7. Why doesn't the light from the two headlights of a distant car produce an interference pattern?
8. Why are interference fringes noticeable only for a *thin* film like a soap bubble and not for a thick piece of glass?
9. Why are the fringes of Newton's rings (Fig. 24–31) closer together as you look farther from the center?
10. Some coated lenses appear greenish yellow when seen by reflected light. What reflected wavelengths do you suppose the coating is designed to eliminate completely?
11. A drop of oil on a pond appears bright at its edges, where its thickness is much less than the wavelengths of visible light. What can you say about the index of refraction of the oil compared to that of water?
12. Radio waves and visible light are both electromagnetic waves. Why can a radio receive a signal behind a hill when we cannot see the transmitting antenna?
13. Hold one hand close to your eye and focus on a distant light source through a narrow slit between two fingers. (Adjust your fingers to obtain the best pattern.) Describe the pattern that you see.
14. For diffraction by a single slit, what is the effect of increasing (*a*) the slit width, (*b*) the wavelength?
15. Describe the single-slit diffraction pattern produced when white light falls on a slit having a width of (*a*) 60 nm, (*b*) 60,000 nm.
16. What happens to the diffraction pattern of a single slit if the whole apparatus is immersed in (*a*) water, (*b*) a vacuum, instead of in air.
17. What is the difference in the interference patterns formed by two slits 10^{-4} cm apart as compared to a diffraction grating containing 10^4 slits/cm?
18. For a diffraction grating, what is the advantage of (*a*) many slits, (*b*) closely spaced slits?
19. White light strikes (*a*) a diffraction grating and (*b*) a prism. A rainbow appears on a wall just below the direction of the horizontal incident beam in each case. What is the color of the top of the rainbow in each case? Explain.
20. What does polarization tell us about the nature of light?
21. Explain the advantage of polarized sunglasses over plain tinted sunglasses.
22. How can you tell if a pair of sunglasses is polarizing or not?

*23. What would be the color of the sky if the Earth had no atmosphere?

*24. If the Earth's atmosphere were 50 times denser than it is, would sunlight still be white, or would it be some other color?

MisConceptual Questions

1. Light passing through a double-slit arrangement is viewed on a distant screen. The interference pattern observed on the screen would have the widest spaced fringes for the case of
   (*a*) red light and a small slit spacing.
   (*b*) blue light and a small slit spacing.
   (*c*) red light and a large slit spacing.
   (*d*) blue light and a large slit spacing.
2. Light from a green laser of wavelength 530 nm passes through two slits that are 400 nm apart. The resulting pattern formed on a screen in front of the slits is shown in Fig. 24–55. If point A is the same distance from both slits, how much closer is point B to one slit than to the other?
   (*a*) 530 nm.
   (*b*) 265 nm.
   (*c*) 400 nm.
   (*d*) 0 nm.
   (*e*) It depends on the distance to the screen.

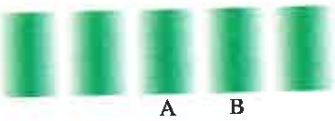

FIGURE 24–55 MisConceptual Question 2.

3. The colors in a rainbow are caused by
   (*a*) the interaction of the light reflected from different raindrops.
   (*b*) different amounts of absorption for light of different colors by the water in the raindrops.
   (*c*) different amounts of refraction for light of different colors by the water in the raindrops.
   (*d*) the downward motion of the raindrops.
4. A double-slit experiment yields an interference pattern due to the path length difference from light traveling through one slit versus the other. Why does a single slit show a diffraction pattern?
   (*a*) There is a path length difference from waves originating at different parts of the slit.
   (*b*) The wavelength of the light is shorter than the slit.
   (*c*) The light passing through the slit interferes with light that does not pass through.
   (*d*) The single slit must have something in the middle of it, causing it to act like a double slit.
5. If you hold two fingers very close together and look at a bright light, you see lines between the fingers. What is happening?
   (*a*) You are holding your fingers too close to your eye to be able to focus on it.
   (*b*) You are seeing a diffraction pattern.
   (*c*) This is a quantum-mechanical tunneling effect.
   (*d*) The brightness of the light is overwhelming your eye.
6. Light passes through a slit that is about 5×10^{-3} m high and 5×10^{-7} m wide. The central bright light visible on a distant screen will be
   (*a*) about 5×10^{-3} m high and about 5×10^{-7} m wide.
   (*b*) about 5×10^{-3} m high and wider than 5×10^{-7} m.
   (*c*) about 5×10^{-3} m high and narrower than 5×10^{-7} m.
   (*d*) taller than 5×10^{-3} m high and wider than 5×10^{-7} m.
   (*e*) taller than 5×10^{-3} m high and about 5×10^{-7} m wide.

7. Blue light of wavelength λ passes through a single slit of width d and forms a diffraction pattern on a screen. If we replace the blue light by red light of wavelength 2λ, we can retain the original diffraction pattern if we change the slit width
(*a*) to $d/4$.
(*b*) to $d/2$.
(*c*) not at all.
(*d*) to $2d$.
(*e*) to $4d$.

8. Imagine holding a circular disk in a beam of monochromatic light (Fig. 24–56). If diffraction occurs at the edge of the disk, the center of the shadow is
(*a*) darker than the rest of the shadow.
(*b*) a bright spot.
(*c*) bright or dark, depending on the wavelength.
(*d*) bright or dark, depending on the distance to the screen.

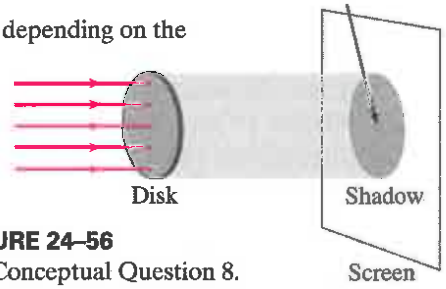

FIGURE 24–56
MisConceptual Question 8.

9. If someone is around a corner from you, what is the main reason you can hear him speaking but can't see him?
(*a*) Sound travels farther in air than light does.
(*b*) Sound can travel through walls, but light cannot.
(*c*) Sound waves have long enough wavelengths to bend around a corner; light wavelengths are too short to bend much.
(*d*) Sound waves reflect off walls, but light cannot.

10. When a CD is held at an angle, the reflected light contains many colors. What causes these colors?
(*a*) An anti-theft encoding intended to prevent copying of the CD.
(*b*) The different colors correspond to different data bits.
(*c*) Light reflected from the closely spaced grooves adds constructively for different wavelengths at different angles.
(*d*) It is part of the decorative label on the CD.

11. If a thin film has a thickness that is
(*a*) $\frac{1}{4}$ of a wavelength, constructive interference will always occur.
(*b*) $\frac{1}{4}$ of a wavelength, destructive interference will always occur.
(*c*) $\frac{1}{2}$ of a wavelength, constructive interference will always occur.
(*d*) $\frac{1}{2}$ of a wavelength, destructive interference will always occur.
(*e*) None of the above is always true.

12. If unpolarized light is incident from the left on three polarizers as shown in Fig. 24–57, in which case will some light get through?
(*a*) Case 1 only.
(*b*) Case 2 only.
(*c*) Case 3 only.
(*d*) Cases 1 and 3.
(*e*) All three cases.

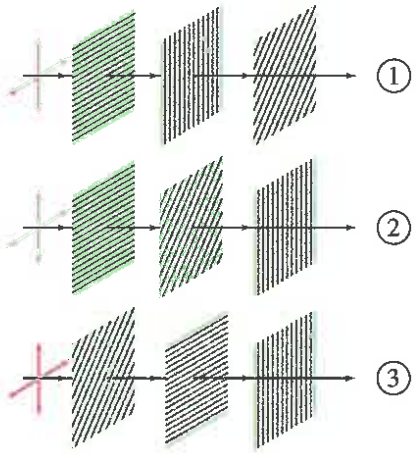

FIGURE 24–57
MisConceptual Question 12.

For assigned homework and other learning materials, go to the MasteringPhysics website.

Problems

24–3 Double-Slit Interference

1. (I) Monochromatic light falling on two slits 0.018 mm apart produces the fifth-order bright fringe at an 8.6° angle. What is the wavelength of the light used?
2. (I) The third-order bright fringe of 610-nm light is observed at an angle of 31° when the light falls on two narrow slits. How far apart are the slits?
3. (II) Monochromatic light falls on two very narrow slits 0.048 mm apart. Successive fringes on a screen 6.50 m away are 8.5 cm apart near the center of the pattern. Determine the wavelength and frequency of the light.
4. (II) If 720-nm and 660-nm light passes through two slits 0.62 mm apart, how far apart are the second-order fringes for these two wavelengths on a screen 1.0 m away?
5. (II) Water waves having parallel crests 4.5 cm apart pass through two openings 7.5 cm apart in a board. At a point 3.0 m beyond the board, at what angle relative to the "straight-through" direction would there be little or no wave action?
6. (II) A red laser from the physics lab is marked as producing 632.8-nm light. When light from this laser falls on two closely spaced slits, an interference pattern formed on a wall several meters away has bright red fringes spaced 5.00 mm apart near the center of the pattern. When the laser is replaced by a small laser pointer, the fringes are 5.14 mm apart. What is the wavelength of light produced by the laser pointer?