

Sound, echoes, ultrasound and hearing

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

How fast does sound travel in air? In this outdoor lab you will use the echo from a large wall and the time between claps to measure the speed of sound. You will repeat the timing five times, calculate a mean and judge how reliable the result is.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** IGCSE 3.4

Aim

To measure the speed of sound in air by timing echoes from a large wall.

Equipment

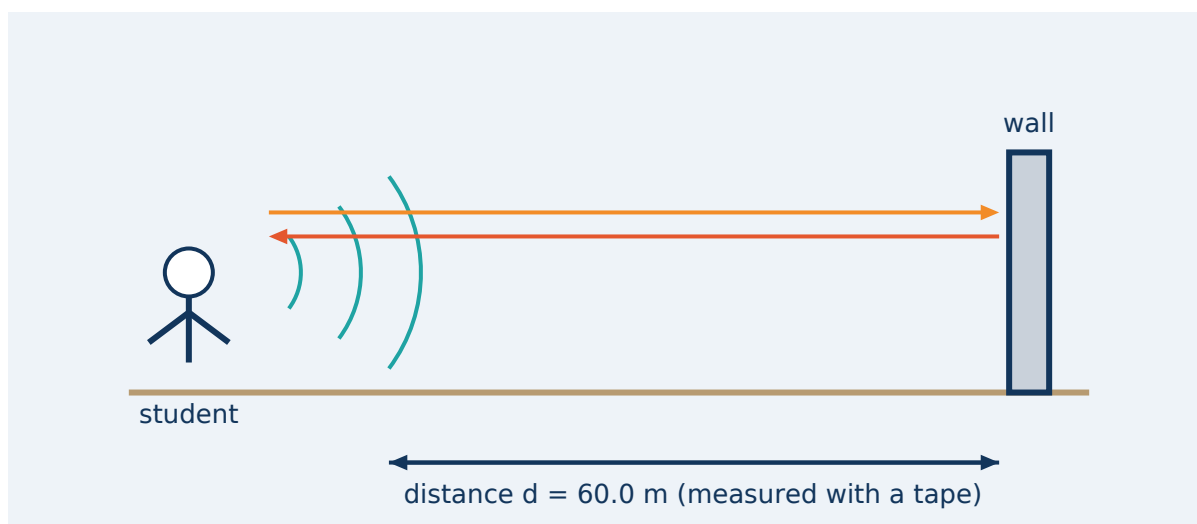
- a large flat wall or building face in an open area
- trundle wheel or 30 m tape (two lengths) to measure 60.0 m
- stopwatch (phone is fine)
- two wooden blocks or a clapperboard to make a sharp sound
- notebook and calculator

Safety

Safety

Work away from roads and keep a safe distance from the wall. Do not use very loud noise makers near other people or animals, and work in dry weather on level ground.

Method



Echo method: sound goes to the wall and comes back.

1. Measure 60.0 m from the wall with the tape or trundle wheel and stand at that spot.
2. Clap the blocks together, listen for the echo, and clap again exactly when you hear the echo. Keep clapping so that every clap coincides with the echo of the one before.
3. Start the stopwatch at one clap (call it zero) and stop it at the 20th interval after the first.
4. Repeat five times and record each time.
5. Calculate the time for one interval and the speed of sound.

Results

Sample measurements. Distance to the wall $d = 60.0 \text{ m}$. Each time is for 20 intervals.

Trial	1	2	3	4	5
Time for 20 intervals (s)	7.4	7.2	7.3	7.1	7.5

Analysis questions

Question 1 Mean time

Calculate the mean time for 20 intervals.

Question 2 Time for one interval

Calculate the time between one clap and the next, and explain what this time represents.

Question 3 Speed of sound

Calculate the speed of sound from the mean.

Question 4 Comparing

The accepted value at 20°C is about 343 m/s . Calculate the percentage difference of your

result from this value.

Question 5 Why 20 intervals

Explain why timing 20 intervals is better than timing one.

Question 6 Uncertainty

Estimate the uncertainty in the mean time from the range of the five readings, and give it as a percentage.

Question 7 Effect of conditions

Predict the effect on the measured speed if the experiment is repeated on a hotter day, and suggest why the wind could cause an error.

Question 8 Improvement

Suggest two improvements to the method.