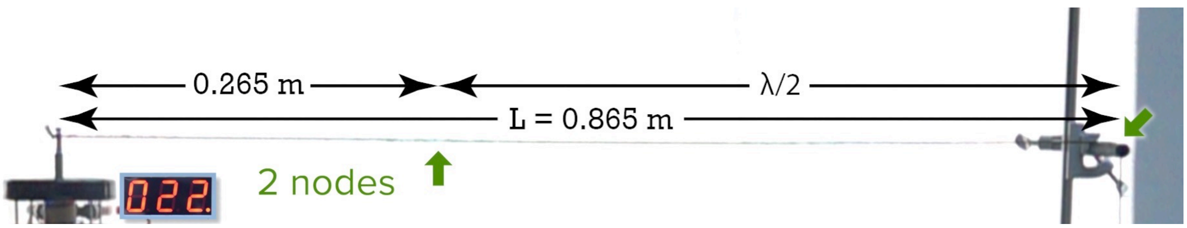
Flipping Physics Lecture Notes:

How Is This Standing Wave Possible?
https://www.flippingphysics.com/standing-wave-impossible.html

In a previous lesson we showed standing wave patterns on a string and explained that standing wave patterns are only able to be created at specific wavelengths and therefore frequencies.[1] For example, standing waves were possible at 15, 30, and 45 hertz on this string. However, while working on this demonstration, I noticed that I was able to set up a standing wave pattern at 22 hertz. So, here is the question.

If standing waves are only “allowed” at 15 and 30 hertz and nowhere in between on this string, then why do we see a standing wave pattern at 22 hertz?

Remember, the reason standing wave patterns are only “allowed” at certain frequencies on this string is because we stated that both ends of the string are fixed ends and therefore are a node or a location of total destructive interference. However, when you look at the left end of the string, it is attached to the oscillator which is moving up and down 22 times every second. In other words, the left end of this string is not truly a node!



The nodes we can see on this string are at the right end and one 0.265 meters to the right of the oscillator. That means we can determine the wavelength of this wave:

$$\frac{1}{2}\lambda = 0.865 - 0.265 = 0.60m \Rightarrow \lambda = 1.2m$$

We now have the frequency and wavelength of the wave, so we can determine the speed of the wave.

$$v = f\lambda = (22)(1.2) = 26.4 \approx 26\frac{m}{s}$$

Which compares nicely to the average velocity we calculated in a previous lesson for this string:

$$v_{average} = 26.1922 \approx 26\frac{m}{s}$$

[1] See https://www.flippingphysics.com/standing-waves.html