

Tutorial 5

- 1) The following four waves are sent along strings with the same linear densities (x is in meters and t is in seconds). Rank the waves according to (a) their wave speed and (b) the tension in the strings along which they travel, greatest first: 1) $y_1 = (3\text{mm})\sin(x - 3t)$; 2) $y_2 = (6\text{mm})\sin(2x - t)$; 3) $y_3 = (1\text{mm})\sin(4x - t)$; $y_4 = (2\text{mm})\sin(x - 2t)$
- 2) A sinusoidal wave travels along a string. The time for a particular point to move from maximum displacement to zero is 0.170 s. What are the (a) period and (b) frequency? (c) The wavelength is 1.40 m; what is the wave speed?
- 3) A transverse sinusoidal wave is moving along a string in the positive direction of an x axis with a speed of 80 m/s. At $t = 0$, the string particle at $x = 0$ has a transverse displacement of 4.0 cm from its equilibrium position and is not moving. The maximum transverse speed of the string particle at $x = 0$ is 16 m/s. (a) What is the frequency of the wave? (b) What is the wavelength of the wave? If $y(x, t) = y_m \sin(kx \pm \omega t + \Phi)$ is the form of the wave equation, what are (c) y_m ; (d) k , (e) ω , (f) Φ , and (g) the correct choice of sign in front of ω ?
- 4) The equation of a transverse wave traveling along a very long string is $y(x, t) = 6.0 \sin(0.020\pi x + 4\pi t)$, where x and y are expressed in centimeters and t is in seconds. Determine (a) the amplitude, (b) the wavelength, (c) the frequency, (d) the speed, (e) the direction of propagation of the wave, and (f) the maximum transverse speed of a particle in the string. (g) What is the transverse displacement at $x = 3.5$ cm when $t = 0.26$ s?
- 5) The function $y(x, t) = (15.0\text{cm})\cos(0.020\pi x - 15\pi t)$, with x in meters and t in seconds, describes a wave on a taut string. What is the transverse speed for a point on the string at an instant when that point has the displacement $y = +12\text{cm}$?
- 6) A sinusoidal wave of frequency 500 Hz has a speed of 350 m/s. (a) How far apart are two points that differ in phase by $\pi/3$ rad? (b) What is the phase difference between two displacements at a certain point at times 1.00 ms apart?
- 7) The equation of a transverse wave on a string is $y(x, t) = (2\text{mm})\sin\left(\left(20\text{m}^{-1}\right)x + \left(30\text{s}^{-1}\right)t\right)$. The tension in the string is 15 N. (a) What is the wave speed? (b) Find the linear density of this string in grams per meter.
- 8) A stretched string has a mass per unit length of 5.00 g/cm and a tension of 10.0 N. A sinusoidal wave on this string has an amplitude of 0.12 mm and a frequency of 100 Hz and is traveling in the negative direction of an x axis. If the wave equation is of the form $y(x, t) = y_m \sin(kx \pm \omega t)$, what are (a) y_m (b) k , (c) ω , and (d) the correct choice of sign in front of ω ?