

Physics Lab
Speed of Sound in Air

This Lab will be assessed against data collection and processing only.

Introduction:

The fundamental frequency of vibration f of sound in a column that is closed at one end and open at the other depends on the length of the column L and the speed of sound in air v according to the relation

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

The purpose of this experiment is to verify the relationship between frequency and length and hence determine the speed of sound in air.

Procedure:

A tall plastic tube partially filled with water is used as a resonance column. The length of the column can be adjusted by changing the level of the water. To cause the air to vibrate in the column a tuning fork is placed at the open end. When the frequency of the tuning fork is at the fundamental frequency the tube will resonate resulting in a note that is louder note than normal (but with the same frequency as the tuning fork).

Hit the tuning fork on the sole of you shoe and place it near the open end. Then adjust the level of the water until you hear resonance. It is easiest to start with the water level high and then let it fall. Once you have a rough idea of where the resonance level is get a more accurate reading by allowing the water level to fall more slowly. Repeat the using as many different tuning forks as you can.

Using graphical analysis verify the above relationship (What is your dependent variable? – Make sure this variable is plotted on the y-axis). In practice the effective length of the column is longer than the physical length because the sound wave extends beyond the open end of the column by a small amount e called the end correction. The end correction is expected to be about one third of the diameter of the tube. Use your graph to determine a value for both the speed of sound in air and an estimate for the end correction. Compare both quantities with expected values.

Extension:

It should be possible to excite the third harmonic (there is no second harmonic) for some of the tuning forks if the column can be made long enough. Based on your earlier observations predict where these might be and try to excite them.