Simple Harmonic Motion Worksheet

Name Key

Hooke's Law Questions and Problems

1. Does Hooke's Law apply to stretch springs, compressed springs or both?

both

2. a) A load of 45 N is attached to a spring that is hanging vertically. The spring is stretched 0.14 m from its equilibrium position. What is the spring constant?

$F = kx \quad 45 = k(.14) \quad k = 321\ N/m$

b) If a 60 N weight is used instead, what would you expect the spring stretch to be instead?

$F = kx \quad 60 = (321)x \quad x = .187\ m$

3. a) A slingshot consists of a light leather cup attached between two rubber bands. If it takes a force of 32 N to stretch the bands 1.2cm, what is the equivalent spring constant of the rubber bands?

$F = kx \quad 32 = k(.012) \quad k = 2667\ N/m$

b) How much force is required to pull the cup of the slingshot 3.0 cm from the equilibrium position?

$F = kx \quad F = (2667)(.03) = 80\ N$

4. If a spring constant is 40 N/m and an object hanging from it stretches it 0.50 m, what is the mass of the object?

$F = kx \quad F = (40)(.50) = 20\ N \quad F = mg \quad 20 = m(10) \quad m = 2\ kg$

5. In problem #4, what would be the period of oscillation associated with the spring pendulum? In your work show the unit cancelation.

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{2\ kg}{40\ N/m}} = 2\pi\sqrt{\frac{2\ kg}{40\ \frac{kg\cdot m}{s^2 \cdot m}}} = 1.40\ sec$

6. A 1.0 kg mass on a spring is stretched and released. The period of oscillation is measured to be 0.46 s. What is the spring constant?

$T = 2\pi\sqrt{\frac{m}{k}} \quad .46 = 2\pi\sqrt{\frac{1}{k}} \quad .0732^2 = \left(\sqrt{\frac{1}{k}}\right)^2 \quad k = \frac{1}{.00536}$

$.00536 = \frac{1}{k} \quad k = 187\ N/m$

Pendulum Questions and Problems

1. Describe how you would make a pendulum with a period of 1.0 sec.

$T = 2\pi\sqrt{\frac{\ell}{g}} \quad 1.0 = 2\pi\sqrt{\frac{\ell}{10}} \quad .159^2 = \left(\sqrt{\frac{\ell}{10}}\right)^2 \quad .0253 = \frac{\ell}{10} \quad \ell = .253\ m$ (use string length)

2. What would be the period of a pendulum that is 1.0 m long?

$T = 2\pi\sqrt{\frac{1.0}{10}} = 1.99\ sec$

3. Imagine you could travel to the moon where the acceleration due to gravity is 1.6 m/s^2. What would be the period of a pendulum that is 1.0 m?

$T = 2\pi\sqrt{\frac{1.0}{1.6}} = 4.97\ sec$

4. A trapeze artist wants a period of 3.8 s. How long should the cables be? (Do not consider the height of the trapeze artist.)

$T = 2\pi\sqrt{\frac{\ell}{g}} \quad 3.8 = 2\pi\sqrt{\frac{\ell}{10}} \quad .605^2 = \left(\sqrt{\frac{\ell}{10}}\right)^2 \quad \ell = 3.66\ m$

5. Is it more fun on a swing with low or high amplitude? Explain.

high = swing longer / higher