Hooke's Law Prelab

by

Dr. Christine P. Cheney, Department of Physics and Astronomy, 401 Nielsen Physics Building, The University of Tennessee, Knoxville, Tennessee 37996-1200

During the Hooke's Law lab you will continue your study of simple harmonic motion from last week. You will hang different masses from a spring and measure the displacement of the spring from equilibrium. By taking several measurements, you will extract the spring constant of the spring by plotting force on the spring vs. displacement. You will also count the oscillations of the mass when disturbed and calculate the period. The period of the spring will depend on the mass and the spring constant.

When you hang a mass from a spring, the forces acting on the spring are the force due to gravity (or weight) (called the applied force in today's lab) and the restoring force of the spring as shown in Fig. 1. If the mass is at rest, then the net force is zero, and these two forces are equal and opposite. The restoring force is always in the direction going back to equilibrium. If you stretch a spring and let go, it will want to coil back up. If you compress a spring and let go, it will want to stretch back out to its equilibrium state. The net force equation can be written as

$$F_{net} = 0 = F_{restoring} - F_g = kx - mg$$

where k is the spring constant of the spring and m is the hanging mass. Thus

$$kx = mg.$$

Figure 1. The mass on the spring exerts the force of gravity on the spring that balances the restoring force of the spring.

The motion of a mass on a spring will also obey simple harmonic motion when there are no outside forces acting on it.[1]

$$y = A\sin\omega t = A\sin\sqrt{\frac{k}{m}}t$$

Here you see that

$$\omega = \sqrt{\frac{k}{m}}$$

and

$$T = \frac{1}{f} = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$$

Questions

1. What is the spring constant of a spring if the hanging mass is 0.100 kg and the displacement from equilibrium is 0.065 m?

Things to consider during lab:

1. During the Hooke's Law lab, attach the small diameter coil part of the spring to the hook. Remove the spring when you are done so that it does not get needlessly stretched out where it is no longer within its elastic limit.

References

[1] http://hyperphysics.phy-astr.gsu.edu/hbase/shm.html