Physics Exploration Homework Supplement P111-1.pdf

Measuring the Speed of Sound through Air and Water

Go to the Physics Exploration Center. Enter through the resource room 311/312 Thaw Hall. This exploration project involves calculating the speed of sound through air and through water and then comparing them.

Part A: (Set-up P111-1A) In the PEC you will find a station with a blue or green colored PVC (plastic) pipe and a microphone positioned above one end of the pipe. The microphone is connected to a computer so that you can measure the amount of time it takes for a sound pulse to travel down and back up the hollow PVC pipe.

1. Click on the "COLLECT" button to get the computer ready to record the sound. Note that the microphone is located next to one end of the PVC pipe. Make a sound by snapping your fingers or clapping your hands very close to the microphone. Wait for the waveform to be displayed as a function of time on the computer screen .

2. You should notice two distinct groups of peaks in your wave: the first group of peaks corresponds to the initial sound wave that you produced by snapping your fingers and smaller group(s) of peaks corresponds to the sound wave that hits the microphone after traveling through the pipe and reflecting back from the other end of the pipe (or possibly several reflections).

3. Print out the graph for submission with your answers. Note the time between the first two groups of peaks on the graph.

4. What is the distance traveled by the wave to go from one end of the PVC pipe to the other? Do you think it is equal to the length of the pipe or twice the length?

5. From the knowledge of the distance traveled by the wave and the time you measured in section 3 above, how can you calculate the speed of the wave? Write down a formula and calculate the speed of the wave through air.

PART B: (Set-up P111-1B) In this section of the experiment we will measure how fast a sound pulse travels through a water filled PVC pipe. Instead of only using one microphone, as we did in Part1, in this exercise we will be using two microphones in conjunction to measure the pulse's transit time and from that measured time calculate the pulses speed.

6. Microphone 1 is taped very near to the "Striking End" of the water filled PVC pipe. Place microphone 2 fully into the opposite end of the long white PVC pipe. [You will note

there is a BLUE mark on the PVC pipe to indicate the actual position of the microphone.]

7. Measure the distance from microphone 1 to the Blue Mark where microphone 2 is positioned. Write down this measurement.

8. Click on the "COLLECT" button to get the computer ready to record the sound pulse. Sharply strike the metal bolt in the end of the PVC pipe nearest to microphone 1 with the provided metal rod to produce a sound pulse that can travel down the PVC pipe and be recorded by microphone 2.

9. The top graph on the computer is the record of the pulse arriving at microphone 1 the bottom graph is a record of the pulse arriving at microphone 2. Using the "EXAMINE" button in the tool bar to measure the transit time of the pulse. Record this time.

10. From the transit time found in step 9 calculate the speed of sound in water.

11. Compare the speed of the wave through air you calculated in step 5 with the speed of the wave through water you calculated in step 9. Which one is larger? Does it make sense?

12. Write down the relation we discussed in the class for the speed of sound through the gas and liquid in terms of the elastic and inertial properties of the medium. Is the density of air larger or smaller than the density of solid? Based upon considerations of inertial properties alone, does your comparison in step 11 make sense? If so, please explain. If not, what can you conclude about the elastic property of the gas vs. the elastic property of the solid (recall from the lecture that the more elastic the medium the faster the sound waves travel through that medium).