Homework: Ch. 16

1. Sketch a picture of the 3rd harmonic for a standing wave on string. In the diagram identify the nodes, antinodes, wavelength, and amplitude

2. Billy and his swing form a simple pendulum of length 2.45 m. What is the period for the swing? If the swing has a maximum displacement of 1.60 m, what is the displacement 0.50 s later?

3. Find the total mechanical energy of a block-spring system with a spring constant of 1.3 N/cm and amplitude of 2.4 cm.

4. A pendulum in a grandfather clock has a period 2.0 s and can be approximated as a simple pendulum. During its swing, the pendulum has a maximum displacement of 0.20 m. What is the length of the pendulum?

5. Oscillations of a 600.0 Hz tuning fork sets up standing waves in a string clamped at both ends. The wave speed for the string is 400.0 m/s. The standing wave has four loops and amplitude of 2.00 mm.
    a. What is the length of the string?
    b. Write an equation for the displacement of the string as a function of position and time.

6. A massless spring with spring constant 19.0 N/m hangs vertically. A block of mass 0.200 kg is attached to its free end and then released. Assume that the spring was upstretched before the block was attached. What is the frequency of the resulting SHM?

7. Fish are hung on a spring scale to determine their mass.
    a. What is the spring constant of the spring in such a scale if the spring stretches 8.00 cm for a 10.0 kg load?
    b. What is the mass of a fish that stretches the spring 5.50 cm?
    c. How far apart are the half-kilogram marks on the scale?

8. If your heart rate is 150 beats per minute during strenuous exercise, what is the time per beat in units of seconds?

9. If the spring constant of a simple harmonic oscillator is doubled, by what factor will the mass of the system need to change in order for the frequency of the motion to remain the same?

10. Find the ratio of the new to old periods of a pendulum if the pendulum were transported from Earth to the Moon. Note that the acceleration due to gravity on the moon is about 1.63 m/s^2.

11. Near the top of the Cititgroup Center building in New York City, there is an object of 4.00×10^5 kg on springs that have adjustable spring constants. Its function is to dampen wind-driven oscillations of the building by oscillating at the same frequency as the building is being driven. What effective spring constant should the springs have to make the object oscillate with a period of 2.00 s? How much energy is stored in the springs if they are displaced by 2.00 m from equilibrium?

12. Seismographs measure the arrival times of earthquakes with a precision of 0.100 s. To get the distance to the epicenter of the quake, they compare the arrival times of S and P waves, which travel at different speeds. If the S and P waves travel at 4.00 and 7.20 km/s, respectively, how precisely can the distance to the source of the earthquake be determined?

13. Energy from the Sun arrives at the top of the Earth's atmosphere with an intensity of 1.30 kW/m^2. How long does it take for 1.50×10^9 J to arrive on an area of 1.00 m^2?

14. The low frequency speaker of a stereo set as a surface are of 0.0500 m^2 and produces 1.00 W of acoustical power.
    a. What is the intensity of the speaker?
    b. If the speaker projects sound uniformly in all directions, at what distance from the speaker is the intensity 0.1 W/m^2?