POPPY SCHOLARS · PHYSICS OF THE UNIVERSE

Home lab 9 · Unit 9 · about 45 minutes

How fast does sound travel in air, and can a tube and a phone measure it?

Name _____ Date _____

MATERIALS

You supply everything. Tick each item as you gather it.

- ☐ A tube about 50 cm long and 3 to 4 cm wide, open at both ends (PVC pipe, a mailing tube, or two paper-towel tubes taped together)
- ☐ A tall container of water, such as a bucket or a deep pitcher, so that the tube can be lowered into it by about 45 cm
- ☐ A phone or computer with a free tone generator, set to 1000 Hz (a steady pure tone)
- ☐ A ruler in centimeters, a thermometer to measure the air temperature, and a calculator

SAFETY

Keep the tone at a comfortable volume, and do not hold the speaker next to your ear. Keep water away from electronics: put the phone on a dry stand above the tube, not inside it. Dry any spills so that nobody slips.

PROCEDURE

1. Measure the temperature of the room air. Start the 1000 Hz tone, and hold the phone speaker just above the open top of the tube.
2. Lower the tube slowly into the water. The part of the tube above the water is a column of air that is closed at the bottom by the water.
3. As you slide the tube down, listen: at certain heights the sound becomes much louder, because the air column resonates. Mark the first position where the sound is loudest. Measure the length of the air column (from the top of the tube to the water surface). Call it L_1.
4. Continue lowering the tube, and find the next loud position (L_2) and the one after that (L_3), if the tube is long enough. Repeat to check your readings.
5. Adjacent resonances are half a wavelength apart: $L_2 - L_1 = \lambda \div 2$. Compute the mean half-wavelength, and then λ.
6. Compute $v = f \times \lambda$. Compare with the accepted value at your air temperature: $v = 331.3 + 0.606 \times T$, with T in °C.

RECORD YOUR DATA

Resonance	Air column length (cm)
First, L1	
Second, L2	
Third, L3	

Also write the tone's frequency, the air temperature, λ, your speed of sound and your percent error.

LAB REPORT

Write a report that gives your table, explains why neighboring resonances are half a wavelength apart (with a diagram of the air displacement in the tube), shows the calculation of λ and v, finds the percent error against the accepted speed at your air temperature, and uses your first resonance length to estimate the end correction.

Report the numbers you actually got, even when they disagree with the lesson. Write on the lines, or type your report on the website and send it to a teacher there.

Question and hypothesis *State the question in your own words, what you expect to happen, and why you expect it.*

Method *What you changed, what you measured, what you kept the same, and how many trials you ran.*

Observations *Describe what you saw, including anything unexpected. Your data tables are added to the report automatically.*

Calculations *Show each calculation step by step, with units.*

Claim and reasoning *Answer the question using your numbers, then explain why, using the science from the unit.*

Limits and next step *What could have affected your results, and one change you would make next time.*