SPH3U 8.4 Determining Wave Speed

1. The universal wave equation

Universal wave equation:	$v = f\lambda$. $\left(v = \frac{\lambda}{T},\ T = \frac{1}{f}\right)$

A harp string supports a wave with a wavelength of 2.3 m and a frequency of 220.0 Hz. Calculate its wave speed.

$v = f\lambda = (220)(2.3) = 506\ m/s.$

A trumpet produces a sound wave that is observed travelling at 350 m/s with a frequency of 1046.50 Hz. Calculate the wavelength of the sound wave.

$v = f\lambda$. $\quad \lambda = \frac{350}{1046.5} = 0.33m$.

$\lambda = \frac{v}{f}$

2. Factors that affect wave speed

Rigidity:	how rigid the medium is: more stiff = faster wave.
Temperature:	(in gas) as the temperature ↑, wave speed ↑
Linear density:	(in strings) mass per unit distance
equation	$\mu = \frac{m}{L}$, where μ is linear density
Speed of a wave on a string:	$v = \sqrt{\frac{F_T}{\mu}}$ $(F_T$: tension force).

On your class wave machine, you have a string of mass 350 g and length 2.3 m. You would like to send a wave along this string at a speed of 50.0 m/s. What must the tension of the string be?

$v = \sqrt{\frac{F_T}{\mu}} \rightarrow v^2 = \frac{F_T}{\mu} \rightarrow F_T = \mu v^2$

$\mu = \frac{m}{L}$ $\quad F_T = \frac{mv^2}{L} = \frac{(0.35)(50)^2}{2.3} = 380N$.

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