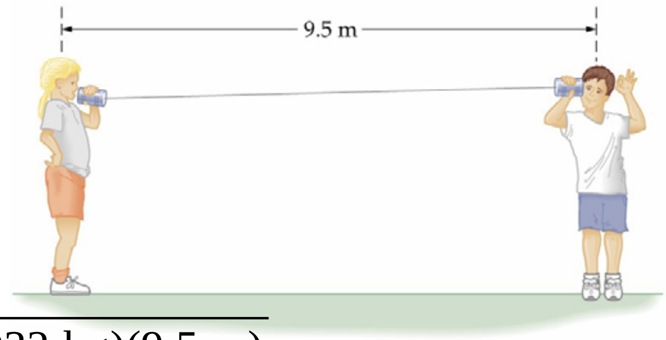
Physics 151 Class Exercise: Waves

1. A brother and sister try to communicate with a string tied between two tin cans as shown below. Rhe string is 9.5 m long, has a mass of 32 g, and is pulled taut with a tension of 8.6 N. (a) How long does it take a wave to travel from one end of the string to the other? (b) Suppose the tension is increased. Does a wave take more, less, or the same time to travel from one end to the other?



$$t = \frac{d}{v} = d\sqrt{\frac{\mu}{F}} = d\sqrt{\frac{\frac{m}{d}}{F}} = \sqrt{\frac{md}{F}} = \sqrt{\frac{(0.032\text{ kg})(9.5\text{ m})}{8.6\text{ N}}} = \boxed{0.19\text{ s}}$$

$$v \propto \sqrt{F}$$

$$t \propto \frac{1}{\sqrt{F}}$$

So with increased tension the wave takes less time.

2. A 5.5-Hz wave with an amplitude of 14 cm and a wavelength of 27 cm travels along a stretched string. (a) How far does a given peak on the wave travel in a time interval of 0.50 s? (b) How far does a knot on the string travel in the same time interval? (c) How would your answers to parts (a) and (b) change if the amplitude of the wave were halved? Explain.

(a) $d_{\text{w}} = vt = \lambda ft = (27\times10^{-2}\text{ m})(5.5\text{ Hz})(0.50\text{ s}) = \boxed{0.74\text{ m}}$

(b) $d_{\text{k}} = (4A)\left(\frac{t}{T}\right) = 4Aft = 4(14\times10^{-2}\text{ m})(5.5\text{ Hz})(0.50\text{ s}) = \boxed{1.5\text{ m}}$

(c) The distance traveled by a wave peak is independent of the amplitude, so the answer in part (a) is unchanged. The distance traveled by the knot varies directly with the amplitude, so the answer in part (b) is halved.