Answer on Question #65640, Physics / Mechanics | Relativity

The linear density of a vibrating string is 1.3 × 10^-4 kg m1. A transverse wave is propagating on the string and is described by the equation y (x, t) = 0.021 sin (30t - x) where x and y are in metres and t is in seconds. Calculate the tension in the string.

Find: T – ?

Given:

$\rho=1.3 \times 10^{-4}$ kg×m^{-3}

y (x, t) = 0.021 sin (30t - x)

Solution:

Wave velocity:

$v = \sqrt{\frac{T}{\rho}}$ (1), where T is tension, ρ is density

Of (1) $\Rightarrow$ $v^2 = \frac{T}{\rho}$ (2)

Of (2) $\Rightarrow$ $T = v^2 \times \rho$ (3)

Wave velocity:

$v = f \times \lambda$ (4)

Linear frequency:

$f = \frac{\omega}{2\pi}$ (5), where ω is cyclic frequency

Wavelength:

$\lambda = \frac{2\pi}{k}$ (6), where k is wave number

(5) and (6) in (4):

$v = \frac{\omega}{2\pi} \times \frac{2\pi}{k} = \frac{\omega}{k}$ (7)

Equation of plane wave:

y (x, t) = A sin (ωt - x) (8)

From the condition of the task:

y (x, t) = 0.021 sin (30t - x) (9)

Of (8) and (9) $\Rightarrow$ $\omega=30$ s^{-1}, $k=1$ m^{-1} (10)

(10) in (7): v=30 m×s^{-1} (11)

(11) in (3) T=0.117 N

Answer:

0.117 N