# Question # 85455, Physics / Mechanics | Relativity

**Task:** The equation of a stationary wave on a string fixed at both ends is given by $y(x,t) = 2\sin(\pi x)\cos(100\pi t)$, where $x$ and $y$ are measured in metre and $t$ in second. Calculate the amplitude, wavelength and frequency of component waves whose superposition generated this stationary wave. Also write the equations of component waves.

**Solution:**

$y(x,t) = 2\sin(\pi x)\cos(100\pi t) = \sin(\pi x+100\pi t)+\sin(\pi x-100\pi t) = \sin(\pi x+100\pi t)+\sin(100\pi t-\pi x+\pi)$

General formula for a standing wave: $y(x,t) = A\sin(\omega t - kx + \phi)$.
We have $y(x,t) = y_1(x,t) + y_2(x,t)$.

Consider first component $y_1(x,t) = \sin(\pi x + 100\pi t)$:
*amplitude* is $A_1 = 1$ m
angular frequency is $\omega_1 = 100\pi$ rad/s
*frequency* is $f_1 = \omega_1/2\pi = 50$ Hz
wave number is $k_1 = -\pi$ rad/m
velocity is $v_1 = \omega_1/k_1 = -100$ m/s
(velocity is negative because the wave is travelling in the negative $x$ direction)
*wavelength* is $\lambda_1 = |v_1|/f_1 = 2$ m

Consider second component $y_2(x,t) = \sin(100\pi t - \pi x + \pi)$:
*amplitude* is $A_2 = 1$ m
angular frequency is $\omega_2 = 100\pi$ rad/s
*frequency* is $f_2 = \omega_2/2\pi = 50$ Hz
wave number is $k_2 = \pi$ rad/m
velocity is $v_2 = \omega_2/k_2 = 100$ m/s
*wavelength* is $\lambda_2 = |v_2|/f_2 = 2$ m