The Gravity Drop Experiment  
(Lab #3)

**Goal:** (1) How much faster do heavy objects in freefall accelerate than light objects?  
(2) What is the acceleration due to gravity for light and heavy objects?  

**Set-up:** See Diagrams Below  

**Procedure:**  
1. Set the first timer directly below the release point of the ball. Be sure the wire goes to port A.  
   Turn on the light under port A and port B and set the timer to interval mode.  
2. Now attach the other timer some distance below the top timer. Measure and record the  
   distance between the two timers (in meters).  
3. Drop and time the metal ball and plastic ball at least 5 times each. Record each time.  
4. Change distance between timers then measure and record the new distance in meters.  
5. Drop and time the metal ball and plastic ball at least 5 times each. Record each time.  
6. Repeat steps 4 and 5 to fill in as much of the data tables as possible.  

**Questions/Calculations:** *(attach sheet with answers)*  
1. What was the initial velocity of the ball in each case? \( v_{\text{initial}} = \) \( \text{m/s} \)  
2. What is the speed of the ball when it crosses the first timer? Is it the same?  
3. Does this make the measured time slightly longer or shorter than the actual time it falls?  
4. How did you measure the distance the ball fell? What part of the timers did you use to  
   measure the distances?  
5. Graph displacement (on y-axis) vs. \( t_{\text{avg}}^{2} \) (on x-axis). Use the average values.  
   Make one graph for the plastic marble and one graph for the metal marble.  
6. Based on your graph, are displacement and \( t_{\text{avg}}^{2} \) directly or inversely proportional?  
7. Draw a best-fit line through the points and calculate your slope including which points you  
   used and units. (Show your work. Don’t use points in the table)  
8. Look at the kinematic equation without \( v_{f} \). What does the slope correspond to? (Hint: it’s the  
   constant of proportionality relating displacement and \( t_{\text{avg}}^{2} \))  
9. Use the slope to determine your 2 experimental accelerations for plastic and metal marbles.  
10. Calculate two values for % error by comparing your average acceleration values for both the  
    plastic and metal balls to the accepted value of \( g \) (-9.81 m/s\(^2\)). Show each calculation.  
11. Based on your answer to #3, would the calculated acceleration be larger or smaller than the  
    actual acceleration if you plug in the measured time values? Justify your answer.  
12. Calculate the % difference between accelerations for the plastic ball and metal ball. Comment  
    on the precision of your measurements.  

**Procedure:**  
1. Instead of using the ball catcher, just catch it below the timers  
2. Hint: Jiggle the wire connections and retry before asking for help.
### Distance 1

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<thead>
<tr>
<th>Trial #</th>
<th>Plastic</th>
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**Conclusion:** (1) Heavy objects in freefall accelerate ________ light objects.

(2) acceleration due to gravity for light objects = ______
and acceleration due to gravity for heavy objects=______