An Object in Free Fall

Objective: The purpose of this experiment is to measure the acceleration due to gravity of an object in free fall close to the earth's surface. This quantity is known in physics as the ubiquitous constant *g*. In this experiment you will measure *g* by a more direct method than that of the previous exercise: by dropping a steel ball and very accurately measuring its time of flight.

Physics Theory: Recall the relationship for distance in terms of time and initial velocity for a freely falling body:

$$h - h_0 = v_0 t + \frac{1}{2} g t^2 \qquad (1)$$

For an object in free fall starting from rest at height $h_0 = 0$, this relationship may be written:

$$h = \frac{1}{2} g t^2 \qquad (2)$$

where $g = 9.80 \text{m/s}^2$ close to the earth's surface (if one ignores the effects of air friction). Some simple algebra yields:

$$g = \frac{2h}{t^2} \qquad (3)$$

Experimental: In this experiment you will use the PASCO 500 Interface, the Precision Timer program, and various series 500 switches and sensors. Your lab instructor will help you set up the equipment you need for this experiment.

- Mount the free fall adaptor ball release mechanism in such a manner that the steel ball will fall at least 1 meter.

- Place the receptor pad directly below the ball release mechanism. Put the ball in the release mechanism and measure the distance from the bottom of the ball to the top of the receptor pad.

- Go to **Experiment Setup**, **Free Fall Adapter**, and click on **Constant Value Units height (m)**.

- Plug the free fall adaptor phone plug into digital channel 1 on the 510 signal interface box.

- Turn on the interface, Open the 113/213 folder, and double click on **Freefall**.

- After the ball is in the mechanism, Click **Start**. Click **Stop** after the ball hits the pad.

- Disregard any obviously bad data

- **Close Program** and **Do Not** save any changes.

Data Analysis: After you have acquired sufficient data, Record the "Time of Flight" and Record the "Mean Value" displayed at the end of the table. You may eliminate any bad data (blunders) with the **Delete Data Option** prior to recording the mean value.

Use your mean value and equation 3 to compute the value of *g*. Compute the % error between the accepted value of 9.80 m/s^2.

Repeat this procedure for a different sized steel ball. What is the result? Is this result what you expected? What does this imply about the factor(s) that affect the value of *g*?