PHYX 106 Lab

Experiment 12 — The Speed of Sound

Objective

You are to measure the speed of sound and compare it with theory.

Procedure

For a pipe closed on one end and open on the other, the closed end should be a node and the open end almost an antinode. However, do not assume the open end is an antinode in your calculations, because usually the actual antinode occurs just above the open end of the tube. With a tuning fork, you will supply sound energy to such a tube. By adjusting the length of the column of air inside the tube, you can reach resonance: the length of the air column will be just right to set up a standing sound wave at the frequency of the tuning fork. You will hear a great increase in the sound level when the resonance condition has been established.

Measure the column length for the first and second resonances. The difference in these two lengths should be 1/2 wavelength.

Question 1. Explain why the difference in the first two resonant wavelengths is $\lambda/2$. Draw sketches of the waves in the tube in order to better answer this question.

Question 2. From the measurements of λ and the frequency stamped on your tuning fork, find the velocity of sound.

Question 3. Find the temperature in the room and compute the theoretical speed of sound. You may use the fact that the speed of sound is 331.5 m/s at 0° C, and that it is proportional to the square root of the Kelvin temperature:

$$v_s = \sqrt{\frac{\gamma RT}{\mu}}, \tag{1}$$

where γ is the ratio of specific heats ($\gamma = 1.4$ for air) and μ is the molecular weight of air (0.0289 kg/mole). Compare with the results from part 1.

Question 4. Find the distance from the end of the pipe where the antinode occurs.

Question 5. Calculate the column length for the second overtone (you already "saw" the first overtone and the fundamental). Is your pipe long enough to produce it?