

final**Multiple Choice**

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

- _____ 1. Consider two identical and symmetrical wave pulses on a string. Suppose the first pulse reaches the fixed end of the string and is reflected back and then meets the second pulse. When the two pulses overlap exactly, the superposition principle predicts that the amplitude of the resultant pulses, at that moment, will be what factor times the amplitude of one of the original pulses?
- 1
 - 8
 - 0
 - 2
 - 4
- _____ 2. If an electron has a measured wavelength of 0.850×10^{-10} m, what is its kinetic energy? ($h = 6.63 \times 10^{-34}$ J·s, $1 \text{ eV} = 1.6 \times 10^{-19}$ J, and $m_e = 9.11 \times 10^{-31}$ kg)
- 209 eV
 - 55.0 eV
 - 245 eV
 - 147 eV
 - 104 eV
- _____ 3. A convex mirror with focal length of -20 cm forms an image 12 cm behind the surface. Where is the object located as measured from the surface?
- 22 cm
 - 7.5 cm
 - 30 cm
 - 50 cm
 - 15 cm
- _____ 4. A diffraction pattern is produced from a light source of wavelength 580 nm. The light goes through a single slit and onto a screen 1.0 m away. The first dark fringe is 5.0 mm from the central bright fringe. What is the slit width? ($1 \text{ nm} = 10^{-9}$ m)
- 0.24 mm
 - 0.062 mm
 - 0.10 mm
 - 0.081 mm
 - 0.12 mm
- _____ 5. A silicon monoxide ($n = 1.45$) film of 100 nm thickness is used to coat a glass camera lens ($n = 1.56$). What wavelength of light in the visible region (390 to 710 nm) will be most efficiently transmitted by this system? ($1 \text{ nm} = 10^{-9}$ m)
- 624 nm
 - 492 nm
 - 400 nm
 - 505 nm
 - 580 nm

- _____ 6. A certain kind of glass has $n_{\text{blue}} = 1.650$ for blue light and $n_{\text{red}} = 1.610$ for red light. If a beam of white light (containing all colors) is incident at an angle of 30.0° , what is the angle between the red and blue light inside the glass?
- 1.63°
 - 1.90°
 - 1.81°
 - 0.22°
 - 0.45°
- _____ 7. An earthquake emits both P-waves and S-waves that travel at different speeds through the Earth. A P-wave travels at $8\,000$ m/s and an S-wave at $4\,000$ m/s. If P-waves are received at a seismic station 30.0 s before an S-wave arrives, how far is the station from the earthquake center?
- $1\,210$ km
 - 100 km
 - 240 km
 - $2\,420$ km
 - 120 km
- _____ 8. An object is placed 25 cm to the left of a lens of focal length 20 cm. 75 cm to the right of this lens is a plane mirror. Where does the final image form?
- 25 cm to the left of the mirror
 - 50 cm to the left of the lens
 - 150 cm to the left of the lens
 - 25 cm to the right of the mirror
 - 100 cm to the left of the lens
- _____ 9. If the speed of light through an unknown liquid is measured at 1.80×10^8 m/s, what is the index of refraction of this liquid? ($c = 3.00 \times 10^8$ m/s)
- 1.80
 - 1.20
 - 0.600
 - 1.67
 - 0.400
- _____ 10. A 2.0 -m long piano string of mass 10 g is under a tension of 338 N. Find the speed with which a wave travels on this string.
- $1\,040$ m/s
 - 130 m/s
 - 520 m/s
 - 260 m/s
 - $1\,200$ m/s
- _____ 11. Laser light sent through a double slit produces an interference pattern on a screen 3.00 m from the slits. If the second order maximum occurs at an angle of 12.0° , at what angle does the eighth order maximum occur?
- 48.0°
 - No eighth order maximum occurs.
 - 56.3°
 - 70.7°
 - Not enough information is given.

- _____ 12. Two thin lenses with 10.0-cm focal lengths are mounted at opposite ends of a 30.0-cm long tube. An object is located 45.0 cm from one end of the tube. How far from the opposite end is the final image?
- 37.2 cm
 - 33.6 cm
 - 24.0 cm
 - 12.8 cm
 - 25.6 cm
- _____ 13. Helium-neon laser light has a wavelength in air of 632.8 nm. What is the energy of a single photon in the beam? ($h = 6.626 \times 10^{-34}$ J·s and $c = 3.00 \times 10^8$ m/s).
- 7.62×10^{-19} J
 - 5.40×10^{-19} J
 - 3.14×10^{-19} J
 - 2.53×10^{-17} J
 - 1.15×10^{-18} J
- _____ 14. A flute behaves like a tube open at both ends. If its length is 65.3 cm, and the speed of sound is 340 m/s, what is its fundamental frequency in Hz?
- 130 Hz
 - 159 Hz
 - 260 Hz
 - 310 Hz
 - 212 Hz
- _____ 15. As an electromagnetic wave travels through free space, its speed can be increased by:
- increasing its energy only.
 - decreasing its frequency
 - increasing its frequency.
 - increasing both its energy and momentum.
 - None of the above will increase its speed.
- _____ 16. A very loud train whistle has an acoustic power output of 100 W. If the sound energy spreads out spherically, what is the intensity level in dB at a distance of 100 meters from the train? ($I_0 = 10^{-12}$ W/m²)
- 81.6 dB
 - 78.3 dB
 - 89.0 dB
 - 95.0 dB
 - 112 dB
- _____ 17. If the energy for the ground state level ($n = 1$) of hydrogen is -13.6 eV, which of the following gives an approximate value for the energy of an electron of the K shell ($n = 1$) of the element oxygen for which the atomic number = 8?
- $-1\ 100$ eV
 - $-1\ 332$ eV
 - -109 eV
 - -95 eV
 - -666 eV

- _____ 18. A nearsighted person cannot see objects clearly beyond 30 cm (the far point). If the patient has no astigmatism and contact lenses are prescribed, what is the power of the lens required to correct the patient's vision?
- 5.0 diopters
 - 3.3 diopters
 - 4.0 diopters
 - 2.0 diopters
 - 6.0 diopters
- _____ 19. A ray of light travels across a liquid-to-glass interface. If the indices of refraction for the liquid and glass are, respectively, 1.75 and 1.52, what is the critical angle at this interface?
- 30.0°
 - 82.5°
 - Critical angle does not exist.
 - 60.3°
 - 52.2°
- _____ 20. A Young's interference experiment is conducted with blue-green argon laser light ($\lambda = 515 \text{ nm}$). The separation between the slits is 0.50 mm and the interference pattern appears on a screen 3.3 m away. What is the spacing between the bright fringes? ($1 \text{ nm} = 10^{-9} \text{ m}$)
- 6.8 mm
 - 1.7 mm
 - 3.4 mm
 - 8.5 mm
 - 5.1 mm
- _____ 21. Three thin lenses, each of focal length f , are placed in contact. What is the resulting focal length of the combination?
- $3f$
 - $(3f)^{-1}$
 - f
 - $f/3$
 - $3/f$
- _____ 22. The wavelength of coherent ruby laser light is 688.3 nm. What energy difference exists between the upper excited state involved and the lower unexcited ground state? ($h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$, $c = 3.00 \times 10^8 \text{ m/s}$, $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$, and $1 \text{ nm} = 10^{-9} \text{ m}$)
- 1.75 eV
 - 1.81 eV
 - 2.21 eV
 - 1.86 eV
 - 1.94 eV

- _____ 23. Two loudspeakers are placed next to each other and driven by the same source at 500 Hz. A listener is positioned in front of the two speakers and on the line separating them, thus creating a constructive interference at the listener's ear. What minimum distance would one of the speakers be moved back away from the listener to produce destructive interference at the listener's ear? (The speed of sound = 340 m/s.)
- a. 1.36 m
 - b. 0.68 m
 - c. 0.34 m
 - d. 0.17 m
 - e. 0.12 m
- _____ 24. What is the maximum velocity of a photoelectron emitted from a surface with work function 5.00 eV when illuminated by 200 nm ultraviolet light? ($m_{\text{electron}} = 9.11 \times 10^{-31}$ kg, $h = 6.63 \times 10^{-34}$ J·s, 1 eV = 1.60×10^{-19} J, and 1 nm = 10^{-9} m)
- a. 800 000 m/s
 - b. 653 000 m/s
 - c. 431 000 m/s
 - d. 212 000 m/s
 - e. 184 000 m/s

final
Answer Section

MULTIPLE CHOICE

1. ANS: C DIF: 2
TOP: 13.10 Interference of Waves, 13.11 Reflection of Waves
2. ANS: A DIF: 3 TOP: 27.6 The Dual Nature of Light and Matter
3. ANS: C DIF: 2
TOP: 23.2 Images Formed by Spherical Mirrors, 23.3 Convex Mirrors and Sign Conventions
4. ANS: E DIF: 2 TOP: 24.6 Diffraction, 24.7 Single-Slit Diffraction
5. ANS: E DIF: 2
TOP: 24.3 Change of Phase Due to Reflection, 24.4 Interference of Thin Films
6. ANS: E DIF: 2 TOP: 22.4 Dispersion and Prisms
7. ANS: C DIF: 2
TOP: 13.6 Damped Oscillations, 13.7 Waves, 13.8 Frequency, Amplitude, and Wavelength
8. ANS: B DIF: 3 TOP: 23.6 Thin Lenses
9. ANS: D DIF: 2 TOP: 22.3 The Law of Refraction
10. ANS: D DIF: 2 TOP: 13.9 The Speed of Waves on Strings
11. ANS: C DIF: 3 TOP: 24.2 Young's Double-Slit Interference
12. ANS: C DIF: 3 TOP: 23.6 Thin Lenses
13. ANS: C DIF: 2 TOP: 22.1 The Nature of Light
14. ANS: C DIF: 2 TOP: 14.10 Standing Waves in Air Columns
15. ANS: E DIF: 1 TOP: 21.12 The Spectrum of Electromagnetic Waves
16. ANS: C DIF: 3 TOP: 14.5 Spherical and Plane Waves
17. ANS: E DIF: 2 TOP: 28.10 Characteristic X-Rays
18. ANS: B DIF: 2 TOP: 25.2 The Eye
19. ANS: D DIF: 2 TOP: 22.7 Total Internal Reflection
20. ANS: C DIF: 2 TOP: 24.2 Young's Double-Slit Interference
21. ANS: D DIF: 2 TOP: 23.6 Thin Lenses
22. ANS: B DIF: 2 TOP: 28.12 Lasers and Holography
23. ANS: C DIF: 2 TOP: 14.7 Interference of Sound Waves
24. ANS: B DIF: 3
TOP: 27.2 The Photoelectric Effect and the Particle Theory of Light