Speed of Sound Lab

Name _____ Class _____ Date _____ EN_____

Purpose:

The purpose of this lab is to determine the speed of sound using the principle of resonance.

Materials:

Large graduated cylinder, ice, thermometer, meter stick, and tuning forks

Background Research:

In this experiment you will use the principle of resonance to determine the wavelength of a sound wave. If you know the frequency of a sound source you can then calculate the speed of sound using the equation below.

Speed of Sound (v) = frequency (f) x wavelength (λ)

Have you ever seen a person shatter a glass with their voice? This is because of resonance. Every object has a natural frequency. If you match the natural frequency of an object, then resonance will occur and the object will vibrate strongly- maybe even strongly enough to break a glass! By holding a vibrating tuning fork over an open tube of water and adjusting the length of the tube, it is possible to get the air column to vibrate at its natural frequency. This will be noticed because the volume becomes louder at the proper length. For a tube open at one end, resonance occurs when the air column is about 1/4th of the wavelength of the sound.

Procedure:

1. Put some water (2/3 full) into a graduated cylinder.
2. The accepted speed of sound is 332 m/s at 0°C, and increases 0.6 m/s for each Celsius degree above zero. Use a thermometer to find the temperature of the air in the cylinder above the water in ° C.
   a. What is the temperature of the air in the cylinder? _____ ° C
   b. Multiple the temperature by 0.6 m/s per degree = _____ m/s
   c. Add your answer from step **b** to the accepted speed of sound (332 m/s) + _____ m/s
   d. What is the accepted value for the speed of sound at the current temperature? _____ m/s

3. Hold the tube in the water. Record tuning fork frequency and tap a tuning fork on a soft object and place the vibrating fork near the opening of the tube. Move the tube up and down until the sound resonates (gets loud). Tuning fork frequency _____ Hz
4. Measure the distance (loudest resonance) in centimeters from the top of the water level to the top of the tube. Record this distance. Convert the distance to meters. _____ cm ÷ 100 = _____ m
5. To find a more accurate wavelength value, you must now correct for the small amount of air just above the tube that also vibrates. To do this, measure the diameter of the tube**.** _____ cm
6. Next multiply the diameter of the tube by **4/10**. This will give you the correct distance for the small amount of air above the tube that vibrates. Diameter x 0.4 = _____ cm

7. Now add the extra length of the air above the tube to the length of the tube when resonance occurred. This number represents 1/4 wavelength in centimeters.1/4 wavelength = Length of tube + _____ = _____cm
8. Now calculate one full wavelength for the sound of the tuning fork

   Wavelength = ¼ wavelength x 4

   = _____ cm x 4 = _____ cm
9. Convert your final answer from centimeters to meters.

   Wavelength _____ cm ÷ 100 = _____ m
10. Repeat the procedure for a second tuning fork.

Data:

	Tuning Fork 1	**Tuning Fork 2**
Length of tube when resonance occurred (cm)		
Diameter of tube (cm)		
Diameter of tube x .4 (cm)		
1/4 Wavelength (cm)		
Wavelength (m)		
Frequency (Hz)		
Speed of Sound (m/s) = frequency (f) x wavelength (λ)		

Questions:

1. How could you tell when resonance occurred in the lab?
2. What is resonance?
3. How does the speed of sound that you calculated compare to the accepted value of the speed of sound?
4. Does sound travel faster in warm or cool air?
5. Which tuning fork had the higher pitch (frequency)? Tuning fork 1 or Tuning fork 2?
6. Which tuning fork had the higher wavelength? Tuning fork 1 or Tuning fork 2?
7. What type of relationship is there between frequency and wavelength? Direct or inverse?
8. What through what type of wave does sound travel?