Name: _____

Air Columns: Determining the speed of sound in air

Apparatus:
- Graduated cylinder and plastic tube
- Tuning fork of known frequency
- Thermometer
- Ruler or meter stick

Background:
- When a vibrating tuning fork is held at the open of an air column, the column acts as a resonator closed at one end and open at the other.
- Standing waves are produced with a node at the bottom of the column (surface of the water)
- When the length of the tube above the water matches the position of an antinode (maxima), the sound you hear will be particularly loud. The sound is quieter when the top of the tube is between antinodes.
- ***Note*** *that the exact position of the antinode (zone of high air pressure) is a little above the edge of the plastic tube (about 1 to 2 cm). Therefore, if you only locate one maxima, your measured wavelength will be smaller than the true value (assuming that you measure from the surface of the water to the top of the plastic tube). The method that eliminates this source of error requires that you locate at least 2 maxima (Ms Bernabei will explain this method in class)*

Data

Air temperature (in °C)	
Frequency of tuning fork (in Hz)	
Length at first antinode: L_1 (in m)	
Length at second antinode: L_2 (in m)	

Calculations

Speed of Sound determined through resonant air column method (standing waves):

wavelength: $\lambda = 2\times(L_2 - L_1) =$ _____

speed of sound: $v = f\lambda =$ _____

Speed of Sound in air determined using the theoretical equation (temperature and pressure are relevant):

For air at sea level, the speed of sound is given by

$$v = 331\tfrac{\text{m}}{\text{s}}\sqrt{1 + \frac{T_{\text{C}}}{273°\text{C}}} = 331\tfrac{\text{m}}{\text{s}}\sqrt{\frac{T_{\text{K}}}{273\,\text{K}}}$$

$v =$ _____

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Data Analysis

Compare your two measured values for the speed of sound in air:

% difference = $\dfrac{[v_1 - v_2]}{[(v_1+v_2)/2]} \times 100\%$ = _____

Sources of Error: (write in full sentences – not point form)
- Limitations when measuring air temperature:

- Limitations when measuring length:

Strategies utilized to minimize the effect of sources of error: (write in full sentences – not point form)
- air temperature:

- length:

Conclusion: Were the speeds determined by the two methods equal, within reasonable experimental limits? Refer to the % difference calculation when stating your conclusion, and explain the context with reference to the sources of error (e.g. if you say something like this, *"With a percent difference of 15%, the speeds determined by the two methods are equal, within reasonable experimental limits."* Follow up with a few sentences explaining why a 15% difference is reasonable, due to the specific sources of error that were relevant to the experimental method)