

Video Analysis of Motion of a Pendulum

Goal: Using a video recording, analyze the motion of a pendulum.

Materials:

- Pendulum
- Ring stand
- Electric balance
- Calipers
- Sheet of plastic with printed grid
- Video recording device (cell phone or video camera)
- Video editing program such as iMovie or Windows Movie Maker (both free)

Procedure:

1. Measure the mass of the pendulum bob. Measure the width of the pendulum bob.
2. Setup a pendulum on a ring stand. Measure the length of the string.
3. Stand the sheet of plastic with the printed grid in front of the pendulum and secure it (use whatever you find handy). It's best to have a vertical line aligned with the lowest point of the pendulum so you can see exactly when the pendulum reaches this point in its swing.
4. Place the video recording device in front of the plastic grid. The intent is to use the grid for precise measurements of the position of the pendulum. You may want to add some marks to the plastic so you know the scale.
5. Record the motion of the pendulum for at least a minute. Make sure it does not hit or rub against the plastic. You want the video camera to be on level with the pendulum so a skewed perspective does not give you bad position measurements.

Analysis:

1. Analyze the video for the first full oscillation. Measure the centripetal acceleration of the pendulum bob at the bottom of the swing.
2. With this information what is the centripetal force of the bob? What is the tension in the string?
3. Find the acceleration due to gravity. How does this value compare with the value you measured in early September (the second lab of the year)? Perform a percentage difference calculation.
4. Now analyze the video for the last full oscillation captured. Find the energy loss in the pendulum by comparing the velocity at the bottom of the swing for the first oscillation and the last oscillation. Any energy loss is due to air friction. What percentage of the initial energy is lost to air friction?