Name _____ Class _____ Date _____

Kinetic and Potential Energy: Pendulum Lab

Background Information: A pendulum can be made by placing a mass at the end of a string or a metal rod. The physics of the swing of a pendulum is so precise that pendulums are often used in clocks and metronomes (instruments used to keep time for musicians). A pendulum swings back and forth at a steady pace under the influence of gravity. The amount of time it takes for a pendulum to complete one swing, (out and back), is called the period of the pendulum. Pendulum clocks are so sensitive that moving the clock from one latitude to another will cause the time to become inaccurate. This is because the Earth is not perfectly round and, therefore, gravity is slightly stronger at the poles than at the equator (gravitational potential energy). In addition to gravity, the length of the pendulum also affects the period of its swing. The mass of the pendulum and the height from which the pendulum starts does not affect the time it takes to complete one swing.

Objectives: To demonstrate the motion of pendulums
To determine which variables will affect the period of a pendulum.
To demonstrate the importance of testing one variable at a time to solve a problem.

Directions: In this lab you will investigate three separate problems. Complete each part before moving on to the next. Be sure to record your data accurately and use complete sentences.

Problem #1: *How does the starting height of the swing affect the number of swings of a pendulum?*

Hypothesis #1: If the starting point is higher **then** the number of swings will (increase/decrease/remain the same) **because** _____

_____

Procedure #1:

1. Adjust your pendulum so that the bob hangs 40 cm below the bar.
2. Using the meter stick and holding the pendulum taut, you will start the pendulum's swing from a point 50 cm above the floor.
3. Using the stop watch, count the number of full swings (to and fro) for 30 seconds.
   Number of swings from a starting height of 50 cm: _____
4. Now repeat step 2, but this time start the pendulum from a point 60 cm above the floor.
5. Using the stop watch, count the number of full swings for 30 seconds.
   Number of swings from a starting height of 60 cm: _____

Conclusion #1: In a statement tell if your hypothesis was supported or not, and what the real answer to the problem is. _____

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Problem #2: *How does mass of the bob affect the number of swings of a pendulum?*

Hypothesis #2: If the mass of the bob is greater **then** the number of swings will (increase/decrease/remain the same) **because** _____

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Procedure #2:

1. Adjust your pendulum so that the bob hangs 40 cm below the bar.
2. Using the meter stick and holding the pendulum taut, you will start the pendulum's swing from a point 70 cm above the floor.
3. Using the stop watch, count the number of full swings for 30 seconds.
   Number of swings with one bob: _____
3. Now attach another bob to the clip already on the string.
4. Using the meter stick and holding the pendulum taut, you will start the pendulum's swing from a point 70 cm above the floor.
5. Using the stop watch, count the number of full swings for 30 seconds.
   Number of swings with two bobs: _____

Conclusion #2: In a statement tell if your hypothesis was supported or not, and what the real answer to the problem is. _____

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Problem #3: *How does the <u>length of the string</u> affect the number of swings of a pendulum?*

Hypothesis #3: **If** the length of string is longer **then** the number of swings will (increase/decrease/remain the same) **because** _____

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Procedure #3:

1. Adjust your pendulum so that the bob hangs 45 cm below the bar.
2. Using the meter stick and holding the pendulum taut, you will start the pendulum's swing from a point 70 cm above the floor.
3. Using the stop watch, count the number of full swings for 30 seconds and record in the table.
4. Repeat this for each of the string lengths given in the data table.

STRING LENGTH (cm)	# OF SWINGS
45	
40	
35	
30	
25	
20	

5. Use the data in the table to make a line graph of pendulum length (x-axis) and number of swings (y-axis).

Conclusion #3: In a statement tell if your hypothesis was supported or not, and what the real answer to the problem is. _____

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Conclusion Questions:

1. How does the starting height of the swing affect the number of swings of a pendulum?

2. How does the mass affect the number of swings of a pendulum?

3. How does the length of the string affect the number of swings of a pendulum?

4. Next weekend you are going to Eleanor Rigby's house to fix her grandfather clock that is a bit slow. Based on what you have learned about pendulums, how will you fix her slow clock?

5. In Problem #1 you dropped the pendulum from two different starting heights. With the higher of the two heights, the pendulum had a farther distance to swing, but it still made the same number swings in 30 seconds as did the pendulum dropped from the lower height. What must happen to the speed of the pendulum as the starting height of the swing is increased?

6. How would the motion of a pendulum be different if the pendulum was on the moon rather than on the Earth?

7. Use your graph to answer the following questions.
   a) How many swings would a 23 cm long pendulum make in 30 seconds?
   b) How many swings would a 37 cm long pendulum make in 30 seconds?
   c) How many swings would a 17 cm long pendulum make in 30 seconds?
   d) How long is a pendulum that swings 32 times every 30 seconds?
   e) How long is a pendulum that swings 24 times every 30 seconds?

Summary: Write a three paragraph summary for this lab using our standard format. (Paragraph one tells what you were doing and why you were doing it. Paragraph two tells what you found out – your results. Paragraph three tells how what you learned relates to life.)