Phys102 (Sec # 40) Quiz # 1 (Ch.16)

Name: Key ID #

The equation of a transverse wave on a string is:

$$Y = (2.0\ \text{mm})\sin[(20\ \text{m}^{-1})\,x - (600\ \text{s}^{-1})\,t]$$

The tension in the string is 15 N.

a- Calculate the speed of the wave.

$v = \frac{\omega}{k} = \frac{600}{20} = \boxed{30\ \frac{m}{s}}$.

b- Find the linear mass density of this string (in kg/m).

$v = \sqrt{\frac{\tau}{\mu}} \Rightarrow \mu = \frac{\tau}{v^2} = \frac{15}{(30)^2} = \boxed{0.017\ \frac{kg}{m}}$

c- Calculate the average power transmitted by the wave.

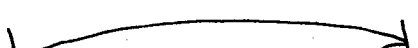
$P_{avg} = \frac{1}{2}\mu v\,\omega^2 y_m^2 = \frac{1}{2}(0.017)(30)(600^2)(2\times10^{-3})^2$

$= \boxed{0.37\ W}$

d- Calculate the magnitude of the transverse speed at x = 2.0 m and t = 1.0 s. $u = \frac{dy}{dt} = -\omega y_m \cos(20x - 600t)$

magnitude $= |u| = |-600(2\ mm)\cos(\underbrace{20(2) - 600}_{\text{rad}})| = 834\ \frac{mm}{s} \simeq \boxed{0.84\ \frac{m}{s}}$.

2- A 1.0 m long string with a mass of 0.02 kg is stretched with a tension of 20 N between two fixed supports. What is the resonant frequency of the longest wavelength on this string?

$n = 1$ 

$L = \frac{\lambda}{2} \Rightarrow \lambda = 2L \Rightarrow$ longest wavelength.

$f_1 = \frac{v}{2L} = \frac{\sqrt{\frac{\tau}{\mu}}}{2L} = \frac{\sqrt{\frac{\tau L}{m}}}{2L}$

$f_1 = \frac{\sqrt{\frac{20(1)}{0.02}}}{2(1)} = \boxed{15.8\ Hz}$