Lab - Speed of Sound in Air

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1 Problem

In this lab our aim is to determine the speed of sound in air.

2 Background

First, sound is a wave and waves have speed. This speed can be determined with the help of a resonant chamber. In this lab, the system we used did not include a whole wavelength, but a quarter of it. This means that the length we find equals to:

$$L = \frac{\lambda}{4}$$

3 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:

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

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:

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

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.

4 Materials:

For this experiment we used the following materials: a flask, a graduating cylinder, a tuning fork and a meter stick.

5 Method:

Initially, we calculated the wavelength by using an approximation of the velocity. Then, we divided the answer by four, knowing that the length of from the end of the water to the tuning fork is one fourth of the wavelength. We also measured the location of the water on the flask just to have a better understanding of the experiment.

6 Data:

In the experiment, we used a fixed velocity of 340 m/s to determine the length related to each frequency.

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

Figure 1: Length x Frequency

7 Results:

After finding the length, we were able to calculate the actual velocity. This can be seen on the table below:

f (Hz)	λ (4L) (m)	V
512	0.66	337.92
384	0.88	337.92
320	1.0	320

Figure 2: Lambda x Velocity

8 Error:

As it is possible to predict, there are some errors related to this experiment. This is mainly related to the fact that the source of frequency is not the best available. Also, the resonant chamber used is not new, and has therefore some deformities. Moreover, the location of the maximum wave is hard to be determined. All of this factors lead to an imprecise length and consequently differences on the value of the velocity.

9 Conclusion:

After this lab, we were able to calculate the speed of sound. Basing on our three different frequencies we were able to determine the speed of sound in air. Despite the errors already stated above, we were able to always find a value similar to the stablished velocity of 340 m/s.