Chapter 33

1 (*a*)

3 The thickness of the air space between the flat glass and the lens is approximately proportional to the square of d, the diameter of the ring. Consequently, the separation between adjacent rings is proportional to $1/d$.

5 Colors are observed when the light reflected from the front and back surfaces of the film interfere destructively for some wavelengths and constructively for other wavelengths. For this interference to occur, the phase difference between the light reflected from the front and back surfaces of the film must be constant. This means that twice the thickness of the film must be less than the coherence length of the light. The film is called a thin film if twice its thickness is less than the coherence length of the light.

7 (*d*)

9 (*a*)

11 (*a*)

13 (*a*)

15 (*a*) False, (*b*) True, (*c*) True, (*d*) True, (*e*) True

17 The condition for the resolution of the two sources is given by Rayleigh's criterion: $\alpha_c = 1.22\lambda/D$ (Equation 33-25), where α_c is the critical angular separation, D is the diameter of the aperture, and λ is the wavelength of the light illuminating (or emitted by) the objects, in this case headlights, to be resolved. Because the diameter of the pupils of your eyes are larger at night, the critical angle is smaller at night, which means that at night you can resolve the light as coming from two distinct sources when they are at a greater distance.

19 (*a*) 11 km, (*b*) 9.6 km

21 $5.9\ c\cdot\text{y}$

23 ≈ 2.9 rad

25 $5.5\ \mu\text{m} < d < 5.8\ \mu\text{m}$

27 (*a*) 600 nm, (*b*) 720 nm, 514 nm, and 400 nm, (*c*) 720 nm, 514 nm, and 400 nm

29 476 nm

31 (*c*) 68, (*d*) 1.14 cm (*e*) The fringes would become more closely spaced.

33 0.535 mm, 0.926 mm

35 4.95 mm

37 (*a*) 50.0 μm, (*b*) Not with the unaided eye. The separation is too small to be observed with the naked eye. (*c*) 0.500 mm

39 625 nm and 417 nm

41 (*a*) 0.60 mrad, (*b*) 6.0 mrad, (*c*) 60 mrad

43 (*a*) 1.53 km

45 (*a*) 20.0 μm, (*b*) 9

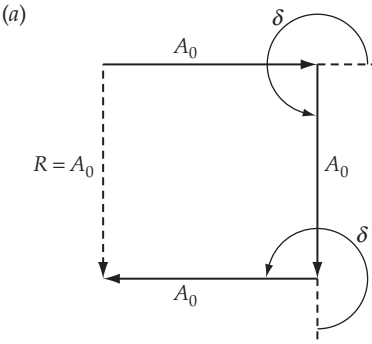
47 8

49 $\vec{E} = 3.6\ A_0 \sin(\omega t - 0.98\ \text{rad})\,\hat{i}$

51 $I/I_0 = 0.0162$

53 (*b*) 6.00 mm. The width for four sources is half the width for two sources.

55 (*a*)



(*b*) $5.56\ \text{mW/m}^2$

57 (*a*) 8.54 mrad, (*b*) 6.83 cm

59 7.00 mm

61 5.00×10^9 m

63 (*a*) 86.9 mrad, 82.1 mrad, (*b*) 709 mrad, 662 mrad

65 30.0°

67 One can see the complete spectrum for only the first and second order spectra. That is, only for $m = 1$ and 2. Because 700 nm $< 2 \times 400$ nm, there is no overlap of the second-order spectrum into the first-order spectrum; however, there is overlap of long wavelengths in the second order with short wavelengths in the third-order spectrum.

69 (*a*) 36.4 cm, 80.1 cm, (*b*) 88.4 μm, (*c*) 8000

71 3.09×10^5, $5.14 \times 10^4\ \text{cm}^{-1}$

73 (*a*) $\phi_m = \frac{1}{2}\sin^{-1}\left(m\frac{\lambda}{d}\right)$, (*b*) 32.1°

75 3.5 μm

77 3.6°, 2.5°

79 (*a*) 15.1 cm, (*b*) $3.33\ \text{m}^{-1}$

81 0.13 mrad

85 (*a*) 97.8 nm, (*b*) No, because 180 nm is not in the visible portion of the spectrum. (*c*) 0.273

87 12 m