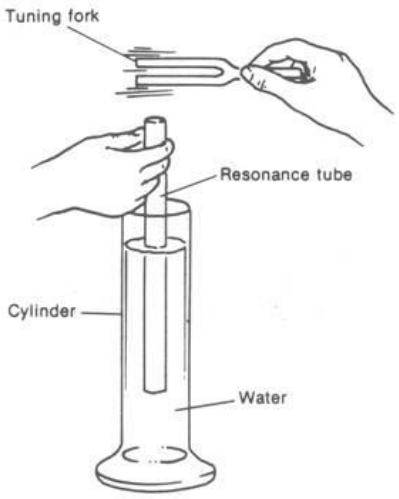
Resonance

Every object has a natural frequency, which is the pitch you will hear if you strike or otherwise "play" the object.

The one (or multiple) *natural frequencies* of an object are based on its possible *standing wave* patterns, sometimes called *harmonics* or *overtones*.

Musical instruments create sound through resonance. In order for an object to *resonate*, there must be an outside *driving force* that causes the object to vibrate at one of its *natural frequencies*.

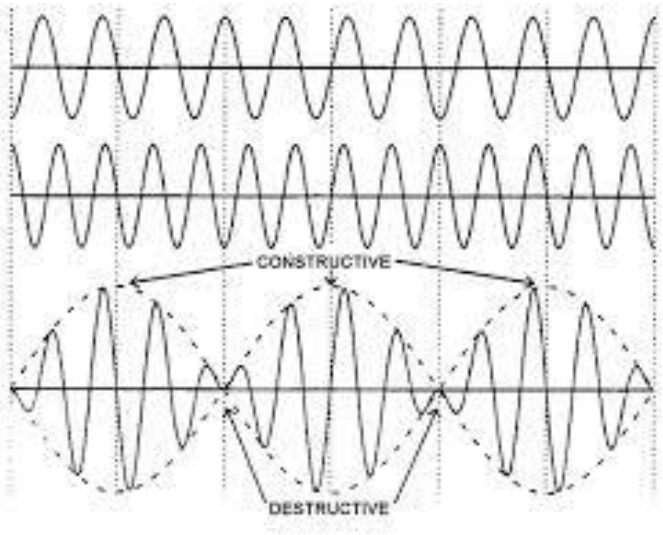


Hold the tuning fork so that the vibrations are directed into the tube (one prong directly above the tube). Adjust the tube length until the loudest sound is heard.

Beat Frequency

- When two sound waves of similar frequency interfere with each other, they create beats of high and low amplitude/volume
    - The beat frequency is simply the difference between the frequencies of the two sound waves

$f_{beat} = |f_1 - f_2|$

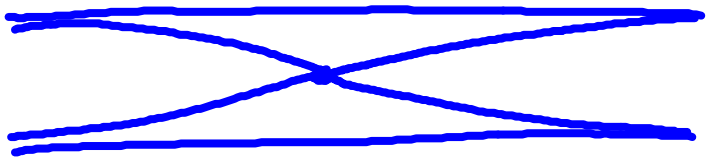


Example calculation (demonstration)

Fundamental frequency

$v = 340 m/s$

$L = 0.941 m$



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

$\lambda = 2L$

$\lambda = 2(0.941m)$

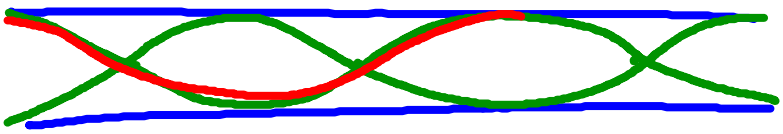
$\lambda = 1.882m$

$v = \lambda f$

$f = \frac{v}{\lambda} = \frac{(340 m/s)}{(1.882m)}$

$\boxed{f = 181 Hz}$

2nd overtone / 3rd harmonic



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

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

$= \frac{2}{3}(0.941m)$

$\lambda = 0.627m$

$v = \lambda f$

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

$f = \frac{(340 m/s)}{0.627m}$

$\boxed{f = 542 Hz}$