Speed of Sound in Air         Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Partner(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Course: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Time:\_\_\_\_\_\_\_

**Purpose:** Determine the speed of sound in air using different methods.

Introductory Video: [**https://www.youtube.com/watch?v=wXRNKz0xMOU&t=**](https://www.youtube.com/watch?v=wXRNKz0xMOU&t=)

**A. Temperature Method**

Apparatus: PC with interface and temperature sensor.

Theory: Speed of sound in air (in m/s) at temperature T (in Kelvin) is given by;   
   
where γ = 1.40 (ratio of specific heats for air),   
*R* = 8.3145 J/(mol.K) (Gas constant), and   
*M* = average molar mass of air in Kg.

Procedure  
1. Write down the percentages of the three most abundant gases (avoid H2O) found in the Earth’s lower atmosphere using the website shown below: (Scroll down to Table 7a-1) [**http://www.physicalgeography.net/fundamentals/7a.html**](http://www.physicalgeography.net/fundamentals/7a.html)

2. Write down the atomic masses for the above three gases using this periodic table: <https://ptable.com/#Properties>

3. Calculate the average molar mass of air (in Kg) using the above three abundant gases found in the Earth’s lower atmosphere.

DATA:

Room temperature, *t* = \_\_\_\_\_\_\_\_\_\_\_0C =  \_\_\_\_\_\_\_\_\_K.

Speed of sound (using temperature) = *V* = \_\_\_\_\_\_\_\_\_\_\_\_

**B.** [**Air-Column Resonance**](https://www.youtube.com/watch?v=d7W2niNqHWg) **Method**

Apparatus: Resonance tube apparatus with water and speaker, audio signal generator, stand w/clamp, sound sensor, interface, and water.

DATA

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Dial Frequency (Hz) | First Resonance Point, L1 (cm) | Second Resonance Point, L2 (cm) | Change in Resonance Points,  L2-L1 (cm) | Wavelength, λ (cm) | Speed of sound, V (cm/s) | Speed of sound, V (m/s) |
| 400 |  |  |  |  |  |  |
| 500 |  |  |  |  |  |  |
| 600 |  |  |  |  |  |  |
| Average Speed of Sound | | | | |  |  |

**C. Echo Method**   
  
Repeat the measurements and complete the Data table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Length of tube**  **(m)** | **Round trip travel Distance (m)** | **Time for initial pulse (s)** | **Time for echo (s)** | **Round trip Travel Time**  **(s)** | **Speed of sound**  **(m/s)** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| Average speed of sound | | | | |  |