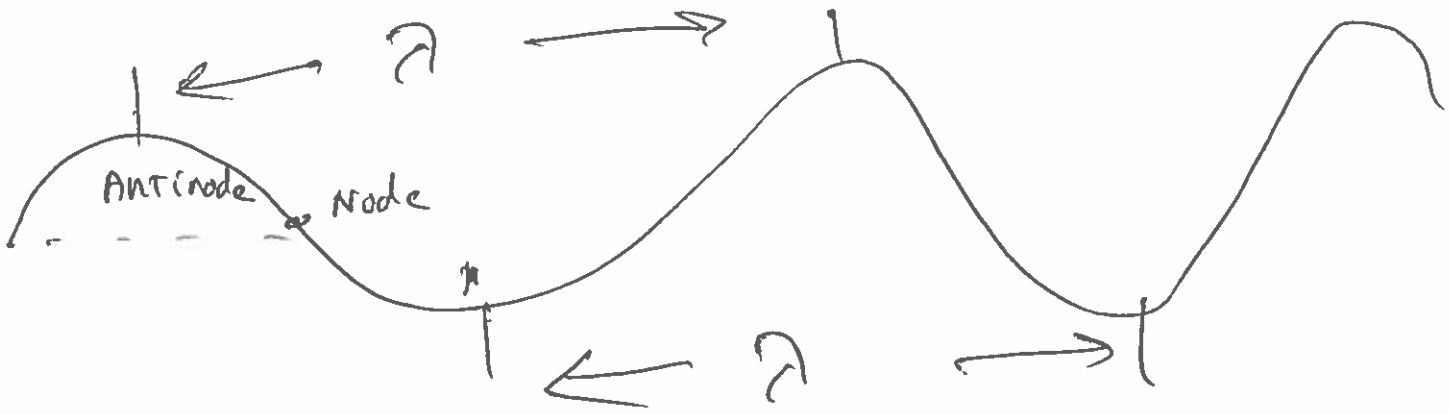
λ - Wavelength is the distance between two identical points of a wave. could be crest to crest or trough to trough



Wavelengths have units of distance
m, cm, km, etc.

frequency is the number of wavelengths that pass a fixed point in a given (unit) amount of time.

Units are $\frac{\text{number}}{\text{time}}$ $\quad Hz = 1/sec$

$Hz = s^{-1}$

$v = f\lambda$

speed $= (1/s)(m) = m/s$

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

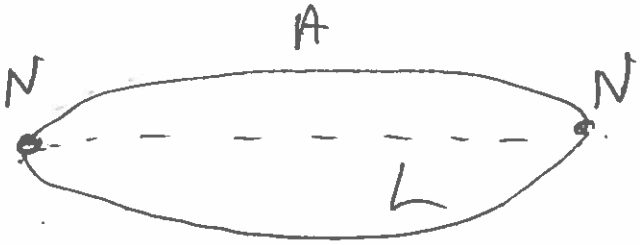
speed (freq)(wavelength)

Antinode is a point of maximum vibration

node is a point of zero vibration.

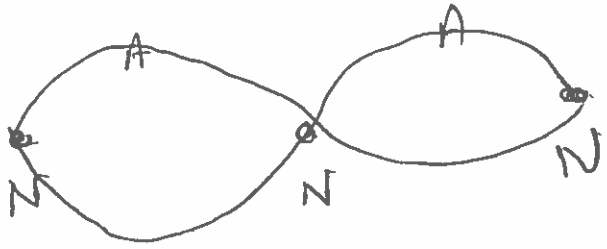
Low Energy

Fundamental frequency

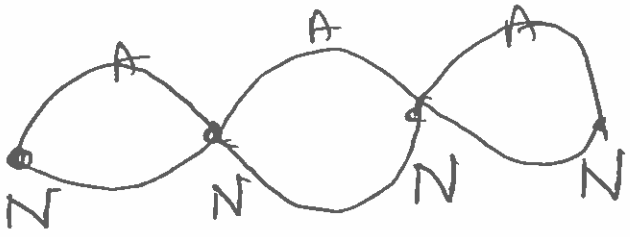


$L = \frac{1}{2}\lambda$

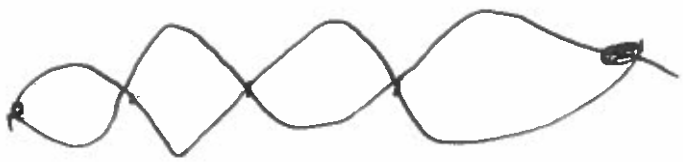
1st Harmonic



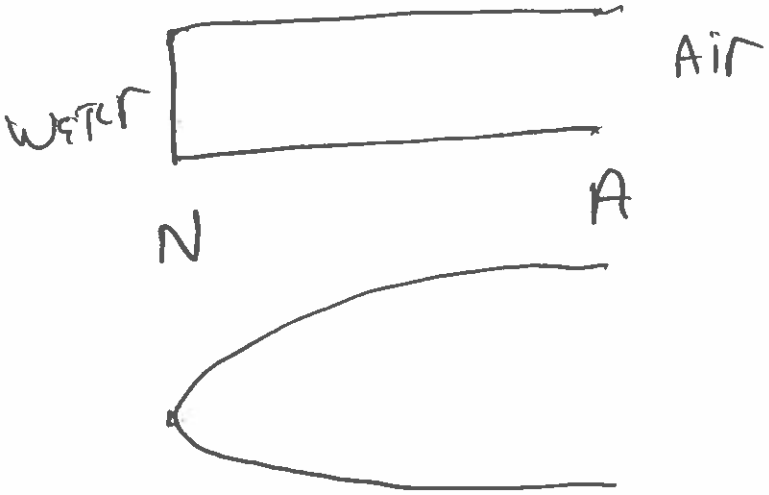
$L = \lambda = \frac{2}{2}\lambda$



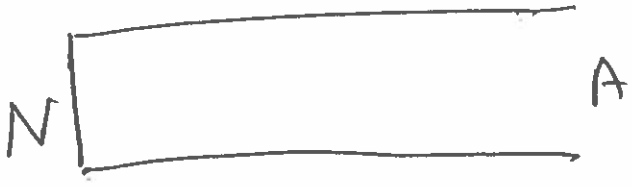
$L = \frac{3}{2}\lambda$

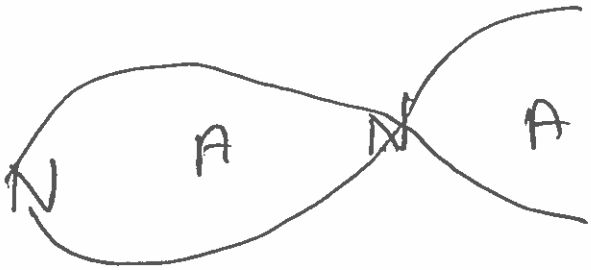


$L = \frac{4}{2}\lambda = 2\lambda$

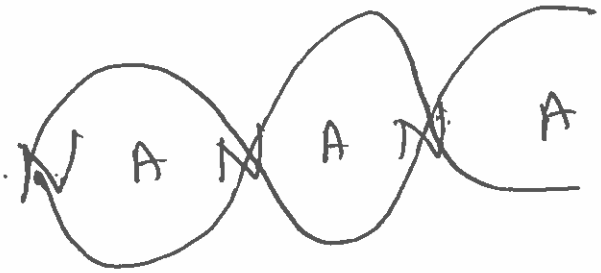


$L = \frac{1}{4}\lambda$





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



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

Pipe 1 end open 1 end closed

only odd harmonics allowed

n_i = # of Antinodes No even harmonics n_i is odd

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

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

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

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

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

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

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

$v_{sound} = 330\ m/s$ @ $0^\circ C$

$v_{sound} = 343\ m/s$ @ $28^\circ C$

$$v = f\lambda$$

$v_{sound} = 340\ m/s$

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

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

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

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

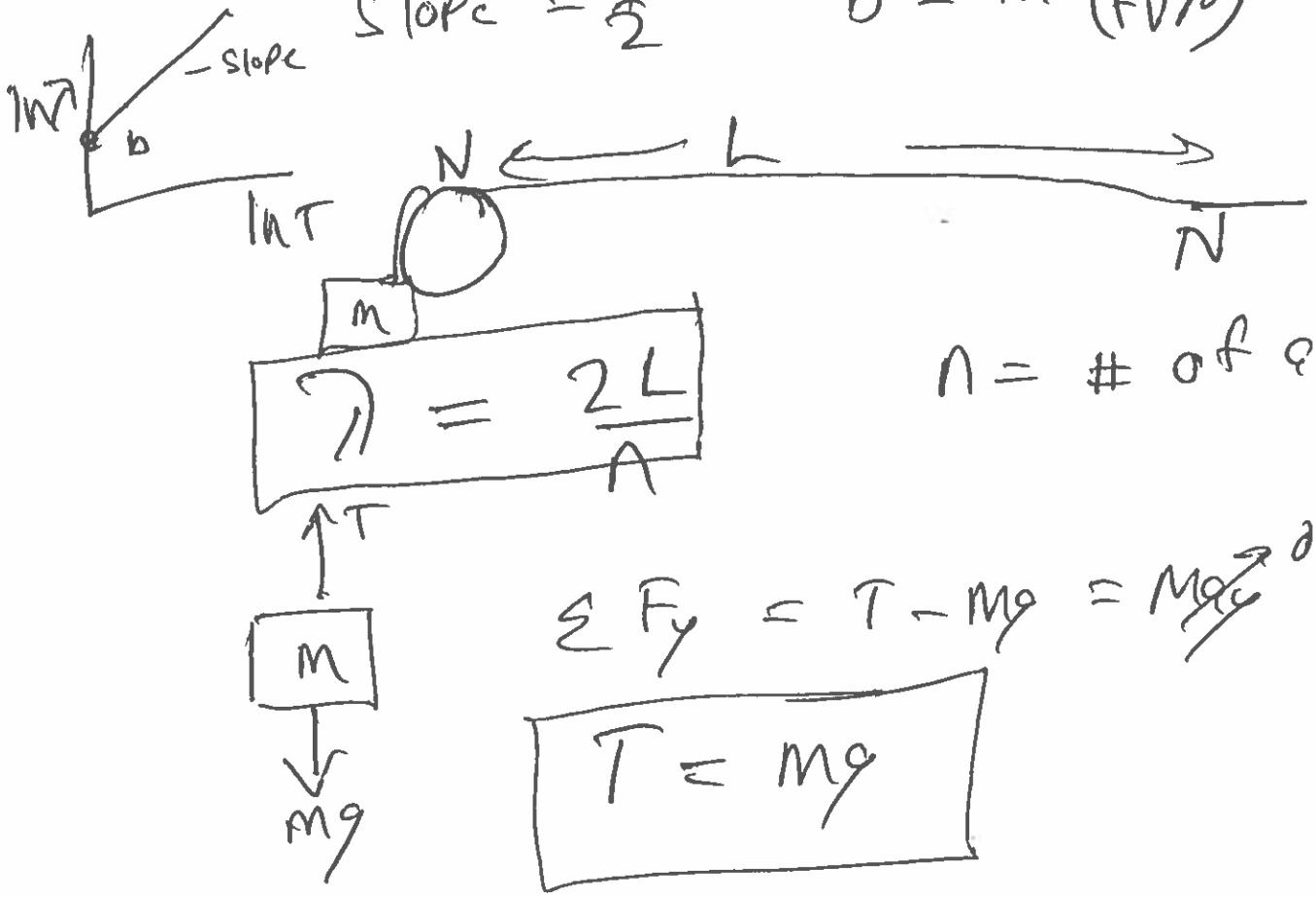
$$\ln\lambda = \ln\left(T^{1/2}\right) + \ln\left(\frac{1}{f\sqrt{\rho}}\right)$$

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

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

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

$$\text{Slope} = \frac{1}{2} \qquad b = \ln\left(\frac{1}{f\sqrt{\rho}}\right)$$



n = # of antinodes

$$\Sigma F_y = T - mg = ma^{\,0}$$

$$\boxed{T = mg}$$

$$b = \ln\left(\frac{1}{f\sqrt{\rho}}\right)$$

Solve for f?

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

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

$f_{\text{tuning fork}}$ Theory $= 60\,hz.$