(a) \( y_m = 2.30 \text{mm} \).
(b) \( f = \frac{588 \text{rad} / s}{(2 \pi \text{rad})} = 93.6 \text{Hz} \)
(c) \( v = \frac{588 \text{rad} / s}{(1822 \text{rad} / \text{m})} = 0.323 \text{m/s} \)
(d) \( \lambda = \frac{2 \pi \text{rad}}{(1822 \text{rad} / \text{m})} = 3.45 \text{mm} \)
(e) \( u_y = y_m \omega = (2.30 \text{mm})(588 \text{rad} / \text{s}) = 1.35 \text{m/s} \).

\[ v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{(487 \text{N})}{[0.0625 \text{kg}] / (2.15 \text{m})}} = 129 \text{m/s} \]

E18-10 First, \( v = \frac{(317 \text{rad} / \text{s})}{(23 \text{rad} / \text{m})} = 13.2 \). Then \( \mu = \frac{F}{v^2} = \frac{(16.3 \text{N})}{(13.32 \text{m} / \text{s})^2} = 0.919 \text{kg/m} \).

E18-14 (a) \( \frac{\partial}{\partial r} \left( \frac{r^2}{\partial r} \right) \right) = \frac{A}{k} \cos(kr - \omega t) - \frac{A}{k} \left\{ r \right\} \sin(kr - \omega t) - \frac{A}{k} \cos(kr - \omega t) = -Ak^2 r \sin(kr - \omega t) \).

Dividing by \( r^2 \) gives \( \frac{\partial}{\partial r} \left( \frac{r^2}{\partial r} \right) \right) = -Ak^2 / r \sin(kr - \omega t) \). Now find \( \frac{\partial^2 y}{\partial r^2} = -Aw \sin(kr - \omega t) \).

(b) \( \text{[length]}^2 \).

E18-17 The intensity is the average power per unit area; as you get farther from the source the intensity falls off because the perpendicular area increases. At some distance \( r \) from the source the total possible area is the area of a spherical shell of radius \( r \), so intensity as a function of the distance from the source would be

\[ I = \frac{P_{aw}}{4\pi r^2} \]

We are given two intensities: \( I_1 = 1.13 \text{W/m}^2 \) at a distance \( r_1 = 2.41 \text{W/m}^2 \) at a distance \( r_2 = r_1 - 5.30 \text{m} \). Since the average power of the source is the same in both cases we can equate these two values as \( 4\pi r_1^2 I_1 = 4\pi r_2^2 I_2 \), \( 4\pi r_2^2 I_1 = 4\pi (r_1 - d)^2 I_2 \), where \( d = 5.30 \text{m} \). Solve for \( r_1 \):

\[ r_1^2 = (r_1^2 - 2dr_1 + d^2)I_2, \]

\[ 0 = (1 - I_1 / I_2) r_1^2 - 2dr_1 + d^2, \]

\[ 0 = (1 - (1.13 \text{W/m}^2) / (2.41 \text{W/m}^2)) (r_1^2 - 2(5.30\text{m})r_1 + (5.30\text{m})^2), \]

\[ 0 = (0.531) r_1^2 - (10.6m)r_1 + (28.1m^2) \]

The solutions to this are \( r_1 = 16.8 \text{m} \) and \( 3.15 \text{m} \). Since the person walked 5.3 m toward the lamp one can assume they started at least that far away, so we choose the former solution. The total power output from the light is \( P = 4\pi r_1^2 I_1 = 4\pi (16.8 \text{m})^2 (1.13 \text{W/m}^2) = 4.01 \times 10^3 \text{W} \).

E18-25 (a) The linear mass density is \( \mu = m / L = (0.122 \text{kg}) / (8.36 \text{m}) = 0.0146 \text{kg/m} \). The wave speed is then

\[ v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{96.7 \text{N}}{0.0146 \text{kg/m}}} = 81.4 \text{m/s} \]

(b) The longest possible standing wave will be twice the length of the string, so \( \lambda = 2L = 16.7 \text{m} \)

(c) Since \( v = f \lambda \), \( f = v / \lambda = (81.4 \text{m/s}) / (16.7 \text{m}) = 4.87 \text{Hz} \)

E18-30 (a) \( f_n = \frac{n v}{2 L} = \frac{(1)(250 \text{m/s})}{2(0.150 \text{m})} = 833 \text{Hz} \).
(b) \( \lambda = \frac{v}{f} = \frac{(348 \text{m/s})}{(833 \text{Hz})} = 0.418 \text{m} \)

E18-31 \( v = \sqrt{FL / m} \). Then \( f_n = \frac{n v}{2 L} = n\sqrt{F / 4 mL} \). So \( f_1 = (1)\sqrt{(236 \text{N}) / (4(0.107 \text{kg})(9.88 \text{m})} = 7.47 \text{Hz} \) and \( f_2 = 2 f_1 = 14.9 \text{Hz} \) while \( f_3 = 3 f_1 = 22.4 \text{Hz} \).