Physics Exploration Homework Supplement P110-11.pdf

Exploration of Simple Harmonic Motion and Pendulums

Go to the Physics Exploration Center. Enter through the resource room 311/312 Thaw Hall. A simple pendulum is an example of a physical system which undergoes simple harmonic motion if the angular displacement from the equilibrium position is small.

Answer the following questions before you begin exploration.

(1) Based upon what you have learned in the class, how does the period of motion of a simple pendulum depend upon the length of the string, the mass hanging from the string, and the amplitude of motion?

(2) A pendulum of length L swings with a period of 1 second. If the length of the pendulum decreased to L/4, the period becomes

(a) 2 seconds
(b) 4 seconds
(c) 1/2 seconds
(d) 1/4 seconds
(e) 1 second

(3) Which of the statements is true about a simple pendulum executing simple harmonic motion?

(a) The acceleration of the mass is constant
(b) The period (T) of the motion depends on the amplitude
(c) The velocity is greatest when the mass has reached its maximum displacement
(d) The acceleration is maximum when the mass has reached its maximum displacement
(e) The acceleration and velocity are both maximum for the same displacement.

Now play with the pendulum setup.

(a) Make the string length 0.5 m* and attach a 100 g mass to the end of the string. Make the pendulum swing with a small angular displacement. Measure the period of the motion by timing ten swings using a stop watch? Also, measure the period using the computer (with photogate) to verify that your measurement with the stop watch is reasonably accurate.

*Note: The pendulums length is measured from where the string enters the overhead support rod to the center of mass of the weight (the white line marked on each of the masses).

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(b) Change the length of the string to 0.25 m*. What happens to the period? Is this consistent with your prediction earlier?

(c) Change the mass hanging from the string to 200 gm? What happens to the period? Is this consistent with your prediction earlier?

(d) Try different amplitude of motion by varying the angular displacement (e.g., 5º, 10º, and 30º etc.). Does the period depend on the amplitude? Does the period depend on the amplitude for small oscillations? Are these results consistent with your prediction earlier?

(e) Write down an observation about this experiment that YOU find interesting. Do you think that your observation can be explained by the laws of physics?

(f) A student comments: "This motion of the simple pendulum is not strictly simple harmonic even for small amplitude motion". Do you agree with the student? Explain your reasoning.

(g) How would the results for each of parts (a)-(d) change if you were performing the measurements on the moon instead of the earth? Explain your reasoning,

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