11.2

Apply Eq. (11.1), with $\lambda = 4.3\,\text{m}$ and $v = 3.5\,\text{km/s}$:

$$f = \frac{v}{\lambda} = \frac{3.5 \times 10^3\,\text{m/s}}{4.3\,\text{m}} = 8.1 \times 10^2\,\text{Hz}\,.$$

11.3

Use Eq. (11.1) to solve for λ, with $v = 1498\,\text{m/s}$ and $f = 440\,\text{Hz}$:

$$\lambda = \frac{v}{f} = \frac{1498\,\text{m/s}}{440\,\text{Hz}} = 3.40\,\text{m}\,.$$

11.15

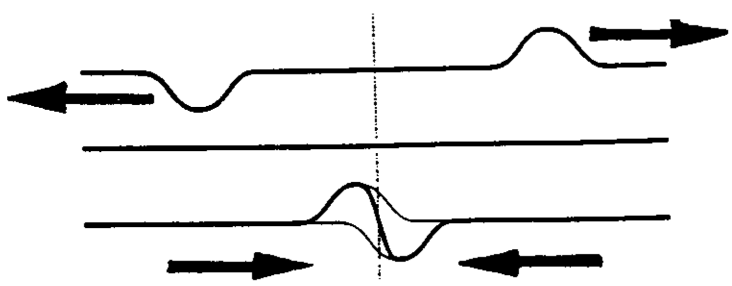
Set up an xy coordinate system, with the origin of x-axis located at the dot and the positive x-direction along the direction of propagation of the wave. The displacement of the wave in the string is in the y-direction with $y = 0$ at the level of zero displacement. The general form of the wave at the given instant is then $y = A\sin(2\pi x/\lambda)$, where A is the amplitude of the wave and λ is the wavelength (you may check for yourself that the dot at $x = 0$ is moving downward when $t = 0$). In this problem the peak-to-peak separation is 50.0 cm so $\lambda = 50.0\,\text{cm}$.

Now, According to the problem statement $x = +4.0\,\text{cm}$ at $y = 12.5\,\text{cm}$, i.e., $+4.0\,\text{cm} = A\sin[2\pi(12.5\,\text{cm})/\lambda] = A\sin[2\pi(12.5\,\text{cm}/50.0\,\text{cm})] = A\sin(\pi/2) = A$, which gives $A = 4.0\,\text{cm}$. So the displacement at $x = 60.0\,\text{cm}$ is

$$y = A\sin\left(\frac{2\pi x}{\lambda}\right) = (4.0\,\text{cm})\sin\left[\frac{2\pi(60.0\,\text{cm})}{50.0\,\text{cm}}\right] = +3.8\,\text{cm}\,.$$

11.31

Similar to the previous problem, suppose that the picture in the text (Fig. P31) was taken at $t = 0$. In the following sequence, the top figure depicts the situation a little before $t = 2\,\text{s}$, the middle one is the picture at exactly $t = 2\,\text{s}$ (when the two peaks coincide), while the bottom one is at $t = 4\,\text{s}$.



11.57

First, find the period T from frequency f:

$$T = \frac{1}{f} = \frac{1}{440\,\text{Hz}} = 2.27 \times 10^{-3}\,\text{s} = 2.27\,\text{ms}\,.$$

From Eq. (11.1), the wavelength λ is

$$\lambda = \frac{v}{f} = \frac{343\,\text{m/s}}{440\,\text{Hz}} = 0.780\,\text{m}\,,$$

where $v = 343\,\text{m/s}$ is the speed of sound in air at room temperature.

11.68

The intensity I is defined as power per unit area: $I = \text{P}/A$. Here $\text{P} = 25.0\,\mu\text{J/s}$ and $A = 10.0\,\text{cm}^2$, so

$$I = \frac{\text{P}}{A} = \frac{25.0 \times 10^{-6}\,\text{J/s}}{10.0 \times 10^{-4}\,\text{m}^2} = 25.0 \times 10^{-3}\,\text{W/m}^2 = 25.0\,\text{mW/m}^2\,.$$

11.79

Use Eq. (11.8), $I = \mathrm{P}/A$. Here $\mathrm{P} = 50\,\mathrm{W}$, and $A = 4\pi R^2$, with $R = 10\,\mathrm{m}$; so

$$I = \frac{\mathrm{P}}{4\pi R^2} = \frac{50\,\mathrm{W}}{4\pi(10\,\mathrm{m})^2} = 0.040\,\mathrm{W/m^2} = 40\,\mathrm{mW/m^2}\,.$$

Since I is the power passing through a unit cross-sectional area, the power intercepted by a detector of area A' is $\mathrm{P}' = IA'$, and so the energy E that passes through the detector during a time interval Δt is $\mathrm{E} = \mathrm{P}'\Delta t = IA'\Delta t$. Plug in $A = (1.0\,\mathrm{cm^2})(10^{-2}\,\mathrm{m/cm})^2 = 1.0 \times 10^{-4}\,\mathrm{m^2}$ and $\Delta t = 1.0\,\mathrm{s}$ to obtain

$$\mathrm{E} = \mathrm{P}'\Delta t = IA'\Delta t = (0.040\,\mathrm{W/m^2})(1.0 \times 10^{-4}\,\mathrm{m^2})(1.0\,\mathrm{s}) = 4.0 \times 10^{-6}\,\mathrm{J} = 4.0\,\mu\mathrm{J}\,.$$

11.113

The beat frequency, 4 Hz, is the difference between the frequencies of the two sources. Thus the wire must be vibrating at either $1000\,\mathrm{Hz} - 4\,\mathrm{Hz} = 996\,\mathrm{Hz}$ or $1000\,\mathrm{Hz} + 4\,\mathrm{Hz} = 1004\,\mathrm{Hz}$.

11.115

According to the problem statement the period of the beats is $T_{\mathrm{beat}} = 0.99\,\mathrm{s}$, so the beat frequency is $f_{\mathrm{beat}} = 1/T_{\mathrm{beat}} = 1/0.99\,\mathrm{s} = 1.0\,\mathrm{Hz}$, which is the same as Δf, the difference in frequency between the two tuning forks which produce the beats.