PROJECT 1 - DON'T LOSE YOUR MARBLES OVER CALCULUS!

In this project, you will compare the distance that a marble rolls down an incline to the time that it takes for a specified distance. You will plot this relationship and identify the function that corresponds to the data.

Procedure:

1. Take one of the marbles, the grooved board, and a stop watch of some type and conduct the following experiment:

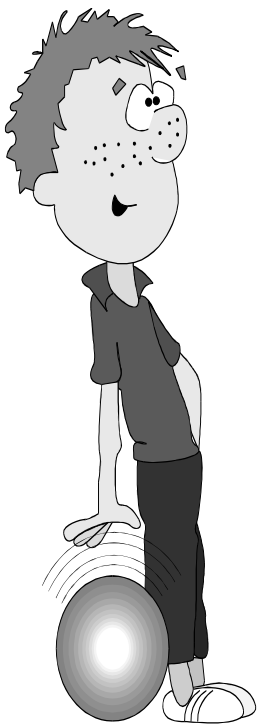
   A) Set the board so that it is at a slight incline by elevating one end by 5 or 6 inches. Release the marble (don't push it!) and measure the time it takes for the marble to travel 1 foot, 2 feet, 3 feet, and 4 feet. For each of these distances, perform 3 repetitions for a total of 12 trials. Find the average time elapsed for each of the 4 distances. Also, find the time in seconds to travel zero feet.

   B) Record your data in a table similar to this

Time in Seconds	Time in Seconds	Time in Seconds	Average Time	Distance Traveled
				1 ft
				2 ft
				3 ft
				4 ft
				0 ft

   Turn in this table with your write-up.

Write-up *(Except for the table, equations, and the graph, the write-up must be typed - use complete sentences!)*



1. Graph the data from this experiment. Graph time on the x-axis and distance dropped on the y-axis. Draw a smooth curve through the points. Turn in this graph with your write-up.

2. Use the fact that a falling body accelerates to explain why your graph does not represent a linear function.

3. Assuming that your data matches a quadratic function with a vertex at (0,0), find the equation of this quadratic function. (Remember that $y = ax^2$)
   Use the 4 coordinate pairs of x and y-values that you found and find 4 values of a. Then, find an average value of a.

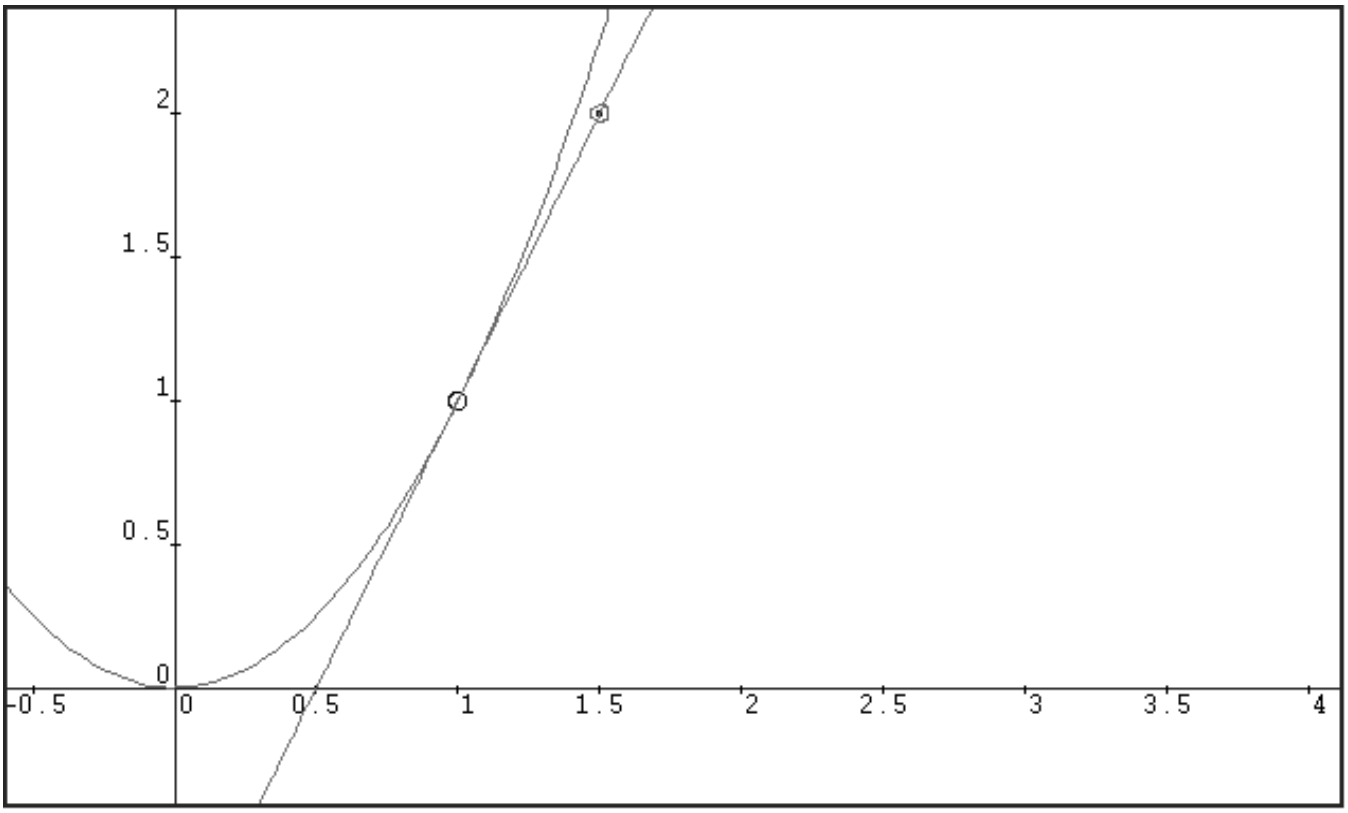
   Sketch the graph of this equation. On this sketch, also plot the experimental points

corresponding to the average times for 1 ft, 2 ft, 3 ft, and 4 ft.

4. Describe why the experimental points do not exactly match up your graph of the equation you found in question 3.

5. The slope of a graph of distance vs. time at a given point indicates the velocity of the object that is moving. The velocity of an object moving at a **constant** speed is equal to the slope of the **linear** graph of distance vs. time. The velocity of an object moving at an increasing speed (accelerating) is equal to the slope of the line tangent to the curve at a given time.

   On your graph from write-up direction 3., draw a straight tangent line to the curve at x = 1 second. Estimate what the slope of this tangent line is. This is the instantaneous velocity at 1 second. An example is given below.



   In the above graph, the tangent line at x = 1 has a slope of approximately m = 2 since two points on the line are (1,1) and (1.5,2) and $m = \frac{2-1}{1.5-1} = \frac{1}{0.5} = 2$. Thus, the velocity is 2 feet per second.

6. If you rolled this marble down a 5000 foot long board with the same angle of incline (5 or 6 inches for every 4 feet), use your equation from question 3. to calculate how many seconds it would take to reach the end of the board. Describe factors which would cause this theoretical value to be different from the actual experimental value if you were to actually perform this experiment with a 5000 foot board.