7. (a) We write the expression for the displacement in the form $y(x,t) = y_m \sin(kx - \omega t)$. A negative sign is used before the ωt term in the argument of the sine function because the wave is traveling in the positive x direction. The angular wave number k is $k = 2\pi/\lambda = 2\pi/(0.10\,\text{m}) = 62.8\,\text{m}^{-1}$ and the angular frequency is $\omega = 2\pi f = 2\pi(400\,\text{Hz}) = 2510\,\text{rad/s}$. Here λ is the wavelength and f is the frequency. The amplitude is $y_m = 2.0\,\text{cm}$. Thus

$$y(x,t) = (2.0\,\text{cm}) \sin\left(\left(62.8\,\text{m}^{-1}\right) x - \left(2510\,\text{s}^{-1}\right) t\right) \ .$$

(b) The (transverse) speed of a point on the cord is given by taking the derivative of y:

$$u(x,t) = \frac{\partial y}{\partial t} = -\omega y_m \cos(kx - \omega t)$$

which leads to a maximum speed of $u_m = \omega y_m = (2510\,\text{rad/s})(0.020\,\text{m}) = 50\,\text{m/s}$.

(c) The speed of the wave is

$$v = \frac{\lambda}{T} = \frac{\omega}{k} = \frac{2510\,\text{rad/s}}{62.8\,\text{m}^{-1}} = 40\ \text{m/s} \ .$$

13. (a) The wave speed is given by $v = \lambda/T = \omega/k$, where λ is the wavelength, T is the period, ω is the angular frequency $(2\pi/T)$, and k is the angular wave number $(2\pi/\lambda)$. The displacement has the form $y = y_m \sin(kx + \omega t)$, so $k = 2.0\,\text{m}^{-1}$ and $\omega = 30\,\text{rad/s}$. Thus $v = (30\,\text{rad/s})/(2.0\,\text{m}^{-1}) = 15\,\text{m/s}$.

(b) Since the wave speed is given by $v = \sqrt{\tau/\mu}$, where τ is the tension in the string and μ is the linear mass density of the string, the tension is

$$\tau = \mu v^2 = \left(1.6 \times 10^{-4}\,\text{kg/m}\right)(15\,\text{m/s})^2 = 0.036\ \text{N} .$$

24. Using Eq. 17-32 for the average power and Eq. 17-25 for the speed of the wave, we solve for $f = \omega/2\pi$:

$$\begin{aligned} f &= \frac{1}{2\pi y_m}\sqrt{\frac{2P_{\text{avg}}}{\mu\sqrt{\tau/\mu}}} \\ &= \frac{1}{2\pi(7.7\times10^{-3}\,\text{m})}\sqrt{\frac{2(85\,\text{W})}{\sqrt{(36\,\text{N})(0.260\,\text{kg}/2.7\,\text{m})}}} = 198\ \text{Hz}\ . \end{aligned}$$

28. We compare the resultant wave given with the standard expression (Eq. 17-39) to obtain $k = 20\,\text{m}^{-1} = 2\pi/\lambda$, $2y_m \cos(\frac{1}{2}\phi) = 3.0\,\text{mm}$, and $\frac{1}{2}\phi = 0.820\,\text{rad}$.

(a) Therefore, $\lambda = 2\pi/k = 0.31\,\text{m}$.

(b) The phase difference is $\phi = 1.64\,\text{rad}$.

(c) And the amplitude is $y_m = 2.2\,\text{mm}$.

33. (a) Eq. 17-25 gives the speed of the wave:

$$v = \sqrt{\frac{\tau}{\mu}} = \sqrt{\frac{150\,\mathrm{N}}{7.2 \times 10^{-3}\,\mathrm{kg/m}}} = 1.4 \times 10^{2}\ \mathrm{m/s}\ .$$

(b) From the Figure, we find the wavelength of the standing wave to be $\lambda = (2/3)(90\,\mathrm{cm}) = 60\,\mathrm{cm}$.

(c) The frequency is

$$f = \frac{v}{\lambda} = \frac{1.4 \times 10^{2}\,\mathrm{m/s}}{0.60\,\mathrm{m}} = 2.4 \times 10^{2}\ \mathrm{Hz}\ .$$