Pendulum Study

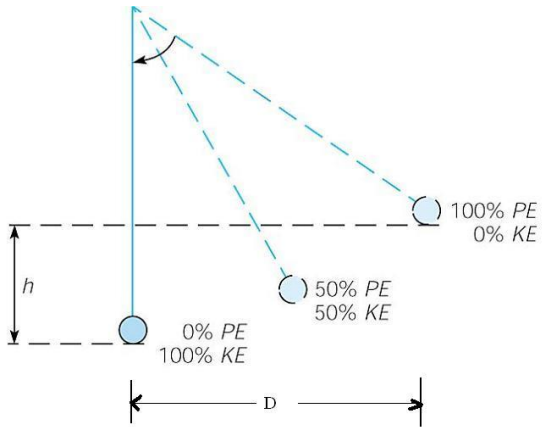
Your name:_____; Points: _____(20 points extra-credit possible)

Last modified 2/11/16.

Introduction

This study will exam the mechanics of pendulae,

A pendulum demonstrates continuous transformation of energy: potential energy to kinetic energy; kinetic energy back to potential energy; potential energy back to kinetic energy; etc.



The figure above shows the evolution of a simple pendulum during one fourth of a period. A period is the interval of time required for the pendulum to return to the position it had at the beginning of the period with the same velocity.

Describe what will happen during the remaining 3/4 period following the 1/4 period shown above.

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In the absence of friction, how long will a pendulum continue to oscillate?

For small displacement, the period of a simple pendulum depends only upon the length of a pendulum and the acceleration of gravity. The formula is:

Equation 1: T=2*Pi*(L/g)^(1/2)

Where Pi is the constant, 3.14; T= the period; L= the length; and g= the acceleration due to gravity = 9.8 m/s^2.
By what percentage will the period increase when the length is doubled?

Why is this equal to 100% * (sqrt(2)-1)?

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Foucault Pendulum

A Foucault Pendulum is used to demonstrate the rotation of the Earth, here is the Wikipedia article.

How does it demonstrate the rotation of the Earth? Hint, take a look at the animation shown in the Wikipedia article.

What employment lead Foucault to the invention of this Pendulum?

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He first demonstrated this pendulum to the public in the Meridian Room. What building was this room located in?

The meridian built into this floor is now at a longitude of 2.3 degrees east. Why is it not at longitude 0.0 as intended?

Where is the Meridian with longitude 0.0?

Why is it located there?

Use the Google Foucault Pendulum Doodle to explore the relationship between the latitude where the pendulum is installed and time required for the pendulum to make one complete revolution in the orientation of the plane of the pendulum's oscillation.

How long does it take at the North Pole?

How long does it take at the South Pole?

How long does it take at on the equator?

The Wikipedia article linked above gives this formula for the pendulum rotation rate, $\omega = 360 \sin \varphi \ ^\circ/\text{day}$, in degrees per day, where phi is the latitude.

Show that this is zero at the equator, +/-360 at the poles, and 207.1 at FSU (where the latitude is 35.1 degrees).

Now show that it takes 41.72 hours to complete one revolution at FSU.

Show a calculation for how long it is expected to take at FSU to rotate 30 degrees (felling two pegs).

At the north end of the first floor of the Lyons Science Building you will find the FSU Foucault Pendulum. Exam it before proceeding

An essential part of this pendulum is the drive magnet shown in the photo below. It is made of iron. The iron oxide (rust) on its surface causes it to be red. It consists of two parts, the outer electromagnet, and the inner armature that is attached several feet below the fulcrum to the cable that suspends the pendulum ball.

How does this electromagnet prevent the swing of the pendulum from decaying due to loss of energy due to friction? You may ask for the instructor's permission to inspect the switched power system for the magnet that is in a nearby storage closet.

Instructor's preliminary checkup on your progress: approval initials:_____(required)

Determine the period of the FSU Foucault Pendulum
Measure the time required to make 3 complete oscillations. Record it here:_____
One third of this is T, the period. Record it here:_____

Now use Equation 1 to calculate the expected length of the pendulum for this period (in m) using your value of T.

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What is the actual length? Hint, the value given on the sign near the pendulum is wrong – so you will have to ask the instructor.

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Calculate the percentage difference between these lengths.

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Discuss possible reasons for discrepancy.

Finally, you are to devise a means to verify the rate of rotation of the plane of oscillation of this pendulum. Report your procedure, data, analysis, and conclusions.

Calculate the percentage difference between your determination of the period of the rotation of the plane of oscillation and the expected 41.72 hours.

What are possible reasons for a discrepancy? Here is one. What are others?