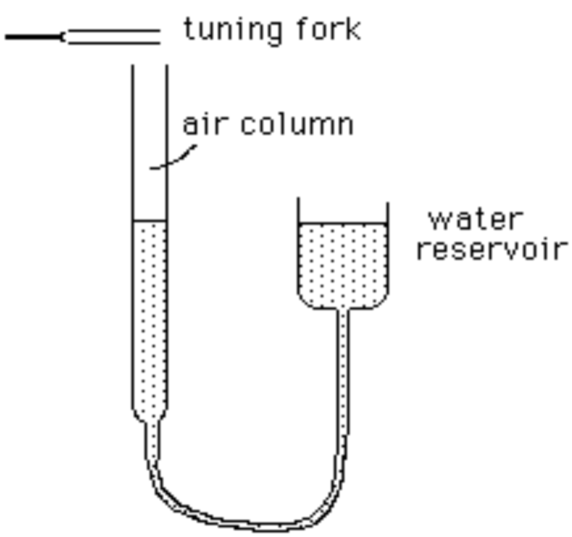
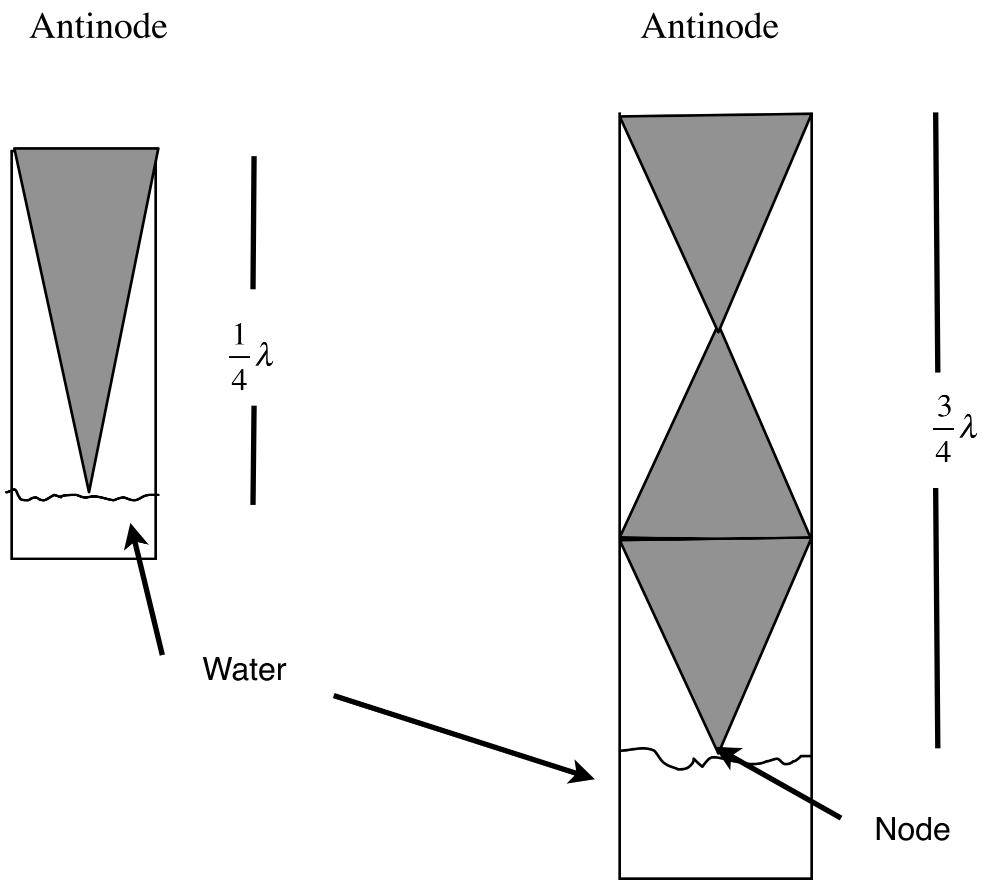
Purpose: To determine the speed of sound in air at room temperature.

Materials: Long tube, 4 tuning forks (of different frequency,**-each greater than 350 Hz**), Thermometer, movable water reservoir on a stand.

Discussion: Because sound travels as a wave, we can use the equation for the speed of a wave to determine the speed of sound in air. $V = f \bullet \lambda$. The letter ‘f’ represents the frequency of the wave and the Greek letter λ (lambda), is the wavelength of the sound. Using tuning forks of known frequency, we will produce standing waves in a hollow tube that is closed at one end.



If we hold a vibrating tuning fork over the tube and adjust the length of the air column in the tube, the air column will resonate due to constructive interference between the incoming and reflected waves. When this occurs, there will be an antinode 'A' at the mouth of the tube and a node at the closed end, near the water. When the air in the tube begins to resonate, the intensity of the sound produced by the vibrating tuning fork will increase.



Please make a mental not that an antinode will exist at the mouth of the tube only when the length of the air column is an odd number multiple of 1/4 the wavelength of the sound produced by the tuning fork. That is, the air column is 1/4, 3/4, 5/4, 7/4 ... wavelengths long. Note that 3/4-1/4 equals 1/2. Also 5/4-3/4 equals 1/2. **Therefore, the distance between consecutive resonance positions is 1/2 wavelength.** Once we know the distance for 1/2 wavelength, we can determine the wavelength of the sound by doubling the distance between two consecutive points of resonance.We can then use the equation, $V = f \bullet \lambda$ to experimentally determine the speed of sound in air.

We will also calculate the he accepted speed of sound in air by using the following equation:

$$Velocity = 331.45 \text{ m/s} + \frac{0.61}{^{\circ}C} \bullet T \text{ m/s}$$

Where T is the air temperature in degrees Celsius, 331.45 m/s and 0.61/˚C are constants.

lab 8 Name:________________________

Lab preparation: Please complete the following exercise before coming to lab. Hand this page in, before the beginning of the lab.

1. What does the difference between each consecutive antinode represent?

2. Write the equation for the speed of any wave.

3. Write the equation for the accepted speed of sound in air.

4. If the air temperature is 22 ˚C, determine the accepted value for the speed of sound.

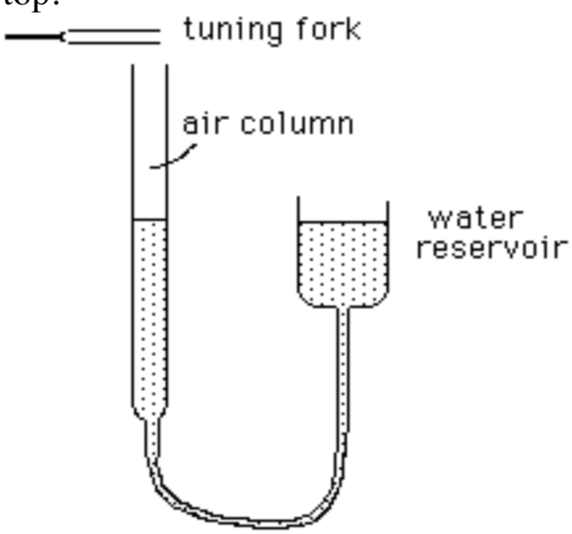
Procedure

PART A-The set up: we will start with a small air column and slowly increase its length by lowering the water reservoir.

(1) Make sure that the column is vertical, stable, and that the stopper and tubing are properly connected so water can't leak out.

(2) Practice hitting the tuning fork on your heel until you are confident that you can get 'good vibrations' every time.

(3) Adjust the water reservoir until the water in the tube is about 10 cm from the top.



(4) Strike the tuning fork and hold it over the top of the air column. For best results, the tines of the fork should be aligned one over the other and the fork should be held in a horizontal position.

(5) Listen very carefully and slowly move the water reservoir toward the floor. As the water flows out of the tube, the length of the air column will increase and there will be two or three different air column lengths that, because of constructive interference of sound waves, will produce significantly louder sounds. Record these lengths one at a time as you find them. Be careful!- Ignore the quieter, high pitched sounds. This part of the lab will take some practice and some patience. When the tuning fork stops vibrating, hit it again.

(6) Select a tuning fork with a different frequency and go back to step 3.

LAB 8 DATA SHEET-Speed of sound Name________________Section____

Room Temperature_______

PART B-Data analysis -Please show the calculations on an attached sheet.

(1) From the recorded lengths of the air columns, determine 1/2 the wavelength of the sound that was produced by taking the average distance between consecutive resonance points. Double that distance and you will have the wavelength of the sound produced by that tuning fork.

(2) Calculate the speed of sound using the information for each fork. Remember that v = frequency x wavelength

(3) Determine your average value for the speed of sound.

(4) Using the equation v = 331.45 m/s + 0.61T m/s, where 'T' is the Celsius temperature, determine the accepted value for the speed of sound in air at today's temperature and calculate your percent error.

Freq. of fork (Hz) length of air column (m)

1)________ 1st antinode______2nd antinode_______3rd antinode______

Ave diff.______wavelength______ velocity______

2)________ 1st antinode______2nd antinode_______3rd antinode______

Ave diff.______wavelength______ velocity______

3)________ 1st antinode______2nd antinode_______3rd antinode______

Ave diff.______wavelength______ velocity______

4) ________ 1st antinode______2nd antinode_______3rd antinode______

Ave diff.______wavelength______ velocity______

Average velocity__________ Accepted value_________% error____________