Answer on Question #47658-Physics-Other

Two children stretch a jump rope between them and send wave pulses back and forth on it. The rope is 2.5 m long, has a mass of 0.50 kg, and the tension exerted on it by the children is 60 N. What is the speed of the waves on the rope? HINT: You need to find the linear mass density first.

If the wavelength is 5.0 m, what is the frequency of the wave?

Solution

The linear mass density is the mass per unit length, or $\frac{m}{L}$:

$$d = \frac{m}{L} = \frac{0.5}{2.5} = 0.2 \frac{kg}{m}.$$

The speed is defined as the square root of the tension over the linear mass density, so:

$$v = \sqrt{\frac{T}{d}} = \sqrt{\frac{60}{0.2}} = 10\sqrt{3} \frac{m}{s} = 17.3 \frac{m}{s}.$$

If the wavelength is 5.0 m, the frequency of the wave is

$$f = \frac{v}{\lambda} = \frac{17.3}{5.0} = 3.5 \; Hz.$$