Experiment 3
DATA SHEET

Name: ________________________

Section: ________________________

Height of raised end = ___________________

Distance (d) (cm)			TIMES (sec)	Avg. Time (t) (sec)	Avg. Time squared T^2 $(sec)^2$	Calculated Acceleration cm/sec^2
	Trial 1	**Trial 2**	**Trial 3**			
100						
85						
70						
55						
40						
25						
0	0	0	0	0	0	0

Average calculated acceleration for steel sphere = ___________________

Distance (d) (cm)			TIMES (sec)	Avg. Time (t) (sec)	Avg. Time squared T^2 $(sec)^2$	Calculated Acceleration cm/sec^2
	Trial 1	Trial 2	Trial 3			
100						

Calculated acceleration for plastic sphere = _________________

Questions

1. Which one of your graphs supports Galileo's findings?

2. Look at the results of the measurements made in step 9. Does the acceleration depend on the mass of the ball?

3. In what way does your answer refute or support Aristotle's ideas on falling bodies?

4. What are possible causes for your data in step 8 not exactly falling on a straight line? What are the most likely causes of experimental uncertainty in the measurements that you made?

Experiment 3
GALILEO'S INCLINED PLANE and FREEFALL

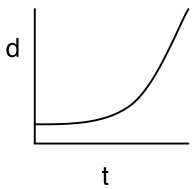
(TURN THIS SHEET IN AS PART OF YOUR DATA SHEET)

B. Freefall

1. Double click on **Exp_3_Freefall.**

The screen will show 3 graphs:

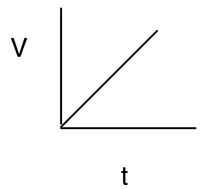
distance vs. time
velocity vs. time
acceleration vs. time.

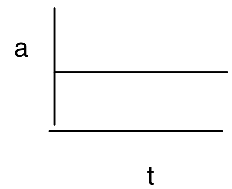


We remember that a curved line on a distance vs. time graph means that an object is accelerating.

The acceleration can be determined from the acceleration vs. time graph, or by calculating the slope of the velocity vs. time graph. If the acceleration is constant, then the acceleration vs. time graph will make a straight horizontal line and the velocity vs. time graph will make a straight diagonal line.

The entire graph may not show constant acceleration, so look for the parts that match the graphs below. These pieces of the graph show constant acceleration.





The object's velocity is changing, but the rate of change (or acceleration) is constant. We can compare the slope of the velocity graph to the mean (or average) value of the acceleration graph, knowing that they should be equal.

2. Open up **Galileo_Freefall** program.
3. Hold the motion detector at about eye level and hold the basketball about 1/2 a meter below it.
4. Have your partner press the collect button, and then drop the ball (be sure that it's below the motion detector!).
5. When the motion detector has stopped collection, find the portions on your graphs that show constant acceleration (find the parts of the velocity graph that are straight diagonal lines; they will match up with the horizontal portions of your acceleration graph).
6. Change your scale to only show this part of the graph. (Remember: change scale by clicking on the numbers at the end of each axis and typing in the values you desire for starting and ending points on the scale.)
7. Highlight the part of the graph with a constant, positive (or rising) slope.
8. Press the R= button to find the equation of the line. *Remember: y = mx + b where m = slope.* The slope is your value for acceleration. Highlight other parts of the velocity graph that exhibit constant slope (both positive and negative, 2 of each total) to find which one has a value for acceleration that is close to $10 m/s^2$.

Basketball

Values for positive slope:		
Values for negative slope:		

9. Repeat steps 3-9 with the racquetball.

Rubber medicine ball

Values for positive slope:		
Values for negative slope:		

Questions:

5. Does mass affect acceleration? Prove your answer by discussing the accelerations and masses of the basketball and medicine ball (The mass of the medicine ball is at least 3 times larger than the mass of the basketball).

6. a.) Why are there 2 straight diagonal lines? (*Hint:* What 2 actions of the ball is the motion detector recording?)

7. Why do we find the freefall acceleration from the line with positive slope? (*Hint:* remember how moving away from and towards the detector affects velocity!)

8. Label on the velocity graph for just one bounce, or one set of diagonal lines, the 2 points where the ball changes direction (label when it hits the floor and when it reaches the top of its path before falling again. *Hint:* as it changes direction, it must stop for a brief moment, so think of how a velocity graph shows that an object has stopped moving.).

9. 1G is the normal force of gravity that we experience, and is equal to 10 m/s^2. Weightlessness, as in space, is 0G; this is when you would not feel the effects of gravity. Fast accelerations, such as are experienced by roller coaster riders, fighter pilots, and astronauts, will give you a higher level of G-force, making you feel the effects of gravity more than normal. Roller coasters, on average, have a G-force near 4G (or 4 times as much gravity as we normally experience) but only for brief moments. Fighter pilots and astronauts long durations of G-forces as high as 8-9G's.

   a.) Divide your value for the negative slope by 10 and see how many G's the basketball is experiencing as it bounces up from the ground.

   _______G

   b.) If you could be saddled (strapped) onto a basketball and dropped from 1m, would you want to? Why? Keep in mind that on most roller coaster rides, you experience around 4g, and the most intense roller coasters have a g-force between 5 and 6g's.