1. If an object travels around a circle of radius 22 cm in 0.645 seconds, what is its velocity in m/s

2. If a 2.50 kg physics book traveling in a horizontal circle at the end of a rope 50 cm long. What is the tension in the rope if it takes the book 2 seconds for one revolution.

3. If the book in the previous problem is swung in a vertical circle what is the tension in the rope when the book is at its (a) highest point? (b) lowest point?
Centripetal Force

OBJECTIVE:
To investigate the dependence of the centripetal force on velocity

APPARATUS:
Rotating platform assembly
Computer interface with photogate and force sensor
Power supply to run motor

INTRODUCTION:
By Newton’s Second Law, the force that produces uniform circular motion, or the centripetal force is given by

\[ F = \frac{M v^2}{R} \]

where \( M \) is the mass being rotated, \( v \) is its tangential velocity, and \( R \) is the radius of the circular motion. As it stands, mass and radius are easy to calculate, but the tangential velocity is not. However, we know that \( v = \frac{2\pi R}{T} \) where \( T \) is the time for one revolution (the period)

PROCEDURE:
1. Make sure that the computer, and interface are turned on.
2. Click on the “Physics Lab” folder. Select the program titled “Centripetal Force”.
3. Carefully remove the brass mass. Measure and record its mass.
4. Carefully replace the mass on the apparatus and read the radius of the motion from the scale on the apparatus. Record the radius.
5. Turn the voltage on the power supply fully counter clockwise before you turn it on. The voltage knob is the lower one. Then turn on the power supply to 2.0 Volts.
6. After the motion becomes steady. Click COLLECT on the computer.
7. The computer will give an average of 5 force measurements and 5 period measurements. Record the force and period from the little boxes on the graphs. You should be reading the mean (average) force and time. See figure;
8. Do the previous step for voltages of 2.5, 3.0, 3.5, 4.5 you should end up with five data points.
9. Turn the power supply to zero on switch it off.

**Data Analysis:**

1. Using a free computer in SM252, click on the **Physics Lab Folder** icon, then select **Graphical Analysis** icon.
2. Compute the velocity for each your data points with the formula 
   \[ v = \frac{2\pi R}{T} \]
3. Enter the velocities and Forces for your data points and begin with the point (0,0)
4. Label your graph and turn off **Connecting lines** under graph options.
5. Under the menu Analyze – choose Automatic curve fit enter the function 
   \[ y = A \times x^2 \]. The computer will find the value of A that gives the best fit to your data.

**PRACTICE QUESTIONS:**

1. The value of A should be equal to \( \frac{M}{R} \) according to theory. What is the percent difference between the value of A from your graph and the value calculated from theory.
2. Using the formula given by theory one could arrive at an experimental value of A by computing \( \frac{F}{v^2} \) for each data point and taking the average. Do this with your data and compare the result to the value of A from question 1.