Name ______________________________ Period __________ Date __________

Centripetal Force

Lab 9.1

Purpose

To find the unknown mass of a stopper using the relationship between velocity, radius, and centripetal force.

Required Equipment

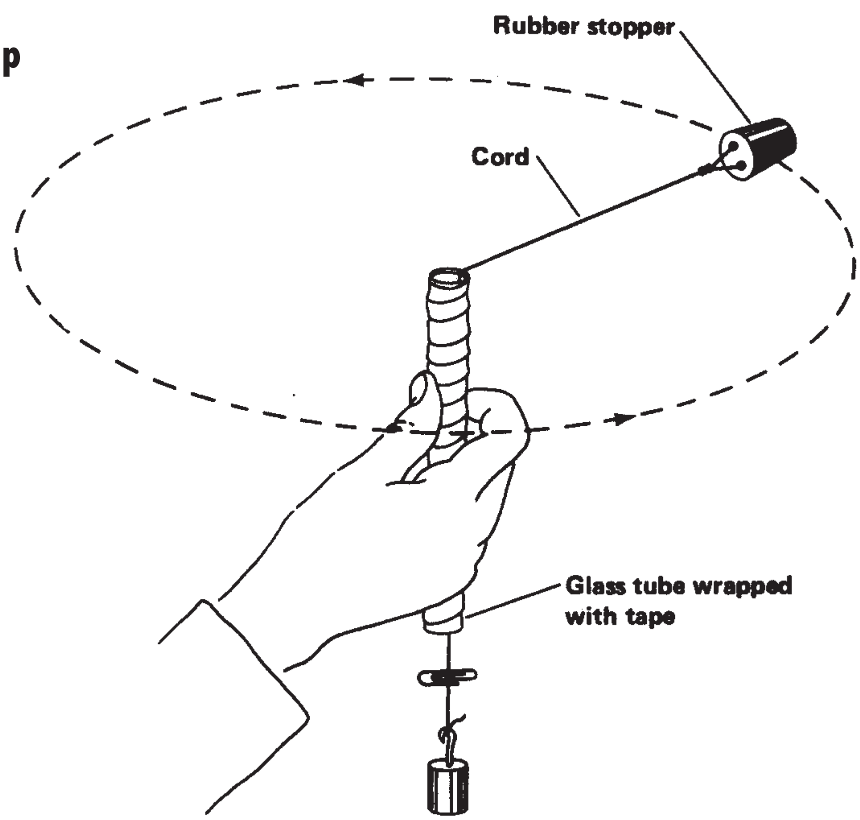
- 2 - 200g masses
- 1 - 100g mass
- Swinging stopper setup
- Timer

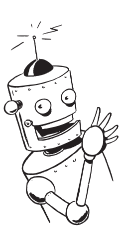
Discussion

A centripetal force is the force an object experiences as it changes direction as with a car going around a turn. In this lab you will fasten a stopper to one end of a string and attach a hanging mass on the other end. By timing how long it take the whirling stopper to make 20 rotation you will then calculate how long it takes to make one rotation and then using the circumference you can find the velocity of the stopper. Once you know the velocity of the stopper you can use the formula for centripetal force to solve for the mass.

$$F_c = \frac{mv^2}{r}$$

The Setup





Procedure: Part A

1. In this part of the lab you will very the amount of weight on the end of the setup thereby changing the amount of centripetal force.
2. Obtain a 100g mass and two 200g masses from your instructor.
3. Measure and then using a piece of tape, place a flag at the bottom of the setup so that the stopper will maintain a 1-meter radius.
4. Place a 100g mass on the bottom of the string and then practice swing the stopper around and maintaining the correct radius.
5. Time how long it takes to complete 20 rotations of the stopper and record.
6. Repeat step 4 - 5 but replace the 100g mass with a 200g mass
7. Complete the rest of the data table by adding more mass as listed in the data table.

Force (N)	Radius (m)	Circumference (m)	Time it takes for 20 rotations (s)				Period (s)	Velocity (m/s)	Stopper (kg)
			trial #1	trial #2	trial #3	Average			
0.98	1.0								
1.96	1.0								
2.94	1.0								
3.92	1.0								
								Average	

Completing the data table

1. Calculate the circumference by multiplying the radius by 2π.
2. Calculate the period by dividing the total time by the total number of rotations (20).

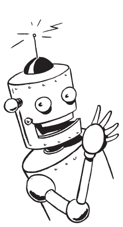
$$Period = \frac{Average\ Time}{Number\ of\ Rotations} \longrightarrow \boxed{Period = \frac{Ave\ Time}{20}}$$

3. Calculate the velocity by dividing the circumference by the period.

$$v = \frac{d}{t} = \frac{circumference}{period}$$

4. Calculate the mass of the stopper by using the formula for centripetal force.

$$F_c = \frac{mv^2}{r} \longrightarrow \boxed{m = \frac{rF_c}{v^2}}$$



Name ______________________________ Period __________ Date __________

Procedure: Part B

1. In this part of the lab you will vary the size of the radius but maintain the same weight on the end of the setup.
2. Measure and then using a piece of tape, place a flag at the bottom of the setup so that the stopper will maintain a 0.5-meter radius.
3. Place a 200g mass on the bottom of the string and then practice swing the stopper around and maintaining the correct radius.
4. Time how long it takes to complete 20 rotations of the stopper and record.
5. Repeat steps 2 - 4 but change the length of the string to 0.75 meters.
6. Complete the rest of the data table by changing the length as listed in the data table.

Force (N)	Radius (m)	Circumference (m)	Time it takes for 20 rotations (s)				Period (s)	Velocity (m/s)	Stopper (kg)
			trial #1	trial #2	trial #3	Average			
1.96	0.5								
1.96	0.75								
1.96	1.0								
1.96	1.25								
								Average	

Percent Error

1. Find the mass of the stopper using a balance and record bellow

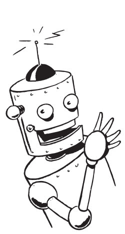
   Actual mass of stopper (kg): __________

2. Using the actual mass for the system in part A and then in part B calculate the percent error using the percent error formula. SHOW WORK

$$\% \text{ Error} = \left(\frac{\text{calculated mass - actual mass}}{\text{actual mass}} \right) \times 100$$

Percent Error (part A): __________

Percent Error (part B): __________



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