Where Stripes Land

Model the bright fringes in a double-slit pattern.

HS-PSII-9.5 "Develop graphical and mathematical representations that describe the relationship between the wavelength of monochromatic light, spacing between slits, distance to screen..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the fringe-position equation, circle the three quantities you can change, and number the three change-and-effect pairs that describe how those quantities affect stripe spacing.

Laser Stripes at the Museum

1. At a science museum, a laser shines through two narrow slits onto a distant wall. Bright stripes appear where waves from the slits arrive in step; dark gaps appear where they cancel. The center stripe is order zero. Order one is the nearest bright stripe on either side, measured from the center.

2. For small angles, the distance y_n from the center to bright stripe number n is approximately $n\lambda L/d$. Here λ is wavelength, d is slit spacing, and L is the slit-to-screen distance. Convert all lengths to the same unit before calculating. The table records order-one positions from four possible museum setups.

MUSEUM DOUBLE-SLIT SETUPS

Setup	Wavelength (nm)	Slit spacing (mm)	Screen distance (m)	Order-one position (mm)
A	500	0.25	2	4
B	750	0.25	2	6
C	500	0.50	2	2
D	500	0.25	3	6

3. A graph of order-one position against wavelength is a straight line through the origin when slit spacing and screen distance stay fixed. Its slope is L/d when the graph uses consistent length units. Increasing wavelength or screen distance spreads bright stripes apart; increasing slit spacing pulls them together. The stripes remain symmetric around the center.

2 ANSWER WITH EVIDENCE

Use the passage

1. In setup A, how far from the center is an order-two bright stripe? Show how you used the table or equation.

2. Changing from setup A to setup B changes the wavelength. By what factor does the stripe spacing change, and where would an order-three bright stripe appear in setup B?

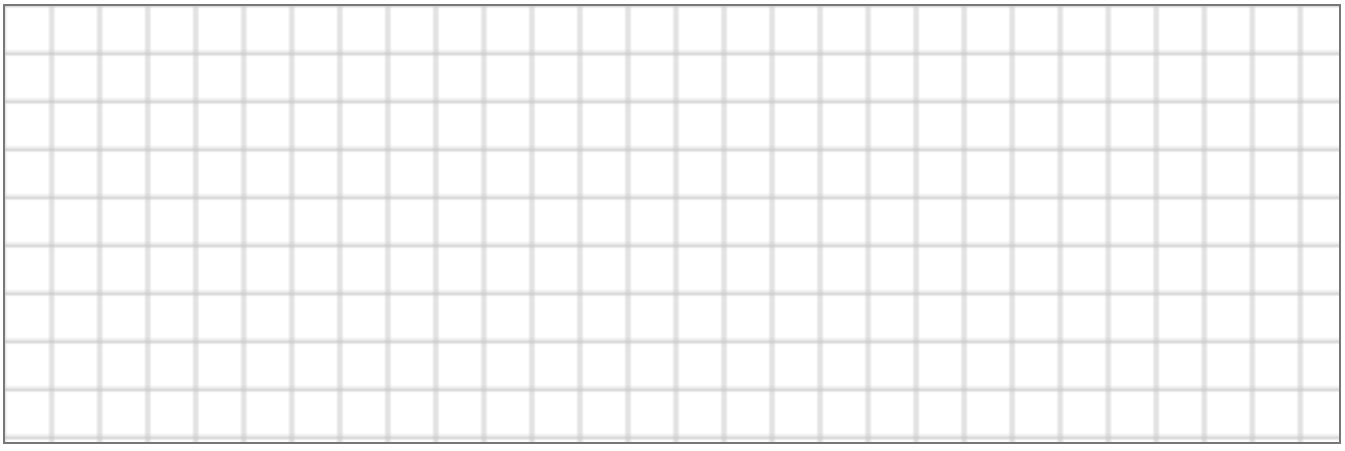
3. Suppose the wavelength is 500 nm, the slit spacing is 0.50 mm, and the screen distance is 3 m. Predict the order-one position.

4. For a graph of order-one position against wavelength, use setups A and B to give two points and find the slope in mm per nm.

3 YOUR TURN

Your own words

A new setup uses 600 nm light, slit spacing of 0.30 mm, and a screen distance of 1.5 m. On the grid, put bright-stripe order on the horizontal axis and right-side position in mm on the vertical axis, then plot orders 0 through 3 and draw the line; below the grid, explain what happens to those positions if the screen distance doubles.



Where Stripes Land

PART 1 · READ AND MARK

Underline the fringe-position equation, circle the three quantities you can change, and number the three change-and-effect pairs that describe how those quantities affect stripe spacing. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In setup A, how far from the center is an order-two bright stripe? Show how you used the table or equation.	**8 mm. Order two is twice the 4 mm order-one position.**
2	Changing from setup A to setup B changes the wavelength. By what factor does the stripe spacing change, and where would an order-three bright stripe appear in setup B?	**Spacing increases by a factor of 1.5, from 4 mm to 6 mm for order one. An order-three stripe is 18 mm from the center.**
3	Suppose the wavelength is 500 nm, the slit spacing is 0.50 mm, and the screen distance is 3 m. Predict the order-one position.	**3 mm. Compared with setup C, increasing the screen distance from 2 m to 3 m multiplies its 2 mm position by 1.5.**
4	For a graph of order-one position against wavelength, use setups A and B to give two points and find the slope in mm per nm.	**The points are (500 nm, 4 mm) and (750 nm, 6 mm). The slope is (6 − 4)/(750 − 500) = 0.008 mm per nm.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Plot (0, 0), (1, 3), (2, 6), and (3, 9), with order on the horizontal axis and position (mm) on the vertical axis, and draw a straight line through the points. Doubling the screen distance leaves order zero at 0 mm and moves orders 1, 2, and 3 to 6, 12, and 18 mm.

Accept positions on either side of the center when a question does not specify a side. For Your Turn, check that the axes are labeled and that the plotted positions increase by 3 mm per order.