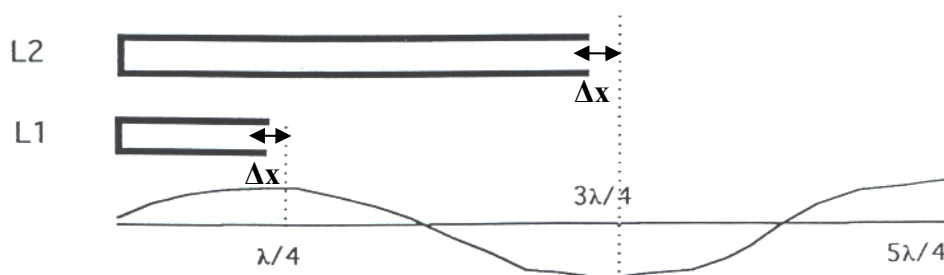


In this experiment, you will use a tuning fork to generate a sound wave of fixed frequency, and then adjust a length of PVC pipe up and down in the water until you find the length of pipe in which the sound produced by the tuning fork resonates. The water forms a “closed end,” while the top is open.



For a pipe with one end open to the air, the antinode is located slightly beyond the end of the tube (the extra antinode distance is shown as Δx in the diagram above). Experimentally, it has been found that $\Delta x = 0.305d$ where d is the diameter of the tube.

Part I: The fundamental

- 1) It is best before you start the experiment to have a rough estimate of the first length at which the pipe will resonate. Use the frequency of your tuning fork and the *approximate* value for the speed of sound (340 m/s) to *estimate* a value for your first resonant length:
- 2) Using the length you calculated above as a starting point, measure the shortest length of pipe out of the water that gives you resonance. Record your data in the table on the back of this sheet.
- 3) Now, find a longer tube and repeat the procedure above to find a second length of tube in which the same note from the tuning fork will resonate (it should be around 3 times the first resonant length).

Part II: The overtone:

- 4) A tuning fork produces many audible overtones, at multiples of the fundamental frequency. Find a short length of pipe and move it up and down in the water until you hear an overtone resonating inside the pipe (this is a much higher pitch tone than what you heard resonating in part I). Record the length of the pipe out of the water and the diameter of the pipe in the table on the back of this sheet.

1. Data (3 points):

PART I

	L (m)	d (m)
1 st resonance		
2 nd resonance		

PART II

	L (m)	d (m)
1 st resonance		

2. (2 points) Write out an equation showing the relationship between **L**, **d**, and λ for the first resonance of the tuning fork in the pipe (read the other side of this handout if you need to refresh your memory):

Write out the equation showing the relationship between **L**, **d**, and λ for the second resonance of the tuning fork in the pipe:

3. (3 points) Calculate the velocity of sound using each of your resonant lengths from Part I. Show all work below.

Part 1a)

Part 1b)

4. (1 point) Average your values for the speed of sound to calculate your best estimate for the speed of sound in air in the lab:

5. a) (1 point) Use your part II data to calculate the wavelength of the overtone which resonated inside the small piece of pipe.

b) (1 point) Use this wavelength and your experimental value for the speed of sound to calculate the frequency of the overtone that you captured.

c) (1 point) Calculate which harmonic of the tuning fork you heard inside the small pipe. Show your work.