

Measuring the Speed of Sound in Air Using a Starter's Gun Name: _____

Aim: To calculate the speed of sound in air by measuring the average time taken for sound to travel a systematically varied distance.

Apparatus: Starter's gun, at least 12 'caps' and ear muffs for starter/s, Trundle wheel (or measuring tape), cones, stop watches (one each), thermometer

Method:

1. Use a trundle wheel to measure out and mark distances of 100m, 150m, and 200m (and beyond if possible) in an appropriate area.
2. The starter stands on the zero marker with both hands in the air. In one hand they will be holding the gun and in the other a flag of some sort. They then drop their flag hand down and count 1, 2, BANG (the gun fires on "3"). This helps the timers anticipate when the gun will fire.
3. The students use their stopwatches to measure the time between seeing the pistol smoke and hearing the sound. They start timing when they see the smoke and stop timing when they hear the sound.
4. Repeat Steps 2 and 3 twice at this distance (so there should be three times).
5. Repeat Steps 2-4 at the other distances specified in Step 1.
6. Since the speed of sound in air varies with air temperature, record the air temperature (in the shade).

Results:

Air Temperature: _____ °C

| distance (m) | time (s) | Av. Time (s) | Speed (m/s) |
|--|----------|--------------|-------------|
| | | | |
| | | | |
| | | | |
| | | | |
| Discounting the highest and lowest value you calculated for speed, calculate an overall average. | | | Av. = |

I measured the speed of sound to be about _____ m/s. In _____ °C air (today's air temperature), the actual speed of sound according to the table below is about _____ m/s.

Questions

| Temp (°C) | Speed of Sound (m/s) (measured by high-tech equipment) |
|-----------|---|
| +35 | 352 |
| +30 | 349 |
| +25 | 346 |
| +20 | 343 |
| +15 | 340 |
| +10 | 337 |
| +5 | 334 |
| 0 | 331 |
| -5 | 328 |

1. Calculate the difference between the speed of sound that you calculated and the actual speed of sound shown in the table (for the right temperature).

Difference = _____ - _____ = _____

2. Calculate the percentage error.

$\% \text{ error} = \frac{\text{difference}}{\text{actual speed of sound}} \times 100\% = \underline{\hspace{2cm}}$

3. How did your value of the speed of sound compare to the accepted values?

4. What uncertainty is associated with your timing measurements? Why do you take an average of the timing data?

5. What uncertainty is associated with your distance measurements?

6. How does the temperature of the air affect the speed of sound?
