47. (a) The angular frequency is $\omega = 8.0\pi/2 = 4.0\pi$ rad/s, so the frequency is $f = \omega/2\pi = (4.0\pi\,\text{rad/s})/2\pi = 2.0\,\text{Hz}$.

(b) The angular wave number is $k = 2.0\pi/2 = 1.0\pi\,\text{m}^{-1}$, so the wavelength is $\lambda = 2\pi/k = 2\pi/(1.0\pi\,\text{m}^{-1}) = 2.0\,\text{m}$.

(c) The wave speed is

$$v = \lambda f = (2.0\,\text{m})(2.0\,\text{Hz}) = 4.0\,\text{m/s}\ .$$

(d) We need to add two cosine functions. First convert them to sine functions using $\cos\alpha = \sin(\alpha+\pi/2)$, then apply Eq. 42. The steps are as follows:

$$\begin{aligned}\cos\alpha + \cos\beta &= \sin\left(\alpha + \frac{\pi}{2}\right) + \sin\left(\beta + \frac{\pi}{2}\right) = 2\sin\left(\frac{\alpha+\beta+\pi}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right)\\ &= 2\cos\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right)\end{aligned}$$

Letting $\alpha = kx$ and $\beta = \omega t$, we find

$$y_m\cos(kx+\omega t) + y_m\cos(kx-\omega t) = 2y_m\cos(kx)\cos(\omega t)\ .$$

Nodes occur where $\cos(kx) = 0$ or $kx = n\pi + \pi/2$, where n is an integer (including zero). Since $k = 1.0\pi\,\text{m}^{-1}$, this means $x = (n + \frac{1}{2})(1.0\,\text{m})$. Nodes occur at $x = 0.50\,\text{m}$, $1.5\,\text{m}$, $2.5\,\text{m}$, etc.

(e) The displacement is a maximum where $\cos(kx) = \pm 1$. This means $kx = n\pi$, where n is an integer. Thus, $x = n(1.0\,\text{m})$. Maxima occur at $x = 0$, $1.0\,\text{m}$, $2.0\,\text{m}$, $3.0\,\text{m}$, etc.