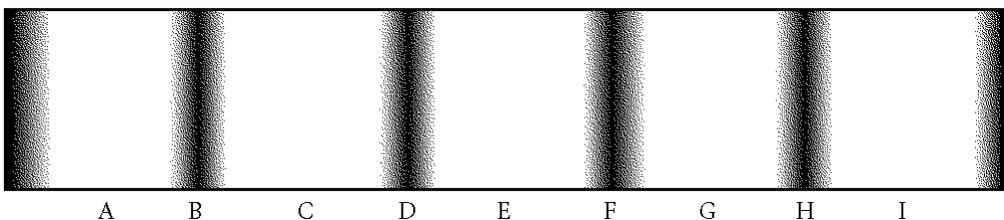


Phys.12-Q3W3-interference and diffraction-H.W

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- ___ 1. In a double-slit interference pattern, the path length from one slit to the first bright fringe of a double-slit interference pattern is longer than the path length from the other slit to the fringe by
- one-half of a wavelength.
 - one-quarter of a wavelength.
 - three-quarters of a wavelength.
 - one full wavelength.
- ___ 2. Interference effects observed in the early 19th century were instrumental in supporting a concept of the existence of which property of light?
- polarization
 - electromagnetic character
 - particle nature
 - wave nature
- ___ 3. Monochromatic light shines on the surface of a diffraction grating with 5.0×10^3 lines/cm. The first-order maximum is observed at an angle of 20.0° . Find the wavelength.
- 680 nm
 - 360 nm
 - 480 nm
 - 520 nm
- ___ 4. Which of the following is the process of using a light wave to produce more waves with properties identical to those of the first wave?
- hologram
 - stimulated emission
 - bandwidth
 - active medium



The figure above shows the pattern of a double-slit interference experiment. The center of the pattern is located at E.

- ___ 5. In the figure above, for which of the following fringes is the path length of the light wave from one slit more than one wavelength greater than the path length of the light wave from the other slit?
- A, B, and C
 - A and B
 - B and C
 - B, C, D, and E
- ___ 6. In the figure above, θ_1 is the angle between the central maximum and the first-order maximum. What is the angle between fringes D and F?
- $\frac{3\theta_1}{2}$
 - $2\theta_1$
 - θ_1
 - $\frac{\theta_1}{2}$
- ___ 7. In the figure above, which fringe represents a second-order minimum?
- F
 - H
 - E
 - G

- ___ 8. In the double-slit interference experiment that produced the figure above, the same slits are illuminated with light of greater wavelength. Which of the following would occur to the pattern shown in the figure?
- F would shift to the left.
 - E would shift to the left.
 - E would shift to the right.
 - F would shift to the right.
- ___ 9. In the double-slit interference experiment that produced the figure above, the two slits are moved closer. Which of the following would occur to the pattern shown in the figure?
- E would shift to the right.
 - F would shift to the right.
 - E would shift to the left.
 - F would shift to the left.
- ___ 10. In a double-slit interference pattern, the path length from one slit to the first dark fringe of a double-slit interference pattern is longer than the path length from the other slit to the fringe by
- three-quarters of a wavelength.
 - one-half of a wavelength.
 - one full wavelength.
 - one-quarter of a wavelength.
- ___ 11. The distance between two slits in a double-slit interference experiment is 2.9×10^{-6} m. The first-order bright fringe is measured on a screen at an angle of 12° from the central maximum. What is the wavelength of the light?
- 6.0×10^2 nm
 - 4.6×10^2 nm
 - 1.2×10^2 nm
 - 3.0×10^2 nm
- ___ 12. A helium-neon laser shines monochromatic light ($\lambda = 632.8$ nm) perpendicular to the surface of a diffraction grating that contains 146 230 lines/m. Find the angles at which one would observe the second-order and third-order maxima.
- $\theta_1 = 10.66^\circ$; $\theta_2 = 16.11^\circ$
 - $\theta_1 = 5.307^\circ$; $\theta_2 = 10.66^\circ$
 - $\theta_1 = 13.25^\circ$; $\theta_2 = 26.50^\circ$
 - $\theta_1 = 10.66^\circ$; $\theta_2 = 18.43^\circ$
- ___ 13. Light with a wavelength of 400.0 nm passes through a 1.00×10^4 lines/cm diffraction grating. What is the second-order angle of diffraction?
- 56.5°
 - 53.1°
 - 72.1°
 - 21.3°
- ___ 14. Monochromatic light ($\lambda = 632.8$ nm) from a helium-neon laser shines at a right angle onto the surface of a diffraction grating that contains 531 001 lines/m. Find the angles at which one would observe the first-order and second-order maxima.
- $\theta_1 = 21.10^\circ$; $\theta_2 = 42.20^\circ$
 - $\theta_1 = 19.63^\circ$; $\theta_2 = 39.26^\circ$
 - $\theta_1 = 33.60^\circ$; $\theta_2 = 67.20^\circ$
 - $\theta_1 = 19.63^\circ$; $\theta_2 = 42.20^\circ$
- ___ 15. Light with a wavelength of 500.0 nm passes through a 3.39×10^5 lines/m diffraction grating. What is the first-order angle of diffraction?
- 53.1°
 - 36.9°
 - 9.73°
 - 23.5°
- ___ 16. Which of the following is a device that produces an intense, nearly parallel beam of coherent light?
- diffraction grating
 - laser
 - spectroscope
 - telescope
- ___ 17. For high resolution in optical instruments, the angle between resolved objects should be
- as large as possible.
 - 1.22° .
 - 45° .
 - as small as possible.
- ___ 18. The distance between two slits in a double-slit interference experiment is 0.0050 mm. What is the angle of the third-order bright fringe ($m = 3$) produced with light of 550 nm?
- 9.9°
 - 19°
 - 5.0°
 - 12°

- _____ 30. If light waves are coherent,
- they remain in phase.
 - they shift over time.
 - they have less than three different wavelengths.
 - their intensity is less than that of incoherent light.
- _____ 31. To produce a sustained interference pattern by light waves from multiple sources, which condition or conditions must be met?
- Sources must be coherent.
 - Sources must be neither coherent nor monochromatic.
 - Sources must be monochromatic.
 - Sources must be coherent and monochromatic.
- _____ 32. In a laser, energy is added to a(n)
- partially transparent mirror.
 - active medium.
 - mirror.
 - light wave.
- _____ 33. At the first dark band in a single-slit diffraction pattern, the path lengths of selected pairs of wavelets differ by
- one-half wavelength.
 - more than one wavelength.
 - one wavelength.
 - less than half of one wavelength.
- _____ 34. Light with a wavelength of 546.1 nm passes through a 6.62×10^3 lines/cm diffraction grating. What is the first-order angle of diffraction?
- 21.2°
 - 34.6°
 - 41.6°
 - 39.2°
- _____ 35. The acronym *laser* stands for light amplification by _____ emission of radiation.
- stimulated
 - spontaneous
 - similar
 - simultaneous
- _____ 36. For stable interference to occur, the phase difference must be
- constant.
 - incoherent.
 - $\frac{1}{2} \lambda$.
 - monochromatic.

Problems

37. Monochromatic light ($\lambda = 798.7 \text{ nm}$) shines at a right angle onto the surface of a diffraction grating that contains 397 645 lines/m. Find the angles at which one would observe the first-order and second-order maxima.
- A. $\theta_1 = 16.52^\circ$, $\theta_2 = 37.43^\circ$
B. $\theta_1 = 17.52^\circ$, $\theta_2 = 38.43^\circ$
C. $\theta_1 = 18.52^\circ$, $\theta_2 = 39.43^\circ$
D. $\theta_1 = 19.52^\circ$, $\theta_2 = 40.43^\circ$
38. The distance between two slits in a double-slit experiment is $3.1 \times 10^{-6} \text{ m}$. The first-order bright fringe is measured on a screen at an angle of 9.6° from the central maximum. What is the wavelength of the light?
- A. 230 nm
B. 330 nm
C. 430 nm
D. 530 nm
39. Monochromatic light from a laser ($\lambda = 426.9 \text{ nm}$) shines at a right angle onto the surface of a diffraction grating that contains 134 749 lines/m. Find the angle at which one would observe the first-order maximum.
- A. $\theta = 1.297^\circ$
B. $\theta = 2.297^\circ$
C. $\theta = 3.297^\circ$
D. $\theta = 4.297^\circ$
40. Monochromatic light shines on the surface of a diffraction grating with 6.7×10^3 lines/cm. The angle between the central maximum and the first dark fringe is 11.5° . Find the wavelength of the light.
- A. $5.9 \times 10^2 \text{ nm}$
B. $6.9 \times 10^2 \text{ nm}$
C. $7.9 \times 10^2 \text{ nm}$
D. $8.9 \times 10^2 \text{ nm}$
41. The surface of a diffraction grating that contains 736 324 lines/m is illuminated by monochromatic light ($\lambda = 615.1 \text{ nm}$) perpendicular to the grating. At what angles would one observe the first-order and second-order maxima?
- A. $\theta_1 = 24.93^\circ$, $\theta_2 = 62.93^\circ$
B. $\theta_1 = 25.93^\circ$, $\theta_2 = 63.93^\circ$
C. $\theta_1 = 26.93^\circ$, $\theta_2 = 64.93^\circ$
D. $\theta_1 = 27.93^\circ$, $\theta_2 = 65.93^\circ$

42. A laser placed perpendicular to a diffraction grating that contains 138 566 lines/m illuminates the grating's surface with monochromatic light with a wavelength of 637.3 nm. At what angle will the second-order maximum appear?
- A. $\theta = 10.17^\circ$
 - B. $\theta = 11.17^\circ$
 - C. $\theta = 12.17^\circ$
 - D. $\theta = 13.17^\circ$
43. The distance between the two slits in a double-slit experiment is 0.0034 mm. The third-order bright fringe ($m = 3$) is measured on a screen at an angle of 22° from the central maximum. What is the wavelength of the light?
- A. 320 nm
 - B. 420 nm
 - C. 520 nm
 - D. 620 nm
44. The distance between two slits in a double-slit experiment is 0.0016 mm. What is the angle between the central maximum and the second dark fringe in the interference pattern produced with light having a wavelength of 520 nm?
- A. 26°
 - B. 27°
 - C. 28°
 - D. 29°
45. Monochromatic light shines on the surface of a diffraction grating with 7.9×10^3 lines/cm. The angle between the central maximum and the third dark fringe is measured as 64.6° . Find the wavelength of the light.
- A. 4.4×10^2 nm
 - B. 4.5×10^2 nm
 - C. 4.6×10^2 nm
 - D. 4.7×10^2 nm

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