AP Physics C: Gravitational Acceleration: A case of constant acceleration

Purpose: To measure the gravitational acceleration constant using a falling mass

Equipment : spark timer , thermal tape to record "sparks", ruler & meter stick, washers, rods & clamps to hold timer, scotch tape, graphing software

Procedure:

1) Mount the spark timer vertically so that the tape can fall through the device.
2) Make sure the timer is OFF and set to 60 Hz or $1/60^{th}$ of a sec.
3) Thread the thermal tape through the timer and tape 2-3 washers on the end. Make sure the tape's length is less than the distance it needs to fall.
4) Have a lab partner hold the tape so that the washers are just below the exit.
5) Turn the spark timer on, but do not release.
6) Verify that you have threaded the correct side of the tape through the device as you should see a rather large black spot.
7) Once you realize you are using the correct side, release the tape.
8) Turn the device off.
9) Choose a spot a few clicks away from the initial black spot. This will be your initial position of ZERO.
10) Measure a record the displacement each successive spot is away from your chose initial position.

Data

Time	Displacement
0 s	**0 m**
0.0160 s	
0.0333 s	
0.0500 s	
0.0667 s	
0.0833 s	
0.1000 s	
0.1167 s	
0.1333 s	
0.1500 s	
0.1667 s	
0.1833 s	

Analysis:

1. Open up Graphical Analysis for Windows
2. You should see 2 columns labeled X & Y
3. At the top choose **DATA** then **COLUMN OPTIONS.**
4. Choose X, then enter **TIME** for the name and **sec** for the units
5. Repeat #4 for Y, with **DISPLACEMENT** as the name and **m** as the unit**.**
6. Enter the values you collected in the experiment.
7. Sketch the graph. Is this graph linear? If not, explain the graph's behavior.

8. Then choose at the top **DATA**, then **NEW COLUMN**, the **CALCULATED**.
9. Type in **VELOCITY** for the column name and then enter the appropriate units.
10. The click the "**OTHER FUNCTIONS**" button and choose **DERIVATIVE** from the list.
11. Then click the **COLUMNS** button and choose **DISPLACEMENT** from the list. What we are basically doing is finding the derivative of our displacement/time data. **<u>This of course will give us VELOCITY.</u>**
12. Now let's make a velocity time graph. At the top choose **WINDOW**, then **NEW WINDOW**, then **GRAPH**.

13. Click on your new graph so that your title bar turns it blue.
14. Then choose **GRAPH**, then **X AXIS OPTIONS**. Choose **TIME** for the x-axis.
15. Repeat #13 for **Y AXIS OPTIONS** choosing Velocity!
16. Sketch the graph.
17. Is this graph linear? If you wanted to find the slope of this graph do you need to use calculus? Justify your answer.
18. Make sure your Velocity-Time graph is highlighted and click on the bottom left of the graph. CLICK HOLD AND DRAG to make a box which covers the entire part of the line which is straight upward.
19. Once the data is boxed choose **ANALYZE** then **REGRESSION** at the top. Record the SLOPE of the graph below with units.

SLOPE = _____

What EXACTLY should the slope of this line represent?

What should the ACTUAL MAGNITUDE of the slope be?

Calculate a % error between the measure value of the slope and the actual value of the slope.

$$\%error = \left| \frac{actual - \exp erimental}{actual} \right| x100$$

Explain any NON-HUMAN factors which may have introduced error into this experiment.