PRACTICE EXERCISES

SINGLE CORRECT CHOICE TYPE QUESTIONS

This section contains Single Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

1. In an interference pattern produced by two identical slits, the intensity at the site of the central maximum is I. The intensity at the same spot when either of two slits is closed is

(A) $\frac{I}{2}$ (B) $\frac{I}{4}$

(C) $\frac{I}{2\sqrt{2}}$ (D) $\frac{I}{\sqrt{2}}$

2. In a $YDSE$ with two identical slits, when the upper slit is covered with a thin, perfectly transparent sheet of mica, the intensity at the centre of screen reduces to 75% of the initial value. Second minima is observed to be above this point and third maxima below it. Which of the following cannot be a possible value of phase difference caused by the mica sheet?

(A) $\frac{\pi}{3}$ (B) $\frac{13\pi}{3}$

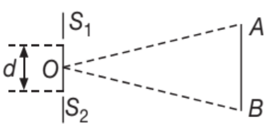
(C) $\frac{17\pi}{3}$ (D) $\frac{11\pi}{3}$

3. Specific rotation of sugar solution is 0.01 SI unit. If $200\ \text{kgm}^{-3}$ of impure sugar solution is taken in a polarimeter tube of length 0.25 m and an optical rotation of 0.4 rad is observed, then the percentage of purity of sugar is the sample is

(A) 80% (B) 89%

(C) 11% (D) 20%

4. The figure shows two coherent sources S_1, S_2 vibrating in same phase. AB is a screen lying at a far distance from the sources S_1 and S_2. Let $\frac{\lambda}{d} = 10^{-3}$ and $\angle BOA = 0.12°$. The number of bright spots seen on the screen, including points A and B.



(A) 2
(B) 3
(C) 4
(D) more than 4

5. Huygens' conception of secondary waves
(A) helps us to find the focal length of a thick lens
(B) is a geometrical method to find the position of a wave-front at a later or an earlier instant
(C) is used to determine the velocity of light
(D) is used to explain polarization of light

6. Longitudinal waves do not exhibit
(A) refraction (B) reflection
(C) diffraction (D) polarization

7. The idea of the quantum nature of light has emerged in an attempt to explain
(A) interference
(B) diffraction
(C) polarization
(D) radiation spectrum of a black body

8. In the spectrum of light of a luminous heavenly body the wavelength of a spectral line is measured to be 4747 Å while actual wavelength of the line is 4700 Å. The relative velocity of the heavenly body with respect to earth will be (velocity of light is $3\times10^8\ \text{ms}^{-1}$)

(A) $3\times10^5\ \text{ms}^{-1}$ moving towards the earth
(B) $3\times10^5\ \text{ms}^{-1}$ moving away from the earth
(C) $3\times10^6\ \text{ms}^{-1}$ moving towards the earth
(D) $3\times10^6\ \text{ms}^{-1}$ moving away from the earth

9. A grating has $5000\ \text{lines cm}^{-1}$. The maximum order visible with wavelength 6000 Å
(A) 2 (B) 3
(C) 4 (D) 0

10. A beam of monochromatic light enters from vacuum into a medium of refractive index n. The ratio of the wavelengths of the incident and refracted waves is

(A) $n:1$ (B) $1:n$

(C) $n^2:1$ (D) $1:n^2$

11. In Young's double slit experiment, 62 fringes are seen in visible region for sodium light of wavelength 5893 Å. If violet light of wavelength 4358 Å is used in place of sodium light, then number of fringes seen will be
(A) 54 (B) 64
(C) 74 (D) 84

12. Monochromatic light of wavelength $5000\,\text{Å}$ illuminates a pair of slits 1 mm apart. The separation of bright fringes in the interference pattern formed on a screen 2 m away is
(A) 0.25 mm (B) 0.1 mm
(C) 0.01 mm (D) 1.0 mm

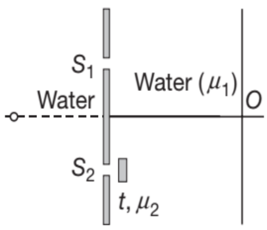
13. Air has refractive index 1.0003. The thickness of an air column, which will have one more wavelength of yellow light $\left(6000\,\text{Å}\right)$ than in the same thickness of vacuum is
(A) 2 mm (B) 2 cm
(C) 2 m (D) 2 km

14. Two coherent monochromatic light beams of intensities I and $4I$ are superposed. The maximum and minimum possible intensities in the resulting beam are
(A) $4I$ and I (B) $5I$ and $3I$
(C) $9I$ and I (D) $9I$ and $3I$

15. There is a wavelength corresponding to each colour. How many colours are possible, then
(A) 3 (B) 1
(C) 7 (D) None of these

16. Though quantum theory of light can explain a number of phenomena observed with light, it is necessary to retain the wave nature of light to explain the phenomenon of
(A) photo-electric effect (B) diffraction
(C) compton effect (D) black body radiation

17. A Young's double slit experiment is carried out in water having refractive index μ_1 as shown in the figure. A glass plate of thickness t and refractive index μ_2 is placed in the path of S_2. The magnitude of the phase difference at O is
(Assume that λ is the wavelength of light in air, O is symmetrical w.r.t. S_1 and S_2).



(A) $\frac{2\pi}{\lambda}\left|\left(\frac{\mu_2}{\mu_1}-1\right)t\right|$ (B) $\frac{2\pi}{\lambda}\left|\left(\frac{\mu_1}{\mu_2}-1\right)t\right|$
(C) $\frac{2\pi}{\lambda}\left|(\mu_2-\mu_1)t\right|$ (D) $\frac{2\pi}{\lambda}\left|(\mu_2-1)t\right|$

18. Which of the following cannot be polarized?
(A) Radio wave (B) X-rays
(C) Infrared radiation (D) Sound waves in air

19. A blue object on a white background when seen through a blue filter will appear
(A) blue on a white background
(B) black on a blue background
(C) blue on red background
(D) invisible

20. Illumination of the sun at noon is maximum because
(A) the sun is nearer to the earth at noon
(B) rays are incident almost normally
(C) refraction of light is minimum at noon
(D) scattering is reduced at noon

21. In Young's double slit experiment, carried out with light of wavelength $\lambda = 5000\,\text{Å}$, the distance between the slits is 0.2 mm and the screen is at 200 cm from the slits. The central maximum is at $x = 0$. The third maximum (taking the central maximum as zeroth maximum) will be at x equal to
(A) 1.67 cm (B) 1.5 cm
(C) 0.5 cm (D) 5.0 cm

22. Ray optics is valid when characteristic dimensions are
(A) of the same order as the wavelength of light
(B) much smaller than the wavelength of light
(C) much larger than the wavelength of light
(D) of the order of 1 mm

23. In order that a thin film of oil floating on the surface of water shows colours due to interference, the thickness of the oil film should be of the order of
(A) 1 cm (B) 10 Å
(C) 5000 Å (D) 10000 Å

24. The blue cross on a white background illuminated with white light is observed through a red filter. The pattern seen is
(A) a red cross on a black background
(B) a blue cross on a red background
(C) a red cross on a blue background
(D) a black cross on a blue background

25. In a single slit diffraction of light of wavelength λ by a slit of width a, the size of the central maximum on a screen at a distance b is
(A) $2b\lambda + a$ (B) $\frac{2b\lambda}{a}$
(C) $\frac{2b\lambda}{a} + a$ (D) $\frac{2b\lambda}{a} - a$

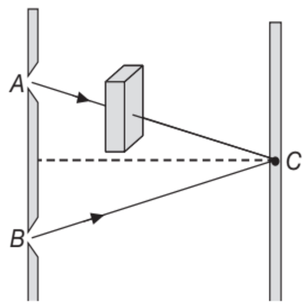
26. The deflection of light in a gravitational field was predicted first by
(A) Einstein (B) Newton
(C) Max Planck (D) Maxwell

27. Both the particle and wave aspects of the wave aspects of light appear to be used in
(A) photoelectric effect (B) gamma emission
(C) interference (D) classical mechanics

28. At sunset, the sun seems to be
(A) higher than it really is
(B) lower than it really is
(C) exactly where it really is
(D) lower than it would be at sunrise

29. In Huygens' wave theory, the locus of all the points in the same state of vibration is called a
(A) half period zone (B) vibrator
(C) wavefront (D) ray

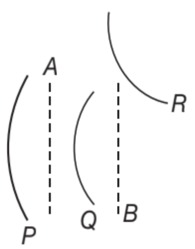
30. In Young's experiment, monochromatic light is used to illuminate the two slits A and B. Interference fringes are observed on a screen placed in front of the slits. Now if a thin glass plate is placed normally in the path of the beam coming from the slit



(A) The fringes will disappear
(B) The fringe width will increase
(C) The fringe width will increase
(D) There will be no change in the fringe width but the pattern shifts

31. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is
(A) zero (B) I_0
(C) $\frac{1}{2}I_0$ (D) $\frac{1}{4}I_0$

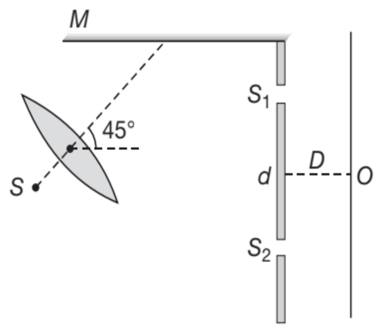
32. The figure shows a wave front P passing through two systems A and B, and emerging as Q and then as R. The systems A and B could, respectively, be



(A) a prism and a convergent lens
(B) a convergent lens and a prism
(C) a divergent lens and a prism
(D) a convergent lens and a divergent lens

33. In Young's double-slit experiment the separation between the slits is doubled and the distance between the slit and the screen is halved. The fringe-width becomes
(A) one-fourth (B) half
(C) double (D) quadruple

34. In Young's double slit experiment, distance between the slits is d and that between the slits and screen is D. Angle between principle axis of lens and perpendicular bisector of S_1 and S_2 is $45°$. The point source S is placed at the focus of lens. The lens has a focal length of 10 cm and its aperture is much larger than d. Assuming only the reflected light from plane mirror M is incident on slits, distance of central maxima from O will be



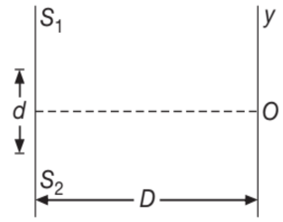
(A) $\frac{D}{\sqrt{2}}$ (B) $\frac{D}{\sqrt{3}}$
(C) $D\sqrt{3}$ (D) $\frac{D}{\sqrt{4}}$

35. Two coherent point sources s_1 and s_2 vibrating in phase emit light of wavelength λ. The separation between the sources is 2λ. The smallest distance from s_2 on a line passing through s_2 and perpendicular to s_1s_2, where a minimum of intensity occurs is
(A) $\frac{7\lambda}{12}$ (B) $\frac{15\lambda}{4}$
(C) $\frac{\lambda}{2}$ (D) $\frac{3\lambda}{4}$

36. In a Young's double slit experiment, the fringes are displaced by a distance x when a glass plate of refractive index 1.5 is introduced in the path of one of the beams. When this plate is replaced by another plate of same thickness, the shift of fringes is $\left(\frac{3}{2}\right)x$. The refractive index of second plate is

(A) 1.75 (B) 1.50
(C) 1.25 (D) 1.00

37. Consider a usual set-up of Young's double slit experiment with slits of equal intensity as shown in the figure. Take O as origin and the Y axis as indicated. If verage intensity between $y_1 = -\frac{\lambda D}{4d}$ and $y_2 = +\frac{\lambda D}{4d}$ equals n times the intensity of maxima, then n equals (take average over phase difference)



(A) $\frac{1}{2}\left(1+\frac{2}{\pi}\right)$ (B) $2\left(1+\frac{2}{\pi}\right)$
(C) $\left(1+\frac{2}{\pi}\right)$ (D) $\frac{1}{2}\left(1-\frac{2}{\pi}\right)$

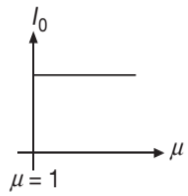
38. A plate of thickness t made of a material of refractive index μ is placed in front of one of the slits in a double slit experiment. What should be the minimum thickness t which will make the intensity at the centre of the fringe pattern zero?

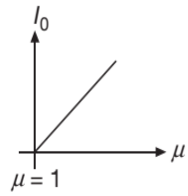
(A) $(\mu-1)\frac{\lambda}{2}$ (B) $(\mu-1)\lambda$
(C) $\frac{\lambda}{2(\mu-1)}$ (D) $\frac{\lambda}{(\mu-1)}$

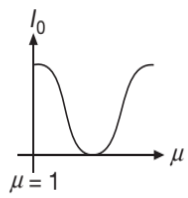
39. Two polaroids are placed in the path of unpolarized beam of intensity I_0 such that no light is emitted from the second polaroid. If a third polaroid whose polarization axis makes an angle θ with the polarization axis of first polaroid, is placed between these polaroids then the intensity of light emerging from the last polaroid will be

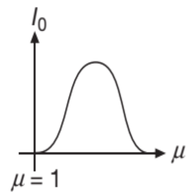
(A) $\left(\frac{I_0}{8}\right)\sin^2 2\theta$ (B) $\left(\frac{I_0}{4}\right)\sin^2 2\theta$
(C) $\left(\frac{I_0}{2}\right)\cos^4\theta$ (D) $I_0\cos^4\theta$

40. In a $YDSE$ experiment, if a slab whose refractive index can be varied is placed in front of one of the slits, then the variation of resultant intensity at mid-point of screen with $\mu(\geq 1)$ will be best represented by (Assume slits are of equal width, there is no absorption by slab and midpoint of screen is the point where the waves interfere with zero phase difference, in absence of slab)

(A)


(B)


(C)


(D)


41. A plane wavefront $\left(\lambda = 6\times10^{-7}\text{ m}\right)$ falls on a slit 0.4 mm wide. A convex lens of focal length 0.8 m placed behind the slit focuses the light on a screen. The linear diameter of second maximum is

(A) 6 mm (B) 12 mm
(C) 3 mm (D) 9 mm

42. If two slightly different wavelengths are present in the light used in Young's double-slit experiment, then

(A) the sharpness of fringes will be more than the case when only one wavelength is present
(B) the sharpness of fringes will decrease as we move away from the central fringe
(C) the central fringe will be white
(D) the central fringe will be dark

43. Two identical coherent sources 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

44. Laser is

(A) intense, coherent and monochromatic
(B) only intense and coherent
(C) only coherent and monochromatic
(D) only intense and monochromatic

45. Imagine a hypothetical convex lens material which can transmit all the following radiation. This lens will have minimum focal length for

(A) ultraviolet rays (B) infrared rays
(C) radio waves (D) X-rays

46. A star emitting yellow light starts accelerating towards earth, its colour as seen from the earth will

(A) turn gradually red (B) turn suddenly red
(C) remains same (D) turn gradually blue

47. The transverse nature of light is shown by
(A) interference of light (B) refraction of light
(C) polarization of light (D) dispersion of light

48. The wave front of a light beam is given by the equation $x+2y+3z=a$, where a is arbitrary constant. The angle made by the direction of light with the y-axis is

(A) $\cos^{-1}\left(\frac{1}{\sqrt{14}}\right)$ (B) $\sin^{-1}\left(\frac{2}{\sqrt{14}}\right)$

(C) $\cos^{-1}\left(\frac{2}{\sqrt{14}}\right)$ (D) $\sin^{-1}\left(\frac{3}{\sqrt{14}}\right)$

49. Laser light is considered to be coherent, because it consists of
(A) many wavelengths
(B) uncoordinated wavelengths
(C) coordinated waves of exactly the same wavelength
(D) divergent beams

50. The wavelength of light observed on the earth, from a moving star is found to decrease by 0.05%. Relative to the earth the star is
(A) Moving away with a velocity of 1.5×10^5 ms^{-1}
(B) Coming closer with a velocity of 1.5×10^5 ms^{-1}
(C) Moving away with a velocity of 1.5×10^4 ms^{-1}
(D) Coming closer with a velocity of 1.5×10^4 ms^{-1}

51. A beam of electron is used in an $YDSE$ experiment. The slit width is d. When the velocity of electron is increased, then
(A) No interference is observed
(B) Fringe width increases
(C) Fringe width decreases
(D) Fringe width remains same

52. The ratio of the intensity at the centre of a bright fringe to the intensity at a point one-quarter of the distance between two fringe from the centre is

(A) 2 (B) $\frac{1}{2}$
(C) 4 (D) 16

53. The ratio of intensities of consecutive maxima in the diffraction pattern due to a single slit is
(A) $1:4:9$ (B) $1:2:3$
(C) $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$ (D) $1:\frac{1}{\pi^2}:\frac{9}{\pi^2}$

54. Minimum thickness of a mica sheet having $\mu=\frac{3}{2}$ which should be placed in front of one of the slits in $YDSE$ is required to reduce the intensity at the centre of screen to half of maximum intensity is

(A) $\frac{\lambda}{4}$ (B) $\frac{\lambda}{8}$

(C) $\frac{\lambda}{2}$ (D) $\frac{\lambda}{3}$

55. A beam of natural light falls on a system of 6 polaroids, which are arranged in succession such that each polaroid is turned through 30° with respect to the preceding one. The percentage of incident intensity that passes through the system will be
(A) 100% (B) 50%
(C) 30% (D) 12%

56. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength in Young's double-slit experiment is
(A) Infinite (B) Five
(C) Three (D) Zero

57. A rocket is going towards moon with a speed v. The astronaut in the rocket sends signals of frequency ν towards the moon and receives them back on reflection from the moon. What will be the frequency of the signal received by the astronaut (Take $v \ll c$)

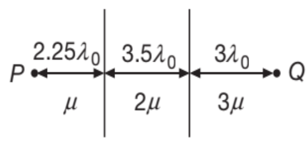
(A) $\frac{c}{c-v}\nu$ (B) $\frac{c}{c-2v}\nu$

(C) $\frac{2v}{c}\nu$ (D) $\frac{2c}{v}\nu$

58. In Young's double slit experiment the y-coordinates of central maxima and 10^{th} maxima are 2 cm and 5 cm respectively. When the YDSE apparatus is immersed in a liquid of refractive index 1.5 the corresponding y-coordinates will be
(A) 2 cm, 7.5 cm (B) 3 cm, 6 cm
(C) 2 cm, 4 cm (D) $\frac{4}{3}$ cm, $\frac{10}{3}$ cm

59. In Young's double slit experiment how many maximas can be obtained on a screen (including the central maximum) on both sides of the central fringe if $\lambda=2000$ Å and $d=7000$ Å
(A) 12 (B) 7
(C) 18 (D) 4

60. An electromagnetic wave of λ_0 (in vacuum) passes from P towards Q crossing three different media of refractive index μ, 2μ and 3μ respectively as shown in the figure.

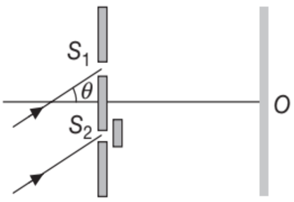


ϕ_P and ϕ_Q be the phase of the wave at points P and Q. The phase difference $\phi_Q - \phi_P$ for $\mu = 1$

(A) 0 (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$ (D) π

61. A monochromatic beam of light falls on *YDSE* apparatus at some angle (say θ) as shown in figure. A thin sheet of glass is inserted in front of the lower slit S_2. The central bright fringe (path difference $= 0$) will be obtained



(A) At O
(B) Above O
(C) Below O
(D) Anywhere depending on angle θ, thickness of plate t and refractive index of glass μ

62. In Young's double slit experiment, the two slits act as coherent sources of equal amplitude A and wavelength λ. In another experiment with the same set up the two slits are of equal amplitude A and wavelength λ but are incoherent. The ratio of the intensity of light at the mid-point of the screen in the first case to that in the second case is

(A) 1 : 2 (B) 2 : 1
(C) 4 : 1 (D) 1 : 1

63. In the ideal double-slit experiment, when a glass-plate (refractive index 1.5) of thickness t is introduced in the path of one of the interfering beams (wavelength λ), the intensity at the position where the central maximum occurred previously remains unchanged. The minimum thickness of the glass-plate is

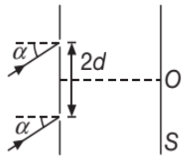
(A) 2λ (B) $\frac{2\lambda}{3}$

(C) $\frac{\lambda}{3}$ (D) λ

64. In a Young's double-slit experiment, the intensity ratio of maxima and minima is infinite. The ratio of the amplitudes of two sources

(A) is infinity (B) is unity
(C) is two (D) cannot be predicted

65. A parallel beam of monochromatic light of wavelength λ is used in Young's Double Slit Experiment. The beam makes an angle α with the normal to the plane of slits as shown in figure.

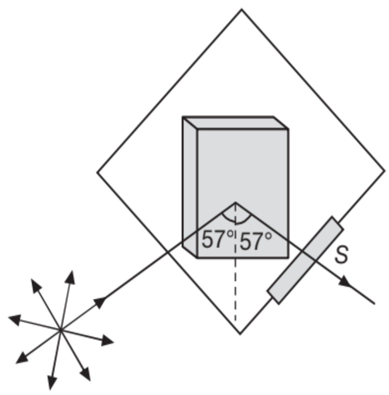


A screen is placed at a large distance $D (\gg 2d)$ from the slits. The value of α for which there is a dark fringe at O is

(A) $\cos^{-1}\left(\frac{\lambda}{4d}\right)$ (B) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

(C) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$ (D) $\cos^{-1}\left(\frac{\lambda}{2d}\right)$

66. Figure represents a glass plate placed vertically on a horizontal table with a beam of unpolarised light falling on its surface at the polarising angle of 57° with the normal. The electric vector in the reflected light on screen S will vibrate with respect to the plane of incidence in a



(A) Vertical plane
(B) Horizontal plane
(C) Plane making an angle of 45° with the vertical
(D) Plane making an angle of 57° with the horizontal

67. A clear sheet of polaroid is placed on the top of similar sheet so that their axes make an angle $\sin^{-1}\left(\frac{3}{5}\right)$ with each other. The ratio of intensity of the emergent light to that of unpolarised incident light is

(A) 16 : 25 (B) 9 : 25
(C) 4 : 5 (D) 8 : 25

68. Optically active substances are those substances which

(A) produce polarized light
(B) rotate the plane of polarization of polarized light
(C) produce double refraction
(D) convert a plane polarized light into circularly polarized light

69. If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled

(A) I_0 (B) $\frac{I_0}{2}$
(C) $2I_0$ (D) $4I_0$

70. The critical angle of a certain medium is $\sin^{-1}\left(\frac{3}{5}\right)$. The polarising angle of the medium is

(A) $\sin^{-1}\left(\frac{4}{5}\right)$ (B) $\tan^{-1}\left(\frac{5}{3}\right)$
(C) $\tan^{-1}\left(\frac{3}{4}\right)$ (D) $\tan^{-1}\left(\frac{4}{3}\right)$

71. A 20 cm length of a certain solution causes right-handed rotation of $38°$. A 30 cm length of another solution causes left-handed rotation of $24°$. The optical rotation caused by 30 cm length of a mixture of the above solution in the volume ratio $1:2$ is

(A) left handed rotation of 14°
(B) right handed rotation of 14°
(C) left handed rotation of 3°
(D) right handed rotation of 3°

72. The ray of light is incident on glass of refractive index 1.5 at polarising angle. The angle of deviation of the incident ray in glass is

(A) 57° (B) 33°
(C) 24° (D) 114°

73. Double refraction of light is shown by

(A) quartz and calcite only
(B) calcite only
(C) calcite and ice only
(D) calcite, ice and quartz

74. A slit of width a is illuminated by red light of wavelength 6500 Å. The first minimum will fall at $\theta = 30°$ if a is

(A) 3250 Å (B) 6.5×10^{-4} mm
(C) 1.3 μm (D) 2.6×10^{-4} cm

75. The resolution of the human eye is 1′. The resolving power of the human eye is nearly

(A) 360 (B) 3600
(C) 36000 (D) 360000

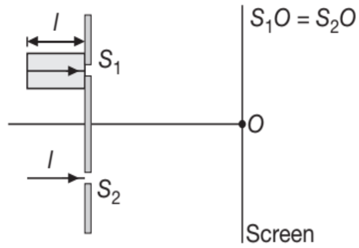
76. Colours of thin films are due to

(A) dispersion of light
(B) interference of light
(C) absorption of light
(D) scattering of light

77. A person standing at a distance of 3.6 km can just resolve two poles. The distance between the poles is

(A) 0.1 m (B) 100 m
(C) 1 m (D) 10 m

78. In the figure shown, a parallel beam of light is incident on the plane of the slits of a Young's double slit experiment. Light incident on the slit, S_1 passes through a medium of variable refractive index $\mu = 1 + ax$ (where x is the distance from the plane of slits as shown), up to a distance ℓ before falling on S_1. The entire remaining space is filled with air. If at O, a minima is formed, then the minimum value of the positive constant a (in terms of ℓ and wavelength λ in air) is



(A) $\frac{\lambda}{\ell}$ (B) $\frac{\lambda}{\ell^2}$
(C) $\frac{\ell^2}{\lambda}$ (D) $\frac{\lambda}{2\ell^2}$

79. A heavenly body is receding from earth such that the fractional change in λ is 1, then its velocity is

(A) c (B) $\frac{3c}{5}$
(C) $\frac{c}{5}$ (D) $\frac{2c}{5}$

80. A star is moving towards the earth with a speed of 4.5×10^6 ms^{-1}. If the true wavelength of a certain line in the spectrum received from the star is 5890 Å, its apparent wavelength will be about $(c = 3\times10^8 \text{ ms}^{-1})$

(A) 5890 Å (B) 5978 Å
(C) 5802 Å (D) 5896 Å

81. Lights of wavelength $\lambda_1 = 4500$ Å, $\lambda_2 = 6000$ Å are sent through a double-slit arrangement simultaneously. Then

(A) no interference pattern will be formed
(B) the third bright fringe of λ_1 will coincide with the fourth bright fringe of λ_2
(C) the third bright fringe of λ_2 will coincide with fourth bright fringe of λ_1
(D) the fringes of wavelength λ_1 will be wider than the fringes of wavelength λ_2

82. Two slits separated by a distance of 1 mm are illuminated with light of wavelength 6×10^{-7} m. The interference fringes are observed on a screen placed 1 m from the slits. The distance between the second dark fringe and the fourth bright fringe is equal to

(A) 0.5 mm (B) 1.0 mm
(C) 1.5 mm (D) 2.0 mm

83. Interference fringes were produced in Young's double-slit experiment using light of wavelength 5000 Å. When a film of thickness 2.5×10^{-3} cm was placed in front of one of the slits, the fringe pattern shifted by a distance equal to 20 fringe-width. The refractive index of the material of the film is

(A) 1.25 (B) 1.35
(C) 1.4 (D) 1.5

84. The maximum intensity in Young's double slit experiment is I_0. Distance between the slits is $d=5\lambda$, where λ is the wavelength of monochromatic light used in the experiment. The intensity of light in front of one of the slits on a screen at a distance $D=10d$ is

(A) $\frac{I_0}{2}$ (B) $\frac{3}{4}I_0$
(C) I_0 (D) $\frac{I_0}{4}$

85. In Young's double-slit experiment, an interference pattern is obtained on a screen by a light of wavelength 6000 Å, coming from the coherent sources S_1 and S_2. At certain point P on the screen third dark fringe is formed. Then the path difference S_1P-S_2P in microns is

(A) 0.75 (B) 1.5
(C) 3.0 (D) 4.5

86. Young's double slit experiment is made in a liquid. The 10th bright fringe in liquid lies where 6th dark fringe lies in vacuum. The refractive index of the liquid is approximately

(A) 1.8 (B) 1.54
(C) 1.67 (D) 1.2

87. A point source emits light equally in all directions. Two points P and Q are at distances 9 m and 25 m respectively from the source. The ratio of the amplitudes of the waves P and Q is

(A) $9:25$ (B) $25:9$
(C) $9^2:25^2$ (D) $25^2:9^2$

88. In Young's double slit experiment the y-co-ordinates of central maxima and 10th maxima are 2 cm and 5 cm respectively. When the *YDSE* apparatus is immersed in a liquid of refractive index 1.5 the corresponding y-co-ordinates will be

(A) 2 cm, 7.5 cm (B) 3 cm, 6 cm
(C) 2 cm, 4 cm (D) $\frac{4}{3}$ cm, $\frac{10}{3}$ cm

89. In Young's double slit experiment $\frac{d}{D}=10^{-4}$ ($d=$ distance between slits, $D=$ distance of screen from the slits). At a point P on the screen resulting intensity is equal to the intensity due to individual slit I_0. Then the distance of point P from the central maximum is ($\lambda=6000$ Å)

(A) 2 mm (B) 1 mm
(C) 0.5 mm (D) 4 mm

90. The Young's double-slit experiment is carried out with light of wavelength 5000 Å. The distance between the slits is 0.2 mm and the screen is at 200 cm from the slits. The central maximum is at $x=0$. The third maximum will be at x equal to

(A) 1.67 cm (B) 1.5 cm
(C) 0.5 cm (D) 5.0 cm

91. Light passes successively through two polarimeters tubes each of length 0.29 m. The first tube contains dextro rotatory solution of concentration 60 kgm^{-3} and specific rotation 0.01 radm^{2}kg^{-1}. The second tube contains laevo rotatory solution of concentration 30 kgm^{-3} and specific rotation 0.02 radm^{2}kg^{-1}. The net rotation produced is

(A) 15° (B) 0°
(C) 20° (D) 10°

92. The blue colour of the sky is explained by

(A) refraction (B) reflection
(C) polarisation (D) scattering

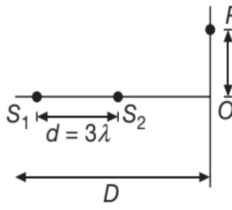
93. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is

(A) Straight line (B) Parabola
(C) Hyperbola (D) Circle

94. Among the two interfering monochromatic sources A and B; A is ahead of B in phase by 66°. If the observation be taken from point P, such that $PB-PA=\frac{\lambda}{4}$. Then the phase difference between the waves from A and B reaching P is

(A) 156° (B) 140°
(C) 136° (D) 126°

95. Two coherent narrow slits emitting light of wavelength λ in the same phase are placed parallel to each other at a small separation of 3λ. The light is collected on a screen S which is placed at a distance $D(\gg \lambda)$ from the slits. The smallest distance y for P to be a maxima is



(A) $\sqrt{3}D$ (B) $\sqrt{8}D$

(C) $\sqrt{5}D$ (D) $\sqrt{5}\dfrac{D}{2}$

96. Two coherent sources S_1 and S_2 are separated by a distance four times the wavelength λ of the source. The sources lie along y-axis whereas a detector moves along $+x$-axis. Leaving the origin and far off points the number of points where maxima are observed is

(A) 2 (B) 3
(C) 4 (D) 5

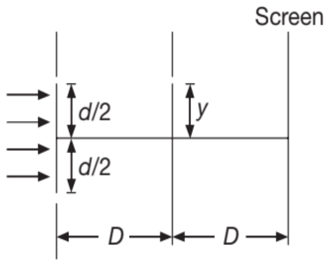
97. The first minimum due to a Fraunhofer diffraction using light of wavelength 500 nm and a slit of width 0.5 mm will be formed at an angle (in minutes)

(A) 2.42 (B) 3.43
(C) 4.84 (D) 1.71

98. Aperture of the human eye is 2 mm. Assuming the mean wavelength of light to be 5000 Å, the angular resolution limit of the eye is nearly

(A) 2 minute (B) 1 minute
(C) 0.5 minute (D) 1.5 minute

99. In the Young's double slit experiment apparatus shown in figure, the ratio of maximum to minimum intensity on the screen is 9. The wavelength of light used is λ, then the value of y is



(A) $\dfrac{\lambda D}{d}$ (B) $\dfrac{\lambda D}{2d}$

(C) $\dfrac{\lambda D}{3d}$ (D) $\dfrac{\lambda D}{4d}$

100. In Young's experiment, using red and blue lights of wavelengths 7800 Å and 5200 Å respectively, the value of n for which nth red fringe coincides with $(n+1)$th blue fringe is

(A) 2 (B) 3
(C) 4 (D) 5

101. Angular width of central maxima in the Fraunhofer diffraction pattern of a slit is measured. The slit is illuminated by light of wavelength 6000 Å. When the slit is illuminated by light of another wavelength, the angular width decreases by 30%. The wavelength of this light will be

(A) 6000 Å (B) 4200 Å
(C) 3000 Å (D) 1800 Å

102. In Young's experiment for interference of light with two slits, maxima occur at angles for which $\sin\theta = \dfrac{m\lambda}{d}$. Here d is

(A) distance of slits from the screen
(B) distance between dark and bright fringes
(C) distance between slits
(D) width of mth fringe

103. Interference is observed in a chamber with air present inside the chamber. The chamber is then evacuated and the same light is again used to produce interference. A careful observer will see

(A) no change in the pattern
(B) that the fringewidth slightly increases
(C) that the fringewidth slightly decreases
(D) no interference pattern

104. Finger prints of a piece of paper may be detected by sprinkling fluorescent powder on the paper and than looking into it under

(A) yellow light (B) brightness
(C) infrared light (D) ultraviolet light

105. Two nicol prisms (polariser and analyser) have their axes at angles of 30° in between. If I is the intensity of light falling on first nicol, then that of emerging light is

(A) $0.125I$ (B) $0.25I$
(C) $0.375I$ (D) $0.5I$

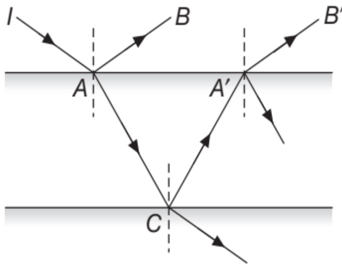
106. The Young's double-slit experiment is performed with blue light and green light of wavelengths 4360 Å and 5460 Å respectively. If X is the distance of 4th maximum from the central one, then

(A) $X(\text{Blue}) = X(\text{Green})$
(B) $X(\text{Blue}) < X(\text{Green})$
(C) $X(\text{Blue}) > (\text{Green})$
(D) $\dfrac{X(\text{Blue})}{X(\text{Green})} = \dfrac{5460}{4360}$

107. v_O and v_E represent the velocity, μ_O and μ_E the refractive indices of ordinary and extraordinary rays for a doubly refracting crystal, then

(A) $v_O \geq v_E$, $\mu_O \leq \mu_E$ if the crystal is calcite
(B) $v_O \leq v_E$, $\mu_O \leq \mu_E$ if the crystal is quartz
(C) $v_O \leq v_E$, $\mu_O \geq \mu_E$ if the crystal is calcite
(D) $v_O \geq v_E$, $\mu_O \geq \mu_E$ if the crystal is quartz

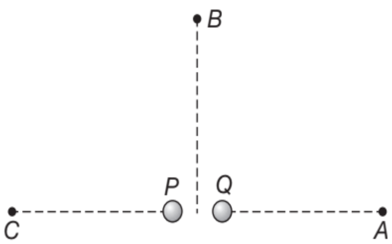
108. A ray of light of intensity I is incident on a parallel glass-slab at a point A as shown in figure. It undergoes partial reflection and refraction. At each reflection 25% of incident energy is reflected. The rays AB and $A'B'$ undergo interference. The ratio I_{max}/I_{min} is



(A) 4 : 1 (B) 8 : 1
(C) 7 : 1 (D) 49 : 1

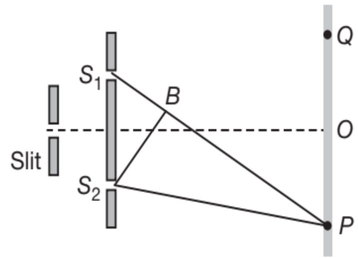
109. Plane polarised light is passed through a polaroid. On viewing through the polaroid we find that when the polaroid is given one complete rotation about the direction of light
(A) the intensity of light gradually decreases to zero and remains at zero
(B) the intensity of light gradually increases to a maximum and remains maximum
(C) there is no change in the intensity of light
(D) the intensity of light varies such that it is twice maximum and twice zero

110. Figure here shows P and Q as two equally intense coherent sources emitting radiations of wavelength 20 m. The separation PQ is 5 m and phase of P is ahead of the phase of Q by 90°. A, B and C are three distant points of observation equidistant from the mid-point of PQ. The intensity of radiations at A, B, C will bear the ratio



(A) 0 : 1 : 4 (B) 4 : 1 : 0
(C) 0 : 1 : 2 (D) 2 : 1 : 0

111. In the figure is shown Young's double slit experiment. Q is the position of the first bright fringe on the right side of O. P is the 11[th] fringe on the other side, as measured from Q. If the wavelength of the light used is 6000×10^{-10} m, then 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

112. In $YDSE$, both slits produce equal intensities on the screen. A 100% transparent thin film is placed in front of one the slits. Now the intensity of the geometrical centre of system on the screen becomes 75% of the previous intensity. The wavelength of the light is 6000 Å and $\mu_{film} = 1.5$. The thickness of the film cannot be
(A) 0.2 μm (B) 1.0 μm
(C) 1.4 μm (D) 1.6 μm

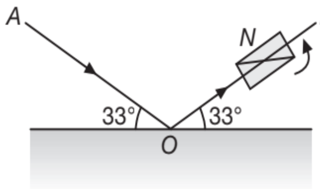
113. The maximum intensity in Young's double slit experiment is I_0. Distance between the slits is $d = 5\lambda$, where λ is the wavelength of monochromatic light used in the experiment. What will be the intensity of light in front of one of the slits on a screen at a distance $D = 10d$

(A) $\frac{I_0}{2}$ (B) $\frac{3}{4}I_0$
(C) I_0 (D) $\frac{I_0}{4}$

114. The polarising angle of diamond is 67°. The critical angle of diamond is nearest to
(A) 22° (B) 34°
(C) 45° (D) 60°

115. No longitudinal wave will show
(A) interference (B) diffraction
(C) T I R (D) polarisation

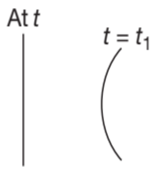
116. A beam of light AO is incident on a glass slab $(\mu = 1.54)$ in a direction as shown in figure. The reflected ray OB is passed through a Nicol prism on viewing through a Nicol prism, we find on rotating the prism that



(A) The intensity is reduced down to zero and remains zero
(B) The intensity reduces down some what and rises again
(C) There is no change in intensity
(D) The intensity gradually reduces to zero and then again increases

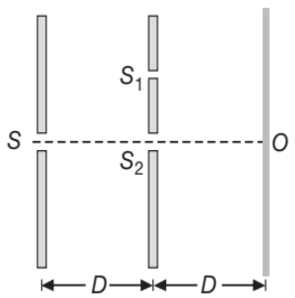
117. When one of the slits of Young's experiment is covered with a transparent sheet of thickness 4.8 mm, the central fringe shifts to a position originally occupied by the 30^{th} bright fringe. What should be the thickness of the sheet if the central fringe has to shift to the position occupied by 20^{th} bright fringe
(A) 3.8 mm (B) 1.6 mm
(C) 7.6 mm (D) 3.2 mm

118. The figure shows a plane wave front at a time t and a time t_1. In the time interval $(t_1 - t)$ the wave front must have passed through



(A) a prism
(B) a prism and a convex lens
(C) a convex lens
(D) a plane mirror and a concave lens

119. Two ideal slits S_1 and S_2 are at a distance d apart, and illuminated by light of wavelength λ passing through an ideal source slit S placed on the line through S_2 as shown. The distance between the planes of slits and the source slit is D. A screen is held at a distance D from the plane of the slits. The minimum value of d for which there is darkness at O is



(A) $\sqrt{\frac{3\lambda D}{2}}$ (B) $\sqrt{\lambda D}$
(C) $\sqrt{\frac{\lambda D}{2}}$ (D) $\sqrt{3\lambda D}$

120. Two waves originating from sources S_1 and S_2 having zero phase difference and common wavelength λ will show completely destructive interference at a point P if $S_1P - S_2P$ is
(A) 5λ (B) $\frac{3\lambda}{4}$
(C) 2λ (D) $\frac{11\lambda}{2}$

121. A thin air film between a plane glass plate and a convex lens is irradiated with parallel beam of monochromatic light and is observed under a microscope. We see
(A) uniform brightness
(B) complete darkness
(C) field crossed over by concentric bright and dark rings
(D) field crossed over by straight bright and dark fringes

122. In Young's double-slit experiment, the intensity of light at a point on the screen where the path difference is λ is I, λ being the wavelength of light used. The intensity at a point where the path difference is $\frac{\lambda}{4}$ will be
(A) $\frac{I}{4}$ (B) $\frac{I}{2}$
(C) I (D) zero

123. In a two slit experiment with monochromatic light fringes are obtained on a screen placed at some distance from the sits. If the screen is moved by 5×10^{-2} m towards the slits, the change in fringe width is 3×10^{-5} m. If separation between the slits is 10^{-3} m, the wavelength of light used is
(A) 6000 Å (B) 5000 Å
(C) 3000 Å (D) 4500 Å

124. In the visible region of the spectrum the rotation of the place of polarization is given by $\theta = a + \frac{b}{\lambda^2}$. The optical rotation produced by a particular material is found to be $30°$ per mm at $\lambda = 5000$ Å and $50°$ per mm at $\lambda = 4000$ Å. The value of constant a will be

(A) $+\frac{50^\circ}{9}$ per mm (B) $-\frac{50^\circ}{9}$ per mm
(C) $+\frac{9^\circ}{50}$ per mm (D) $-\frac{9^\circ}{50}$ per mm

125. In Young's experiment using monochromatic light, the fringe pattern shifts by a certain distance on the screen when a mica sheet of refractive index 1.6 and thickness 1.964 micron is introduced in the path of one of the interfering waves. The mica sheet is then removed and the distance between the slits and the screen is doubled. It is found that the distance between successive maxima now is the same as the observed fringe shift upon the introduction of the mica sheet. The wavelength of light is
(A) 5762 Å (B) 5825 Å
(C) 5892 Å (D) 6500 Å

126. The phenomenon of interference is shown by
(A) longitudinal mechanical waves only
(B) transverse mechanical waves only
(C) non-mechanical transverse waves only
(D) all the above types of waves

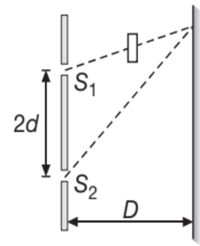
127. In Young's double-slit experiment, if L is the distance between the slits and the screen upon which the interference pattern is observed, x is the average distance between the adjacent fringes and d is the slit separation, then the wavelength of light is
(A) $\frac{xd}{L}$ (B) $\frac{xL}{d}$
(C) $\frac{Ld}{x}$ (D) $\frac{1}{Ldx}$

128. Interference can take place between
(A) transverse waves only, but not in longitudinal waves
(B) longitudinal waves only, but not in transverse waves
(C) both longitudinal and transverse waves
(D) light waves only, but not sound waves

129. Young's double-slit experiment is performed with light of wavelength $\lambda = 6000$ Å. A glass plate of thickness 0.01 mm and $\mu = 1.5$ is introduced. The number of fringes shifting in the system is
(A) 2000 (B) 8
(C) 120 (D) 4910

130. The contrast in the fringes in an interference pattern depends on
(A) fringe width
(B) wavelength
(C) intensity ratio of the sources
(D) distance between the slits

131. If a thin mica sheet of thickness t and refractive index $\mu = \frac{5}{3}$ is placed in the path of one of the interfering beams as shown in the figure, then the displacement of the fringe system is



(A) $\frac{Dt}{3d}$ (B) $\frac{Dt}{5d}$
(C) $\frac{Dt}{4d}$ (D) $\frac{2Dt}{5d}$

132. In a Young's double slit experiment the source S and the two slits A and B are vertical 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 the 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

133. In the Young's double slit experiment, if the phase difference between the two waves interfering at a point is ϕ, the intensity at that point can be expressed by the expression
(A) $I = \sqrt{A^2 + B^2 \cos^2 \phi}$ (B) $I = \frac{A}{B}\cos\phi$
(C) $I = A + B\cos\frac{\phi}{2}$ (D) $I = A + B\cos\phi$

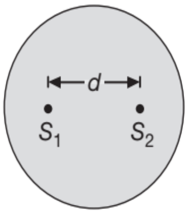
Where A and B depend upon the amplitudes of the two waves.

134. The time period of rotation of the sun is 25 days and its radius is 7×10^8 m. The Doppler shift for the light of wavelength 6000 Å emitted from the surface of the sun will be
(A) 0.04 Å
(B) 0.40 Å
(C) 4.00 Å
(D) 40.0 Å

135. A flake of glass (refractive index 1.5) is placed over one of the openings of a double slit apparatus. The interference pattern displaces itself through seven successive maxima towards the side where the flake is placed. if wavelength of the diffracted light is $\lambda = 600$ nm, then the thickness of the flake is

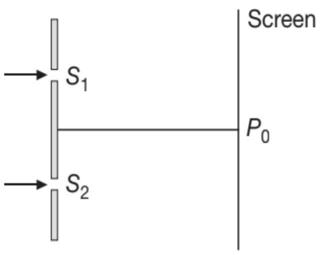
(A) 2100 nm (B) 4200 nm
(C) 8400 nm (D) None of these

136. Two coherent sources separated by distance d are radiating in phase having wavelength λ. A detector moves in a big circle around the two sources in the plane of the two sources. The angular position of $n = 4$ interference maxima is given as



(A) $\sin^{-1}\left(\frac{n\lambda}{d}\right)$ (B) $\cos^{-1}\left(\frac{4\lambda}{d}\right)$
(C) $\tan^{-1}\left(\frac{d}{4\lambda}\right)$ (D) $\cos^{-1}\left(\frac{\lambda}{4d}\right)$

137. In a standard Young's slit experiment with coherent light of wavelength 600 nm, the fringe width of the fringes in the central region (near the central fringe, P_0) is observed to be 3 mm. An extremely thin glass plate is introduced in front of the first slit, and the fringes are observed to be displaced by 11 mm. Another thin plate is placed before the second slit and it is observed that the fringes are now displaced by an additional 12 mm. If the additional optical path lengths introduced are Δ_1 and Δ_2, then



(A) $11\Delta_1 = 12\Delta_2$ (B) $12\Delta_1 = 11\Delta_2$
(C) $11\Delta_1 > 12\Delta_2$ (D) None of these

138. White light may be considered to be a mixture of waves with λ ranging between 3900 Å and 7800 Å. An oil film of thickness 10,000 Å is examined normally by 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

139. The k line of singly ionised calcium has a wavelength of 393.3 nm as measured on earth. In the spectrum of one of the observed galaxies, this spectral line is located at 401.8 nm. The speed with which the galaxy is moving away from us, will be

(A) 6480 kms^{-1} (B) 3240 kms^{-1}
(C) 4240 kms^{-1} (D) None of these

140. The two coherent sources of equal intensity produce maximum intensity of 100 units at a point. If the intensity of one of the sources is reduced by 36% by reducing its width then the intensity of light at the same point will be

(A) 90 (B) 89
(C) 67 (D) 81

141. In a double slit arrangement fringes are produced using light of wavelength 4800 Å. One slit is covered by a thin plate of glass of refractive index 1.4 and the other with another glass plate of same thickness but of refractive index 1.7. By doing so the central bright shifts to original fifth bright fringe from centre. Thickness of glass plate is

(A) 8 μm (B) 6 μm
(C) 4 μm (D) 10 μm

142. Polarisation of light establishes

(A) corpuscular theory of light
(B) quantum nature of light
(C) transverse nature of light
(D) all the three

143. A ray of unpolarised light is incident on glass plate at the polarising angle, then

(A) the reflected and transmitted rays will be completely plane polarised
(B) the reflected ray is completely polarised and the transmitted ray is partially polarised
(C) the reflected ray is partially polarised and the transmitted ray is completely polarised
(D) the reflected ray and the transmitted ray will be partially polarised

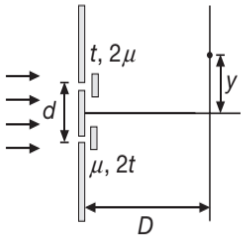
144. To observe diffraction, the size of the obstacle

(A) should be of the same order as the wavelength
(B) should be much larger than the wavelength
(C) has no relation to wavelength
(D) should be exactly half the wavelength

145. A slit is illuminated by red light of wavelength 6500 Å. The first minimum is obtained at $\theta = 30°$. The width of the slit is

(A) 3200 Å (B) 1.24 micron
(C) 6.5×10^{-4} mm (D) 2.6×10^{-4} cm

146. In *YDSE* setup shown, the two slits are covered with thin sheets having thickness t and $2t$ and refractive index 2μ and μ. The position (y) of central maxima is



(A) zero (B) $\frac{tD}{d}$
(C) $-\frac{tD}{d}$ (D) None of these

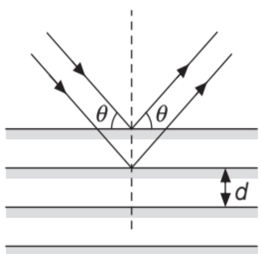
147. A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewster's angle ϕ. If μ represents the refractive index of glass with respect to air, then the angle between reflected and refracted rays is

(A) $90° + \phi$ (B) $\sin^{-1}(\mu\cos\phi)$
(C) $90°$ (D) $90° - \sin^{-1}\left(\frac{\sin\phi}{\mu}\right)$

148. A beam of plane polarized light falls normally on a polarizer of cross sectional area $3\times10^{-4}\ \text{m}^2$. Flux of energy of incident ray in 10^{-3} W. The polarizer rotates with an angular frequency of $31.4\ \text{rad s}^{-1}$. The energy of light passing through the polarizer per revolution will be

(A) 10^{-4} Joule (B) 10^{-3} Joule
(C) 10^{-2} Joule (D) 10^{-1} Joule

149. A beam with wavelength λ falls on a stack of partially reflecting planes with separation d. The angle θ that the beam should make with the planes so that the beams reflected from successive planes may interfere constructively is (where $n = 1, 2, \ldots\ldots$)



(A) $\sin^{-1}\left(\frac{n\lambda}{d}\right)$ (B) $\tan^{-1}\left(\frac{n\lambda}{d}\right)$
(C) $\sin^{-1}\left(\frac{n\lambda}{2d}\right)$ (D) $\cos^{-1}\left(\frac{n\lambda}{2d}\right)$

150. A diffraction pattern is obtained using a beam of red light. If the red light is replaced by blue light, then

(A) the diffraction pattern remains unchanged
(B) diffraction bands become narrower and crowded together
(C) bands become broader and farther apart
(D) bands disappear

151. At sunrise or at sunset the sun appears to be reddish while at mid-day the sun looks white. The reason is that

(A) the sun is less hot at sunrise or at sunset than at noon
(B) diffraction sends red rays to the earth at these time
(C) refraction is responsible for this effect
(D) scattering due to dust particles and air molecules

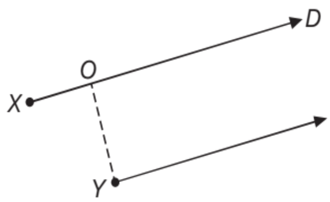
152. A screen is placed at 50 cm from a single slit, which is illuminated with 600 nm light. If separation between the first and third minima in the diffraction pattern is 3.0 mm, then width of the slit is

(A) 4 mm (B) 0.1 mm
(C) 0.3 mm (D) 0.2 mm

153. Light of wavelength 6328 Å is incident normally on a slit having a width of 0.2 mm. The distance of the screen from the slit is 0.9 m. The angular width of the central maximum is

(A) 0.09 degree (B) 0.72 degree
(C) 0.18 degree (D) 0.36 degree

154. Two point sources X and Y emit waves of same frequency and speed but Y lags in phase behind X by $2\pi l$ radian. If there is a maximum in direction D the distance XO using n as an integer is given by



(A) $\frac{\lambda}{2}(n-l)$ (B) $\lambda(n+l)$
(C) $\frac{\lambda}{2}(n+l)$ (D) $\lambda(n-l)$

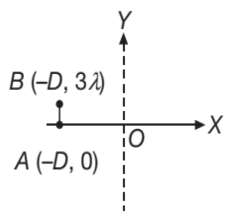
155. In a Young's double slit experiment, the slits are 2 mm apart and are illuminated with a mixture of two wavelength $\lambda_0 = 750$ nm and $\lambda = 900$ nm. The minimum distance from the common central bright fringe on a screen $2m$ from the slits where a bright fringe from one interference pattern coincides with a bright fringe from the other is
(A) 1.5 mm (B) 3 mm
(C) 4.5 mm (D) 6 mm

156. If sound waves can be assumed to be diffracted, which of the following objects will diffract sound waves in air from a 384 Hz tuning fork
(A) A sphere of radius 1 cm
(B) A sphere of radius 1 mm
(C) A sphere of radius 1 m
(D) A sphere of radius 10 m

157. A beam of light of wavelength 600 nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between the first dark fringes on either side of the central bright fringe is
(A) 1.2 cm (B) 1.2 mm
(C) 2.4 cm (D) 2.4 mm

158. A nicol prism is based on the action of
(A) refraction (B) double refraction
(C) dichroism (D) both (B) and (C)

159. Two coherent points sources A and B emitting light of wavelength λ is are placed at position $(-D, 0)$ and $(-D, 3\lambda)$ respectively. Here, $D >> \lambda$. The shape of fringes on the screen placed along y-axis (in YZ-plane) is



(A) straight line (B) circular
(C) hyperbolic (D) parabolic

160. A thin sheet of glass (refractive index 1.5) of thickness 6 micron, introduced in the path of one of the interfering beams in a double-slit experiment, shifts the central fringe to a position earlier occupied by the fifth bright fringe. The wavelength of light used is
(A) 3000 Å (B) 6000 Å
(C) 4500 Å (D) 7000 Å

161. Which of the following cannot be polarised?
(A) Radio waves (B) β rays
(C) Infrared rays (D) γ rays

162. When light is incident on a transparent surface at the polarizing angle, which of the following is completely polarized?
(A) Reflected light
(B) Refracted light
(C) Both reflected as well as refracted light
(D) Neither reflected nor refracted light

163. An optically active substance
(A) produces polarized light
(B) rotates the plane of polarization of polarized light
(C) converts a plane polarized light into circularly polarized light
(D) converts a circularly polarized light into plane polarized light

164. Diffraction pattern of a single slit consists of a central bright band which is
(A) wide, and is flanked by alternate dark and bright bands of decreasing intensity
(B) narrow, and is flanked by alternate dark and bright bands of equal intensity
(C) wide, and is flanked by alternate dark and bright bands of equal intensity
(D) narrow, and is flanked by alternate dark and bright bands of decreasing intensity

165. In Young's experiment with one source and two slits, one of the slits is covered with black paper. Then
(A) the fringes will be darker
(B) the fringes will be narrower
(C) the fringes will be broader
(D) no fringes will be obtained and the screen will have uniform illumination

166. The distance between two coherent sources is 0.1 mm. The fringewidth on a screen 1.2 m away from the sources is 6.0 mm. The wavelength of light used is
(A) 4000 Å (B) 5000 Å
(C) 6000 Å (D) 7200 Å

167. If three slits are used in Young's experiment instead of two, we get
(A) no fringe pattern
(B) the same fringe pattern as that with two slits
(C) a pattern with fringe width reduced to half of that in the two slit pattern
(D) alternate bright and dim fringes

168. When a transparent parallel plate of uniform thickness t and refractive index n is interposed normally in the path of a beam of light, the optical path is
(A) increased by nt
(B) decreased by nt
(C) decreased by $(n-1)t$
(D) increased by $(n-1)t$

169. In Young's experiment, monochromatic light is used to illuminate the two slits and 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 one of the slits, then
(A) the fringes will disappear
(B) the fringe-width will decrease
(C) the fringe-width will increase
(D) there will be no change in the fringe-width

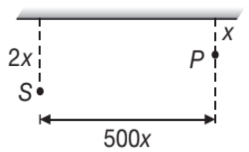
170. If the Young's double slit-experiment is performed with white light, then the colour which will have maximum fringe width is
(A) Blue (B) Green
(C) Yellow (D) Violet

171. In the interference pattern, energy is
(A) created at the positions of maxima
(B) destroyed at the positions of minima
(C) conserved but is redistributed
(D) not conserved

172. Fluorescent tubes give more light than a filament bulb of same power because
(A) the tube contains gas at low temperature
(B) ultraviolet light is converted into visible light by fluorescence
(C) light is diffused through the walls of the tube
(D) it produces more heat than bulb

173. Energies of photons of four different electromagnetic radiations are given below. The energy value corresponds to a visible photon is equal to
(A) 1 eV (B) 2 eV
(C) 5 eV (D) 1000 eV

174. The point S is a monochromatic source of light emitting light of wavelength λ. At the point P, at a distance x from the mirror as shown in the figure, interference takes place between two light rays, one directly coming from source S and another after reflection from the mirror such that a maxima is formed at P. The minimum value of x is



(A) 120λ (B) 125λ
(C) 62.5λ (D) None of these

175. If a torch is used in place of monochromatic light in Young's experiment
(A) fringes will appear as for monochromatic light
(B) fringes will appear for a moment and then they will disappear
(C) no fringes will appear
(D) only bright fringes will appear

176. beam of unpolarized light of intensity I is passed first through a tourmaline crystal A and then through another tourmaline crystal B oriented so that its principal plane is parallel to that of A. If A is now rotated by 45° in a plane perpendicular to the direction of the incident ray, the intensity of the emergent light will be
(A) $\frac{I}{2}$ (B) $\frac{I}{\sqrt{2}}$
(C) I (D) $\frac{I}{4}$

177. Interference pattern is obtained on a screen due to two identical coherent sources of monochromatic light. The intensity of the central bright fringe is I. When one of the sources is blocked, the intensity become I_0. The intensity in the two situations are related as
(A) $I = I_0$ (B) $I = 2I_0$
(C) $I = 3I_0$ (D) $I = 4I_0$

178. The phase difference between two wave trains giving rise to a dark fringe in Young's double-slit experiment is (where n is an integer)
(A) zero (B) $2\pi n + \frac{\pi}{2}$
(C) $2\pi n + \pi$ (D) $2\pi n + \frac{\pi}{4}$

179. A Young's double-slit set-up for interference is shifted from air to within water. Then the
(A) fringe pattern disappears
(B) fringewidth decreases
(C) fringewidth increases
(D) fringewidth remains unchanged

180. Two interfering beams have intensities in the ratio of $9:4$. Then the ratio of maximum to minimum intensity in the interference pattern is
(A) $25:1$ (B) $13:5$
(C) $5:1$ (D) $3:2$

181. In the far field diffraction pattern of a single slit under polychromatic illumination, the first minimum with the wavelength λ_1 is found to be coincident with the third maximum at λ_2. So

(A) $3\lambda_1 = 0.3\lambda_2$ (B) $3\lambda_1 = \lambda_2$
(C) $\lambda_1 = 3.5\lambda_2$ (D) $0.3\lambda_1 = 3\lambda_2$

182. In interference with two coherent beams of light, the fringe width is proportional

(A) to wavelength
(B) to inverse wavelength
(C) to square of wavelength
(D) to inverse square of wavelength

183. The fringe pattern observed in Young's double-slit experiment is

(A) a diffraction pattern
(B) an interference pattern
(C) a combination of diffraction and interference patterns
(D) neither a diffraction nor an interference pattern

184. In Young's interference experiment with one source and two slits, one slit is covered with a cellophane sheet which absorbs half the intensity. Then

(A) no fringes are obtained
(B) bright fringes will be brighter and dark fringes will be darker
(C) all fringes will be dark
(D) bright fringes will be less bright and dark fringes will be less dark

185. The distance between sources in a biprism of angle α and refractive index μ, if the source is placed at a distance a from it is

(A) $2(\mu-1)\alpha$ (B) $2(\mu-1)\alpha a$
(C) $(\mu-1)\alpha$ (D) $(\mu-1)\alpha a$

186. To obtain a sustained interference pattern, we require two sources which emit radiation of

(A) the same frequency.
(B) nearly the same frequency.
(C) the same frequency having a definite phase relationship.
(D) different wavelengths.

187. A thin mica sheet of thickness 2×10^{-6} m and refractive index $(\mu=1.5)$ is introduced in the path of the first wave. 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

188. In Young's double slit experiment, the slits are 0.5 mm apart and interference pattern is observed on a screen placed at a distance of 1 m from the plane containing the slits. If wavelength of the incident light is 6000 Å, then the separation between the third bright fringe and the central maxima is

(A) 4 mm (B) 3.5 mm
(C) 3 mm (D) 2.5 mm

189. Interference fringes are obtained due to the interference of waves from two coherent sources of light with amplitudes a_1 and $a_2 (a_1 = 2a_2)$. The ratio of the maximum and minimum intensities of light in the interference pattern is

(A) 2 (B) 4
(C) 9 (D) ∞

190. In the double-slit experiment, the distance of the second dark fringe from the central line is 3 mm. The distance of the fourth bright fringe from the central line is

(A) 6 mm (B) 8 mm
(C) 12 mm (D) 16 mm

191. In Young's double-slit experiment, we get 60 fringes in the field of view if we use light of wavelength 4000 Å. The number of fringes we will get in the same field of view if we use light of wavelength 6000 Å is

(A) 40 (B) 90
(C) 60 (D) 50

192. With a monochromatic light, the fringe-width obtained in a double-slit experiment is 1.33 mm. If the whole set-up is immersed in water of refractive index 1.33, the new fringe-width will be

(A) 1.33 mm (B) 1 mm
(C) 1.33×1.33 mm (D) $\frac{1.33}{2}$ mm

193. Two waves having amplitudes in the ratio 5 : 1 produce interference. The ratio of the maximum to the minimum intensity is

(A) 25 : 1 (B) 6 : 4
(C) 9 : 4 (D) 3 : 2

194. If the intensities of the two interfering beams in Young's double-slit experiment are I_1 and I_2, then the contrast between the maximum and minimum intensities is good when

(A) $|I_1 - I_2|$ is large
(B) $|I_1 - I_2|$ is small
(C) either I_1 or I_2 is zero
(D) $I_1 = I_2$

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

This section contains Multiple Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONE OR MORE is/are correct.

1. In Young's double slit experiment the two slits are covered by slabs of same thickness but refractive index 1.4 and 1.7. If slit to screen separation is 1 m and slits are at 1 mm separation using a coherent source of wavelength 4000 Å and the central fringe shifts to the 3^{rd} bright fringe position, then

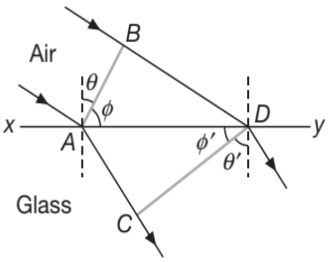
(A) shift will be towards slab of index 1.7 by 1.2 mm

(B) shift will be towards slab of index 1.4 by 1.2 mm

(C) slabs are of thickness $4\ \mu\text{m}$

(D) slabs are of thickness 4 Å

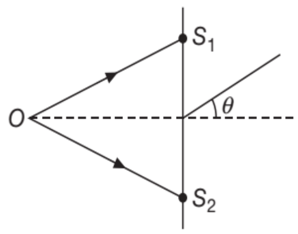
2. In the given diagram a wavefront AB moving in air is incident on a plane glass surface xy. Its position CD after refraction through the glass slab is shown also along with normals drawn at A and D. The refractive index of glass will be equal to $(\mu_{air} = 1)$



(A) $\left(\dfrac{BD}{AC}\right)$ (B) $\left(\dfrac{AB}{CD}\right)$

(C) $\left(\dfrac{\sin\phi}{\sin\phi'}\right)$ (D) $\left(\dfrac{\cos\theta}{\cos\theta'}\right)$

3. In a modified $YDSE$ experiment if point source of monochromatic light O is placed in such a manner that $OS_1 - OS_2 = \dfrac{\lambda}{4}$, where λ is the wavelength of light and S_1, S_2 are the slits separated by a distance 2λ. Then value(s) of θ for which a maxima is obtained is/are



(A) $\sin^{-1}\left(\dfrac{1}{8}\right)$ (B) $\sin^{-1}\left(-\dfrac{1}{4}\right)$

(C) $\sin^{-1}\left(\dfrac{5}{6}\right)$ (D) $\sin^{-1}\left(-\dfrac{7}{8}\right)$

4. Two coherent waves represented by

$$y_1 = A\sin\left(\frac{2\pi x_1}{\lambda} - \omega t + \frac{\pi}{4}\right) \text{ and}$$

$$y_2 = A\sin\left(\frac{2\pi x_2}{\lambda} - \omega t + \frac{\pi}{6}\right)$$

are superposed. The two waves will produce

(A) constructive interference at $x_1 - x_2 = \dfrac{11\lambda}{24}$

(B) constructive interference at $x_1 - x_2 = \dfrac{23\lambda}{24}$

(C) destructive interference at $x_1 - x_2 = \dfrac{23\lambda}{24}$

(D) destructive interference at $x_1 - x_2 = \dfrac{11\lambda}{24}$

5. To observe a stationary interference pattern formed by two light waves, it is not necessary that they must have

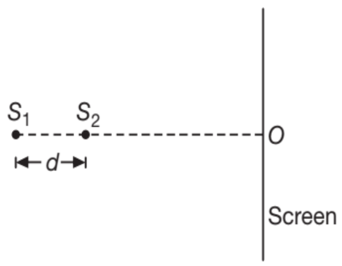
(A) the same frequency

(B) the same amplitude

(C) a constant phase difference

(D) the same intensity

6. Two point monochromatic and coherent sources of light of wavelength λ are placed on the dotted line in front of a large screen. The source emit waves in phase with each other. The distance between S_1 and S_2 is d while their distance from the screen is much larger. Then for



(A) $d = \dfrac{3\lambda}{2}$, O will be a minima

(B) $d = 3\lambda$, there will be a total of 6 minima on screen

(C) $d = \lambda$, there will be one maxima on the screen

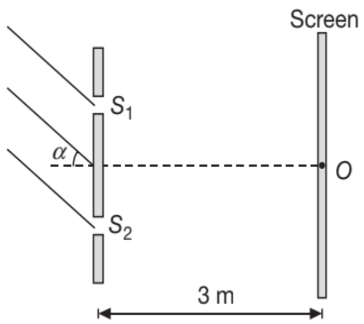
(D) $d = 2\lambda$, there will be two maxima on the screen

7. If white light is used in a Young's double-slit experiment, then

(A) bright white fringe is formed at the centre of the screen

(B) fringes of different colours are observed clearly only in the first order
(C) the first-order violet fringes are closer to the centre of the screen than the first order red fringes
(D) the first-order red fringes are closer to the centre of the screen than the first order violet fringes

8. A parallel beam of light $(\lambda = 5000\ \text{Å})$ is incident at an angle $\alpha = 30°$ with the normal to the slit plane in a young's double slit experiment. Assume that the intensity due to each slit at any point on the screen is I_0. Point O is equidistant from S_1 and S_2. The distance between slits is $1\ \text{mm}$.



(A) the intensity at O is $4I_0$
(B) the intensity at O is zero
(C) the intensity at a point on the screen $4\ \text{m}$ from O is $4I_0$
(D) the intensity at a point on the screen $4\ \text{m}$ from O is zero

9. Four coherent light waves are represented by

(i) $y_1 = a_1 \sin(\omega t)$
(ii) $y_2 = a_2 \sin(\omega t + \phi)$
(iii) $y_3 = a_1 \sin(2\omega t)$
(iv) $y_4 = a_2 \sin(2\omega t + \phi)$

Interference fringes may be observed due to superposition of

(A) (i) and (ii)
(B) (i) and (iii)
(C) (ii) and (iv)
(D) (iii) and (iv)

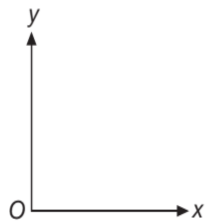
10. If one of the slits of a standard Young's double slit experiment is covered by a thin parallel slit glass so that it transmits only one half the light intensity of the other, then

(A) The fringe pattern will get shifted towards the covered slit
(B) The fringe pattern will get shifted away from the covered slit
(C) The bright fringes will become less bright and the dark ones will become more bright
(D) The fringe width will remain unchanged

11. If the first minima in a Young's slit experiment occurs directly in front of one of the slits, (distance between slits and screen $d = 5\ \text{cm}$) then the wavelength of the radiation used can be

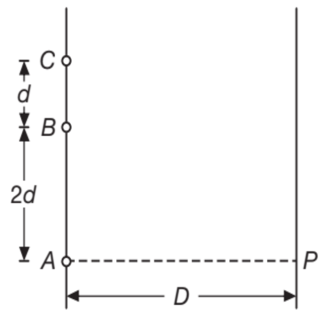
(A) 2 cm
(B) 4 cm
(C) $\frac{2}{3}$ cm
(D) $\frac{4}{3}$ cm

12. Two coherent sources A and B emitting light of wavelength λ are placed at positions $(-D, O)$ and $(-D, 3\lambda)$ respectively $D \gg \lambda$



(A) number of minima on y-axis is 6
(B) number of minima is more than number of maxima on y-axis
(C) number of maxima on x-axis is 3
(D) number of maxima on x-axis is more than number of minima on x-axis

13. In the figure A, B and C are three slits each of them individually producing the same intensity I_0 at P when they are illuminated by parallel beam of light of wavelength λ. It is given that $BP - AP = \frac{\lambda}{2}$. Also given that $d \ll D$, then wavelength λ and resultant intensity I at P will be



(A) $\lambda = \frac{2d^2}{D}$
(B) $\lambda = \frac{4d^2}{D}$
(C) $I = 2I_0$
(D) $I = I_0$

14. Light waves travel in vacuum along the x-axis. Which of the following may represent the wavefronts

(A) $x = c$
(B) $y = c$
(C) $z = c$
(D) $x + y + z = c$

15. A Young's double-slit apparatus is immersed in oil of refractive index $\frac{5}{3}$. The wavelength of light used in 500 nm (in oil), slit separation 2 mm, and distance to screen is 3 m. A glass slab of thickness $10\ \mu m$ and refractive index $\frac{3}{2}$ is placed before one slit. The fringe pattern will shift
(A) 2 mm towards the other slit
(B) 2 mm away from the other slit
(C) 2.5 mm towards the other slit
(D) 2.5 mm away from the other slit

16. The fringe width in Young's double-slit experiment can be increased by decreasing
(A) separation of the slits
(B) frequency of the source of light
(C) distance between slit and screen
(D) wavelength of the source of light

REASONING BASED QUESTIONS

This section contains Reasoning type questions, each having four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Each question contains STATEMENT 1 and STATEMENT 2. You have to mark your answer as

Bubble (A) If both statements are TRUE and STATEMENT 2 is the correct explanation of STATEMENT 1.
Bubble (B) If both statements are TRUE but STATEMENT 2 is not the correct explanation of STATEMENT 1.
Bubble (C) If STATEMENT 1 is TRUE and STATEMENT 2 is FALSE.
Bubble (D) If STATEMENT 1 is FALSE but STATEMENT 2 is TRUE.

1. **Statement-1:** If the phase difference between the light waves emerging from the slits of the Young's experiment is π-radian, the central fringe will be dark.
Statement-2: Phase difference is equal to $\frac{2\pi}{\lambda}$ times the path difference.

2. **Statement-1:** When a thin transparent sheet is placed in front of both the slits of Young's experiment, the fringe width will increase.
Statement-2: In Young's experiment the fringe width is proportional to wavelength of the source used.

3. **Statement-1:** In Young's double slit experiment, we observe an interference pattern on the screen if both the slits are illuminated by two bulbs of same power.
Statement-2: The interference pattern is observed when source is monochromatic and coherent.

4. **Statement-1:** No interference pattern is detected when two coherent sources are infinitely close to each other in simple $YDSE$.
Statement-2: The fringe width is inversely proportional to the distance between the two slits in simple $YDSE$.

5. **Statement-1:** The minimum slit separation d for interference to produce at least one maxima other than central maxima is 3λ.
Statement-2: For a maxima, path difference equals $n\lambda$. The maximum value of path difference is d.

6. **Statement-1:** Two slits in $YDSE$ are illuminated by two different sodium lamps emitting light of same wavelength. No interference pattern is observed.
Statement-2: To obtain interference pattern, source must be coherent. Two different light sources can never be coherent.

7. **Statement-1:** In Young's double slit experiment interference pattern disappears when one of the slits is covered by transparent slab.
Statement-2: Interference occurs due to superimposition of light wave from two coherent sources.

8. **Statement-1:** When a thin transparent sheet is placed in front of both the slits of Young's experiment, the fringe width will increase.
Statement-2: In Young's experiment the fringe width is proportional to wavelength of the source used.

9. **Statement-1:** Total number of maxima obtained over screen remains same whether Young's Double slit experiment is performed in air or in water with same setup.
Statement-2: $\beta_{\text{water}} = \frac{\beta_{\text{air}}}{\mu_{\text{water}}}$ (in Young's double slit experiment).

10. **Statement-1:** Interference obeys the Law of Conservation of Energy.
Statement-2: The energy is redistributed in case of interference.

11. **Statement-1:** Geometrical optics can be regarded as the limiting case of wave optics.
Statement-2: When size of obstacle or opening is very large compared to the wavelength of light then wave nature can be ignored and light can be assumed to be travelling in straight line.

12. **Statement-1:** Light from two coherent sources is reaching the screen. If the path difference at a point on the screen for yellow light is $\frac{3\lambda}{2}$, then the fringe at the point will be coloured.
Statement-2: Two coherent sources always have constant phase relationship.

13. **Statement-1:** The maximum intensity in interference pattern is four times the intensity due to each slit.
Statement-2: Intensity is directly proportional to square of amplitude.

14. **Statement-1:** Interference can be obtained by using two different lamps.
Statement-2: Two different lamps are incoherent sources as constant phase difference cannot be maintained between them.

15. **Statement-1:** Interference pattern is made by using blue light instead of red light, the fringes becomes narrower.
Statement-2: In Young's double slit experiment, fringe width is given by relation $\beta = \frac{\lambda D}{d}$.

16. **Statement-1:** Interference pattern is obtained on a screen due to two identical coherent sources of monochromatic light. The intensity at the central part of the screen becomes one-fourth if one of the source is blocked.
Statement-2: The resultant intensity is the sum of the intensities due to two sources.

17. **Statement-1:** Thin films such a soap bubble or a thin layer of oil on water show beautiful colours when illuminated by monochromatic light.
Statement-2: Colour in film are obtained due to interference between reflected light from the upper & lower layer of film.

18. **Statement-1:** The fringe obtained at the centre of the screen is known as zeroth order fringe, or the central fringe.
Statement-2: Path difference between the wave from S_1 and S_2, reaching the central fringe (or zero order fringe) is zero.

19. **Statement-1:** The phase difference between any two points on a wavefront is zero.
Statement-2: Light from the source reaches every point of the wavefront at the same time.

20. **Statement-1:** In Young's double slit experiment interference pattern disappears when one of the slits is closed.
Statement-2: Interference occurs due to superimposition of light wave from two coherent sources.

21. **Statement-1:** If a clean glass slide is observed under white light, one does not observe any colours. However, if this slide is touches with oily hands, coloured fringes appear on the slide.
Statement-2: These fringes are due to interference of reflected light, reflected from the upper and lower surfaces of the thin oil film.

LINKED COMPREHENSION TYPE QUESTIONS

This section contains Linked Comprehension Type Questions or Paragraph based Questions. Each set consists of a Paragraph followed by questions. Each question has four choices (A), (B), (C) and (D), out of which only one is correct. (For the sake of competitiveness there may be a few questions that may have more than one correct options)

Comprehension I

In a Young's experiment the upper slit is covered by a thin glass plate of refractive index $\mu = 1.4$. The interference pattern is observed using light of interference 5000 Å. Based on above information, answer the following questions.

1. It is observed that
(A) the central maxima shifts upwards.
(B) the central maxima shifts downwards.
(C) fringe pattern will change after introduction of thin plate.
(D) none of the above phenomenon is observed.

2. Now a thin plate of refractive index 1.7 is placed in front of lower slit then
(A) central maxima will be obtained above centre.
(B) central maxima will be obtain at centre.
(C) there will not be any change in central maxima after introduction of thin plate.
(D) no conclusion can be withdrawn without knowing the thickness of the plate.

3. Assume the thickness of both thin glass plate is t, the path difference between waves incident at center is
(A) $0.5t$ (B) $0.3t$
(C) $0.8t$ (D) $\frac{1.7}{1.5}t$

4. If minima is to be obtained at center then minimum value of t is (source wavelength is λ)

(A) $t=\frac{\lambda}{0.6}$ (B) $t=\frac{\lambda}{0.3}$

(C) $t=\lambda$ (D) $t=\frac{\lambda}{0.15}$

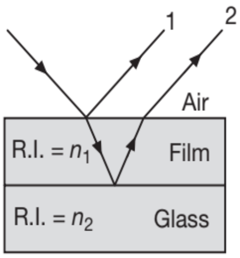
5. If intensity at center is $\frac{3}{4}$ of maximum intensity then minimum value of t is

(A) $t=2777.7$ Å (B) $t=3188$ Å

(C) $t=4188.8$ Å (D) $t=2122.9$ Å

Comprehension 2

A thin film of a specific material can be used to decrease the intensity of reflected light. There is destructive interference of waves reflected from upper and lower surfaces of the film. These films are called non–reflecting or antireflection coatings. The process of coating the lens or surface with non–reflecting film is called blooming as shown in the figure. The refracting index of coating (n_1) is less than that of the glass (n_2). Based on above information, answer the following questions.



6. If the light of wavelength λ is incident normally and the thickness of film is t then optical path difference between waves reflected from upper and lower surface of film is

(A) $2n_1t$ (B) $2n_1t-\frac{\lambda}{2}$

(C) $2n_1t+\frac{\lambda}{2}$ (D) $2t$

7. Magnesium fluoride (MgF_2) is generally used as anti–reflection coating. If refractive index of MgF_2 is 1.38 then minimum thickness of film required for $\lambda=550$ nm is

(A) 112.4 nm (B) 78.2 nm

(C) 99.64 nm (D) 225 nm.

8. Assuming that the thickness of film in above problem is not technically possible to manufacture, then next thickness of film required is (approximately)

(A) 298.9 nm

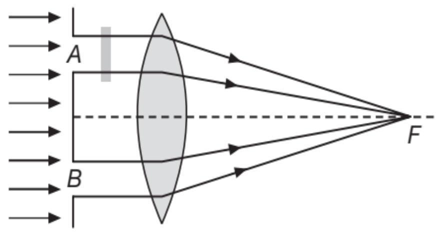
(B) 271.7 nm

(C) 304.7 nm

(D) 550 nm

Comprehension 3

In a modified Young's double slit experiment, a monochromatic uniform and parallel beam of light of wavelength 6000 Å and intensity $\frac{10}{\pi}$ Wm^{-2} is incident normally on two circular apertures A and B of radii 0.001 m and 0.002 m respectively. A perfect transparent film of thickness 2000 Å and refractive index 1.5 for the wavelength of 6000 Å is placed in front of aperture A. The lens is symmetrically placed with respect to the apertures. Assume that 10% of the power received by each aperture goes in the original direction and is brought to the focal spot.



Based on the above facts, answer the following questions.

9. The power received at A is

(A) 10^{-5} W (B) 4×10^{-5} W

(C) 10^{-6} W (D) 4×10^{-6} W

10. The power received at B is

(A) 10^{-5} W (B) 4×10^{-5} W

(C) 10^{-6} W (D) 4×10^{-6} W

11. The power transmitted through A is

(A) 10^{-5} W (B) 4×10^{-5} W

(C) 10^{-6} W (D) 4×10^{-6} W

12. The power transmitted through B is

(A) 10^{-5} W (B) 4×10^{-5} W

(C) 10^{-6} W (D) 4×10^{-6} W

13. The path difference introduced by the film is

(A) 10^{-3} m (B) 10^{-5} m

(C) 10^{-7} m (D) 10^{-9} m

14. The phase difference introduced by the film is

(A) π radian (B) $\frac{\pi}{2}$ radian

(C) $\frac{\pi}{3}$ radian (D) $\frac{\pi}{4}$ radian

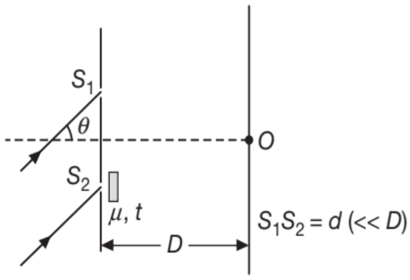
15. The power in watt received at the focal point F of the lens is

(A) 2 μW (B) 5 μW

(C) 6 μW (D) 7 μW

Comprehension 4

A monochromatic beam of light of wavelength $\lambda = 600$ nm falls on Young's double slit experiment apparatus as shown in figure. A thin sheet of glass is inserted in front of lower slit S_2. Based on above information, answer the following questions.



16. The central bright fringe can be obtained
(A) at O
(B) at O or below O
(C) at O or above O
(D) anywhere on the screen

17. If central bright fringe is obtained on screen at O, then we have
(A) $(\mu-1)t = d\sin\theta$ (B) $(\mu-1)t = d\cos\theta$
(C) $\mu t = d\theta$ (D) $\frac{t}{\mu-1} = \frac{d}{\sin\theta}$

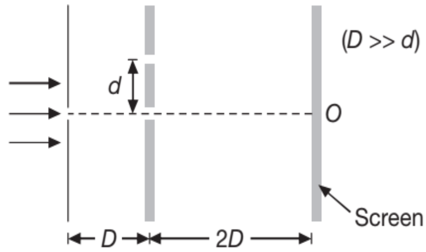
18. The phase difference between central maxima and fifth minima is
(A) $\frac{\pi}{6}$ (B) 9π
(C) $\frac{3\pi}{2}$ (D) $8\pi \pm \frac{\pi}{6}$

19. Fringe width for the pattern obtained on screen, if $\lambda = 600$ nm, $\mu = 1.5$, $d = 3$ mm, $D = 2$ m and $\theta = 30°$ is
(A) 2×10^5 nm (B) 4×10^5 nm
(C) 10^4 nm (D) 3×10^6 nm

20. Assume if $\theta\left(<\frac{\pi}{2}\right)$ is increased then for a given value of μ
(A) central maxima will move downwards.
(B) central maxima will move upward.
(C) fringe width will increase.
(D) fringe width will decrease.

Comprehension 5

In the arrangement shown in the figure, the distance D is large compared to the separation d between the slits. Monochromatic light of wavelength λ is incident on the slit, based on the information provided answer the following questions.



21. The minimum value of d for which there is a dark fringe at the point O is
(A) $\sqrt{\frac{\lambda D}{2}}$
(B) $\sqrt{\frac{D\lambda}{3}}$
(C) $\sqrt{\lambda D}$
(D) not possible to be calculated

22. The position of first bright fringe for the minimum value of d is
(A) $\frac{d}{2}$ below (B) d above
(C) $\frac{3d}{2}$ below (D) $\frac{3d}{2}$ above

23. The fringe width is
(A) $\frac{3D\lambda}{4d}$ (B) $\frac{3D\lambda}{2d}$
(C) $\frac{D\lambda}{d}$ (D) $\frac{2D\lambda}{d}$

Comprehension 6

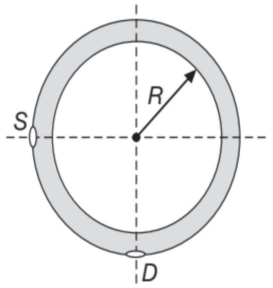
If light incident on a thin film has wavelength as 900 nm and refractive index of film is 1.5. Based on above information, answer the following questions.

24. Minimum thickness of film needed for constructive interference in reflected light system is
(A) 100 nm (B) 150 nm
(C) 200 nm (D) 250 nm

25. Minimum thickness of film for destructive interference in transmitted light system is
(A) 150 nm (B) 200 nm
(C) 250 nm (D) 100 nm

Comprehension 7

A narrow tube is bent in the form of circle of radius R as shown. Two small holes S and D are made in the tube at the positions right angles to each other. A source placed at S generates a wave of intensity I_0 which is equally divided into two parts. One part travels along the longer path, while the other travels along the shorter path. Both the part waves meet at point D where a detector is placed. Based on above information, answer the following questions.



26. Maximum intensity produced at D is given by

(A) $4I_0$ (B) $3I_0$
(C) $2I_0$ (D) I_0

27. The maximum value of wavelength λ to produce a maximum at D is given by

(A) πR (B) $2\pi R$
(C) $\frac{\pi R}{2}$ (D) $\frac{3\pi R}{2}$

28. The maximum value of wavelength λ to produce a minimum at D is given by

(A) πR (B) $2\pi R$
(C) $\frac{\pi R}{2}$ (D) $\frac{3\pi R}{2}$

Comprehension 8

When Fresnel's biprism experiment is performed in air then distance between coherent sources is 0.5 mm and distance between source and screen is 1 m. Fringe width obtained in air is 1 mm. Refractive index of biprism is 1.5. Now the experiment is performed in water having refractive index $\mu_w = \frac{4}{3}$. If the refractive index of the biprism is $\mu = \frac{3}{2}$. Based on above information, answer the following questions.

29. The distance between coherent sources in water is

(A) 1 mm (B) $\frac{1}{2}$ mm
(C) $\frac{1}{4}$ mm (D) $\frac{1}{8}$ mm

30. The fringe width in water is

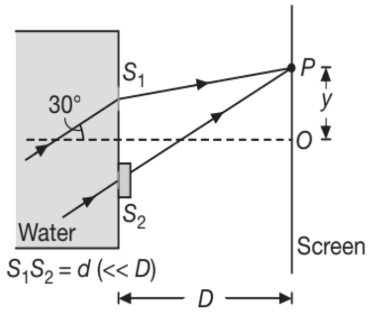
(A) 1 mm (B) 2 mm
(C) 3 mm (D) 4 mm

31. The wavelength of light in air is

(A) 4000 Å (B) 4500 Å
(C) 5000 Å (D) 6000 Å

Comprehension 9

In a $YDSE$ experiment, the two slits are covered with transparent membranes of negligible thickness which allow light to pass through it but does not allow water. A glass slab of thickness $t = 0.41$ mm and refractive index $\mu_g = 1.5$ is placed in front of one of the slits as shown in figure. The separation between the slits is $d = 0.30$ mm. The entire space to the left of the slits is filled with water of refractive index $\mu_w = \frac{4}{3}$. A coherent light of intensity I and absolute wavelength $\lambda = 5000$ Å is being incident on the slits making an angle of $30°$ with horizontal. Screen is placed at a distance $D = 1$ m from the slits. Based on above information, answer the following questions.



32. At point O, equidistant from slits we get

(A) 9^{th} dark fringe (B) 10^{th} dark fringe
(C) 11^{th} bright fringe (D) 10^{th} bright fringe

33. Central maxima is located at

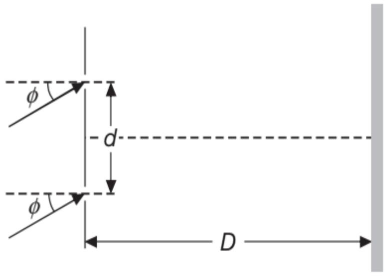
(A) $y = +\frac{5}{6}$ cm (B) $y = -\frac{5}{6}$ cm
(C) $y = +\frac{5}{3}$ cm (D) $y = -\frac{5}{3}$ cm

34. The ratio of intensity at point P at $y = \frac{1}{8}$ cm on screen and maximum intensity is

(A) 0 (B) 1
(C) $\frac{1}{\sqrt{2}}$ (D) $\frac{1}{2}$

Comprehension 10

Light of wavelength $\lambda = 500$ nm falls on two narrow slits placed a distance $d = 50 \times 10^{-4}$ cm apart, at an angle $\phi = 30°$ relative to the slits shown in figure. On the lower slit a transparent slab of thickness 0.1 nm and refractive index $\frac{3}{2}$ is placed. The interference pattern is observed on a screen at a distance $D = 2$ m from the slits. Based on above information, answer the following questions.



35. The angular position of the central maxima w.r.t. central line is

(A) 60° (B) 45°

(C) 30° (D) 15°

36. The order of minima closest to centre C of screen is

(A) 50 (B) 49

(C) 48 (D) 47

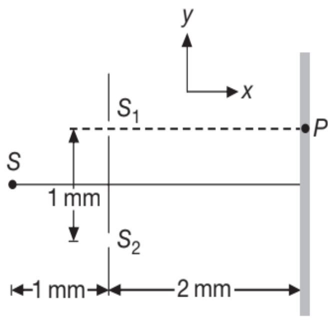
37. The number of fringes that will pass over C, when the transparent slab from the lower slit is removed is

(A) 100 (B) 98

(C) 96 (D) 94

Comprehension 11

In a Young's double slit experiment set-up source S of wavelength 5000 Å illuminates two slits S_1 and S_2, which act as two coherent sources. The source S oscillates about its shown position according to the equation $y = 0.5\sin(\pi t)$, where y is in millimetres and t in seconds. Based on above information, answer the following questions.



38. The position of the central maxima as a function of time is best represented by the equation

(A) $-\cos(\pi t)$ (B) $\cos(\pi t)$

(C) $-\sin[(\pi+1)t]$ (D) $-\sin[\pi(1+t)]$

39. The minimum time t at which the intensity at point P on the screen exactly in front of the upper slit becomes maximum is

(A) $\frac{1}{2}$ s (B) $\frac{1}{3}$ s

(C) $\frac{1}{6}$ s (D) 1 s

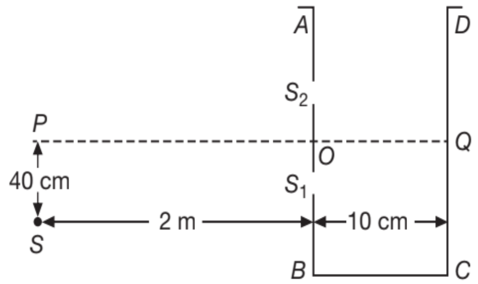
40. The minimum time t at which the intensity at point P on the screen exactly in front of the upper slit becomes minimum is

(A) 1 s (B) $\frac{1}{2}$ s

(C) $\frac{1}{3}$ s (D) $\frac{1}{6}$ s

Comprehension 12

A vessel $ABCD$ of 10 cm width has two small slits S_1 and S_2 sealed with identical glass plates of equal thickness. The distance between the slits is 0.8 mm. POQ is the line perpendicular to the plane AB and passing through O, the middle point of S_1 and S_2. A monochromatic light source is kept at S, 40 cm below P and 2 m from the vessel, to illuminate the slits as shown in the figure. Based on above information, answer the following questions.



41. The position of the central bright fringe on the other wall CD with respect to the line OQ is

(A) 2 cm below Q (B) 2 cm above Q

(C) 4 cm below Q (D) 4 cm above Q

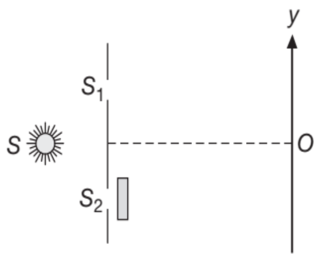
42. It is observed that when a liquid is poured into the vessel and filled upto OQ, the central bright fringe is found to be at Q. The refractive index of the liquid is

(A) 1.0008 (B) 1.0004

(C) 1.0016 (D) 1.0012

Comprehension 13

The Young's double slit experiment is done in a medium of refractive index $\frac{4}{3}$. A light of 600 nm wavelength is falling on the slits having 0.45 mm separation. The lower slit S_2 is covered by a thin glass sheet of thickness 10.4 μm and refractive index 1.5. The interference pattern is observed on a screen placed 1.5 m from the slits as shown in the figure. Assume that all wavelengths in the problem are for the given medium of refractive index $\frac{4}{3}$ and ignore dispersion. Based on above information, answer the following questions.



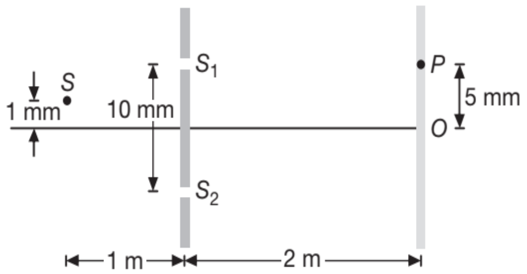
43. The central maximum formed on the y-axis is located at
(A) $y = \frac{11}{3}$ mm above O
(B) $y = \frac{11}{3}$ mm below O
(C) $y = \frac{14}{3}$ mm above O
(D) $y = \frac{13}{3}$ mm below O

44. The ratio of light intensity of point O to the maximum fringe intensity is
(A) $\frac{1}{4}$ (B) $\frac{1}{2}$
(C) $\frac{3}{4}$ (D) 1

45. Assuming the 600 nm light to be replaced by white light of range 400 to 700 nm, the wavelengths of the light that form maxima exactly at point O are
(A) $\frac{1300}{3}$ nm, 500 nm (B) $\frac{1400}{3}$ nm, 600 nm
(C) $\frac{1300}{3}$ nm, 650 nm (D) $\frac{1400}{3}$ nm, 650 nm

Comprehension 14

In the Young's double slit experiment a point source of $\lambda = 5000$ Å is placed slightly off the central axis as shown in the figure. Based on the information provided, answer the following questions.



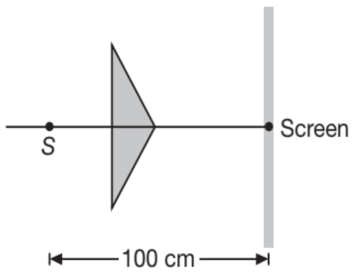
46. The order and nature of the interference at the point P is
(A) 50^{th} order, maxima (B) 50^{th} order, minima
(C) 70^{th} order, maxima (D) 70^{th} order, minima

47. The order and the nature of the interference at O is
(A) 50^{th} order, minima
(B) 50^{th} order, maxima
(C) 20^{th} order, minima
(D) 20^{th} order, maxima

48. If the zero order maxima is formed at O, then
(A) we should place a film of refractive index $\mu = 1.5$, thickness 10 μm in front of S_2.
(B) we should place a film of refractive index $\mu = 1.5$, thickness 20 μm in front of S_2.
(C) we should place a film of refractive index $\mu = 1.5$, thickness 10 μm in front of S_1.
(D) we should place a film of refractive index $\mu = 1.5$, thickness 20 μm in front of S_1.

Comprehension 15

A narrow slit S allows monochromatic light of wavelength $\lambda = 6000$ Å to fall on a prism of very small angle as shown in figure. A screen is placed at a distance $l = 100$ cm from the source to obtain an interference pattern. To determine the distance between the virtual images formed by the prism an experiment is done. The prism and screen are kept fixed and a convex lens is moved between the prism and the screen. For two positions of the lens (between the prism and the screen) we get two sharp point images on the screen in each case. The images are separated from each other by a distance 6 mm and 1.5 mm in the other. Now lens is removed and interference pattern is obtained on the screen. Based on the information provided, answer the following questions.



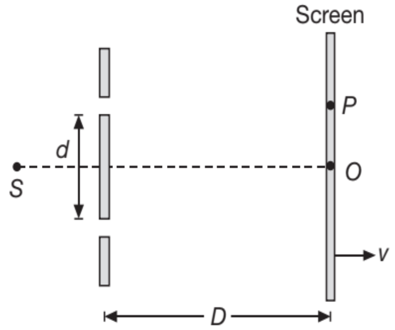
49. Focal length of the lens is
(A) 16 cm (B) 20 cm
(C) 36 cm (D) 40 cm

50. Fringe width of the pattern on the screen is
(A) 0.1 mm (B) 0.2 mm
(C) 0.3 mm (D) 0.4 mm

51. If screen is displaced slightly away from prism, then
(A) No interference pattern is observed
(B) fringe width remains same.
(C) fringe width decreases.
(D) fringe width increases.

Comprehension 16

In YDSE apparatus shown in figure, wavelength of light used is λ. The screen is moved away from the source with a constant speed v. Initial distance between screen and plane of slits was D. Based on the information provided answer the following questions.



Based on the information provided, answer the following questions.

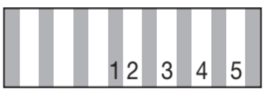
52. At a point P on the screen, the order of fringe will
(A) increase
(B) decrease
(C) remain constant
(D) first increase then decrease

53. Suppose P is the point where 5^{th} order maxima was lying at $t=0$. Then after how much time third order minima will lie at this point

(A) $\frac{2D}{v}$ (B) $\frac{D}{v}$
(C) $\frac{3D}{2v}$ (D) $\frac{3D}{v}$

Comprehension 17

The figure shows the interference pattern obtained in a double-slit experiment using light of wavelength 600 nm with fringes 1, 2, 3, 4 and 5 marked on it. If fringe 2 represents the central bright fringe, then based on the information provided answer the following questions.



54. The third order bright fringe is
(A) 2 (B) 3
(C) 4 (D) 5

55. Which fringe results from a phase difference of 4π between the light waves incidenting from two slits
(A) 2 (B) 3
(C) 4 (D) 5

56. Let Δx_1 and Δx_3 represent path differences between waves interfering at 1 and 3 respectively then $(|\Delta x_3| - |\Delta x_1|)$ is equal to
(A) 0 (B) 300 nm
(C) 600 nm (D) 900 nm

Comprehension 18

If light of wavelength 900 nm is incident on a thin film of refractive index 1.5, then answer the following questions.

57. Minimum thickness of film required for constructive interference in reflected light is
(A) 100 nm (B) 150 nm
(C) 200 nm (D) 250 nm

58. Minimum thickness of film for destructive interference in transmitted light is
(A) 150 nm (B) 200 nm
(C) 250 nm (D) 100 nm

Comprehension 19

When Fresnel's biprism experiment is performed in air, then distance between coherent sources is 0.5 mm and distance between source and screen is 1 m. The fringe width obtained in air is 1 mm. Refractive index of biprism is 1.5. Now the experiment is performed in water $\left(\mu = \frac{4}{3}\right)$.

Based on the information provided answer the following questions.

59. Distance between coherent sources in water is
(A) $\frac{1}{2}$ mm (B) $\frac{1}{4}$ mm
(C) 1 mm (D) None of these

60. Fringe width in water is
(A) 3 mm (B) 2 mm
(C) 1 mm (D) None of these

61. Wavelength of light in air is
(A) 5000 Å (B) 4000 Å
(C) 6000 Å (D) 4500 Å

Comprehension 20

A Young's double slit apparatus is immersed in a liquid of refractive index 1.33. It has slit separation of 1 mm and interference pattern is observed on the screen at a distance 1.33 m from plane of slits. The wavelength in air 6300 Å. Based on the information provided answer the following questions.

62. The distance of seventh bright fringe from third bright fringe lying on the same side of central bright fringe is

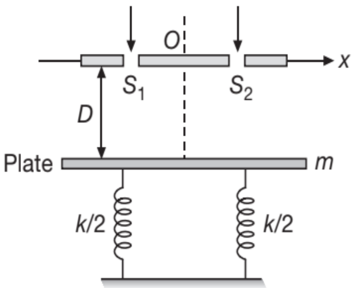
(A) 2.52 mm (B) 4.41 mm
(C) 1.89 mm (D 1.26 mm

63. One of the slits of the apparatus is covered by a thin glass sheet of refractive index 1.53. The smallest thickness of the sheet to interchange the position of minima and maxima assuming that the apparatus is still in same liquid is

(A) 2.575 μm (B) 1.575 μm
(C) 2.095 μm (D) None of these

Comprehension 21

In an arrangement, two slits S_1 and S_2 (lie on the x-axis and symmetric with respect to y-axis) are illuminated by a parallel monochromatic light beam of wavelength λ as shown.



The distance between slits is $d(\gg \lambda)$. Point O is the mid-point of the line S_1S_2 and this point is considered as origin. The slits are in horizontal plane. The interference pattern is observed on a horizontal plate (acting as screen) of mass m to which two vertical massless springs each of spring constant $\frac{k}{2}$ are connected. The other ends of springs are fixed to the ground. At $t=0$, plate is at C , a distance $D(\gg d)$ below the plane of slits and springs are in their natural lengths. The plate is released from rest from its initial position. Based on the information provided answer the following questions.

64. The rate by which fringe width will increase when the acceleration of the plate is zero is

(A) $\frac{\lambda g}{d}\sqrt{\frac{m}{k}}$ (B) $\frac{\lambda g}{3d}\sqrt{\frac{m}{k}}$
(C) $\frac{\lambda g}{4d}\sqrt{\frac{m}{k}}$ (D) $\frac{\lambda g}{2d}\sqrt{\frac{m}{k}}$

65. The difference between two fringe widths when the plate is at rest for a moment is

(A) $\frac{2\lambda}{d}$ (B) $\frac{\lambda mg}{kd}$
(C) $\frac{2\lambda mg}{kd}$ (D) $\frac{mgd}{k\lambda}$

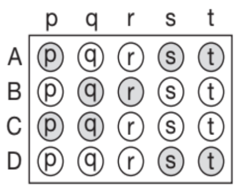
66. A thin slab of refractive index μ is kept in front of one of slits such that position of first maxima shifts to the position of central maxima (at the instant when the plate has been held at rest initially). The thickness of slab is

(A) $\frac{d}{\mu-1}$ (B) $\frac{\lambda d}{D(\mu-1)}$
(C) $\frac{\lambda D}{d(\mu-1)}$ (D) $\frac{\lambda}{(\mu-1)}$

MATRIX MATCH/COLUMN MATCH TYPE QUESTIONS

Each question in this section contains statements given in two columns, which have to be matched. The statements in **COLUMN-I** are labelled A, B, C and D, while the statements in **COLUMN-II** are labelled p, q, r, s (and t). Any given statement in **COLUMN-I** can have correct matching with **ONE OR MORE** statement(s) in **COLUMN-II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following examples:

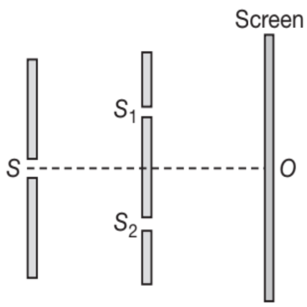
If the correct matches are A → p, s and t; B → q and r; C → p and q; and D → s and t; then the correct darkening of bubbles will look like the following :



1. **COLUMN-I** shows the effect on the fringe pattern in *YDSE* corresponding to the changes mentioned in **COLUMN-II**. Match the effects in **COLUMN-I** with the corresponding causes in **COLUMN-II**.

COLUMN-I	COLUMN-II
(A) Angular fringe width remains same	(p) Screen is moved away from the plane of the slits
(B) Angular fringe width changes	(q) Wavelength of light used is decreased
(C) Fringe width (linear separation between two consecutive fringes) changes	(r) The separation between the slits is increased
(D) The fringe pattern may disappear	(s) The width of the source slit is increased

2. Figure shows a set-up to perform Young's double slit experiment. A monochromatic source of light is placed at S. S_1 and S_2 act as coherent sources and interference pattern is obtained on the screen. Match **COLUMN-I** with **COLUMN-II** keeping in mind the Young's double slit experiment.



COLUMN-I	COLUMN-II
(A) S is removed and two real sources emitting light of same wavelength are placed at S_1 and S_2.	(p) Interference fringes disappear.
(B) Width of S_1 is two times the width of S_2.	(q) There is uniform illumination on a large part of the screen.
(C) S_1 is closed.	(r) The zero order fringe will not form at O.
(D) A thin transparent plate is placed in front of S_1. Assuming negligible absorption by the plate.	(s) Intensity of a dark fringe will be non-zero, but less than the intensity of bright fringe.

(Continued)

3. Match the contents of **COLUMN-I** with the respective phenomenon in **COLUMN-II**.

COLUMN-I	COLUMN-II
(A) Shining of diamonds.	(p) interference
(B) Light waves projected on oil surface shows seven colours.	(q) total internal reflection
(C) Huygen's wave theory of light cannot explain.	(r) origin of spectra
(D) Phenomena which is not Explained by Huygen's construction of wavelength.	(s) photoelectric effect

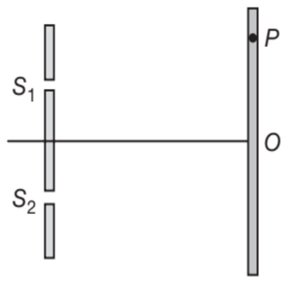
4. In Young's Double Slit Experiment, if distance between slits is d, distance between slit and screen is D, wavelength of light used is λ. Then match **COLUMN-I** with **COLUMN-II**.

COLUMN-I	COLUMN-II
(A) For bright fringe, path difference.	(p) $\frac{D\lambda}{2d}$
(B) For dark fringe, path difference.	(q) $\frac{D}{d}(\mu-1)t$
(C) Displacement of fringe when glass plate of thickness t is placed.	(r) $n\lambda$
(D) Distance between central maxima and first dark fringe when glass plate of thickness t is used.	(s) $(2n-1)\frac{\lambda}{2}$

5. Match the contents of **COLUMN-I** with the respective contents of **COLUMN-II**.

COLUMN-I	COLUMN-II
(A) Sources of variable phase difference.	(p) Incoherent sources
(B) Point on a wavefront behaves as a light source.	(q) Coherent sources
(C) Net displacement is the vector sum of individual displacement.	(r) Superposition principle
(D) Young's double slit experiment uses.	(s) Huygen's principle

6. In the *YDSE* appratus shown in figure, Δx is the path difference between S_2P and S_1P. If, now a glass slab is introduced in front of S_2, then match the contents of **COLUMN-I** with the respective matches in **COLUMN-II**.



COLUMN-I	COLUMN-II
(A) Fringe width will	(p) increase
(B) Fringe pattern will	(q) decrease
(C) Number of fringes between O and P will	(r) remain same
(D) Δx at P will	(s) shift upward
	(t) shift downward

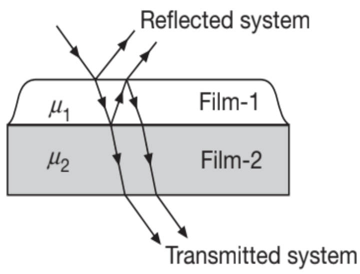
7. Match the quantities in **COLUMN-I** with their respective matches in **COLUMN-II**.

COLUMN-I	COLUMN-II
(A) Point source of light	(p) Spherical wavefront
(B) Limit of resolution of telescope	(q) Amplitude division
(C) Interference	(r) Superposition of waves
(D) Coherent sources	(s) Radius of lens

8. In the light of possibility of occurrence of phenomena listed in **COLUMN-I** match the listings in **COLUMN-I** to the corresponding waves in **COLUMN-II**.

COLUMN-I	COLUMN-II
(A) Reflection	(p) Non-mechanical waves
(B) Interference	(q) Electromagnetic waves
(C) Diffraction	(r) Visible light waves
(D) Polarisation	(s) Sound waves

9. For the situation shown in the figure below, match the entries of **COLUMN-I** with **COLUMN-II**.



COLUMN-I	COLUMN-II
(A) $\mu_1 = \mu_2$	(p) Film 1 appears shiny from the reflected system
(B) $\mu_1 > \mu_2$	(q) Film 1 appears dark from the reflected system
(C) $\mu_1 < \mu_2$	(r) Film 1 appears shiny from the transmitted system
(D) $\mu_1 \neq \mu_2$	(s) Film 1 appears dark from the transmitted system

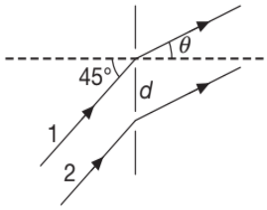
INTEGER/NUMERICAL ANSWER TYPE QUESTIONS

In this section, the answer to each question is a numerical value obtained after doing series of calculations based on the data given in the question(s).

1. Interference pattern with Young's double slit 1.5 mm apart are formed on a screen at a distance 1.5 m from the plane of slits. In the path of the beam from one of the slits, a transparent film of 10 micron thickness and the refractive index 1.6 is interposed while in the path of the beam from the other slit a transparent film of 15 micron thickness and a refractive index 1.2 is interposed. Find the displacement of the fringe pattern, in mm.

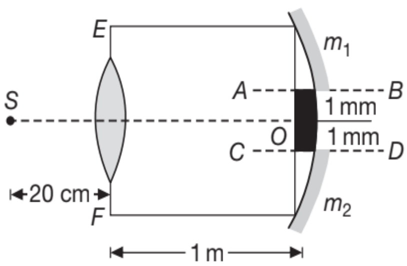
2. Two coherent radio point sources that are separated by 2 m are radiating in phase with a wavelength of 0.25 m. If a detector moves in a large circle around their midpoint, at how many points will the detector show a maximum signal?

3. In the figure shown the distance between the slits is $d = 20\lambda$, where λ is the wavelength of light used. Find the angle θ, in degree, where



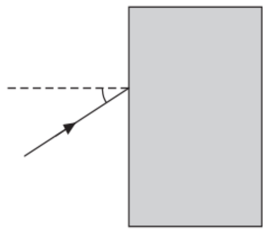
(a) central maxima (where path difference is zero) is obtained.
(b) third order maxima is obtained.

4. An equiconvex lens of focal length 10 cm (in air) and refractive index $\frac{3}{2}$ is put at a small opening on a tube of length 1 m fully filled with liquid of refractive index $\frac{4}{3}$. A concave mirror of radius of curvature 20 cm is cut into two halves m_1 and m_2 and placed at the end of the tube. m_1 and m_2 are placed such that their principal axes AB and CD respectively are separated by 1 mm each from the principle axes of the lens.



A slit S placed in air illuminates the lens with light of frequency 7.5×10^{14} Hz. The light reflected from m_1 and m_2 forms interference pattern on the left and EF of the tube. O is an opaque substance to cover the hole created by the placement of m_1 and m_2. Find :
(a) The position of the image, in cm, formed by lens-water combination.
(b) The distance, in mm, between the images formed by m_1 and m_2.
(c) Width of the fringes on EF, in μm.

5. A ray of light is incident on the left vertical face of the glass slab. If the incident light has an intensity I and on each reflection the intensity decreases by 90% and on each refraction the intensity decreases by 10%, find the ratio of the intensities of maximum to minimum in the reflected pattern.

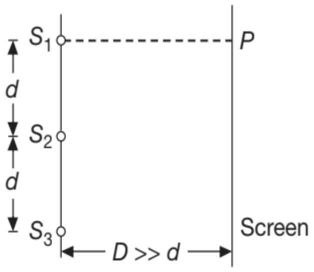


6. Two slits are separated by 0.32 mm. A beam of 500 nm light strikes the slits producing an interference pattern. Determine the number of maxima observed in the angular range $-30° < \theta < 30°$.

7. Interference fringes were produced by Young's double slit method, the wavelength of light used being 6000 Å. The separation between the two slits is 2 mm. The distance between the slits and screen is 10 cm. When a transparent plate of thickness 0.5 mm is placed over one of the slits, the fringe pattern is displaced by 5 mm. If μ be the refractive index of the material of the plate, then find 5μ.

8. In young's double slit experiment mixture of two light wave having wavelengths $\lambda_1 = 500$ nm and $\lambda_2 = 700$ nm are being used. Find the position next to central maxima, where maximas due to both waves coincides. $\left(\text{Given } \frac{D}{d} = 1000\right)$

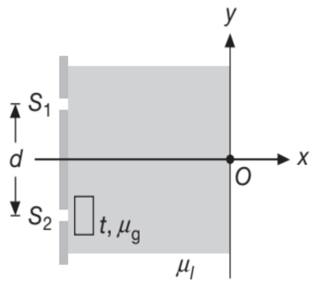
9. Consider the interference at P between waves emanating from three coherent sources in same phase located at S_1, S_2 and S_3. If intensity due to each source is $I_0 = 12\ \text{Wm}^{-2}$ at P and $\frac{d^2}{2D} = \frac{\lambda}{3}$ then find the resultant intensity at P, in Wm^{-2}.



10. In a *YDSE* (young double slit experiment) screen is placed 1 m from the slits wavelength of light used is 6000 Å. The fringes formed on the screen are observed by a student sitting close to the slits. The student's eye can distinguish two neighboring fringes, if they subtend an angle more than 1 minute of the arc. Calculate the maximum distance between the slits, in mm, so that fringes are clearly visible. Give your answer to the nearest integer.

11. A parallel beam of white light falls from air on a thin film in air whose refractive index is $\sqrt{3}$. The angle of incidence is $i = 60°$. Find the minimum film thickness (in nanometer), if the reflected light is most intense for $\lambda = 6000$ Å.

12. In a modified *YDSE* the region between screen and slits is immersed in a liquid whose refractive index varies with time as $\mu_l = \frac{5}{2} - \frac{t}{4}$, until it reaches a steady state value $\frac{5}{4}$. A glass plate of thickness $T = 36\ \mu\text{m}$ and refractive index $\mu = \frac{3}{2}$ is introduced in front of one of the slits. If the separation between the sources and the screen is 1 m and the separation between the sources is 2 mm, then calculate the speed of the central maxima, in mms^{-1}, when it is at O,



13. In a Young's double slit experiment, 12 fringes are observed to be formed in a certain segment of the screen when light of wavelength 600 nm is used. If the wavelength of light is now changed to 400 nm, what will be the new number of fringes observed in the same segment of screen.

14. A glass wedge of angle 0.01 radian is illuminated by monochromatic light of wavelength 6000 Å falling normally on it. Find the distance from the edge of the wedge, in mm where the 10^{th} fringe will be observed due to the reflected light.

15. In Young's double slit experiment the two slits act as coherent sources of equal amplitude A and wavelength λ. In another experiment with the same set up the two slits are source of equal amplitude A and wavelength λ but are incoherent. Find the ratio of intensity of light at the mid-point of the screen in the first case to that in second case.

16. In *YDSE* setup, a light of wavelength 6000 Å is used. Calculate the separation between the slits (in mm rounded off to nearest integer) so that at a point (on the screen 1 m from the sources) in front of one of the slits, a third bright fringe is obtained.

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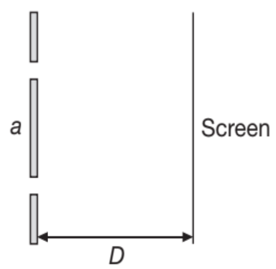
1. **[Online April 2019]**
In an interference experiment the ratio of amplitudes of coherent waves is $\frac{a_1}{a_2} = \frac{1}{3}$. The ratio of maximum and minimum intensities of fringes will be

(A) 4 (B) 18
(C) 9 (D) 2

2. **[Online April 2019]**
The figure shows a young's double slit experimental setup. It is observed that when a thin transparent sheet of thickness t and refractive index μ is put in front of one of the slits, the central maximum gets shifted by a distance equal to n fringe widths. If the wavelength of light used is λ, t will be



(A) $\dfrac{2nD\lambda}{a(\mu-1)}$ (B) $\dfrac{n\lambda}{\mu-1}$

(C) $\dfrac{na\lambda}{\mu-1}$ (D) $\dfrac{nD\lambda}{\mu-1}$

3. [Online April 2019]
In a Young's double slit experiment, the ratio of the slit's width is $4:1$. The ratio of the intensity of maxima to minima, close to the central fringe on the screen, will be

(A) $(\sqrt{3}+1)^4:16$ (B) $4:1$
(C) $25:9$ (D) $9:1$

4. [Online April 2019]
In a double slit experiment, when a thin film of thickness t having refractive index μ is introduced in front of one of the slits, the maximum at the centre of the fringe pattern shifts by one fringe width. The value of t is (λ is the wavelength of the light used)

(A) $\dfrac{2\lambda}{(\mu-1)}$ (B) $\dfrac{\lambda}{2(\mu-1)}$

(C) $\dfrac{\lambda}{(2\mu-1)}$ (D) $\dfrac{\lambda}{(\mu-1)}$

5. [Online April 2019]
A system of three polarizers P_1, P_2, P_3 is set up such that the pass axis of P_3 is crossed with respect to that of P_1. The pass axis of P_2 is inclined at $60°$ to the pass axis of P_3. When a beam of unpolarized light of intensity I_0 is incident on P_1, the intensity of light transmitted by the three polarizers is I. The ratio $\left(\dfrac{I_0}{I}\right)$ equals (nearly)

(A) 1.80 (B) 5.33
(C) 10.67 (D) 16.00

6. [Online January 2019]
Two coherent sources produce waves of different intensities which interfere. After interference, the ratio of the maximum intensity to the minimum intensity is 16. The intensity of the waves are in the ratio

(A) $25:9$ (B) $4:1$
(C) $16:9$ (D) $5:3$

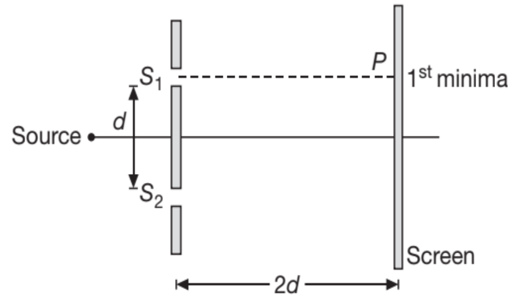
7. [Online January 2019]
In a Young's double slit experiment, the slits are placed 0.320 mm apart. Light of wavelength $\lambda = 500$ nm is incident on the slits. The total number of bright fringes that are observed in the angular range $-30° \le \theta \le 30°$ is

(A) 640 (B) 320
(C) 321 (D) 641

8. [Online January 2019]
In a Young's double slit experiment with slit separation 0.1 mm, one observes a bright fringe at angle $\dfrac{1}{40}$ rad by using light of wavelength λ_1. When the light of wavelength λ_2 is used a bright fringe is seen at the same angle in the same set up. Given that λ_1 and λ_2 are in visible range (380 nm to 740 nm), their values are

(A) 380 nm, 500 nm (B) 625 nm, 500 nm
(C) 380 nm, 525 nm (D) 400 nm, 500 nm

9. [Online January 2019]
Consider a Young's double slit experiment as shown in figure. What should be the slit separation d in terms wavelength λ such that the first minima occurs directly in front of the slit (S_1)?



(A) $\dfrac{\lambda}{2(\sqrt{5}-2)}$ (B) $\dfrac{\lambda}{2(5-\sqrt{2})}$

(C) $\dfrac{\lambda}{(5-\sqrt{2})}$ (D) $\dfrac{\lambda}{(\sqrt{5}-2)}$

10. [Online January 2019]
In a Young's double slit experiment, the path difference, at a certain point on the screen, between two interfering waves is $\left(\dfrac{1}{8}\right)^{th}$ of wavelength. The ratio of the intensity at this point to that at the centre of a bright fringe is close to

(A) 0.74 (B) 0.94
(C) 0.80 (D) 0.85

11. [Online January 2019]
In a double-slit experiment, green light (5303 Å) falls on a double slit having a separation of 19.44 μm and a width of 4.05 μm. The number of bright fringes between the first and the second diffraction minima is

(A) 05 (B) 09
(C) 10 (D) 04

12. [2018]
Unpolarized light of intensity I passes through an ideal polarizer A. Another identical polarizer B is placed behind A. The intensity of light beyond B is

found to be $\frac{I}{2}$. Now another identical polarizer C is placed between A and B. The intensity beyond B is now found to be $\frac{I}{8}$. The angle between polarizer A and C is

(A) $0°$ (B) $30°$
(C) $45°$ (D) $60°$

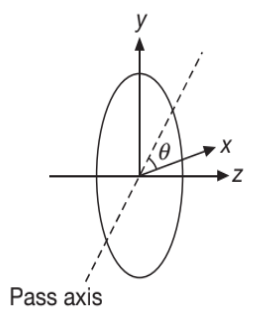
13. [2018]
The angular width of the central maximum in a single slit diffraction pattern is $60°$. The width of the slit is $1\ \mu m$. The slit is illuminated by monochromatic plane waves. If another slit of same width is made near it, Young's fringes can be observed on a screen placed at a distance 50 cm from the slits. If the observed fringe width is 1 cm, what is slit separation distance?
(i.e. distance between the centres of each slit.)

(A) $25\ \mu m$ (B) $50\ \mu m$
(C) $75\ \mu m$ (D) $100\ \mu m$

14. [Online 2018]
Light of wavelength 550 nm falls normally on a slit of width 22.0×10^{-5} cm. The angular position of the second minima from the central maximum will be (in radians)

(A) $\frac{\pi}{8}$ (B) $\frac{\pi}{12}$
(C) $\frac{\pi}{6}$ (D) $\frac{\pi}{4}$

15. [Online 2018]
A plane polarized light is incident on a polariser with its pass axis making angle θ with x-axis, as shown in the figure. At four different values of θ, $\theta = 8°$, $38°$, $188°$ and $218°$, the observed intensities are same. What is the angle between the direction of polarization and x-axis?



(A) $203°$ (B) $128°$
(C) $98°$ (D) $45°$

16. [Online 2018]
Unpolarized light of intensity I is incident on a system of two polarizers, A followed by B. The intensity of emergent light is $\frac{I}{2}$. If a third polarizer C is placed between A and B, the intensity of emergent light is reduced to $\frac{I}{3}$. The angle between the polarizers A and C is θ. Then

(A) $\cos\theta = \left(\frac{1}{3}\right)^{\frac{1}{2}}$ (B) $\cos\theta = \left(\frac{2}{3}\right)^{\frac{1}{4}}$
(C) $\cos\theta = \left(\frac{2}{3}\right)^{\frac{1}{2}}$ (D) $\cos\theta = \left(\frac{1}{3}\right)^{\frac{1}{4}}$

17. [2017]
An observer is moving with half the speed of light towards a stationary microwave source emitting waves at frequency 10 GHz. What is the frequency of the microwave measured by the observer?
(speed of light $= 3\times10^8\ ms^{-1}$)

(A) 10.1 GHz (B) 12.1 GHz
(C) 17.3 GHz (D) 15.3 GHz

18. [2017]
In a Young's double slit experiment, slits are separated by 0.5 mm and the screen is placed 150 cm away. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes on the screen. The least distance from the common central maximum to the point where the bright fringes due to both the wavelengths coincide is

(A) 1.56 mm (B) 7.8 mm
(C) 9.75 mm (D) 15.6 mm

19. [Online 2017]
A single slit of width b is illuminated by a coherent monochromatic light of wavelength λ. If the second and fourth minima in the diffraction pattern at a distance 1 m from the slit are at 3 cm and 6 cm respectively from the central maximum, what is the width of the central maximum? (i.e. distance between first minimum on either side of the central maximum)

(A) 6.0 cm (B) 1.5 cm
(C) 4.5 cm (D) 3.0 cm

20. [Online 2017]
A single slit of width 0.1 mm is illuminated by a parallel beam of light of wavelength 6000 Å and diffraction bands are observed on a screen 0.5 m from the slit. The distance of the third dark band from the central bright band is

(A) 3 mm (B) 1.5 mm
(C) 9 mm (D) 4.5 mm

21. [2016]

The box of a pin hole camera, of length L, has a hole of radius a. It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say b_{min}) when

(A) $a = \frac{\lambda^2}{L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$

(B) $a = \sqrt{\lambda L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$

(C) $a = \sqrt{\lambda L}$ and $b_{min} = \sqrt{4\lambda L}$

(D) $a = \frac{\lambda^2}{L}$ and $b_{min} = \sqrt{4\lambda L}$

22. [Online 2016]

In Young's double slit experiment, the distance between slits and the screen is 1.0 m and monochromatic light of 600 nm is being used. A person standing near the slits is looking at the fringe pattern. When the separation between the slits is varied, the interference pattern disappears for a particular distance d_0 between the slits. If the angular resolution of the eye is $\frac{1^\circ}{60}$, the value of d_0 is close to

(A) 1 mm (B) 3 mm
(C) 2 mm (D) 4 mm

23. [2015]

On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam

(A) bends downwards
(B) bends upwards
(C) becomes narrower
(D) goes horizontally without any deflection

24. [Online 2015]

In a Young's double slit experiment with light of wavelength λ the separation of slits is d and distance of screen is D such that $D \gg d \gg \lambda$. If the fringe width is β, the distance from point of maximum intensity to the point where intensity falls to half of maximum intensity on either side is

(A) $\frac{\beta}{2}$ (B) $\frac{\beta}{4}$
(C) $\frac{\beta}{3}$ (D) $\frac{\beta}{6}$

25. [Online 2015]

Unpolarized light of intensity I_0 is incident on surface of a block of glass at Brewster's angle. In that case, which one of the following statements is true?

(A) Transmitted light is partially polarized with intensity $\frac{I_0}{2}$.
(B) Transmitted light is completely polarized with intensity less than $\frac{I_0}{2}$.
(C) Reflected light is completely polarized with intensity less than $\frac{I_0}{2}$.
(D) Reflected light is partially polarized with intensity $\frac{I_0}{2}$.

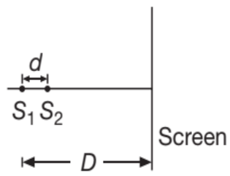
26. [2014]

Two beams, A and B, of plane polarized light with mutually perpendicular planes of polarization are seen through a polaroid. From the position when the beam A has maximum intensity (and beam B has zero intensity), a rotation of polaroid through 30° makes the two beams appear equally bright. If the initial intensities of the two beams are I_A and I_B respectively, then $\frac{I_A}{I_B}$ equals

(A) $\frac{1}{3}$ (B) 3
(C) $\frac{3}{2}$ (D) 1

27. [2013]

Two coherent point sources S_1 and S_2 are separated by a small distance d as shown. The fringes obtained on the screen will be



(A) concentric circles (B) points
(C) straight lines (D) semi-circles

28. [2013]

A beam of unpolarised light of intensity I_0 is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of 45° relative to that of A. The intensity of the emergent light is

(A) $\frac{I_0}{8}$ (B) I_0
(C) $\frac{I_0}{2}$ (D) $\frac{I_0}{4}$

29. [2012]

In Young's double slit experiment, one of the slit is wider than other, so that the amplitude of the light from one slit is double of that from other slit. If I_m be the maximum intensity, the resultant intensity I when they interfere at phase difference ϕ is given by

(A) $\frac{I_m}{3}\left(1+2\cos^2\frac{\phi}{2}\right)$ (B) $\frac{I_m}{5}\left(1+4\cos^2\frac{\phi}{2}\right)$

(C) $\frac{I_m}{9}\left(1+8\cos^2\frac{\phi}{2}\right)$ (D) $\frac{I_m}{9}(4+5\cos\phi)$

30. [2011]

Direction: The question has a paragraph followed by two statements, Statement-1 and Statement-2. Of the given four alternatives after the statements, choose the one that describes the statements.

A thin air film is formed by putting the convex surface of a plane-convex lens over a plane glass plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate) surface of the film.

Statement-1: When light reflects form the air-glass plate interface, the reflected wave suffers a phase change of π.

Statement-2: The centre of the interference pattern is dark.

(A) Statement-I is true, Statement-2 is false.

(B) Statement-1 is true, Statement-2 is true, Statement-2 is the correct explanation of Statement-1.

(C) Statement-1 is true, Statement-2 is true, Statement-2 is not the correct explanation of Statement-1.

(D) Statement-1 is false, Statement-2 is true.

31. [2009]

A mixture of light, consisting of wavelength 590 nm and an unknown wavelength, illuminates Young's double slit and gives rise to two overlapping interference patterns on the screen. The central maximum of both lights coincide. Further, it is observed that the third bright fringe of known light coincides with the 4^{th} bright fringe of the unknown light. From this data, the wavelength of the unknown light is

(A) 393.4 nm (B) 885.0 nm

(C) 442.5 nm (D) 776.8 nm

ARCHIVE: JEE ADVANCED

Single Correct Choice Type Problems

(In this section each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct)

1. [IIT-JEE 2013]

In the Young's double slit experiment using a monochromatic light of wavelength λ, the path difference (in terms of an integer n) corresponding to any point having half the peak intensity is

(A) $(2n+1)\frac{\lambda}{2}$ (B) $(2n+1)\frac{\lambda}{4}$

(C) $(2n+1)\frac{\lambda}{8}$ (D) $(2n+1)\frac{\lambda}{16}$

2. [IIT-JEE 2012]

Young's double slit experiment is carried out by using green, red and blue light, one color at a time. The fringe widths recorded are β_G, β_R and β_B respectively. Then,

(A) $\beta_G > \beta_B > \beta_R$ (B) $\beta_B > \beta_B > \beta_R$

(C) $\beta_R > \beta_B > \beta_G$ (D) $\beta_R > \beta_G > \beta_B$

3. [IIT-JEE 2005]

In Young's double slit experiment intensity at a point is $\left(\frac{1}{4}\right)$ of the maximum intensity. Angular position of this point is

(A) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ (B) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

(C) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$ (D) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

4. [IIT-JEE 2004]

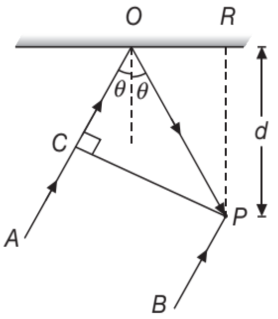
In *YDSE* bi-chromatic light of wavelengths 400 nm and 560 nm are used. The distance between the slits is 0.1 mm and the distance between the plane of the slits and the screen is 1 m. The minimum distance between two successive regions of complete darkness is

(A) 4 mm (B) 5.6 mm

(C) 14 mm (D) 28 mm

5. [IIT-JEE 2003]

In the diagram, CP represent a wavefront and AO and BP, the corresponding two rays. Find the condition on θ for constructive interference at P between the ray BP and reflected ray OP



(A) $\cos\theta = \frac{3\lambda}{2d}$ (B) $\cos\theta = \frac{\lambda}{4d}$

(C) $\sec\theta - \cos\theta = \frac{\lambda}{d}$ (D) $\sec\theta - \cos\theta = \frac{4\lambda}{d}$

6. **[IIT-JEE 2002]**
In the ideal double-slit experiment, when a glass-plate (refractive index 1.5) of thickness t is introduced in the path of one of the interfering beams (wavelength λ), the intensity at the position where the central maximum occurred previously remains unchanged. The minimum thickness of the glass-plate is

(A) 2λ (B) $\frac{2\lambda}{3}$

(C) $\frac{\lambda}{3}$ (D) λ

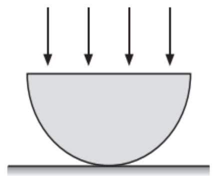
7. **[IIT-JEE 2001]**
In a Young's double slit experiment, 12 fringes are observed to be formed in a certain segment of the screen when light of wavelength 600 nm is used. If the wavelength of light is changed to 400 nm, number of fringes observed in the same segment of the screen is given by
(A) 12 (B) 18
(C) 24 (D) 30

8. **[IIT-JEE 2001]**
Two beams of light having intensities I and $4I$ interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\frac{\pi}{2}$ at point A and π at point B. Then the difference between resultant intensities at A and B is
(A) $2I$ (B) $4I$
(C) $5I$ (D) $7I$

9. **[IIT-JEE 2000]**
In a double slit experiment instead of taking slits of equal widths, one slit is made twice as wide as the other, then in the interference pattern
(A) the intensities of both the maxima and the minima increases
(B) the intensity of the maxima increases and the minima has zero intensity
(C) the intensity of maxima decreases and that of minima increases
(D) the intensity of maxima decreases and the minima has zero intensity

10. **[IIT-JEE 1999]**
Yellow light is used in a single slit diffraction experiment with slit width of 0.6 mm. If yellow light is replaced by X-rays, then the observed pattern will reveal
(A) that the central maximum is narrower
(B) more number of fringes
(C) less number of fringes
(D) no diffraction pattern

11. **[IIT-JEE 1999]**
A thin slice is cut out of a glass cylinder along a plane parallel to its axis. The slice is placed on a flat plate as shown. The observed interference fringes from this combination shall be



(A) straight
(B) circular
(C) equally spaced
(D) having fringe spacing which increases as we go outwards

12. **[IIT-JEE 1998]**
A parallel monochromatic beam of light is incident normally on a narrow slit. A diffraction pattern is formed on a screen placed perpendicular to the direction of the incident beam. At the first minimum of the diffraction pattern, the phase difference between the rays coming from the two edges of the slit is

(A) ZERO (B) $\frac{\pi}{2}$

(C) π (D) 2π

13. **[IIT-JEE 1995]**
Consider Fraunhoffer diffraction pattern obtained with a single slit illuminated at normal incidence. At the angular position of the first diffraction minimum the phase difference (in radian) between the wavelets from the opposite edges of the slit is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$

(C) 2π (D) π

14. [IIT-JEE 1994]
A narrow slit of width 1 mm is illuminated by monochromatic light of wavelength 600 nm. The distance between the first minima on either side of a screen at a distance of 2 m is

(A) 1.2 cm (B) 1.2 mm

(C) 2.4 cm (D) 2.4 mm

15. [IIT-JEE 1988]
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 $3I$

16. [IIT-JEE 1981]
In Young's double slit experiment, the separation between the slits is halved and the distance between the slits and the screen is doubled. The fringe width is

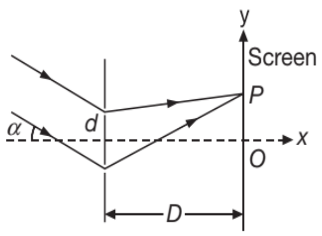
(A) unchanged (B) halved

(C) doubled (D) quadrupled

Multiple Correct Choice Type Problems

(In this section each question has four choices (A), (B), (C) and (D), out of which ONE OR MORE is/are correct)

1. [JEE (Advanced) 2019]
In a Young's double slit experiment, the slit separation d is 0.3 mm and the screen distance D is 1 m. A parallel beam of light of wavelength 600 nm is incident on the slits at angle α as shown in figure. On the screen, the point O is equidistant from the slits and distance PO is 11 mm. Which of the following statement(s) is/are correct?



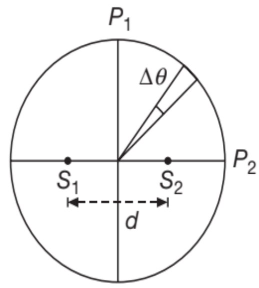
(A) For $\alpha = \frac{0.36}{\pi}$ degree, there will be destructive interference at point P.

(B) Fringe spacing depends on.

(C) For $\alpha = 0$, there will be constructive interference at point P.

(D) For $\alpha = \frac{0.36}{\pi}$ degree, there will be destructive interference at point O.

2. [JEE (Advanced) 2017]
Two coherent monochromatic point sources S_1 and S_2 of wavelength $\lambda = 600$ nm are placed symmetrically on either side of the centre of the circle as shown. The sources are separated by a distance $d = 1.8$ mm. This arrangement produces interference fringes visible as alternate bright and dark spots on the circumference of the circle. The angular separation between two consecutive bright spots is $\Delta\theta$. Which of the following options is/are correct?



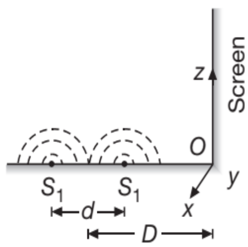
(A) The angular separation between two consecutive bright spots decreases as we move from P_1 to P_2 along the first quadrant

(B) A dark spot will be formed at the point P_2

(C) The total number of fringes produced between P_1 and P_2 in the first quadrant is close to 3000

(D) At P_2 the order of the fringe will be maximum

3. [JEE (Advanced) 2016]
While conducting the Young's double slit experiment, a student replaced the two slits with a large opaque plate in the x-y plane containing two small holes that act as two coherent point sources (S_1, S_2) emitting light of wavelength 600 mm. The student mistakenly placed the screen parallel to the x-z plane (for $z > 0$) at a distance $D = 3$ m from the mid-point of S_1S_2, as shown schematically in the figure. The distance between the source $d = 0.6003$ mm. The origin O is at the intersection of the screen and the line joining S_1S_2.



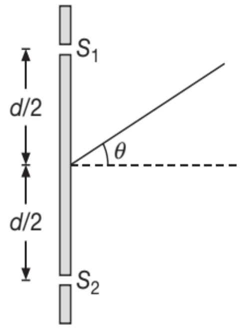
Which of the following is (are) true of the intensity pattern on the screen?
(A) Semi circular bright and dark bands centered at point O
(B) The region very close to the point O will be dark
(C) Straight bright and dark bands parallel to the X-axis
(D) Hyperbolic bright and dark bands with foci symmetrically placed about O in the x-direction

4. **[JEE (Advanced) 2014]**
A light source, which emits two wavelengths $\lambda_1 = 400$ nm and $\lambda_2 = 600$ nm, is used in a Young's double-slit experiment. If recorded fringe width for λ_1 and λ_2 are β_1 and β_2 and the number of fringes for them within a distance y on one side of the central maximum are m_1 and m_2, respectively, then
(A) $\beta_2 > \beta_1$
(B) $m_1 > m_2$
(C) from the central maximum, 3rd maximum of λ_2 overlaps with 5th minimum of λ_1
(D) the angular separation of fringes of λ_1 is greater than λ_2

5. **[JEE (Advanced) 2013]**
Using the expression $2d\sin\theta = \lambda$, one calculates the values of d by measuring the corresponding angles θ in the range 0 to 90°. The wavelength λ is exactly known and the error in θ is constant for all values of θ. As θ increases from 0°
(A) the absolute error in d remains constant
(B) the absolute error in d increases
(C) the fractional error in d remains constant
(D) the fractional error in d decreases

6. **[IIT-JEE 2008]**
In a Young's double slit experiment, the separation between the two slits is d and the wavelength of the light is λ. The intensity of light falling on slit 1 is four times the intensity of light falling on slit 2. Choose the correct choice(s).
(A) If $d = \lambda$, the screen will contain only one maximum.
(B) If $\lambda < d < 2\lambda$, at least one more maximum (besides the central maximum) will be observed on the screen.
(C) If the intensity of light falling on slit 1 is reduced so that it becomes equal to that of slit 2, the intensities of the observed dark and bright fringes will increase.
(D) If the intensity of light falling on slit 2 is increased so that it becomes equal to that of slit 1, the intensities of the observed dark and bright fringes will increase.

7. **[IIT-JEE 1995]**
In an interference arrangement similar to Young's double-slit experiment, the slits S_1 and S_2 are illuminated with coherent microwave sources, each of frequency 10^6 Hz. The sources are synchronized to have zero phase difference. The slits are separated by a distance $d = 150.0$ m. The intensity $I(\theta)$ is measured as a function of θ, where θ is defined as shown. If I_0 is the maximum intensity, then $I(\theta)$ for $0 \le \theta \le 90^\circ$ is given by



(A) $I(\theta) = \frac{I_0}{2}$ for $\theta = 30^\circ$
(B) $I(\theta) = \frac{I_0}{4}$ for $\theta = 90^\circ$
(C) $I(\theta) = I_0$ for $\theta = 0^\circ$
(D) $I(\theta)$ is constant for all values of θ

8. **[IIT-JEE 1984]**
White light is used to illuminate the two slits in a Young's double-slit experiment. The separation between the slits is b and the screen is at a distance $d(\gg b)$ from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing. Some of these missing wavelengths are
(A) $\lambda = \frac{b^2}{d}$ (B) $\lambda = \frac{2b^2}{d}$
(C) $\lambda = \frac{b^2}{3d}$ (D) $\lambda = \frac{2b^2}{3d}$

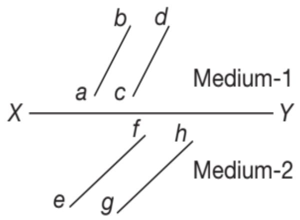
9. **[IIT-JEE 1982]**
In the Young's double slit experiment, the interference pattern is found to have an intensity ratio between bright and dark fringes as 9. This implies that -
(A) the intensities at the screen due to the two slits are 5 units and 4 units respectively
(B) the intensities at the screen due to the two slits can be 4 units and 1 unit respectively
(C) the amplitude ratio is 3
(D) the amplitude ratio is 2

Comprehension Type Questions

This section contains Linked Comprehension Type Questions or Paragraph based Questions. Each set consists of a Paragraph followed by questions. Each question has four choices (A), (B), (C) and (D), out of which only one is correct. (For the sake of competitiveness there may be a few questions that may have more than one correct options)

Comprehension I

The figure shows a surface XY separating two transparent media, Medium-1 and Medium-2. The lines ab and cd represent wavefronts of a light wave travelling in Medium-1 and incident on XY. The lines ef and gh represent wavefronts of the light wave in Medium-2 after refraction.



Based on the above facts, answer the following questions.

1. **[IIT-JEE 2007]**
Light travels as a
(A) parallel beam in each medium
(B) convergent beam in each medium
(C) divergent beam in each medium
(D) divergent beam in one medium and convergent beam in the other medium

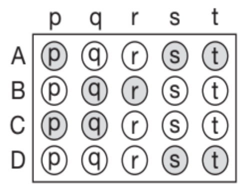
2. **[IIT-JEE 2007]**
The phases of the light wave at c, d, e and f are ϕ_c, ϕ_d, ϕ_e and ϕ_f respectively. It is given that $\phi_c \neq \phi_f$
(A) ϕ_c cannot be equal to ϕ_d
(B) ϕ_d can be equal to ϕ_e
(C) $(\phi_d - \phi_f)$ is equal to $(\phi_c - \phi_e)$
(D) $(\phi_d - \phi_c)$ is not equal to $(\phi_f - \phi_e)$

3. **[IIT-JEE 2007]**
Speed of light is:
(A) the same in medium-1 and medium-2
(B) larger in medium-1 than in medium-2
(C) larger in medium-2 than in medium-1
(D) different at b and d

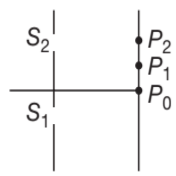
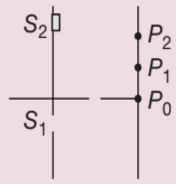
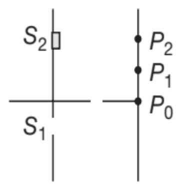
Matrix Match/Column Match Type Questions

Each question in this section contains statements given in two columns, which have to be matched. The statements in **COLUMN-I** are labelled A, B, C and D, while the statements in **COLUMN-II** are labelled p, q, r, s (and t). Any given statement in **COLUMN-I** can have correct matching with **ONE OR MORE** statement(s) in **COLUMN-II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following examples:

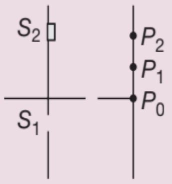
If the correct matches are A → p, s and t; B → q and r; C → p and q; and D → s and t; then the correct darkening of bubbles will look like the following:



1. **[IIT-JEE 2009]**
COLUMN I shows four situations of standard Young's double slit arrangement with the screen placed far away from the slits S_1 and S_2. In each of these cases $S_1P_0 = S_2P_0$, $S_1P_1 - S_2P_1 = \frac{\lambda}{4}$ and $S_1P_2 - S_2P_2 = \frac{\lambda}{2}$ when λ is the wavelength of the light used. In the cases B, C and D, a transparent sheet of refractive index μ and thickness t is pasted on slit S_2. The thickness of the sheets are different in different cases. The phase difference between the light waves reaching a point P on the screen from the two slits is denoted by $\delta(P)$ and the intensity by $I(P)$. Match each situation given in **COLUMN-I** with the statement(s) in **COLUMN-II** valid for that situation.

COLUMN-I	COLUMN-II
A. 	p. $\delta(P_0) = 0$
B. $(\mu - 1)t = \frac{\lambda}{4}$ 	q. $\delta(P_1) = 0$
C. $(\mu - 1)t = \frac{\lambda}{2}$ 	r. $I(P_1) = 0$

(Continued)

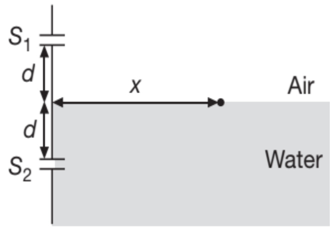
COLUMN-I	COLUMN-II
D. $(\mu-1)t=\dfrac{3\lambda}{4}$ 	s. $I(P_0)>I(P_1)$
	t. $I(P_2)>I(P_1)$

Integer/Numerical Answer Type Questions

In this section, the answer to each question is a numerical value obtained after series of calculations based on the data provided in the question(s).

1. [JEE (Advanced) 2015]

A Young's double slit interference arrangement with slits S_1 and S_2 is immersed in water (refractive index $\frac{4}{3}$) as shown in the figure. The positions of maxima on the surface of water are given by $x^2 = p^2m^2\lambda^2 - d^2$, where λ is the wavelength of light in air (refractive index $=1$), $2d$ is the separation between the slits and m is an integer. The value of p is



ANSWER KEYS–TEST YOUR CONCEPTS AND PRACTICE EXERCISES

Test Your Concepts-I (Based on Interference)

1. (a) 7.8 μm (b) 0.6 mm
2. 5 μm
3. (a) $\dfrac{2\pi}{\lambda}\left[\left(\sqrt{d^2+\ell^2}-d\right)+\dfrac{\mu d^2}{2D}\right]$
   (b) $\dfrac{2\pi}{\lambda}\left(\mu\left(\sqrt{d^2+\ell^2}-\ell\right)+\dfrac{d^2}{2D}\right)$
4. 94.8 nm
5. 0.546 mm
6. 112.78 nm
7. (a) 0.5 mm (b) 2.25 mm
   (c) $3I_0$ (d) $\dfrac{1}{\sqrt{3}}$ meter
   (e) $n = 5000$ is not possible
8. (a) $\dfrac{5\pi}{2}$
   (b) $\dfrac{25\pi}{4}$
9. 5890 Å
10. 1.2 μm
11. Zero order maxima will remain unchanged. Tenth order will now be at 4.55 mm.
12. 8.75 mm
14. 4.5 mm
15. 7
16. 0.21
17. (a) $3\times10^{-4}I_0$ (b) 5.49
18. 3.5 mm
19. 1.5

Test Your Concepts-II (Based on Diffraction)

1. 11.8 mm
2. 9×10^{-4} m
3. 0.2 mm
4. 40 m
5. 12.5 cm
6. 1.3 μm
7. 0.2 mm
8. 3.534×10^{-3} rad
9. 10^{-6} m, 5×10^{-7} m
10. (a) 8.54×10^{-4} radian (b) 1.823×10^{-15} m^2
    (c) 10.97×10^{12} Wm^{-2}

Test Your Concepts-III (Based on Polarisation)

1. $\pm45°$, $\pm135°$
2. (a) 0.75 (b) 0.25
3. 37.5%
4. $\dfrac{I_0}{4}$
5. 1 : 3
7. 30°, 45°
8. 59°, 31°
9. (a) 2.136×10^{-5} m (b) 2.762×10^{-5} m
10. 60° cm^{3}g^{-1}(dm)$^{-1}$
11. 7.5 cm

Single Correct Choice Type Questions

1. B	2. A	3. A	4. B	5. B	6. D	7. D	8. D	9. B	10. A
11. D	12. D	13. A	14. C	15. D	16. B	17. C	18. D	19. D	20. B
21. B	22. C	23. C	24. D	25. C	26. B	27. D	28. A	29. C	30. D
31. C	32. D	33. A	34. A	35. A	36. A	37. A	38. C	39. A	40. C
41. A	42. B	43. A	44. A	45. D	46. D	47. C	48. C	49. C	50. B
51. B	52. A	53. C	54. C	55. D	56. B	57. B	58. C	59. B	60. C

61. D	**62.** B	**63.** A	**64.** B	**65.** B	**66.** A	**67.** D	**68.** B	**69.** D	**70.** B
71. D	**72.** C	**73.** D	**74.** C	**75.** B	**76.** B	**77.** C	**78.** B	**79.** A	**80.** C
81. C	**82.** C	**83.** C	**84.** A	**85.** B	**86.** A	**87.** B	**88.** C	**89.** A	**90.** B
91. B	**92.** D	**93.** C	**94.** A	**95.** B	**96.** B	**97.** B	**98.** B	**99.** C	**100.** A
101. B	**102.** C	**103.** B	**104.** D	**105.** C	**106.** B	**107.** C	**108.** D	**109.** D	**110.** D
111. A	**112.** D	**113.** A	**114.** A	**115.** D	**116.** D	**117.** D	**118.** B	**119.** C	**120.** D
121. C	**122.** B	**123.** A	**124.** B	**125.** C	**126.** D	**127.** A	**128.** C	**129.** B	**130.** C
131. A	**132.** A	**133.** D	**134.** A	**135.** C	**136.** B	**137.** B	**138.** A	**139.** A	**140.** D
141. A	**142.** C	**143.** B	**144.** A	**145.** B	**146.** B	**147.** C	**148.** A	**149.** C	**150.** B
151. D	**152.** D	**153.** D	**154.** A	**155.** C	**156.** C	**157.** D	**158.** D	**159.** B	**160.** B
161. B	**162.** A	**163.** B	**164.** A	**165.** D	**166.** B	**167.** D	**168.** D	**169.** D	**170.** C
171. C	**172.** B	**173.** B	**174.** C	**175.** C	**176.** D	**177.** D	**178.** C	**179.** B	**180.** A
181. C	**182.** A	**183.** C	**184.** D	**185.** B	**186.** C	**187.** A	**188.** B	**189.** C	**190.** B
191. A	**192.** B	**193.** C	**194.** D						

Multiple Correct Choice Type Questions

1. A, C	**2.** A, C, D	**3.** A, D	**4.** B, D	**5.** B, D
6. A, B, C	**7.** A, B, C	**8.** A, C	**9.** A, B	**10.** A, C, D
11. A, C	**12.** A, B, C	**13.** B, D	**14.** A	**15.** C
16. A, B				

Reasoning Based Questions

1. B	**2.** D	**3.** D	**4.** B	**5.** D	**6.** A	**7.** D	**8.** D	**9.** D	**10.** A
11. A	**12.** D	**13.** B	**14.** D	**15.** A	**16.** C	**17.** D	**18.** D	**19.** A	**20.** A
21. A									

Linked Comprehension Type Questions

1. A	**2.** D	**3.** B	**4.** A	**5.** A	**6.** A	**7.** C	**8.** A	**9.** A	**10.** B
11. C	**12.** D	**13.** C	**14.** C	**15.** D	**16.** D	**17.** A	**18.** B	**19.** B	**20.** B
21. B	**22.** C	**23.** D	**24.** B	**25.** A	**26.** C	**27.** A	**28.** B	**29.** D	**30.** C
31. C	**32.** D	**33.** D	**34.** C	**35.** C	**36.** B	**37.** A	**38.** D	**39.** C	**40.** A
41. B	**42.** C	**43.** D	**44.** C	**45.** C	**46.** C	**47.** D	**48.** D	**49.** A	**50.** B
51. D	**52.** B	**53.** B	**54.** D	**55.** C	**56.** B	**57.** B	**58.** A	**59.** D	**60.** A
61. A	**62.** A	**63.** B	**64.** A	**65.** C	**66.** D				

Matrix Match/Column Match Type Questions

1. A → (p, s)	B → (q, r)	C → (p, q, r)	D → (q, r, s)
2. A → (p, q)	B → (s)	C → (p, q)	D → (r)
3. A → (q)	B → (p)	C → (s)	D → (r)
4. A → (r)	B → (s)	C → (q)	D → (p)
5. A → (p)	B → (s)	C → (r)	D → (q, r)

6. A → (r)	B → (t)	C → (r)	D → (p)
7. A → (p)	B → (s)	C → (r)	D → (q)
8. A → (p, q, r, s)	B → (p, q, r, s)	C → (p, q, r, s)	D → (p, q, r)
9. A → (q, r)	B → (q, s)	C → (p, s)	D → (p, q, r, s)

Integer/Numerical Answer Type Questions

1. 3	**2.** 32	**3.** (a) 45, (b) 59	**4.** (a) 80, (b) 4, (c) 60	**5.** 361
6. 739	**7.** 6	**8.** 3	**9.** 36	**10.** 2
11. 100	**12.** 3	**13.** 18	**14.** 3	**15.** 2
16. 2				

ARCHIVE: JEE MAIN

1. A	**2.** B	**3.** D	**4.** D	**5.** C	**6.** A	**7.** D	**8.** B	**9.** A	**10.** D
11. D	**12.** C	**13.** A	**14.** C	**15.** A	**16.** B	**17.** C	**18.** B	**19.** D	**20.** C
21. C	**22.** C	**23.** B	**24.** B	**25.** C	**26.** A	**27.** A	**28.** D	**29.** C	**30.** C
31. C									

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Single Correct Choice Type Problems

1. B	**2.** D	**3.** C	**4.** D	**5.** B	**6.** A	**7.** B	**8.** B	**9.** A	**10.** D
11. A	**12.** D	**13.** C	**14.** D	**15.** C	**16.** D				

Multiple Correct Choice Type Problems

1. A	**2.** C, D	**3.** A, B	**4.** A, C	**5.** D
6. A, B	**7.** A, C	**8.** A, C	**9.** B, D	

Comprehension Type Questions

1. A	**2.** C	**3.** B

Matrix Match/Column Match Type Questions

1. A → (p, s)	B → (q)	C → (t)	D → (r, s, t)

Integer/Numerical Answer Type Questions

1. 3