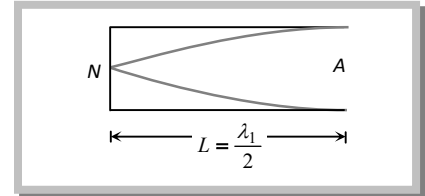


## Standing Wave in a Closed Organ Pipe.

Organ pipes are the musical instrument which are used for producing musical sound by blowing air into the pipe. Longitudinal stationary waves are formed on account of superimposition of incident and reflected longitudinal waves.

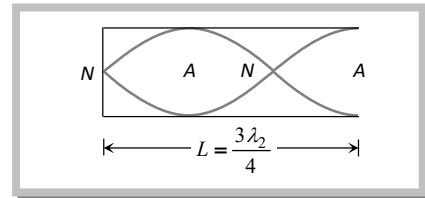
Equation of standing wave  $y = 2a \cos \frac{2\pi vt}{\lambda} \sin \frac{2\pi x}{\lambda}$

General formula for wavelength  $\lambda = \frac{4L}{(2n-1)}$



(1) First normal mode of vibration:  $n_1 = \frac{v}{4L}$

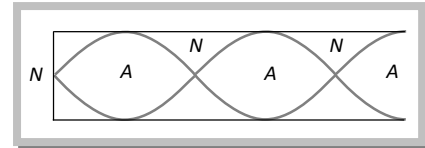
This is called fundamental frequency. The note so produced is called fundamental note or first harmonic.



(2) Second normal mode of vibration:  $n_2 = \frac{v}{\lambda_2} = \frac{3v}{4L} = 3n_1$

This is called third harmonic or first overtone.

(3) Third normal mode of vibration:  $n_3 = \frac{5v}{4L} = 5n_1$



This is called fifth harmonic or second overtone.

Position of nodes:  $x = 0, \frac{2L}{(2n-1)}, \frac{4L}{(2n-1)}, \frac{6L}{(2n-1)}, \dots, \frac{2nL}{(2n-1)}$

For first mode of vibration  $x = 0$  [One node]

For second mode of vibration  $x = 0, x = \frac{2L}{3}$  [Two nodes]

For third mode of vibration  $x = 0, x = \frac{2L}{5}, \frac{4L}{5}$  [Three nodes]

Position of antinode:  $x = \frac{L}{2n-1}, \frac{3L}{2n-1}, \frac{5L}{2n-1}, \dots, L$

For first mode of vibration  $x = L$  [One antinode]

For second mode of vibration  $x = \frac{L}{3}, x = L$  [Two antinode]

For third mode of vibration  $x = \frac{L}{5}, \frac{3L}{5}, L$

[Three antinode]