Question:

A sinusoidal wave is described by $y(x, t) = 0.3 \sin(5.95t - 4.20x)$ cm, where x is the position along the wave propagation. Determine the amplitude, wave number, wavelength, frequency and velocity of the wave.

Solution:

The general equation describing a sinusoidal wave looks like:

$$y(x, t) = A \sin(\omega t - kx),$$

here, A is the amplitude of the wave, ω is the angular frequency of the wave, k is the wave number.

a) As we can see from the equation above, the amplitude of the wave is $A = 0.003\ m$.

b) The wave number is $k = 4.20\ \frac{rad}{cm} = 420\ \frac{rad}{m}$.

c) We can find the wavelength from the formula:

$$k = \frac{2\pi}{\lambda},$$

here, λ is the wavelength of the wave.

Then, we get:

$$\lambda = \frac{2\pi}{k} = \frac{2\pi}{420\ \frac{rad}{m}} = 0.015\ m.$$

d) We can find frequency of the wave from the formula:

$$\omega = 2\pi f,$$

here, ω is the angular frequency of the wave, f is the frequency of the wave.

Then, we get:

$$f = \frac{\omega}{2\pi} = \frac{5.95\ \frac{rad}{s}}{2\pi} = 0.95\ Hz.$$

e) We can find the velocity of the wave from the wave speed formula:

$$v = f\lambda = 0.95 \, Hz \cdot 0.015 \, m = 0.014 \, \frac{m}{s}.$$

Answer:

a) $A = 0.003 \, m.$

b) $k = 420 \, \frac{rad}{m}.$

c) $\lambda = 0.015 \, m.$

d) $f = 0.95 \, Hz.$

e) $v = 0.014 \, \frac{m}{s}.$