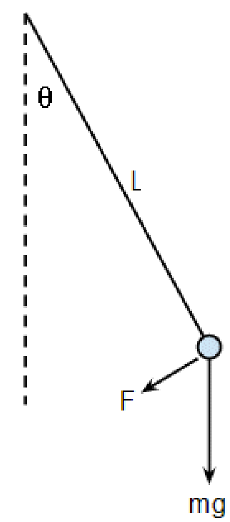
PHY 181: Summer 2023
Measuring g with a pendulum.

Name:______________________________ Group Name: ________________ Date: __________

1 Setup

In this lab you will be using a stopwatch and a pendulum to measure the acceleration due to Earth's gravity.



1. To begin, pick your groups' spot on the stairwell and measure the distance from the bottom of the stairwell to the landing that you are standing on.

2. Return inside and affix the string to a chemistry stand. One way to do this is to trap the string between a clamp and the rod.

3. If you can find a section of string the right length skip step 4.

4. Measure out the string so that it is a little less than the length that you measured earlier. Cut the string.

5. Connect the string to the hanging weight provided. Measure the length of the entire pendulum. This starts at the connection point on the chemistry stand and ends at the center of the weight on the hanging weight.

6. Return outside with the pendulum and a stopwatch.

$$T = 2\pi\sqrt{\frac{L}{g}} \tag{1}$$

$$g = \frac{4\pi^2 L}{T^2} \tag{2}$$

7. Disconnect the hanging weight from the pendulum and slide the string and top of the chemistry stand in between the railings so that the top of the chemistry stand is resting on a rail and the pivot point of the pendulum is over the bottom of the stairwell. **Do not attempt to feed the weight through the railings and lower it down. This could seriously injure someone below.**

8. Go to the bottom of the stairwell and reconnect your hanging weight.

9. Pick two members of your group. One member will pull back on the pendulum bob, the other will operate the stopwatch. When agreed (a countdown may be useful), release the pendulum and start the stopwatch at the same time. When the pendulum returns to where it started, stop the stopwatch. Record the time in the table below. Take at least one measurement for every person in the group (let everyone have a turn at both the stopwatch and releasing the pendulum).

   It is important that the angle that the pendulum swings is small. This effectively means that the bob should not travel much more than a yard.

2 Analysis

Length of pendulum: ________ m

Your group doesn't need to fill this table. However, more measurements should give more accuracy (less error).

time(s)								
time(s)								

Average time: _____ s

What is the accepted value for g: _____ m/s^2

Using equation 1 and the accepted value for g, what is the theoretical value for T? _____

Using equation 2 and your average time, what do you calculate for g: _____ m/s^2

$$\text{Percent Error} = \frac{100 \times (experimental - accepted)}{accepted} = \frac{100 \times (experimental - theoretical)}{theoretical} \tag{3}$$

Using equation 3, calculate the percent error of T:_____

Using equation 3, calculate the percent error of g (par is 5%, extra credit is less than 2%):_____

3 Conceptual questions

What was the most likely source of error in your measurements? Hint, think about everything that you did and your setup. What part is the least precise?

If you had to do the experiment again, what would you improve? Hint, this should attempt to address concerns raised in the prior question. Of course, it could go beyond that.