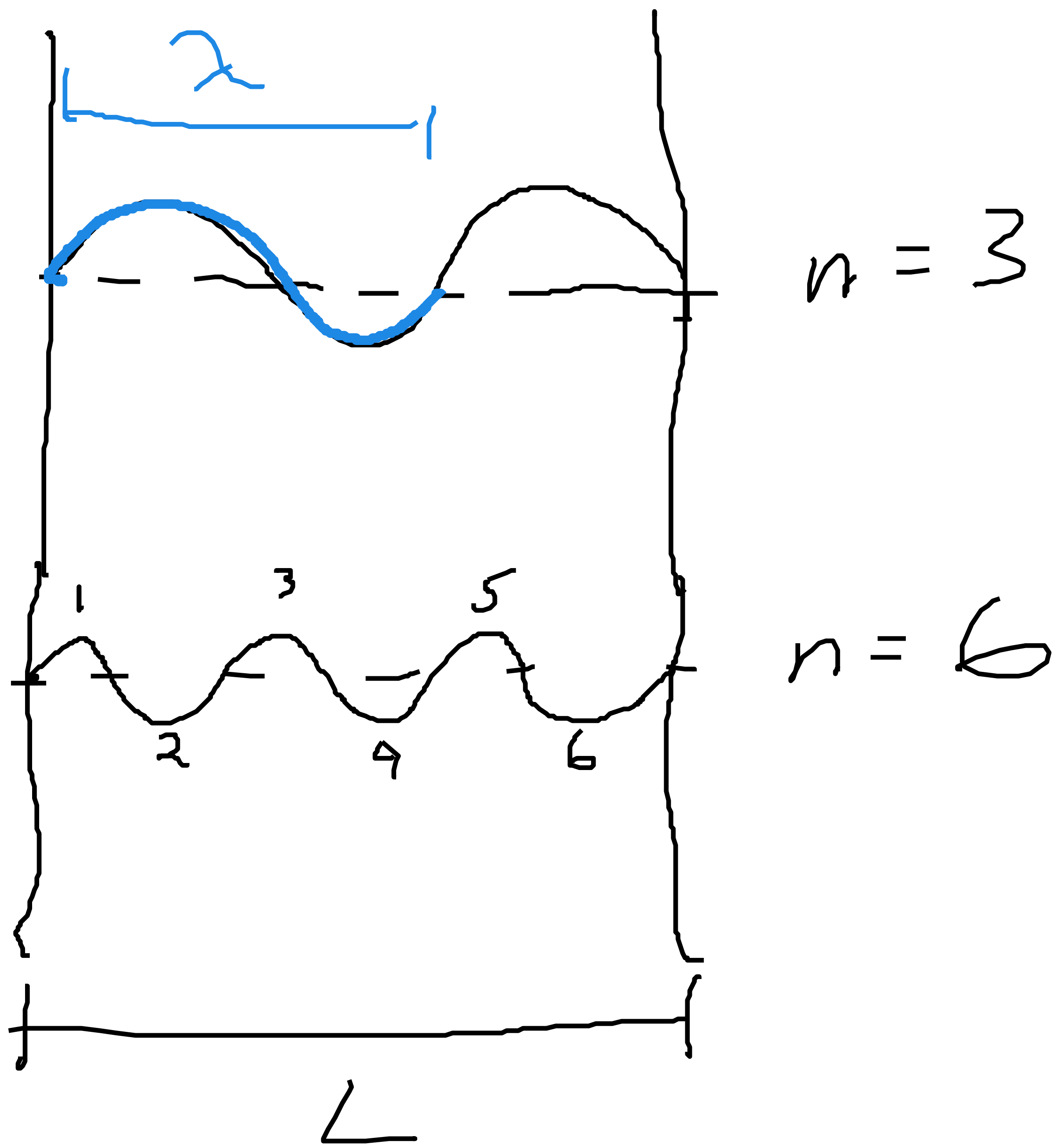
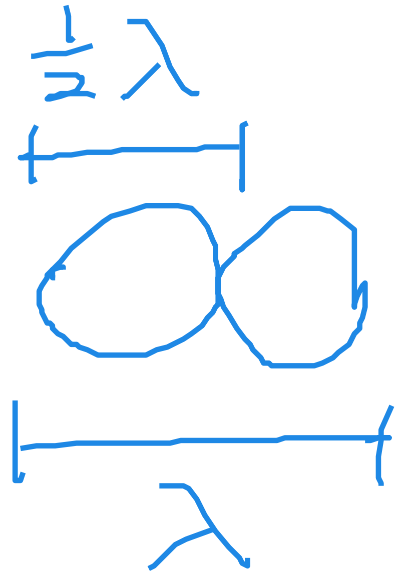
Standing Waves on a String



1 wavelength =

2 antinodes



n antinodes ⟶

$$L = n\left(\frac{1}{2}\lambda\right)$$

$$\lambda_n = \frac{2L}{n}$$

"v" = speed of waves that make up the standing wave

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

$$f_n = \frac{v}{2L/n} = \frac{nv}{2L}$$

$$\boxed{f_n = n\frac{v}{2L}}$$

$$f_1 = \frac{v}{2L} \qquad f_2 = \frac{2v}{2L}$$

$$f_3 = \frac{3v}{2L} \qquad \boxed{f_n = n f_1}$$

f_1 : fundamental frequency

In sound: it's the frequency you hear as the "pitch"

higher frequencies — overtones or harmonics — give sound its timbre/color/ - -

Find wavelength & frequency of the $n = 6$ mode on a string if $f_1 = 200\,Hz$ and $L = 3m$.

$$\lambda_n = \frac{2L}{n}$$

$$f_n = n\frac{v}{2L} = n f_1$$

$$f_1 = \frac{v}{2L}$$

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

$$\lambda = \frac{2L}{n} = \frac{2L}{6} = \frac{2(3m)}{6} = 1m$$

$v =$

$$200\,Hz = \frac{v}{2(3m)}$$

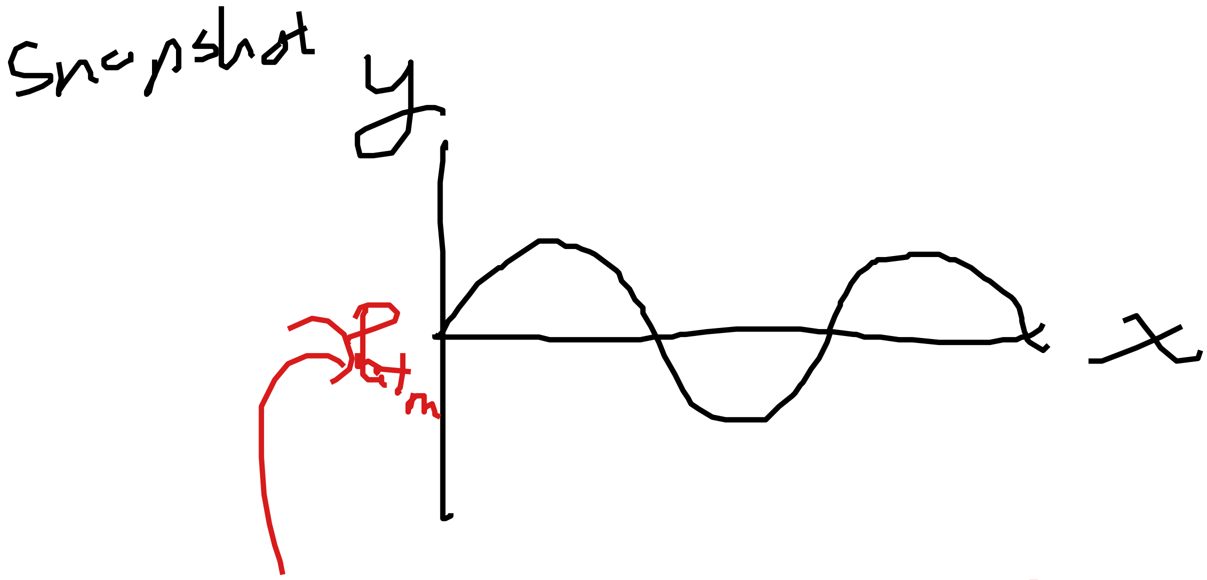
$$\rightarrow v = 200(6) = 1200\,m/s$$

$$f_6 = \frac{1200\,m/s}{1\,m} = 1200\,Hz$$

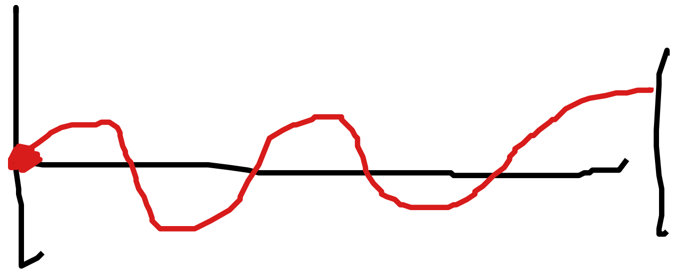
OR

$$f_6 = 6 \times (200\,Hz) = 1200\,Hz$$

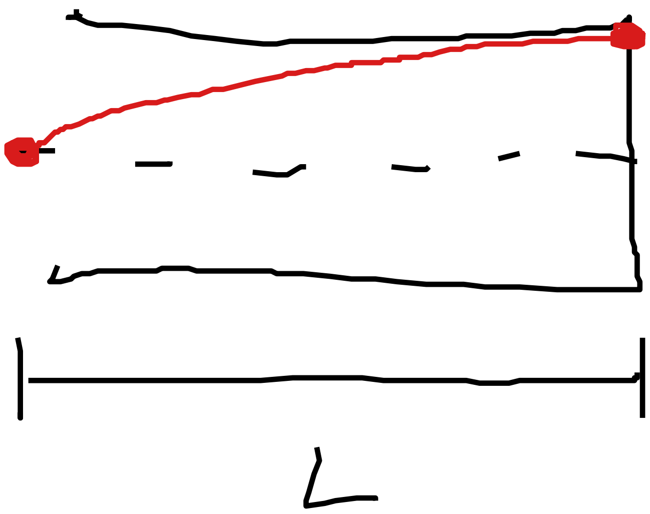
Standing Waves in Pipes (columns of air)



displacement in sound waves = pressure variations



half-open



$$f_1 = \frac{v}{4L}$$

lower

full-open

$$\lambda_1 = \frac{2L}{1} = 2L$$

$$f_1 = \frac{v}{2L}$$

higher