PHYS 201 SECOND MAJOR 031

35-1 A virtual image is one:
A) toward which light rays converge but do not pass through
B) from which light rays diverge but do not pass through
C) from which light rays diverge as they pass through
D) toward which light rays converge and pass through
E) with a ray normal to a mirror passing through it

35-15. The focal length of a spherical mirror is *N* times its radius of curvature where *N* is:
A) 1/4
B) 1/2
C) 1
D) 2
E) 4

35-23. Where must an object be placed in front of a concave mirror so that the image and object are the same size? (F is the focal point and C is the center of curvature.)
A) at F
B) at C
C) between F and the mirror
D) between F and C
E) beyond C

35-28. A concave spherical mirror has a focal length of 12 cm. If an object is placed 6 cm in front of it the image position is:
A) 4 cm behind the mirror
B) 4 cm in front of the mirror
C) 12 cm behind the mirror
D) 12 cm in front of the mirror
E) at infinity

35-42. Where must an object be placed in front of a converging lens in order to obtain a virtual image?
A) At the focal point
B) At twice the focal length
C) Greater than the focal length
D) Between the focal point and the lens
E) Between the focal length and twice the focal length

35-48. The object-lens distance for a certain converging lens is 400 mm. The image is three times the size of the object. To make the image five times the size of the object-lens distance must be changed to:
A) 360 mm
B) 540 mm
C) 600 mm

D) 720 mm
E) 960 mm

35-56.A 3-cm high object is in front of a thin lens. The object distance is 4 cm and the image distance is –8 cm. The image height is:
A) 0.5 cm
B) 1 cm
C) 1.5 cm
D) 6 cm
E) 24 cm

35-63.What type of eyeglasses should a nearsighted person wear?
A) diverging lenses
B) bifocal lenses
C) converging lenses
D) plano-convex lenses
E) double convex lenses

35-14.A parallel beam of monochromatic light in air is incident on a plane glass surface. In the glass, the beam:
A) remains parallel
B) undergoes dispersion
C) becomes diverging
D) follows a parabolic path
E) becomes converging

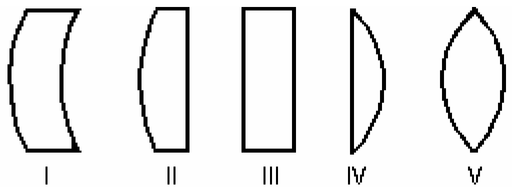
35-17.The image produced by a convex mirror of an erect object in front of the mirror is always:
A) virtual, erect, and larger than the object
B) virtual, erect, and smaller than the object
C) real, erect, and larger than the object
D) real, erect, and smaller than the object
E) none of the above

35-41.An erect object is placed on the central axis of a thin lens, further from the lens than the magnitude of its focal length. The magnification is +0.4. This means:
A) the image is real and erect and the lens is a converging lens
B) the image is real and inverted and the lens is a converging lens
C) the image is virtual and erect, and the lens is a diverging lens
D) the image is virtual and erect, and the lens is a converging lens

E) the image is virtual and inverted and the lens is a diverging lens

35-44. An object is 30 cm in front of a converging lens of focal length 10 cm. The image is:
A) real and larger than the object
B) real and the same size than the object
C) real and smaller than the object
D) virtual and the same size than the object
E) virtual and smaller than the object

35-54. Which of the following five glass lenses is a diverging lens?



A) I
B) II
C) III
D) IV
E) V

35-60. Which instrument uses a single converging lens with the object placed just inside the focal point?
A) Camera
B) Compound microscope
C) Magnifying glass
D) Overhead projector
E) Telescope

35-67. An object is 20 cm to the left of a lens of focal length +10 cm. A second lens, of focal length +12.5 cm, is 30 cm to the right of the first lens. The distance between the original object and the final image is:
A) 28 cm
B) 50 cm
C) 100 cm
D) 0
E) infinity

36-1. A "wave front" is a surface of constant:
A) phase
B) frequency
C) wavelength
D) amplitude
E) speed

36-6. Interference of light is evidence that:
A) the speed of light is very large
B) light is a transverse wave
C) light is electromagnetic in character
D) light is a wave phenomenon
E) light does not obey conservation of energy

36-7. The reason there are two slits, rather than one, in a Young's experiment is:
A) to increase the intensity
B) one slit is for frequency, the other for wavelength
C) to create a path length difference
D) one slit is for $\vec{E}$ fields, the other is for $\vec{B}$ fields
E) two slits in parallel offer less resistance

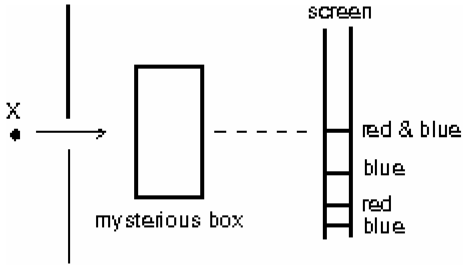
36-15. In a Young's double-slit experiment, light of wavelength 500 nm illuminates two slits which are separated by 1 mm. The separation between adjacent bright fringes on a screen 5 m from the slits is:
A) 0.10 cm
B) 0.25 cm
C) 0.50 cm
D) 1.0 cm
E) none of the above

36-18. In an experiment to measure the wavelength of light using a double slit, it is found that the fringes are too close together to easily count them. To spread out the fringe pattern, one could:
A) halve the slit separation
B) double the slit separation
C) double the width of each slit
D) halve the width of each slit
E) none of these

36-19. The phase difference between the two waves which give rise to a dark spot in a Young's double-slit experiment is (where m = integer):
A) zero
B) $2\pi m + \pi/8$
C) $2\pi m + \pi/4$

D) $2\pi m + \pi/2$
E) $2\pi m + \pi$

36-25.Light from a point source X contains only blue and red components. After passing through a mysterious box, the light falls on a screen. Red and blue hands are observed as shown. The box must contain:



A) a lens
B) a mirror
C) a prism
D) a double slit
E) a blue and red filter

36-27.Monochromatic light, at normal incidence, strikes a thin film in air. If λ denotes the wavelength in the film, what is the thinnest film in which the reflected light will be a maximum?
A) much less than λ
B) $\lambda/4$
C) $\lambda/2$
D) $3\lambda/4$
E) λ

36-28.A soap film, 4×10^{-5} cm thick, is illuminated by white light normal to its surface. The index of refraction of the film is 1.50. Which wavelengths will be intensified in the reflected beam?
A) 400 nm and 600 nm
B) 480 nm and 800 nm
C) 360 nm and 533 nm
D) 400 nm and 800 nm
E) 510 nm and 720 nm

36-8. In a Young's double-slit experiment the center of a bright fringe occurs wherever waves from the slits differ in the distance they travel by a multiple of:
A) a fourth of a wavelength
B) a half a wavelength

C) a wavelength
D) three-fourths of a wavelength
E) none of the above

37-2. Radio waves are readily diffracted around buildings whereas light waves are negligibly diffracted around buildings. This is because radio waves:
A) are plane polarized
B) have much longer wavelengths than light waves
C) have much shorter wavelengths than light waves
D) are nearly monochromatic (single frequency)
E) are amplitude modulated (AM)

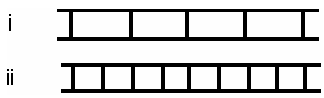
37-5. When a highly coherent beam of light is directed against a very fine wire, the shadow formed behind it is not just that of a single wire but rather looks like the shadow of several parallel wires. The explanation of this involves:
A) refraction
B) diffraction
C) reflection
D) Doppler effect
E) an optical illusion

37-20. A diffraction pattern is produced on a viewing screen by illuminating a long narrow slit with light of wavelength λ. If λ is increased and no other changes are made:
A) the intensity at the center of the pattern decreases and the pattern expands away from the bright center
B) the intensity at the center of the pattern increases and the pattern contracts toward the bright center
C) the intensity at the center of the pattern does not change and the pattern expands away from the bright center
D) the intensity at the center of the pattern does not change and the pattern contracts toward the bright center
E) neither the intensity at the center of the pattern nor the pattern itself change

37-27. Figure (i) shows a double-slit pattern obtained using monochromatic light. Consider the following five possible changes in conditions:
1. decrease the frequency

2. increase the frequency
3. increase the width of each slit
4. increase the separation between the slits
5. decrease the separation between the slits

Which of the above would change Figure (i) into Figure (ii)?

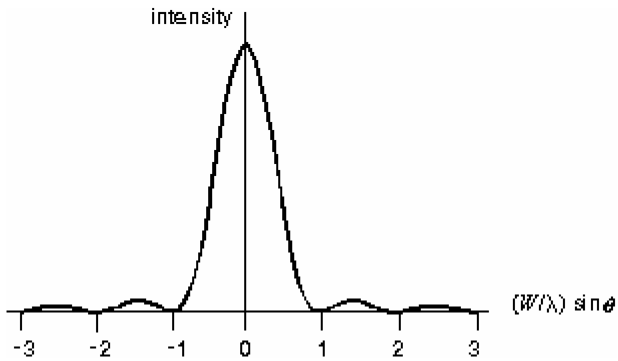


A) 3 only
B) 5 only
C) 1 and 3 only
D) 1 and 5 only
E) 2 and 4 only

37-43. Monochromatic light is normally incident on a diffraction grating that is 1 cm wide and has 10,000 slits. The first order line is deviated at a 30° angle. What is the wavelength, in nm, of the incident light?

A) 300
B) 400
C) 500
D) 600
E) 1000

53. Light of wavelength is normally incident on some plane optical device. The intensity pattern shown is observed on a distant screen (θ is the angle measured to the normal of the device). The device could be:



A) a single slit of width *W*
B) a single slit of width 2*W*
C) two narrow slits with separation *W*
D) two narrow slits with separation 2*W*
E) a diffraction grating with slit separation *W*

7-63. To obtain greater dispersion by a diffraction grating:
A) the slit width should be increased
B) the slit width should be decreased
C) the slit separation should be increased
D) the slit separation should be decreased
E) more slits with the same width and separation should be added to the system

37-69. Bragg's law for x-ray diffraction is $2d \sin\theta = m\lambda$, the quantity d is:
A) the height of a unit cell
B) the smallest inter atomic distance
C) the distance from detector to sample
D) the distance between planes of atoms
E) the usual calculus symbol for a differential

37-74. A beam of x rays of wavelength 1 ! is found to diffract in second order from the face of a LiF crystal at a Bragg angle of 30°. The distance between adjacent crystal planes, in nm, is about:
A) 0.15
B) 0.20
C) 0.25
D) 0.30
E) 0.40

38-5. Two events occur simultaneously at separated points on the x axis of reference frame S. According to an observer moving in the positive x direction:
A) the event with the greater x coordinate occurs first
B) the event with the greater x coordinate occurs last
C) either event might occur first, depending on spatial separation of the events and the observer's speed
D) the events are simultaneous
E) none of the above

38-19. An observer notices that a moving clock runs slow by a factor of exactly 10. The speed of the clock is:
A) $0.100c$
B) $0.0100c$
C) $0.990c$
D) $0.900c$
E) $0.995c$

38-20. A meson when at rest decays 2 μs after it is created. If moving in the laboratory at $0.99c$, its lifetime according to laboratory clocks would be:
A) the same
B) 0.28 s

C) 14 μs
D) 4.6 s
E) none of these

38-24.A meter stick moves at 0.95*c* in the direction of its length through a laboratory. According to measurements taken in the laboratory, its length is:
A) 0
B) 0.098 m
C) 0.31 m
D) 3.2 m
E) 1.0 m

38-26.A rocket ship of rest length 100 m is moving at speed 0.8*c* past a timing device which records the time interval between the passage of the front and back ends of the ship. This time interval is:
A) 0.20 μs
B) 0.25 μs
C) 0.33 μs
D) 0.52 μs
E) 0.69 μs

38-39.Light from some stars shows an apparent change in frequency because of:
A) interference
B) refraction by layers of air
C) diffraction
D) reflection
E) relative motion

38-49.A particle with rest mass m moves with speed 0.6*c*. Its kinetic energy is:
A) $0.18mc^2$
B) $0.22mc^2$
C) $0.25mc^2$
D) mc^2
E) $1.25mc^2$

38-54.An electron ($m = 9.11 \times 10^{-31}$ kg) has a speed of 0.95*c*. Its momentum is:
A) 2.6×10^{-22} kg · m/s
B) 2.9×10^{-22} kg · m/s
C) 6.0×10^{-22} kg · m/s
D) 8.3×10^{-22} kg · m/s
E) 8.8×10^{-22} kg · m/s

38-56. The mass of a particle is m. In order for its total energy to be twice its rest energy, its momentum must be:

A) $mc/2$

B) $mc/\sqrt{2}$

C) mc

D) $\sqrt{3}mc$

E) $2mc$

38-61. If the kinetic energy of a free particle is much greater than its rest energy then its kinetic energy is proportional to:

A) the magnitude of its momentum

B) the square of the magnitude of its momentum

C) the square root of the magnitude of its momentum

D) the reciprocal of the magnitude of its momentum

E) none of the above

38-64. An electron ($m = 9.11 \times 10^{-31}$ kg) has a momentum of 4.0×10^{-13} kg ·m/s. Its kinetic energy is:

A) 6.3×10^{-14} J

B) 8.2×10^{-14} J

C) 1.2×10^{-13} J

D) 1.5×10^{-13} J

E) 2.7×10^{-13} J