LAB 25, RESONANCE & SPEED OF SOUND

Name ________________________ Period_____

Resonance, or sympathetic vibration, is the reinforcing of wave strength. It occurs when the natural vibration rates of two objects are the same. The air column in a closed glass tube produces its best resonance when it is approximately one-fourth as long as the wavelength of the sound that it reinforces. A small correction in wavelength must be made for the internal diameter of the tube. The wavelength of the sound may be calculated from the resonant length of the tube by using the equation $\lambda = 4(l + 0.4d)$, where λ (lambda) is the wavelength, l is the length of the resonant column of the closed tube, and d is the diameter of the tube.

In this experiment the best resonant length of a closed tube will be determined and from this length and the diameter of the tube, the wavelength of the sound will be calculated. The speed of sound will then be calculated from the equation $v = f\lambda$, where v is the speed of sound, f is the frequency, and λ is the wavelength.

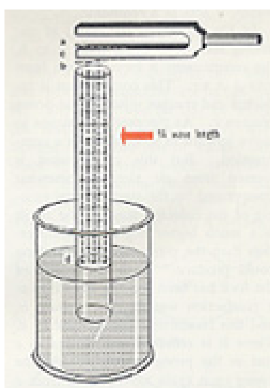
OBJECTIVE:

After completing this experiment, you should know how to determine the resonant length of a closed tube for a known frequency and to use this technique for determining the speed of sound in air of known temperature.

PROCEDURE Part I:

To set a tuning fork vibrating, hold it by the shank and strike it with the tuning fork hammer. **(do not strike the fork on the table top or other hard surface).**

1. Set up a cylinder as shown in Figure 25-1. Using a siphon tube, fill the cylinder with water and establish a siphon so that the water level may be varied.



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2. Set the tuning fork to vibrating **(do not strike the fork on the table top or other hard surface)** and, while holding the vibrating fork over the open end of the glass tube, slowly raise and lower the water level with the siphon tube until a position is located where resonance produces the **loudest** sound. Then, hold the tube firmly in the optimum resonance position while another student measures the length of the air column from the **top** of the **tube** to the **water surface** inside the tube in centimeters. Record this data table below.

3. Measure the **internal diameter** of the tube in centimeters and record it.

4. Collect and record data for two more forks of **different frequencies**. The frequencies are stamped on the forks.

5. Take and record the temperature of the water in the tube.

Data Table

Fork Frequency Hz	Length of Tube cm	Diameter of Tube cm	Temp of water ^{o}C
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CALCULATIONS:

1. Compute the wavelength of the sound from the resonant length of the air column for each fork and record in the calculations table. $\lambda = 4(l + 0.4d)$.

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2. Compute the speed of sound for each fork from the wavelength and frequency data and record in the calculations table as your experimental values. $v = f\lambda$.

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3. Change your speed of sound from **cm/s** to **m/s** by dividing by **100cm/m**. and record it.

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4. Calculate and record the accepted speed of sound in air at the temperature of the resonant air column (the water). $v = 331$ **m/s + 0.6(t) m/s.** $t = {}^{o}C$**.**

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5. Calculate your experimental error and record it. **HINT: Percent error = your error/accepted value X 100%.**

Calculations Table

Wavelength λ cm	Speed of sound experimental cm/s	Speed of Sound experimental m/s	Speed of Sound Accepted m/s	Your error m/s	Percent error
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QUESTIONS:

1. If a longer glass tube were available, would it be possible to find another position where resonance is produced? Explain.

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2. Account for any discrepancies between the speeds of sound found by the different forks.

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3. Explain how the amplitude of vibration affects the data?

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5. How could you modify the experiment to find the resonant length of an open pipe? Hint: For an open pipe resonator $\lambda = 2(l + 0.8d)$.

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PROCEDURE Part II:

Experience the sound action of the **Spoon**, **Fork**, and **Coat Hanger**. List observations.

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CRITIQUE: