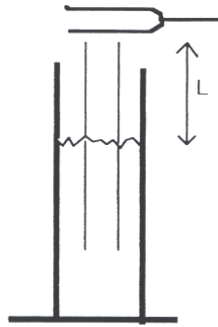
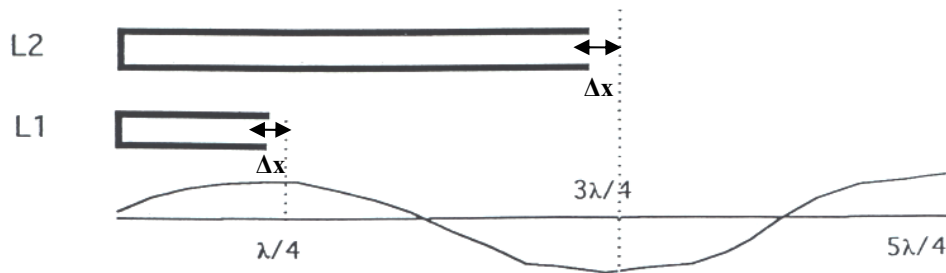


AP Physics B
Experiment, Sounds Waves in Pipes

Name: _____



In this experiment, you will use a tuning fork to generate a sound wave of fixed frequency, then adjust a length of plastic 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.



When solving mathematical problems involving open and closed tubes, we usually make the assumption that a closed end forms a node and an open end forms an antinode. In reality, though, for an open end 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 the extra distance beyond the edge of the tube where the antinode extends is equal to $0.305 \times d$ (the diameter of the tube).*

Part I: The fundamental

Hearing resonance in the pipe can be difficult, especially since the pipe will resonate somewhat at a number of different lengths. For this reason, it is best before you even 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 an estimated value for the speed of sound (340 m/s) to calculate an approximate value for your first resonant length:

Now find an appropriate length of pipe and place it in the graduated cylinder. Strike the tuning fork with a mallet, hold it just over the mouth of the pipe as shown in the diagram above, and move the tube up and down in the water until you hear the place where the sound inside the tube is a maximum. Record your data in the table on the back of this sheet.

Now, find a longer tube and repeat the procedure above to find a second length of tube in which the sound from the tuning fork will resonate (it should be around 3 times the first resonant length).

Part II: The overtone:

As may or may not have been described in class, a tuning fork produces many audible overtones, at multiples of the fundamental frequency. Find an appropriate length of pipe (it will be very short) 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.

1. Data:

	L (m)	D (m)
PART I 1 st resonance		
2 nd resonance		

	L (m)	D (m)
PART II 1 st resonance		

2. 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. Calculate the velocity of sound using each of your resonant lengths from Part I. Show all work below.

Part 1a)

Part 1b)

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

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

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

c) Calculate which harmonic you heard inside the small pipe. Show your work.