The Speed of Sound in Air

|  |  |  |
| --- | --- | --- |
| Author: |  | Jared Fowler |
| Lab Partners: |  | Chikheang Soeng |
|  |  | David Awad |
| Class/Period: |  | Physics M20C Lab. Thursday 1pm-4pm. |
| Date: |  | January 26, 2019 |

Theory

Procedure

Analysis / Discussion

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 1.1**  **Open Resonance Air Column Apparatus at Variable Length** | | | |
| **Frequency (Hertz)** | **(1/4) (meters)** | **(3/4) (meters)** | **(5/4) (meters)** |
| 600 | 0.135 | 0.420 | 0.720 |
| 500 | 0.170 | 0.506 | 0.850 |
| (Note: ) | | | |

|  |  |  |
| --- | --- | --- |
| **Table 2.1**  **Acoustic Delay Time** | | |
| **Test Number** | **Distance ‘d’ (meters)** | **Time Difference ‘t’ (Seconds)** |
| 1 | 0.400 | 0.00119 |
| 2 | 0.270 | 0.00082 |
| 3 | 0.435 | 0.00124 |
| (Note: ) | | |

Calculations

|  |  |  |
| --- | --- | --- |
| **Calculation 1.1 -**  **Speed of Sound from Average Wavelength and Frequency (600Hz)** | | |
|  |  | 1.1a |
|  |  | 1.1b |
|  |  | 1.1c |
|  |  |  |
|  |  | Average of 1.1a-1.1c |
|  |  |  |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| **Calculation 1.2 -**  **Speed of Sound from Average Wavelength and Frequency (500Hz)** | | |
|  |  | 1.2a |
|  |  | 1.2b |
|  |  | 1.2c |
|  |  |  |
|  |  | Average of 1.2a-1.2c |
|  |  |  |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| **Calculation 1.3 -**  **Error Propagation for Speed of Sound with Average Wavelength and Frequency** | | |
|  |  | Definition of wave speed. |
|  |  |  |
|  |  | Take partial derivatives in respect for wavelength and frequency. |
|  |  |  |
|  |  | Definition for absolute error. |
|  |  |  |
|  |  | Definition for relative error. |
|  |  |  |
|  |  | Substitute in partial derivatives and V. Simplify. Note: . |
|  |  |  |
|  |  | Use the smallest measured wavelength to estimate largest possible error. |

|  |  |  |
| --- | --- | --- |
| **Calculation 1.4 -**  **Percent Discrepancies for Speed of Sound with Average Wavelength and Frequency** | | |
|  |  | Definition of percent discrepancy. |
|  |  |  |
|  |  | Percent discrepancy for 600Hz test. |
|  |  |  |
|  |  | Percent discrepancy for 500Hz test. |

|  |  |  |
| --- | --- | --- |
| **Calculation 2.1 -**  **Speed of Sound from Acoustic Delay Time** | | |
|  |  | 2.1a |
|  |  | 2.1b |
|  |  | 2.1c |
|  |  |  |
|  |  | Average of 2.1a-2.1c |

|  |  |  |
| --- | --- | --- |
| **Calculation 2.2 -**  **Error Propagation for Speed of Sound from Acoustic Delay Time** | | |
|  |  | Definition of speed. |
|  |  |  |
|  |  | Take partial derivatives in respect for distance and time. |
|  |  |  |
|  |  | Definition for absolute error. |
|  |  |  |
|  |  | Definition for relative error. |
|  |  |  |
|  |  | Substitute in partial derivatives and V. Simplify. Note: . |
|  |  |  |
|  |  | Use the smallest measured distance and time to estimate largest possible error. |

|  |  |  |
| --- | --- | --- |
| **Calculation 2.3 -**  **Theoretical Speed of Sound in Dry Air** | | |
|  |  | Empirical equation for the speed of sound, where ‘T’ is air temperature in Celsius. |
|  |  |  |
|  |  | Measured temperature at time of experiment was 23.3C. |

|  |  |  |
| --- | --- | --- |
| **Calculation 2.4 -**  **Percent Discrepancy for Speed of Sound from Acoustic Delay Time** | | |
|  |  | Definition of percent discrepancy. |
|  |  |  |
|  |  | Use the empirical formula result from Calculation 2.3 and the experimental average. |

Conclusion