LAB 1 Laboratory Activity

The Energy of a Pendulum

When you ride on a playground swing, you have energy. Any moving object has kinetic energy, which is energy due to motion. Kinetic energy depends on the velocity and the mass of the moving object. Increasing the mass on the swing by holding something in your lap or your velocity by swinging faster increases your kinetic energy.

An object at rest may also have energy. When an object is held in a position where it would move if released, it has energy of position called potential energy. When you begin to swing, a friend may pull your swing back and up. See Figure 1. Before your friend releases the swing, you are at rest and have potential energy. In this position, you are not moving, so you have no kinetic energy. But you could move if released, so you have potential energy. As long as the swing is in a position where it can move, you have potential energy. After your friend releases the swing, you have both potential energy and kinetic energy. See Figure 2.

Figure 1

Figure 2

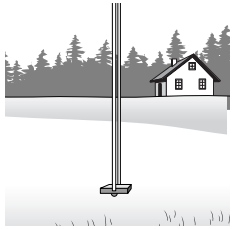


Figure 3

If you were to sit in the swing and allow it to hang straight down from its supports, you would not move. You are not held in a position where you can move. With reference only to the swing, you have no potential energy and no kinetic energy. See Figure 3.

A swing is one example of a pendulum. Many clocks have a swinging mass, or pendulum, to move the hands. A pendulum can have both potential energy and kinetic energy, depending on its position. How much energy depends also on its mass and velocity. A pendulum hanging straight down, at rest, has neither potential energy nor kinetic energy.

How do potential energy and kinetic energy change as a pendulum swings? Write your hypothesis in the Data and Observations section.

Strategy

You will construct a pendulum.
You will explain how a pendulum behaves.
You will describe the potential energy and kinetic energy of a pendulum.

Materials

ring
strings, 20 cm and 30 cm long (2)
ring stand
sinkers, different sizes (2)
metric ruler
watch with second hand

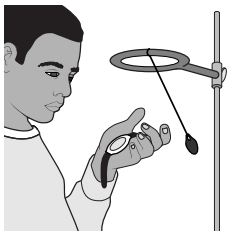
Hands-On Activities

Laboratory Activity 1 (continued)

Procedure

1. Set up the ring and ring stand. Use the metric ruler to adjust the ring to a height of 35 cm above the table or desk.

Figure 4



2. Securely tie the short string to the smaller sinker. Measure 15 cm along the string. Tie the string at this point to the ring as shown in Figure 4.
3. Allow the pendulum to hang at rest. Consider the energy of the Pendulum—potential, kinetic, or both. Record your observations in the Data and Observations section.
4. Hold the pendulum above the table to form a small angle with the ring stand. Record your observations about the pendulum's energy.
5. From the raised position, release the pendulum and allow it to swing for exactly two minutes. Count the number of full swings (back and forth) during the two minutes. Record this information in the Data and Observations section.
6. Run a second trial, counting the swings for another two minutes. Record this information in the data table.
7. Do three other sets of trials. Vary either the length of the string or the size of the sinker as indicated in the data table. Record your information in the data table.
8. Calculate the average number of swings for each two-minute trial. Record this information in the data table.

Data and Observations

Hypothesis:

Step 3 observations:

Copyright © Glencoe/McGraw-Hill, a division of the McGraw-Hill Companies, Inc.

Laboratory Activity 1 (continued)

Step 4 observations:

Pendulum		Similarities and differences		
String length (cm)	Trial 1	Trial 1	Trial 2	Average
15	small			
15	large			
25	small			
25	large			

Questions and Conclusions

1. What type of energy does the pendulum have when it is hanging straight down?

2. What type of energy does the pendulum have if it is held at a right angle to the stand?

3. What force acted on the pendulum when it was released from its raised position?

4. Which string length caused the pendulum to swing more times in two minutes? Which sinker size caused the pendulum to swing more times in two minutes?

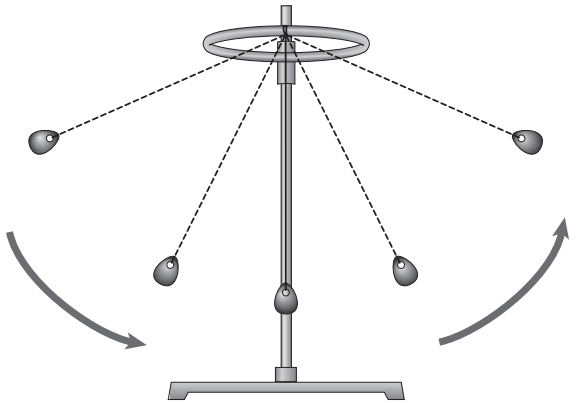
5. Describe the best method for increasing the number of swings of a pendulum during a set time period.

Hands-On Activities

Laboratory Activity 1 (continued)

6. Figure 5 represents a pendulum in motion. Look at the diagram and label it as indicated.
   a. Write the letter P at the position of maximum potential energy.
   b. Write the letter K at the position of maximum kinetic energy.
   c. Write the letter I at the position where kinetic energy is increased.
   d. Write the letter D at the position where kinetic energy is decreased.

Figure 5



Strategy Check

_____ Can you explain how a pendulum behaves?

_____ Can you describe the potential energy of a pendulum?

_____ Can you describe the kinetic energy of a pendulum?