Prelab 5:
Resonant Pipes & Harmonic Series

PHYS 1320
Fall 2014
Due at the beginning of class.

1) It is a very hot day in Dallas, and the speed of sound is 400 m/s. Given the formula,

\[ v = 332 \left( \frac{m}{s} \right) + 0.6 \left( \frac{m}{s^\circ C} \right) T, \]

determine the present temperature in Celsius. (We will use \( v_{\text{sound}} = 400 \text{ m/s} \) for the prelab exercise ONLY to make the numbers come out nicely.)

2) OPEN PIPE: Draw the resonant standing wave patterns corresponding to the lowest 3 frequencies of an OPEN pipe. (You may draw pressure or displacement—your choice.)

\[ L = \frac{2\lambda}{N}, \quad N = 1, 2, 3, \ldots \]

\[ f = \frac{v}{\lambda} = \frac{Nv}{2L} \]

Use this formula, with \( v_{\text{sound}} = 400 \text{ m/s} \) to compute the first 3 resonant frequencies. For the length of the pipe use \( L = 1 \text{ m} \).
3) CLOSED PIPE: Draw the resonant standing wave patterns corresponding to the lowest 3 frequencies of a CLOSED pipe. (You may draw pressure or displacement–your choice.)

You should observe a pattern. We will now calculate the frequency. If \( L = \frac{N}{4} \lambda \) where \( N = 1, 2, 3, \ldots \), then \( \frac{1}{\lambda} = \frac{N}{4L} \). Using \( v = f\lambda \), we have:

\[
f = \frac{v}{\lambda} = \frac{Nv}{4L}
\]

Use this formula, with \( v_{\text{sound}} = 400 \text{ m/s} \) to compute the first 3 resonant frequencies. For the length of the pipe use \( L = 1 \text{ m} \).

4) COMPARISON:
Fill in the following tables. (Yeah, we only calculated the first 3 resonances, but you’re smart and can figure out the pattern–we make use of this in the lab.)

<table>
<thead>
<tr>
<th>OPEN PIPE</th>
<th>CLOSED PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonance</td>
<td>Frequency</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>