Name ___________________________

Test Prep Worksheet

Simple Harmonic Motion

1. A mass is attached to a spring on a frictionless, horizontal surface. When it's set into oscillation, its period is T. An equal mass collides head-on with this mass, and the two masses stick together. The oscillation period is now:
    a. T
    b. $\sqrt{2} \cdot T$
    c. 2T
    d. $T/\sqrt{2}$
    e. T/2

Questions 2-4

A 2kg mass oscillates vertically at the end of a spring according to:

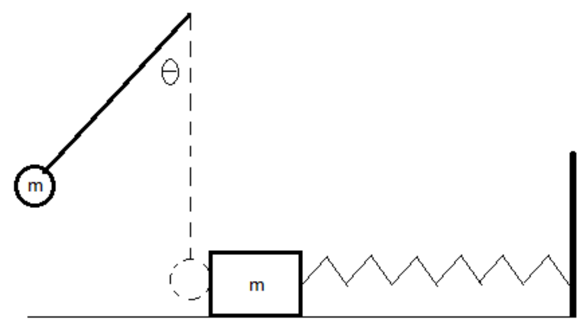
$$x(t) = 4 \sin\left(\frac{\pi}{6} t + \frac{\pi}{8}\right)$$

2. The period of oscillation is:
    a. 3s
    b. (1/3)s
    c. (1/12)s
    d. 12s
    e. $(\pi/6)$s

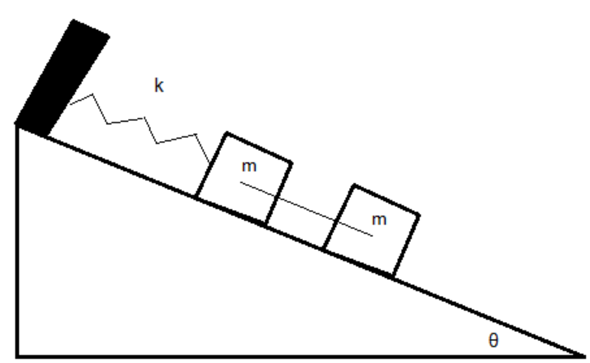
3. The spring constant has a value in N/m of:
    a. $8\pi^2 / 9$
    b. $72\pi^2$
    c. $1{,}152\pi^2$
    d. $\pi^2 / 18$
    e. $81 / 8\pi^2$

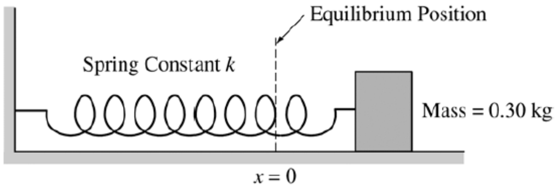
4. The maximum kinetic energy of the mass is:
    a. 16 J
    b. $(2\pi/3)$ J
    c. 4 J
    d. 32 J
    e. $(4\pi^2/9)$ J

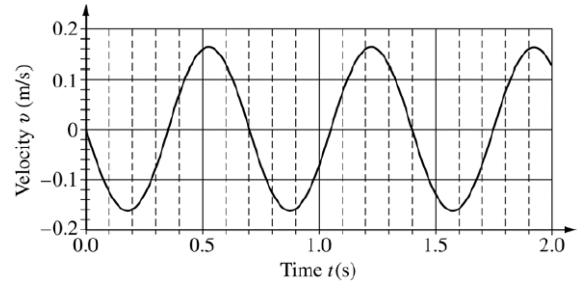
5. A mass *m* is attached to a light string of length *L*, making a simple pendulum. It is displaced an angle θ from the vertical and released at t = 0. Directly below the pivot of the pendulum is a stationary second mass *m* equal to the first, attached to a spring of constant *k* on a frictionless, horizontal surface. When the first mass collides with the stationary mass, the first mass detaches from the string and sticks to the second mass.
    a. At what time will the spring first reach its maximum compression?
    b. Find the amplitude of the spring oscillations



6. Two equal mass *m* connected by a light string are currently at rest on a frictionless surface inclined at an angle θ. One of the masses is connected by a spring with constant *k* to a point at the top of the incline. At t = 0, the string is cut, and the mass connected to the spring begins to oscillate.
    a. Determine the period of the oscillations
    b. Determine the amplitude of the oscillations
    c. In terms of the given quantities, write an expression for the velocity of the oscillating mass at an arbitrary time







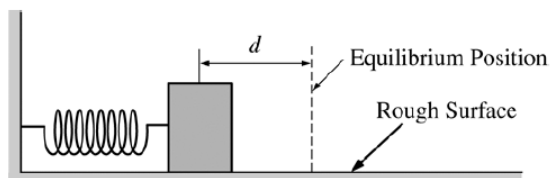
7. A block of mass 0.30 kg is placed on a frictionless table and is attached to one end of a horizontal spring of spring constant *k*, as shown above. The other end of the spring is attached to a fixed wall. The block is set into oscillatory motion by stretching the spring and releasing the block from rest at time $t = 0$. A motion detector is used to record the position of the block as it oscillates. The resulting graph of velocity *u* versus time *t* is shown below. The positive direction for all quantities is to the right.

(a) Determine the equation for $u(t)$, including numerical values for all constants.

(b) Given that the equilibrium position is at $x = 0$, determine the equation for $x(t)$, including numerical values for all constants.

(c) Calculate the value of *k*.

The block and spring arrangement is now placed on a rough surface, as shown below. The block is displaced so that the spring is compressed a distance d and released from rest.



(d) On the dots below that represent the block, draw and label the forces (not components) that act on the block when the spring is compressed a distance $x = d / 2$ and the block is moving in the direction indicated below each dot.

(e) Draw a sketch of *u* versus *t* in this case. Assume that there is a negligible change in the period and that the positive direction is still to the right.