Sound Lab

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1 Objective

Measure the speed of sound by calculating the wavelength and using the known frequency.

2 Background

When i was a child, i always question myself why I see the lightning first then the sound afterward. Later, as I grow up, I find out that the speed of light is much greater than the speed of sound; as a result, the lighting is always ahead of the thunder. I know beforehand that the speed of light is approximately 300 milion meters per second and the speed of sound is roughly 340 meters per second. I want to verify them but the speed of light is just too great so I'm only able to examine the speed of sound.

3 Definitions

Speed $V-$being a scalar quantity, is the rate at which an object covers distance.

Frequency $f-$a measurement of how often the particles of a medium vibrate when a wave passes through the medium.

Wavelength $\lambda-$the distance between one peak of a wave to the next corresponding peak

Amplitude $A-$the maximum amount of displacement of a particle on the medium from its rest position.

Period $T-$the time for a particle on a medium to make one complete vibrational cycle.

Standing Wave - 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.

Resonance - when one object vibrating at the same natural frequency of a second object forces that second object into vibrational motion

4 Materials

A ruler A liter of water A smartphone with a frequency generator application A long test tube (cylinder)

5 Method

Filling the test tube with water and then measuring the difference in the height of the water to the top of the tube. Finding the appropriate frequency range with the known speed of sound(340). Using the application to find out at what value of frequency, the noise would be loudest. Afterward, plugging in the wavelength and the frequency to find out the speed of sound

6 Data

We calculate the difference in the height of the water to the top of the tube by ruler than multiply by 4 in order to get the wavelength.

Trial	Frequency (Hz)	Wavelength (meter)
1	350	0.92
2	482	0.68
3	308	1.12
4	223	1.52

Table 1 : Results of the experiment

7 Calculations

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

$$\lambda_{0.92} = \frac{340m/s}{0.92m} = 369Hz$$

$$\lambda_{0.68} = \frac{340m/s}{0.68m} = 500Hz$$

$$\lambda_{1.12} = \frac{340m/s}{1.12m} = 303Hz$$

$$\lambda_{1.52} = \frac{340m/s}{1.52m} = 224Hz$$

Then, we use the above frequency to find the exact frequency. After conducting the experiment, this is the frequency value I attain

Calculated Frequency (Hz)	Actual Frequency (Hz)
369	350
500	482
303	308
224	223

Table 2 : Value of frequency

Then I can use the formula

$$V = \lambda * f$$

to find the speed of sound

$$V_{350} = 0.92 * 350 = 322m/s$$

$$V_{482} = 482 * 0.68 = 327m/s$$

$$V_{308} = 303 * 1.12 = 335m/s$$

$$V_{223} = 223 * 1.52 = 339m/s$$

8 Results

Trial	Frequency (Hz)	Wavelength (meter)	Speed of sound (m/s)	% of error
1	350	0.92	322	5.29
2	482	0.68	327	3.82
3	308	1.12	345	1.47
4	223	1.52	339	0.29

Table 3 : Results of the calculations

9 Discussion of Error

After implementing the experiment, I found out that, for most of the time, the higher the wavelength, the percentage of error is smaller. This happen due to the error in length will become less significant if the total distance is greater. There will be some percentage of error since the volume of the water was observed and measured by naked eye, so there will be no definite accuracy. Furthermore, the place where the sound came out is placed a little further from the top of the tube. Hence, there will be some unavoidable uncertainty. I heard the other class talking about a different way to measure the speed of sound by using a tuning fork. However, I found that it hold a bigger chance of

risk as well as harder to implementing. Therefore, if i ever have a chance to redo the experiment, i will stick with the same method using a frequency generator application.