## Lab: Free-Fall Acceleration

## Purpose:

- To determine the acceleration due to gravity here in our classroom and to compare it to the accepted average acceleration due to gravity at the surface of Earth


## Materials:

- Pasco free-fall apparatus
- Smart timer and DC converter plug
- Ring Stand
- Right-angle clamp
- Meter stick, ruler, and/or a 2-m measuring stick
- Steel Marble


## Procedural Tips:

- Note: this is not a step-by-step procedure. The equipment was demonstrated in class both during the pre-lab and at the beginning of the lab class period. This is a list of tips that will help you use the equipment properly.
- You are to collect the necessary data using the equipment given so that you can determine the acceleration due to gravity.
- To insert the marble into the clamp, make sure the thumb screw is loose, insert the marble so that it is aligned with the circular electrical connector and also fits into the hole on the external metal plate. Hold the marble in place by compressing the spring/plunger, then tightening the thumb screw just enough that the marble does not fall out.
- To release the marble, just slightly loosen the thumb screw. The timer will start when the marble leaves the clamp.
- Make sure the marble is hitting fairly close to the center of the landing plate-that tends to get the best, most consistent results. Drop the marble once just to line things up, then set the timer.
- To set the Smart Timer so that you can get the time it takes the marble to fall:
- Plug it in and turn it on.
- Click the left (red) button once to get Time: visible in the screen
- Click the middle (blue) 4 or 5 times until the screen now reads Time: Stopwatch
- The second line of the display is where the time will show to the nearest $\pm 0.0002 \mathrm{~s}$. The timer is ready to measure data when the ${ }^{*}$ is visible to the far left of the line.
- To get the * visible, push the black "start/stop" button once. To clear your unwanted data, click it again.
- Use a wide range of heights for the marble to fall. The more data you can collect, the better.


## Data and Analysis:

| Height from which the <br> marble falls $/ \pm 0.005 \mathrm{~m}$ | Time for the Marble to Fall $/ \pm 0.0002 \mathrm{~s}$ |  |  |
| :--- | :--- | :--- | :--- |
|  | Trial 1 | Trial 2 | Trial 3 |
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*note: Watch your precision-please report your values in the table above to the appropriate precision.

## Analysis:

1. Create a graph to show the linearized relationship between the distance fallen and the time to fall for the steel marble. Include max and min slopes on your final graph, and attach this graph to this sheet.
a. Maximum Slope = $\qquad$
b. Minimum Slope = $\qquad$
c. Best-Fit Slope = $\qquad$
2. How can you use your slope to determine the acceleration of free-fall your marble experienced?
a. Explain in words:
b. Show your calculation to determine your experimental acceleration due to gravity:
3. Quantitatively compare your experimental value to the accepted value for the world-average acceleration due to gravity of $9.81 \mathrm{~m} \cdot \mathrm{~s}^{-2}$ (determine a percent difference):
