

WAVES AND OSCILLATIONS

PROBLEM SET 2

January 10, 2018

1. A sinusoidal wave traveling in the positive x direction has an amplitude of 15.0 cm, a wavelength of 40.0 cm, and a frequency of 8.00 Hz. The vertical displacement of the medium at $t = 0$ and $x = 0$ is also 15.0 cm. (a) Find the angular wave number k , period T , angular frequency ω , and speed v of the wave.
2. My friend holds one end of the rope taut and wiggles it up and down sinusoidally with frequency 2.00 Hz and amplitude 0.075 m. The wave speed on the rope is $v = 12.0$ m/s. At $t = 0$, my friend's end of the rope has maximum positive displacement and is instantaneously at rest. Assume that no wave bounces back from the far end. (a) Find the wave amplitude A , angular frequency ω , period T , wavelength λ and wave number k . (b) Write a wave function describing the wave. (c) Write equations for the displacement, as a function of time, of my friend's end of the clothesline and of a point 3.00 m from that end.
3. The string tied to a vibrating source is driven at a frequency of 5.00 Hz. The amplitude of the motion is 12.0 cm, and the wave speed is 20.0 m/s. Determine the angular frequency ω and angular wave number k for this wave, and write an expression for the wave function.
4. A certain transverse wave is described by $y(x, t) = (6.50\text{mm})\cos 2\pi\left(\frac{x}{28\text{cm}} - \frac{t}{0.0360\text{s}}\right)$. Determine the wave's (a) amplitude; (b) wavelength; (c) frequency; (d) speed of propagation; (e) direction of propagation.
5. Use $y(x, t) = A\cos\left[\frac{2\pi}{\lambda}(x - vt)\right]$ to calculate an expression for the transverse velocity v_y of a particle in the string on which the wave travels. Find the maximum speed of a particle on the string. Under what circumstances is this equal to the propagation speed v ? Less than v ? Greater than v ?
6. A transverse sinusoidal wave on a string has a period 25 ms and travels in the negative x direction with a speed of 30.0 m/s. At $t = 0$, a particle on the string at $x = 0$ has a displacement of 2.00 cm and travels downward with a speed of 2.00 m/s. (a) What is the amplitude of the wave? (b) What is the initial phase angle? (c) What is the maximum transverse speed of the string? (d) Write the wave function for the wave.