Exercise 36.3 - Enhanced - with Solution

Light of wavelength 585 nm falls on a slit 0.0666 mm wide.

You may want to review (Page) .

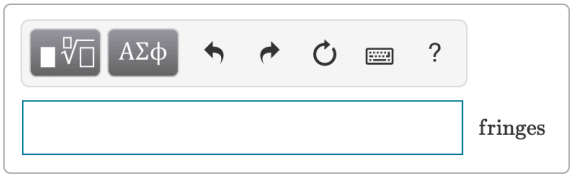
For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of Single-slit diffraction.

Review | Constants

Part A

On a very large distant screen, how many *totally* dark fringes (indicating complete cancellation) will there be, including both sides of the central bright spot? Solve this problem *without* calculating all the angles! (*Hint*: What is the largest that $\sin\theta$ can be? What does this tell you is the largest that m can be?)

Express your answer as an integer.

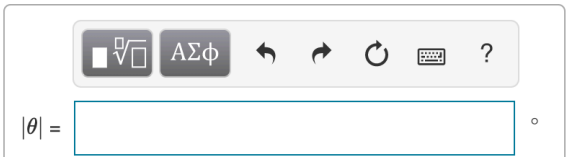


Submit Request Answer

Part B

At what angle will the dark fringe that is most distant from the central bright fringe occur?

Express your answer in degrees.



Exercise 36.9 - Enhanced - with Feedback

Sound with a frequency of 1250 Hz leaves a room through a doorway with a width of 1.05 m .

Review | Constants

Part A

At which angles relative to the centerline perpendicular to the doorway will someone outside the room hear no sound? Use 344 $\mathrm{m/s}$ for the speed of sound in air and assume that the source and listener are both far enough from the doorway for Fraunhofer diffraction to apply. You can ignore effects of reflections.

Enter your answers in ascending order separated by commas. Express your answers in degrees.

$|\theta| =$ °

Submit | Request Answer

Provide Feedback

Next

Exercise 36.11 - Enhanced - with Solution

Red light of wavelength 633 nm from a helium-neon laser passes through a slit 0.400 mm wide. The diffraction pattern is observed on a screen 3.80 m away. Define the width of a bright fringe as the distance between the minima on either side.

You may want to review (Page) .

For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of Single-slit diffraction.

Review | Constants

Part A

What is the width of the central bright fringe?

Express your answer in meters.

$w =$ m

Submit Request Answer

Part B

What is the width of the first bright fringe on either side of the central one?

Express your answer in meters.

$w_1 =$ m

Submit Request Answer

Exercise 36.15

Public Radio station KXPR-FM in Sacramento broadcasts at 88.9 MHz. The radio waves pass between two tall skyscrapers that are 15.0 m apart along their closest walls.

Review | Constants

Part A

At what horizontal angles, relative to the original direction of the waves, will a distant antenna not receive any signal from this station?

Enter your answers in ascending order separated by commas. Enter only positive angles. Express your answers in dergees.

$\theta =$ °

Submit Request Answer

Part B

If the maximum intensity is 3.40 $\mathrm{W/m^2}$ at the antenna, what is the intensity at $\pm 5.50^\circ$ from the center of the central maximum at the distant antenna?

Express your answer in watts per square meter.

$I =$ $\mathrm{W/m^2}$

Exercise 36.42 - Enhanced - with Feedback

A wildlife photographer uses a moderate telephoto lens of focal length 135 mm and maximum aperture $f/4.00$ to photograph a bear that is 14.0 m away. Assume the wavelength is 550 nm.

Review | Constants

Part A

What is the width of the smallest feature on the bear that this lens can resolve if it is opened to its maximum aperture?

Express your answer in millimeters.

$x =$ mm

Submit Request Answer

Part B

If, to gain depth of field, the photographer stops the lens down to $f/22.0$, what would be the width of the smallest resolvable feature on the bear?

Express your answer in millimeters.

$x =$ mm

Exercise 36.43 - Enhanced - with Feedback

The Hubble Space Telescope has an aperture of 2.4 m and focuses visible light (400-700 nm). The Arecibo radio telescope in Puerto Rico is 305 m (1000 ft) in diameter (it is built in a mountain valley) and focuses radio waves of wavelength 75 cm.

Review | Constants

Part A

Under optimal viewing conditions, what is the smallest crater that each of these telescopes could resolve on our moon?

Express your answers in meters separated by a comma.

$y_{\text{Hubble}}, y_{\text{Arecibo}} =$ m

Submit Request Answer

Part B

If the Hubble Space Telescope were to be converted to surveillance use, what is the highest orbit above the surface of the earth it could have and still be able to resolve the license plate (not the letters, just the plate) of a car on the ground? Assume optimal viewing conditions, so that the resolution is diffraction limited. Assume that the size of the license plate is 30 cm.

Express your answer in kilometers.

$s =$ km

Problem 36.47

Laser light of wavelength 632.8 nm falls normally on a slit that is 0.0200 mm wide. The transmitted light is viewed on a distant screen where the intensity at the center of the central bright fringe is 8.90 $\mathrm{W/m^2}$.

Review | Constants

Part A

Find the maximum number of totally dark fringes on the screen, assuming the screen is large enough to show them all.

Express your answer as an integer.

m_{max} =

Submit Request Answer

Part B

At what angle does the dark fringe that is most distant from the center occur?

Express your answer in degrees.

$|\theta_{\mathrm{max}}|$ = °

Part C

What is the maximum intensity of the bright fringe that occurs immediately before the dark fringe in part (b)? Approximate the angle at which this fringe occurs by assuming it is midway between the angles to the dark fringes on either side of it.

$I =$ $\mathrm{W/m^2}$

Submit Request Answer