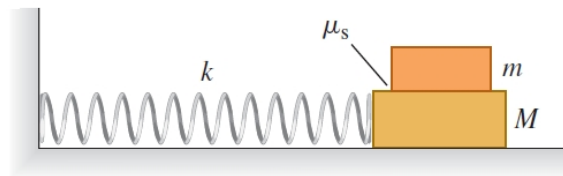


# PHY250 - Fall 2021: Review II

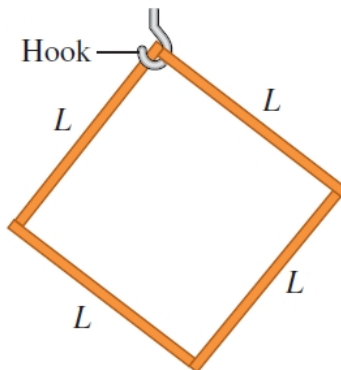
## Exercise 1

A block with mass  $M$  rests on a frictionless surface and is connected to a horizontal spring of force constant  $k$ . The other end of the spring is attached to a wall (Fig. P14.72). A second block with mass  $m$  rests on top of the first block. The coefficient of static friction between the blocks is  $\mu_s$ . Find the maximum amplitude of oscillation such that the top block will not slip on the bottom block.



## Exercise 2

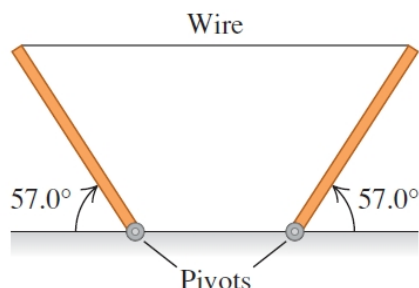
A square object of mass  $m$  is constructed of four identical uniform thin sticks, each of length  $L$ , attached together. This object is hung on a hook at its upper corner. If it is rotated slightly to the left and then released, at what frequency will it swing back and forth?



---

### Exercise 3

A 5.00-m, 0.732-kg wire is used to support two uniform 235-N posts of equal length (Fig. P15.62). Assume that the wire is essentially horizontal and that the speed of sound is 344 m/s. A strong wind is blowing, causing the wire to vibrate in its 5th overtone. What are the frequency and wavelength of the sound this wire produces?



### Exercise 4

The gas cloud known as the Crab Nebula can be seen with even a small telescope. It is the remnant of a supernova, a cataclysmic explosion of a star. The explosion was seen on the earth on July 4, 1054 C.E. The streamers glow with the characteristic red color of heated hydrogen gas. In a laboratory on the earth, heated hydrogen produces red light with frequency  $4.568 \times 10^{14}$  Hz; the red light received from streamers in the Crab Nebula pointed toward the earth has frequency  $4.586 \times 10^{14}$  Hz. (a) Estimate the speed with which the outer edges of the Crab Nebula are expanding. Assume that the speed of the center of the nebula relative to the earth is negligible. (The speed of light is  $3 \times 10^8$  m/s). (b) Assuming that the expansion speed has been constant since the supernova explosion, estimate the diameter of the Crab Nebula. Give your answer in meters and in light-years. (c) The angular diameter of the Crab Nebula as seen from earth is about 5 arc minutes (1 arc minute =  $1/60$  degree). Estimate the distance (in light-years) to the Crab Nebula, and estimate the year in which the supernova explosion actually took place.

### Exercise 5

Two identical loudspeakers are located at points A and B, 2.00 m apart. The loudspeakers are driven by the same amplifier and produce sound waves with a frequency of 784 Hz. Take the speed of sound in air to be 344 m/s. A small microphone is moved out from point B along a line perpendicular to the line connecting A and B. (a) At what distances from B will there be destructive interference? (b) At what distances from B will there be constructive interference? (c) If the frequency is made low enough, there

---

will be no positions along the line BC at which destructive interference occurs. How low must the frequency be for this to be the case?

