Centripetal Force Worksheet

GROUP #_____

NAMES _____ **DATE** _____**PERIOD**_____

_____

_____

_____

Objective: To determine the relationship between centripetal force, rotational speed, and gravity.

Materials:

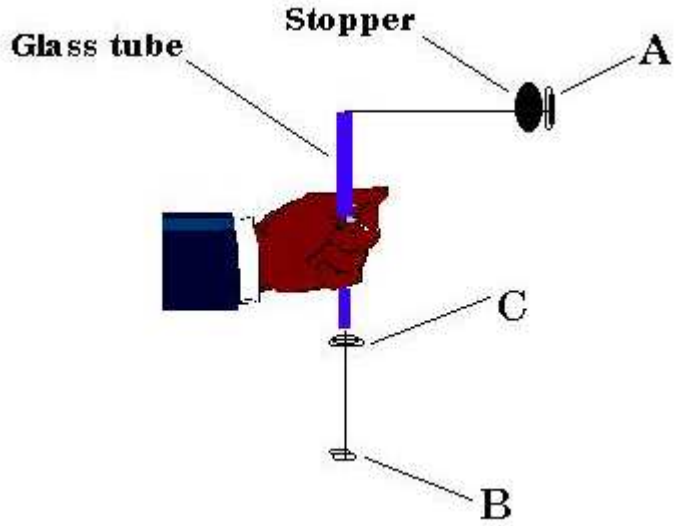
- Graph paper
- Glass tube or drinking straw
- String (24-36 inches)
- Paper clips (3 each)
- large washers (10-12 ea)
- Rubber stopper (single hole) or other substitute weighted object.
- Timer (stop watch, clock with second hand, etc.)

Group/Team member assignments:

- **Twirler:** twirls stopper in a safe manner
- **Timer:** uses clock or stopwatch to count time
- **Counter(s):** counts number of revolutions to 25

Procedure:

1. Thread the string through the glass tube and through the one-hole stopper at one end. Attach a paper clip ('A') to the end of the string with the stopper so that the stopper cannot slide off that end. Attach a second paper clip ('B') the other end of the string (opposite end from the stopper) which is extending out of the glass tube. Bend the paper clip 'B' in such a way that you can hang weights from it. Attach a third paper clip ('C') about 4 inches above clip 'B'.



2. Suspend several washers (4-5) from the paper clip 'B'. Grasping the tubing in the middle, begin to twirl the stopper so that the stopper is making circles above your head. Twirl the stopper in such a way as the bottom paper clip 'C' is only SLIGHTLY (1-2 cm) below the tubing, but not actually touching. When you are spinning, always keep the clip 'C' in the same position. If necessary, adjust the paper clip 'C' to a position on the string that makes this possible; mark this as position #1. . Measure up an additional 4 inches; mark this as position #2.
3. At an appropriate time and position, the counter says, "GO" and the timer starts timing. After 25 revolutions (it is best to count out loud and to have an assistant counter) the counter says "STOP" and the timer marks the time in seconds (round to the tenth if possible).
4. Note the time on a data collection table of your own design. The data collection table should note that there were 25 revolutions, the number of washers that were suspended, and the amount of time it took to complete those revolutions.
5. Repeat this 3 times with the same number of washers. Average the number of seconds it took for 25 revolutions.
6. Now, move the paper clip to position #2, and repeat steps 3-5.
7. Add two washers to the paper clip 'B'. Repeat the above steps #2-6, but DO NOT adjust the locations of positions #1 or #2 (keep those positions the same as in the first trial). Enter the average results on the data table.
8. For a third time, add two washers to the paper clip 'B'. Repeat the above steps #2-6, but DO NOT adjust the locations of positions #1 or #2 (keep those positions the same as in the first trial). Enter the average results on the data table.

Questions:

1. How much time did it take for 25 revolutions in the first trial from position #1? What do you observe about the number of washers suspended by the clip in trial #2 and the amount of time it takes to make 25 revolutions from position #1?
2. Compare the time it took for 25 revolutions in the first trial from position #1 and the time it took for 25 revolutions in the first trial from position #2. What conclusion can you make from analyzing these results?
3. In all trials, the diameter of the circle traced by the stopper with the paper clip 'C' in position #1 is larger than that traced when 'C' is in position #2. What general conclusion can you make about the diameter of the circle and the time it takes to do 25 revolutions?
4. In the three trials with the paper clip 'C' in position #1, what did you notice about the time it took for 25 revolutions as the weight was increased? State a hypothesis about the speed of revolution and the weights suspended at 'B'.
5. The Sun pulls in on the earth as the earth revolves around the Sun. This force is called gravity and is represented by the string. In the model above, what object(s) represent(s) the force of gravity?
6. How do we measure the centripetal force of the swinging stopper?

Use what you've learned:

7. Popular science fiction often portrays the construction of a space station to be in the shape of a large spinning wheel or spinning ball. Using what you have learned here, explain why you think this construction might be useful, and what effect this would have on the people living in the space station.
8. Using ***Excel,*** graph your data in a bar or line graph. Using this data, predict the amount of time it would take to do 25 revolutions if you increased the suspended washers by two.

Turn in your answers to the above questions, your data chart, and your graph.