

Wavelength, frequency and how waves behave

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

Name: _____ Date: _____ Class: _____

Does the speed of water waves change when you change their frequency? In this lab you will use a ripple tank to measure the wavelength at several frequencies, calculate the speed with $v = f \lambda$ and look for a pattern. You will also predict what happens in shallow water.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS4-1, GCSE P6

Aim

To measure the speed of water waves in a ripple tank and to test whether the speed is the same at different frequencies.

Equipment

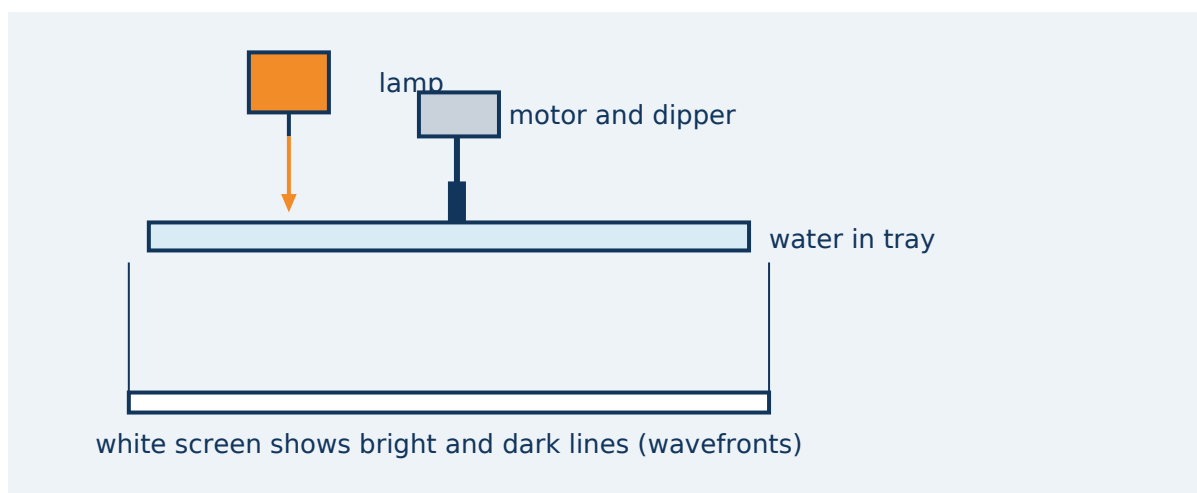
- ripple tank with a lamp, tray and white screen (or a large clear dish on a white sheet)
- motor-driven dipper with a variable frequency control
- stroboscope or a phone camera to freeze the pattern
- 30 cm ruler
- water (about 5 mm deep)
- stopwatch or the dipper frequency display

Safety

Safety

Keep mains electrical equipment away from the water. Dry your hands before touching switches. Wipe up spills at once because wet floors are a slipping hazard.

Method



Ripple tank: a motor-driven dipper makes waves and the lamp casts their shadows on the screen.

1. Fill the tray to a depth of about 5 mm and check that it is level. Lower the dipper so that it just touches the water.
2. Set the dipper to 6.0 Hz. Use the stroboscope (or a photo) to freeze the pattern on the screen.
3. Measure the distance across 5 wavelengths on the screen with the ruler. Divide by 5 to get the wavelength.
4. Repeat at 8.0, 10, 12 and 14 Hz without changing the depth of the water.
5. Calculate the speed $v = f \lambda$ for each frequency.

Results

Sample measurements (distances already scaled to real size on the tray):

f (Hz)	Distance across 5 wavelengths (cm)	λ (cm)	$v = f \lambda$ (cm/s)
6.0	14.5	2.9	17.4
8.0	11.0	2.2	17.6
10.0	9.0	1.8	18.0
12.0	7.5	1.5	18.0
14.0	6.5	1.3	18.2

Analysis questions

Question 1 Wavelength from 5 waves

Show how the wavelength was found at 8.0 Hz and explain why five wavelengths are measured together.

Question 2 Calculate the speeds

Verify the speed at 12.0 Hz and calculate the mean speed of all five.

Question 3 Spread of results

By how many percent does the lowest speed fall below the mean? Decide whether the five speeds agree.

Question 4 Expected graph

A graph of wavelength (y) against $1/f$ (x) is plotted. Describe its shape and what its gradient represents.

Question 5 Gradient from one point

Use the point $f = 6.0$ Hz and the origin to estimate the gradient.

Question 6 Prediction

Use the mean speed to predict the wavelength at 9.0 Hz.

Question 7 Entering shallow water

A glass plate is placed in the tray to make the water shallower. At 10 Hz the wavelength over the plate is 1.2 cm. Calculate the speed over the plate and compare it with the deep value.

Question 8 Errors and improvement

Describe one source of error and one improvement.