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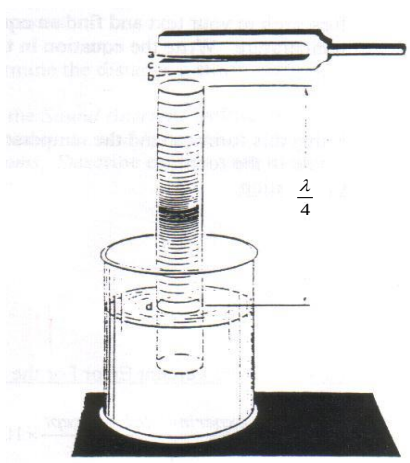
SPEED OF SOUND IN AIR

Purpose: To determine the speed of sound in air using resonance in a closed tube.

Introduction: If a tuning fork is placed over the open end of a closed tube, the air column inside the tube will resonate when it is one-fourth of a wavelength long. Adjusting the length of the air column in the tube by moving it up and down in the water, a position can be found where the sound is amplified by resonance. If the length of the closed tube is measured at that point, the wavelength of the sound wave can be found from the following



Equation: $\lambda = 4(L + 0.3D)$
where *L* is the length of the air column
and *D* is the diameter of the tubing.

Knowing the frequency of the sound stamped on the tuning fork and the wavelength, the speed of sound is calculated as the product of the two.

Part I: Data Collection

(Do two trials for 3 different tuning forks)

Trial	Frequency (Hz)	Length of air column (m)	Wavelength (m)	Speed of Sound (m/s)
1				
2				
1				
2				
1				
2				
			Average Speed of Sound =	

Sample Calculation: Show a sample calculation for determining the wavelength and speed of sound for one of your trials.

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PART II: Theoretical Calculations

You will now calculate the theoretical speed of sound based on the ambient air temperature and the equation below.

Temperature of the Air: _____ ^{0}C

The equation for the speed of sound in air at a given temperature is given by the equation below:

$$v_s = 332 + 0.6T$$

Where, v_s is the speed of sound and T is the temperature of the air in ^{o}C. Using this formula, and the temperature you measured, determine the *accepted speed* of sound in the room.

Calculation:

Determine the percent error For the Speed you found and the accepted value found above

$$\%error = \frac{experimental - accepted}{accepted\ value} \times 100\%$$

Calculation:

PART III:

Determine the **frequency of an unknown** tuning fork using the methods you have learned from this lab. Do two trials and find the average.

Trial	Length of tube (m)	Wavelength (m)	Frequency (Hz)
1			
2			

Average frequency: _____

Sample Calculation:

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Part IV: Discussion and Follow-up

1. When do the speed of sound waves travel the fastest; in hot or cold temperatures? Explain by referencing the equation.
2. On page 448, **read** how it is possible to determine the distance a storm is from you based on when you see a lightning flash. Write in your own words how this is done.
3. On page 449, **read and define** the terms *Mach Number* and the *Sound Barrier*. Also define the following terms: *Mach number, supersonic, subsonic, and hypersonic*.
4. **Read and make a short note** about the *Sound Barrier* and *Sonic Booms*.
5. Do the questions from the **hand-out**. All work must be shown.

Marking Rubric & Checklist:

Check List:

	Unacceptable	Acceptable
Part 1	One or more of the items in the acceptable column is not complete or is unacceptable.	Table is completed correctly. Information is neat and legible. The data values are accurate. The average speed calculation is done and close to the accepted value. One sample calculation is done; all work is shown and units are included.
Part 2	One or more of the items in the acceptable column is not complete or is unacceptable.	Air temperature is recorded. The equation is written in the box and each of the variables is described. Calculation of the speed of sound using the equation is complete, correct and all work is shown. Percent error calculation is complete, correct and all work is shown.
Part 3	One or more of the items in the acceptable column is not complete or is unacceptable.	Table is completed correctly. Information is neat and legible. The data values are accurate. The average frequency is calculated correctly. One sample calculation is done; all work is shown and units are included.
Part 4	One or more of the items in the acceptable column is not complete or is unacceptable.	Explanation of why speed of sound in faster in hot air is completed. Explanation of storm distance is completed. Definitions are completed and accurate. Sound barrier and sonic boom definitions are completed and correct. All questions from the assignment questions have been attempted.

Question Marking Scheme (deductions):

1 mark	for each question not attempted or done incorrectly, but attempted
0.5 mark	Answer is correct, but the form of your written solutions is poor, key steps are missing

Total: **/10**

You will only receive a mark if the check list is completed satisfactorily. Your total is zero until each part has been completed.