Speed of Sound – MCA Physical Science

Introduction

The speed of sound varies slightly with temperature, but at constant temperature, the distance sound travels increases linearly with time according to the equation, D = Vt, where D is the distance traveled (in meters), V is the speed of sound (in m/s), and t is the time in seconds. In this experiment, the time for the report of a firecracker to travel specific round trip distances will be measured as a test of the above formula. *Hypothesis:* The distance sound travels is linear in time, according to D = Vt, and the velocity is well approximated by accounting for temperature.

Method

Data will be acquired as a class by setting a fire cracker a series of carefully measured distances from a large flat wall and igniting the firecracker a short distance from a microphone while digitally recording the microphone signal. The initial report and the echo off the wall should be easily visible in the data when graphed. The time between these two signals is the round trip travel time of the sound to the wall and back (keep in mind that the travel distance is TWICE the distance of the firecracker from the wall). After the digital files are acquired and saved, they will be provided to students for analysis.

Students should graph each file to determine the direct report time and the echo time. The difference is the round trip travel time. These times are to be recorded carefully in a table in the results section along with the raw distances and the round trip distances. When computing the round trip distance, be sure to convert to m and multiply by 2. Then the distance data is plotted vs. the time data in graph.exe. When fitting to a trendline in graph.exe, be sure to check the box to set the vertical intercept to zero, as the hypothesis predicts not only a linear relationship, but also a vertical intercept of zero (a direct proportionality.

Results

Distance (ft)	Direct T (s)	Echo T(s)	Round Trip T(s)	Round Trip D (m)

Table 1: Distance vs. Time for Firecracker echo off wall.

Your results section should also contain the graph described above complete with the best fit line showing the slope and R squared. Make sure the axes are labeled properly (with units) and numbered. The slope of the line is the best estimate of the speed of sound from the available data.

This sheet can form the first page of your lab report with the figure described above, together with descriptive captions forming the rest of the results section. Your discussion should state clearly whether the hypothesis was supported, as well as why you think it may or may not have been supported. If you were to perform this experiment again, how would you reduce the uncertainties and errors? Look up online the expected speed of sound for the temperature that day (the temperature can be found at weather web sites). Does your measured value agree with the expected value at the given temperature?

Your lab report will be graded as follows: *Results section*: 50% *Discussion section: 5*0%