Measuring the Speed of Sound

Adetoun Adeyemi

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1 Objective

The objective of this experiment is to measure the speed of sound in the physics room using an application to project frequency into a measuring cylinder.

2 Definitions

Wavelength The distance between successive crests on a wave

Wave Speed The distance a wave travels per unit of time

Frequency The number of crests of a wave that moves past a point in a given peroiod of time (normally a second)

Standing wave a vibration of a system in which some particular points remain fixed while others between them vibrate with the maximum amplitude.

3 Theory

In this experiment the velocity of sound in air is to be found by using a frequency generator from a phone instead of a tune fork for its practicality. The wavelength of the sound will be determined by making use of the resonance of an air column. The apparatus for the experiment consists of a long cylindrical tube with water in it. The length of the water column may be changed by raising or lowering the water level while the phone is held over the open end of the tube. Resonance is indicated by the sudden increase in the intensity of the sound when the column is adjusted to the proper length. The resonance is a standing wave phenomenon in the air column and occurs when the column length is:

$$\frac{\lambda}{4}$$

where lamda is the wavelength.The water surface constitutes a node of the standing wave since the air is not free to move longitudinally. The open end provides the conditions for an antinode T

4 Materials

- water
- measuring cylinder
- phone
- frequency generator application
- ruler

5 Method

a. Fill the measuring cylinder to 800ml with water

b. Measure the length from the top of the measuring cylinder to the water level

c. Open the frequency application and put on top of the measuring cylinder until the highest resonance of sound is heard . This requires a trial and error method

d. Take note of this frequency

e. Use the length to calculate the wavelength of the sound using the equation:

$$\frac{\lambda}{4}$$

f. Calculate the speed of the sound with the calculated wavelength and the obtained frequency using the equation:

$$v = f/lambda$$

g. repeat steps b-f using (600, 500 and 200) ml of water

6 Data

Water volume (mL)	Length (m)	Frequency (Hz)	Wavelength (m)
800	0.17	485	0.68
600	0.23	380	0.92
500	0.28	305	1.12
200	0.38	223	1.52

Table 1: Experimental data

7 Example Calculations

This is the calculation for speed of the measuring cylinder filled with 500mL of water.
L = 28cm which is $\equiv 0.28m$
$f = 308$ Hertz as measured from the application

$$\frac{\lambda}{4}$$

so

$$\lambda = 4L$$

therefore

$$= 4 * 0.28 = 1.12m$$

Now using equation

$$v = f/lambda$$

you can calculate the speed as lamda and frequency have been obtained.

$$v = 308 * 1.12 \approx 345m/s$$

The calculated value for the speed of sound in dry air at 20is 343.2 m/s.
Even though this may not be the ideal conditions in the room we can use it as an estimate to predict what may happen.
The percent error is calculated as follows.

$$Error = \frac{345 - 343.2}{343.5} = 0.524\%$$

8 Results

Water Volume (mL)	Measured Speed (m/s)	Percent Error (%)
800	330	3.85
600	322	6.12
200	339	1.22

Table 2: Calculated speed

9 Discussion of Error

Sources of error may include random error from the ruler an an an an as well as from the measuring cylinder. Systematic error from the frequency generator app

10 Conclusion

The speed of sound experiment is a simplistic experiment. The different values for the speed that arised from the different values of L

11 Refrences

Hyper Physics. (n.d.). Quarks. Retrieved March 2, 2016, from http://hyperphysics.phy-astr.gsu.edu/hbase/particles/quark.html