

••24 In Fig. 15-35, two springs are joined and connected to a block of mass 0.245 kg that is set oscillating over a frictionless floor. The springs each have spring constant $k = 6430\text{ N/m}$. What is the frequency of the oscillations?

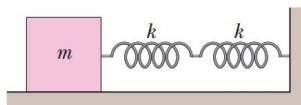


Figure 15-35 Problem 24.

••25 In Fig. 15-36, a block weighing 14.0 N , which can slide without friction on an incline at angle $\theta = 40.0^\circ$, is connected to the top of the incline by a massless spring of unstretched length 0.450 m and spring constant 120 N/m . (a) How far from the top of the incline is the block's equilibrium point? (b) If the block is pulled slightly down the incline and released, what is the period of the resulting oscillations?

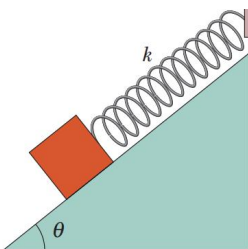


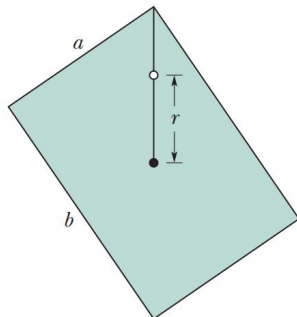
Figure 15-36 Problem 25.

••34 In Fig. 15-41, block 2 of mass 2.0 kg oscillates on the end of a spring in SHM with a period of 20 ms . The block's position is given by $x = (1.0\text{ cm}) \cos(\omega t + \pi/2)$. Block 1 of mass 4.0 kg slides toward block 2 with a velocity of magnitude 6.0 m/s , directed along the spring's length. The two blocks undergo a completely inelastic collision at time $t = 5.0\text{ ms}$. (The duration of the collision is much less than the period of motion.) What is the amplitude of the SHM after the collision?



Figure 15-41 Problem 34.

••48 A rectangular block, with face lengths $a = 35$ cm and $b = 45$ cm, is to be suspended on a thin horizontal rod running through a narrow hole in the block. The block is then to be set swinging about the rod like a pendulum, through small angles so that it is in SHM. Figure 15-45 shows one possible position of the hole, at distance r from the block's center, along a line connecting the center with a corner. (a) Plot the period versus distance r along that line such that the minimum in the curve is apparent. (b) For what value of r does that minimum occur? There is a line of points around the block's center for which the period of swinging has the same minimum value. (c) What shape does that line make?



••53 In the overhead view of Fig. 15-48, a long uniform rod of mass 0.600 kg is free to rotate in a horizontal plane about a vertical axis through its center. A spring with force constant $k = 1850$ N/m is connected horizontally between one end of the rod and a fixed wall. When the rod is in equilibrium, it is parallel to the wall. What is the period of the small oscillations that result when the rod is rotated slightly and released?

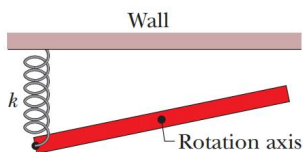


Figure 15-48 Problem 53.

100 In Fig. 15-59, a solid cylinder attached to a horizontal spring ($k = 3.00$ N/m) rolls without slipping along a horizontal surface. If the system is released from rest when the spring is stretched by 0.250 m, find (a) the translational kinetic energy and (b) the rotational kinetic energy of the cylinder as it passes through the equilibrium position. (c) Show that under these conditions the cylinder's center of mass executes simple harmonic motion with period

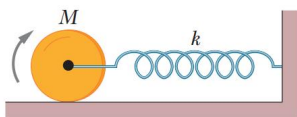


Figure 15-59 Problem 100.

$$T = 2\pi \sqrt{\frac{3M}{2k}},$$

where M is the cylinder mass. (Hint: Find the time derivative of the total mechanical energy.)