ANSWERS

1. The amplitude of the resultant wave is twice the amplitude of either interfering wave, so a bright fringe forms; The amplitude of the resultant wave is zero, so a dark fringe forms.
2. by differences in brightness
3. $\lambda_{blue\ light} < \lambda_{red\ light}$, so interference fringes form at smaller angles for blue light.
4. d, m, θ
5. θ would decrease because λ is shorter in water.
6. no; because the light from the stars is not coherent
7. No interference is observed because the two waves have different wavelengths.
8. The separation of the fringes decreases because d and sin θ are inversely proportional.
9. 630 nm
10. **a.** 589 nm
    b. 0.327°
    c. 0.436°
11. 160 μm
12. At certain angles the diffracted waves from different parts of the slit destructively interfere with each other, forming dark fringes like those observed in an interference pattern.
13. It increases as the light with longer wavelength is diffracted more.
14. Light of a particular wavelength interferes constructively at a particular angle.
15. The larger an orbiting telescope is, the more expensive it is to place in orbit. In order to

INTERFERENCE

Review Questions

1. What happens if two light waves with the same amplitude interfere constructively? What happens if they interfere destructively?
2. Interference in sound is recognized by differences in volume; how is interference in light recognized?
3. A double-slit interference experiment is performed with red light and then again with blue light. In what ways do the two interference patterns differ? (Hint: Consider the difference in wavelength for the two colors of light.)
4. What data would you need to collect to correctly calculate the wavelength of light in a double-slit interference experiment?

Conceptual Questions

5. If a double-slit experiment were performed underwater, how would the observed interference pattern be affected? (Hint: Consider how light changes in a medium with a higher index of refraction.)
6. Because of their great distance from us, stars are essentially point sources of light. If two stars were near each other in the sky, would the light from them produce an interference pattern? Explain your answer.
7. Assume that white light is provided by a single source in a double-slit experiment. Describe the interference pattern if one slit is covered with a red filter and the other slit is covered with a blue filter.
8. An interference pattern is formed by using green light and an apparatus in which the two slits can move. If the slits are moved farther apart, will the separation of the bright fringes in the pattern decrease, increase, or remain unchanged? Why?

Practice Problems

For problems 9–11, see Sample Problem A.

9. Light falls on two slits spaced 0.33 mm apart. If the angle between the first dark fringe and the central maximum is 0.055°, what is the wavelength of the light?
10. A sodium-vapor street lamp produces light that is nearly monochromatic. If the light shines on a wooden door in which there are two straight, parallel cracks, an interference pattern will form on a distant wall behind the door. The slits have a separation of 0.3096 mm, and the second-order maximum occurs at an angle of 0.218° from the central maximum. Determine the following quantities:
    a. the wavelength of the light
    b. the angle of the third-order maximum
    c. the angle of the fourth-order maximum
11. All but two gaps within a set of venetian blinds have been blocked off to create a double-slit system. These gaps are separated by a distance of 3.2 cm. Infrared radiation is then passed through the two gaps in the blinds. If the angle between the central and the second-order maxima in the interference pattern is 0.56°, what is the wavelength of the radiation?

DIFFRACTION

Review Questions

12. Why does light produce a pattern similar to an interference pattern when it passes through a single slit?
13. How does the width of the central region of a single-slit diffraction pattern change as the wavelength of the light increases?
14. Why is white light separated into a spectrum of colors when it is passed through a diffraction grating?