Topic Name : Wave Optics Practice Sheet

Target: JEE Main | NEET

Instructor: Vikas Sharma Sir

General Instructions:

1) You must submit the ASSIGNMENT within the time frame.

2) Be Genuine to yourself.

3) Always consult your mentor at premiumvikas.com if you find any difficulty.

4) Submit assignment in the prescribed format explained by your instructor during the LIVE Session.

1. Huygens' concepts of secondary waves
(a) allow us to find the focal length of a thin lens
(b) gives the magnifying power of a microscope
(c) is a geometrical method to find a wavefront
(d) is used to determine the velocity of light

2. The concept of secondary wavelets from all points on a wavefront was first proposed by
(a) Newton (b) Huygen
(c) Faraday (d) Raman

3. The wavefront is a surface in which
(a) all points are in the same phase
(b) there are pairs of points in opposite phase
(c) there are pairs of points with phase difference ($\pi/2$)
(d) there is no relation between the phases

4. Two light sources are coherent when
(a) their amplitudes are equal
(b) their frequencies are equal
(c) their wavelengths are equal
(d) their frequencies are equal and their phase difference is constant

5. Newton has postulated his corpuscular theory on the basis of
(a) Newton's ring
(b) colour due to thin film
(c) dispersing of light
(d) rectilinear propagation of light

6. Which of the following pairs denote coherent sources?
(a) Two pinholes infront of a broad sodium lamp
(b) Two pinholes infront of two identical sodium lamps
(c) Two pinholes infront of a laser beam
(d) All of the above

7. Two waves are said to be coherent if they have
(a) same amplitude
(b) same wavelength

(c) same amplitude and same wavelength
(d) same wavelength and constant phase difference

8. Two light waves are coherent if they are obtained from a single monochromatic source by
(a) division of amplitude only
(b) division of wavefront only
(c) both of the above
(d) none of the above

9. In the phenomenon of interference, the energy
(a) conservation does not hold good as energy is redistributed from destructive interference regions to constructive interference regions
(b) conservation is valid, only redistribution of energy takes place
(c) conservation is not valid but amplitude addition holds good
(d) conservation is not valid but intensity addition holds good

10. The necessary condition for an interference by two sources of light is that
(a) two light sources must have the same wavelength
(b) two point sources should have the same amplitude and same wavelength
(c) two sources should have the same wavelength, nearly the same amplitude and have a constant phase angle difference
(d) the two point sources should have a randomly varying phase differences

11. Two independent monochromatic sources are said to be incoherent, because the detector of light intensity requires time to detect intensity at a given position, that is
(a) much greater than 10^{-8} sec
(b) nearly equal to 10^{-8} sec
(c) much less than 10^{-8} sec
(d) none of the above

12. Two coherent monochromatic light beams of intensities I and $4I$ are superposed; the maximum and minimum possible intensities in the resulting beam are
(a) $5I$ and I (b) $5I$ and $3I$
(c) $9I$ and I (d) $9I$ and $3I$

13. If two waves, each of intensity I_o, having the same frequency but differing by a constant phase angle of 60°, superpose at a certain point in space, then the intensity of resultant wave is
(a) $2I_o$ (b) $\sqrt{3}I_o$
(c) $3I_o$ (d) $4I_o$

14. The light waves from two independent monochromatic light sources are given by

$$y_1 = 2 \sin \omega t \text{ and } y_2 = 3 \cos \omega t,$$

then the correct statement is
(a) Both the waves are coherent
(b) Both the waves are incoherent
(c) Both the waves have different time periods
(d) None of the above

15. Two monochromatic waves each of intensity I have a constant phase difference of ϕ. If these waves superpose, then the intensity of the resultant wave is
(a) $4I$ (b) $4I \cos \phi$
(c) $4I \cos^2 \phi$ (d) $4I_o \cos^2 (\phi/2)$

16. If the two waves represented by $y_1 = 4 \sin \omega t$ and $y_2 = 3 \sin (\omega t + \pi/3)$ interfere at a point, the amplitude of the resulting wave will be about
(a) 7 (b) 5 (c) 6 (d) 3.5

17. Four light sources produce the following four waves
(i) $y_1 = a \sin (\omega t + \phi_1)$
(ii) $y_2 = a \sin 2\omega t$
(iii) $y_3 = a' \sin (\omega t + \phi_2)$
(iv) $y_4 = a' \sin (3\omega t + \phi)$
Superposition of which two waves give rise to interference?
(a) (i) and (ii) (b) (ii) and (iii)
(c) (i) and (iii) (d) (iii) and (iv)

18. For distructive interference the phase difference between the interfering waves should be
(a) $0, 2\pi, 4\pi, 6\pi, \ldots$
(b) $\pi, 3\pi, 5\pi, 7\pi, \ldots$
(c) only zero phase difference
(d) $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}, \ldots$

19. The distinguishable characteristic of a monochromatic light wave irrespective of medium is
(a) wavelength (b) velocity
(c) intensity (d) frequency

20. Select the right option in the following
(a) Christian Huygens, a contemporary of Newton established the wave theory of light by assuming that light waves were transverse
(b) Maxwell provided the theoretical evidence that light is transverse wave
(c) Thomas Young experimentally proved the wave behaviour of light and Huygens assumption
(d) All the statements given above, correctly answers the question "what is light"

21. The wave front of a distant source of unknown shape is approximately
(a) spherical (b) cylindrical
(c) elliptical (d) plane

22. In the Young's double slit experiment, if monochromatic light used is replaced by white light, then
(a) no fringes are observed
(b) all bright fringes become white
(c) all bright fringes have colours between violet and red
(d) only central fringe is white and all other fringes are coloured

23. In Young's double slit experiment, if width (aperture) of the slit *S* is increased keeping other parameters constant, then the interference fringes will
(a) remain unchanged
(b) from closer
(c) form further away
(d) gradually disappear

24. The contrast in the fringes in any interference pattern depends on
(a) fringewidth
(b) wavelength
(c) intensity ratio of the sources
(d) distance between the sources

25. In Young's double slit experiment the separation between the slits is halved and the distance between the slits and screen is doubled. The fringe width is
(a) unchanged (b) halved
(c) doubled (d) quadrupled

26. In a Young's double slit experiment, the fringe width is found to be 0.4 mm. If the whole apparatus is immersed in water of refractive index (4/3), without disturbing the geometrical arrangement, the new fringe width will be
(a) 0.30 mm (b) 0.40 mm
(c) 0.53 mm (d) 450 microns

27. Interference fringes of light are observed in an interference chamber containing pure water ($\mu = 4/3$). Now, if the water is drained out first and then the chamber is evacuated, then
(a) no interference fringe pattern is observed
(b) same interference fringe pattern is observed
(c) interference pattern with smaller fringe width is observed
(d) interference pattern with larger fringe width is observed

28. Interference was observed in an interference chamber, when air was present. Now, the chamber is evacuated and if the same light is used, a careful observation will show
(a) no interference
(b) interference with bright bands
(c) interference with dark bands
(d) interference in which breadth of the fringe will be slightly increased

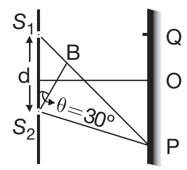
29. Interference of light waves from two coherent sources is possible for
(a) unpolarised light waves only
(b) polarised light waves only if their polarisation is in the same direction
(c) both of the above
(d) none of the above

30. In a two slit experiment with white light, a white fringe is observed on a screen kept behind the slits. When the screen is moved away by 0.05 m, this white fringe
(a) does not move at all
(b) gets displaced from its earlier position
(c) becomes coloured
(d) disappears

31. For best contrast between maxima and minima in the interference pattern of Young's double slit experiment, the intensity of light emerging out of the two slits should be
(a) equal (b) double
(c) small (d) large

32. The angular fringe width of fringes formed with sodium light of wavelength 5890 Å is 0.20°. If the whole arrangement is immersed in water, then the angular width of the fringes will become
(a) 0.11° (b) 0.15°
(c) 0.22° (d) 0.30°

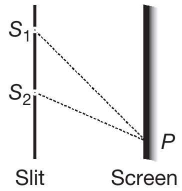
33. The double slit experiment of Young has been shown in the figure. *Q* is the position of the first bright fringe on the right side and *P* is the 11th fringe on the other side as measured from *Q*. If wavelength of light used is 6000 Å, S_1B will be equal to



(a) 6×10^{-6} m (b) 6.6×10^{-6} m
(c) 3.138×10^{-7} m (d) 3.144×10^{-7} m

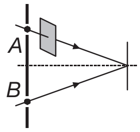
34. Yellow light emitted by sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity
(a) fringe width will decrease
(b) fringe width will increase
(c) fringe width will remain unchanged
(d) fringes will become less intense

35. In a Young's double slit experimental arrangement shown here, if a mica sheet of thickness *t* and refractive index μ is placed in front of the slit S_1, then the path difference ($S_1P - S_2P$)



(a) decreases by $(\mu - 1)t$
(b) increases by $(\mu - 1)t$
(c) does not change
(d) increases by μt

36. In Young's experiment monochromatic light is used to illuminate the two slits A and B. Interference fringes are observed on a screen placed in front of the slits. Now, if a thin glass plate is placed normally in the path of the beam coming from the slit A, then



(a) the fringes will disappear
(b) the fringes width will increase
(c) the fringe width will decrease
(d) there will be no change in fringe width but fringe pattern shifts

37. The interference fringes pattern, in Young's double slit experiment, will not be observed if
(a) the separation d between the two slits is of the order of λ
(b) the separation d between the two slits is very large of the order of a metre
(c) the width of the slit S is large of the order of a few mm
(d) all of the above

38. If a thin mica sheet of thickness t and refractive index μ is placed in the path of one of the waves producing interference, then the whole interference pattern shifts towards the side of the sheet by a distance

(a) $\frac{d}{D}(\mu - 1)t$ (b) $\frac{D}{d}(\mu - 1)t$
(c) $Dd(\mu - 1)t$ (d) $(\mu - 1)t$

39. In Young's double slit experiment, white light source is used to obtain a white central fringe and a few coloured fringes. Now if a filter allowing only red light is used in front of slit S_1 and another filter allowing only blue light is used in front of second slit S_2, then
(a) only red coloured fringes will be observed
(b) only blue colourd fringes will be observed
(c) both red coloured and blue coloured fringes will be observed
(d) interference pattern will not form on the screen

40. In the Young's double slit experiment, separation between the two slits is 0.9 mm and the fringes are observed one metre away. if it produces the second dark fringe at a distance of 1 mm from the central fringe, then wavelength of the monochromatic source of light used is
(a) 400 mm (b) 450 mm
(c) 500 mm (d) 600 nm

41. In the Young's double slit experiment, initially equal intensities were coming out of the two slits S_1 and S_2. Now if infront of one slit, a glass sheet which absorbs half of the intensity is placed, then
(a) the brighter fringes will become comparatively darker
(b) the darker fringes will become comparatively brighter
(c) the central fringe will shift on the side of the glass plate
(d) all of the above

42. The fringe width in Young's double slit experiment increases when
(a) wavelength increases
(b) distance between source and screen decreases
(c) distance between slits increases
(d) the width of the slits increases

43. If in an interference pattern, $I_{max.}$ represents the intensity maximum value and $I_{min.}$ represents the intensity minimum value, then the fringe visibility is defined as

(a) $V = \frac{I_{max.}}{I_{min.}}$ (b) $V = \frac{I_{max.} + I_{min.}}{I_{max.} - I_{min.}}$

(c) $V = \frac{I_{max.} - I_{min.}}{I_{max.} + I_{min.}}$ (d) $V = \frac{\sqrt{I_{max.}} - \sqrt{I_{min.}}}{\sqrt{I_{max.}} + \sqrt{I_{min.}}}$

44. In Young's double slit experiment, the 7th maximum with wavelength λ_1 is at a distance d_1 and that with wavelength λ_2 is at a distance d_2. Then (d_1/d_2) is
(a) (λ_1/λ_2) (b) (λ_2/λ_1)
(c) $(\lambda_1^2/\lambda_2^2)$ (d) $(\lambda_2^2/\lambda_1^2)$

45. In Young's double slit experiment, illuminated by yellow light, one slit is covered with plane transparent thin glass plate and the other slit by blue filter. Then
(a) there will be yellow and blue interference fringes formed on the screen
(b) there will be uniform illumination on the screen
(c) the maximum intensity fringes will be doubly coloured
(d) the minimum intensity fringes will be dark

46. If one of the two slits of a Young's double slit experiment is painted over so that it transmits half the light intensity of the other, then
(a) the fringe system would disappear
(b) the bright fringes will be more bright and dark fringes will be more dark
(c) the dark fringes would be brighter and bright fringes would be darker
(d) bright as well as dark fringes would be darker

47. In the Young's double slit experiment, the two equally bright slits are coherent, but of phase difference $\pi/3$. If the maximum intensity on the screen is I_o, the intensity at the point on the screen equidistant from the slits is
(a) I_o (b) $I_o/2$ (c) $I_o/4$ (d) $3I_o/4$

48. In Young's double slit experiment if two slightly different wavelengths are present in the light used then
(a) the sharpness of fringes will increase everywhere (compared to the case when monochromatic light is used)
(b) there will be no fringes at all
(c) the sharpness of fringes will decrease as we move away from central fringe
(d) the central fringe will be white

49. White light may be considered to be a mixture of waves with λ ranging between 3000 Å and 7800 Å. Anoil film of thickness 10000 Å is examined normally by the reflected light. If $\mu = 1.4$, then the film appears bright for
(a) 4308 Å, 5091 Å, 6222 Å
(b) 4000 Å, 5091 Å, 5600 Å
(c) 4667 Å, 6222 Å, 7000 Å
(d) 4000 Å, 4667 Å, 5600 Å, 7000 Å

50. A source emits electromagnetic waves of wavelength 3 m. One beam reaches the observer directly and other after reflection from a water surface, travelling 1.5 m extra distance and with intensity reduced to (1/4) as compared to intensity due to direct beam alone. The resultant intensity will be
(a) (1/4) fold (b) (3/4) fold
(c) (5/4) fold (d) (9/4) fold

51. Find the thickness of a plate which will produce a change in optical path equal to half the wavelength λ of the light passing through it normally. The refractive index of the plate μ is

(a) $\dfrac{\lambda}{4(\mu-1)}$ (b) $\dfrac{2\lambda}{4(\mu-1)}$

(c) $\dfrac{\lambda}{(\mu-1)}$ (d) $\dfrac{\lambda}{2(\mu-1)}$

52. In Young's double slit experiment, the source S and two slits A and B are horizontal with slit A above slit B. The fringes are observed on a vertical screen K. The optical path length from S to B is increased very slightly (by introducing a transparent material of higher refractive index) and optical path length from S to A is not changed. As a result the fringe system on K moves
(a) vertically downwards slightly
(b) vertically upwards slightly
(c) horizontally, slightly to the left
(d) horizontally, slightly to the right

53. Two light rays having the same wavelength λ in vacuum are in phase initially. Then the first ray travels a path L_1 through a medium of refractive index n_1 while the second ray travels a path of length L_2 through a medium of refractive index n_2. The two waves are then combined to observe interference. The phase difference between the two waves is

(a) $\dfrac{2\pi}{\lambda}(L_2 - L_1)$ (b) $\dfrac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$

(c) $\dfrac{2\pi}{\lambda}(n_2L_1 - n_1L_2)$ (d) $\dfrac{2\pi}{\lambda}\left(\dfrac{L_1}{n_1} - \dfrac{L_2}{n_2}\right)$

54. In Young's double slit experiment the wavelength of light was changed from 7000 Å to 3500 Å. While doubling the separation between the slits which of the following is not true for this experiment?
(a) The width of the fringes changes
(b) The colour of the bright fringes changes
(c) The separation between successive bright fringes changes
(d) The separation between successive dark fringes remains unchanged

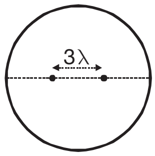
55. A thin mica sheet of thickness 2×10^{-6} m and refractive index $\mu = 1.5$ is introduced in the path of one of the waves. The wavelength of the wave used is 5000 Å. The central bright maximum will shift
(a) 2 fringes upward (b) 2 fringes downward
(c) 10 fringes upward (d) none of these

56. The maximum intensity in Young's double slit experiment is I_o. Distance between the slits is $d = 5\lambda$, where λ is the wavelength of monochromatic light used in the experiment. What will be the intensity of light in front of one of the slits on a screen at a distance $D = 10d$?

(a) $\dfrac{I_o}{2}$ (b) $\dfrac{3I_o}{4}$

(c) I_o (d) $\dfrac{I_o}{4}$

57. If two coherent sources are placed at a distance 3λ from each other symmetric to the centre of the circle shown in the figure, then number of fringes shown on the screen placed along the circumference is



(a) 16 (b) 12 (c) 8 (d) 4

58. A plate of thickness t made of a material of refractive index μ is placed in front of one of the slits in a double slit experiment. What should be the minimum thickness t which will make the intensity at the centre of fringe pattern zero?

(a) $(\mu - 1)\frac{\lambda}{2}$ (b) $(\mu - 1)\lambda$

(c) $\frac{\lambda}{2(\mu - 1)}$ (d) $\frac{\lambda}{(\mu - 1)}$

59. Two identical coherent sources are placed on a diameter of a circle of radius R at separation x ($<< R$) symmetrically about the centre of the circle. The sources emit identical wavelength λ each. The number of points on the circle with maximum intensity is ($x = 5\lambda$)
(a) 20 (b) 22 (c) 24 (d) 26

60. Microwaves from a transmitter are directed normally towards a plane reflector. A detector moves along the normal to the reflector. Between positions of 14 successive maxima the detector travels a distance of 0.14 m. The frequency of transmitter is ($c = 3 \times 10^8$ m/s)
(a) 1.5×10^{10} Hz (b) 10^{10} Hz
(c) 3×10^{10} Hz (d) 6×10^{10} Hz

61. In Young's double slit experiment, the type of diffraction is
(a) Fresnel (b) Fraunhofer
(c) both (a) and (b) (d) none of these

62. The phase difference between two wave trains giving rise to a dark fringe in Young's double slit interference experiment in (n integer)
(a) $2\pi n + \pi/4$ (b) $2\pi n + \pi$
(c) $2\pi n + \pi/2$ (d) zero

63. In Young's double slit interference pattern the fringe width
(a) can be changed only by changing the wavelength of incident light
(b) cab be changed only by changing the separation between the two slits
(c) can be changed either by changing the wavelength or by changing the separation between the two slits
(d) is a universal constant, hence cannot be changed

64. When petrol drops from a vehicle fall over rain water on the road, colours are seen because of
(a) dispersion of light
(b) scattering of light
(c) interference of light
(d) absorption of light

65. What is the minimum thickness of a soap bubble needed for constructive interference in reflected light if the light incident on the film is 900 nm? Assume the refractive index for the film is $\mu = 1.5$
(a) 100 nm (b) 150 nm
(c) 200 nm (d) 250 nm

66. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on the screen is a
(a) straight line (b) parabola
(c) hyperbola (d) circle

67. In Young's double slit experiment, a third slit is made in between the double slits, Then
(a) intensity of fringes totally disappears
(b) only bright light is observed on the screen
(c) fringes of unequal width are formed
(d) contrast between bright and dark fringes is reduced

68. If white light is used in a biprism experiment then
(a) fringe pattern disappears
(b) all fringes will be coloured
(c) central fringe will be white while others will be coloured
(d) increase or decrease depending upon the prism angle

69. In a biprism experiment, if the biprism is moved towards the light source a little, then the fringe width will
(a) increase
(b) decrease
(c) not change
(d) increase or decrease depending upon the prism angle

70. In a Fresnel biprism experiment, the two positions of lens give separation between the slits as 16 cm and 9 cm respectively. What is the actual distance of separation?
(a) 12.5 cm (b) 12.0 cm (c) 13 cm (d) 14 cm

71. The phenomenon of diffraction can be exhibited by
(a) polarised waves only
(b) unpolarised waves only
(c) longitudinal waves only
(d) all, polarised or unpolarised, longitudinal or transverse waves

72. The main difference in the phenomenon of interference and diffraction is that
(a) diffraction is due to interaction of light from the same wavefront whereas interference is the interaction of waves from two isolated sources
(b) diffraction is due to interaction of light from same wavefront, whereas the interference is the interaction of two waves derived from the same source
(c) diffraction is due to interaction of waves derived from the same source, whereas the interference is the bending of light from the same wavefront
(d) diffraction is caused by the reflected waves from a source whereas interference is caused due to refraction of waves from a source

73. The phenomenon of diffraction can be exhibited by
(a) infrared waves (b) microwaves
(c) *X*-rays (d) all of these

74. Diffraction effects are easily observable for
(a) microwaves (b) sound waves
(c) radio waves (d) all of these

75. In Fresnel's class of diffraction, the
(a) obstacle-screen distance is small
(b) the diffracted wavefront is considered as spherical
(c) no convex lens is used to focus the diffraction fringes on the screen
(d) all of the above

76. A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue light?
(a) No change
(b) Diffraction bands become narrower and crowded together
(c) Bands become broader and farther apart
(d) Bands disappear

77. nth bright fringe if red light (λ_1 = 7500 Å) coincides with $(n + 1)$th bright fringe of green light (λ_2 = 6000 Å.) The value of n =?
(a) 4 (b) 5 (c) 3 (d) 2

78. A parallel beam of fast moving electrons is incident normally on a narrow slit. A screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statement is correct?
(a) Diffraction pattern is not observed on the screen in the case of electron.
(b) The angular width of the central maximum of the diffraction pattern will increase.
(c) The angular width of the central maximum will decrease
(d) The angular width of the central maximum will remains the same.

79. A slit of width a is illuminated with a monochromatic light of wavelength λ from a distant source and the diffraction pattern is observed on a screen placed at a distance D from the slit. To increase the width of the central maximum one should
(a) decrease D
(b) decrease a
(c) decrease λ
(d) the width cannot be changed

80. Polarisation of light proves the
(a) corpuscular nature of light
(b) quantum nature of light
(c) transverse wave nature of light
(d) longitudinal wave nature of light

81. The fact that light is transverse wave phenomenon derives its evidential support from the observation that
(a) light is a wave motion
(b) light is characterised by interference
(c) light shows polarising effects
(d) light can be diffracted

82. If light is polarised by reflection, then the angle between reflected and refracted light is
(a) π (b) $\pi/2$ (c) 2π (d) $\pi/4$

83. One of the devices to produce plane polarised light is
(a) nicol prism (b) a crystal
(c) a biprism (d) a half wave plate

84. A ray of unpolarised light is incident on a glass plate at the polarising angle 57°. Then
(a) the reflected ray and the transmitted ray both will be completely polarised
(b) the reflected ray will be completely polarised and the transmitted ray will be partially polarised
(c) the reflected ray will be partially polarised and the transmitted ray will be completely polarised
(d) the reflected and transmitted both rays will be partially polarised

85. Polaroid glass is used in sun glasses because
(a) it reduces the light intensity to half on account of polarisation
(b) it is fashionable
(c) it has good colour
(d) it is cheaper

86. Waves that cannot be polarised are
(a) light waves (b) electromagnetic waves
(c) transverse waves (d) longitudinal waves

87. The phenomenon of rotation of plane polarised light is called
(a) double refraction (b) kerr effect
(c) dichroism (d) optical activity

88. An optically active compound
(a) rotates the plane polarised light
(b) changes the direction of polarised light
(c) do not allow lane polarised light to pass through
(d) none of the above

89. In case of linearly polarised light, the magnitude of the electric field vector
(a) does not change with time
(b) varies periodically with time
(c) increases and decreases linearly with time
(d) is parallel to the direction of propagation

90. A Nicol prism is based on the principle of
(a) refraction (b) scattering
(c) dichroism (d) double refraction

91. What does not change on polarization of light?
(a) Intensity (b) Phase
(c) Frequency (d) Wavelength

92. A calcite crystal is placed over a dot on a piece of paper and rotated; On seeing through the calcite, one will see
(a) one dot
(b) two stationary dots
(c) two rotating dots
(d) one dot rotating about the other

93. A polaroid is placed at 45° to an incoming light of intensity I_o. Now the intensity of light passing through the polaroid after polarisation would be
(a) I_o (b) $I_o/2$ (c) $I_o/4$ (d) zero

94. Which of the following cannot be explained on the basis of wave nature of light?
(i) Polarization
(ii) Optical activity
(iii) Photoelectric effect
(iv) Compton effect
(a) (iii) and (iv) (b) (ii) and (iii)
(c) (i) and (iii) (d) (ii) and (iv)

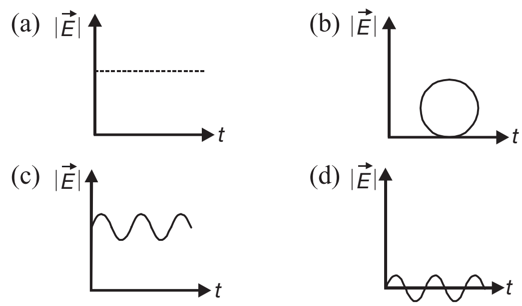
95. What happens inside optical fibre?
(a) Diffraction
(b) Polarisation
(c) Interference
(d) Total Internal reflection

96. The phenomenon of polarisation of electromagnetic waves proves that the electromagnetic waves are
(a) transverse
(b) mechanical
(c) longitudinal
(d) neither longitudinal nor transverse

97. Which of the following as a dichroic crystal?
(a) Quartz (b) Tourmaline
(c) Mica (d) Selenite

98. When the light is incident at the polarizing angle on the transparent medium, then the completely polarized light is
(a) refracted light
(b) reflected light
(c) refracted and reflected light
(d) neither reflected nor refracted light

99. Which of the following diagrams represent the variation of electric field vector with time for a circularly polarised light?



100. The angle of incidence of light is equal to Brewster's angle, then
(1) reflected ray is perpendicular to refracted ray
(2) reflected ray is parallel to refracted ray
(3) reflected light is polarized having its electric vector in the plane of incidence
(4) refracted light is polarized
(a) (1) and (4) are true
(b) (1) and (2) are true
(c) (1) and (3) are true
(d) (2) and (4) are true

Answer Keys

1. (c)	**2. (b)**	**3. (a)**	**4. (d)**	**5. (b)**	**6. (c)**	**7. (d)**	**8. (c)**	**9. (b)**	**10. (c)**
11. (a)	**12. (c)**	**13. (c)**	**14. (b)**	**15. (d)**	**16. (c)**	**17. (c)**	**18. (b)**	**19. (d)**	**20. (b)**
21. (d)	**22. (d)**	**23. (d)**	**24. (c)**	**25. (d)**	**26. (a)**	**27. (d)**	**28. (d)**	**29. (c)**	**30. (a)**
31. (a)	**32. (b)**	**33. (d)**	**34. (a)**	**35. (b)**	**36. (d)**	**37. (d)**	**38. (b)**	**39. (d)**	**40. (d)**

41. (d)	**42. (a)**	**43. (c)**	**44. (a)**	**45. (b)**	**46. (c)**	**47. (c)**	**48. (c)**	**49. (a)**	**50. (d)**
51. (d)	**52. (b)**	**53. (b)**	**54. (d)**	**55. (a)**	**56. (a)**	**57. (d)**	**58. (c)**	**59. (a)**	**60. (a)**
61. (a)	**62. (b)**	**63. (c)**	**64. (a)**	**65. (b)**	**66. (a)**	**67. (d)**	**68. (c)**	**69. (a)**	**70. (d)**
71. (d)	**72. (b)**	**73. (d)**	**74. (d)**	**75. (d)**	**76. (b)**	**77. (a)**	**78. (c)**	**79. (b)**	**80. (c)**
81. (c)	**82. (b)**	**83. (a)**	**84. (b)**	**85. (a)**	**86. (d)**	**87. (d)**	**88. (a)**	**89. (b)**	**90. (d)**
91. (c)	**92. (d)**	**93. (b)**	**94. (a)**	**95. (d)**	**96. (a)**	**97. (b)**	**98. (b)**	**99. (a)**	**100. (a)**

Hints & Solutions for Selected Questions:

10. Two sources should have the same wavelengths, nearly the same amplitude and have a constant phase difference. If the phase difference between two interfering waves does not remain constant, interference pattern will not be sustained.

Hence, the correct answer is option (c).

11. Detector takes a time much greater than 10^{-8} sec to detect the intensity at a given point.

(Resolution time for human eye = $\left(\frac{1}{20}\right)$ sec)

Hence, the correct answer is option (a).

12. $I = I_1 + I_2 + 2(\sqrt{I_1 I_2})\cos\phi$

I will be maximum when cos ϕ = maximum = 1

$$\therefore I_{max.} = I_1 + I_2 + 2\sqrt{I_1 I_2} = 4I + I + 2\sqrt{4I \times I} = 9I$$

and I will be minimum when cos ϕ = minimum = –1

$$\therefore I_{min.} = I_1 + I_2 - 2\sqrt{I_1 I_2} = 4I + I - 2\sqrt{4I \times I} = I$$

Hence, the correct answer is option (c).

13. $\phi = 60°$, cos ϕ = 1/2, $I_1 = I_2 = I_o$

$$\therefore \quad I = I_1 + I_2 + 2\sqrt{I_1 I_2})\cos\phi$$

$$= I_o + I_o + 2\sqrt{I_o \times I_o})\cos 60° = 3I_o$$

Hence, the correct answer is option (c).

14. Two independent light sources cannot be coherent because they cannot generate waves having a constant phase difference.

Hence, the correct answer is option (b).

17. Interference phenomenon takes place between two waves which have equal frequency and propagate in the same direction.

Hence, $y_1 = a \sin(\omega t + \phi_1)$

$y_3 = a' \sin(\omega t + \phi_2)$

will give rise to interference as the two waves have same frequency ω.

Hence, the correct answer is option (c).

20. Maxwell first proved it mathematically that light waves are transverse in nature.

Hence, the correct answer is option (b).

22. We know that if white light is used in the Young's double slit experiment, we get a central white fringe surrounded by coloured fringes. The central spot is white, because all wavelengths of white light have zero path difference and all other points close to both sides to the central white fringes have different geometrical path differences for different wavelengths of white light. Thus, coloured fringes are observed on both sides of central white fringe.

Hence, the correct answer is option (d).

28. When the chamber is evacuated the refractive index decreases. Therefore, the wavelength increases. As $\beta = (D\lambda/d)$, the fringe width increases.

Hence, the correct answer is option (d).

30. Using white light, we get white fringe at the centre. *i.e.*, white fringe is the central maximum. When the screen is moved, its position is not changed.

Hence, the correct answer is option (a).

34. Fringe width $\beta = (D\lambda/d)$, *i.e.*, $\beta \propto \lambda$

As $\lambda_B < \lambda_R$, hence $\beta_B < \beta_R$,

i.e., fringe width will decrease.

Hence, the correct answer is option (a).

40. Given, d = 0.9 mm = 0.9 × 10^{-3} m; D = 1 m; distance between the second dark fringe and central fringe (x_2) = 1 mm = 10^{-3} m and number of dark fringe (n) = 2.

We know from the Young's double slit experiment that distance between second dark fringe and central fringe

$$x_2 = \frac{(2n-1)D\lambda}{2d}$$

or $$\lambda = \frac{2dx_2}{(2n-1)D} = \frac{2\times(0.9\times10^{-3})\times10^{-3}}{[(2\times2)-1]\times1}$$

$$= 6 \times 10^{-7} \text{ m} = 600 \text{ nm}$$

Hence, the correct answer is option (d).

44. $^7\beta_1 = d_1 = 7\dfrac{\lambda_1 D}{d}$ and $^7\beta_2 = d_2 = 7\dfrac{\lambda_2 D}{d}$

$\therefore \qquad \dfrac{d_1}{d_2} = \dfrac{\lambda_1}{\lambda_2}$

Hence, the correct answer is option (a).

49. The film appears bright when the path difference

$2\mu t \cos r = (2n-1)\dfrac{\lambda}{2}$, $n = 1, 2, 3\ldots$

$$\therefore \quad \lambda = \frac{4\mu t \cos r}{(2n-1)}$$

$$= \frac{4\times 1.4\times 10000\times 10^{-10}\times \cos 0°}{(2n-1)} = \frac{56000}{(2n-1)} \text{ Å}$$

$\therefore \quad \lambda = 56000$ Å, 18666 Å, 8000 Å, 6222 Å, 5091 Å, 4308 Å, 3733 Å

The wavelength which are not within specified range are to be rejected.

Hence, the correct answer is option (a).

50. We know that a phase change of π occurs when the reflection takes place at the boundary of denser medium. this is equivalent to a path difference of $\lambda/2$.

$\therefore$ Total phase difference $= \pi - \pi = 0$. *i.e.*, two waves superimpose in phase. Hence, resultant amplitude

$$= \sqrt{I} + \sqrt{I/4} = \frac{3}{2}\sqrt{I}$$

So, resultant intensity $= \left(\dfrac{3}{2}\sqrt{I}\right)^2 = \dfrac{9}{4}I = \dfrac{9}{4}$ fold

Hence, the correct answer is option (d).

51. Path difference, $\Delta x = (\mu - 1)t$

$$\therefore \qquad \frac{\lambda}{2} = (\mu - 1)t \text{ or } t = \frac{\lambda}{2(\mu - 1)}$$

Hence, the correct answer is option (d).

53. Optical path for 1st ray $= n_1 L_1$

Optical path for 2nd ray $= n_2 L_2$

$\therefore$ Path diff. $= (n_1 L_1 - n_1 L_2)$

Now, Phase diff. $= \dfrac{2\pi}{\lambda} \times$ path difference

$$= \frac{2\pi}{\lambda}(n_1 L_1 - n_2 L_2)$$

Hence, the correct answer is option (b).

56. Path difference $Dx = \dfrac{yd}{D}$

Here, $y = \dfrac{d}{2} = \dfrac{5\lambda}{2}$ (as $d = 5\lambda$)

and $\qquad D = 10d = 50\lambda$

So, $\qquad \Delta x = \dfrac{5\lambda}{2} \times \dfrac{5\lambda}{50\lambda} = \dfrac{\lambda}{4}$

Corresponding phase difference will be,

$$\Delta\phi = \frac{2\pi}{\lambda}\cdot \Delta x = \left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{4}\right) = \frac{\pi}{2}$$

or $\qquad \dfrac{\Delta\phi}{2} = \dfrac{\pi}{4}$

$$\therefore \qquad I = I_o \cos^2\left(\frac{\Delta\phi}{2}\right)$$

$$= I_o \cos^2\left(\frac{\pi}{4}\right) = \frac{I_o}{2}$$

Hence, the correct answer is option (a).

58. Intensity at the centre will be zero if path difference $= \dfrac{\lambda}{2}$

or $\qquad (\mu - 1)t = \dfrac{\lambda}{2} \qquad$ or $\qquad t = \dfrac{\lambda}{2(\mu - 1)}$

Hence, the correct answer is option (c).

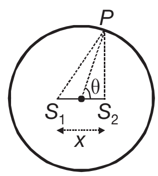
59. Path difference at P is,

$$\Delta x = 2\left(\frac{x}{2}\cos\theta\right) = x \cos\theta$$

For intensity to be maximum,

$\Delta x = n\lambda$

$(n = 0, 1, 2, \ldots)$



$\therefore \qquad x \cos\theta = n\lambda$

$\cos\theta = \dfrac{n\lambda}{x} \qquad \cos\theta \ngtr 1$

$\therefore \qquad \dfrac{n\lambda}{x} > 1 \quad \therefore \quad n > \dfrac{x}{\lambda}$

Putting $x = 5\lambda$, $n > 5$

or $\qquad$ n = 1, 2, 3, 4, 5

Therefore, in all four quadrants there can be 20 maximas. There are more maximas at $\theta = 0°$ and $\theta = 180°$.

But $n = 5$ corresponds to $\theta = 90°$ and $\theta = 270°$ which are coming only twice while we have multiplied it four times. Therefore, total number of maximas are still 20, *i.e.*, $n = 1$ to 4 in four quadrants (total 16) plus four more at $\theta = 0°$, $90°$, $180°$ and $270°$.

Hence, the correct answer is option (a).

60. The detector receives direct as well as reflected waves. Distance moved between two consecutive positions of maxima = $\lambda/2$.

For 14 successive maxima = $14 \times \frac{\lambda}{2}$

Given that; $14 \times \frac{\lambda}{2} = 0.14$ m

$\therefore \quad \lambda = 2 \times 10^{-2}$ m

So, $\quad v = \frac{c}{\lambda} = \frac{3 \times 10^8}{2 \times 10^{-2}} = 1.5 \times 10^{10}$ Hz

Hence, the correct answer is option (a).

61. As source and screen are at finite distances and no lens is used, hence the type of diffraction in Young's double slit experiment is Fresnel's diffraction.

Hence, the correct answer is option (a).

63. In Young's double slit experiment, the fringe width is $\beta = \frac{D\lambda}{d}$, where D is the distance of the slits from the screen, d is the separation of the slits and λ, the wavelength.

Therefore, the fringe width β can be changed either by changing the separation between the two slits or the wavelength.

Hence, the correct answer is option (c).

65. In reflected light, condition for constructive interference is,

$$2\mu t \cos r = (2n+1)\frac{\lambda}{2}$$

where $n = 0, 1, 2\ldots$

For minimum thickness, $n = 0$

$$\therefore \quad t = \frac{\lambda}{4\mu\cos r} = \frac{900}{4 \times 1.5 \times 1} \text{ nm}$$
$$= 150 \text{ nm}$$

Hence, the correct answer is option (b).

70. Given that; $d_1 = 16$ cm and $d_2 = 9$ cm

Now, $2d = \sqrt{d_1 d_2} = \sqrt{16 \times 9} = 12$ cm

Hence, the correct answer is option (d).

78. Angular fringe width is the ratio of fringe width to distance (D) of screen from the source, *i.e.*,

$$\theta = \frac{\beta}{D}$$

As D is taken large, hence angular fringe width of the central maximum will decrease.

Hence, the correct answer is option (c).

79. Width of the central maximum, $\beta_o = \frac{2D\lambda}{a}$

$$\beta_o \propto \frac{1}{a}$$

$\therefore$ To increase the width of the central maximum one should decrease a.

Hence, the correct answer is option (b).

91. Intensity decreases because only a portion of light will pass through. Both in the study of polarisation by reflection and by double refraction, there is also a phase change.

As the refractive indices of the ordinary and extra ordinary rays are different, both the wavelengths and velocity also change.

It is only the frequency which does not change on polarisation of light. Hence, only option (c) is correct.

Hence, the correct answer is option (c).

98. When the light is incident at the polarising angle on the transparent medium, the reflected light is completely polarised.

Hence, the correct answer is option (b).

100. The reflected ray is perpendicular to the refracted ray. Refracted ray is also polarised. The vibrations of the reflected rays are perpendicular to the plane of incidence and that of the refracted ray are parallel.

Hence, the correct answer is option (a).