

131.

**Problem 17.39E (HRW)**

*Two sinusoidal waves of the same wavelength travel in the same direction along a stretched string with amplitudes of 3.0 cm and 4.0 cm and they have phase constants of 0 and  $\pi/2$ , respectively. We have to determine the amplitude of the resultant wave.*

**Solution:**

We represent the two waves by the functions

$$y_1 = 3.0 \sin(kx - \omega t),$$

$$y_2 = 4.0 \sin(kx - \omega t + \pi/2) = 4.0 \cos(kx - \omega t).$$

The combined wave will be given by the expression

$$y = 3.0 \sin(kx - \omega t) + 4.0 \cos(kx - \omega t),$$

$$= 5.0 \left( \frac{3.0}{\sqrt{3^2 + 4^2}} \sin(kx - \omega t) + \frac{4.0}{\sqrt{3^2 + 4^2}} \cos(kx - \omega t) \right).$$

Let

$$\cos \theta = \frac{3}{\sqrt{3^2 + 4^2}},$$

then

$$\sin \theta = \frac{4}{\sqrt{3^2 + 4^2}}.$$

We thus find the function for the combined wave,

$$y = 5.0 \sin(kx - \omega t + \theta).$$

Amplitude of the resultant wave is 5.0 cm and its phase is  $\theta$ .

