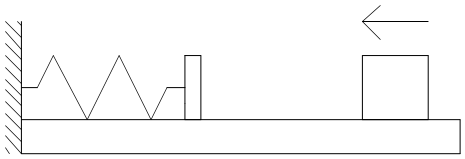
W8.03

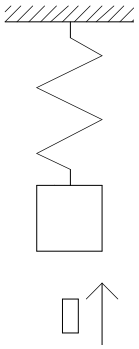
Springs 3

1. A 0.5-kg block, initially moving at 2 m/s, is fired into (and sticks to) a horizontal spring with a spring constant of 32 N/m. No speed is lost during the impact with the spring and the horizontal surface is frictionless. Determine:
   a. the maximum compression of the spring.
   b. the period of the resulting oscillation.
   c. the maximum KE of the block.
   d. the amplitude of the oscillation.
   e. the maximum acceleration of the block during the oscillation.
   f. the speed and acceleration of the block when the spring is stretched 0.1 m.



2. A horizontal spring-mass simple harmonic oscillator has a maximum speed of 6.28 m/s and an amplitude of 40 cm. Calculate the maximum acceleration of the oscillator and the period of the oscillator.

3. A 2-kg block is hung from a vertical spring with k = 80 N/m.
   a. Determine how much the spring stretched when the mass is hung on it. (What is the equilibrium position?)



   A 0.05-kg bullet is fired vertically at the block. The speed of the bullet just before impact is 200 m/s. The bullet "bounced off" the block with a speed of 0 m/s.

   b. By conservation of momentum, find the speed of the block after impact.
   c. Determine the kinetic energy of the block just after impact.
   d. Using energy methods, find the speed of the block when it reaches the unstretched position.
   e. Calculate the period of the oscillator.
   f. Find the maximum speed of the oscillator.
   g. By energy methods, determine how far below the equilibrium position the block will drop. (Hint: Set GPE = 0 at equilibrium. What is the total energy of the system? What is the GPR below this point? Remember that $s_{max} = s_{eq} + s$.)
   h. Calculate the maximum stretch of the spring, s_{max}, and the maximum EPE.
   i. Determine the amplitude of the oscillation. (Remember the mass oscillates symmetrically about the equilibrium position.)
   j. Calculate the maximum acceleration of the oscillator.

ANSWERS:

1. .
   a. 0.25 m
   b. 0.785 s
   c. 1J
   d. 0.25 m
   e. 16 m/s^2
   f. 1.83 m/s, 6.4 m/s^2

2. 98.6 m/s^2, 0.4 s

3. .
   a. 0.25 m
   b. 5 m/s
   c. 25 J
   d. 4.74 m/s
   e. 0.993 sec
   f. 5 m/s
   g. 0.791 m
   h. 1.041 m; 43.3 J
   i. 0.791 m
   j. 31.6 m/s^2