Problems from MasteringPhysics with minor clarifications.

15.3 - Speed, Wavelength, Frequency

The speed of sound in air at 20°C is v =344m/s.

Part A

What is the wavelength, λ, of a sound wave with a frequency of $f = 784$ Hz, corresponding to the note G_5 on a piano?

Part B

What is the frequency of a sound wave with a wavelength of $\lambda = 6.30 \times 10^{-2}$mm? (This frequency is too high for you to hear.)

15.5 - Audible Wavelengths

Provided that the amplitude is sufficiently great, the human ear can respond to longitudinal waves over a range of frequencies from about 20.0 Hz to about 20,000Hz.

Part A

Compute the wavelength corresponding to f =20Hz for waves in air ($v = 344\,\frac{\text{m}}{\text{s}}$).

Part B

Compute the wavelength corresponding to f = 20,000 Hz for waves in air ($v = 344\,\frac{\text{m}}{\text{s}}$).

Part C

Compute the wavelength corresponding to 20 Hz for waves in water ($v = 1480\,\frac{\text{m}}{\text{s}}$).

Part D

Compute the wavelength corresponding to 20,000 Hz for waves in water ($v = 1480\,\frac{\text{m}}{\text{s}}$).

15.6 - Transverse Wave

A certain transverse wave is described by

$$y(x,t) = A\cos\left[2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right)\right],$$

where $A = 6.10$ mm, $\lambda = 28.0$ cm, and $T = 3.10 \times 10^{-2}$ s.

Part A

Determine the wave's amplitude.
Enter your answer in meters.

Part B

Determine the wave's wavelength, λ.
Enter your answer in meters.

Part C

Determine the wave's frequency, f.
Enter your answer in hertz (Hz).

Part D

Determine the wave's speed of propagation, v.
Enter your answer in meters per second ($\frac{\text{m}}{\text{s}}$).

Part E

Determine the wave's direction of propagation.
Enter your answer in hertz (Hz).

15.7 - Transverse Waves on a String

Transverse (sinusoidal) waves on a string have wave speed $v = 8.00$m/s, amplitude $A = 0.0700$m, and wavelength $\lambda = 0.320$m. The waves travel in the -x direction, and at $t = 0$ the $x = 0$ end of the string has its maximum upward displacement.

Part A

Find the frequency of these waves.
Express your answer to four significant figures.

Part B

Find the period of these waves.
Express your answer to four significant figures.

Part C

Find the wave number of these waves.
Express your answer to four significant figures.

Part D

Write a wave function describing the wave.
Express your answer in terms of the variables x and t.
Enter each numeric value to four significant figures.

Part E

Find the transverse displacement of a particle at $x = 0.360$m at time $t = 0.150$s.
Express your answer to three significant figures.

Part F

How much time must elapse from the instant in part (E) until the particle at $x = 0.360$m next has maximum upward displacement?
Express your answer to three significant figures.

15.15 - Speed of Propagation vs. Particle Speed

Part A

The equation

$$y(x,t) = A\cos\left[2\pi f\left(\frac{x}{v} - t\right)\right]$$

may be written as

$$y(x,t) = A\cos\left[\frac{2\pi}{\lambda}(x - vt)\right]$$

Part B

Find the maximum speed of a particle of the string.

15.17 - Transverse Pulse on a Rubber Tube

One end of a rubber tube of length L, with total mass m_1, is fastened to a fixed support. A cord attached to the other end passes over a pulley and supports an object with a mass of m_2. The tube is struck a transverse blow at one end.

Part A

Find the time, t, required for the pulse to reach the other end.
Take free fall acceleration to be g.