Medical Physics

The Simple Pendulum

Experiment four

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The purpose:

1-Study the simple harmonic motion of a simplependulum.

2-Study the relationship between periodic time and thelength of a pendulum.

3- to determine the acceleration due to gravity "g".

***Apparatus*: simple pendulum**

Metric Ruler

Stop watch

The theory

A simple pendulum: it is a small mass (ball) that is suspended vertically by a thin thread that is neglected in the block and is not stretched.

By neglecting the force of friction between the thread and the point of suspension, the suspended mass (the ball) is in equilibrium under the influence of two forces of equal and opposite magnitude. They are the body weight (the force of the ground pulling the body down) and the upward force of the string By shifting the ball no more than 10 degrees and letting it move freely, the ball is no longer balanced The Earth's gravitational force mg decomposes into two components, one of which is mg cosθ , which is equal in size and opposing in direction with the tensile force of the thread oblique on the shaft at an angle and the other is the tensile force of the thread mgsinθ, which makes the ball move automatically in the direction back to the equilibrium position. On this basis, the relationship was inferred to calculate the aperiodic time.

$$T = 2\pi\sqrt{L/g}$$

$$T^2 = 4\,\pi^2 L/\,g$$

Time period: The time required to complete one oscillation or vibration is called a time period.

Frequency: The number of vibrations or oscillations per second is called frequency.

Time period = $\frac{1}{\text{Frequency}}$

Where T: is the periodic time is measured in units of seconds(s)

L: is the length of the pendulum thread in meters (m), and g is ground acceleration.

Simple harmonic motion is a vibratory motion in a straight line in which the acceleration of the mass is directly proportional to the amount of displacement, and opposite in direction, or a motion that repeats itself every time, and the amplitude of the vibration of the motion is constant, the speed is proportional to the displacement of the body from the position of equilibrium, and its direction is always towards the position of equilibrium. Examples include:

Spring-bound block movement.

Simple dance movement. Swing-like movement.

Procedure:

The period T of a simple pendulum (measured in seconds) is given by the formula:

$T = 2\pi \sqrt{\frac{L}{g}}$ ..... (1)

$T = t_{ave}/10$ ..... (2)

Using equation (1) to solve for "g",

L: is the length of the pendulum (measured in meters)

and

g: is the acceleration due to gravity (measured in meters/sec^2).

Now with a bit of algebraic rearranging, we may solve (eq. 1).

For the acceleration due to gravity g (You should derive this result on your own).

$g = 4\pi^2 L/T^2$ ..... (3)

1. Measure the length of the pendulum to the center of the pendulum ball. Record the length of the pendulum in the table below.

2 - Set the pendulum in motion until it completes 10 oscillations back and forth, taking care to record this time. Then the period T of one oscillation is just the number recorded divided by 10 using (Eq. 2).

3. You will measure g using four different values for the length L.

L(cm)	t_1(sec)	t_2(sec)	t(Average time)=$t_1+t_2/2$	T=t/10 periodic time	T^2 (sec^2)
70	16	16.5			
60	15.4	16.3			
50	14	14.7			
40	13.1	12.8			
30	12.4	12.6			
20	12	11.8			
10	11	11.2			

And by plotting the relationship between T^2 On an axis and L

On y and on the x-axis and calculating the slope, we deduce the value of the ground acceleration from the relationship

$g=4\pi^2$ slope

EXAMPLE 1: What is the acceleration due to gravity in an area with a simple pendulum of length 75cm with a period of 1.7357 seconds?

Solution

Square $T=2\pi\sqrt{L/g}$

$T^2=4\pi^2 \frac{L}{g}$ and solve for g:

$g=4\pi^2 \frac{L}{T2}$

Substitute known values into the new equation:

$g=4\pi^2 \frac{0.75\ m}{(1.7357\ s)2}$

Questions

1- A pendulum with duration 3 sec located where the acceleration of gravity is 9.79 m/s ^{2} What is the length of the pendulum?

2- What is the time it takes the child on the swing to complete one swing if his center of gravity is 4meters below the axis? Note that the acceleration value is $1.63 m/s^2$.