Answer on Question #39385, Physics, Other

Question:

1.A harmonic wave on a rope is described by the expression

y(x,t)=(4.3 mm)sin[(2pi/0.82 m)(x+ (12 m/s)t)]

What are the wave's wavelength, period, wave number, frequency, and direction of propagation.

2.For the wave in qus 1 above, determine the displacement and acceleration of the element of the rope located at x = 0.58m at the instant t = 0.41s.

Answer:

1. Traveling sinusoidal wave is represented mathematically in terms of its velocity v (in the x direction) and wave number k as:

$$y(x,t) = A\sin\big(k(x-vt)\big)$$

In our case equation of a wave is:

$$y(x,t) = 4.3mm\sin\left[\frac{2\pi}{0.82m}\left(x+\left(12\frac{m}{s}\right)t\right)\right]$$

sign "+" means wave moving to left (opposite axis direction)

Therefore, wave number k equals:

$$k = \frac{2\pi}{0.82m}$$

Wavelength λ equals:

$$\lambda = \frac{2\pi}{k} = 0.82\ m$$

Period equals:

$$T = \frac{0.82\ m}{12\frac{m}{s}} = 0.068\ s$$

Frequency equals:

$$f = \frac{1}{T} = \frac{12\frac{m}{s}}{0.82m} = 14.63\frac{1}{s}$$

2. Displacement at x = 0.58m and t = 0.41s equals:

$$y(x,t) = 4.3mm\sin\left[\frac{2\pi}{0.82m}\left(0.58\text{m} + \left(12\frac{m}{s}\right)0.41\text{s}\right)\right] = -4.15\ mm$$

Acceleration equals:

$$a = \frac{d^2}{dt^2}\big(y(t)\big) = -4.3mm\left(\frac{2\pi * 12\frac{m}{s}}{0.82m}\right)^2 \sin\left[\frac{2\pi}{0.82m}\left(x + \left(12\frac{m}{s}\right)t\right)\right]$$

Acceleration at x = 0.58m and t = 0.41s equals:

$$a = 382\frac{mm}{s^2}$$