

Wavelength, frequency and how waves behave

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

Model answers use the sample results. Your own values depend on the tray and water depth, but the speed should be almost constant across frequencies when the depth does not change. Explain any difference by pointing to reading uncertainty and the way the pattern is measured.

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

Question 1 Wavelength from 5 waves

$\lambda = 11.0 / 5 = \mathbf{2.2 \text{ cm}}$. Measuring five wavelengths together divides the reading error of the ruler (about 0.1 cm) by five, so the wavelength is more precise.

Question 2 Calculate the speeds

$v = 12.0 \times 1.5 = 18.0 \text{ cm/s}$. Mean = $(17.4 + 17.6 + 18.0 + 18.0 + 18.2) / 5 = 89.2 / 5 = \mathbf{17.8 \text{ cm/s}}$.

Question 3 Spread of results

The lowest speed is 17.4 cm/s, which is $17.84 - 17.4 = 0.44 \text{ cm/s}$ below the mean. $0.44 / 17.84 \times 100 = \mathbf{2.5 \%}$. The speed is the same within error.

Question 4 Expected graph

Since $\lambda = v \times (1 / f)$, the graph is a straight line through the origin and its gradient equals the wave speed v .

Question 5 Gradient from one point

$1 / f = 1 / 6.0 = 0.167 \text{ s}$. Gradient = $2.9 / 0.167 = \mathbf{17.4 \text{ cm/s}}$.

Question 6 Prediction

$\lambda = v / f = 17.8 / 9.0 = \mathbf{1.98 \text{ cm}}$, about 2.0 cm.

Question 7 Entering shallow water

$v = f \lambda = 10 \times 1.2 = \mathbf{12 \text{ cm/s}}$, which is lower than the deep-water value of about 18 cm/s. The waves are slower in shallow water and the wavelength is shorter.

Question 8 Errors and improvement

The stroboscope may not freeze the pattern exactly, or the screen may magnify the pattern so lengths are not true. Improvement: **calibrate with an object of known length on the screen** and repeat each reading.