

The speed of sound in air

Kundt's tube method

Name: _____

Include the same sections on your report that you always have. You will have to calculate a percent uncertainty this week. See below.

Theory: In a Kundt's tube, a standing wave is formed and there is dust on the inside to help you see it. You will use the speaker at one end to generate different frequencies. The dust will hop upward at the antinodes! Since the distance between antinodes equals the distance between nodes, you'll be able to calculate λ for each frequency.

Here is a sample picture of a tube. Our version has the speaker built in at the end. Be sure to spread the dust around a little after each trial.



Data you'll need:

Calculate what the speed of sound in air *should* be for the current room temperature. I'll call this v below.

For six different frequencies (choose between 1000 and 2000 Hz), complete the following table. For column two, measure the distance between the centers of two far-apart antinodes. We're trying to find an *average* gap between antinodes. Note that if, for example, you see 6 antinodes in the dust, there are 5 gaps. You'll see what the $1/f$ column is for later. Write out more than one sig fig for $1/f$ if possible.

[illegible]

Now, we have f and λ . If you multiply these columns, you can get the speed of sound. Check this for one of your rows of data – make sure you get a result close to what you expect.

There's a way to get the speed of sound using all your data graphically. The wave speed equation can look a bit weird to graph, since if we call "x" the frequency and "y" the wavelength you measure, the data will obey the equation $xy = c$, which is a hyperbola. It's theoretically possible to deal with a hyperbola mathematically, but it would simplify matters if we can "linearize" the data.

Instead of saying: $v = f\lambda$

let's write the equation: $\lambda = v \times \frac{1}{f}$

Therefore, if you **graph wavelength on the y-axis and 1/f on the x-axis**, the graph will be linear with a slope equal to the speed of sound v . (Remember $y = mx + b$? It's $y = mx$ in cases where $b = 0$.)

Make this graph either by hand or on a computer, and find its slope. We'll call this slope v_{expt} .

For your report, you will need to calculate % error: $\% \text{ error} = \frac{|v_{\text{expt}} - v|}{v} \times 100\%$. v_{expt} is the speed of sound you got in the experiment and v is the speed you expect for the current room temperature. Your conclusion should give values for both the speed of sound you expect from the room temperature as well as the speed you got from the slope of your graph. Also, include the percent error **AND** the biggest source of uncertainty in your group's results.