Introduction: This activity is designed for you to measure and compare, to accepted values, the lengths of closed air columns that resonate with a known frequency.

In your theory section of your laboratory report, I will be expecting you to discuss the concept of resonance and standing wave patterns. I will expect you to clarify what is meant by a closed-end air column and how standing waves can be set up in these columns. I will expect you to discuss how a column can resonate at the same frequency at various lengths and how a column of a given length can generate harmonics. I will further expect you to discuss how various closed air column instruments sound different when playing the same tone (Read pg. 501-503 of the text book. Also Google search the following expression *harmonic signature of instruments*)

Materials

- Thermometer
- Tall cylinder
- Metre stick
- Glass tube
- 8 tuning forks
- Rubber Hammer

Procedure:

1. Nearly fill a closed-end tube or graduated cylinder with water at or near room temperature. Place a hollow glass tube (open at both ends) in the tube containing the water.
2. Record the temperature of the room.
3. Strike the tuning fork with the rubber hammer and dampen the high frequency ring by quickly and lightly sliding your finger over the bottom 3rd of the fork.
4. Hold the tuning fork over the top end of the glass tube, taking care not to allow the tuning fork to strike the tube.
5. Slowly draw the tube out of the water and listen for the first resonant point. You will hear it when the intensity of the tone reaches a sudden peak.
6. Measure the length of the air column from the surface of the water to open end of the glass tube and record this measurement as your first resonant lengths. Include the frequency of the tuning fork as well as the associated note (i.e. high C = 512 Hz) when you record your observations
7. Repeat the above steps for the remaining 7 tuning forks.
8. Using the extra long glass tube, determine all the resonant lengths of the tube using the “high C” tuning fork (512 Hz).

Observations:

Record all collected data in tabular (chart or table) format

Analysis:

1. Determine the speed of sound and, using the frequency of the tuning fork, determine the wavelength of the sound wave.
2. Use the theoretical equation for closed-one-end columns to determine the various resonant lengths.
3. Compare your experimentally determined resonant length to those obtained by applying the theory. Do the results support the theory behind resonance in closed air columns?
4. Discuss how the theory of resonance and standing wave patterns is applied to open air columns. Give examples of musical instruments which operate under this principle.
5. Based on your observations you should have three resonant lengths associated with “high C” (512Hz). Determine the following ratios “shortest length / middle length” and “shortest length / longest) rounding off to the closes whole-number ratio. Compare these ratios to first 3 resonant lengths that are predicted by theory for a tube closed at one end. Draw a diagram to indicate the standing wave patterns for the first 3 resonant lengths

Conclusion: