λ - wavelength is the distance between two identical points on a wave. Could be crest to crest or trough to trough

Wavelength has units of distance.
m, cm, km, etc.

f - frequency is the number of wavelengths that pass a fixed point per unit time.

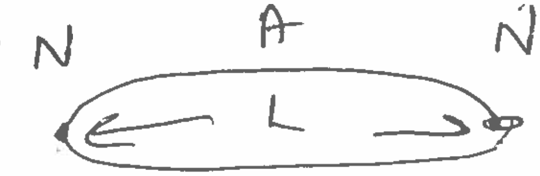
frequency has units of number per time.

$$Hz = 1 \frac{wave}{sec} \qquad Hz = s^{-1}$$

$$\boxed{v = f\lambda} = (/s)(m) = m/s$$

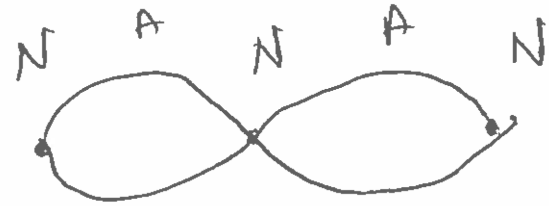
Node is a point of zero vibration
Antinode is a point of maximum vibration.

fundemental

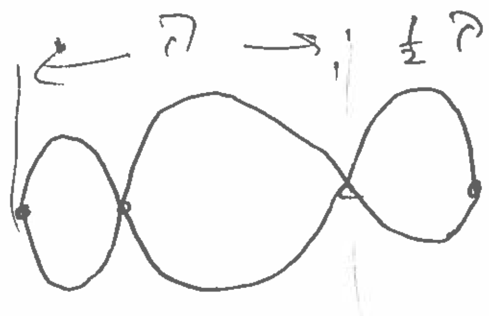


$L = \frac{1}{2}\lambda$

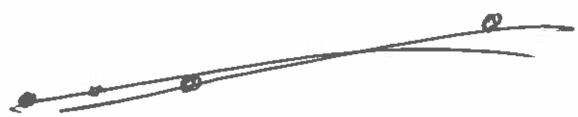
Harmonics

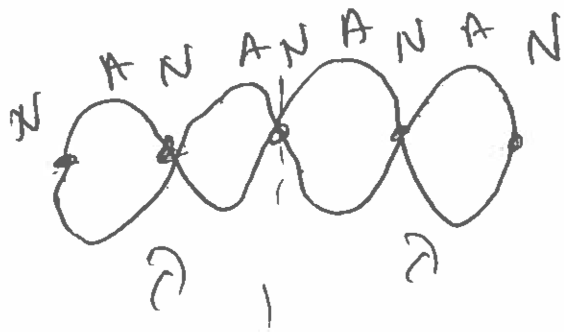


$L = \lambda$ even Harmon
$= \frac{2}{2}\lambda$



$L = \frac{3}{2}\lambda$ odd Harmonic



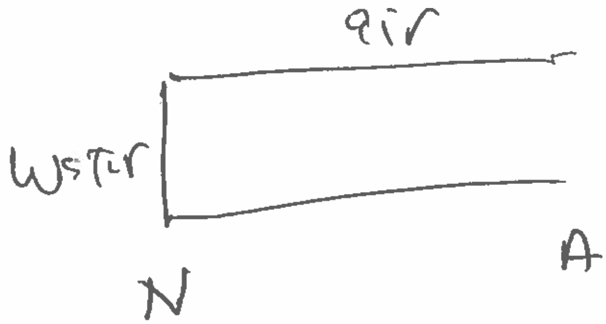


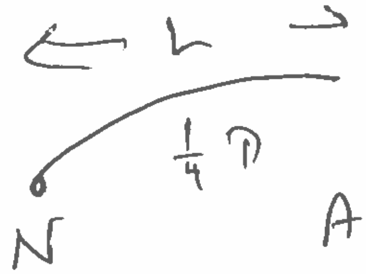
$L = 2\lambda$ even Harmonic
$= \frac{4}{2}\lambda$

Increasing Energy always adds

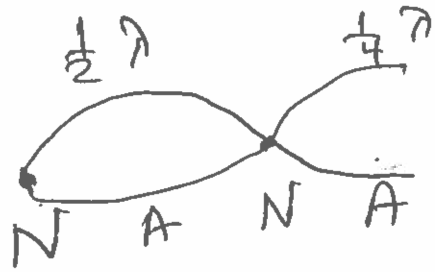
1 Antinode

and 1 node

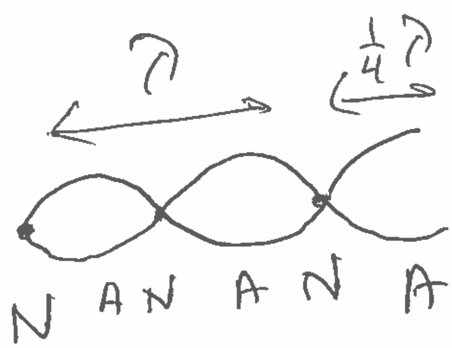




$$L = \frac{1}{4}\lambda$$



$$L = \frac{3}{4}\lambda$$



$$L = \frac{5}{4}\lambda$$

only odd harmonics allowed!

No even harmonics!

$$L_i = \frac{n_i}{4}\lambda$$

n must be odd

$$\Delta L = L_{i+1} - L_i$$

$$\Delta L = \left(\frac{n_{i+1}}{4} - \frac{n_i}{4}\right)\lambda$$

$$4\Delta L = (n_{i+1} - n_i)\lambda = 2\lambda$$

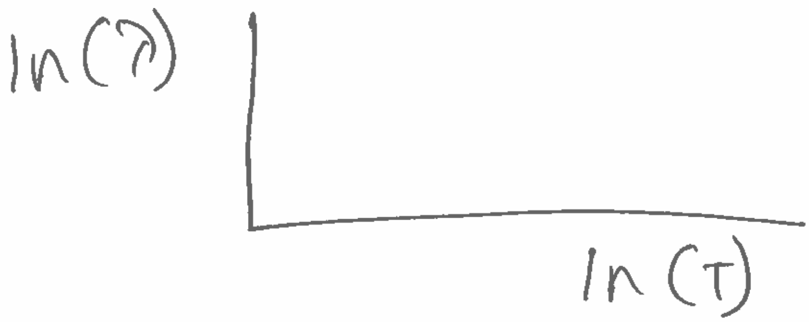
$$\lambda = \frac{4}{2}\Delta L = 2\Delta L$$

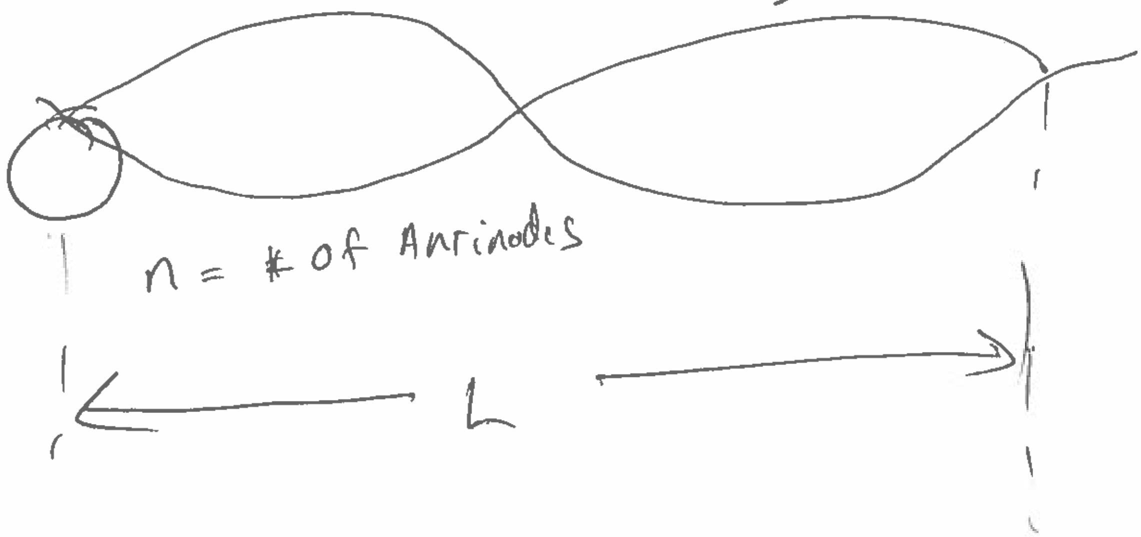
$$\boxed{\lambda = 2\Delta L}$$

$$\underline{v} = \underline{f}\,\underline{\lambda}$$

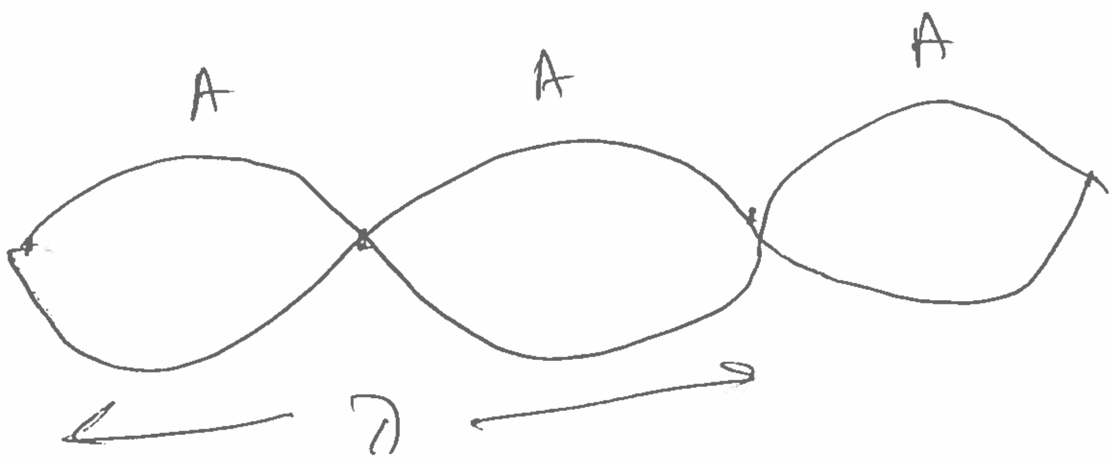
speed of sound in air 343 m/s @ room temp → 330 m/s @ 0°C

340 m/s – expected value





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



$$\frac{3}{2}\lambda = L$$

$$\lambda = \frac{2}{3}L$$

$$v_{string} = \sqrt{\frac{T}{m/L}} = \sqrt{\frac{T}{\rho}}$$

ρ - linear density

$\rho = \frac{\text{mass}}{\text{Length}}$

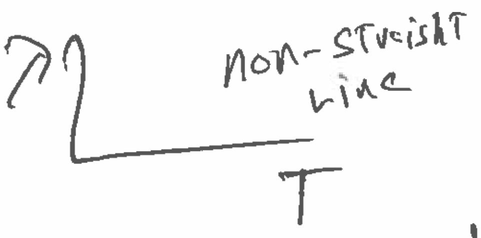
$$v_{string} = f\lambda$$

$$f\lambda = \sqrt{\frac{T}{\rho}}$$

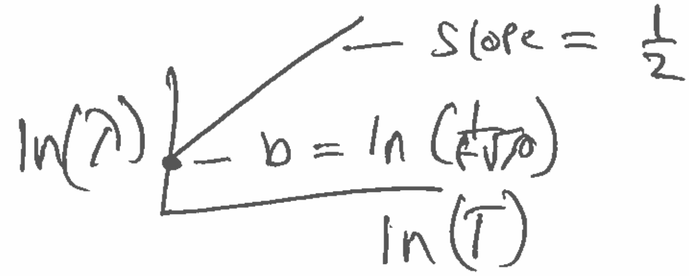
$$\lambda = \frac{1}{f\sqrt{\rho}} T^{1/2}$$

Power Law

$$y = kx^n$$



To get a straight line



$$\lambda = \left(\frac{1}{f\sqrt{\rho}}\right) T^{1/2}$$

$$\ln \lambda = \ln\left(\left(\frac{1}{f\sqrt{\rho}}\right) T^{1/2}\right)$$

$\ln(AB) = \ln(A) + \ln(B)$

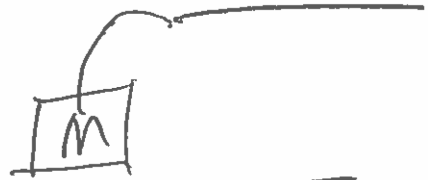
$$\ln \lambda = \ln(T^{1/2}) + \ln\left(\frac{1}{f\sqrt{\rho}}\right)$$

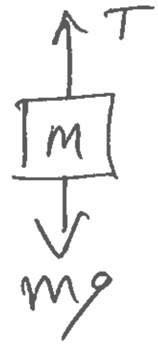
$\ln(A^B) = B\ln(A)$

$$\ln \lambda = \frac{1}{2}\ln(T) + \ln\left(\frac{1}{f\sqrt{\rho}}\right)$$

$$y' = m' \; x' + b'$$

$$T = mg$$





$$\sum F_y = T - mg = ma$$

$$T = mg$$

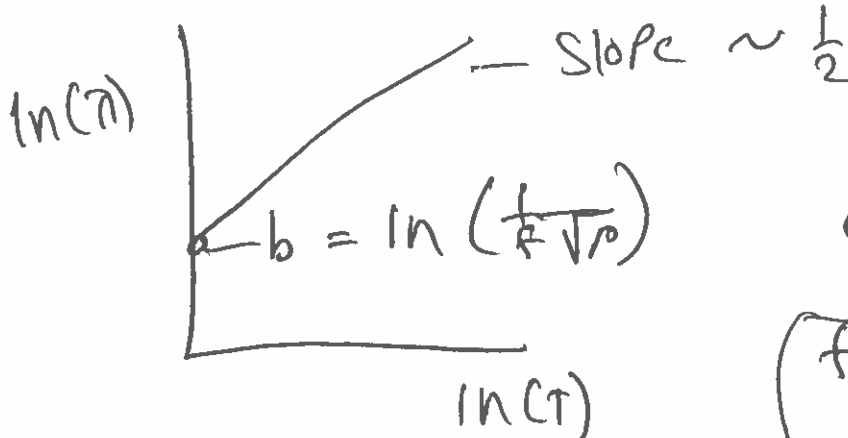
$$\lambda = \frac{1}{f\sqrt{\rho}} T^{1/2}$$

$$T = mg$$

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

$$\rho = \frac{M}{\ell}$$

$$\ln(\lambda) = \frac{1}{2}\ln(T) + \ln\left(\frac{1}{f\sqrt{\rho}}\right)$$



$$e^{b} = \frac{1}{f\sqrt{\rho}}$$

$$f = \frac{1}{e^{b}\sqrt{\rho}} = \frac{e^{-b}}{\sqrt{\rho}}$$