CONCEPTUAL PHYSICS LAB SPEED OF SOUND

PURPOSE: To measure the speed of sound in air and compare it to the expected value.

INTRODUCTION: Compared to most objects, sound waves travel very fast. It is fast enough that measuring the speed of sound is a technical challenge. One method you could use would be to time an echo. For example, if you were in an open field with a large building a quarter of a kilometer away, you could start a stopwatch when a loud noise was made and stop it when you heard the echo. You could then calculate the speed of sound.

MATERIALS: Stopwatches, thermometer, tape measure

PROCEDURE:

1. Your first task will be to learn the length of your average pace. To do so, you will walk at your normal, natural pace for a distance of 10 meters. Record how many paces (steps) you take to walk this distance: _____.

2. Divide 10 meters by the number of paces it took you to determine the length of your average pace, in meters. Record your average pace here, with units: _____.

3. Now, we will go outside to the field and choose an appropriate location from which to time an echo. Once we determine our location, you should pace out the distance from the building or wall to the spot where we will stand to time the echo. Make sure to walk at your same normal, natural pace. Record the number of paces: _____.

5. We will use the clapping technique and a stopwatch to time the echo of our claps. Record the number of claps here: _____. The number of claps tells you the number of round trips the sound made during the time you are recording. Do three trials, and record the three times and the average time here:
time #1: _____ time #2: _____ time #3: _____. Average time: _____

6. While we're outside, we should record the temperature of the air, which affects the speed of sound. Record the air temperature here, with units: _____.

7. Using our data for the distance the sound traveled and the time it took to do so, calculate the speed of sound below, showing your steps.

8. Now use the outside air temperature to calculate the *actual* speed of sound, using the formula below. Be sure to watch your units!

$v_{\text{sound in air}} = (331.4 + 0.6T)$ *meters per second*, where T is the air temperature in °C.

ANALYSIS:

1. Calculate a percent error for your experimentally determined speed of sound. For your information,

$$\%error = \frac{|\text{actual value} - \text{experimental value}|}{\text{actual value}} x100$$

2. Write a paragraph analyzing the experimental error involved in your ***method*** of measuring the speed of sound. Do NOT write "human error" in this analysis. (If you believe that a human made a mistake, describe exactly what it was. Then continue with your experimental error analysis.) Remember, experimental error means something that is impossible to completely correct for when following the procedure dictated for the lab, rather than an actual mistake that could be avoided.