Chapter 22 Homework

Due: 8:00am on Wednesday, February 3, 2010

Note: To understand how points are awarded, read your instructor's Grading Policy.

[Return to Standard Assignment View]

	Constructive and Destructive Interference Conceptual Question
	rent radio waves broadcasting in phase are located as shown below. Each grid square is 0.5 m square, and the radio sources
broadcast at $\lambda = 2.0$	) m.
	* • <sub>B</sub> • <sub>A</sub> • <sub>C</sub> • <sub>D</sub> *
Part A	
At Point A is the int	erference between the two sources constructive or destructive?
Hint A.1	Path-length difference
	Hint not displayed
Hint A.2	Find the path-length difference
	Hint not displayed
ANSWER:	
ANOWER:	constructive     destructive
	o destructive
	Correct
Part B	
At Point B is the int	erference between the two sources constructive or destructive?
Hint B.1	Find the path-length difference
	Hint not displayed
L	
ANSWER:	○ constructive
	⊙ destructive
	Connect
	Correct
Part C	
At Point C is the int	erference between the two sources constructive or destructive?
ANSWER:	○ constructive
	• destructive
	Correct
Part D	
At Point D is the int	erference between the two sources constructive or destructive?
ANSWER:	
ANSWER.	constructive     destructive
	Correct
	Single-Slit Diffraction
You have been asked	to measure the width of a slit in a piece of paper. You mount the paper 80.0 centimeters from a screen and illuminate it from behind with laser light of wavelength 633 nanometers (in air).
You mark two of the	intensity minima as shown in the figure, and measure the distance between them to be 17.9 millimeters.
	k
Part A	

What is the width	a of the slit?
Hint A.1	The equation for single-slit diffraction
	Hint not displayed
Hint A.2	Small-angle approximations Hint not displayed
Express your answ	ver in micrometers, to three significant figures.
ANSWER:	$a = \frac{170}{Correct} \mu m$
Part B	
	tus were submerged in water, would the width of the central peak change?
Hint B.1	How to approach the problem Hint not displayed
ANSWER:	<ul> <li>The width would increase.</li> <li>The width would decrease.</li> <li>The width would not change.</li> </ul>
	Correct
When redia	Why You Can Still Receive AM Radio in a City
vavelengths refract	ry to pass through a city, they encounter thin vertical slits: the separations between the buildings. This causes the radio waves to diffract. In this problem, you will see how different as they pass through a city and relate this to reception for radios and cell phones. You will use the angle from the central of the central intensity maximum to the first intensity minimum as a h of the central maximum (where nearly all of the diffracted energy is found).
Consider radio wa	ves of wavelength $\lambda$ entering a city where the buildings have an average separation of $a$ .
Part A	
_	the first minimum from the center of the central maximum.
Hint A.1 The equation for i	The equation for intensity ntensity as a function of angle for diffraction from a slit is
T	
	$I = I_0 \left( \frac{\sin[\pi a \sin(\theta)/\lambda]}{\pi a \sin(\theta)/\lambda} \right)^2.$
Hint A.2	A criterion for the first minimum
Which of the follo	wing is a correct (exact) criterion for the location of the first intensity minimum of the diffraction pattern?
Hint A.2.1	Finding the first intensity minimum Hint not displayed
ANSWER:	$\sin( heta) = \pi$
	$\theta = \pi$
	$\odot \sin( heta) = \lambda/a \ \odot \  heta = \lambda/a$
	$\theta = 0$
	Correct
Now solve for	θ in this criterion to obtain the expression that you need.
	ver in terms of $\lambda$ and $a$ .
ANSWER:	$\theta = \frac{\sin^{-1}\left(\frac{\lambda}{a}\right)}{Correct}$
Assume that the av	erage spacing between buildings is $a = 20 \text{ m}$ .
Part B	
	$f_{\rm FM}$ to the first minimum for an FM radio station with a frequency of 101 MHz?
Hint B.1	Find the wavelength Hint not displayed
Express your answ	ver numerically in degrees to three significant figures. Note: Do not write your answer in terms of trignometric functions. Evaluate any such functions in your working.
ANSWER:	$ heta_{\rm FM} = rac{8.54}{Correct}$ $\circ$
Part C	
What is the angle $\theta$	cell for a cellular phone that uses radiowaves with a frequency of 900 MHz?
Hint C.1	Find the wavelength Hint not displayed

ANNING	Express your answe	er in degrees to three significant figures.	
Image: Set in the set is the range is only the range is the range is the range is only interest.       Image: Set is the range is the range is the range is the range is only interest.         Image: Set is the range is the r		$\theta_{\rm coll} = 0.955$ $\circ$	
		Correct	
<ul> <li>i engine main</li> <li>i engine mai</li></ul>	<b>Part D</b> What problem do yo	u encounter in trying to find the angle $\theta_{AM}$ for an AM radio station with frequency 1000 kHz?	
I is did to explore the the functions of a structure did to explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure path is direct explore the function. Explore the function of a structure function of a structure function. Explore the function of a structure function. Explore the function of a structure function of a structure function. Explore the function of a structure function of a structure function. Explore the function of a structure function of a structure function. Explore the function of a structure function of a structure function. Explore the function of a structure function of a structure function. Explore the function of a structure function of a structure function of a structure function. Explore the function of a structure function of a structure function of a structure function. Explore the function of a structure function. Explore the function of a structure function of a	ANSWER:		
The problem backers share here in an an intension minimum for the wavelength of AM tailor. The maximum for feel types the integration of the maximum for feel types the wavelength of AM tailor. The maximum for feel types the maximum for the maximum for feel types		To find the angle it would be necessary to take the arcsine of a negative number.	
space of kips are obtained and ones in a singly back in any set of the product is made to a back in the set of college to a set of the product is made to a back in the set of college to a set of the product is reported to a set of the product is		Correct	
sectorement light of waveforgh 433 subservet is incident on a small probe in a piece of paper. On a serven 0,000 meters from the pinkde, you observe the diffuscion patter shows in the figure. You will be a served 0,000 meters from the pinkde, you observe the diffuscion patter shows in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters. The show figure of the shown in the figure of the central maximum to figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the shown in the shown in the shown	you are likely to e listening to AM ra	ncounter dead zones for cell phones in a city (unless you are in an area with many cell-phone towers), you should expect less trouble with FM radio, and you should have no trouble dio. Note also that some buildings have no roads between them, making for slits with much smaller width <i>a</i> . These slits give broad central maxima for FM radio waves, but still have	
sectorement light of waveforgh 433 subservet is incident on a small probe in a piece of paper. On a serven 0,000 meters from the pinkde, you observe the diffuscion patter shows in the figure. You will be a served 0,000 meters from the pinkde, you observe the diffuscion patter shows in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters, as shown in the figure. You will be the central maximum to be 10.3 millimeters. The show figure of the shown in the figure of the central maximum to figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the figure of the shown in the shown in the shown in the shown in the shown			
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has the diameter d of the pinkole?       If in the angular separation       If in not displayed         Int A.1       Find the angular separation       If in not displayed         Int A.2       Solve for the diameter       If in not displayed         express your answer in millimeters, to three significant figures.       If $a = 0.20$ If $a = 0.20$ ANSWER:       If $a = 0.20$ If $a = 0.20$ If $a = 0.20$ Interval       Double Slit 2       If $a = 0.00$ If $a = 0.00$ If $a = 0.00$ Int A.1       Second maximum and fourth minimum       If $a = 0.00$ If $a = 0.0$	-	diameter of the central maximum to be 10.3 millimeters, as shown in the figure.	
Hint not displayed         Hint not displayed         But not displayed         ANSWER: $d = 0.20$ Correct mm         Double Slit 2         Inter Not displayed         Inter Not displayed <th cos<="" td=""><td>Part A What is the diameter</td><td>• <i>d</i> of the pinhole?</td></th>	<td>Part A What is the diameter</td> <td>• <i>d</i> of the pinhole?</td>	Part A What is the diameter	• <i>d</i> of the pinhole?
Hit not displayed         Hit not displayed         But not displayed         ANSWER: $d = 0.20$ Correct mm         Correct mm         Double Slit 2         Inter Not displayed         In		·	
Hin not displayed         spress your answer in millimeters, to three significant figures.         ANSWER: $d = 0.120$ Correct mm         Conceptual Question 22.2         Answer in millimeters, to three significant figures.         Answer in millimeters, to three significant figures.         Double Slit 2         Second maximum and fourth minimum         Hint or displayed         Hint not displayed         Million terverence maximum and fourth minimum         Hint not displayed         Million terverence maximum and fourth minimum         Hint not displayed         Million terverence maximum and fourth minimum         Hint not displayed         Million terverence maximum and fourth minimum         Hint not displayed         Million terverence maximum and fourth minimum         Hint not displayed         Million terverence maximum and fourth minimum         Hint not displayed         Million terverence maximum and fourth minimum         Million terverence maximum and fourth minimum         Million terverence maximum and bourth minimum	11111 7.1		
a wave in millimeters, to three significant figures.         ANSWER: $d = 0.120$ $d = 0.120$ mm         Double Slit 2         Interview wavelength d/8 is shining light on a double slit with slit separation 0.500 mm. This results in an interference pattern on a screen a distance L away from the slits. We wish to shine a second laser, the adifferent wavelength, through the same slits.         And a different wavelength d/8 is shining light on a double slit with slit separation 0.500 mm. This results in an interference pattern on a screen a distance L away from the slits. We wish to shine a second laser, the adifferent wavelength h, and fourth minimum         Interview mavelength d/8 is shining light on a double slit with slit separation 0.500 mm. This results in an interference pattern on a screen a distance L away from the slits. We wish to shine a second laser, the adifferent wavelength h adifferent wavelength h and fourth minimum         Interview mavelength d/8 is shining light on a double-slit interference setup are given by         Interview maximum and fourth minimum         Interview maximum for a double-slit interference setup are given by         disting( $w_m$ ) = $m\lambda$ for $m = 0, \pm 1, \pm 2, \ldots$ wavelength of the interference maximum for a double-slit interference setup are given by         disting( $w_m$ ) = $m\lambda$ for $m = 0, \pm 1, \pm 2, \ldots$ wavelength of the maximum $d = 0.500 \text{ mm}$ for $m = 0, \pm 1, \pm 2, \ldots$ Note core	Hint A.2 Solve for the diameter		
ANSWER: $d = 0.120 \text{ Greece mm}$ Double Slit 2 Double Slit 2 Double Slit 2 Double Slit 2 Double Slit 4 Double Sl			
Haser with wavelength $d/8$ is shining light on a double slit with slit separation 0.500 mm. This results in an interference pattern on a screen a distance <i>L</i> away from the slits. We wish to shine a second laser, th a different wavelength, through the same slits. <b>art A</b> That is the wavelength $\lambda_2$ of the second laser that would place its second maximum at the same location as the fourth minimum of the first laser, if $d = 0.500 \text{ mm}$ ? <b>That A.1</b> Second maximum and fourth minimum Hint not displayed <b>That A.2</b> Locating interference maxima and minima Recall that the locations of the interference maxima for a double-slit interference setup are given by $d\sin(\theta_m) = m\lambda$ for $m = 0, \pm 1, \pm 2,,$ where $\theta_m$ is the angle to the maximum, 0.500 mm is the separation between the slits, and $\lambda$ is the wavelength of the light. Similarly, the locations of interference minima are given by the equation $d\sin(\theta_m) = \left(m + \frac{1}{2}\right)\lambda$ for $m = 0, \pm 1, \pm 2,$ <b>ANSWER:</b> $\lambda_2 = 0.109$ mm <b>Conceptual Question 22.2</b> a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase? <b>art A</b>		d = 0.120 mm	
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art A         That is the wavelength $\lambda_2$ of the second laser that would place its second maximum at the same location as the fourth minimum of the first laser, if $d = 0.500 \text{ mm}$ ?         Lint A.1       Second maximum and fourth minimum         Hint not displayed         Lint A.2       Locating interference maxima and minima         Receal that the locations of the interference maxima for a double-slit interference setup are given by $d \sin(\theta_m) = m\lambda$ for $m = 0, \pm 1, \pm 2, \ldots$ ,         where $\theta_m$ is the angle to the maximum, 0.500 mm is the separation between the slits, and $\lambda$ is the wavelength of the light. Similarly, the locations of interference minima are given by the equation $d \sin(\theta_m) = \left(m + \frac{1}{2}\right)\lambda$ for $m = 0, \pm 1, \pm 2, \ldots$ .         xpress your answer in millimeters.         ANSWER: $\lambda_2 = 0.109$ $\Delta_2 = 0.109$ mm         Conceptual Question 22.2       a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?         art A	A laser with waveler	gth $d/8$ is shining light on a double slit with slit separation 0.500 mm. This results in an interference pattern on a screen a distance $L$ away from the slits. We wish to shine a second laser,	
That is the wavelengh $\lambda_2$ of the second laser that would place its second maximum at the same location as the fourth minimum of the first laser, if $d = 0.500 \text{ mm}$ ? <b>Lint A.1</b> Second maximum and fourth minimum Hint not displayed <b>Lint A.2</b> Locating interference maxima and minima Recall that the locations of the interference maxima for a double-slit interference setup are given by $d\sin(\theta_m) = m\lambda$ for $m = 0, \pm 1, \pm 2,,$ where $\theta_m$ is the angle to the maximum, 0.500 mm is the separation between the slits, and $\lambda$ is the wavelength of the light. Similarly, the locations of interference minima are given by the equation $d\sin(\theta_m) = (m + \frac{1}{2})\lambda$ for $m = 0, \pm 1, \pm 2,$ <b>Aryress your answer in millimeters.</b> <b>ANSWER:</b> $\lambda_2 = 0.109$ mm <b>Conceptual Question 22.2</b> a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase? <b>art A</b>		length, through the same slits.	
Hint not displayed         Int A.2       Locating interference maxima and minima         Recall that the locations of the interference maxima for a double-slit interference setup are given by $d \sin(\theta_m) = m\lambda$ for $m = 0, \pm 1, \pm 2,,$ where $\theta_m$ is the angle to the maximum, 0.500 mm is the separation between the slits, and $\lambda$ is the wavelength of the light. Similarly, the locations of interference minima are given by the equation $d \sin(\theta_m) = \left(m + \frac{1}{2}\right)\lambda$ for $m = 0, \pm 1, \pm 2,$ xpress your answer in millimeters.         ANSWER: $\lambda_2 = 0.109$ Correct mm         Conceptual Question 22.2         a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?	Part A What is the wavelen	gth $\lambda_2$ of the second laser that would place its second maximum at the same location as the fourth minimum of the first laser, if $d = 0.500 \text{ mm}$ ?	
Int A.2       Locating interference maxima and minima         Recall that the locations of the interference maxima for a double-slit interference setup are given by $d \sin(\theta_m) = m\lambda  \text{for } m = 0, \pm 1, \pm 2, \dots,$ where $\theta_m$ is the angle to the maximum, 0.500 mm is the separation between the slits, and $\lambda$ is the wavelength of the light. Similarly, the locations of interference minima are given by the equation $d \sin(\theta_m) = \left(m + \frac{1}{2}\right)\lambda$ for $m = 0, \pm 1, \pm 2, \dots$ xpress your answer in millimeters.         ANSWER: $\lambda_2 = 0.109$ Correct       mm         Conceptual Question 22.2         a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?         art A	Hint A.1	Second maximum and fourth minimum	
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$d\sin(\theta_m) = \left(m + \frac{1}{2}\right)\lambda  \text{for } m = 0, \pm 1, \pm 2, \dots$ xpress your answer in millimeters.          ANSWER: $\lambda_2 = 0.109 \\ Correct$ mm         Conceptual Question 22.2         a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?         art A		$d\sin( heta_m) = m\lambda$ for $m = 0, \pm 1, \pm 2, \dots$	
xpress your answer in millimeters.         ANSWER: $\lambda_2 = 0.109$ Correct       mm         Conceptual Question 22.2         a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?         art A	where $\theta_{\rm m}$ is the ang	gle to the maximum, 0.500 mm is the separation between the slits, and $\lambda$ is the wavelength of the light. Similarly, the locations of interference minima are given by the equation	
ANSWER: $\lambda_2 = 0.109$ mm Correct mm Conceptual Question 22.2 a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase? art A		$d\sin( heta_m) = \left(m+rac{1}{2} ight)\lambda  ext{ for } m=0,\pm 1,\pm 2,\ldots$	
Conceptual Question 22.2 a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase? art A	Express your answe	er in millimeters.	
a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?	ANSWER:	$\lambda_2 = \frac{0.109}{Correct}$ mm	
a double-slit interference experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?			
art A		Conceptual Question 22.2	
	n a double-slit interf	erence experiment, which of the following actions (perhaps more than one) would cause the fringe spacing to increase?	
ANSWER:	Part A		
	ANSWER		
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	<u>2W</u>
Ca	Forrect
	Problem 22.10
A diffraction grating produc	uces a first-order maximum at an angle of 20.0°.
Part A	
What is the angle of the see	econd-order maximum?
ANSWER: $\theta_2$	$\theta_2 = \frac{43.2}{Correct}$ $\circ$
	Problem 22.11
ight of wavelength 580 m	in illuminates a diffraction grating. The second-order maximum is at angle 37.5°.
Part A	
How many lines per millir	imeter does this grating have?
ANSWER: 52	25 Correct

Score Summary: Your score on this assignment is 99.9%. You received 44.96 out of a possible total of 45 points.