Diffraction?

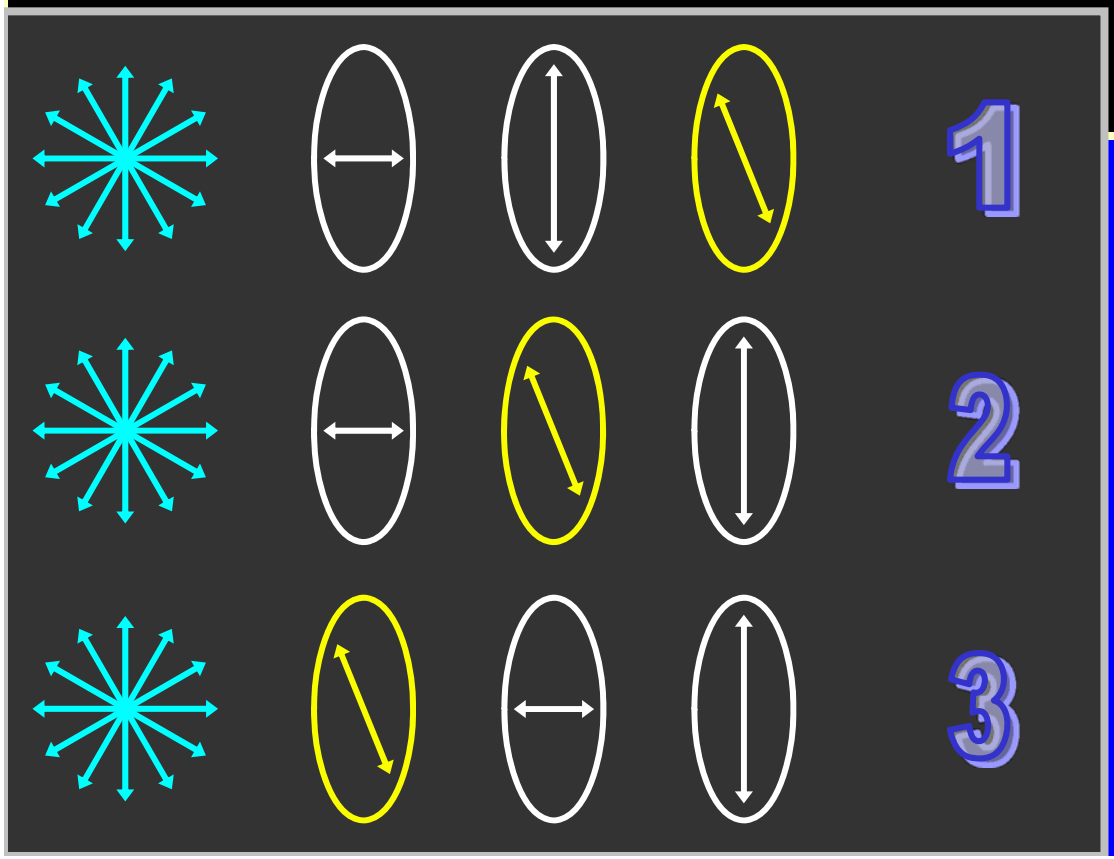
- Consider a beam of coherent monochromatic light. At a certain time and position, the beam shape is a perfect circle of diameter D. However, it is moving in free space.
- Will this beam show a diffraction pattern at a screen some distance far away later on?

A. Yes, sure
B. No way.

ConcepTest 35.3 Polarization

If unpolarized light is incident from the left, in which case will some light get through?

1) only case 1
2) only case 2
3) only case 3
4) cases 1 and 3
5) all three cases



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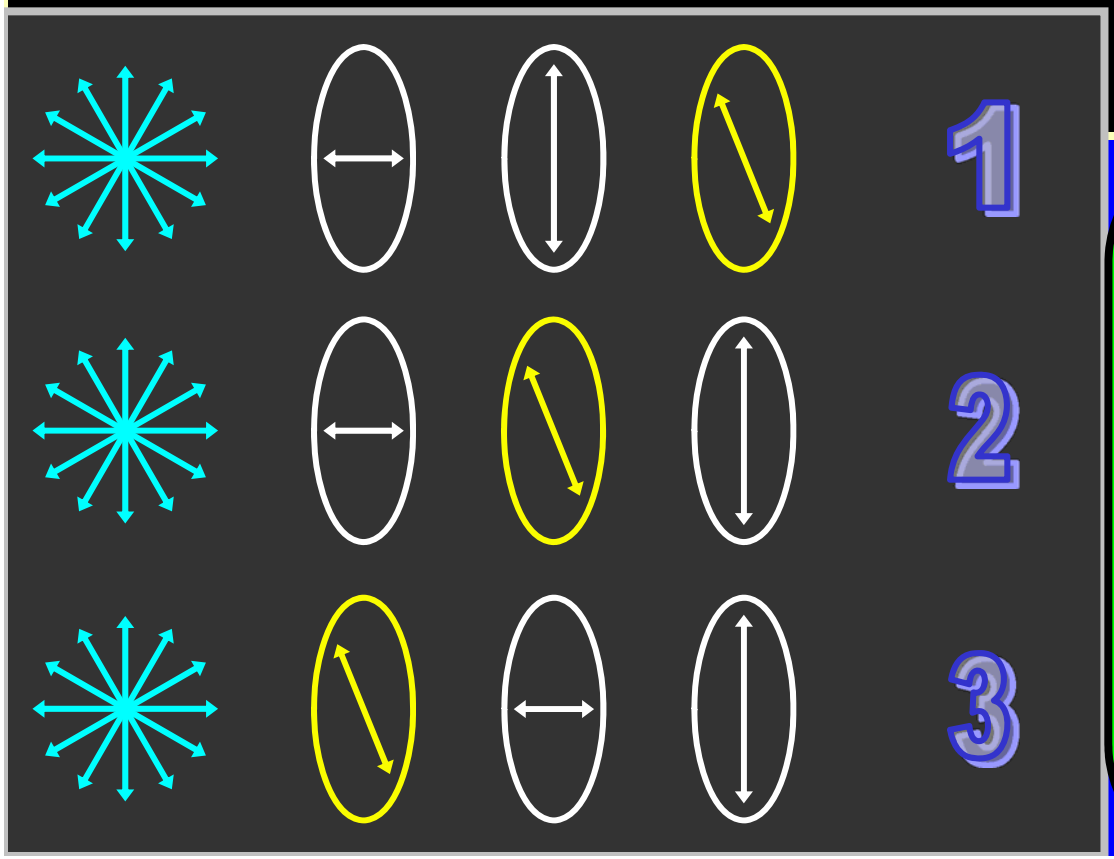
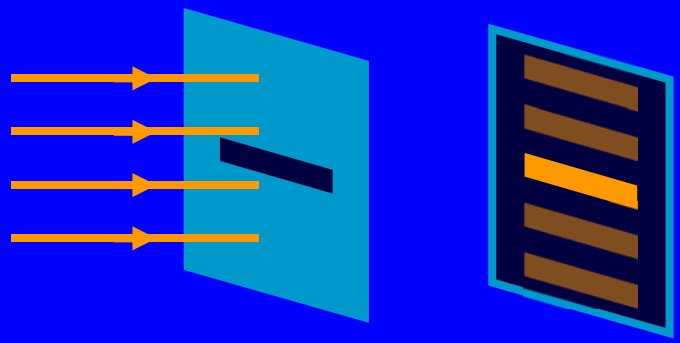


In cases 1 and 3, light is blocked by the adjacent horizontal and vertical polarizers. However, in case 2, the intermediate 45° polarizer allows some light to get through the last vertical polarizer.

ConcepTest 35.1a Diffraction I

The diffraction pattern below arises from a single slit. If we would like to sharpen the pattern, i.e., make the central bright spot narrower, what should we do to the slit width?

1) narrow the slit
2) widen the slit
3) enlarge the screen
4) close off the slit



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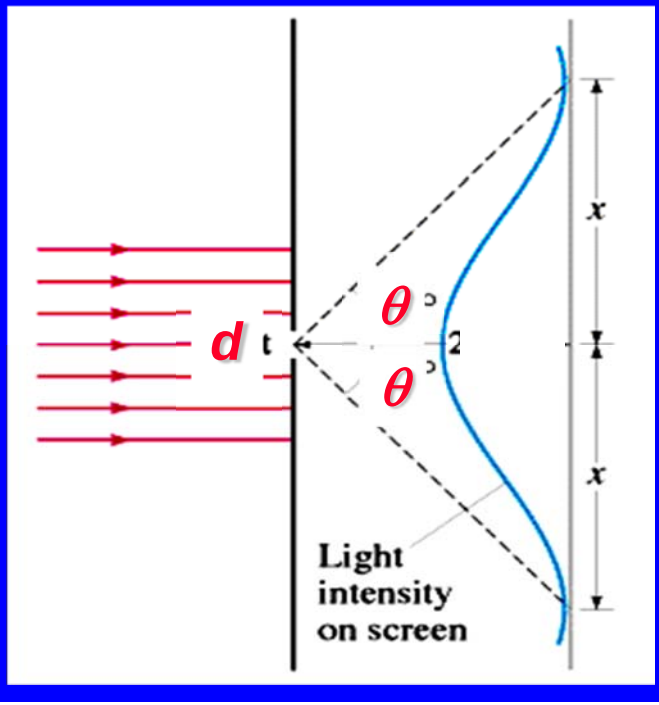
The angle at which one finds the first minimum is:

$$\sin\theta = \lambda / d$$

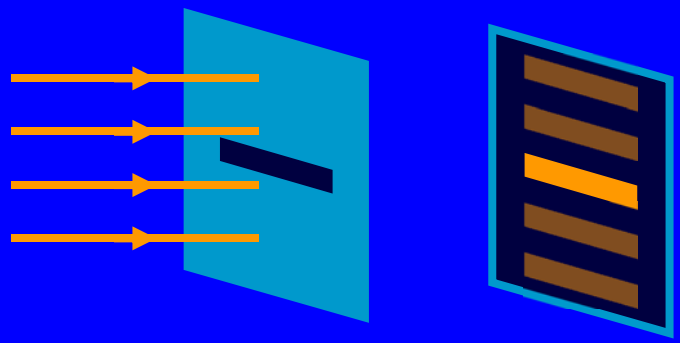
The central bright spot can be narrowed by having a smaller angle. This in turn is accomplished by widening the slit.



ConcepTest 35.1b Diffraction II

Blue light **of wavelength λ passes through a single slit of width *d* and forms a diffraction pattern on a screen. If the *blue light* is replaced by *red light* of wavelength 2λ, the original diffraction pattern can be reproduced if the slit width is changed to:**

1) $d/4$
2) $d/2$
3) no change needed
4) $2d$
5) $4d$



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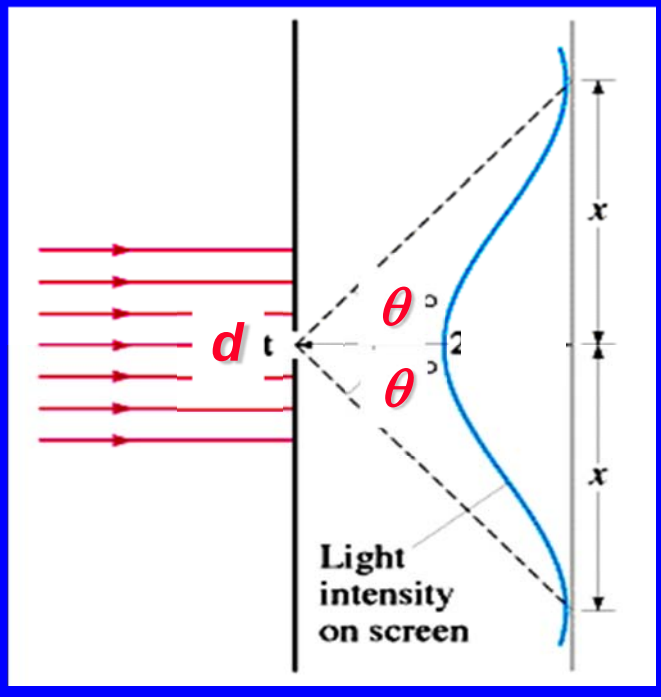
2) *d*/2
3) no change needed
4) 2*d*
5) 4*d*

$$d \sin\theta = m\lambda \quad \text{(minima)}$$

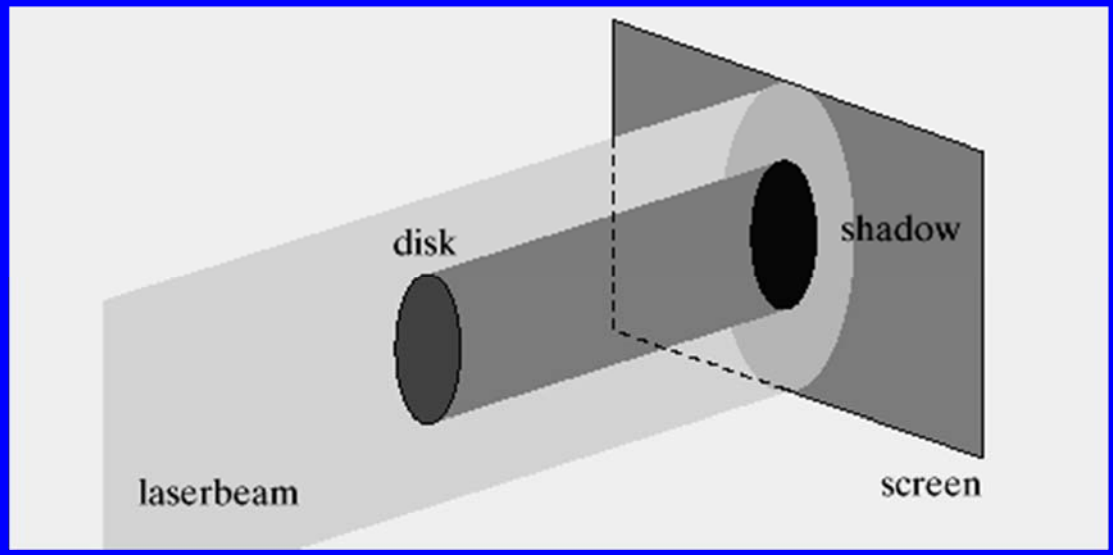
If $\lambda \rightarrow 2\lambda$, then we must have $d \rightarrow 2d$ for $\sin\theta$ to remain unchanged (and thus give the same diffraction pattern).



ConcepTest 35.2 Diffraction Disk

Imagine holding a circular disk in a beam of monochromatic light. If diffraction occurs at the edge of the disk, the center of the shadow is

1) darker than the rest of the shadow
2) a bright spot
3) bright or dark, depending on the wavelength
4) bright or dark, depending on the distance to the screen



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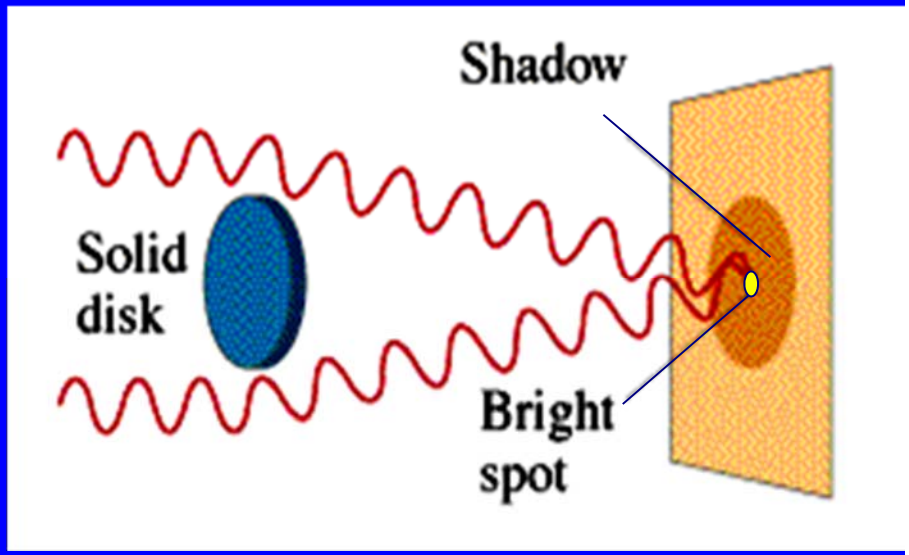
By symmetry, all of the waves coming from the edge of the disk *interfere constructively* in the middle because they are all in phase and they all travel the same distance to the screen.



Follow-up: What if the disk is oval and not circular?