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Physics SL
Speed of Sound Lab

Objective:
To measure the speed of sound using the concept of resonance; to determine what, if any, effect varying the frequency of a sound wave on the speed of that sound wave.

Background:

Blowing across the top of a bottle creates a sound. Standing sound waves in the bottle creates the tone. Bottles of different lengths, or similar bottles with different amounts of water in it will produce different frequencies based on the size of the column of air inside.

Each tube generally has its own resonant frequency. It sound is introduced at the open end at the resonant frequency, it will produce a loud tone.

A standing wave of one wavelength :

The system in this lab will include a quarter of a wavelength. The length will be found using this formula :

$L = \lambda /4$

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Definitions:

Wave Speed:

A wave is defined as a disturbance which is moved medium; for example, the wave of the ocean moves in medium water and we can see the movement of wave crest from one side to the other side in a given time period. The motion of objects is described in terms of speed which shows the fastness of the object. Speed is the covered distance per units of time. The formula for the speed of a wave is the following: $v = f \times \lambda$

Wavelength:

Wavelength is the distance between two identical adjacent points in a wave. Wavelength is inversely proportional to frequency. That means if two waves are traveling at the same speed, the wave with a higher frequency will have a shorter wavelength. Likewise, if one wave has a longer wavelength than another wave, it will also have a lower frequency if both waves are traveling at the same speed. The following formula can be used to determine wavelength: $\lambda = v\ f$

Frequency:

The frequency of a wave refers to the number of crests of a wave that move past a given point in a given unit of time. The most common unit of frequency is the hertz (Hz), corresponding to one crest per second.The frequency of a wave can be calculated by: $f = v\ \lambda$

Resonance:

: It is the reinforcement or prolongation of sound by reflection from a surface or by the synchronous vibration of a neighboring object.

Standing Wave:

It is a vibrational pattern created within a medium when the vibrational frequency of the source causes reflected waves from one end of the medium to interfere with incident waves from the source. This interference occurs in such a manner that specific points along the medium appear to be standing still

Apparatus:

- graduating cylinder
- flask
- tuning fork
- meter stick

Procedure :

1. Fill the flask and graduated cylinder with water at the desired height.
2. Select a tuning for and strike either on a hard surface.
3. While holding the tuning fork just over the open end of the graduated cylinder, adjust the level of water until you find the point where it resonates the loudest.
4. Record the data.

Data :

L(m)	**f(Hz)**
0.165	**512**
0.22	**384**
0.25	**320**

Note: To determine the length related to each frequency, a fixed velocity of 340 m/s was used.

Results :

f(Hz)	**λ (4L)(m)**	**V**
512	0.66	337.92
384	0.88	337.92
320	1.00	320

Using the formula $v = f\lambda$, I was able to determine the velocity.

Conclusion:

Although we were limited to using three different frequencies, the speed of sound found after the calculation was slightly close to the established speed of sound of 340 m/s. The velocities of 337.92 and 320 show that the margin error was +/- 20 m/s which is alright considering the number of errors we encountered.

Error

Numerous errors were faced during this experiment. For one, the frequency forks were completely accurate in their emission because they were old and used up. Moreover, the graduated cylinder was not new and contained some water drops on the inside surface while we were experimenting. Also, it was hard to determined the maximum tone using our solely our hearing capabilities. A build up of all these errors has considerably affected our data.