

Physics 221 – Spring 2012

Quiz #3

This is a group quiz

Names: _____

1. A spring is hanging from the ceiling and you hook a 10.2 kg bunch of bananas to the bottom. The spring was originally hanging 2.0 meters from the floor. After hanging the bananas, the spring stretches so that the end of it is only 1.3 meters from the floor. Your kid brother thinks the only real value for this spring is to use it to shoot things. He takes it and places it on the floor with one end attached to the wall. He then places a rubber ball (200g) on the end of the spring (he pokes the end into the ball so it sticks) and compresses it 30 cm. (the spring and the floor are frictionless) Find
 - a. the velocity of the ball when the spring is at its relaxed length.
 - b. the velocity of the ball when the spring is 60 cm from where your brother started it.
 - c. If the ball didn't stick to the spring, will this be an exciting shooter? Why?
 - d. Write the equations of motion for the spring/ball system.
 - e. Determine the maximum acceleration of the ball.
 - f. What is the ball's period?
 - g. What is the speed of the ball at 2.0 cm?
 - h. What is the speed of the ball at 2.0 seconds?
 - i. Is there anything about this system that you cannot calculate? What is it?

$$F = -kx$$

$$a = -\frac{k}{m}x$$

$$T = 1/f$$

$$\text{Period of a Spring: } T = 2\pi\sqrt{\frac{m}{k}} \quad \text{Period of a pendulum: } T = 2\pi\sqrt{\frac{L}{g}}$$

$$g = 9.8 \text{ m/s}^2$$

$$PE_s = \frac{1}{2}kx^2$$

$$PE_g = mgh$$

$$KE = \frac{1}{2}mv^2$$

$$v = \pm \sqrt{\frac{k}{m}(A^2 - x^2)}$$

$$\text{Equations of motion general: } x = A \cos(2\pi f t)$$

$$v = -2\pi f A \sin(2\pi f t) \quad a = -(2\pi f)^2 A \cos(2\pi f t)$$

$$\text{Equations of motion springs: } x = A \cos\left(\sqrt{\frac{k}{m}} t\right)$$

$$v = -\sqrt{\frac{k}{m}} A \sin\left(\sqrt{\frac{k}{m}} t\right) \quad a = -\frac{k}{m} A \cos\left(\sqrt{\frac{k}{m}} t\right)$$