23. When a compact disk (CD) is held at an angle in white light, the reflected light is a full spectrum (Fig. 24–56). Explain. What would you expect to see if monochromatic light was used?

FIGURE 24–56 Question 23.

24. Why are Newton's rings (Fig. 24–31) closer together farther from the center?

25. Some coated lenses appear greenish yellow when seen by reflected light. What wavelengths do you suppose the coating is designed to transmit completely?

26. 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?

27. What does polarization tell us about the nature of light?

28. Explain the advantage of polarized sunglasses over normal tinted sunglasses.

29. How can you tell if a pair of sunglasses is polarizing or not?

30. Two polarized sheets rotated at an angle of 90° with respect to each other will not let any light through. Three polarized sheets, each rotated at an angle of 45° with respect to each other, will let some light through. What will happen to unpolarized light if you align four polarized sheets, each rotated at an angle of 30° with respect to the one in front of it?

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

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

Problems

24–3 Double-Slit Interference

1. (I) Monochromatic light falling on two slits 0.016 mm apart produces the fifth-order fringe at an 8.8° angle. What is the wavelength of the light used?

2. (I) The third-order fringe of 610 nm light is observed at an angle of 18° 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 5.00 m away are 6.5 cm apart near the center of the pattern. Determine the wavelength and frequency of the light.

4. (II) A parallel beam of light from a He-Ne laser, with a wavelength 656 nm, falls on two very narrow slits 0.060 mm apart. How far apart are the fringes in the center of the pattern on a screen 3.6 m away?

5. (II) Light of wavelength 680 nm falls on two slits and produces an interference pattern in which the fourth-order fringe is 38 mm from the central fringe on a screen 2.0 m away. What is the separation of the two slits?

6. (II) If 720-nm and 660-nm light passes through two slits 0.58 mm apart, how far apart are the second-order fringes for these two wavelengths on a screen 1.0 m away?

7. (II) In a double-slit experiment, it is found that blue light of wavelength 460 nm gives a second-order maximum at a certain location on the screen. What wavelength of visible light would have a minimum at the same location?

8. (II) Water waves having parallel crests 2.5 cm apart pass through two openings 5.0 cm apart in a board. At a point 2.0 m beyond the board, at what angle relative to the "straight-through" direction would there be little or no wave action?

9. (II) Suppose a thin piece of glass is placed in front of the lower slit in Fig. 24–7 so that the two waves enter the slits 180° out of phase (Fig. 24–57). Describe in detail the interference pattern on the screen.

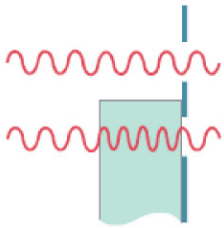

FIGURE 24–57
Problem 9.

10. (II) In a double-slit experiment, the third-order maximum for light of wavelength 500 nm is located 12 mm from the central bright spot on a screen 1.6 m from the slits. Light of wavelength 650 nm is then projected through the same slits. How far from the central bright spot will the second-order maximum of this light be located?

11. (II) Two narrow slits separated by 1.0 mm are illuminated by 544 nm light. Find the distance between adjacent bright fringes on a screen 5.0 m from the slits.

12. (III) Light of wavelength 480 nm in air falls on two slits 6.00×10^{-2} mm apart. The slits are immersed in water, as is a viewing screen 40.0 cm away. How far apart are the fringes on the screen?

13. (III) A very thin sheet of plastic ($n = 1.60$) covers one slit of a double-slit apparatus illuminated by 640-nm light. The center point on the screen, instead of being a maximum, is dark. What is the (minimum) thickness of the plastic?

24–4 Dispersion

14. (I) By what percent, approximately, does the speed of red light (700 nm) exceed that of violet light (400 nm) in silicate flint glass? (See Fig. 24–14.)

15. (II) A light beam strikes a piece of glass at a 60.00° incident angle. The beam contains two wavelengths, 450.0 nm and 700.0 nm, for which the index of refraction of the glass is 1.4820 and 1.4742, respectively. What is the angle between the two refracted beams?