Physics 110
Spring 2006
Springs

1. When a 4.0kg mass is hung vertically on a light spring that obeys Hooke's law, the spring stretches 2.5cm.
    a. If the 4.0kg mass is removed, how far will the spring stretch if a 1.5kg mass is hung from the same spring?
    b. How much work must an external agent do to stretch the spring 4.0cm from its un-stretched length?

2. If it takes 4.0J of work to stretch a Hooke's law spring 10.0cm from its un-stretched length, how much extra work is required to stretch it an additional 10.0cm?

3. When different weights are hung on a spring, the spring stretches to different lengths as shown in the table below.
    a. Make a graph of the applied force versus the stretch of the spring and if the data are linear obtain the slope of the best fit line. What does this slope represent?
    b. If the spring is stretched 105cm, what force dies the spring exert on the suspended weight?

F (N)	2	4	6	8	10	12	14	16	18
x (mm)	15	32	49	64	79	98	112	126	149

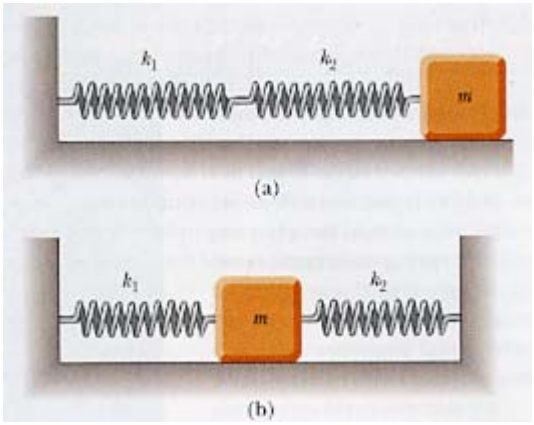
4. A 200g block is pressed against a spring with spring constant 1.4kN/m until the block compresses the spring 10cm. The spring rests at the bottom of a ramp inclined at 60^o to the horizontal. Using energy methods how far up the incline does the block move before it stops if there is no friction present and if there is friction present where the coefficient of kinetic friction is 0.400?

5. A 0.5kg mass is attached to a spring with a spring constant of 8.0N/m and vibrates with an amplitude of 10cm.
    a. What are the maximum values for the magnitudes of the speed and of the acceleration?
    b. What are the speed and the acceleration when the mass is 6cm from the equilibrium position?
    c. What is the time it takes the mass to move from x = 0cm to x = 8cm?
    d. What is the period of the motion?
    e. What are the displacement, velocity and acceleration as functions of time?

6. A 1.50kg block at rest on a horizontal tabletop is attached to a horizontal spring having a force constant of 19.6N/m. The spring is initially un-stretched. A constant 20.0N horizontal force is applied to the block causing the spring to stretch.
    a. What is the speed of the mass after it has moved 0.3m from the equilibrium position if the surface that the block is resting on is frictionless.
    b. What is the speed of the mass after it has moved 0.3m from the equilibrium position if the surface that the block resting on is not frictionless but has a coefficient of kinetic friction of 0.2?

7. After a thrilling plunge bungee jumpers bounce freely on the bungee cords though many cycles. After watching many people of differing masses jump and then bounce up and down, you come up with a relation: A mass *m* is oscillating freely on a vertical spring with a period *T*. An unknown mass *m'* on the same spring oscillates with a period *T'*.
    a. What is the spring constant of the bungee cord?
    b. What is the unknown mass *m'*?

8. A mass is connected to two springs of force constants k_1 and k_2 as shown below. In each case the mass moves on a frictionless table and is displaced from its equilibrium position and then released. Show that in each case the mass exhibits simple harmonic motion with periods



    a. $T = 2\pi\sqrt{\dfrac{m(k_1 + k_2)}{k_1 k_2}}$
    b. $T = 2\pi\sqrt{\dfrac{m}{(k_1 + k_2)}}$