

Interference, resonance and the Doppler shift

AP Physics 2 (algebra-based) · Lab

Name: _____ Date: _____ Class: _____

How does the spacing of double-slit fringes change with the distance to the screen? You will measure the spacing at several distances and use the gradient of a graph to find the wavelength of a laser pointer.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 14

Aim

Measure how the fringe spacing from a double slit changes with the distance to the screen, then use the gradient to find the wavelength of a laser pointer.

Equipment

- red laser pointer (class 2, under 1 mW)
- double-slit slide, slit separation 0.25 mm
- clamp stand and clamp
- white screen or wall
- tape measure and 30 cm ruler
- tape or blu-tack

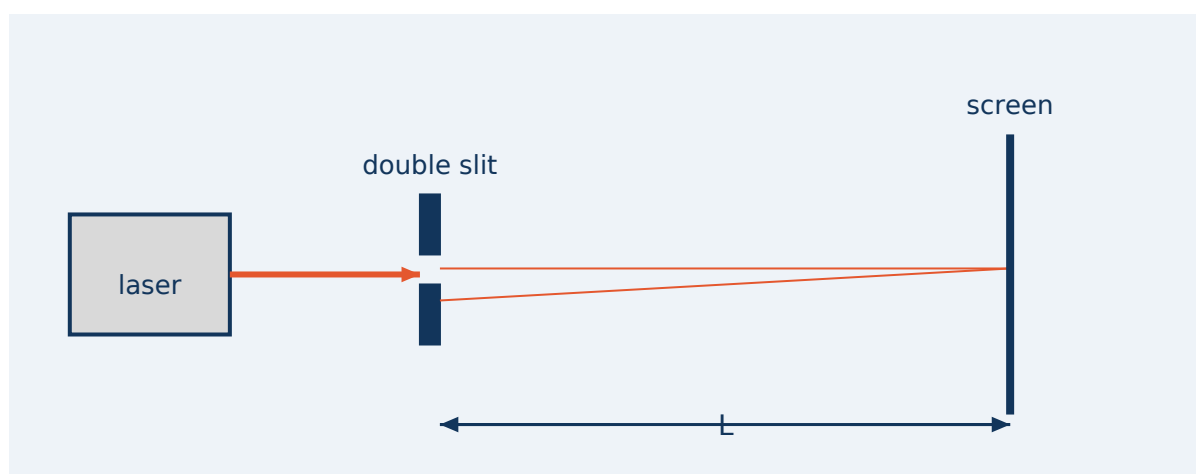
Safety

Safety

Never look into the beam or point it at another person. Block the beam after the screen so it cannot reflect off a shiny surface. Switch the laser off when you are not measuring.

Method

1. Clamp the laser and slide so the beam crosses the slits. Tape a sheet of paper to the screen.
2. Place the screen 1.00 m from the slide, measured with the tape. Switch on and adjust until a clear pattern appears.
3. Mark the centres of 11 bright fringes along the paper (10 gaps). Measure the length of the 10 gaps and divide by 10 to find the fringe spacing Δy .
4. Repeat for $L = 1.50, 2.00, 2.50$ and 3.00 m.



Lab set-up: change L and record the fringe spacing each time.

Results

Sample measurements from Bilal in Lahore (slit separation $d = 0.25 \text{ mm}$):

$L \text{ (m)}$	Distance across 10 gaps (mm)	$\Delta y \text{ (mm)}$
1.00	26	2.6
1.50	39	3.9
2.00	53	5.3
2.50	64	6.4
3.00	79	7.9

Analysis questions

Question 1 Calculate the fringe spacings

Show how the distance across 10 gaps gives Δy , and state why measuring 10 gaps is better than 1 gap.

Question 2 Plot the graph

Plot Δy (vertical axis, in mm) against L (horizontal axis, in m). Draw a best-fit line and describe its shape.

Question 3 Gradient

Calculate the gradient of the best-fit line using the first and last points. Give the units.

Question 4 Wavelength

Use the gradient and the slit separation to calculate the wavelength in nanometres.

Question 5 Compare with the label

The laser is labelled 650 nm. Calculate the percentage difference between your value and 650 nm.

Question 6 Uncertainty

State two sources of uncertainty in measuring Δy and the largest one, then suggest one improvement.

Question 7 Predict a green laser

Predict the fringe spacing at $L = 2.00$ m for a green laser of wavelength 532 nm. Explain your reasoning.