Lab 9: Simple Harmonic Motion Prelab

A pendulum is constructed as shown below using a brass cylinder and a thin nylon string. The string has a linear mass density (mass per unit length) of $2.255 \times 10^{-4}$ kg/m and the brass cylinder has a mass of 0.098 kg. The string has length $L = 0.750$ m, the cylinder’s height and radius are $H = 0.025$ m and $R = 0.012$ m.

**Problem 1:** An ideal simple pendulum consists of a point mass, $m$, hanging from a pivot point by a massless string of length $L$. The oscillation period (the time it takes the pendulum to complete one full swing) of a simple pendulum is given by $T = 2\pi \sqrt{\frac{L}{g}}$. If we assume our pendulum here is a simple pendulum, what would we expect its oscillation period to be?

**Problem 2:** Our pendulum is not a perfect pendulum. The cylinder is not a point mass and the string is not massless. The oscillation period for a “physical pendulum” (an imperfect pendulum) is given by $T = 2\pi \sqrt{\frac{I}{M_{Tot}gh_{COM}}}$, where $I$ is the rotational inertia of the swinging object moment about the pivot point, $M_{Tot}$ is the total mass of the object, and $h_{COM}$ is the distance from the pivot point to the center of mass of the pendulum.

a) For our pendulum swinging about the pivot point at the top, what is this object’s rotational inertia? (Looking at Table 10-2 from the book will be helpful. Treat the string as a very thin rod. You will have to use the parallel axis theorem to find the moment of inertia of the cylinder and also the string)

b) What is the distance $h_{COM}$ from the pivot point to the center of mass of our pendulum?

c) Using your answers to a) and b) what should the actual period of our pendulum be? What is the percentage difference between this and your answer to question 1?