LAB 15.3 Speed of Sound Name______________________________

Discussion

In this experiment you will use the concept of resonance to determine the wavelength and speed of a sound wave in air. You are familiar with many applications of resonance. You may have heard a vase across the room rattle when a particular note on a piano was played, or you may have noticed an annoying rattle in your car whenever you travel at a certain speed. Your textbook has other examples of resonating objects.

Gases can resonate as well; organ pipes, flutes, and soda-pop bottles make sound by resonating air. A vibrating tuning fork held over an open tube may vibrate the air column in it at its resonant frequency. The length of the air column can be adjusted by moving it up or down with its lower end immersed in water. The volume of the sound becomes loudest when the air column is the proper length for maximum resonance at the frequency of the tuning fork.

When an air column in a tube resonates, there is a small amount of air just above the tube that also vibrates. This "extra length" must be added to the length of the air column in the tube to account for the total length of the vibrating air column. Fortunately, this correction is easy to calculate:

"extra length" = 0.4 x diameter of tube.

Procedure

Given the information above and what you have learned in class about standing waves in air columns, devise a method for determining the wavelength and speed of sound waves using resonance in air columns. Make a sketch showing the mode of vibration in the air column. (Hint: consider each end of the column – is it a node or an antinode?)

Compare your proposed method with those suggested by your lab partners. Come to a group decision on how to proceed. (This includes what measurements to make and how to calculate λ and v.)

Perform the experiment at least three times, using a different tuning fork each time.

Analysis

1. Calculate the wavelength and the speed of sound for each of the frequencies tested.

2. Calculate the average speed of sound from the three outcomes above.

3. The accepted value for the speed of sound in air is 332 m/s at 0 °C. The speed of sound increases 0.6 m/s for each degree Celsius above zero. Measure the temperature of the air in the tube and calculate (a) the accepted value for the speed of sound, and (b) the percent error considering the entire range of your average outcome.

Data – record all measurements in a table below *(or attach spreadsheet)*

Calculation setups:

Conclusion

SPEED OF SOUND IN AIR = ________________m/s
(average)

ACCEPTED VALUE: ______________ m/s % ERROR: _________ %