

A string is jiggled by two independent oscillators, creating two waves:

$$y_1(x,t) = 2.6 \text{ mm} \cos\left(19 \frac{\text{rad}}{\text{m}} x - 6 \frac{\text{rad}}{\text{s}} t + 0.58 \text{ rad}\right)$$

$$y_2(x,t) = 2.6 \text{ mm} \cos\left(19 \frac{\text{rad}}{\text{m}} x - 6 \frac{\text{rad}}{\text{s}} t + 1.78 \text{ rad}\right)$$

The two waves interfere to create a summed wave  $y_3(x,t)$ .  
What are its properties?

The difference in phase between  $y_1$  and  $y_2$  is

$$\Delta\phi = (1.78 \text{ rad} - 0.58 \text{ rad}) = 1.20 \text{ rad}$$

So the sum can be written, in general, as

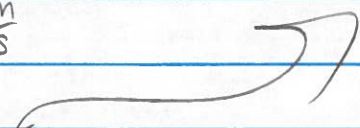
$$y_3(x,t) = 2A \cos\left(\frac{\phi}{2}\right) \cos\left(kx - \omega t + \frac{\phi}{2}\right)$$

and in this case

$$y_3(x,t) = 5.2 \text{ mm} (0.83) \cos\left(19 \frac{\text{rad}}{\text{m}} x - 6 \frac{\text{rad}}{\text{s}} t + 0.6 \text{ rad}\right)$$

$$\rightarrow \text{amp} = 5.2 \text{ mm} (0.83) = 4.3 \text{ mm}$$

$$\omega = 6 \frac{\text{rad}}{\text{s}}$$

$$v_s = \frac{\omega}{k} = \frac{6 \frac{\text{rad}}{\text{s}}}{19 \frac{\text{rad}}{\text{m}}} = 0.32 \frac{\text{m}}{\text{s}}$$


The maximum transverse speed can be found by taking derivative

$$v_y(x,t) = \frac{dy_3}{dt} = -6 \frac{\text{rad}}{\text{s}} (4.3 \text{ mm}) \cos \left( 19 \frac{\text{rad}}{\text{m}} - 6 \frac{\text{rad}}{\text{s}} + 0.6 \text{ rad} \right)$$

The maximum value of this speed is

$$\max v_y = -6 \frac{\text{rad}}{\text{s}} (4.3 \text{ mm}) = 26 \frac{\text{mm}}{\text{s}}$$