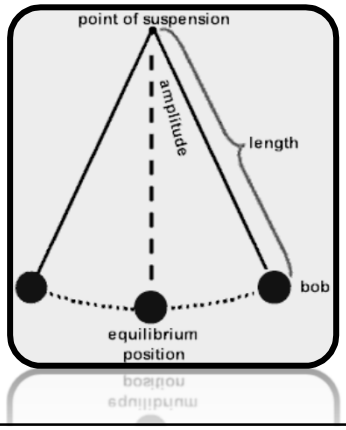
Simple Harmonic Motion

Pendulums

1

Periodic Motion

Simple periodic motion is that motion in which a body moves back and forth over a fixed path, returning to each position and velocity after a definite interval of time.



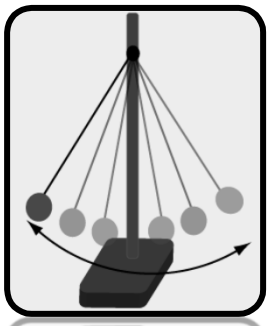
$$f = \frac{1}{T}$$

Period, T, is the time for one complete oscillation. (seconds,s)

Frequency, f, is the number of complete oscillations per second. Hertz (s^{-1})

2

Example 1: The pendulum makes 30 complete oscillations in 15 s. What is the period and frequency of the motion?



$$T = \frac{15\text{ s}}{30\text{ cycles}} = 0.50\text{ s}$$

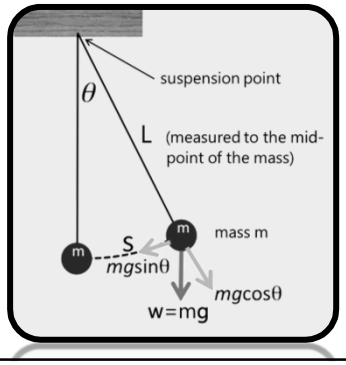
Period: T = 0.500 s

$$f = \frac{1}{T} = \frac{1}{0.50\text{ s}}$$

Frequency: f = 2.00 Hz

Simple Harmonic Motion (SHM)

Simple harmonic motion is periodic motion in the absence of friction and produced by a restoring force that is directly proportional to the displacement and oppositely directed.



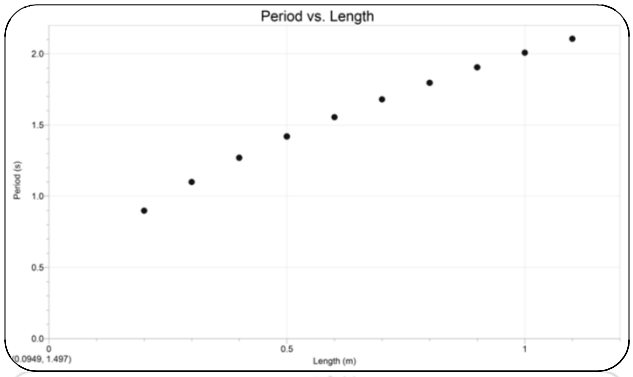
A restoring force, F, acts in the direction opposite the displacement of the oscillating body.

$$F = -mg\sin\theta$$

Data from Lab

What variable affected the period of oscillation?

Sample Graph



What relationship is this?

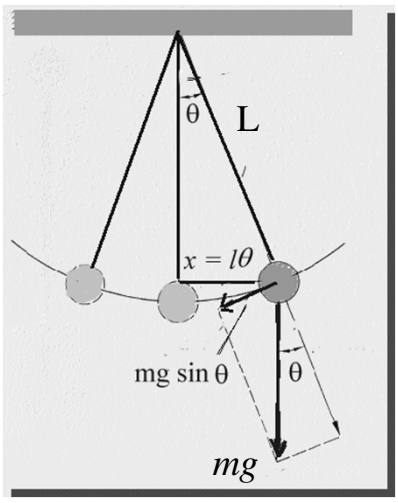
The Simple Pendulum

The period of a simple pendulum is given by:

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

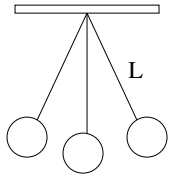
For small angles θ.

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$



Example 2. What must be the length of a simple pendulum for a clock which has a period of two seconds?

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



$$T^2 = 4\pi^2\frac{L}{g}; \quad L = \frac{T^2 g}{4\pi^2}$$

$$L = \frac{(2\,\text{s})^2(9.8\,\text{m/s}^2)}{4\pi^2}$$

L = 0.993 m