Name: _____ Date: _____ Period: ____

LAB: Testing Variables of a Pendulum

Lab Preview:

Directions: *Answer these questions before you begin the lab.*

1. What will you use to make a pendulum in this lab?

   _____

   _____

2. What will you use to determine the angle of release?_____

A pendulum is an old, but accurate, timekeeping device. It works because of two natural phenomena—gravity and inertia—that are important in the study of Earth science. Gravity makes all objects fall toward Earth's surface. Inertia makes matter remain at rest or in motion unless acted upon by an external force. In the following lab, you will test some variables that might affect the swing of a pendulum.

Objectives/Goals:

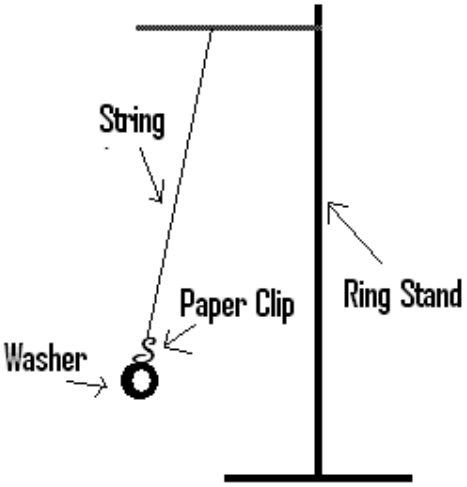
1. Manipulate variables of a pendulum.
2. Draw conclusions from experimentation with pendulums.
3. When done with the experiment, understand how the length of a pendulum, the attached mass, and the angle of release of the mass affect the swing of a pendulum.

Materials:

String (70 cm)
Metal Washers (5)
Watch with a second hand (ipod, phone, etc)
Metric Ruler
Paper Clip
Protractor
Ring Stand
Meter Stick

Safety Precautions: Please be careful when using the pendulums. Do not leave your lab group other than to go to the supply table. If you need to leave your lab group for any other reason, please raise your hand and ask permission. Wash your hands when you are done with lab.

Procedure:



1. Study the three data tables.
2. Bend the paperclip into an "S" Shape and tie it to one end of the string.
3. Hang one washer from the paper clip.
4. Measure: 50 cm of string from the washer and hold the string at that distance with one hand.
5. Use your other hand to pull back the end of the pendulum with the washer so it is parallel (90 degrees) with the ground. Be sure to use a protractor.
6. Let go of the washer. Count the number of complete swings in 1 minute (you can do 30 seconds and double it if you'd like). Record the number under table for Table 1: "Angle of the Release of the Mass" for trial 1.
7. Repeat steps 5-6 and record your answer under trial 2.
8. Adjust the angle and repeat for 80, 70, 60, and 50 degrees. Remember you need to do two trials for each.
9. Calculate the averages for Table 1.

Table 1: Angle of Release of the Mass			
Angle of Release (Angle with the ground)	Swings Per Minute		
	Trial 1	Trial 2	Average (Swings Per Minute)
90 °			
80 °			
70 °			
60 °			
50 °			

10. Measure: 50 cm of string from the washer and hold the string at that distance with one hand.
11. Use your other hand to pull back the end of the pendulum with the washer so it is parallel (90 degrees) with the ground. Be sure to use a protractor.
12. Let go of the washer. Count the number of complete swings in 1 minute (You may time for 30 seconds and double it if you'd like). Record the number under table for Table 2: "Amount of Mass on the Pendulum. " for trial 1.
13. Repeat steps 11-12 and record your answer in trial 2.

14. Repeat steps 11-3, but complete for 2, 3, 4, & 5 weights.
15. Calculate the average swings per minute for each in table 2.

Table 2: Amount of Mass on the Pendulum			
Units of Mass (Washers)	Swings Per Minute		
	Trial 1	Trial 2	Average (Swings Per Minute)
1			
2			
3			
4			
5			

16. Measure: 50 cm of string from the washer and hold the string at that distance with one hand.
17. Use your other hand to pull back the end of the pendulum with the washer so it is parallel (90 degrees) with the ground. Be sure to use a protractor.
18. Let go of the washer. Count the number of complete swings in 1 minute (you may time for 30 seconds and double it if you'd like). Record the number under table for Table 3: "The Length of the Pendulum" for trial 1.
19. Repeat 17-18 for trial 2.
20. Repeat the experiment for 50, 30, 20, and 10 cm.
21. Calculate your average swings per minute for each.

Table 3: The Length of the Pendulum			
Length of the String (cm)	Swings Per Minute		
	Trial 1	Trial 2	Average (Swings Per Minute)
10			
20			
30			
40			
50			

Conclude and Apply: All answers must be in complete sentences, unless otherwise noted.

1. Explain. When you tested the effect of the angle of the drop of the pendulum on the swings per minute, which variables did you keep constant?

_____
_____
_____

2. Infer which of the variables you tested affects the swing of a pendulum. Circle all that apply. Explain how you came up with that answer.

   A. Angle of Release
   B. Mass
   C. Length of the string

   Explain your answer:

   _____
   _____

3. Predict: Suppose you have a pendulum clock that indicates an earlier time than it really is (for example, it says 7 am, and its actually 8 am right now). This would only happen if there are two few swings per minute. What could you do to the clock to make it keep better time? Be sure to justify your answer.

   _____
   _____

Graphing: Graph the data from your tables. For full credit include the following:

1. Header
2. Title for each graph
3. Labels for x and y axis on each graph. Your Y axis should be "Average Swings Per Minute", your x axis will vary. But the x axis' should be "angle", "mass", or "length."
4. Determine a scale to use for ALL three graphs. They should all have the same scale for the y axis. For example, they should all include 0 to 100 swings per minute or 0 to 60 swings per minute. You need to determine this scale. You need to label some intervals. For example, you may choose to have a number for every 10 or every 5.
5. Each graph should take up ½ a page.
6. Plot the data using DIFFERENT COLOR PENCILS for each graph.
7. Draw a line of BEST FIT using a pencil.
8. You will be graded on following directions (1-7) AND neatness.

Students who are absent or need to practice this lab, may refer to the following website:
http://phet.colorado.edu/sims/pendulum-lab/pendulum-lab_en.html