking at a "position vs. time" graph if the velocity (speed) is constant?
2. How should the "position vs. time" graph of a faster car compare with the graph of a slower car?



## Relative Velocity (Speed)

In this portion of the lab, you will determine the *relative velocity* (speed) of your two vehicles as they 1) approach each other from **opposite** directions, and 2) as the faster vehicle approaches and catches up to the slower one **from behind**.

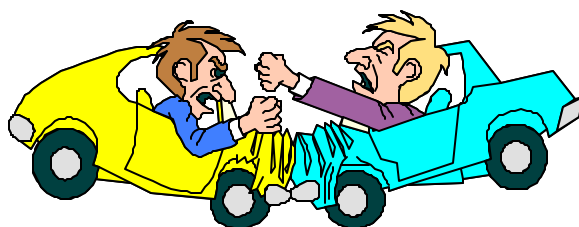
- 1) Based on the average speeds of the two vehicles that you determined in Part I, what do you expect the relative speed of the vehicles to be as they approach each other from opposite directions? (i.e., At what rate should they close in on each other?) \_\_\_\_\_  
Why?
  
- 2) What do you expect the relative speed to be as the faster vehicle catches up to the other one from behind? (i.e., At what rate does the faster one close in on the other?) \_\_\_\_\_  
Why?

### Relative Velocity (Speed) Approaching from Opposite Directions

**Procedure:**

1. Place the vehicles facing each other the distance apart indicated in the table.
2. Turn on each vehicle, releasing them at the same instant. Record the time for the vehicles to meet. Perform two trials and take the average value as your accepted time.
3. Make a graph of "Closing Distance vs. Time" for this procedure. Determine the equation of the line that best fits these data points. The slope of this line will be the *relative velocity* (speed) of the two vehicles as they approach each other from opposite directions.

Closing Distance, m	Time, seconds		Average Time, seconds
	Trial 1	Trial 2	
0.0	0	0	0
0.5			
1.0			
1.5			
2.0			
2.5			
3.0			



## Relative Velocity (Speed) as Vehicle Approaches from Behind

### Procedure continued:

4. Now place the vehicles facing the same direction the distance apart indicated in the table. The faster vehicle should be the indicated distance behind the slower one.
5. Turn on each vehicle, releasing them at the same instant. Record the time for the faster vehicle to catch up to the slower one. Perform two trials and take the average value as your accepted time.
6. Make a graph of "Closing Distance vs. Time" for this procedure. Determine the equation of the best fit line for these data points. The slope of this line will be the *relative velocity* (speed) of the two cars as the faster vehicle approaches the slower one from behind.

Closing Distance, m	Time, seconds		Time, seconds
	Trial 1	Trial 2	
0.0	0	0	0
0.20			
0.40			
0.60			
0.80			
1.00			
1.20			

### Questions:

1. Compare your experimental relative speeds with the estimates you made earlier.
  
2. Do you think your method of calculating relative speeds (addition or subtraction of speeds) is always valid regardless of the speeds of the two objects? \_\_\_\_\_  
Comment on your answer.
  
3. List possible sources of error in this lab.