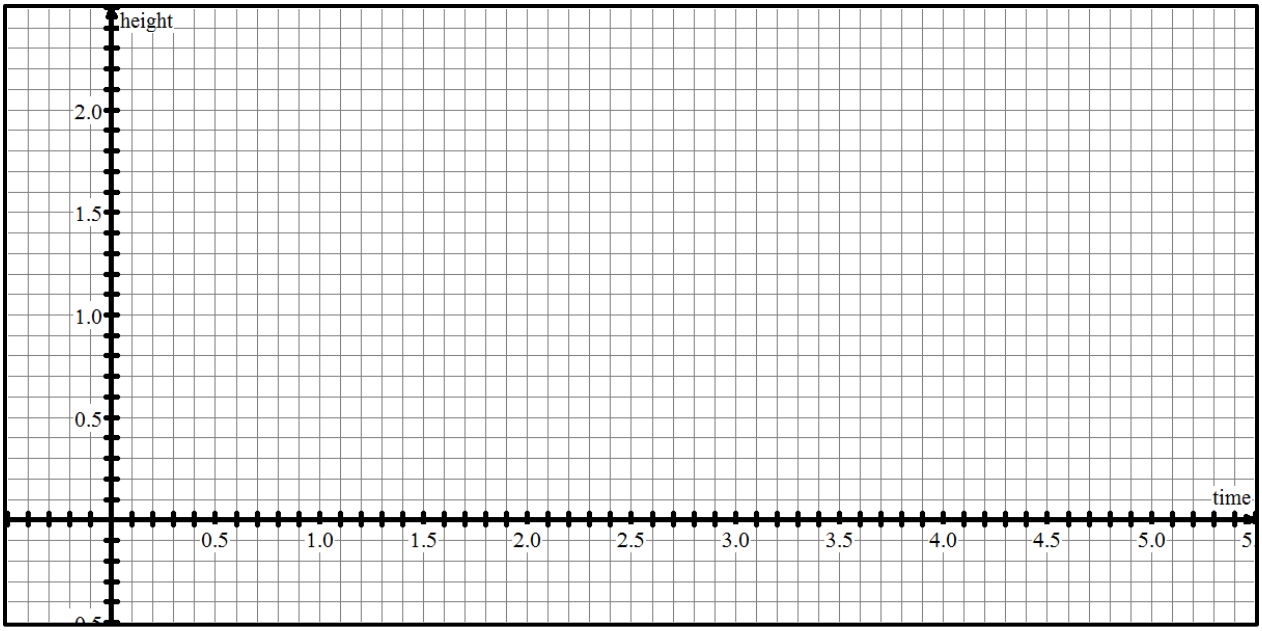
Ball Drop Experiment – The Calculus of Motion

Your data analysis will involve answering the following questions:

1. Include a sketch of the graph you see on your TI-84. The scale on the x-axis is seconds and the y-axis is 0.50 m.



2. Use the cursor keys to move through the data points that are part of the motion of the ball. Record 4 consecutive data points of the first or second bounce. Determine the average rate of change between consecutive pairs of points.

	Point 1	Point 2	Point 3	Point 4
(x,y)				
Average rate of change				

3. Now select one point on either the first or second bounce. Record the data point, with its units and EXPLAIN what the data point means in the context of the experiment.

4. At the point you have selected, is the function increasing or decreasing? Explain WHY it makes sense that the function is increasing/decreasing at this point.

5. At the point you have selected, is the function concave up or concave down? Explain WHY it makes sense that the function is concave up/down at this point.

6. Explain how you determine the instantaneous velocity and acceleration of the ball at this EXACT point?

7. PREDICT the instantaneous velocity and acceleration at this point.

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At this point, you can quite the data-gathering program. When you exit the program, your data will be stored in the LISTS of your calculator. List 1 has the time data. List 2 has the position/distance/height data. List 3 has the first derivative data. List 4 has the second derivative data. We can now select a given "bounce" by simply adjusting our window settings (especially the xmin and xmax)

8. The position-time graph of any one of your bounces at your selected point looks like a parabola. Use your knowledge from the various topics we have discussed this year and determine the equation of a parabola that fit this "bounce." Record your analytically developed equation.

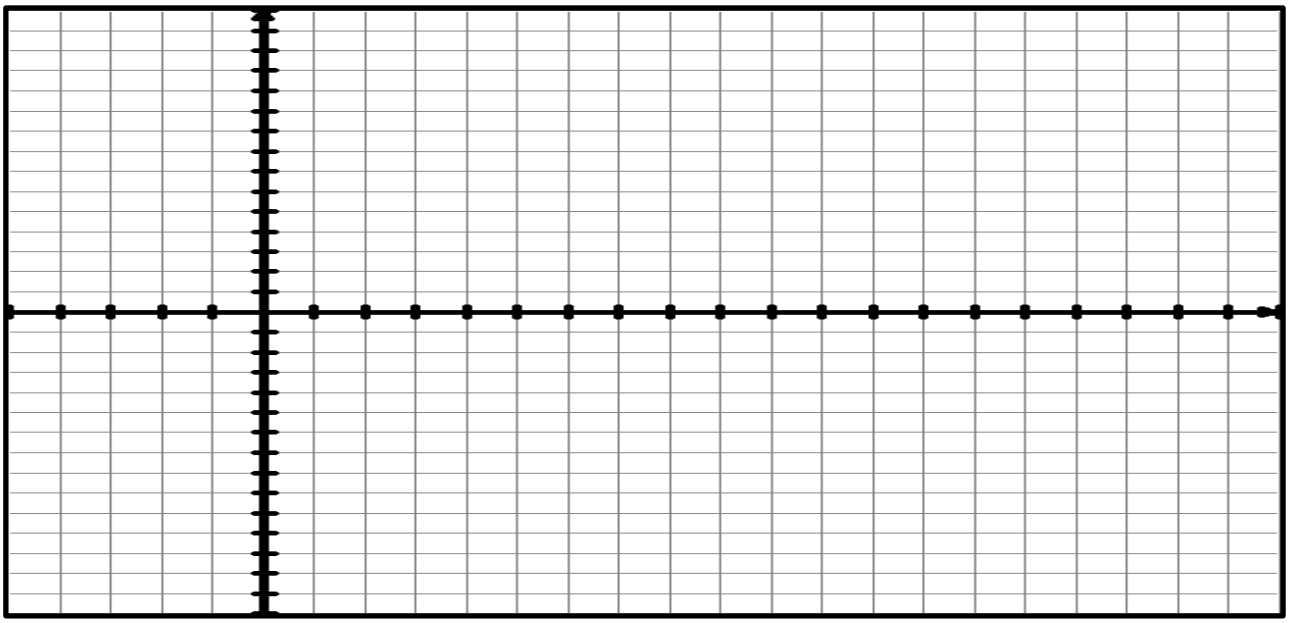
9. You may try a regression analysis from your TI84. Record this equation (if you tried it.)

10. This first function represents the relationship between distance/time, height/time or position/time graph. EXPLAIN what the derivative function MEANS.

11. Determine the equation of the first derivative. Record this equation.

12. Evaluate the first derivative at your selected point. INTERPRET the meaning of the value of the first derivative at your selected point.

13. The data for the first derivative is recorded in the third list. Graph the first and third lists on a scatterplot as well as your equation for the first derivative. Include a sketch of the scatterplot & graph and comment upon what you see.



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14. The data for the first derivative is recorded in the third list. Use the cursor keys to move through the data points and record the first 4 data points of the first derivative. Determine the average rate of change between consecutive pairs of points.

	Point 1	Point 2	Point 3	Point 4
(x,y)				
Average rate of change				

15. The data for the second derivative is recorded in the fourth list. The "original" function represents a distance/time, height/time or position/time graph. EXPLAIN what the second derivative function MEANS.

16. Determine the equation of the second derivative. Record this equation.

17. Evaluate the second derivative at your selected point. INTERPRET the meaning of the value of the second derivative at your selected point. How does this value compare to your work in Q13?