

37. Possible wavelengths are given by $\lambda = 2L/n$, where L is the length of the wire and n is an integer. The corresponding frequencies are given by $f = v/\lambda = nv/2L$, where v is the wave speed. The wave speed is given by $v = \sqrt{\tau/\mu} = \sqrt{\tau L/M}$, where τ is the tension in the wire, μ is the linear mass density of the wire, and M is the mass of the wire. $\mu = M/L$ was used to obtain the last form. Thus

$$f = \frac{n}{2L} \sqrt{\frac{\tau L}{M}} = \frac{n}{2} \sqrt{\frac{\tau}{LM}} = \frac{n}{2} \sqrt{\frac{250 \text{ N}}{(10.0 \text{ m})(0.100 \text{ kg})}} = n(7.91 \text{ Hz}) .$$

For $n = 1$, $f = 7.91 \text{ Hz}$; for $n = 2$, $f = 15.8 \text{ Hz}$; and for $n = 3$, $f = 23.7 \text{ Hz}$.