

Worksheet - Exp 11: Simple Harmonic Motion

Objective: To investigate simple harmonic motion using a simple pendulum and an oscillating spring; to determine the spring constant of a spring.

Theory: Simple harmonic motion describes an object that is drawn to equilibrium with a force that is proportional to its distance from equilibrium. Such a restorative force will return an object to equilibrium after a fixed time interval, regardless of where the object is placed. The time it takes for an oscillator to return the object to its original position is called the period of oscillation.

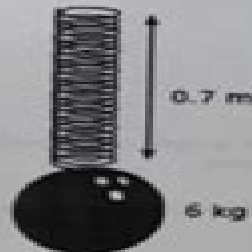
One example of a harmonic oscillator is a spring that obeys Hooke's Law ($F = -kx$). The period of an ideal, massless spring is related to the spring constant, k (or spring stiffness), and the mass of the object, m , that it moves:

$$T = 2\pi\sqrt{\frac{m}{k}}$$

The other harmonic oscillator modeled in this experiment is the ideal simple pendulum, whose period is related to its length, L , and the pull of gravity:

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

1. A bowling ball is hung from a spring of unstretched length 0.5 m. It stretches the spring to 0.7 m as shown. Find the spring constant of this spring. (3 pts)



$$k = \underline{39.4} \text{ N/m}$$

$$2\pi\sqrt{\frac{6}{2}}$$

2. The restorative force of a pendulum is the part of gravity that acts perpendicular to the pendulum arm: $F = -mg \sin \theta$. For small angles, this force is directly proportional to displacement because $\sin \theta \approx \theta$. To verify this, convert 20° to radians, then compute the sine of the angle. (5 pts)

$$\theta \approx \sin \theta \approx \tan \theta$$

$$\theta = \underline{\hspace{2cm}}$$

$$\sin \theta = \underline{\hspace{2cm}}$$

$$\% \text{ Diff} = \underline{\hspace{2cm}}$$

By the small angle approximation, then, the pendulum behaves as a simple harmonic oscillator:
 $F = -(mg)\theta$.

Skill Sheet 11 Harmonic Motion

CL Gary



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