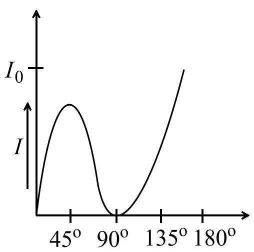
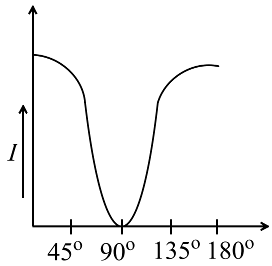
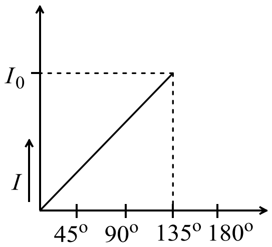
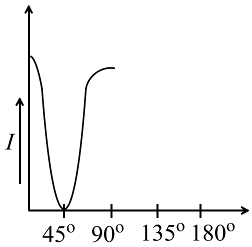
Single Correct Answer Type

1. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is
   a) Hyperbola b) Circle c) Straight line d) Parabola
2. Due to Doppler's effect, the shift in wavelength observed is 0.1Å for a star producing wavelength 6000Å. Velocity of recession of the star will be
   a) 2.5 km/s b) 10 km/s c) 5 km/s d) 20 km/s
3. The graph showing the dependence of intensity of transmitted light on the angle between polarizer and analyser, is
   a) 

   b) 

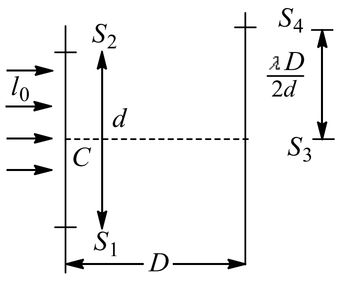
   c) 

   d) 

4. The idea of secondary wavelets for the propagation of a wave was first given by
   a) Newton b) Huygen c) Maxwell d) Fresnel
5. A ray of light is incident at polarising angle such that its deviation is 24°, then angle of incidence is
   a) 24° b) 57° c) 66° d) 90°
6. If a source is transmitting electromagnetic wave of frequency $8.2 \times 10^6 Hz$, then wavelength of the electromagnetic waves transmitted from the source will be
   a) 36.6 m b) 40.5 m c) 42.3 m d) 50.9 m
7. Light of wavelength λ is incident on a slit of width$d$. The resulting diffraction pattern is observed on a screen at a distance$D$. The linear width of the principal maximum is equal to the width of the slit, if D equals
   a) $\frac{d^2}{2\lambda}$ b) $\frac{d}{\lambda}$ c) $\frac{2\lambda^2}{d}$ d) $\frac{2\lambda}{d}$
8. In Young's double slit experiment, the central bright fringe can be identified
   a) As it has greater intensity than the other bright fringes
   b) As it is wider than the other bright fringes
   c) As it is narrower than the other bright fringes
   d) By using white light instead of monochromatic light
9. Yellow light is used in single slit diffraction experiment with slit width 0.6 mm. If yellow light is replaced by X- rays then the pattern will reveal
   a) That the central maxima is narrower b) No diffraction pattern
   c) More number of fringes d) Less number of fringes
10. The wavelength of the matter waves is independent of
   a) Charge b) Momentum c) Velocity d) Mass
11. In Young's double slit experiment, first slit has width four times the width of the second slit. The ratio of the maximum intensity to the minimum intensity in the interference fringe system is
   a) 2 : 1 b) 4 : 1 c) 9 : 1 d) 8 : 1
12. A very thin film that reflects white light appears
   a) Coloured b) White c) Black d) Red
13. What is the minimum thickness of a thin film required for constructive interference in the reflected light from it?
   Given, the refractive index of the film = 1.5
   Wavelength of the light incident on the film = 60nm

a) 100 nm b) 300 nm c) 50 nm d) 200 nm

14. Two light sources are said to be coherent if they are obtained from
    a) Two independent point sources emitting light of the same wavelength
    b) A single point source
    c) A wide source
    d) Two ordinary bulbs emitting light of different wavelengths
15. 80 g of impure sugar when dissolved in a litre of water given an optical rotation of9.9°, when placed in a tube of length 20 cm. If the specific rotation of sugar is 66°, then concentration of sugar solution will be
    a) 80 gL^{-1} b) 75 gL^{-1} c) 65 gL^{-1} d) 50 gL^{-1}
16. Select the right option in the following
    a) Christian Huygens, a contemporary of Newton established the wave theory of light by assuming that light waves were transverse
    b) Maxwell provided the theoretical evidence that light is transverse wave
    c) Thomas Young experimentally proved the wave behavior of light and Huygens assumption
    d) All the statements given above, correctly answers the question "what is light?"
17. The oscillating electric and magnetic vectors of an electromagnetic wave are oriented along
    a) The same direction but differ in phase by 90°
    b) The same direction and are in phase
    c) Mutually perpendicular directions and are in phase
    d) Mutually perpendicular directions and differ in phase by 90°
18. H-polaroid is prepared by
    a) Orienting herapathite crystal in the same direction in nitrocellulose
    b) Using thin tourmaline crystals
    c) Stretching polyvinyl alcohol and then heated with dehydration agent
    d) Stretching polyvinyl alcohol and then impregnation with iodine
19. In a double slit experiment, the distance between slits is increased 10 times whereas their distance from screen is halved, then what is the fringe width?
    a) It remains same b) Becomes 1/10 c) Becomes 1/20 d) Becomes 1/90
20. Consider Fraunhofer diffraction pattern obtained with a single slit at normal incidence. At the angular position of first diffraction minimum, the phase difference between the wavelets from the opposite edges of the slit is
    a) $\frac{\pi}{4}$ b) $\frac{\pi}{2}$ c) π d) 2π
21. Two slits separated by a distance of 1 mm are illuminated with red light of wavelength 6.5×10^{-7} m. the interference fringes are observed on a screen place 1 m from the slits. The distance between the third dark fringe and the fifth bright fringe is equal to
    a) 0.65 mm b) 1.63 mm c) 3.25 mm d) 4.88 mm
22. In the given figure, C is middle point of lineS_1S_2. A monochromatic light of wavelength λ is incident on slits. The ratio intensity of S_3 and S_4 is

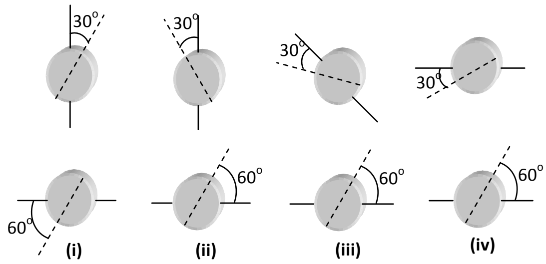


    a) Zero b) ∞ c) 4:1 d) 1:4
23. When a thin transparent plate of thickness t and refractive index μ is placed in the path of one of the two interfering waves of light, then the path difference changes by
    a) $(\mu + 1)t$ b) $(\mu - 1)t$ c) $\frac{(\mu + 1)}{t}$ d) $\frac{(\mu - 1)}{t}$

24. For the constructive interference the path difference between the two interfering waves must be equal to

a) $(2n+1)\lambda$ b) $2n\pi$ c) $n\lambda$ d) $(2n+1)\frac{\lambda}{2}$

25. The figure shows four pairs of polarizing sheets, seen face-on. Each pair is mounted in the path of initially unpolarised light. The polarizing direction of each sheet (indicated by the dashed line) is referenced to either a horizontal x-axis or a vertical y axis. Rank the pair according to the fraction of the initial intensity that they pass, greatest first



a) (i) > (ii) > (iii) > (iv)
b) (i) > (iv) > (ii) > (iii)
c) (i) > (iii) > (ii) > (iv)
d) (iv) > (iii) > (ii) > (i)

26. Which of the following is electromagnetic wave

a) X-rays and light waves b) Cosmic rays and sound waves
c) Beta rays and sound waves d) Alpha rays and sound waves

27. In Young's double slit experiment, carried out with light of wavelength $\lambda = 5000$ 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 (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

28. The region of the atmosphere above troposphere is known as

a) Lithosphere b) Uppersphere c) Ionosphere d) Stratosphere

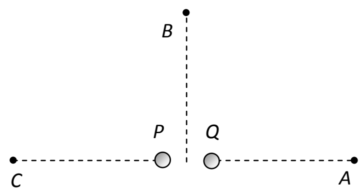
29. when monochromatic light is replaced by white light in Fresnel's biprism arrangement, the central fringe is

a) Coloured b) White c) Dark d) None of these

30. The ratio of intensities of successive maxima in the diffraction pattern due to the single slit is

a) 1:4:9 b) 1:2:3 c) $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$ d) $1:\frac{4}{\pi^2}:\frac{9}{\pi^2}$

31. Figure here shows P and Q as two equally intense coherent sources emitting radiations of wavelength 20 m. The separation PQ is 5.0 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

32. A rocket is going towards moon with a speed v. The astronaut in the rocket sends signals of frequency v 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) $\frac{c}{c-v}v$ b) $\frac{c}{c-2v}v$ c) $\frac{2v}{c}v$ d) $\frac{2c}{v}v$

33. A beam of plane polarized light falls normally on a polarizer of cross sectional area $3 \times 10^{-4} m^2$. Flux of energy of incident ray in $10^{-3} W$. The polarizer rotates with an angular frequency of 31.4 rad/s. 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) $10^{-1} Joule$

34. A signal emitted by an antenna from a certain point can be received at another point of the surface in the form of

a) Sky wave b) Ground wave c) Sea wave d) Both (a) and (b)

35. In Young's double slit experiment with monochromatic light of wavelength 600 mm, the distance between slits is 10^{-3} m. For changing fringe width by 3×10^{-5} m

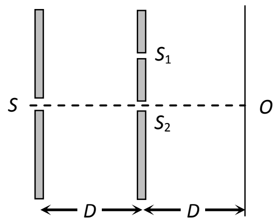
a) The screen is moved away from the slits by 5 cm

b) The screen is moved by 5 cm towards the slits

c) The screen is moved by 3 cm towards the slits

d) Both (a) and (b) are correct

36. 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) $\sqrt{3\lambda D}$

37. Which one of the following phenomena is not explained by Huygen's construction of wavefront

a) Refraction b) Reflection c) Diffraction d) Origin of spectra

38. A star is going away from the earth. An observer on the earth will see the wavelength of light coming from the star

a) Decreased

b) Increased

c) Neither decreased nor increased

d) Decreased or increased depending upon the velocity of the star

39. In the diffraction pattern of a straight slit

a) All bands are uniformly bright b) All bands are uniformly wide

c) Central band is narrower d) Central band is wider

40. Light of wavelength 6000 Å is incident on a single slit. The first minimum of the diffraction pattern is obtained at 4 mm from the centre. The screen is at a distance of 2 m from the slit. The slit width will be

a) 0.3 mm b) 0.2 mm c) 0.15 mm d) 0.1 mm

41. Which of the following is a dich roic crystal?

a) Quartz b) Tourmaline c) Mica d) Selenite

42. In order to see diffraction the thickness of the film is

a) 100 Å b) 10,000 Å c) 1 mm d) 1 cm

43. Specific rotation of sugar solution is 0.5 deg m^2k/g. 200 kgm^{-3} of impure sugar solution is taken in a sample polarimeter tube of length 20 cm and optical rotation is found to be 19°. The percentage of purity of sugar is

a) 20% b) 80% c) 95% d) 89%

44. The angle of polarization for any medium is 60°, what will be critical angle for this

a) $\sin^{-1}\sqrt{3}$ b) $\tan^{-1}\sqrt{3}$ c) $\cos^{-1}\sqrt{3}$ d) $\sin^{-1}\frac{1}{\sqrt{3}}$

45. Unpolarized light of intensity $32 Wm^{-2}$ passes through three polarizers such that transmission axes of the first and second polarizer makes an angle 30° with each other and the transmission axis of the last polarizer is crossed with that of the first. The intensity of final emerging light will be

a) $32\ Wm^{-2}$ b) $3\ Wm^{-2}$ c) $8\ Wm^{-2}$ d) $4\ Wm^{-2}$

46. If two waves represented by $y_1 = 4\sin\omega t$ and $y_2 = 3\sin\left(\omega t + \frac{\pi}{3}\right)$ interfere at a point, the amplitude of the resulting wave will be about

a) 7 b) 6 c) 5 d) 3.5

47. In single slit diffraction pattern

a) Central fringe has negligible width than others

b) All fringes are of same width

c) Central fringes do not exist

d) None of the above

48. In Young's double-slit experiment the fringe width is β. If entire arrangement is placed in a liquid of refractive index n, the fringe width becomes

a) $\frac{\beta}{n+1}$ b) $n\beta$ c) $\frac{\beta}{n}$ d) $\frac{\beta}{n-1}$

49. In Young's double slit experiment, phase difference between light waves reaching 3rd bright fringe from the central fringe when $\lambda = 5000$ Åis

a) $6\,\pi$ b) $2\,\pi$ c) $4\,\pi$ d) zero

50. Direction of the first secondary maximum in the Fraunhoffer diffraction pattern at a single slit is given by (a is the width of the slit)

a) $a\sin\theta = \frac{\lambda}{2}$ b) $a\cos\theta = \frac{3\lambda}{2}$ c) $a\sin\theta = \lambda$ d) $a\sin\theta = \frac{3\lambda}{2}$

51. In the Young's double slit experiment, a mica slip of thickness t and refractive index μ is introduced in the ray from first sourceS_1. By how much distance fringes pattern will be displaced.

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

52. In Young's double slit experiment, the wavelength of the light used is doubled and distance between two slits is half of initial distance, the resultant fringe width becomes

a) 2 *times* b) 3 *times* c) 4 *times* d) 1/2 *times*

53. If a torch is used in place of monochromatic light in Young's experiment what will happen

a) Fringe will appear for a moment then it will disappear

b) Fringes will occur as from monochromatic light

c) Only bright fringes will appear

d) No fringes will appear

54. The angular resolution of a 10 cm diameter telescope at a wavelength of 5000Å is of the order of

a) 10^6 rad b) 10^{-2} rad c) 10^{-4} rad d) 10^{-6} rad

55. What should be refractive index of a transparent medium to be invisible in vacuum?

a) 1 b) <1 c) >1 d) None of these

56. In Young's double slit experiment, the distance between the two slits is made half, then the fringe width will become

a) Half b) Double c) One fourth d) Unchanged

57. The maximum intensity in the case if n identical incoherent waves, each of intensity 2 Wm^{-2} is 32Wm^{-2}. The value of n is

a) 4 b) 16 c) 32 d) 64

58. According to corpuscular theory of light, the different colours of light are due to

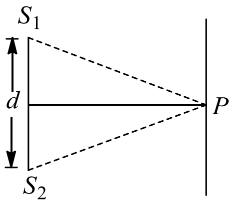
a) Different electromagnetic waves b) Different force of attraction among the corpuscles

c) Different size of the corpuscles d) None of the above

59. A beam of unpolarized light having flux 10^{-3} W falls normally on a polarizer of cross sectional area $3 \times 10^{-4}\ m^2$. The polarizer rotates with an angular frequency of 31.4 rads^{-1}. The energy of light passing through the polarizer per revolution will be

a) 10^{-4} J b) 10^{-3} J c) 10^{-2} J d) 10^{-1} J

60. In the given arrangement, S_1 and S_2 are coherent sources (shown in figure). The point P is a point of



a) Bright fringe b) Dark fringe c) Either dark or light d) None of the above

61. 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

62. In a double slit interference experiment, the distance between the slits is 0.05 cm and screen is 2 m away from the slits. The wavelength of light is 8.0×10^{-5} cm. The distance between successive fringes is
a) 0.24 cm b) 3.2 cm c) 1.28 cm d) 0.32 cm

63. Unpolarised light falls on two polarizing sheets placed one on top of the other. What must be the angle between the characteristic directions of the sheets if the intensity of the final transmitted light is one-third the maximum intensity of the first transmitted beam
a) 75° b) 55° c) 35° d) 15°

64. Consider the following statements A and B and identify the correct answer.
A. Fresnel's diffraction pattern occurs when the source of light or the screen on which the diffraction pattern is seen or when both are at finite distance from the aperture.
B. Diffracted light can be used to estimate the helical structure of nucleic acids.
a) A and B are true b) A and B are false
c) A is true but B is false d) A is false but B is true

65. In Young's double slit experiment, the slits are 3 mm apart. The wavelength of light used is 5000 Å and the distance between the slits and the screen is 90 cm. The fringe width in 9 (mm) is
a) 1.5 b) 0.015 c) 2.0 d) 0.15

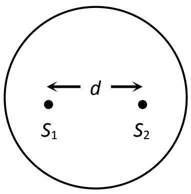
66. The magnetic field amplitude of an electromagnetic wave is $2 \times 10^{-7} T$. It's electric field amplitude if the wave is travelling in free space is :
a) $6Vm^{-1}$ b) $60Vm^{-1}$ c) $10/6Vm^{-1}$ d) None of these

67. The velocity of a moving galaxy is 300 $km\ s^{-1}$ and the apparent change in wavelength of a spectral line emitted from the galaxy is observed as 0.5 nm. Then, the actual wavelength of the spectral line is
a) 3000 Å b) 5000 Å c) 6000 Å d) 4500 Å

68. A laser beam can be focused on an area equal to the square of its wavelength, A He-Ne laser radiates energy at the rate of $1mV$ and its wavelength is 632.8 nm. The intensity of focussed beam will be
a) $1.5 \times 10^{13} W/m^2$ b) $2.5 \times 10^{9} W/m^2$ c) $3.5 \times 10^{17} W/m^2$ d) None of these

69. The frequencies of X-rays, γ-rays and ultraviolet rays are respectively a, b and c. Then
a) $a < b, b > c$ b) $a > b, b > c$ c) $a > b, b < c$ d) $a < b, b < c$

70. 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) $\sin^{-1}\frac{n\lambda}{d}$ b) $\cos^{-1}\frac{4\lambda}{d}$ c) $\tan^{-1}\frac{d}{4\lambda}$ d) $\cos^{-1}\frac{\lambda}{4d}$

71. If λ_v, λ_r and λ_m represent the wavelength of visible light x-rays and microwaves respectively, then
a) $\lambda_m > \lambda_x > \lambda_v$ b) $\lambda_v > \lambda_m > \lambda_y$ c) $\lambda_m > \lambda_v > \lambda_x$ d) $\lambda_v > \lambda_x > \lambda_m$

72. A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue

light

a) No change

b) Diffraction bands become narrower and crowded together

c) Band become broader and farther apart

d) Bands disappear altogether

73. Assuming that universe is expanding, if the spectrum of light coming from a star which is going away from earth is tested, then in the wavelength of light

a) There will be no change

b) The spectrum will move to infrared region

c) The spectrum will seems to shift to ultraviolet side

d) None of the above

74. In Young's double slit experiment, distance between two sources is 0.1 mm. The distance of screen from the source is 20 cm. Wavelength of light used is 5460 Åhen angular position of first dark fringe is

a) 0.08° b) 0.16° c) 0.20° d) 0.32°

75. 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) $1:\frac{1}{\pi^2}:\frac{9}{\pi^2}$

76. The time period of rotation of the sun is 25 days and its radius is $7 \times 10^8 m$. 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

77. When light is incident on a doubly refracting crystal, two refracted rays-ordinary ray (O-ray) and extra ordinary ray (E-ray) are produced. Then

a) Both O-ray and E-ray are polarized perpendicular to the plane of incidence

b) Both O-ray and E-ray are polarized in the plane of incidence

c) E-ray is polarised perpendicular to the plane of incidence and O-ray in the plane of incidence

d) E-ray is polarized in the plane of incidence and O-ray perpendicular to the plane of incidence

78. A light wave is incident normally over a slit of width $24 \times 10^{-5} cm$. The angular position of second dark fringe from the central maxima is 30°. What is the wavelength of light

a) 6000 Å b) 5000 Å c) 3000 Å d) 1500 Å

79. In an interference pattern the position of zeroth order maxima is 4.8 mm from a certain point P on the screen. The fringe width is 0.2 mm. The position of second maxima from point P is

a) 5.1 mm b) 5 mm c) 40 mm d) 5.2 mm

80. Light if wavelength 2×10^{-3} m falls on a slit of width 4×10^{-3} m. The angular dispersion of the central maximum will be

a) 30° b) 60° c) 90° d) 180°

81. In a double slit experiment, the screen is placed at a distance of 1.25 m from the slits. When the apparatus is immersed in water ($\mu_w = 4/3$), the angular width of a fringe is found to be 0.2°. When the experiment is performed in air with same set up, the angular width of the fringe is

a) 0.4° b) 0.27° c) 0.35° d) 0.15°

82. Two luminous point sources separated by a certain distance are at 10 km from an observer. If the aperture of his eye is 2.5×10^{-3} m and the wavelength of light used is 500 nm, the distance of separation between the point sources just seen to be resolved is

a) 12.2 m b) 24.2 m c) 2.44 m d) 1.22 m

83. The similarity between the sound waves and light waves is

a) Both are electromagnetic waves b) Both are longitudinal waves

c) Both have the same speed in a medium d) They can produce interference

84. In a Young's double slit experiment, the slit separation is 1 mm and the screen is 1 m from the slit. For a monochromatic light of wavelength 500 nm, the distance of 3rd minima from the central maxima is

a) 0.50 mm b) 1.25 mm c) 1.50 mm d) 1.75 mm

85. The Brewster angle for the glass-air interface is 54.74°. If a ray of light going from air to glass strikes at an

angle of incidence 45°, then the angle of refraction is
(Hint : $\tan 54.74° = \sqrt{2}$)

a) 60° b) 30° c) 25° d) 54.74°

86. A slit of width a is illuminated by red light of wavelength 6500Å. If the first minimum falls at $\theta = 30°$, the value of a is

a) 6.5×10^{-4}mm b) 1.3 micron c) 3250Å d) 2.6×10^{-4}cm

87. An electromagnetic wave travels along z-axis. Which of the following pairs of space and time varying fields would generate such a wave

a) E_x, B_y b) E_y, B_x c) E_z, B_x d) E_y, B_z

88. What will be the angular width of central maxima in Fraunhoffer diffraction when light of wavelength 6000Å is used and slit width is $12 \times 10^{-5} cm$

a) 2 rad b) 3 rad c) 1 rad d) 8 rad

89. The phenomenon which does not take place in sound waves is

a) Scattering b) Diffraction c) Interference d) Polarisation

90. In a single slit diffraction of light of wavelength λ by a slit of width e, the size of the central maximum on a screen at a distance b is

a) $2b\lambda + e$ b) $\frac{2b\lambda}{e}$ c) $\frac{2b\lambda}{e} + e$ d) $\frac{2b\lambda}{e} - e$

91. A beam of circularly polarised light us completely absorbed by an object on which it falls. If U represents absorbed energy and ω represents angular frequency, then angular momentum transferred to the object is given by

a) $\frac{U}{\omega^2}$ b) $\frac{U}{2\omega}$ c) $\frac{U}{\omega}$ d) $\frac{2U}{\omega}$

92. If white light is used in the Newton's rings experiment, the colour observed in the reflected light is complementary to that observed in the transmitted light through the same point. This is due to

a) 90° change of phase in one of the reflected waves
b) 180° change of phase in one of the reflected waves
c) 145° change of phase in one of the reflected waves
d) 45° change of phase in one of the reflected waves

93. The periodic time of rotation of a certain star is 22 days and its radius is 7×10^8 $metres$. If the wavelength of light emitted by its surface be 4320 Å, the Doppler shift will be (1 day = 86400 sec)

a) 0.033 Å b) 0.33 Å c) 3.3 Å d) 33 Å

94. A point source of electromagnetic radiation has an average power output of 1500 W. The maximum value of electric field at a distance of $3m$ from this source in Vm^{-1} is

a) 500 b) 100 c) $\frac{500}{3}$ d) $\frac{250}{3}$

95. At what angle should an unpolarised beam be incident on a crystal of$\mu = \sqrt{3}$, so that reflected beam is polarised?

a) 45° b) 60° c) 90° d) 0°

96. In Young's double slit experiment, the intensity of light coming from the first slit is double the intensity from the second slit. The ratio of the maximum intensity to the minimum intensity on the interference fringe pattern observed is

a) 34 b) 40 c) 25 d) 38

97. Huygens wave theory allows us to know

a) The wavelength of the wave
b) The velocity of the wave
c) The amplitude of the wave
d) The propagation of wave fronts

98. Two coherent sources of intensities, I_1 and I_2 produce an interference pattern. The maximum intensity in the interference pattern will be

a) $I_1 + I_2$ b) $I_1^2 + I_2^2$ c) $(I_1 + I_2)^2$ d) $\left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

99. The main difference between the phenomena of interference and diffraction is that

a) Diffraction is caused by reflected waves from a source whereas interference is caused due to refraction of waves from a source
b) Diffraction is due to interaction of waves derived from the same source, whereas interference is that bending of light from the same wavefront
c) Diffraction is due to interaction of light from wavefront, whereas the interference is the interaction of two waves derived from the same source
d) Diffraction is due to interaction of light from the same wavefront whereas interference is the interaction of waves from two isolated sources

100. Approximate height of ozone layer above the ground is
a) 60 to 70 km
b) 59 km to 80 km
c) 70 km to 100 km
d) 100 km to 200 km

101. In Young's double slit experiment, when violet light of wavelength 4358 Å is used, the 84 fringe are seen in the field of view, but when sodium light of certain wavelength is used, then 62 fringes are seen in the field of view, the wavelength of sodium light is
a) 6893 Å
b) 5904 Å
c) 5523 Å
d) 6429 Å

102. In a certain double slit experimental arrangement interference fringes of width 1.0 mm each are observed when light of wavelength 5000 Å is used. Keeping the set up unaltered, if the source is replaced by another source of wavelength 6000 Å, the fringe width will be
a) 0.5 mm
b) 1.0 mm
c) 1.2 mm
d) 1.5 mm

103. 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 $3I$

104. Light appears to travel in straight lines since
a) It is not absorbed by the atmosphere
b) It is reflected by the atmosphere
c) Its wavelength is very small
d) Its velocity is very large

105. The ratio of intensities of two waves is 9:1. They are producing interference. The ratio of maximum and minimum intensities will be
a) 10 : 8
b) 9 : 1
c) 4 : 1
d) 2 : 1

106. In a Young's double slit experiment, the slit separation is 0.2cm, the distance between the screen and slit is 1m. Wavelength of the light used is 5000 Å. The distance between two consecutive dark fringes (in mm) is
a) 0.25
b) 0.26
c) 0.27
d) 0.28

107. 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 which is doubled
a) I_0
b) $\frac{I_0}{2}$
c) $2I_0$
d) $4I_0$

108. In the phenomenon of interference, energy is
a) Destroyed at bright fringes
b) Created at dark fringes
c) Conserved but it is redistributed
d) Same at all points

109. If n represents the order of a half period zone, the area of this zone is approximately proportional to n^m where m is equal to
a) Zero
b) Half
c) One
d) Two

110. In the spectrum of light of a luminous heavenly body the wavelength of a spectral line is measured to be 4747Å while actual wavelength of the line is 4700Å. The relative velocity of the heavenly body with respect to earth will be (velocity of light is $3 \times 10^8 m/s$)
a) $3 \times 10^5 m/s$ moving towards the earth
b) $3 \times 10^5 m/s$ moving away from the earth
c) $3 \times 10^6 m/s$ moving towards the earth
d) $3 \times 10^6 m/s$ moving away from the earth

111. In Young's double slit experiment, the distance between the two slits is 0.1 mm and the wavelength of light used is $4 \times 10^{-7} m$. If the width of the fringe on the screen is 4 mm, the distance between screen and slit is
a) 0.1 mm
b) 1 cm
c) 0.1 cm
d) 1 m

112. The slits in a Young's double slit experiment have equal widths and the source is placed symmetrically relative to the slits. The intensity at the central fringes is I_0. If one of the slits is closed, the intensity at this

point will be

a) I_0 b) $I_0/4$ c) $I_0/2$ d) $4I_0$

113. In Fresnel's biprism experiment is held in water instead of air, then what will be the effect on fringe width

a) Decreases b) Increases c) No effect d) None of these

114. Irreducible phase difference in any wave of 5000 Å from a source of light is

a) π b) 12π c) $12\pi \times 10^6$ d) $\pi \times 10^6$

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

a) $\tan^{-1}\left(\frac{4}{3}\right)$ b) $\tan^{-1}\left(\frac{3}{4}\right)$ c) $\tan^{-1}\left(\frac{5}{3}\right)$ d) $\sin^{-1}\left(\frac{4}{5}\right)$

116. Which of the following shows green house effect

a) Ultraviolet rays b) Infrared rays c) X-rays d) None of these

117. Two Nicols are oriented with their principal planes making an angle of 60°. The percentage of incident unpolarised light which passes through the system is

a) 50% b) 100% c) 12.5% d) 37.5%

118. In an electromagnetic wave, the amplitude of electric field is 1 V/m, the frequency of wave is $5 \times 10^{14} Hz$. The wave is propagating along z-axis. The average energy density of electric field, in $Joule/m^3$, will be

a) 1.1×10^{-11} b) 2.2×10^{-12} c) 3.3×10^{-13} d) 4.4×10^{-14}

119. In a Young's double slit experiment, distance between sources is 1 mm and distance between the screen and sources is 1 m. If the fringe width on the screen is 0.06 cm, then λ is

a) 6000 Å b) 4000 Å c) 1200 Å d) 2400 Å

120. In Young's double slit experiment, a minimum is obtained when the plane difference of super imposing waves is

a) Zero b) $(2n-1)\pi$ c) $n\pi$ d) $(n+1)\pi$

121. Which one of the following is INCORRECT statement in the transmission of electromagnetic waves

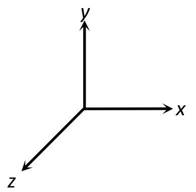
a) Ground wave propagation is for high frequency transmission

b) Sky wave propagation is facilitated by ionospheric

c) Space wave is of high frequency and is suitable for line of sight communication

d) Space wave is used for satellite communication

122. Light wave is travelling along y-direction. If the corresponding $\vec{E}$ vector at any time is along the x-axis, the direction of $\vec{B}$ vector at that time is along



a) y-axis b) x-axis c) $+z$-axis d) $-z$-axis

123. A single slit of width a is illuminated by violet light of wavelength 400 nm and the width of the diffraction pattern is measured as y. When half of the slit width is covered and illuminated by yellow light of wavelength 600 nm, the width of the diffraction pattern is

a) The pattern vanishes and the width is zero b) $y/3$

c) $3y$ d) None of these

124. A single slit of width 0.20 mm is illuminated with light of wavelength 500 nm. The observing screen is placed 80 cm from the slit. The width of the central bright fringe will be

a) 1 mm b) 2 mm c) 4 mm d) 5 mm

125. The diffraction effect can be observed in

a) Only sound waves b) Only light waves

c) Only ultrasonic waves d) Sound as well as light waves

126. How will the diffraction pattern of single slit change when yellow light us replaced by blue light? The fringe will be

a) Wider b) Narrower c) Brighter d) Fainter

127. A lamp emits monochromatic green light uniformly in all directions. The lamp is 3% efficient in converting electrical power to electromagnetic waves and consumes $100W$ of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of $10m$ from the lamp will be

a) 1.34 V/m b) 2.68 V/m c) 5.36 V/m d) 9.37 V/m

128. In a Fresnel biprism experiment, the two positions of lens give separation between the slits as 16 cm and 9 cm, respectively. What is the actual distance of separation?

a) 12.5 cm b) 12 cm c) 13 cm d) 14 cm

129. Two waves of intensity I undergo Interference. The maximum intensity obtained is

a) $I/2$ b) I c) $2I$ d) $4I$

130. Colours of thin films result from

Or

On a rainy day, a small oil film on water show brilliant colours. This is due to

a) Dispersion of light b) Interference of light c) Absorption of light d) Scattering of light

131. The width of the diffraction band varies

a) Inversely as the wavelength
b) Directly as the width of the slit
c) Directly as the distance between the slit and the screen
d) Inversely as the size of the source from which the slit is illuminated

132. TV waves have a wavelength range of 1-10 $meter$. Their frequency range in MHz is

a) 30-300 b) 3-30 c) 300-3000 d) 3-3000

133. Diffraction and interference of light suggest

a) Nature of light is electro-magnetic b) Wave nature
c) Nature is quantum d) Nature of light is transverse

134. If L is the coherence length and c the velocity of light, the coherent time is

a) cL b) $\frac{L}{c}$ c) $\frac{c}{L}$ d) $\frac{1}{Lc}$

135. If the polarizing angle of a piece of glass for green light is 54.74°, then the angle of minimum deviation for an equilateral prism made of same glass is

[Given : $\tan 54.74° = 1.414$]

a) 45° b) 54.74° c) 60° d) 30°

136. Young's experiment establishes that

a) Light consists of waves b) Light consists of particles
c) Light consists of neither particles nor waves d) Light consists of both particles and waves

137. A ray of light strikes a glass plate at an angle of60°. If the reflected an refracted rays are perpendicular to each other, the index of refraction of glass is

a) $\frac{1}{2}$ b) $\sqrt{\frac{3}{2}}$ c) $\frac{3}{2}$ d) 1.732

138. 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 $\pi/2$ at point A and π at point B.Then the difference between the resultant intensities at A and B is

a) $2I$ b) $4I$ c) $5I$ d) $7I$

139. Which statement is correct for a zone plate and a lens

a) Zone plate has multi focii whereas lens has one
b) Zone plate has one focus whereas lens has multiple focii
c) Both are correct
d) Zone plate has one focus whereas a lens has infinite

140. Two coherent waves are represented by $y_1 = a_1 \cos \omega t$ and$y_2 = a_1 \sin \omega t$, superimposed on each other. The resultant intensity is

a) $(a_1 + a_2)$ b) $(a_1 - a_2)$ c) $(a_1^2 + a_2^2)$ d) $(a_1^2 - a_2^2)$

141. In Young's double slit interference experiment, the slit separation is made 3 fold. The fringe width

becomes

a) 1/3 $times$ b) 1/9 $times$ c) 3 $times$ d) 9 $times$

142. In Young's experiment, the ratio of maximum to minimum intensities of the fringe system is 4:1. The amplitudes of the coherent sources are in the ratio

a) 4 : 1 b) 3 : 1 c) 2 : 1 d) 1 : 1

143. When the angle of incidence on a material is 60°, the reflected light is completely polarized. The velocity of the refracted ray inside the material is (in ms^{-1})

a) 3×10^8 b) $\left(\frac{3}{\sqrt{2}}\right) \times 10^8$ c) $\sqrt{3} \times 10^8$ d) 0.5×10^8

144. The rms value of the electric field of the light coming from the Sun is 720 N/C. The average total energy density of the electromagnetic wave is

a) $6.37 \times 10^{-9} J/m^3$ b) $81.35 \times 10^{-12} J/m^3$ c) $3.3 \times 10^{-3} J/m^3$ d) $4.58 \times 10^{-6} J/m^3$

145. If a source of light is moving away from a stationary observer, then the frequency of light wave appears to change because of

a) Doppler's effect b) Interference c) Diffraction d) None of these

146. Light propagates 2cm distance in glass of refractive index 1.5 in timet_0. In the same timet_0, light propagates a distance of 2.25 cm in a medium. The refractive index of the medium is

a) 4/3 b) 3/2 c) 8/3 d) None of these

147. In Young's double slit experiment, a minimum is obtained when the phase difference of superimposing waves is

a) Zero b) $(2n - 1)\pi$ c) $n\pi$ d) $(n + 1)\pi$

148. Which if the following phenomena is not common to sound and light waves?

a) Interference b) Diffraction c) Coherence d) Polarisation

149. The diffraction effect can be observed in

a) Only sound waves b) Only light waves
c) Only ultrasonic waves d) Sound as well as light waves

150. Consider the following statements A and B and identify the correct answer

A. Polarised light can be used to study the helical surface of nucleic acids

B. Optics axis is a direction and not any particular line in the crystal

a) A and B are correct b) A and B are wrong
c) A is correct but B is wrong d) A is wrong but B is correct

151. In the context of Doppler effect in light, the term 'red shift' signifies

a) Decrease in frequency b) Increase in frequency
c) Decrease in intensity d) Increase in intensity

152. The limit of resolution of an optical instrument arises on account of

a) Reflection b) Diffraction c) Polarization d) Interference

153. In young's two slit experiment the distance between the two coherent sources is 2 mm and the screen is at a distance of 1 m. If the fringe width is found to be 0.03 cm, then the wavelength of the light used is

a) 4000Å b) 5000Å c) 5890Å d) 6000Å

154. Colours in thin films are due to

a) Diffraction phenomenon b) Scattering phenomenon
c) Interference phenomenon d) Polarization phenomenon

155. Which rays are not the portion of electromagnetic spectrum

a) X-rays b) Microwaves c) α-rays d) Radio waves

156. In Young's double slit interference pattern the fringe width

a) Can be changed only by changing the wavelength of incident light
b) Can be changed only by changing the separation between the two slits
c) Can be changed either by changing the wavelength or by changing the separation between the two slits
d) Is a universal constant, hence cannot be changed

157. Maxwell in his famous equation of electromagnetism introduced the concept of

a) a.c. current b) d.c. current c) Displacement current d) Impedance

158. In a Young's experiment, two coherent sources are placed 0.90 mm apart and the fringes are observed one meter away. If it produces the second dark fringe at a distance of 1 mm from the central fringe, the wavelength of monochromatic light used will be

a) 60×10^{-4} cm b) 10×10^{-4} cm c) 60×10^{-5} cm d) 6×10^{-5} cm

159. In young's experiment the wavelength of red light is 7.8×10^{-5} cm and that of blue light 5.2×10^{-2} cm. The value of n for which $(n+1)$th blue bright band coincides with n^{th}red band is

a) 4 b) 3 c) 2 d) 1

160. Consider the following statements about electromagnetic waves and choose the correct ones

S1 : Electromagnetic waves having wavelengths 1000 times smaller than light waves are called X-rays

S2 : Ultraviolet waves are used in the treatment of swollen joints

S3 : Alpha and gamma rays are not electromagnetic waves

S4 : de Broglie waves are not electromagnetic in nature

S5 : Electromagnetic waves exhibit polarization while sound waves do not

a) S1, S4 and S5 b) S3, S4, and S5 c) S1, S3 and S5 d) S2, S3 and S4

161. Conditions of diffraction is

a) $\frac{a}{\lambda} = 1$ b) $\frac{a}{\lambda} \gg 1$ c) $\frac{a}{\lambda} \ll 1$ d) None of these

162. A parallel beam of fast moving electrons is incident normally on a narrow slit. A screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statement is correct

a) Diffraction pattern is not observed on the screen in the case of electrons

b) The angular width of the central maxima of the diffraction pattern will increase

c) The angular width of the central maxima will decrease

d) The angular width of the central maxima will remain the same

163. In Young's experiment, one slit is covered with a blue filter and the other (slit) with a yellow filter. Then the interference pattern

a) Will be blue b) Will be yellow c) Will be green d) Will not be formed

164. The fringe width a distance of 50 cm from the slits in Young's experiment for light of wavelength 6000 Å is 0.048 cm. The fringe width at the same distance for $\lambda = 5000$ Å will be

a) 0.04 cm b) 0.4 cm c) 0.14 cm d) 0.45 cm

165. A wave is propagating in a medium of electric dielectric constant 2 and relative magnetic permeability 50. The wave impedance of such a medium is

a) 5 Ω b) 376.6 Ω c) 1883 Ω d) 3776 Ω

166. Light of wavelength 589.3nm is incident normally on the slit of width 0.1nm. What will be the angular width of the central diffraction maximum at a distance of 1m from the slit

a) 0.68° b) 1.02° c) 0.34° d) None of these

167. When the wavelength of light coming from a distant star is measured it is found shifted towards red. Then the conclusion is

a) The star is approaching the observer b) The star recedes away from earth

c) There is gravitational effect on the light d) The star remains stationary

168. The idea of the quantum nature of light has emerged in an attempt to explain

a) Interference b) Diffraction

c) Radiation spectrum of a black body d) Polarization

169. Which scientist experimentally proved the existence of electromagnetic waves

a) Sir J.C. Bose b) Maxwell c) Marconi d) Hertz

170. In Young's double slit experiment, the two slit act as coherent sources if equal amplitude A and wavelengthλ. In another experiment with the same setup, the two slits are sources 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) 2:1 b) 1:2 c) 3:4 d) 4:3

171. In single slit diffraction pattern

a) Central fringe has negligible width than others
b) All fringes are of same width
c) Central fringes do not exist
d) None of the above

172. The distance between the first and the sixth minima in the diffraction pattern of a single alit is 0.5 mm. The screen is 0.5 m away from the slit. If the wavelength of light used is 5000 Å, then the slit width will be
a) 5 mm
b) 2.5 mm
c) 1.25 mm
d) 1.0 mm

173. The angle of incidence of light is equal to Brewster's angle, then
A. Reflected ray is perpendicular to refracted ray
B. Refracted ray is parallel to reflected ray
C. Reflected light is polarized having its electric vector in the plane of incidence
D. Refracted light is polarized
a) (A) and (D) are true
b) (A) and (B) are true
c) (A) and (C) are true
d) (B) and (C) are true

174. Which of the following electromagnetic waves have minimum frequency
a) Microwaves
b) Audible waves
c) Ultrasonic waves
d) Radiowaves

175. The frequency of light ray having the wavelength 3000Å is
a) $9 \times 10^{13} cycles/s$
b) $10^{15} cycles/s$
c) 90 $cycles/s$
d) 3000 $cycles/s$

176. In which of the following is the interference due to the division of wave front
a) Young's double slit experiment
b) Fresnel's biprism experiment
c) Lloyd's mirror experiment
d) Demonstration colours of thin film

177. Light is incident normally on a diffraction grating through which the first order diffraction is seen at 32°. The second order diffraction will be seen at
a) 48°
b) 64°
c) 80°
d) There is no second order diffraction in this case

178. A spectral line $\lambda = 5000$ Å in the light coming from a distant star is observed as a 5200 Å. What will be recession velocity of the star
a) $1.15 \times 10^7 cm/s$
b) $1.15 \times 10^7 m/s$
c) $1.15 \times 10^7 km/s$
d) 1.15 km/s

179. A long straight wire of resistance R, radius a and length l carries a constant current I. The Poynting vector for the wire will be
a) $\frac{IR}{2\pi al}$
b) $\frac{IR^2}{al}$
c) $\frac{I^2R}{al}$
d) $\frac{I^2R}{2\pi al}$

180. Pick out the correct statement in the propagation of electromagnetic waves for communication purposes
a) Space wave propagation is achieved by ionospheric reflection
b) Sky wave propagation is used for line-of-sight communication
c) Electromagnetic waves of frequencies higher than 30 MHz penetrate ionosphere
d) Satellite communication uses sky wave mode of propagation

181. Two waves originating from source S_1 and S_2 having zero phase difference and common wavelength λ will show complete destructive interference at a point P, is $(S_1P - S_2P) =$
a) 5λ
b) $\frac{3\lambda}{4}$
c) $\frac{4\lambda}{2}$
d) $\frac{11\lambda}{2}$

182. In a Young's double slit experiment, the separation of the two slits is doubled. To keep the same spacing of fringes, the distance D of the screen from the slits should be made
a) $\frac{D}{2}$
b) $\frac{D}{\sqrt{2}}$
c) $2D$
d) $4D$

183. 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 mm
b) 1.2 cm
c) 2.4 cm
d) 2.4 mm

184. Two coherent sources of light can be obtained by
a) Two different lamps
b) Two different lamps but of the same power
c) Two different lamps of same power and having the same colour
d) None of the above

185. In hydrogen spectrum the wavelength of H_α line is 656 nm whereas in the spectrum of a distant galaxy, H_α line wavelength is 706 nm. Estimated speed of the galaxy with respect to earth is

a) $2 \times 10^8 m/s$ b) $2 \times 10^7 m/s$ c) $2 \times 10^6 m/s$ d) $2 \times 10^5 m/s$

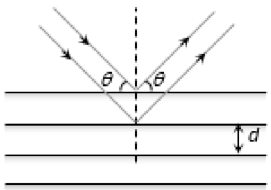
186. The distance between the first dark and bright band formed in Young's double slit experiment with band width B is

a) $\frac{B}{4}$ b) B c) $\frac{B}{2}$ d) $\frac{3B}{2}$

187. If for a calcite crystal μ_0 and μ_e are the refractive indices of the crystal for O- ray and E-ray respectively, then along the optic axis of the crystal

a) $\mu_0 = \mu_e$ b) $\mu_e = \mu_0$ c) $\mu_e = \mu_0$ d) None of these

188. 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 $n = 1, 2, \dots \dots$)



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

189. Which one of the following have minimum wavelength

a) Ultraviolet rays b) Cosmic rays c) X-rays d) γ-rays

190. A star is moving towards the earth with a speed of $4.5 \times 10^6 m/s$. If the true wavelength of a certain line in the spectrum received from the star is 5890 Å, its apparent wavelength will be about ($c = 3 \times 10^8 m/s$)

a) 5890Å b) 5978Å c) 5802Å d) 5896Å

191. Select the right option in the following

a) Christian Huygens a contemporary of Newton established the wave theory of light by assuming that light waves were transverse

b) Maxwell provided the compelling theoretical evidence that light is transverse wave

c) Thomas Young experimentally proved the wave behaviour of light and Huygens assumption

d) All the statements give above, correctly answers the question "what is light"

192. The average electric field of electromagnetic waves in certain region of free space is $9 \times 10^{-4} NC^{-1}$. Then the average magnetic field in the same region is of the order of

a) $27 \times 10^{-4} T$ b) $3 \times 10^{-12} T$ c) $\left(\frac{1}{3}\right) \times 10^{-12} T$ d) $3 \times 10^{12} T$

193. The radius r of half period zone is proportional to

a) $\sqrt{n}$ b) $\frac{1}{\sqrt{n}}$ c) n^2 d) $\frac{1}{n}$

194. In a Young's double slit experiment, the source illuminating the slits is changed from blue to violet. The width of the fringes

a) Increases b) Decreases c) Becomes unequal d) Remains constant

195. In a Young's double slit experiment, the fringe width is found to be 2 mm, when light of wavelength 6000 Å is used. Find the change in fringe width if the whole apparatus is immersed in water of refractive index 1.33.

a) 0.5 mm b) 1 mm c) 1.5 mm d) 2 mm

196. A parallel plate capacitor with plate area A and separation between the plates d, is charged by a constant current i, consider a plane surface of area $A/2$ parallel to the plates and drawn symmetrically between the plates, the displacement current through this area, will be

a) i b) $\frac{i}{2}$ c) $\frac{i}{4}$ d) None of these

197. In a Young's double-slit experiment, constructive interference is produced at a certain point P. The

intensities of light at P due to the individual sources are 4 and 9 units. The resultant intensity at point P will be

a) 13 units b) 25 units c) $\sqrt{97}$ units d) 5 units

198. The wavefront of distant source of unknown shape is approximately

a) Spherical b) Cylindrical c) Elliptical d) Plane

199. According to Newton's corpuscular theory, the speed of light is

a) Same in all the media b) Lesser in rarer medium
c) Lesser in denser medium d) Independent of the medium

200. In a Young's double slit experiment, the slit separation is $1mm$ and the screen is $1m$ from the slit. For a monochromatic light of wavelength 500 nm, the distance of 3rd minima from the central maxima is

a) 0.50 mm b) 1.25 mm c) 1.50 mm d) 1.75 mm

201. A parallel beam of light of wavelength 6000Å gets diffracted by a single silt of width 0.3 mm. The angular position of the first minima of diffracted light is

a) 6×10^{-3} rad b) 1.8×10^{-3} rad c) 3×10^{-3} rad d) 2×10^{-3} rad

202. A circular disc is placed in front of a narrow source. When the point of observation is at a distance of 1 $meter$ from the disc, then the disc covers first HPZ. The intensity at this point is I_0. The intensity at a point distance 25 cm from the disc will be (If ratio of consecutive amplitude of HPZ is 0.9)

a) $I_1 = 0.531I_0$ b) $I_1 = 0.053I_0$ c) $I_1 = 53I_0$ d) $I_1 = 5.03I_0$

203. In Young's double slit experiment intensity at a point is (1/4) of the maximum intensity. Angular position of this point is

a) $\sin^{-1}(\lambda/d)$ b) $\sin^{-1}(\lambda/2d)$ c) $\sin^{-1}(\lambda/3d)$ d) $\sin^{-1}(\lambda/4d)$

204. An electromagnetic wave going through vacuum is described by $E = E_0 \sin(kx - \omega t); B = B_0 \sin(kx - \omega t)$. Which of the following equations is true

a) $E_0 k = B_0 \omega$ b) $E_0 \omega = B_0 k$ c) $E_0 B_0 = \omega k$ d) None of these

205. To observe diffraction, the size of an aperture

a) Should be of the same orders wavelength should be much larger than the wavelength
b) Should be much larger than the wavelength
c) Have no relation to wavelength
d) Should be exactly $\lambda/2$

206. Wave which cannot travel in vacuum is

a) X-rays b) Infrasonic c) Ultraviolet d) Radiowaves

207. The fringe width in Young's double slit experiment increases when

a) Wavelength increases
b) Distance between the slits increases
c) Distance between the source and screen decreases
d) The width of the slits increases

208. Two beams of light will not give rise to an interference pattern, if

a) They are coherent
b) They have the same wavelength
c) They are linearly polarized perpendicular to each other
d) They are not monochromatic

209. In a 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 $1m$. The minimum distance between two successive regions of complete darkness is

a) 4 mm b) 5.6 mm c) 14 mm d) 28 mm

210. The ratio of maximum and minimum intensities of two sources is 4 :1. The ratio of their amplitudes is

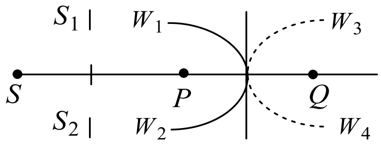
a) 1 : 3 b) 3 : 1 c) 1 : 9 d) 1 : 16

211. The wave theory of light was given by

a) Maxwell b) Planck c) Huygen d) Young

212. Interference fringes are being produced on screen XY by the slits S_1 and S_2. In figure, the correct fringe

locus is



a) PQ b) W_1W_2 c) W_3W_4 d) XY

213. The width of a single slit if the first minimum is observed at an angle 2° with a light of wavelength 6980Å

a) 0.2 mm b) 2×10^{-5} mm c) 2×10^{5} mm d) 2 mm

214. In Young's double slit experiment, a mica slit of thickness t and refractive index μ is introduced in the ray from the first source S_1. By how much distance the fringes pattern will be displaced

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

215. In Young's double slit experiment, the distance between sources is 1 mm and distance between the screen and source is 1 m. If the fringe width on the screen is 0.06 cm, then $\lambda =$

a) 6000 Å b) 4000 Å c) 1200 Å d) 2400 Å

216. When two coherent monochromatic beams of intensity I and $9I$ interface, the possible maximum and minimum intensities of the resulting beam are

a) $9I$ and I b) $9I$ and $4I$ c) $16I$ and $4I$ d) $16I$ and I

217. Maxwell's equations describe the fundamental laws of

a) Electricity only b) Magnetism only c) Mechanics only d) Both (a) and (b)

218. If we observe the single slit Frunhofer diffraction with wavelength λ and slit width e, the width of the central maxima is 2θ. On decreasing the slit width for the same λ

a) θ increases
b) θ remains unchanged
c) θ decreases
d) θ increases or decreases depending on the intensity of light

219. In Young's double slit experiment, the distance between slits is 0.0344 mm. The wavelength of light used is 600 mm. what is the angular width of a fringe formed on a distant screen?

a) 1° b) 2° c) 3° d) 4°

220. A point source of electromagnetic radiation has an average power output of 800 W. The maximum value of electric field at a distance 4.0 m from the source is

a) 64.7 V/m b) 57.8 V/m c) 56.72 V/m d) 54.77 V/m

221. For a wave propagating in a medium, identify the property that is independent of the others

a) Velocity b) Wavelength
c) Frequency d) All these depend on each other

222. In Young's double alit experiment, the seventh maximum with wavelength λ_1 is at a distance d_1 and the same maximum with wavelength λ_2 is at distanced_2. Then $d_1/d_2 =$

a) $\frac{\lambda_1}{\lambda_2}$ b) $\frac{\lambda_2}{\lambda_1}$ c) $\frac{\lambda_1^2}{\lambda_2^2}$ d) $\frac{\lambda_2^2}{\lambda_1^2}$

223. An oil flowing on water seems coloured due to interference. For observing this effect, the approximate thickness of the oil film should be

a) 100 Å b) 10000 Å c) 1 mm d) 1 cm

224. The wave theory of light was given by

a) Maxwell b) Planck c) Huygen d) Young

225. In Young's double slit experiment, the phase difference between the light waves reaching third bright fringe from the central fringe will be $(\lambda = 6000\text{Å})$

a) Zero b) 2π c) 4π d) 6π

226. Laser beams are used to measure long distance because

a) They are monochromatic b) They are highly polarized
c) They are coherent d) They have high degree of parallelism

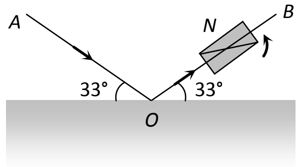
227. In the far field diffraction pattern of a single slit under polychromatic illumination, the first minimum with the wavelength λ_1 is found to be coincident with the third maximum at λ_2. So

a) $3\lambda_1 = 0.3\lambda_2$ b) $3\lambda_1 = \lambda_2$ c) $\lambda_1 = 3.5\lambda_2$ d) $0.3\lambda_1 = 3\lambda_2$

228. White light is used to illuminate the two slits in a Young's double slit experiment. The separation between slits is b and the screen is at a distance $d(>> b)$ from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing, figure. Some of these missing wavelengths are

a) $\lambda = \frac{b^2}{d}, \frac{2b^2}{3d}$ b) $\lambda = \frac{b^2}{2d}, \frac{3b^2}{2d}$ c) $\lambda = \frac{2b^2}{3d}$ d) $\lambda = \frac{3b^2}{4d}$

229. 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 Nicole 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

230. A parallel beam of fast moving electrons is incident normally on a narrow slit. A screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statement is correct?

a) Diffraction pattern is not observed on the screen in the case of electrons
b) The angular width of the central maximum of the diffraction pattern will increase
c) The angular width of the central maximum will decrease
d) The angular width of the central maximum will remains the same

231. Which of the following radiations has the least wavelength

a) γ-rays b) β-rays c) α-rays d) X-rays

232. Which of the following waves have the maximum wavelength

a) X-rays b) I.R. rays c) UV rays d) Radio waves

233. A circular disc is placed in front of a narrow source. When the point of observation is 2 m from the disc, then it covers first HPZ. The intensity at this point is I. When the point of observation is 25 cm from the disc then intensity will be

a) $\left(\frac{R_6}{R_2}\right)^2 I$ b) $\left(\frac{R_7}{R_2}\right)^2 I$ c) $\left(\frac{R_8}{R_2}\right)^2 I$ d) $\left(\frac{R_9}{R_2}\right)^2 I$

234. A light of wavelength 5890 Å falls normally on a thin air film. The minimum thickness of the film such that the film appears dark in reflected light is

a) $2.945 \times 10^{-7} m$ b) $3.945 \times 10^{-7} m$ c) $4.95 \times 10^{-7} m$ d) $1.945 \times 10^{-7} m$

235. Polarizing angle for water is 53°4′. If light is incident at this angle on the surface of water and reflected, the angle of refraction is

a) 53°4′ b) 126°56′ c) 36°56′ d) 30°4′

236. In Young's double slit experiment, the separation between the slit and the screen increases. The fringe width

a) Increases b) Decreases c) Remains unchanged d) None of these

237. In which of the following is the interference due to the division of wavefront?
a) Young's double slit experiment
b) Fresnel's biprism experiment
c) Liyod's mirror experiment
d) Demonstration colours of thin film

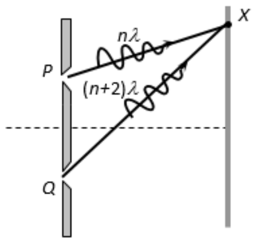
238. Air has refractive index 1.0003. The thickness of air column, which will have one more wavelength of yellow light (6000Å) than in the same thickness of vacuum is
a) $2\ mm$ b) $2\ cm$ c) $2\ m$ d) $2\ km$

239. A star emitting radiation at a wavelength of 5000Å is approaching earth with a velocity of $1.5 \times 10^6 m/s$. The change in wavelength of the radiation as received on the earth, is
a) 25Å b) Zero c) 100Å d) 2.5Å

240. In Young's double slit experiment when wavelength used is 6000Å and the screen is 40 cm from the slits, the fringes are 0.012 cm wide. What is the distance between the slits
a) 0.024 cm b) 2.4 cm c) 0.24 cm d) 0.2 cm

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

242. The figure shows a double slit experiment where P and Q are the slits. The path lengths PX and QX are $n\lambda$ and $(n+2)\lambda$ respectively, where n is a whole number and λ is the wavelength. Taking the central fringe as zero, what is formed at X



a) First bright b) First dark c) Second bright d) Second dark

243. When the angle of incidence on a material is 60°, the reflected light is completely polarized. The velocity of the refracted ray inside the material is (in ms^{-1})
a) 3×10^8 b) $\left[\frac{3}{\sqrt{2}}\right] \times 10^8$ c) $\sqrt{3} \times 10^8$ d) 0.5×10^8

244. In Young's double slit experiment, if monochromatic light is replaced by white light
a) All bright fringes become white
b) All bright fringes have colours between violet and red
c) Only the central fringe is white, all other fringes are coloured
d) No fringes are observed

245. By corpuscular theory of light, the phenomenon which can be explained is
a) Refraction b) Interference c) Diffraction d) Polarization

246. In Young's double slit experiment, the intensity on screen at a point where path difference is λ is K. What will be intensity at the point where path difference is $/4$?
a) $K/4$ b) $K/2$ c) K d) zero

247. 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) $2I_0$ b) $4I_0$ c) I_0 d) $\frac{I_0}{2}$

248. Electromagnetic radiation of highest frequency is
a) Infrared radiations b) Visible radiation c) Radio waves d) γ-rays

249. Maximum diffraction takes place in a given slit for

a) $\gamma -$ rays
b) Ultraviolet light
c) Infrared light
d) Radiowaves

250. In Young's double slit experiment, an interference pattern is obtained on a screen by a light of wavelength 6000Å coming from the coherent sources S_1 and S_2. At certain point Pon 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

251. The two slits at a distance of 1 mm are illuminated by the light of wavelength $6.5 \times 10^{-7} m$. The interference fringes are observed on a screen placed at a distance of $1m$. The distance between third dark fringe and fifth bright fringe will be

a) 0.65 mm
b) 1.63 mm
c) 3.25 mm
d) 4.88 mm

252. To observe diffraction the size of an obstacle

a) Should be of the same order as wavelength
b) Should be much larger than the wavelength
c) Have no relation to wavelength
d) Should be exactly $\lambda/2$

253. An unpolarised beam of intensity I_0 is incident on a pair of nicols making an angle of 60° with each other. The intensity of light emerging from the pair is

a) I_0
b) $I_0/2$
c) $I_0/4$
d) $I_0/8$

254. A light has amplitude A and angle between analyser and polarizer is 60°. Light is reflected by analyser has amplitude

a) $A\sqrt{2}$
b) $A/\sqrt{2}$
c) $\sqrt{3}A/2$
d) $A/2$

255. Oil floating on water looks coloured due to interference of light. What should be the order of magnitude of thickness of oil layer in order that this effect may be observed?

a) 10,000 Å
b) 1 cm
c) 10 Å
d) 100 Å

256. 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 $1.5 \times 10^5 m/s$
b) Coming closer with a velocity of $1.5 \times 10^5 m/s$
c) Moving away with a velocity of $1.5 \times 10^4 m/s$
d) Coming closer with a velocity of $1.5 \times 10^4 m/s$

257. An interference pattern was made by using red light. If the red light changes with blue light, the fringes will become

a) Wider
b) Narrower
c) Fainter
d) Brighter

258. Two waves having the intensities in the ratio of 9:1 produce interference. The ratio of maximum to minimum intensity is equal to

a) 10: 8
b) 9:1
c) 4:1
d) 2:1

259. The theory associated with secondary wavelets is

a) Doppler's effect
b) Special theory of relativity
c) Huygen's wave theory
d) None of the above

260. A narrow slit of width 2 mm is illuminated by monochromatic light of wavelength 500 nm. The distance between the first minima on either side on a screen at a distance of 1 m is

a) 5 mm
b) 0.5 mm
c) 1 mm
d) 10 mm

261. The Young's double slit experiment is performed with blue and with green light of wavelength 4360 Å and 5460 Å respectively. If x is the distance of 4th maxima from the central one, then

a) $x(\text{blue}) = x(\text{green})$
b) $x(\text{blue}) > x(\text{green})$
c) $x(\text{blue}) < x(\text{green})$
d) $x(\text{blue})/x(\text{green}) = 5400/4360$

262. Frequency of wave is $6 \times 10^{15} Hz$. The wave is

a) Radiowave
b) Microwave
c) X-ray
d) None of these

263. 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 resultant intensity is equal to the intensity due to the individual slitI_0.

Then the distance of point P from the central maximum is $(\lambda = 6000\ \text{Å})$

a) 0.5 mm b) 2 mm c) 1 mm d) 4 mm

264. 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

265. Light waves travel in vacuum along the y – axis. Which of the following may represent the wavefront?

a) $y =$constant b) $x =$constant c) $z =$constant d) $x + y + z =$constant

266. In Young's double slit experiment distance between source is 1 mm and distance between the screen and source is 1m. If the fringe width on the screen is0.06 cm, then λ is

a) 6000 Å b) 4000 Å c) 1200 Å d) 2400 Å

267. Two waves of same frequency and same amplitude from two monochromatic source are allowed to superpose at a certain point. If in once case the phase difference is 0° and in other case is $\pi/2$, the ratio of the intensities in the two cases will be

a) 1:1 b) 2:1 c) 4:1 d) None of these

268. In an interference pattern produced by two identical slits, the intensity at the slit of the central maximum is I. The intensity at the same spot when either if the slits is closed isI_0. Therefore

a) $I = I_0$
b) $I = 2I_0$
c) $I = 4I_0$
d) I and I_0 are not related to each other

269. Red light of wavelength 625 nm is incident normally on an optical diffraction grating with 2×10^5lines/m. Including central principal maxima, how many maxima may be observed on a screen which is far from the grating

a) 15 b) 17 c) 8 d) 16

270. In Young's double slit experiment, 12 fringes are obtained to be formed in a certain segment of the screen when light of wavelength 600 mm is used. If the wavelength of light is changed to 400 mm, number of fringes observed in the same segment of the screen is given by

a) 12 b) 18 c) 24 d) 30

271. In a biprism experiment, 5th dark fringe is obtained at a point. If a thin transparent film is placed in the path of one of waves, then 7th bright fringes is obtained at the same point. The thickness of the film in terms of wavelength l and refractive index μ will be

a) $\frac{1.5\lambda}{(\mu - 1)}$ b) $1.5(\mu - 1)\lambda$ c) $2.5(\mu - 1)\lambda$ d) $\frac{2.5\lambda}{(\mu - 1)}$

272. An astronaut floating freely in space decides to use his flash light as a rocket. He shines a 10 $watt$ light beam in a fixed direction so that he acquires momentum in the opposite direction. If his mass is 80 kg, how long must he need to reach a velocity of 1 ms^{-1}

a) 9 s b) $2.4 \times 10^3\ s$ c) $2.4 \times 10^6\ s$ d) $2.4 \times 10^9\ s$

273. In Young's double slit experiment if monochromatic light used is replaced by white light, then

a) No fringes are observed
b) Only central fringe is white, all other fringes are coloured
c) All bright fringes become white
d) All bright fringes have colours between violet and red

274. A single slit of width d is illuminated by violet light of wavelength 400 nm and the width of the diffraction patter is measured as y. When half of the slit width is covered and illuminated by yellow light of wavelength 600 nm, the width of the diffraction pattern is

a) The pattern vanishes and the width is zero
b) $y/3$
c) 3y
d) None of the above

275. For the sustained interference of light, the necessary condition is that the two sources should

a) Have constant phase difference
b) Be narrow
c) Be close to each other
d) Of same amplitude

276. In a two-slit experiment, with monochromatic light, fringes are obtained on a screen placed at some distance from the slits. If the screen is moved by $5 \times 10^{-2} m$ towards slits, the change in fringe width is $10^{-3} m$ Then the wavelength of light used is (given that distance between the slits is $0.03 mm$)

a) 4000 Å
b) 4500 Å
c) 5000 Å
d) 6000 Å

277. Electromagnetic waves are transverse in nature is evident by

a) Polarization
b) Interference
c) Reflection
d) Diffraction

278. A polarizer is used to

a) Reduce intensity of light
b) Produce polarized light
c) Increase intensity of light
d) Produce unpolarised light

279. In case of linearly polarized light, the magnitude of the electric field vector

a) Does not change with time
b) Varies periodically with time
c) Increases and decreases linearly with time
d) Is parallel to the direction of propagation

280. In young's double slit experiment, the intensity of the maxima is$I$. If the width of each slit is doubled, the intensity if the maxima will be

a) $I/2$
b) $2I$
c) $4I$
d) I

281. The speed of electromagnetic wave in vacuum depends upon the source of radiation

a) Increases as we move from γ-rays to radio waves
b) Decreases as we move from γ-rays to radio waves
c) Is same for all of them
d) None of these

282. In Young's double slit experiment the amplitudes of two sources are $3a$ and a respectively. The ratio of intensities of bright and dark fringes will be

a) 3 : 1
b) 4 : 1
c) 2 : 1
d) 9 : 1

283. Illumination of the sun at noon is maximum because

a) Scattering is reduced at noon
b) Refraction of light is minimum at noon
c) Rays are incident almost normally
d) The sun is nearer to earth at noon

284. The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to $\frac{I}{8}$. The thickness of lead which will reduce the intensity to $\frac{I}{2}$ will be

a) 18 mm
b) 12 mm
c) 6 mm
d) 9 mm

285. The pressure exerted by an electromagnetic wave of intensity $I(watts/m^2)$ on a nonreflecting surface is [c is the velocity of light]

a) Ic
b) Ic^2
c) I/c
d) I/c^2

286. In an interference experiment, third bright fringes are obtained at a point on the screen with a light of 700 nm. What should be the wavelength of the light source in order to obtain 5th bright fringe at the same point?

a) 630 nm
b) 500 nm
c) 420 nm
d) 750 nm

287. A slit of width a is illuminated with a monochromatic light of wavelength λ from a distant source and the diffraction pattern is observed on a screen placed at a distance D from the slit. To increase the width of the central maximum one should

a) Decrease D
b) Decrease a
c) Decrease λ
d) The width cannot be changed

288. Light from two coherent sources of the same amplitude A and wavelength λ illuminates the screen. The intensity of the central maximum is I_0. If the sources were incoherent, the intensity at the same point will be

a) $4I_0$
b) $2I_0$
c) I_0
d) $\frac{I_0}{2}$

289. Two parallel slits 0.6 mm apart are illuminated by light source of wavelength 6000 Å. The distance

between two consecutive dark fringes on a screen 1 m away from the slits is

a) 1 mm b) 0.01 mm c) 0.1 m d) 10 m

290. As a result of interference of two coherent sources of light energy is

a) Redistributed and the distribution does not very with time

b) Increased

c) Redistributed and that distribution changes with time

d) Decreased

291. Which of the following statements indicates that light waves are transverse

a) Light waves can travel in vacuum b) Light waves show interference

c) Light waves can be polarized d) Light waves can be diffracted

292. Huygen's principle of secondary wavelets may be used to

a) Find the velocity of light in vacuum b) Explain the particle behavior of light

c) Find the new position of the wavefront d) Explain photoelectric effect

293. To demonstrate the phenomenon of interference, we require two sources which emit radiation

a) Of the same frequency and having a definite phase relationship b) Of nearly the same frequency

c) Of the same frequency d) Of different wavelengths

294. The electric and the magnetic field, associated with an e.m. wave propagating along the $+z$-axis, can be represented by

a) $[\vec{E}=E_0\hat{j},\vec{B}=B_0\hat{k}]$ b) $[\vec{E}=E_0\hat{j},\vec{B}=B_0\hat{j}]$ c) $[\vec{E}=E_0\hat{k},\vec{B}=B_0\hat{i}]$ d) $[\vec{E}=E_0\hat{j},\vec{B}=B_0\hat{i}]$

295. In Young's double slit experiment with sodium vapour lamp of wavelength 589 nm and the slits 0.589 mm apart, the half angular width of the central maximum is

a) $\sin^{-1}(0.01)$ b) $\sin^{-1}(0.0001)$ c) $\sin^{-1}(0.001)$ d) $\sin^{-1}(0.1)$

296. In Young's double slit experiment intensity at a point is (1/4) of the maximum intensity. Angular position of this point is

a) $\sin^{-1}(\lambda/d)$ b) $\sin^{-1}(\lambda/2d)$ c) $\sin^{-1}(\lambda/3d)$ d) $\sin^{-1}(\lambda/4d)$

297. If the separation between slits in Young's double slit experiment is reduced to $\frac{1}{3}rd$, the fringe width becomes n times. The value of n is

a) 3 b) $\frac{1}{3}$ c) 9 d) $\frac{1}{9}$

298. Wave nature of light follows because

a) Light rays travel in a straight line

b) Light exhibits the phenomena of reflection and refraction

c) Light exhibits the phenomena of interference

d) Light causes the phenomena of photoelectric effect

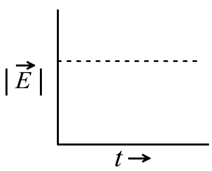
299. Which radiation in sunlight, causes heating effect

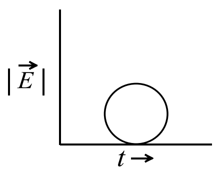
a) Ultraviolet b) Infrared c) Visible light d) All of these

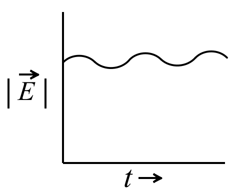
300. In a given direction, the intensities of the scattered light by a scattering substance for two beams of light are in the ratio of 256 : 81. The ratio of the frequency of the first beam to the frequency of the second beam is

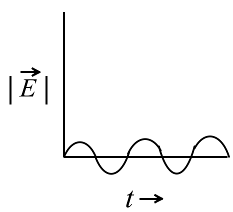
a) 64 : 127 b) 1 : 2 c) 64 : 27 d) None of these

301. Which of the following diagrams represent the variation of electric field vector with time for a circularly polarized light

a) 

b) 

c) 

d) 

302. In a Young's experiment, one of the slits is covered with a transparen't sheet of thickness 3.6×10^{-3} cm due to which position of central fringe shifts to a position originally occupied by 30th fringe. The refractive

index of the sheet, if $\lambda = 6000$ Å, is

a) 1.5 b) 1.2 c) 1.3 d) 1.7

303. The range of wavelength of the visible light is

a) 10 Å to 100 Å b) 4,000 Å to 8,000 Å c) 8,000 Å to 10,000 Å d) 10,000 Å to 15,000 Å

304. Radius of central zone of circular zone plate is $2.3mm$. Wavelength of incident light is 5893 Å. Source is at a distance of $6m$. Then the distance of first image will be

a) $9m$ b) $12m$ c) $24m$ d) $36m$

305. 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) $\frac{2c}{5}$

306. The phenomenon of polarization of light indicates that

a) Light is a longitudinal wave

b) Light is a transverse wave

c) Light is not a wave

d) Light travels with the velocity of 3×10^8 ms^{-1}

307. When unpolarised light beam is incident from air onto glass ($n = 1.5$) at the polarizing angle

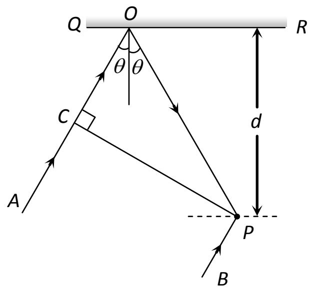
a) Reflected beam is polarized 100 percent

b) Reflected and refracted beams are partially polarized

c) The reason for (a) is that almost all the light is reflected

d) All of the above

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



a) $\cos\theta = 3\lambda/2d$ b) $\cos\theta = \lambda/4d$ c) $\sec\theta - \cos\theta = \lambda/d$ d) $\sec\theta - \cos\theta = 4\lambda/d$

309. The sun is rotating about its own axis. The spectral lines emitted from the two ends of its equator, for an observer on the earth, will show

a) Shift towards red end

b) Shift towards violet end

c) Shift towards red end by one line and towards violet end by other

d) No shift

310. Evidence for the wave nature of light cannot be obtained from

a) Reflection b) Doppler effect c) Interference d) Diffraction

311. 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 4th bright fringe of 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

312. A single slit Fraunhofer diffraction pattern is formed with white light. For what wavelength of light the third secondary maximum in the diffraction pattern coincides with the second secondary maximum in the pattern for red light of wavelength 6500Å?

a) 4400 Å b) 4100 Å c) 4642.8 Å d) 9100 Å

313. A narrow slit of width $2mm$ is illuminated by monochromatic light of wavelength $500nm$. The distance between the first minima on either side on a screen at a distance of $1m$ is

a) $5mm$ b) $0.5mm$ c) $1mm$ d) $10mm$

314. Which of following can not be polarized

a) Radio waves b) Ultraviolet rays c) Infrared rays d) Ultrasonic waves

315. In Young's experiment, the distance between the slits is reduced to half and the distance between the slit and screen is doubled, then the fringe width

a) Will not change b) Will become half

c) Will be doubled d) Will become four times

316. In a Young's double slit experiment using red and blue lights of wavelengths 600 nm and 480 nm respectively, the value of n from which the n^{th} red fringe coincides with $(n+1)$ the blue fringe is

a) 5 b) 4 c) 3 d) 2

317. In Young's experiment, the third bright band for light of wavelength 6000 Å coincides with the fourth bright band for another source of light in the same arrangement. Then the wavelength of second source is

a) 3600 Å b) 4000 Å c) 5000 Å d) 4500 Å

318. In Fresnel's biprism $(\mu = 1.5)$ experiment the distance between source and biprism is 0.3 m and that between biprism and screen is 0.7m and angle of prism is 1°. The fringe width with light of wavelength 6000 Å will be

a) 3 cm b) 0.011 cm c) 2 cm d) 4 cm

319. The rectilinear propagation of light in a medium is due to its

a) High Velocity b) Large wavelength c) High frequency d) Source

320. If an interference pattern has maximum and minimum intensities in 36 : 1 ratio then what will be the ratio of amplitudes

a) 5 : 7 b) 7 : 4 c) 4 : 7 d) 7 : 5

321. Light of wavelength 500nm is used to form interference pattern in Young's double slit experiment. A uniform glass plate of refractive index 1.5 and thickness 0.1nm is introduced in the path of one of the interfering beams. The number of fringes which will shift the cross wire due to this is

a) 100 b) 200 c) 300 d) 400

322. If white light is used in the Newton's rings experiment, the colour observed in the reflected light is complementary to that observed in the transmitted light is complementary to that observed in the transmitted light through the same point. This is due to

a) 90° change of phase in one of the reflected waves

b) 180° change of phase in one of the reflected waves

c) 145° change of phase in one of the reflected waves

d) 45° change of phase in one of the reflected waves

323. A beam of light of wavelength 600 nm from a distance source falls on a single slit 1.00 mm wide and the resulting diffraction pattern is observed on a screen 2m 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

324. Air has refractive index 1.003, the thickness of air column, which will have one more wave length of yellow light (6000 Å) than in the same thickness of vacuum is

a) 2 mm b) 2 cm c) 2 m d) 2 km

325. Two stars are situated at a distance of 8 light year from the earth. These are to be just resolved by a telescope of diameter 0.25 m. If the wavelength of light used is 5000Å, then the distance between the stars must be

a) 3×10^{10} m b) 3.35×10^{11} m c) 1.95×10^{11} m d) 4.32×10^{10} m

326. Electromagnetic waves travel in a medium which has relative permeability 1.3 and relative permittivity 2.14. Then the speed of the electromagnetic wave in the medium will be

a) $13.6 \times 10^{6}\ m/s$ b) $1.8 \times 10^{2}\ m/s$ c) $3.6 \times 10^{8}\ m/s$ d) $1.8 \times 10^{8}\ m/s$

327. In Fresnel's biprism experiment, on increasing the prism angle, fringe width will

a) Increase b) Decrease

c) Remain unchanged d) Depend on the position of object

328. A slit 5 cm wide is irradiated normally with microwaves of wavelength 1.0 cm. Then the angular spread of

the central maximum on either side if incident light is nearly

a) 1/5 rad b) 4 rad c) 5 rad d) 6 rad

329. Which of the following phenomena can explain quantum nature of light

a) Photoelectric effect b) Interference c) Diffraction d) Polarization

330. Two slits, 4 mm apart are illuminated by light of wavelength600 Å. What will be the fringe width on a screen placed 2 m from the slits?

a) 0.12 mm b) 0.3 mm c) 3.0 mm d) 4.0 mm

331. Consider the following statements in case of Young's double slit experiment.

I. A slit $S$is necessary if we use an ordinary extended source of light.

II. A slit $S$is not needed if we use an ordinary but well collimated beam of light.

III. A slit $S$is not needed if we use a spetially coherent source of light.

Which of the above statement are correct?

a) (i)And (iii) b) (ii) and (iii) c) (i)and (ii) d) (i), (b) and (iii)

332. For skywave propagation of a 10 MHz signal, what should be the maximum electron density in ionosphere

a) $\sim 1.2 \times 10^{12} m^{-3}$ b) $\sim 10^{6} m^{-3}$ c) $\sim 10^{14} m^{-3}$ d) $\sim 10^{22} m^{-3}$

333. In a Young's double slit experiment the intensity at a point where the path difference is $\frac{\lambda}{6}$(λ being the wavelength of the light used) is I. If I_0 denotes the maximum intensity, I/I_0 is equal to

a) $\frac{1}{\sqrt{2}}$ b) $\frac{\sqrt{3}}{2}$ c) $\frac{1}{2}$ d) $\frac{3}{4}$

334. Two sources of waves are called coherent if

a) Both have the same amplitude of vibrations

b) Both produce waves of the same wavelength

c) Both produce waves of the same wavelength having constant phase difference

d) Both produce waves having the same velocity

335. 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

336. nth Bright fringe if red light $(\lambda_1 = 7500 \text{ Å})$ coincides with $(n+1)^{th}$ bright fringe of green light$(\lambda_2 = 6000\, Å$. The value of n=?

a) 4 b) 5 c) 3 d) 2

337. Which of the following statements is true, when spherical waves fall on a plane refracting surface, separating two media

a) The reflected waves form spherical wave fronts

b) The reflected waves form plane wave fronts

c) The refracted waves form plane wave fronts

d) There are no refracted waves

338. Brewster's angle in terms of refractive index (n) of the medium

a) $\tan^{-1}[\sqrt{n}]$ b) $\sin^{-1}[n]$ c) $\sin^{-1}[\sqrt{n}]$ d) $\tan^{-1}[n]$

339. In double slit experiment, for light of which colour the fringe width will be minimum

a) Violet b) Red c) Green d) Yellow

340. If a white light is used in Young's double slit experiments then a very large number of coloured fringes can be seen

a) With first order violet fringes being closer to the central white fringes

b) First order red fringes being closer to the central white fringes

c) With a central white fringe

d) With a central black fringe

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

a) 1.75 b) 1.50 c) 1.25 d) 1.00

342. Two waves are represented by the equations $y_1 = a \sin \omega t$ and $y_2 = a \cos \omega t$. The first wave

a) Leads the second by π b) Lags the second by π

c) Leads the second by $\frac{\pi}{2}$ d) Lags the second by $\frac{\pi}{2}$

343. In a Young' s double slit experiment, the intensity at a point where the path difference is $\frac{\lambda}{6}$ where(λ is wavelength of the light) is I. I f I_0denotes the maximum intensity, then $\frac{I}{I_0}$ is equal to

a) $\frac{1}{2}$ b) $\frac{\sqrt{3}}{2}$ c) $\frac{1}{\sqrt{2}}$ d) $\frac{3}{4}$

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

a) Hyperbola b) Circle c) Straight line d) Parabola

345. In a 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

346. Two waves $y_1 = A_1 \sin(\omega t - \beta_1)$ and $y_2 = A_2 \sin(\omega t - \beta_2)$ superimpose to form a resultant wave whose amplitude is

a) $\sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos(\beta_1 - \beta_2)}$ b) $\sqrt{A_1^2 + A_2^2 + 2A_1A_2 \sin(\beta_1 - \beta_2)}$

c) $A_1 + A_2$ d) $|A_1 + A_2|$

347. 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

348. A plane electromagnetic wave of wave intensity 6 W/m^2 strikes a small mirror area 40 cm^2, held perpendicular to the approaching wave. The momentum transferred by the wave to the mirror each second will be

a) $6.4 \times 10^{-7} kg - m/s^2$ b) $4.8 \times 10^{-8} kg - m/s^2$

c) $3.2 \times 10^{-9} kg - m/s^2$ d) $1.6 \times 10^{-10} kg - m/s^2$

349. The dual nature of light is exhibited by

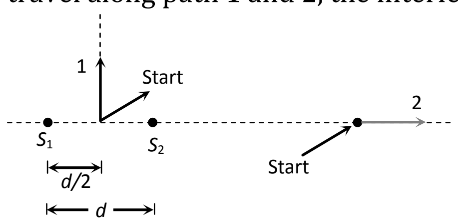
a) Photoelectric effect b) Refraction and interference

c) Diffraction and reflection d) Diffraction and photoelectric effect

350. The wavelength of the light used in Young's double slit experiment is λ. The intensity at a point on the screen is I, where the path difference is $\frac{\lambda}{6}$. If I_0 denotes the maximum intensity, then the ratio of I and I_0 is

a) 0.866 b) 0.5 c) 0.707 d) 0.75

351. Following figure shows sources S_1 and S_2 that emits light of wavelength λ in all directions. The sources are exactly in phase and are separated by a distance equal to 1.5λ. If we start at the indicated start point and travel along path 1 and 2, the interference produce a maxima all along



a) Path 1 b) Path 2 c) Any path d) None of these

352. An electromagnetic wave in vacuum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then

a) $\vec{X}||\vec{B}$ and $\vec{k}||\vec{B} \times \vec{E}$ b) $\vec{X}||\vec{E}$ and $\vec{k}||\vec{E} \times \vec{B}$ c) $\vec{X}||\vec{B}$ and $\vec{k}||\vec{E} \times \vec{B}$ d) $\vec{X}||\vec{E}$ and $\vec{k}||\vec{B} \times \vec{E}$

353. Two coherent sources of different intensities send waves which interfere. The ratio of maximum intensity to the minimum intensity is 25. The intensities of the sources are in the ratio

a) 25 : 1 b) 5 : 1 c) 9 : 4 d) 25 : 16

354. Which of the following is not an essential condition for interference?

a) The two interfering waves must be propagated in almost the same direction or the two interfering waves must intersect at very small angle

b) The wave must have the same period and wavelength

c) The amplitude of the two waves must be equal

d) The two interfering beams of light must originate from the same source

355. 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 $PB - PA = \lambda/4$. Then the phase difference between the waves from A and B reaching P is

a) 156° b) 140° c) 136° d) 126°

356. Wave nature of light is verified by

a) Interference b) Photoelectric effect c) Reflection d) Refraction

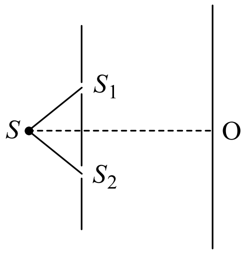
357. Heat radiations propagate with the speed of

a) α-rays b) β-rays c) Light waves d) Sound waves

358. A new system of units is evolved in which the values of μ_0 and ϵ_0 are 2 and 8 respectively. Then the speed of light in this system will be

a) 0.25 b) 0.5 c) 0.75 d) 1

359. In the set up shown in figure, the two slits S_1 and S_2 are not equidistant from the slit S. The central fringe at O is, then



a) Always bright

b) Always dark

c) Either dark or bright depending on the position of S

d) Neither dark nor bright

360. Critical angle for certain medium is $\sin^{-1}(0.6)$. The polarizing angle of that medium is

a) $\tan^{-1}[1.5]$ b) $\sin^{-1}[0.8]$ c) $\tan^{-1}[1.6667]$ d) $\tan^{-1}[0.6667]$

361. A zone plate of focal length $60cm$, behaves as a convex lens, If wavelength of incident light is 6000 Å, then radius of first half period zone will be

a) $36 \times 10^{-8}m$ b) $6 \times 10^{-8}m$ c) $\sqrt{6} \times 10^{-8}m$ d) $6 \times 10^{-4}m$

362. 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 solutions 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°

363. In an apparatus, the electric field was found to oscillate with an amplitude of 18 V/m. The magnitude of the oscillating magnetic field will be

a) $4 \times 10^{-6}T$ b) $6 \times 10^{-8}T$ c) $9 \times 10^{-9}T$ d) $11 \times 10^{-11}T$

364. The dielectric constant of air is 1.006. The speed of electromagnetic wave travelling in air is $a \times 10^8 ms^{-1}$, where a is about

a) 3 b) 3.88 c) 2.5 d) 3.2

365. In Young's double slit experiment, the spacing between the slits is d and wavelength of light used is 6000Å. If the angular width of a fringe formed on a distance screen is 1°, then value of d is

a) 1 mm b) 0.05 mm c) 0.03 mm d) 0.01 mm

366. In Young's double slit experiment, the aperture screen distance is 2 m. The slit width is 1 mm. Light of 600 nm is used. If a thin plate of glass ($\mu - 1.5$) of thickness 0.06 mm is placed over one of the slits, then there will be a lateral displacement of the fringes by

a) Zero b) 6 cm c) 10 cm d) 15 cm

367. Four independent waves are represented by equations

VIII. $X_1 = a_1 \sin \omega t$

IX. $X_2 = a_1 \sin 2\,\omega t$

X. $X_3 = a_1 \sin \omega_1 t$

XI. $X_4 = a_1 \sin(\omega t + \delta)$

Interference is possible between waves represented by equation

a) 3 and 4 b) 1 and 2 c) 2 and 3 d) 1 and 4

368. In the Young's double slit experiment, the central maxima are observed to beI_0. If one of the slits is covered, then the intensity at the central maxima will become

a) $\frac{I_0}{2}$ b) $\frac{I_0}{\sqrt{2}}$ c) $\frac{I_0}{4}$ d) I_0

369. Which of the following represents an infrared wavelength

a) $10^{-4}\ cm$ b) $10^{-5}\ cm$ c) $10^{-6}\ cm$ d) $10^{-7}\ cm$

370. Two identical light sources S_1 and S_2 emit light of same wavelength λ. These light rays will exhibit interference if

a) Their phase differences remain constant

b) Their phases are distributed randomly

c) Their light intensities remain constant

d) Their light intensities change randomly

371. 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

372. The electric field associated with an e.m. wave in vacuum is given by $\vec{E} = \hat{\imath}\, 40 \cos(kz - 6 \times 10^8 t)$, where E, z and t are in $volt/m$, meter and seconds respectively. The value of wave vector k is

a) $2m^{-1}$ b) $0.5m^{-1}$ c) $6m^{-1}$ d) $3m^{-1}$

373. 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

374. How fast a person should drive his car so that the red signal of light appears green? (Wavelength for red colour = 6200Å and wavelength for green colour = 5400Å)

a) $1.5 \times 10^8 m/s$ b) $7 \times 10^7 m/s$ c) $3.9 \times 10^7 m/s$ d) $2 \times 10^8 m/s$

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

a) $\frac{2\pi}{\lambda}(L_2 - L_1)$ b) $\frac{2\pi}{\lambda}(n_1 L_1 - n_2 L_2)$ c) $\frac{2\pi}{\lambda}(n_2 L_1 - n_1 L_2)$ d) $\frac{2\pi}{\lambda}\left(\frac{L_1 - L_2}{n_1 - n_2}\right)$

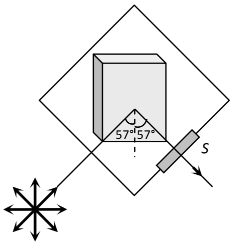
376. On introducing a thin film in the path of one of the two interfering beams, the central fringe will shift by one fringe width. If $\mu - 1.5$, the thickness of the film is (wavelength of monochromatic light is λ)

a) 4λ b) 3λ c) 2λ d) λ

377. In Young's double slit experiment, the length if band is 1 mm. The ring width is 1.021 mm. The number of fringe is

a) 45 b) 46 c) 47 d) 48

378. Figure represents a glass plate placed vertically on a horizontal table with a beam of unpolarised light falling on its surface at the polarizing 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

379. Huygen's conception of secondary waves
a) Allow us to find the focal length of a thick lens
b) Is a geometrical method to find a wavefront
c) Is used to determine the velocity of light
d) Is used to explain polarization

380. An electromagnetic wave propagating along north has its electric field vector upwards. Its magnetic field vector point towards
a) North b) East c) West d) Downwards

381. In a single slit diffraction experiment first minimum for red light (660 nm) coincides with first maximum of some other wavelength λ'. The value of λ' is
a) 4400 Å b) 6600 Å c) 2000 Å d) 3500 Å

382. In Young's double slit experiment with sodium vapour lamp of wavelength 589 nm and the slits 0.589 mm apart, the half angular width of the central maximum is
a) $\sin^{-1} 0.01$ b) $\sin^{-1} 0.0001$ c) $\sin^{-1} 0.001$ d) $\sin^{-1} 0.1$

383. Infrared radiation was discovered in 1800 by
a) William Wollaston b) William Herschel c) Wilhelm Roentgen d) Thomas Young

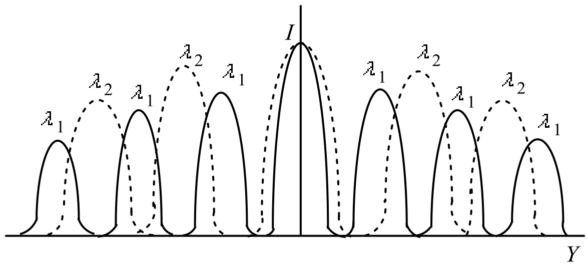
384. By Huygen's wave theory of light, we cannot explain the phenomenon of
a) Interference b) Diffraction c) Photoelectric effect d) Polarization

385. A single slit is used to observe diffraction pattern with red light. On replacing the red light with violet light the diffraction pattern would
a) Remain unchanged b) Become narrower c) Become broader d) Disappear

386. The width of the diffraction band varies
a) Inversely as the wavelength
b) Directly as the width of the slit
c) Directly as the distance between the slit and the screen
d) Inversely as the size of the source from which the slit is illuminated

387. The angular width of the central maximum of the diffraction pattern in a single slit (of width $'a'$) experiment, with λ as the wavelength of light is
a) $\frac{3\lambda}{2a}$ b) $\frac{\lambda}{2a}$ c) $\frac{2\lambda}{a}$ d) $\frac{\lambda}{a}$

388. Following diffraction pattern was obtained using a diffraction grating using two different wavelengths λ_1 and λ_2. With the help of the figure identify which is the longer wavelength and their ratios.



a) λ_2 is longer than λ_1 and the ratio of the longer to the shorter wavelength is 1.5
b) λ_1 is longer than λ_2 and the ratio of the longer to the shorter wavelength is 1.5
c) λ_1 and λ_2 are equal and their ratio is 1.0
d) λ_2 is longer than λ_1 and the ratio of the longer to the shorter wavelength is 2.5

389. The ozone layer absorbs
a) Infrared radiations b) Ultraviolet radiations c) X-rays d) γ-rays

390. A plane electromagnetic wave is incident on a material surface. If the wave delivers momentum p and energy E, then
a) $p = 0, E = 0$ b) $p \neq 0, E \neq 0$ c) $p \neq 0, E = 0$ d) $p = 0, E \neq 0$

391. The magnetic field in a plane electromagnetic wave is given by
$B_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$
This electromagnetic wave is
a) A visible light b) An infrared wave c) A microwave d) A radio wave

392. The radiation pressure (in N/m^2) of the visible light is of the order of
a) 10^{-2} b) 10^{-4} c) 10^{-6} d) 10^{-8}

393. The phenomenon of interference is shown by
a) Longitudinal mechanical waves only b) Transverse mechanical waves only
c) Electromagnetic waves only d) All the above types of waves

394. In Young's double slit experiment we get 60 fringes in the field of view of monochromatic light of wavelength 4000Å. If we use monochromatic light of wavelength 6000 Å, then the number of fringes obtained in the same field of view are
a) 60 b) 90 c) 40 d) 1.5

395. When a beam of light is used to determine the position of an object, the maximum accuracy is achieved if the light is
a) Polarized b) Of longer wavelength
c) Of shorter wavelength d) Of high intensity

396. Three observers A, B and C measure the speed of light coming from a source to be v_A, v_B and v_C. The observer A moves towards the source, the observer C moves away from the source with the same speed. The observer B stays stationary, the surrounding space is vacuum every where. Then
a) $v_A > v_B > v_C$ b) $v_A < v_B < v_C$ c) $v_A = v_B = v_C$ d) $v_A = v_B > v_C$

397. Intensities of the two waves of light are I and $4I$. The maximum intensity of the resultant wave after superposition is
a) $5\,I$ b) $9\,I$ c) $16\,I$ d) $25\,I$

398. The waves of wavelength 5900 Å emitted by any atom or molecule must have some finite total length which is known as coherence length. For sodium light, this length is 2.4 cm. The number of oscillations in this length will be
a) 4.068×10^8 b) 4.068×10^4 c) 4.068×10^6 d) 4.068×10^5

399. If white light is used in a biprism experiment then
a) Fringe pattern will be disappears
b) All fringe will be coloured
c) Central fringe will be white while others will be coloured
d) Central fringe will be dark

400. If separation between screen and source is increased by 2%, what would be the effect on the intensity
a) Increases by 4% b) Increases by 2% c) Decreases by 2% d) Decreases by 4%

401. When a compact disc is illuminated by a source of white light, coloured 'lanes' are observed. This is due to
a) Dispersion b) Diffraction c) Interference d) Refraction

402. Two coherent sources of intensities I_1 and I_2 produce an interference pattern. The maximum intensity in the interference pattern will be
a) $I_1 + I_2$ b) $I_1^2 + I_2^2$ c) $(I_1 + I_2)^2$ d) $\left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

403. The phase difference between incident wave and reflected wave is 180° when light ray

a) Enters into glass from air
b) Enters into air from glass
c) Enters into glass from diamond
d) Enters into water from glass

404. Wavefront of a wave has direction with wave motion
a) Parallel
b) Perpendicular
c) Opposite
d) At an angle of θ

405. Light is incident on a glass surface at polarizing angle of 57.5°. Then the angle between the incident ray and the refracted ray is
a) 57.5°
b) 115°
c) 65°
d) 205°

406. Through which character we can distinguish the light waves from sound waves
a) Interference
b) Refraction
c) Polarization
d) Reflection

407. 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 incident beam. At the first maximum of the diffraction pattern, the phase difference between the rays coming from the edges of the slit is
a) 0
b) $\frac{\pi}{2}$
c) π
d) 2π

408. The principle of superposition is basic to the phenomenon of
a) Total internal reflection
b) Interference
c) Reflection
d) Refraction

409. The observed wavelength of light coming from a distant galaxy is found to be increased by 0.5% as compared with that coming from a terrestrial source. The galaxy is
a) Stationary with respect to the earth
b) Approaching the earth with velocity of light
c) Receding from the earth with the velocity of light
d) Receding from the earth with a velocity equal to $1.5 \times 10^6 m/s$

410. The equations of displacement of two waves are given as $y_1 = 10 \sin(3\pi t + \pi/3)$ $y_2 = 5(\sin 3\pi t + 3\cos 3\pi t$, then what is the ratio of their amplitude?
a) 1:2
b) 2:1
c) 1:1
d) None of these

411. Through quantum theory of light we 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) Photoelectric effect
b) Diffraction
c) Compton effect
d) Black body radiation

412. If the shift of wavelength of light emitted by a star is towards violet, then this shows that star is
a) Stationary
b) Moving towards earth
c) Moving away from earth
d) Information is incomplete

413. What is the path difference of destructive interference
a) $n\lambda$
b) $n(\lambda + 1)$
c) $\frac{(n+1)\lambda}{2}$
d) $\frac{(2n+1)\lambda}{2}$

414. Two light sources are said to be of coherent nature
a) When they have same frequency and a varying phase difference
b) When they have same frequency and a constant phase difference
c) When they have constant phase difference and different frequencies
d) When they have varying phase difference and different frequencies

415. A star is moving away from the earth with a velocity of 100 km/s. If the velocity of light is $3 \times 10^8 m/s$ then the shift of its spectral line of wavelength 5700 Å due to Doppler's effect will be
a) 0.63Å
b) 1.90Å
c) 3.80Å
d) 5.70Å

416. In an interference experiment, third bright fringe is obtained at a point on the screen with a light of 700 nm. What should be the wavelength of the light source in order to obtain 5^{th} bright fringe at the same point?
a) 500 nm
b) 630 nm
c) 750 nm
d) 420 nm

417. If the amplitude ratio of two sources producing interference is 3 : 5, the ratio of intensities at maxima and minima is
a) 25 : 16
b) 5 : 3
c) 16 : 1
d) 25 : 9

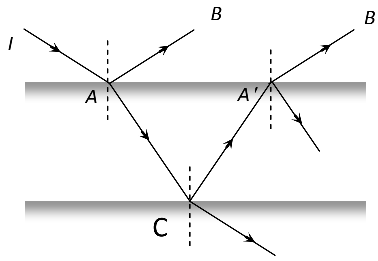
418. In Young's double slit experiment, the aperture screen distance is $2m$. The fringe width is 1 mm. Light of 600 nm is used. If a thin plate of glass ($\mu = 1.5$) of thickness 0.06 mm is placed over one of the slits, then there will be a lateral displacement of the fringes by

a) 0 cm b) 5 cm c) 10 cm d) 15 cm

419. In a two slit experiment with monochromatic light fringes are obtained on a screen placed at some distance from the slits. If the screen is moved by $5 \times 10^{-2}m$ towards the slits, the change in fringe width is $3 \times 10^{-5}m$. 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

420. A ray of light of intensity I is incident on a parallel glass-slab at a point A as shown in fig. 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

421. The wave front due to a source situated at infinity is

a) Spherical b) Cylindrical c) Planar d) None of these

422. In the propagation of light waves, the angle between the direction of vibration and plane of polarization is

a) 0° b) 90° c) 45° d) 80°

423. In Young's double slit experiment, the distance between the slits is 1 mm and that between slit and screen is 1 meter and 10th fringe is 5 mm away from the central bright fringe, then wavelength of light used will be

a) 5000 Å b) 6000 Å c) 7000 Å d) 8000 Å

424. Which of the following cannot be explained on the basis of wave nature of light?

(i) Polarization

(ii) Optical activity

(iii) Photoelectric effect

(iv) Compton effect

a) (ii) and (iv) b) (ii) and (iii) c) (i) and (iii) d) (ii) and (iv)

425. An unpolarised beam of intensity I_0 falls on a polariod. The intensity of the emergent light is

a) $\frac{I_0}{2}$ b) I_0 c) $\frac{I_0}{4}$ d) Zero

426. The two slits are 1mm apart from each other and illuminated with a light of wavelength $5 \times 10^{-7}m$. If the distance of the screen is 1 m from the slits, then the distance between third dark fringe and fifth bright fringe is

a) 1.5 mm b) 0.75 mm c) 1.25 mm d) 0.625 mm

427. A. The wavelength of microwaves is greater than that of UV-rays

B. The wavelength of IR rays is lesser than that of UV-rays

C. The wavelength of microwaves is lesser than that of IR rays

D. Gamma rays has shortest wavelength in the electromagnetic spectrum

Of the above statements

a) A and B are true b) B and C are true c) C and D are true d) A and D are true

428. In Young's double slit experiment the two slits are d distance apart. Interference pattern is observed on a screen at a distance D from the slits. A dark fringe is observed on the screen directly opposite to one of the slits. The wavelength of light is

a) $\frac{D^2}{2d}$ b) $\frac{d^2}{2D}$ c) $\frac{D^2}{d}$ d) $\frac{d^2}{D}$

429. In a Young's double slit experiment, the two slits act as coherent sources of waves of equal amplitude A and wavelength λ. In another experiment with the same arrangement the two slits are made to act as incoherent sources of waves of same amplitude and wavelength. If the intensity at the middle point of the screen in the first case is I_1 and in the second case I_2, then the ratio $\frac{I_1}{I_2}$ is

a) 4 b) 2 c) 1 d) 0.5

430. 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 two slits are 5 units and 4 units respectively
b) The intensities at the screen due to two slits are 4 units and 1 units respectively
c) The amplitude ratio is 3
d) The amplitude ratio is 2

431. In Young's double slit experiment, angular width of fringes is 0.20° for sodium light of wavelength 5890 Å. If complete system is dipped in water, then angular width of fringes becomes

a) 0.11° b) 0.15° c) 0.22° d) 0.30°

432. Which one of the following is the property of a monochromatic, plane electromagnetic wave in free space

a) Electric and magnetic fields have a phase difference of $\pi/2$
b) The energy contribution of both electric and magnetic fields are equal
c) The direction of propagation is in the direction of $\vec{B} \times \vec{E}$
d) The pressure exerted by the wave is the product of its speed and energy density

433. Intensity of light depends upon

a) Velocity b) Wavelength c) Amplitude d) Frequency

434. The Young's double slit experiment is performed with blue and with 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) $x(\text{blue}) < x\ (\text{green})$ d) $\frac{x(\text{blue})}{x(\text{green})} \cdot \frac{5460}{4360}$

435. In Young's double slit experiment, the $8th$ maximum with wavelength λ_1 is at a distance d_1 from the central maximum and the $6th$ maximum with a wavelength λ_2 is at a distance d_2. Then (d_1/d_2) is equal to

a) $\frac{4}{3}\left(\frac{\lambda_2}{\lambda_1}\right)$ b) $\frac{4}{3}\left(\frac{\lambda_1}{\lambda_2}\right)$ c) $\frac{3}{4}\left(\frac{\lambda_2}{\lambda_1}\right)$ d) $\frac{3}{4}\left(\frac{\lambda_1}{\lambda_2}\right)$

436. Two identical radiators have a separation of $d = \lambda/4$ where λ is the wavelength of the waves emitted by either source. The initial phase difference between the sources is $\pi/4$. Then the intensity on the screen at a distant point situated at an angle $\theta = 30°$ from the radiators is (here I_o is intensity at that point due to one radiator alone)

a) I_o b) $2I_o$ c) $3I_o$ d) $4I_o$

437. In a biprism experiment, by using light of wavelength5000 Å, 5mm wide fringes are obtained on a screen 1.0 m away from the coherent sources. The separation between the two coherent sources is

a) 1.0 mm b) 0.1 mm c) 0.05 mm d) 0.01 mm

438. For constructive interference to take place between two monochromatic light waves of wavelength λ, the path difference should be

a) $(2n-1)\frac{\lambda}{4}$ b) $(2n-1)\frac{\lambda}{2}$ c) $n\lambda$ d) $(2n+1)\frac{\lambda}{2}$

439. Which phenomenon best supports the theory that matter has a wave nature?

a) Electron momentum b) Electron diffraction c) Photon momentum d) Photon diffraction

440. In Young's double slit interference pattern the fringe width

a) Can be changed only by changing the wavelength of incident light
b) Can be changed only by changing the separation between the two slits
c) Can be changed either by changing the wavelength or by changing the separation between two sources
d) Is a universal constant and hence cannot be changed

441. The electric field of an electromagnetic wave in free space is given by $\vec{E} = 10\cos(10^7 t + kx)\hat{j}\ V/m$, where t and x are in seconds and metres respectively. It can be inferred that

(1) The wavelength λ is 188.4 m
(2) The wave number k is 0.33 rad/m
(3) The wave amplitude is 10 V/m
(4) The wave is propagating along $+x$ direction
Which one of the following pairs of statements is correct
a) (3) and (4) b) (1) and (2) c) (2) and (3) d) (1) and (3)

442. The electric and magnetic field of an electromagnetic wave are
a) In phase and parallel to each other
b) In opposite phase and perpendicular to each other
c) In opposite phase and parallel to each other
d) In phase and perpendicular to each other

443. In Young's double slit experiment, the slit width and the distance of slits from the screen both are doubled. The fringe width
a) Increases b) Decreases c) Remains unchanged d) None of these

444. What is ozone hole
a) Hole in the ozone layer
b) Formation of ozone layer
c) Thinning of ozone layer in troposphere
d) Reduction in ozone thickness in stratosphere

445. Two slits are separated by a distance of 0.5 mm and illuminated with light of $\lambda = 6000$ Å. If the screen is placed 2.5 m from the slits. The distance of the third bright fringe from the centre will be
a) 1.5 mm b) 3 mm c) 6 mm d) 9 mm

446. Pick out the longest wavelength from the following types of radiations
a) Blue light b) γ-rays c) X-rays d) Red light

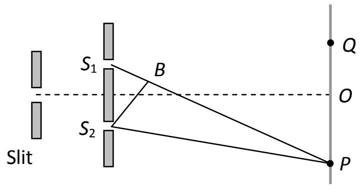
447. The bending of beam of light around corners of obstacles is called
a) Reflection b) Diffraction c) Refraction d) Interference

448. A parallel beam of light of wavelength 3141.59Å is incident on a small aperture. After passing through the aperture, the beam is no longer parallel but diverges at 1° to the incident direction. What is the diameter of the aperture?
a) 180m b) 18µm c) 1.8m d) 0.18m

449. Two sources give interference pattern which is observed on a screen, D distance apart from the sources. The fringe width is 2ω. If the distance D is now doubled, the fringe width will
a) Become $\omega/2$ b) Remain the same c) Become ω d) Become 4ω

450. In Young's experiment, the distance between slits is 0.28 mm and distance between slits and screen is 1.4 m. Distance between central bright fringe and third bright fringe is 0.9 cm. What is the wavelength of used light
a) 5000 Å b) 6000 Å c) 7000 Å d) 9000 Å

451. 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 11th fringe on the other side, as measured from Q. If the wavelength of the light used is $6000 \times 10^{-10} m$, then S_1B will be equal to



a) $6 \times 10^{-6} m$ b) $6.6 \times 10^{-6} m$ c) $3.138 \times 10^{-7} m$ d) $3.144 \times 10^{-7} m$

452. Angular width (β) of central maximum of a diffraction pattern on a single slit does not depend upon
a) Distance between slit and source
b) Wavelength of light used
c) Width of the slit
d) Frequency of light slit

453. If the sodium light in Young's double slit experiment is replaced by red light, the fringe width will
a) Decrease
b) Increase
c) Remain unaffected
d) First increase, then decrease

454. It is believed that the universe is expanding and hence the distant stars are receding from us. Light from such a star will show
a) Shift in frequency towards longer wavelengths
b) Shift in frequency towards shorter wavelengths
c) No shift in frequency but a decrease in intensity
d) A shift in frequency sometimes towards longer and sometimes towards shorter wavelengths
455. What is the effect on Fresnel's biprism experiment when the use of white light is made
a) Fringe are affected
b) Diffraction pattern is spread more
c) Central fringe is white and all are coloured
d) None of these
456. If fringe width is 0.4 mm, the distance between fifth bright and third and third dark band on same side is
a) 1 mm
b) 2 mm
c) 3 mm
d) 4 mm
457. When a thin metal plate is placed in the path of one of the interfering beams of light
a) Fringe width increases
b) Fringes disappear
c) Fringes become brighter
d) Fringes becomes blurred
458. When light is incident on a diffraction grating the zero order principal maximum will be
a) One of the component colours
b) Absent
c) Spectrum of the colours
d) White
459. Radio waves and visible light in vacuum have
a) Same velocity but different wavelength
b) Continuous emission spectrum
c) Band absorption spectrum
d) Line emission spectrum
460. An optically active compound
a) Rotates the plane polarized light
b) Changing the direction of polarized light
c) Do not allow plane polarized light to pass through
d) None of the above
461. 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) $90° - \sin^{-1}(\sin^{-1} \phi/\mu)$
462. Which of the following has/have zero average value in a plane electromagnetic wave
a) Both magnetic and electric fields
b) Electric field only
c) Magnetic field only
d) Magnetic energy
463. In a Fresnel's diffraction arrangement, the screen is at a distance of 2 meter from a circular aperture. It is found that for light of wavelengths λ_1 and λ_2, the radius of $4th$ zone for λ_1 coincides with the radius of 5^{th} zone for λ_2. Then the ratio $\lambda_1 : \lambda_2$ is
a) $\sqrt{4/5}$
b) $\sqrt{5/4}$
c) $5/4$
d) $4/5$
464. A star moves away from earth at speed 0.8 c while emitting light of frequency $6 \times 10^{14} Hz$. What frequency will be observed on the earth (in units of $10^{14} Hz$) ($c =$ speed of light)
a) 0.24
b) 1.2
c) 30
d) 3.3
465. A plane wave of wavelength 6250 Å is incident normally on a slit of width 2×10^{-2} cm. The width of the principal maximum on a screen distant 50 cm will be
a) 312.5×10^{-3} cm
b) 312.5×10^{-4} cm
c) 312 cm
d) 312.5×10^{-5} cm
466. If the intensities of the two interfering beams in Young's double alit experiment be I_1 and I_2, then the contrast between the maximum and minimum intensity is good when
a) I_1 is much greater than I_2
b) I_1 is much smaller than I_2
c) $I_1 = I_2$
d) Either $I_1 = 0$ or $I_2 = 0$
467. Two coherent sources of intensity ratio 1 : 4 produce an interference pattern. The fringe visibility will be
a) 1
b) 0.8
c) 0.4
d) 0.6
468. The electromagnetic wave having the shortest wavelength is

a) X-rays b) γ-rays c) Infrared rays d) Microwaves

469. A slit of width a is illuminated by white light. For red light ($\lambda = 6500$ Å), the first minima is obtained at $\theta = 30°$. Then the value of a will be

a) 3250 Å b) $6.5 \times 10^{-4} mm$ c) 1.24 $microns$ d) $2.6 \times 10^{-4} cm$

470. Wavefront means

a) All particles in it have same phase
b) All particles have opposite phase of vibrations
c) Few particles are in same phase, rest are in opposite phase
d) None of these

471. An electromagnetic wave of frequency $v = 3.0\ MHz$ passes from vacuum into a dielectric medium with relative permitivity $\varepsilon_r = 4.0$. Then

a) Wavelength is doubled and the frequency remains unchanged
b) Wavelength is doubled and frequency becomes half
c) Wavelength is halved and frequency remains unchanged
d) Wavelength and frequency both remain unchanged

472. Ordinary light incident on a glass slab at the polarising angle, suffers a deviation of22°. The value of the angle of refraction in glass in this case is

a) 56° b) 68° c) 34° d) 22°

473. What will be the angle of diffraction for the first order maximum due to Fraunhofer diffraction by a single slit of width 0.50 mm, using light of wavelength 500 nm?

a) 1×10^{-3} rad b) 3×10^{-3} rad c) 1.5×10^{-4} rad d) 1.5×10^{-3} rad

474. The Young' experiment is performed with the lights of blue ($\lambda = 4360$ Å) and green colour ($\lambda = 5460$Å), if the distance of the 4th fringe from the centre is x, then

a) x (Blue) $=$ x (Green) b) x(Blue) $>$ x(Green) c) x(Blue) $<$ x(Green) d) $\frac{x(Blue)}{x(Green)} = \frac{5460}{4360}$

475. In a Young's double slit experiment, the fringe width will remain same, if (D = distance between screen and plane of slits, d = separation between two slits and λ = wavelength of light used)

a) Both λ and D are doubled
b) Both d and D are doubled
c) D is doubled but d is halved
d) λ is doubled but d is halved

476. A beam of light consisting of two wavelengths 650 nm and 520 nm is used to illuminate the slit of a Young's double slit experiment. Then the order of the bright fringe of the longer wavelength that coincide with a bright fringe of the shorter wavelength at the least distance from the central maximum is

a) 1 b) 2 c) 3 d) 4

477. If white light is used in Young's double slit experiment

a) No interference pattern is formed
b) White fringes are formed
c) Central bright fringe is white
d) Central bright fringe is coloured

478. The maximum distance upto which TV transmission from a TV tower of height h can be received is proportional to

a) $h^{1/2}$ b) h c) h d) h^2

479. Which of the following generates a plane wave front?

a) $\alpha -$ rays b) $\beta -$ rays c) $\gamma -$ rays d) None of these

480. In Young's double slit experiment, the width of one of the slits is slowly increased to make it twice the width of the other slit. Then in the interference pattern

a) The intensities of maxima increase while that of minima decrease
b) The intensities of both maxima and minima decrease
c) The intensities of both maxima and minima remain the same
d) The intensities of both maxima and minima increase

481. A single slit Fraunhoffer diffraction pattern is formed with white light. For what wavelength of light the

third secondary maximum in the diffraction pattern coincides with the second secondary maximum in the pattern for red light of wavelength 6500 Å

a) 4400 Å b) 4100 Å c) 4642.8 Å d) 9100 Å

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

a) 15° b) 0° c) 20° d) 10°

483. Two coherent sources of intensity ratio 1:4 produce an interference pattern. The fringe visibility will be

a) 1 b) 0.8 c) 0.4 d) 0.6

484. Two polaroids are kept crossed to each other. Now one of them us rotated through an angle of 45°. The percentage of incident light now transmitted through the system is

a) 15% b) 25% c) 50% d) 60%

485. In Young's double slit experiment, the interference pattern is found to have an intensity ratio between bright and dark fringes is 9, this implies that

a) The intensities at the screen due to two slits are 5 units and 4 units respectively

b) The intensities at the screen due to the two slits are 4 units and 1 units, respectively

c) The amplitude ratio is 7

d) The amplitude ratio is 6

486. Interference may be seen using two independent

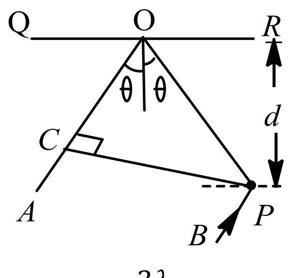
a) Sodium lamps b) Fluorescet tubes

c) Lasers d) Mercury vapour lamps

487. In a Young's double slit experiment, the separation between the two slits is 0.9 mm and the fringes are observed 1 m away. If it produces the second dark fringes at a distance of 1 mm from the central fringe, the wavelength of the monochromatic source of light used is

a) 450 nm b) 400 nm c) 5002 nm d) 600 nm

488. In the adjacent diagram, CP represents a wavefront and AO and BP, the corresponding two rays. Find the condition on θ for constructive interference at Pbetween 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) $\sec\theta - \cos\theta = \frac{4\lambda}{d}$

489. In double slit experiment, the distance between two slits is 0.6 mm and these are illuminated with light of wavelength 4800 Å. The angular width of first dark fringe on the screen distant 120 cm from slits will be

a) 8×10^{-4} rad b) 6×10^{-4} rad c) 4×10^{-4} rad d) 16×10^{-4} rad

490. In an experiment of Newton's rings, the diameter of the 20th dark ring was found to be 5.82 mm and that of the 10th ring 3.36 mm. If the radius of the plano-convex lens is 1 m, the wavelength of light used is

a) 5646 Å b) 5896 Å c) 5406 Å d) 5900 Å

491. A radio receiver antenna that is 2 m long is oriented along the direction of the electromagnetic wave and receives a signal of intensity $5 \times 10^{-16}W/m^2$. The maximum instantaneous potential difference across the two ends of the antenna is

a) 1.23 μV b) 1.23 mV c) 1.23 V d) 12.3 mV

492. In a Young's experiment, two coherent sources are placed 0.90 mm apart and the finges are observed one metre away. If it produces the second dark fringe at a distance of 1 mm from the central fringe, the wavelength of monochromatic light used would be

a) 60×10^{-4}cm b) 10×10^{-4}cm c) 10×10^{-5}cm d) 6×10^{-5}cm

493. The condition for observing Fraunhoffer diffraction from a single slit is that the light wavefront incident on the slit should be

a) Spherical b) Cylindrical c) Plane d) Elliptical

494. In a Young's experiment, two coherent sources are placed 0.90 mm apart and the fringes are observed one metre away. If it produces the second dark fringe at a distance of 1 mm from the central fringe, the wavelength of monochromatic light used would be

a) $60 \times 10^{-4} cm$ b) $10 \times 10^{-4} cm$ c) $10 \times 10^{-5} cm$ d) $6 \times 10^{-5} cm$

495. In Young's double slit experiment the wavelength of light was changed from 7000Å to 3500Å. While doubling the separation between the slits which of the following is not true for this experiment

a) The width of the fringes changes

b) The colour of bright fringes changes

c) The separation between successive bright fringes changes

d) The separation between successive dark fringes remains unchanged

496. 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 respct to the preceding one. The percentage of incident intensity that passes through the system will be

a) 100% b) 50% c) 30% d) 12%

497. Newton postulated his corpuscular theory on the basis of

a) Newton's rings b) Colours of thin films

c) Rectilinear propagation of light d) Dispersion of white light

498. A screen is placed 50cm from a single slit, which is illuminated with 6000Å light. If distance between the first and third minima in the diffraction pattern is 3mm, the width of the slit is

a) 0.1mm b) 0.2mm c) 0.3mm d) 0.4mm

499. In a Fraunhoffer diffraction at single slit of width $'d'$ with incident light of wavelength 5500 Å, the first minimum is observed, at angle 30°. The first secondary maximum is observed at an angle $\theta =$

a) $\sin^{-1}\frac{1}{\sqrt{2}}$ b) $\sin^{-1}\frac{1}{4}$ c) $\sin^{-1}\frac{3}{4}$ d) $\sin^{-1}\frac{\sqrt{3}}{2}$

500. In Young's experiment, using red light $(\lambda = 6600\text{Å})$, 60 fringes are seen in the field of view. How many fringes will be seen by using violet light $(\lambda = 4400\text{Å})$?

a) 10 b) 20 c) 45 d) 90

501. A beam of natural light falls on a system of 5 polaroids, which are arranged in succession such that the pass axis of each Polaroid is turned through 60° with respect to the preceding one. The fraction of the incident light intensity that passes through the system is

a) $\frac{1}{64}$ b) $\frac{1}{32}$ c) $\frac{1}{256}$ d) $\frac{1}{512}$

502. Plane microwaves are incident on a long slit having a width of 5 cm. The wavelength of the microwaves if the first minimum is formed at 30° is

a) 2.5 cm b) 2 cm c) 25 cm d) 2 mm

503. At two points P and Q on screen in Young's double slit experiment. Waves from slits S_1 and S_2 have a path difference of 0 and $\frac{\lambda}{4}$ respectively. The ratio of intensities at P and Q will be

a) 3 : 2 b) 2 : 1 c) $\sqrt{2} : 1$ d) 4 : 1

504. In a two slits experiment with monochromatic light, fringes are obtained on a screen placed at some distance from the slits. 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) 4500 Å b) 3000 Å c) 5000 Å d) 6000 Å

505. In a Young's double-slit experiment the fringe width is 0.2mm. If the wavelength of light used is increased by 10% and the separation between the slits is also increased by 10%, the fringe width will be

a) 0.20 mm b) 0.401 mm c) 0.242 mm d) 0.165 mm

506. For what distance is ray optics a good approximation when the aperture is 4mm wide and the wavelength

is 500 nm

a) 32 m b) 64 m c) 16 m d) 8 m

507. 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,

508. Two non-coherent sources emit light beams of intensities I and $4I$. The maximum and minimum intensities in the resulting beam are

a) 9I and I b) $9I$ and $3I$ c) $5I$ and I d) $5I$ and $3I$

509. In an interference experiment, the spacing between successive maxima or minima is

a) $\lambda d/D$ b) $\lambda D/d$ c) dD/λ d) $\lambda d/4D$

510. 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) $\frac{1}{4}I_0$

511. When a plane polarized light is passed through an analyser and analyser is rotated through 90°, the intensity of the emerging light

a) Varies between a maximum and minimum b) Becomes zero
c) Does not vary d) Varies between a maximum and zero

512. Which of the following phenomenon exhibits particle's nature of light?

a) Interference b) Diffraction c) Polarization d) Photoelectric effect

513. Refractive index of material is equal to tangent of polarizing angle. It is called

a) Brewster's law b) Lambert's law c) Malus's law d) Bragg's law

514. In Young's double slit experiment, the fringe width is $1 \times 10^{-4} m$. If the distance between the slit and screen is doubled and the distance between the two slit is reduced to half and wavelength is changed from $6.4 \times 10^{-7} m$ to $4.0 \times 10^{-7} m$, the value of new fringe width will be

a) $0.15 \times 10^{-4} m$ b) $2.0 \times 10^{-4} m$ c) $1.25 \times 10^{-4} m$ d) $2.5 \times 10^{-4} m$

515. In Young's double slit experiment, if d, D and λ represent, the distance between the slits, the distance of the screen from the slits and wavelength of light used respectively, then the band width is inversely proportional to

a) λ b) d c) D d) λ^2

516. Energy stored in electromagnetic oscillations is in the form of

a) Electrical energy b) Magnetic energy c) Both (a) and (b) d) None of these

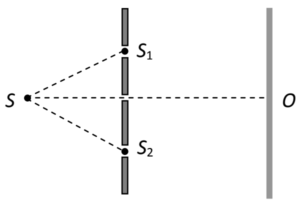
517. Light waves can be polarized as they are

a) Transverse b) Of high frequency c) Longitudinal d) Reflected

518. A single slit is located effectively at infinity in front of a lens of focal length 1 m and it is illuminated normally with light of wavelength 600 nm. The first minima on either side of central maximum are separated by 4 mm. Width of the slit is ……

a) 0.1 mm b) 0.2 mm c) 0.3 mm d) 0.4 mm

519. In the set up shown in Fig the two slits, S_1 and S_2 are not equidistant from the slit S. The central fringe at O is then



a) Always bright b) Always dark
c) Either dark or bright depending on the position of S d) Neither dark nor bright

520. In Young's double slit experiment, if one of the slits is closed fully, then in the interference pattern

a) A bright slit will be observed, no interference pattern will exist
b) The bright fringes will become more bright
c) The bright fringes will become fainter
d) None of the above

521. Find the thickness of a plate which will produce a change in optical path equal to half the wavelength λ of the light passing through it normally. The refractive index of the plate μ is
a) $\frac{\lambda}{4(\mu-1)}$ b) $\frac{2\lambda}{4(\mu-1)}$ c) $\frac{\lambda}{(\mu-1)}$ d) $\frac{\lambda}{2(\mu-1)}$

522. Radiations of intensity 0.5 W/m^2 are striking a metal plate. The pressure on the plate is
a) $0.166 \times 10^{-8} N/m^2$ b) $0.332 \times 10^{-8} N/m^2$ c) $0.111 \times 10^{-8} N/m^2$ d) $0.083 \times 10^{-8} N/m^2$

523. A light source approaches the observer with velocity 0.8 c. The Doppler shift for the light of wavelength 5500Å is
a) 4400 Å b) 1833 Å c) 3167 Å d) 7333 Å

524. A thin film of soap solution ($n = 1.4$) lies on the top of a glass plate ($n = 1.5$). When visible light is incident almost normal to the plate, two adjacent reflection maxima are observed at two wavelengths 400 and 630 nm. The minimum thickness of the soap solution is
a) 420 nm b) 450 nm c) 630 nm d) 1260 nm

525. What is the minimum thickness of a thin film required for constructive interference in the reflected light from it?
Given, the refractive index of the film = 1.5, wavelength of the light incident on the film = 600 nm
a) 100 nm b) 300nm c) 50 nm d) 200 nm

526. A thin mica sheet of thickness $2 \times 10^{-6} m$ 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

527. In Fraunhofer diffraction experiment, L is the distance between screen and the obstacle, b is the size of obstacle and λ is wavelength of incident light. The general condition for the applicability of Fraunhofer diffraction is
a) $\frac{b^2}{L\lambda} >> 1$ b) $\frac{b^2}{L\lambda} = 1$ c) $\frac{b^2}{L\lambda} << 1$ d) $\frac{b^2}{L\lambda} \neq 1$

528. In Young's double slit experiment, a glass plate is placed before a slit which absorbs half the intensity of light. Under this case
a) The brightness of fringes decreases
b) The fringe width decreases
c) No fringes will be observed
d) The bright fringes become fainter and the dark fringes have finite light intensity

529. The coherent formula for fringe visibility is
a) $V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ b) $V = \frac{I_{max} + I_{min}}{I_{max} - I_{min}}$ c) $V = \frac{I_{max}}{I_{min}}$ d) $V = \frac{I_{min}}{I_{max}}$

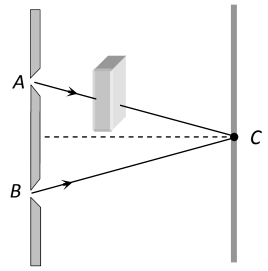
530. If Young's double slit experiment, is performed in water
a) The fringe width will decrease b) The fringe width will increase
c) The fringe width will remain unchanged d) There will be no fringe

531. Microwaves from a transmitter are directed normally towards a plane reflector. A detector moves along the normal to the reflector. Between positions of 14 successive maxima, the detector travels a distance of 0.14 m. The frequency of transmitter is
a) 1.5×10^{10}H b) 10^{10}H c) 3×10^{10}H d) 6×10^{10}H

532. In a Young's double slit experiment the intensity at a point where the path difference is $\frac{\lambda}{6}$ (λ being the wavelength of the light used) is I. If I_0 denotes the maximum intensity, $\frac{I}{I_0}$ is equal to
a) $\frac{1}{\sqrt{2}}$ b) $\frac{\sqrt{3}}{2}$ c) 1/2 d) 3/4

533. 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 decrease
d) There will be no change in the fringe width but the pattern shifts

534. In Young's double slit experiment if the slits widths are in the ratio 1 : 9, the ratio of the intensities at minima to that at maxima will be
a) 1 b) 1/9 c) 1/4 d) 1/3

535. When a compact disc is illuminated by small source of white light, coloured bands are observed. This is due to
a) Dispersion b) Diffraction c) Interference d) Reflection

536. If $\vec{E}$ and $\vec{B}$ are the electric and magnetic field vectors of E.M. waves then the direction of propagation of E.M. wave is along the direction of
a) $\vec{E}$ b) $\vec{B}$ c) $\vec{E} \times \vec{B}$ d) None of these

537. The condition for diffraction of m th order minima is
a) $d \sin \theta_m = m\lambda, m = 1, 2, 3, \ldots$
b) $d \sin \theta_m = \frac{m\lambda}{2}, m = 1, 2, 3, \ldots$
c) $d \sin \theta_m = (m+1)\frac{\lambda}{2}, m = 1, 2, 3, \ldots$
d) $d \sin \theta_m = (m-1)\frac{\lambda}{2}, m = 1, 2, 3, \ldots$

538. In the phenomenon of diffraction of light, when blue light is used in the experiment instead of red light, then
a) Fringes will become narrower b) Fringes will become broader
c) No change in fringe width d) None of the above

539. The electric field of a plane electromagnetic wave varies with time of amplitude $2Vm^{-1}$ propagating along z-axis. The average energy density of the magnetic field is (in Jm^{-3})
a) 13.29×10^{-12} b) 8.86×10^{-12} c) 17.72×10^{-12} d) 4.43×10^{-12}

540. Angular width of central maxima in the Fraunhoffter 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

541. The transverse nature of light is shown by
a) Interference of light b) Refraction of light c) Polarisation of light d) Dispersion of light

542. In an interference experiment, phase difference for points where the intensity is minimum is $(n = 1, 2, 3, \ldots$
a) $n\pi$ b) $(n+1)\pi$ c) $(2n-1)\pi$ d) Zero

543. Soap bubble appears coloured due to the phenomenon of
a) Interference b) Diffraction c) Dispersion d) Reflection

544. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength is Young's double-slit experiment, is
a) Infinite b) Five c) Three d) Zero

545. A polaroid is placed at 45° to an incoming light of intensity I_0. Now the intensity of light passing through polaroid after polarization would be

a) I_0 b) $I_0/2$ c) $I_0/4$ d) Zero

546. Two polaroids are placed in the path of unpolarised 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) $\left(\frac{I_0}{2}\right)\cos^4 2\theta$ d) $I_0\cos^4\theta$

547. Two beams of light of intensity I_1 and I_2 interfere to give an interference pattern. If the ratio of maximum intensity to that of minimum intensity is $\frac{25}{9}$, then $\frac{I_1}{I_2}$ is

a) 5/3 b) 4 c) $\frac{81}{625}$ d) 16

548. When two coherent monochromatic light beams of intensities I and $4I$ are superimposed. What are the maximum and minimum possible intensities in the resulting beams?

a) $5I$ and I b) $5I$ and $3I$ c) $9I$ and I d) $9I$ and $3I$

549. A plane electromagnetic wave travels in free space along x-axis. At a particular point in space, the electric field along y-axis is 9.3 Vm^{-1}. The magnetic induction (B) along z-axis is

a) $3.1\times10^{-8}T$ b) $3\times10^{-5}T$ c) $3\times10^{-6}T$ d) $9.3\times10^{-6}T$

550. 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) $\beta_B>\beta_G>\beta_R$ c) $\beta_R>\beta_B>\beta_G$ d) $\beta_R>\beta_G>\beta_B$

551. An electromagnetic wave, going through vacuum is described by $E=E_0\sin(kx-\omega t)$. Which of the following is independent of wavelength

a) k b) ω c) k/ω d) $k\omega$

552. Two waves of equal amplitude and frequency interfere each other. The ratio of intensity when the two waves arrive in phase to that when they arrive 90° out of phase is

a) 1 : 1 b) $\sqrt{2}$: 1 c) 2 : 1 d) 4 : 1

553. In Young's double slit experiment, when two light waves form third minimum, they have

a) Phase difference of 3π b) Phase difference of $\frac{5\pi}{2}$

c) Path difference of 3λ d) Path difference of $\frac{5\lambda}{2}$

554. In a Young's double slit experiment, the fringe width is found to be 0.4 mm. If the whole apparatus is immersed in water of refractive index 4/3 without disturbing the geometrical arrangement, the new fringe width will be

a) 0.30 mm b) 0.40 mm c) 0.53 mm d) 450 $micron$

555. In a biprism experiment, by using light of wavelength 5000 Å, 5mm wide fringes are obtained on a screen 1.0 m away from the coherent sources. The separation between the two coherent sources is

a) 1.0 mm b) 0.1 mm c) 0.05 mm d) 0.01 mm

556. 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 solutions 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°

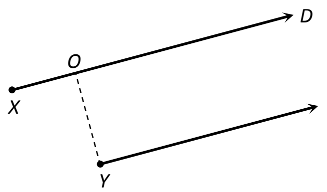
557. Light is an electromagnetic wave. Its speed in vacuum is given by the expression

a) $\sqrt{\mu_o\varepsilon_o}$ b) $\sqrt{\frac{\mu_o}{\varepsilon_o}}$ c) $\sqrt{\frac{\varepsilon_o}{\mu_o}}$ d) $\frac{1}{\sqrt{\mu_o\varepsilon_o}}$

558. n coherent source of intensity I_0 are superimposed at a point, the intensity of the point is

a) nI_0 b) $\frac{I_0}{n}$ c) n^2I_0 d) None of these

559. Biological importance of Ozone layer is
a) It stops ultraviolet rays
b) Ozone rays reduce green house effect
c) Ozone layer reflects radio waves
d) Ozone layer controls O_2/H_2 radio in atmosphere
560. In which one of the following regions of the electromagnetic spectrum will the vibrational motion of molecules give rise to absorption
a) Ultraviolet
b) Microwaves
c) Infrared
d) Radio waves
561. Which of the following is not a property of light
a) It requires a material medium for propagation
b) It can travel through vacuum
c) It involves transportation of energy
d) It has finite speed
562. A parallel beam of light of intensity I_0 is incident on a glass plate, 25% of light is reflected by upper surface and 50% of light is reflected from lower surface. The ratio of maximum to minimum intensity in interference region of reflected rays is
a) $\left(\frac{\frac{1}{2}+\sqrt{\frac{3}{8}}}{\frac{1}{2}-\sqrt{\frac{3}{8}}}\right)^2$
b) $\left(\frac{\frac{1}{4}+\sqrt{\frac{3}{8}}}{\frac{1}{2}-\sqrt{\frac{3}{8}}}\right)^2$
c) $\frac{5}{8}$
d) $\frac{8}{5}$
563. The 21 cm radio wave emitted by hydrogen in interstellar space is due to the interaction called the hyperfine interaction is atomic hydrogen. the energy of the emitted wave is nearly
a) $10^{-17} Joule$
b) $1\ Joule$
c) $7 \times 10^{-8} Joule$
d) $10^{-24} Joule$
564. In Young's double slit experiment, a third slit is made in between the double slits. Then
a) Fringes of unequal width are formed
b) Contrast between bright and dark fringes is reduced
c) Intensity of fringes totally disappears
d) Only bright light is observed on the screen
565. 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 in as an integer is given by



a) $\frac{\lambda}{2}(n-l)$
b) $\lambda(n+l)$
c) $\frac{\lambda}{2}(n+l)$
d) $\lambda(n-l)$
566. A glass slab of thickness 8 cm contains the same number of waves as 10 cm of water when both are transverse by the same monochromatic light. If the refractive index of water is 4/3, then refractive index of glass is
a) 5/4
b) 3/2
c) 5/3
d) 16/15
567. In Young's double slit experiment, if L is the distance between the slits and the screen upon which interference pattern is observed, x is the average distance between the adjacent fringes and d being the slit separation. The wavelength of light is given by
a) $\frac{xd}{L}$
b) $\frac{xL}{d}$
c) $\frac{Ld}{x}$
d) $\frac{1}{Ldx}$
568. λ_a and λ_m are the wavelength of a beam of light in air and medium respectively. If θ is the polarising angle, the correct relation between λ_a, λ_m and θ is
a) $\lambda_a = \lambda_m \tan^2\theta$
b) $\lambda_m = \lambda_a \tan^2\theta$
c) $\lambda_a = \lambda_m \cot\theta$
d) $\lambda_m = \lambda_a \cot\theta$
569. Out of the following statements which is not correct
a) When unpolarised light passes through a Nicol prism, the emergent light is elliptically polarised
b) Nicol prism works on the principle of double refraction and total internal reflection
c) Nicol prism can be used to produce and analyse polarized light

d) Calcite and Quartz are both doubly refracting crystals

570. In Young's double slit experiment, distance between two sources is 0.1 mm. The distance of screen from the sources is 20 cm. Wavelength of light used is 5460 Å. Then angular position of the first dark fringe is

a) 0.08° b) 0.18° c) 0.20° d) 0.313°

571. In Young's double slit experiment, the intensity on the screen at a point where path difference λ is K. What will be the intensity at the point where path difference is $\lambda/4$

a) $\frac{K}{4}$ b) $\frac{K}{2}$ c) K d) Zero

572. A wavefront presents one, two and three HPZ at points A, B and C respectively. If the ratio of consecutive amplitudes of HPZ is 4 : 3, then the ratio of resultant intensities at these point will be

a) 169 : 16 : 256 b) 256 : 16 : 169 c) 256 : 16 : 196 d) 256 : 196 : 16

573. V_o and V_E represent the velocities, 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

574. 100 π phase difference = ……. Path difference.

a) 10λ b) 25λ c) 50λ d) 100λ

575. Diffraction effects are easier to notice in the case of sound waves than in the case of light waves because

a) Sound waves are longitudinal
b) Sound is perceived by the ear
c) Sound waves are mechanical waves
d) Sound waves are of longer wavelength

576. Three waves of equal frequency having amplitudes $10\mu m, 4\mu m, 7\mu m$ arrive at a given point with successive phase difference of $\frac{\pi}{2}$, the amplitude of the resulting wave in μm is given by

a) 4 b) 5 c) 6 d) 7

577. An unpolarised beam of intensity 2 a^2 passes through a thin Polaroid. Assuming zero absorption in the Polaroid, the intensity of emergent plane polarized light is

a) 2 a^2 b) a^2 c) $\sqrt{2}a^2$ d) $\frac{a^2}{2}$

578. In an interference pattern by two identical slits, the intensity of central maxima is I. what will be the intensity of the same spot, if one of the slits is closed?

a) $I/4$ b) $I/2$ c) I d) $2I$

579. In the diffraction pattern of a single slit

a) All bands are uniformly bright
b) All bands are uniformly wide
c) Central band is narrower
d) Central band is wider

580. Electromagnetic waves can be deflected by

a) Electric field only b) Magnetic field only c) Both (a) and (b) d) None of these

581. If c is the speed of electromagnetic waves in vacuum, its speed in a medium of dielectric constant K and relative permeability μ_r is

a) $v = \frac{1}{\sqrt{\mu_r K}}$ b) $v = c\sqrt{\mu_r K}$ c) $v = \frac{c}{\sqrt{\mu_r K}}$ d) $v = \frac{K}{\sqrt{\mu_r C}}$

582. In diffraction from a single slit, the angular width of the central maxima does not depend on

a) λ of light used
b) Width of slit
c) Distance of slits from screen
d) Ratio of λ and slit width

583. A wave can transmit ………. from one place to another

a) Energy b) Amplitude c) Wavelength d) Matter

584. Ozone is found in

a) Stratosphere b) Ionosphere c) Mesosphere d) Troposphere

585. A parallel plate capacitor of plate separation 2 mm is connected in an electric circuit having source voltage 400 V. If the plate area $60cm^2$, then the value of displacement current for $10^{-6}s$ will be

a) 1.062 amp b) 1.062×10^{-2} amp c) 1.062×10^{-3} amp d) 1.062×10^{-4} amp

586. If a transparent medium of refractive index $\mu = 1.5$ and thickness $t = 2.5 \times 10^{-5} m$ is inserted in front of one of the slits of Young's Double Slit experiment, how much will be the shift in the interference pattern? The distance between the slits is 0.5 mm and that between slits and screen is 100 cm

a) 5 cm b) 2.5 cm c) 0.25 cm d) 0.1 cm

587. The electromagnetic waves do not transport

a) Energy b) Charge c) Momentum d) Information

588. Plane polarized light is passed through a polaroid. On viewing through the polaroid we find that when the polariod is given one complete rotation about the direction of the light, one of the following is observed

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 at maximum

c) There is no change in intensity

d) The intensity of light is twice maximum and twice zero

589. In the visible region of the spectrum the rotation of the plane 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) $+\frac{50°}{9} per\ mm$ b) $-\frac{50°}{9} per\ mm$ c) $+\frac{9°}{50} per\ mm$ d) $-\frac{9°}{50} per\ mm$

590. 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

591. In Young's double slit experiment a minima is observed when path difference between the interfering beam is

a) λ b) 1.5λ c) 2λ d) 2.25λ

592. The k line of singly ionized 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 km/s b) 3240 km/s c) 4240 km/s d) None of these

593. Two coherent sources S_1 and S_2 are separated by a distance four times the wavelength λ of the source. The sources lies 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

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

a) 80% b) 89% c) 11% d) 20%

595. To demonstrate the phenomenon of interference we require two sources which emit radiations of

a) Nearly the same frequency

b) The same frequency

c) Different wavelength

d) The same frequency and having a definite phase relationship

596. The 6563 Å line emitted by hydrogen atom in a star is found to be red shifted by 5 Å. The speed with which the star is receding from the earth is

a) $17.29 \times 10^9 m/s$ b) $4.29 \times 10^7 m/s$ c) $3.39 \times 10^5 m/s$ d) $2.29 \times 10^5 m/s$

597. A thin film of soap solution ($\mu_s = 1.4$) lies on the top of a glass plate ($\mu_g = 1.5$). When visible light is incident almost normal to the plate, two adjacent reflection maxima are observed at two wavelengths 420 and 630 nm. The minimum thickness of the soap solution are

a) 420 nm b) 450 nm c) 630 nm d) 1260 nm

598. The electromagnetic theory of light failed to explain

a) Photoelectric effect b) Polarization c) Diffraction d) Interference

599. Which of the following are not electromagnetic waves
a) Cosmic rays b) Gamma rays c) β-rays d) X-rays

600. When unpolarised light beam is incident from air onto glass ($n = 1.5$) at the polarizing angle
a) Reflected beam is polarized 100 percent
b) Reflected and refracted beams are partially polarized
c) The reason for (a) is that almost all the light is reflected
d) All of the above

601. Which of the following is conserved when light waves interfere
a) Intensity b) Energy c) Amplitude d) Momentum

602. In Young's double slit experiment, slit separation is 0.6 mm and the separation between slit and screen is 1.2 m. The angular width is (the wavelength of light used is 4800 Å
a) 30 rad b) 8×10^{-4} rad c) 12 rad d) 70.5 rad

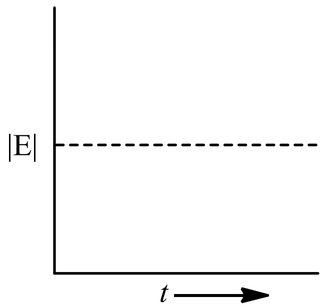
603. Light of wavelength 6000 Å falls on a single slit of width 0.1 mm. The second minimum will be formed for the angle of diffraction of
a) 0.08 rad b) 0.06 rad c) 0.12 rad d) 0.012 rad

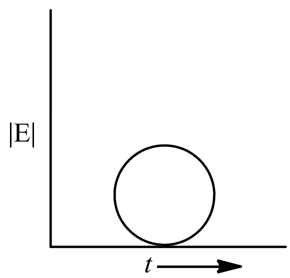
604. Two sources of same intensity interfere at a point and produced resultant I. When one source is removed, the intensity at that point will be
a) I b) $I/2$ c) $I/4$ d) $I/3$

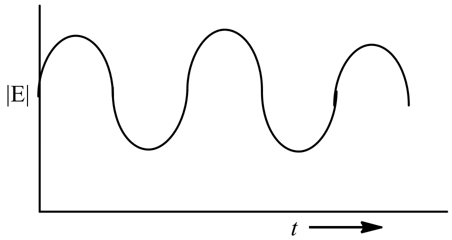
605. Two identical light waves, propagating in the same direction, have a phase difference δ. After they superpose, the intensity of the resulting wave will be proportional to
a) $\cos\delta$ b) $\cos(\delta/2)$ c) $\cos^2(\delta/2)$ d) $\cos^2\delta$

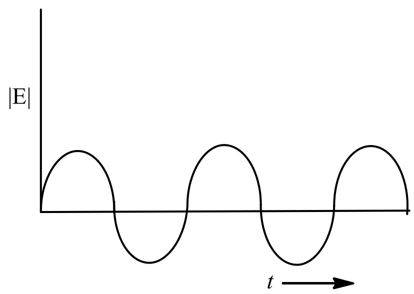
606. In Young's double slit experiment, one of the slit is wider than other, so that amplitude of the light from one slit is double of that from other slit. If I_m be the maximum intensity, the resultant intensity I when they interfere at phase difference ϕ is given by
a) $\frac{I_m}{9}(4 + 5\cos\phi)$ b) $\frac{I_m}{3}\left(1 + 2\cos^2\frac{\phi}{2}\right)$ c) $\frac{I_m}{5}\left(1 + 4\cos^2\frac{\phi}{2}\right)$ d) $\frac{I_m}{9}\left(1 + 8\cos^2\frac{\phi}{2}\right)$

607. Which of the following diagrams represent the variation of electric field vector with time for a cirularly polarized light?

a) 

b) 

c) 

d) 

608. In Young's double slit experiment, let S_1 and S_2 be the two slits and C be the centre of the screen. If $\angle S_1CS_2 = \theta$ and λ is the wavelength, the fringe width will be
a) $\frac{\lambda}{\theta}$ b) $\lambda\theta$ c) $2\lambda/\theta$ d) $\frac{\lambda}{2\theta}$

609. Which one of the following property of light does not support wave theory of light?

a) Light obeys laws of reflection and refraction
b) Light waves get polarized
c) Light shows photoelectric effect
d) Light shows interference

610. A parallel beam of monochromatic light of wavelength 5000 Å is incident normally on a single narrow slit of width $0.001 mm$. The light is focused by a convex lens on a screen placed on the focal plane. The first minimum will be formed for the angle of diffraction equal to
a) 0° b) 15° c) 30° d) 60°

611. In Huygen's wave theory, the locus of all points in the same state of vibration is called
a) A half period zone b) Oscillator c) A wave front d) A ray

612. In an interference experiment, the spacing between successive maxima or minima is
(Where the symbols have their usual meanings)
a) $\frac{\lambda d}{D}$ b) $\frac{\lambda D}{d}$ c) $\frac{dD}{\lambda}$ d) $\frac{\lambda d}{4D}$

613. In a diffraction pattern by a wire, on increasing diameter of wire, fringe width
a) Decreases
b) Increases
c) Remains unchanged
d) Increasing or decreasing will depend on wavelength

614. 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

615. Wavelength of light of frequency $100 Hz$
a) $2 \times 10^6 m$ b) $3 \times 10^6 m$ c) $4 \times 10^6 m$ d) $5 \times 10^6 m$

616. Two nicol prism are first crossed and then one of them is rotated through 60°. The percentage of incident light transmitted is
a) 1.25 b) 25.0 c) 37.5 d) 50

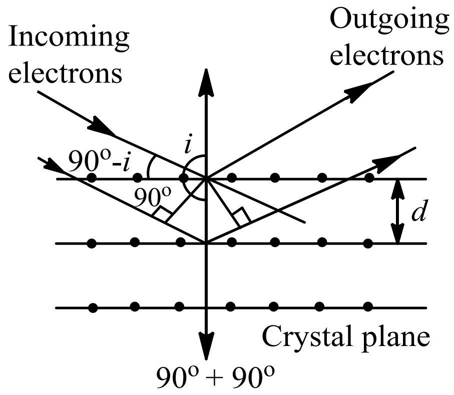
617. A star emitting light of wavelength 5896 Å is moving away from the earth with a speed of 3600 km/s. The wavelength of light observed on earth will
($c = 3 \times 10^8 m/s$ is the speed of light)
a) Decrease by 5825.25 Å
b) Increase by 5966.75 Å
c) Decrease by 70.75 Å
d) Increase by 70.75 Å

618. A Young's double slit set up for interference is shifted from air to within water, then the fringe width
a) Becomes infinite b) Decreases c) Increases d) Remain unchanged

619. Young's experiment is performed in air and then performed in water, the fringe width
a) Will remain same b) Will decrease c) Will increase d) Will be infinite

620. Two beams of light will not give rise to an interference pattern, if
a) They are coherent
b) They have the same wavelength
c) They are linearly polarized perpendicular to each other
d) They are not monochromatic

621. A grating which would be most suitable for constructing a spectrometer for the visible and ultraviolet region, should have



a) 100 lines/cm b) 1000 lines/cm c) 10000 lines/cm d) 100000 lines/cm

622. In Young's double slit experiment, distance between two slits is 0.28 mm and distance between slits and screen is 1.4 m. Distance between central bright fringe and third bright fringe is 0.9 cm, what is the wavelength of light used?
a) 4000 Å b) 6000 Å c) 3000 Å d) 5000 Å

623. If the total electromagnetic energy falling on a surface is U, then the total momentum delivered (for complete absorption) is
a) $\frac{U}{c}$ b) cU c) $\frac{U}{c^2}$ d) c^2U

624. Light appears to travel in straight lines since
a) It is not absorbed by the atmosphere b) It is reflected by the atmosphere
c) Its wavelength is very small d) Its velocity is very large

625. Red light is generally used to observe diffraction pattern from single slit. If blue light is used instead of red light, then diffraction pattern
a) Will be more clear b) Will contract c) Will expanded d) Will not be visualized

626. The Fraunhofer diffraction pattern of a single slit is formed in the focal plane of a lens of focal length 1 m. The width of slit is 0.3 mm. If third minimum is formed at a distance of 5 mm from central maximum, then wavelength of light will be
a) 5000Å b) 2500Å c) 7500Å d) 8500Å

627. The separation between successive fringes in a double slit arrangement is$x$. If the whole arrangement is dipped under water, what will be the new fringe separation?
[The wavelength of light being used in 5000 Å]
a) 1.5 x b) x c) 0.75 x d) 2 x

628. Interference was observed in interference chamber when air was present, now the chamber is evacuated and if the same light is used, a careful observer will see
a) No interference
b) Interference with bright bands
c) Interference with dark bands
d) Interference in which width of the fringe will be slightly increased

629. Light waves can propagate through vacuum but sound waves cannot do so. Mark the wrong statement
a) Light waves are transverse electromagnetic waves and do not require any medium for their propagation
b) Sound waves are longitudinal mechanical waves and require inertial and elastic medium for their propagation
c) Velocity of light for all transparent media is same
d) Velocity of light for all transparent media is different

630. In a Young's double slit experiment, $I_1/I_2 = 16/9$. Ratio of maximum to minimum intensity is
a) 1 : 49 b) 9 : 16 c) 16 : 9 d) 49 : 1

631. In a Young's double slit experiment, I_o is the intensity at the central maximum and β is the fringe width. The intensity at a point P distant x from the centre will be

a) $I_o \cos\frac{\pi x}{\beta}$ b) $4I_o \cos^2\frac{\pi x}{\beta}$ c) $I_o \cos^2\frac{\pi x}{\beta}$ d) $\frac{I_o}{4}\cos^2\frac{\pi x}{\beta}$

632. 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) $\frac{1}{2}I_0$ b) $\frac{1}{4}I_0$ c) Zero d) I_0

633. Two light rays having the same wavelength λ in vacuum are in phase initially. Then the first ray travel a path L_1through a medium of refractive index n_1, while the travel second ray travels a path of length L_2 through a medium of refractive index n_2. The two waves are then combined to observe interference. The phase difference the two waves is

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

634. 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) $\left(\frac{I_0}{2}\right)\cos^4 2\theta$ d) $I_0\cos^4\theta$

635. In two separate set-ups of the Young's double slit experiment, fringes of equal width are observed when lights of wavelengths in the ratio 1:2 are used. If the ratio of the slit separation in the two cases is 2 : 1, the ratio of the distances between the plane of the slits and the screen in the two set-ups is

a) 4 : 1 b) 1 : 1 c) 1 : 4 d) 2 : 1

636. If a star is moving towards the earth, then the lines are shifted towards

a) Red b) Infrared c) Blue d) Green

637. In an electromagnetic wave, the electric and magnetizing fields are 100 Vm^{-1} and 0.265 Am^{-1}. The maximum energy flow is

a) 26.5 W/m^2 b) 36.5 W/m^2 c) 46.7 W/m^2 d) None of these

638. Two slits, 4mm apart, are illuminated by light of wavelength 6000 Å. What will be fringe width on a screen placed 2m from the slits

a) 0.12 mm b) 0.3 mm c) 3.0 mm d) 4.0 mm

639. 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 4th 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

640. 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 incident beam. At the first maxima of the diffraction pattern the phase difference between the rays coming from the edges of the slit is

a) 0 b) $\frac{\pi}{2}$ c) π d) 2π

641. 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

642. The condition for obtaining secondary maxima in the diffraction pattern due to single slit is

a) $a\sin\theta = n\lambda$ b) $a\sin\theta = (2n-1)\frac{\lambda}{2}$ c) $a\sin\theta = (2n-1)\lambda$ d) $a\sin\theta = \frac{n\lambda}{2}$

643. Red light of wavelength 625 nm is incident normally on an optical diffraction grating with 2×10^5 lines/m. Including central principal maxima, how many maxima may be observed on a screen which is for from the grating?

a) 15 b) 17 c) 8 d) 16

644. By a monochromatic wave, we mean

a) A single ray
b) A single ray of a single colour
c) Wave having a single wavelength
d) Many rays of a single colour

645. In Huygen's wave theory, the locus of all points in the same state of vibration is called
a) A half period zone
b) Oscillator
c) A wave-front
d) A ray

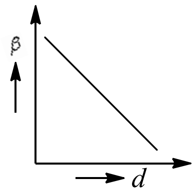
646. A rocket is moving away from the earth at a speed of $6 \times 10^7 m/s$. The rocket has blue light in it. What will be the wavelength of light recorded by an observer on the earth (wavelength of blue light $= 4600$ Å)
a) 4600 Å
b) 5520 Å
c) 3680 Å
d) 3920 Å

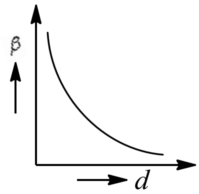
647. All components of the electromagnetic spectrum in vacuum have the same
a) Energy
b) Velocity
c) Wavelength
d) Frequency

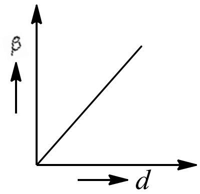
648. The average magnetic energy density of an electromagnetic wave of wavelength λ travelling in free space is given by
a) $\frac{B^2}{2\lambda}$
b) $\frac{B^2}{2\mu_0}$
c) $\frac{2B^2}{\mu_0\lambda}$
d) $\frac{B}{\mu_0\lambda}$

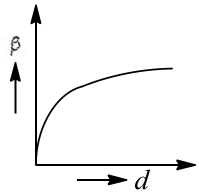
649. The intensity ratio of two coherent sources of light is p. They are interfering in some region and produce interference pattern. Then the fringe visibility is
a) $\frac{1+p}{2\sqrt{p}}$
b) $\frac{2\sqrt{p}}{1+p}$
c) $\frac{p}{1+p}$
d) $\frac{2p}{1+p}$

650. An optically active compound
a) Rotates the plane polarized light
b) Changes the direction of polarized light
c) Does not allow plane polarized light to pass through
d) None of the above

651. The coherent curve between fringe width β and distance between the slits (d)in figure is
a) 

b) 

c) 

d) 

652. According to Maxwell's hypothesis, a changing electric field gives rise to
a) An e.m.f.
b) Electric current
c) Magnetic field
d) Pressure radiant

653. In a double slit experiment, 5th dark fringe is formed opposite to one the slits. The wavelength of light is
a) $\frac{d^2}{6D}$
b) $\frac{d^2}{5D}$
c) $\frac{d^2}{15D}$
d) $\frac{d^2}{9D}$

654. In a Young's double slit experiment (slit distance d) monochromatic light of wavelength λ is used and the figure pattern observed at a distance L from the slits. The angular position of the bright fringes are
a) $\sin^{-1}\left(\frac{N\lambda}{d}\right)$
b) $\sin^{-1}\left(\frac{\left(N+\frac{1}{2}\right)\lambda}{d}\right)$
c) $\sin^{-1}\left(\frac{N\lambda}{L}\right)$
d) $\sin^{-1}\left(\frac{\left(N+\frac{1}{2}\right)\lambda}{L}\right)$

655. The equations of two interfering waves are $y_1 = b\cos\omega t$ and$y_2 = b\cos(\omega t + \phi)$. For destructive interference the path difference is
a) 0°
b) 360°
c) 180°
d) 720°

656. In a wave, the path difference corresponding to a phase difference of ϕ is
a) $\frac{\pi}{2\lambda}\phi$
b) $\frac{\pi}{\lambda}\phi$
c) $\frac{\lambda}{2\pi}\phi$
d) $\frac{\lambda}{\pi}\phi$

657. The velocity of light emitted by a source S observed by an observer O, who is at rest with respect to S is c. If the observer moves towards S with velocity v, the velocity of light as observed will be
a) $c+v$
b) $c-v$
c) c
d) $\sqrt{1-\frac{v^2}{c^2}}$

658. A plane wavefront ($\lambda = 6 \times 10^{-7} m$) falls on a slit 0.4 mm wide. A convex lens of focal length 0.8m placed behind the slit focusses the light on a screen. What is the linear diameter of second maximum

a) $6mm$ b) $12mm$ c) $3mm$ d) $9mm$

659. The maximum intensity of fringes in Young's experiment is I. If one of the slit is closed, then the intensity at that place becomes I_o. Which of the following relation is true

a) $I = I_o$ b) $I = 2I_o$

c) $I = 4I_o$ d) There is no relation between I and I_o

660. In the Young's double slit experiment, for which colour the fringe width is least

a) Red b) Green c) Blue d) Yellow

661. In the Young's double slit experiment, the spacing between two slits is 0.1 mm. If the screen is kept at a distance of 1.0 m from the slits and wavelength of light is 5000 Å, then the fringe width is

a) $1.0cm$ b) $1.5cm$ c) $0.5cm$ d) $2.0cm$

662. Doppler's effect in sound in addition to relative velocity between source and observer, also depends while source and observer or both are moving. Doppler effect in light depends only on the relative velocity of source and observer. The reason of this is

a) Einstein's mass – energy relation b) Einstein's theory of relatively

c) Photoelectric effect d) None of these

663. Monochromatic green light of wavelength $5 \times 10^{-7}m$ illuminates a pair of slits 1 mm apart. The separation of bright lines on the interference pattern formed on a screen 2 m away is

a) 0.25 mm b) 0.1 mm c) 1.0 mm d) 0.01 mm

664. If the two waves represented by $y_1 = 4 \ \sin \omega t$ and $y_2 = 3 \sin(\omega t + \pi/3)$ interfere at a point, the amplitude of the resulting wave will be about

a) 7 b) 5 c) 6 d) 3.5

665. In Young's double slit experiment, a third slit is made in between the double slits. Then

a) Intensity of fringes totally disappears

b) Only bright light is observed on the screen

c) Fringes of unequal width are formed

d) Contrast between bright and dark fringes is reduced

666. Radio waves diffract around building although light waves do not. The reason is that radio waves

a) Travel with speed larger than c b) Have much larger wavelength than light

c) Carry news d) Are not electromagnetic waves

667. The wavelength of light visible to eye is of the order of

a) $10^{-2}m$ b) $10^{-10}m$ c) $1m$ d) $6 \times 10^{-7}m$

668. The electromagnetic waves travel with a velocity

a) Equal to velocity of sound b) Equal to velocity of light

c) Less than velocity of light d) None of these

669. Light of wavelength $\lambda = 5000$ Å falls normally on a narrow slit. A screen placed at a distance of $1m$ from the slit and perpendicular to the direction of light. The first minima of the diffraction pattern is situated at 5 mm from the centre of central maximum. The width of the slit is

a) 0.1 mm b) 1.0 mm c) 0.5 mm d) 0.2 mm

670. What causes change in the colours of the soap or oil films for the given beam of light

a) Angle of incidence b) Angle of reflection c) Thickness of film d) None of these

671. If the distance between a point source and screen is doubled, then intensity of light on the screen will become

a) Four times b) Double c) Half d) One-fourth

672. In a double slit interference experiment, the distance between the slits is 0.05 cm and screen is 2 m away from the slits. The wavelength of light is 6000Å. The distance between the fringe is

a) 0.24 cm b) 0.12 cm c) 1.24 cm d) 2.28 cm

673. The size of an obstacle in order to observe diffraction of light must be

a) Of any order

b) Of the order of wavelength

c) Much larger than wavelength

d) Much smaller than wavelength

674. If fringes width $\lambda = 5.89 \times 10^{-5}$ cm is 0.431 mm and shift of white central fringe on introducing a mica sheet in one path is 1.89 mm. Thickness of the mica sheet will be ($\mu = 1.59$)

a) 438×10^{-6} m b) 538×10^{-6} m c) 638×10^{-6} m d) None of these

675. A plane electromagnetic wave travelling along the X-direction has a wavelength of 3 mm. The variation in the electric field occurs in the Y-direction with an amplitude 66 $V\ m^{-1}$. The equations for the electric and magnetic fields as a function of x and t are respectively

a) $E_y = 33 \cos \pi \times 10^{11} \left(t - \frac{x}{c}\right)$
$B_z = 1.1 \times 10^{-7} \cos \pi \times 10^{11} \left(t - \frac{x}{c}\right)$

b) $E_y = 11 \cos 2\pi \times 10^{11} \left(t - \frac{x}{c}\right)$
$B_y = 11 \times 10^{-7} \cos 2\pi \times 10^{11} \left(t - \frac{x}{c}\right)$

c) $E_x = 33 \cos \pi \times 10^{11} \left(t - \frac{x}{c}\right)$
$B_x = 11 \times 10^{-7} \cos \pi \times 10^{11} \left(t - \frac{x}{c}\right)$

d) $E_y = 66 \cos 2\pi \times 10^{11} \left(t - \frac{x}{c}\right)$
$B_z = 2.2 \times 10^{-7} \cos 2\pi \times 10^{11} \left(t - \frac{x}{c}\right)$

676. In Young's double slit experiment, the separation between the slit is haled and the distance between the slits and screen is doubled. The fringe-width will

a) Be halved b) Be doubled
c) Be quadrupled d) Remain unchanged

677. In a two slit experiment with monochromatic light fringes are obtained on a screen placed at some distance from the slits. If the screen is moved by 5×10^{-2} m towards the slits, the charge 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

678. In Fresnel diffraction, if the distance between the disc and the screen is decreased, the intensity of central bright spot will

a) Increase b) Decrease c) Remain constant d) None of these

679. When light is incident on a diffraction grating, the zero order principal maximum will be

a) Spectrum of the colours b) White
c) One of the component colours d) Absent

680. The angle of incidence at which reflected light is totally polarized for reflection from air to glass (refractive index n) is

a) $\sin^{-1}(n)$ b) $\sin^{-1}\left(\frac{1}{n}\right)$ c) $\tan^{-1}\left(\frac{1}{n}\right)$ d) $\tan^{-1}(n)$

681. A stone thrown into still water, creates a circular wave pattern moving radially outwards. If r is the distance measured from the centre of the pattern, the amplitude of the wave varies as

a) $r^{-1/2}$ b) r^{-1} c) r^{-2} d) $r^{-3/2}$

682. 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) 1/2 c) 4 d) 16

683. Fringes are obtained with the help of a biprism in the focal plane of an eyepiece distance 1 m from the slit. A convex lens produces images of the slit in two positions between biprism and eyepiece. The distances between two images of the slit in two positions are4.05×10^{-3}m and 2.90×10^{-3}m respectively. The distance between the slits will be

a) 3.43×10^{-3}m b) 0.343m c) 0.0343m d) 43.3m

684. In a Fraunhofer diffraction experiment at a single slit using a light of wavelength 400 nm, the first

minimum is formed at an angle of 30°. The direction θ of the first secondary maximum is given by

a) $\sin^{-1}\left(\frac{2}{3}\right)$ b) $\sin^{-1}\left(\frac{3}{4}\right)$ c) $\sin^{-1}\left(\frac{1}{4}\right)$ d) $\tan^{-1}\left(\frac{2}{3}\right)$

685. In double slit experiment, the angular width of the fringes is 0.20° for the sodium light ($\lambda = 5890$Å). In Order to increase the angular width of the fringes by 10%, the necessary change in the wavelength is

a) Increase of 589 Å b) Decrease of 589 Å c) Increase of 6479 Å d) Zero

686. The wave theory of light, in its original form, was first postulated by

a) Issac Newton b) Christian Huygens
c) Thomas Young d) Augustin Jean Fresnel

687. Which of the following cannot be polarized?

a) Ultraviolet rays b) Ultrasonic waves c) X-rays d) Radiowaves

688. Ray diverging from a point source form a wave front that is

a) Cylindrical b) Spherical c) Plane d) Cubical

689. In the experiment of diffraction at a single slit, if the slit width is decreased, the width of the central maximum

a) Increases in both Fresnel and Fraunhoffer diffraction
b) Decreases both in Fresnal and Fraunhoffer diffraction
c) Increases in Fresnel diffraction but decreases in Fraunhoffer diffraction
d) Decreases in Fresnel diffraction but increases in Fraunhoffer diffraction

690. The phenomenon of diffraction of light was discovered by

a) Huyghen b) Newton c) Fresnel d) Grimaldi

691. In Young's double slit experiment, the 7th maximum wavelength λ_1 is at a distance d_1 and that with wavelength λ_2 is at a distance d_2.Then (d_1/d_2) is

a) (λ_1/λ_2) b) (λ_2/λ_1) c) $(\lambda_1^2/\lambda_2^2)$ d) $(\lambda_2^2/\lambda_1^2)$

692. 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

693. If the eighth bright band due to light of wavelength λ_1 coincides with ninth bright band from light of wavelength λ_2 in Young's double slit experiment, then the possible wavelength of visible light are

a) 400 nm and 450 nm b) 425 nm and 400 nm c) 400 nm and 425 nm d) 450 nm and 400 nm

694. Yellow light is used in single slit diffraction experiment with slit width 0.6 mm. If yellow light is replaced by X-rays, then the pattern will reveal that

a) No diffraction pattern b) That the central maxima narrower
c) Less number of fringes d) More number of fringes

695. In Young's double slit experiment, if the widths of the slits are in the ratio 4 : 9, the ratio of the intensity at maxima to the intensity at minima will be

a) 169 : 25 b) 81 : 16 c) 25 : 1 d) 9 : 4

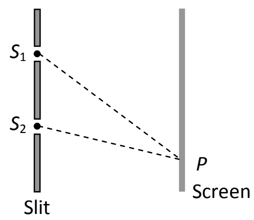
696. Which of the following is not electromagnetic in nature

a) X-rays b) Gamma rays c) Cathode rays d) Infrared rays

697. The penetration of light into the region of geometrical shadow is called

a) Polarization b) Interference c) Diffraction d) Refraction

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



a) Decreases by $(\mu - 1)t$
b) Increases by $(\mu - 1)t$
c) Does not change
d) Increases by μt

699. In a Young's double slit experiment, the central point on the screen is
a) Bright
b) Dark
c) First bright and then dark
d) First dark and then bright

700. S_1 And S_2 are two coherent sources. The intensity of both sources are same. If the intensity at the point of maxima is 4 Wm^{-2}, the intensity of each source is
a) 1 Wm^{-2}
b) 2 Wm^{-2}
c) 3 Wm^{-2}
d) 4 Wm^{-2}

701. If Young's double slit experiment, is performed in water
a) The fringe width will decrease
b) The fringe width will increase
c) The fringe width will remain unchanged
d) There will be no fringe

702. 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) $I = A + B \cos \phi$

703. As a result of interference of two coherent sources of light, energy is
a) Increased
b) Redistributed and the distribution does not vary with time
c) Decreased
d) Redistributed and the distribution changes with time

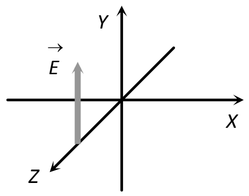
704. The rectilinear propagation of light in a medium is due to
a) Its short wavelength
b) Its high frequency
c) Its high velocity
d) The refractive index of medium

705. In the interference pattern, energy is
a) Created at the position of maxima
b) Destroyed at the position of minima
c) Conserved but is redistributed
d) None of the above

706. Consider Fraunhoffer diffraction pattern obtained with a single slit at normal incidence. At the angular position of first diffraction minimum, the phase difference between the wavelets from the opposite edges of the slit is
a) $\pi/4$
b) $\pi/2$
c) π
d) 2π

707. A beam of natural light falls on a system of 5 polaroids, which are arranged in succession such that the pass axis of each polaroid is turned through 60° with respect to the preceding one. The fraction of the incident light intensity that passes through the system is
a) $\frac{1}{64}$
b) $\frac{1}{32}$
c) $\frac{1}{256}$
d) $\frac{1}{512}$

708. The figure here gives the electric field of an EM wave at a certain point and a certain instant. The wave is transporting energy in the negative z direction. What is the direction of the magnetic field of the wave at that point and instant



a) Towards $+X$ direction
b) Towards $-X$ direction
c) Towards $+Z$ direction
d) Towards $-Z$ direction

709. In a Young's double slit experiment(slit distance d) monochromatic light of

wavelength λ is used and the fringe pattern observed at a distance L from the slits.
The angular position of the bright fringes are

a) $\sin^{-1}\left(\frac{n\lambda}{d}\right)$ b) $\sin^{-1}\left(\frac{\left(n+\frac{1}{2}\right)\lambda}{d}\right)$ c) $\sin^{-1}\left(\frac{n\lambda}{L}\right)$ d) $\sin^{-1}\left(\frac{\left(n+\frac{1}{2}\right)\lambda}{L}\right)$

710. A beam of ordinary unpolarised light passes through a tourmaline crystal C_1 and then it passes through another tourmaline crystal C_2, which is oriented such that its principal plane is parallel to that of C_2. The intensity if emergent light isI_0. Now C_2 is rotated by 60° about the ray. The emergent ray will have an intensity

a) $2I_0$ b) $I_0/2$ c) $I_0/4$ d) $I_0/\sqrt{2}$

: ANSWER KEY :

1)	d	2)	c	3)	a	4)	b	189)	b	190)	c	191)	b	192)	b
5)	b	6)	a	7)	a	8)	d	193)	a	194)	b	195)	c	196)	b
9)	b	10)	a	11)	c	12)	a	197)	b	198)	d	199)	b	200)	b
13)	a	14)	b	15)	b	16)	b	201)	d	202)	a	203)	c	204)	a
17)	c	18)	d	19)	c	20)	d	205)	a	206)	b	207)	a	208)	d
21)	b	22)	b	23)	b	24)	c	209)	d	210)	b	211)	c	212)	c
25)	b	26)	a	27)	b	28)	d	213)	b	214)	b	215)	a	216)	c
29)	b	30)	c	31)	d	32)	b	217)	d	218)	a	219)	a	220)	d
33)	a	34)	d	35)	d	36)	c	221)	c	222)	a	223)	b	224)	c
37)	d	38)	b	39)	d	40)	a	225)	d	226)	d	227)	c	228)	a
41)	b	42)	b	43)	c	44)	d	229)	d	230)	c	231)	a	232)	d
45)	b	46)	b	47)	d	48)	c	233)	d	234)	a	235)	c	236)	a
49)	a	50)	d	51)	b	52)	c	237)	b	238)	a	239)	a	240)	d
53)	d	54)	d	55)	a	56)	b	241)	a	242)	c	243)	c	244)	c
57)	b	58)	c	59)	a	60)	a	245)	a	246)	b	247)	c	248)	d
61)	d	62)	d	63)	b	64)	c	249)	d	250)	b	251)	b	252)	a
65)	d	66)	a	67)	b	68)	b	253)	c	254)	d	255)	a	256)	b
69)	a	70)	b	71)	c	72)	b	257)	b	258)	c	259)	c	260)	b
73)	b	74)	b	75)	c	76)	a	261)	c	262)	d	263)	b	264)	c
77)	d	78)	a	79)	a	80)	b	265)	a	266)	a	267)	b	268)	c
81)	d	82)	c	83)	d	84)	b	269)	b	270)	b	271)	d	272)	d
85)	b	86)	b	87)	a	88)	c	273)	b	274)	b	275)	a	276)	d
89)	d	90)	c	91)	c	92)	a	277)	a	278)	b	279)	b	280)	b
93)	a	94)	b	95)	b	96)	a	281)	c	282)	b	283)	c	284)	b
97)	d	98)	d	99)	c	100)	a	285)	c	286)	c	287)	b	288)	d
101)	b	102)	c	103)	c	104)	c	289)	a	290)	a	291)	c	292)	c
105)	c	106)	a	107)	d	108)	c	293)	a	294)	b	295)	c	296)	c
109)	a	110)	d	111)	d	112)	b	297)	a	298)	c	299)	b	300)	d
113)	b	114)	a	115)	c	116)	b	301)	a	302)	a	303)	b	304)	a
117)	c	118)	b	119)	a	120)	b	305)	a	306)	b	307)	a	308)	b
121)	a	122)	d	123)	c	124)	c	309)	c	310)	a	311)	c	312)	c
125)	d	126)	b	127)	a	128)	b	313)	b	314)	d	315)	d	316)	b
129)	d	130)	b	131)	c	132)	a	317)	d	318)	b	319)	c	320)	d
133)	b	134)	b	135)	d	136)	a	321)	a	322)	b	323)	d	324)	a
137)	d	138)	b	139)	a	140)	c	325)	c	326)	d	327)	b	328)	a
141)	a	142)	b	143)	c	144)	d	329)	a	330)	b	331)	a	332)	a
145)	a	146)	a	147)	b	148)	d	333)	d	334)	c	335)	d	336)	a
149)	d	150)	a	151)	a	152)	b	337)	a	338)	d	339)	a	340)	c
153)	d	154)	c	155)	c	156)	c	341)	b	342)	d	343)	d	344)	d
157)	c	158)	d	159)	c	160)	a	345)	d	346)	a	347)	c	348)	d
161)	a	162)	c	163)	d	164)	a	349)	d	350)	d	351)	a	352)	b
165)	c	166)	a	167)	b	168)	c	353)	c	354)	c	355)	a	356)	a
169)	d	170)	a	171)	d	172)	b	357)	c	358)	a	359)	c	360)	c
173)	c	174)	b	175)	b	176)	b	361)	d	362)	d	363)	b	364)	a
177)	d	178)	b	179)	d	180)	c	365)	c	366)	b	367)	d	368)	a
181)	d	182)	c	183)	d	184)	d	369)	a	370)	a	371)	d	372)	a
185)	b	186)	c	187)	a	188)	c	373)	d	374)	c	375)	b	376)	c

377)	c	378)	a	379)	b	380)	b
381)	a	382)	c	383)	b	384)	c
385)	b	386)	c	387)	c	388)	c
389)	b	390)	b	391)	c	392)	c
393)	d	394)	c	395)	c	396)	c
397)	b	398)	b	399)	c	400)	d
401)	b	402)	d	403)	a	404)	b
405)	d	406)	c	407)	d	408)	b
409)	d	410)	c	411)	b	412)	b
413)	d	414)	b	415)	b	416)	d
417)	c	418)	b	419)	a	420)	d
421)	c	422)	a	423)	a	424)	a
425)	a	426)	c	427)	d	428)	d
429)	b	430)	b	431)	b	432)	b
433)	c	434)	c	435)	b	436)	b
437)	b	438)	c	439)	b	440)	c
441)	d	442)	d	443)	c	444)	d
445)	d	446)	d	447)	b	448)	b
449)	d	450)	b	451)	a	452)	a
453)	b	454)	a	455)	c	456)	a
457)	b	458)	d	459)	a	460)	a
461)	c	462)	a	463)	c	464)	b
465)	a	466)	c	467)	b	468)	b
469)	c	470)	a	471)	c	472)	c
473)	a	474)	c	475)	b	476)	d
477)	c	478)	a	479)	d	480)	d
481)	c	482)	b	483)	b	484)	b
485)	b	486)	c	487)	d	488)	b
489)	a	490)	a	491)	a	492)	d
493)	c	494)	d	495)	d	496)	d
497)	c	498)	b	499)	c	500)	d
501)	d	502)	a	503)	b	504)	d
505)	a	506)	a	507)	a	508)	d
509)	b	510)	c	511)	d	512)	d
513)	a	514)	d	515)	b	516)	c
517)	a	518)	c	519)	c	520)	a
521)	d	522)	b	523)	c	524)	b
525)	a	526)	a	527)	c	528)	d
529)	a	530)	a	531)	c	532)	d
533)	d	534)	c	535)	b	536)	c
537)	a	538)	a	539)	b	540)	b
541)	c	542)	c	543)	a	544)	b
545)	b	546)	a	547)	d	548)	c
549)	a	550)	d	551)	c	552)	c
553)	d	554)	a	555)	b	556)	d
557)	d	558)	a	559)	a	560)	b
561)	a	562)	a	563)	d	564)	b
565)	b	566)	c	567)	a	568)	d
569)	a	570)	d	571)	b	572)	b
573)	c	574)	c	575)	d	576)	b
577)	b	578)	a	579)	d	580)	d

581)	c	582)	c	583)	a	584)	a
585)	b	586)	b	587)	b	588)	d
589)	b	590)	b	591)	b	592)	a
593)	b	594)	a	595)	d	596)	d
597)	b	598)	a	599)	c	600)	a
601)	b	602)	b	603)	d	604)	c
605)	c	606)	d	607)	a	608)	a
609)	c	610)	c	611)	c	612)	b
613)	a	614)	a	615)	b	616)	c
617)	d	618)	b	619)	b	620)	c
621)	d	622)	b	623)	a	624)	c
625)	b	626)	a	627)	c	628)	d
629)	c	630)	d	631)	c	632)	a
633)	b	634)	a	635)	a	636)	c
637)	a	638)	b	639)	c	640)	d
641)	b	642)	b	643)	b	644)	c
645)	c	646)	b	647)	b	648)	b
649)	b	650)	a	651)	b	652)	c
653)	d	654)	a	655)	c	656)	c
657)	c	658)	a	659)	c	660)	c
661)	c	662)	b	663)	c	664)	c
665)	d	666)	b	667)	d	668)	b
669)	a	670)	c	671)	d	672)	a
673)	b	674)	a	675)	d	676)	c
677)	a	678)	b	679)	b	680)	d
681)	b	682)	a	683)	a	684)	b
685)	a	686)	b	687)	b	688)	b
689)	a	690)	d	691)	a	692)	c
693)	d	694)	a	695)	c	696)	c
697)	c	698)	b	699)	a	700)	a
701)	a	702)	d	703)	b	704)	c
705)	c	706)	d	707)	d	708)	a
709)	a	710)	c				

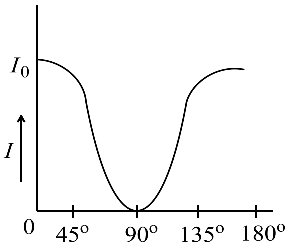
: HINTS AND SOLUTIONS :

2 **(c)**

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \therefore v = \frac{\Delta\lambda}{\lambda}c = \frac{0.1}{6000} \times 3 \times 10^5 km/s$$
$$= 5\ km/s$$

3 **(a)**

According to law of Malus, when a beam of completely plane polarized light is incident on an analyser, the resultant intensity of light (I) transmitted from the analyser varies directly as the square of the cosine of the angle (θ) between planes of transmission of analyser and polarizer $ie, I \propto \cos^2\theta$ and $I = I_0 \cos^2\theta$ ...(i)



Where $I_0 =$ intensity of the light from polarizer

From Eq. (i), we note that if the transmission axes of polarizer and analyser are parallel $(ie, \theta = 0°$ or $180°)$, then $I = I_0$. It means that intensity of transmitted light is maximum. When the transmission axes of polarizer and analyser are perpendicular $(ie, \theta = 90°)$, then $I = I_0 \cos^2 90° = 0$. It means the intensity of transmitted light is minimum

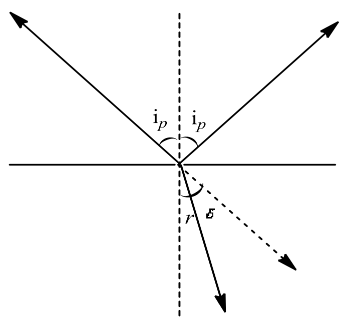
On plotting a graph between I and θ as given by relation (i), we get the curve as shown in figure

4 **(b)**

The idea of secondary wavelets is given by Huygen

5 **(b)**

Here, $i_p = r + \delta$



$i_p = r + 24$ ... (i)

Moreover, $i_p + r = 90°$ ... (ii)

From Eqs. (i) and (ii), we get

$i_p + (i_p - 24) = 90°$

$\Rightarrow i_p = 57°$

6 **(a)**

$$\lambda = \frac{c}{v} = \frac{3 \times 10^8}{8.2 \times 10^6} = 36.5m$$

7 **(a)**

The linear width of central principal maximum

$$= \frac{2\lambda D}{d}$$

If it is equal to width of slit (d), then

$$\frac{2\lambda D}{d} = d \text{ or } D = \frac{d^2}{2\lambda}$$

8 **(d)**

When white light is used instead of monochromatic light, the central bright fringe becomes white, while others are coloured. Hence, distinction is made.

9 **(b)**

Diffraction is obtained when the slit width is of the order of wavelength of EM waves (or light). Here wavelength of X-rays $(1 - 100\text{Å})$ is very-very lesser than slit width $(0.6\ mm)$. Therefore no diffraction pattern will be observed

10 **(a)**

Wavelength of matter wave or de Broglie wave length

$$\lambda = \frac{h}{mv} = \frac{h}{p}$$

From the above relation it is clear that wavelength of matter wave is independent the charge

11 **(c)**

Let intensity of light coming from each slit of a coherent source is I.

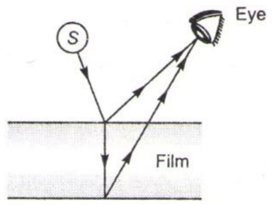
As first slit has width 4 times the width of the second slit, so

$I_1 = 4I$ and $I_2 = I$

$$\therefore \frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{I_1}+\sqrt{I_2}\right)^2}{\left(\sqrt{I_1}-\sqrt{I_2}\right)^2} = \frac{\left(\sqrt{4I}+\sqrt{I}\right)^2}{\left(\sqrt{4I}-\sqrt{I}\right)^2} = \frac{9}{1}$$

12 **(a)**

When a thin film (say of oil) is spread over (say water), seen in broad light brilliant coloured pattern in observed. This coloured pattern arises due to interference of light reflected from the upper and lower surfaces of the film.



13 **(a)**

The condition for constructive interference in a thin film of thickness t and refractive index μ in the reflected system, for normal incidence is

$2\mu t = \left(n+\frac{1}{2}\right)\lambda$, where $n = 0, 1, 2, 3$

For minimum thickness, $n = 0$

$\therefore 2\mu t = \frac{\lambda}{2} \Rightarrow t = \frac{\lambda}{4\mu} = \frac{600 \times 10^{-9}}{4 \times 1.5} = 100nm$

14 **(b)**

When two sources are obtained from a single source, the wavefront is divided into two parts. These two wavefronts act as if they are emanated from two sources having a fixed phase relationship

15 **(b)**

Here, $\theta = 9.9°, l = 20$ cm $= 0.2$m$, s = 66°$

$c =? \; c = \frac{\theta}{ls} = \frac{9.9}{2\times 66} = 0.075\text{g cc}^{-1}$

$= 75\text{gL}^{-1}$.

16 **(b)**

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

17 **(c)**

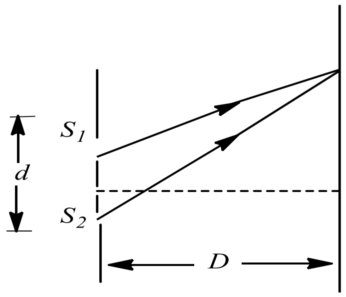
$\vec{E}$ and $\vec{B}$ are mutually perpendicular to each other and are in phase i.*e*. they become zero and minimum at the same place and at the same time

18 **(d)**

When a thin sheet of polyvinyl alcohol is stretched and then impregnating with iodine, H-polaroid is obtained.

19 **(c)**

Let λ be wavelength of monochromatic light, d the distance between coherent sources, and D the distance between screen and source, then fringe width is



$$\beta = \frac{D\lambda}{d}$$

Given, $d_1 = d, D_1 = D, d_2 = 10d, D_2 = \frac{D}{2}$

$$\therefore \; \beta_2 = \frac{\frac{D}{2}\lambda}{10d} = \frac{D\lambda}{20d}$$

$$\Rightarrow \beta_2 = \frac{\beta}{20}$$

20 **(d)**

The angular position of first diffraction minimum is

$$\sin\theta = \frac{\lambda}{a}$$

The phase difference

$$\phi = \frac{2\pi}{\lambda} \times \Delta x$$

$$\phi = \frac{2\pi}{\lambda} \times \lambda$$

$$\phi = 2\pi$$

21 **(b)**

Here, $d = 1$ mm $= 10^{-3}$m,

$\lambda = 6.5 \times 10^{-7}$m

$D = 1$m

$$x_5 = n\lambda\frac{D}{d} = 5 \times 6.5 \times 10^{-7} \times \frac{1}{10^{-3}}$$

$$= 32.5 \times 10^{-4}\text{m}$$

$$x_3 = (2n-1)\frac{\lambda}{2}\frac{D}{d}$$

$$= \frac{(2 \times 3 - 1) \times 6.5 \times 10^{-7}}{2 \times 10^{-3}}$$

$$= 16.25 \times 10^{-4}\text{ m}$$

$$x_5 - x_3 = (32.5 - 16.25)10^{-4}\text{m}$$

$$= 16.25 \times 10^{-4}\text{m} = 1.63\text{ mm}$$

22 **(b)**

As $S_3, \Delta x = S_1S_3 - S_2S_3 = 0$

$$\therefore \ \phi = \frac{2\pi}{\lambda}\Delta x = 0$$

$$\therefore I_3 = I_0 + I_0 + 2\sqrt{I_0 \times I_0(\cos 0°)}$$

$$\therefore I_3 = 4I_0$$

The path difference at S_4 is

$$\Delta x' = S_1S_4 - S_2S_4 = \frac{xd}{D} \qquad \left(\text{here}, x = \frac{\lambda D}{2d}\right)$$

$$= \frac{d}{D} \times \frac{\lambda D}{2d} = \frac{\lambda}{2}$$

$$\therefore \ \phi' = \frac{2\pi}{\lambda}\frac{\lambda}{2} = \pi$$

$$\therefore I_4 = I_0 + I_0 + 2I_0 \cos\pi = 0$$

$$\therefore \frac{I_3}{I_4} = \frac{4I_0}{0} = \infty$$

24 **(c)**

Phase difference,

$$\Delta\phi = \frac{2\pi}{\lambda}\Delta x$$

In a constructive interference,

$\Delta\phi = 2n\pi$

Where $n = 0, 1, 2, 3, \dots\dots$

$$\therefore 2n\pi = \frac{2\pi}{\lambda}\Delta x$$

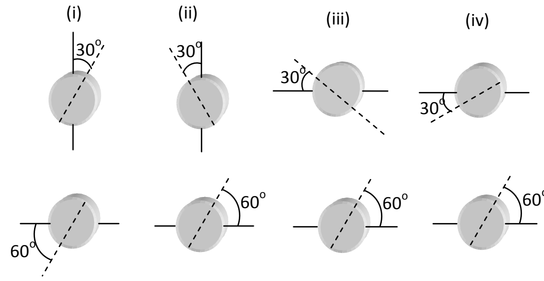
Or $\Delta x = n\lambda$

25 **(b)**

Final intensity of light is given by Malus law

$I = I_0 \cos^2\theta$; where $\theta =$ Angle between transmission axes of polarizer and analyser

Hence decreasing order of intensity is (i) > (iv) > (ii) > (iii)



27 **(b)**

Distance of third maxima from central maxima is

$$x = \frac{3\lambda D}{d} = \frac{3 \times 5000 \times 10^{-10} \times (200 \times 10^{-2})}{0.2 \times 10^{-3}}$$

$$= 1.5cm$$

29 **(b)**

At the centre, all colours meet in phase, hence central fringe is white.

30 **(c)**

The ratio of intensities of successive maxima is

$$1:\left(\frac{2}{3\pi}\right)^2:\left(\frac{2}{5\pi}\right)^2:\left(\frac{2}{7\pi}\right)^2$$

$$= 1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$$

31 **(d)**

Since P is ahead of Q by 90° and path difference between P and Q is $\lambda/4$. Therefore at A, phase difference is zero, so intensity is $4I$. At C it is zero and at B, the phase difference is 90°, so intensity is $2I$

32 **(b)**

In this case, we can assume that both the source and the observer are moving towards each other with speed

v. Hence $v' = \frac{c-u_o}{c-u_s} = \frac{c-(-v)}{c-v}v = \frac{c+v}{c-v}v$

$$= \frac{(c+v)(c-v)}{(c-v)^2}v = \frac{c^2 - v^2}{c^2 + v^2 - 2vc}v$$

Since $v << c$, therefore $v' = \frac{c^2}{c^2-2vc} = \frac{c}{c-2v}v$

33 **(a)**

Using Malus law, $I = I_0 \cos^2\theta$

As here polarizer is rotating, *i.e.*, all the values of θ are possible

$$I_{av} = \frac{1}{2\pi}\int_0^{2\pi} I\,d\theta = \frac{1}{2\pi}\int_0^{2\pi} I_0\cos^2\theta\ d\theta$$

On integration we get $I_{av} = \frac{I_0}{2}$

Where $I_0 = \frac{\text{Energy}}{\text{Area}\times\text{Time}} = \frac{p}{A} = \frac{10^{-3}}{3\times10^{-4}} = \frac{10}{3}\frac{Watt}{m^2}$

$$\therefore I_{av} = \frac{1}{2} \times \frac{10}{3} = \frac{5}{3}Watt$$

and Time period $T = \frac{2\pi}{\omega} = \frac{2\times3.14}{31.4} = \frac{1}{5}s$

$\therefore$ Energy of light passing through the polarizer per revolution $= I_{av} \times \text{Area} \times T = \frac{5}{3} \times 3 \times 10^{-4} \times \frac{1}{5} = 10^{-4} J$

34 **(d)**

Ground wave and sky wave both are amplitude modulated wave and the amplitude modulated signal is transmitted by a transmitting antenna and received by the receiving antenna at a distance place

35 **(d)**

$$\beta = \frac{D}{d}\lambda$$

$$\Delta\beta = \frac{\Delta D}{d}\lambda$$

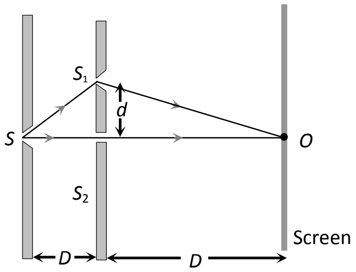
$$\Delta D = \frac{d\Delta\beta}{\lambda}$$

$$= \frac{10^{-3} \times 3 \times 10^{-5}}{600 \times 10^{-9}}$$

$= 5$ cm away or towards the slits

36 **(c)**

Path difference between the waves reaching at $O, \Delta = \Delta_1 + \Delta_2$ where $\Delta_1 =$ Initial path difference $\Delta_2 =$ Path difference between the waves after emerging from slits



$\Delta_1 = SS_1 - SS_2 = \sqrt{D^2 + d^2} - D$ and

$\Delta_2 = S_1O - S_2O = \sqrt{D^2 + d^2} - D$

$\therefore \Delta = 2\left\{(D^2 + d^2)^{\frac{1}{2}} - D\right\} = 2\left\{\left(D + \frac{d^2}{2D}\right) - D\right\}$

$= \frac{d^2}{D}$ (From Binomial expansion)

For obtaining dark at O, Δ must be equals to $(2n-1)\frac{\lambda}{2}$ $i.e \frac{d^2}{D} = (2n-1)\frac{\lambda}{2} \Rightarrow \sqrt{\frac{(2n-1)\lambda D}{2}} = d$

For minimum distance $n = 1$ so $d = \sqrt{\frac{\lambda D}{2}}$

37 **(d)**

Origin of spectra is not explained by Huygen's theory

40 **(a)**

From $a \sin\theta = n\lambda$

$$a\frac{x}{D} = n\lambda, a = \frac{n\lambda D}{x} = \frac{1 \times 6000 \times 10^{-10} \times 2}{4 \times 10^{-3}}$$

$= 3 \times 10^{-4} = 0.3$ mm

41 **(b)**

Some crystals such as tourmaline and sheets of iodosulphate of quinine have the property of strongly absorbing the light with vibrations perpendicular to a specific direction (called transmission axis) transmitting the light with vibrations parallel to it. This selective absorption of light is called dichroism.

42 **(b)**

Thickness of the film must be of the order of wavelength of light falling on film (*i.e.*, visible light)

43 **(c)**

The strength of solution is given by

$$c = \frac{\theta}{l \times s}$$

Where the symbols have their usual meanings.

Here, $\theta = 19°, l = 20$ cm $= 0.20$ m

$S = 0.5 \deg \text{m}^2\text{kg}^{-1}$

$$\therefore c = \frac{19}{0.20 \times 0.5} = 190 \text{ kg} - \text{m}^{-3}$$

The sugar sample dissolved in a m^3 of water is 200 kg in which 190 kg is pure sugar.

Therefore, purity is $\frac{190}{200} \times 100 = 95\%$

44 **(d)**

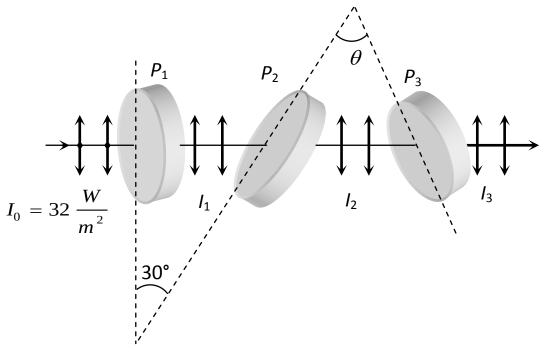
By using $\mu = \tan\theta_p \Rightarrow \mu = \tan 60 = \sqrt{3}$

Also $C = \sin^{-1}\left(\frac{1}{\mu}\right) \Rightarrow C = \sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

45 **(b)**

Angle between P_1 and $P_2 = 30°$ [Given]

Angle between P_2 and $P_3 = \theta = 90° - 30° = 60°$



The intensity of light transmitted by P_1 is

$I_1 = \frac{I_0}{2} = \frac{32}{2} = 16\,\frac{W}{m^2}$

According to Malus law the intensity of light transmitted

by P_2 is $I_2 = I_1 \cos^2 30° = 16\left(\frac{\sqrt{3}}{2}\right)^2 = 12\,\frac{W}{m^2}$

Similarly intensity of light transmitted by P_3 is

$I_3 = I_2 \cos^2\theta = 12\cos^2 60° = 12\left(\frac{1}{2}\right)^2 = 3\,\frac{W}{m^2}$

46 **(b)**

$\phi = \pi/3, a_1 = 4, a_2 = 3$

So, $A = \sqrt{a_1^2 + a_2^2 + 2a_1.a_2\cos\phi} \Rightarrow A = 6$

47 **(d)**

In single slit diffraction, the central fringe has maximum intensity and has the width double than other fringes.

48 **(c)**

$\beta \neq \frac{\lambda D}{d}$ and $\lambda \propto \frac{1}{\mu}$

49 **(a)**

Path difference of 3rd bright fringe from central fringe=3λ, so that the phase difference=$3(2\pi) = 6\pi$ rad.

50 **(d)**

For n^{th} secondary maxima path difference

$d\sin\theta = (2n+1)\frac{\lambda}{2} \Rightarrow a\sin\theta = \frac{3\lambda}{2}$

51 **(b)**

For a path difference $(\mu - 1)t$, the shift is

$x = (\mu - 1)t\frac{D}{d}$

52 **(c)**

$\beta \propto \frac{\lambda}{d}$

53 **(d)**

If we use torch light in place of monochromatic light then overlapping of fringes pattern take place. Hence no fringe will appear

54 **(d)**

Angular resolution $= \frac{1.22\lambda}{d}$

$= \frac{1.22 \times 5000 \times 10^{-10}}{10 \times 10^{-2}} = 6.1 \times 10^{-6}$

$\approx 10^{-6}$ rad

55 **(a)**

To be invisible in vacuum μ of medium must be equal to μ of vacuum, which is 1.

56 **(b)**

$\beta \propto \frac{1}{d}$

57 **(b)**

For incoherent waves,

$I_{\text{max}} = nI$

$\therefore \quad n = \frac{I_{\text{max}}}{I} = \frac{32}{2} = 16$

58 **(c)**

According to Corpuscular theory different colours of light are due to different sizes of Corpuscules

59 **(a)**

Here, $\omega = 31.4$ rads^{-1}

$\therefore$ Time period of revolution,

$T = \frac{2\pi}{\omega} = \frac{2 \times 3.14}{31.4} = 0.2$s

Energy transmitted/revolution

$= (IA)T = \left(\frac{I_0}{2}A\right)T$

$= \frac{\phi_0 T}{2} = \frac{10^{-3} \times 0.2}{31.4} = 10^{-4}$J

61 **(d)**

Intensity of each source $= I_0 = \frac{100}{4} = 25unit$

If the intensity of one of the source is reduced by 36% then $I_1 = 25\,unit$ and $I_2 = 25 - 25 \times \frac{36}{100} = 16\,(unit)$

Hence resultant intensity at the same point will be

$I = I_1 + I_2 + 2\sqrt{I_1 I_2} = 25 + 16 + 2\sqrt{25 \times 16}$

$= 81unit$

62 **(d)**

Distance between successive fringes-fringe width

$= \beta = \frac{\lambda D}{d} = \frac{8\times10^{-5}\times2}{0.05} = 0.32$ cm

63 **(b)**

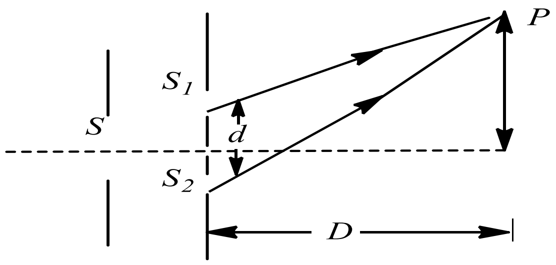
$I' = \frac{I}{2}\cos^2\theta = \frac{I}{6}$ or $\cos\theta = \frac{1}{\sqrt{3}}$ $\therefore \theta = 55°$

65 **(d)**

Let λ be wavelength of monochromatic light, used to illuminate the slit S, and d be the distance between coherent sources, then width of slits is given by

$$W = \frac{D\lambda}{d}$$

When D is distance between screen and source.



Given, $d = 3$ mm, $\lambda = 5000$ Å $= 5\times10^{-7}$ m

$= 5\times10^{-4}$ mm

$D = 90$ cm $= 900$ mm

$$\therefore W = \frac{5\times10^{-4}\times900}{3}$$

$= 15\times10^{-2}$ mm $= 0.15$ mm

66 **(a)**

$c = \frac{E_0}{B_0}$ = speed of light

$\Rightarrow E_0 = B_0 c$

Given, $B_0 = 2\times10^{-7}T, c = 3\times10^8 m/s$

$E_0 = 2\times10^{-7}\times3\times10^8 = 60T\ m/s = 60\ Vm^{-1}$

67 **(b)**

Here, $\Delta\lambda = 0.5nm = 0.5\times10^{-9}m$

$v = 300kms^{-1} = 300\times10^3 ms^{-1}$

As $\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \lambda = \frac{\Delta\lambda c}{v}$

$$\therefore \lambda = \frac{(0.5\times10^{-9}m)(3\times10^8 ms^{-1})}{(300\times10^3 ms^{-1})} = 5\times10^{-7}m$$

$= 5000\times10^{-10}m = 5000$ Å

68 **(b)**

Area through which the energy of beam passes

$= (6.328\times10^{-7})^2 = 4\times10^{-13}m^2$

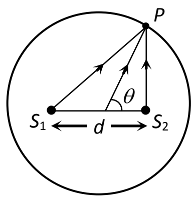
$$\therefore I = \frac{P}{A} = \frac{10^{-3}}{4\times10^{-13}} = 2.5\times10^9 W/m^2$$

69 **(a)**

$v_{\gamma-rays} > v_{X-rays} > v_{UV-rays}$

70 **(b)**

Here path difference at a point P on the circle is given by



$\Delta x = d\cos\theta$ ...(i)

For maxima at P

$\Delta x = n\lambda$ ...(ii)

From equation (i) and (ii)

$n\lambda = d\cos\theta \Rightarrow \theta = \cos^{-1}\left(\frac{n\lambda}{d}\right) = \cos^{-1}\left(\frac{4\lambda}{d}\right)$

71 **(c)**

$\lambda_m > \lambda_v > \lambda_x$

72 **(b)**

As $\lambda_{\text{blue}} < \lambda_{\text{red}}$ and width of diffraction bands is directly proportional to λ, therefore diffraction bands become narrower and crowded

73 **(b)**

Due to expansion of universe, the star will go away from the earth thereby increasing the observed wavelength. Therefore the spectrum will shift to the infrared region

74 **(b)**

$d = 0.1$ mm $= 10^{-4}$, D $= 20$ cm $= \frac{1}{5}$ m

$\lambda = 5460$Å $= 5.46\times10^{-7}$m

Angular position of first dark fringe is

$$\theta = \frac{x}{D} = \frac{\lambda}{2d} = \frac{5.46\times10^{-7}}{2\times10^{-4}}$$

$= 2.73\times10^{-3}$ rad

$$= 2.73\times10^{-3}\times\frac{180°}{\pi} = 0.156°$$

75 **(c)**

$I = I_0\left[\frac{\sin\alpha}{\alpha}\right]^2$, where $\alpha = \frac{\phi}{2}$

For n^{th} secondary maxima $d\sin\theta = \left(\frac{2n+1}{2}\right)\lambda$

$$\Rightarrow \alpha = \frac{\phi}{2} = \frac{\pi}{\lambda}[d\sin\theta] = \left(\frac{2n+1}{2}\right)\pi$$

$$\therefore I = I_0\left[\frac{\sin\left(\frac{2n+1}{2}\right)\pi}{\left(\frac{2n+1}{2}\right)\pi}\right]^2 = \frac{I_0}{\left\{\left(\frac{2n+1}{2}\right)\pi\right\}^2}$$

So $I_0 : I_1 : I_2 = I_0 : \frac{4}{9\pi^2}I_0 : \frac{4}{25\pi^2}I_0$

$= 1 : \frac{4}{9\pi^2} : \frac{4}{25\pi^2}$

76 **(a)**

$\Delta\lambda = \lambda\frac{v}{c}$ and $v = r\omega$

$$v = 7 \times 10^8 \times \frac{2\pi}{25 \times 24 \times 3600}, c = 3 \times 10^8 m/s$$

$\therefore \Delta\lambda = 0.04\text{Å}$

78 **(a)**

For second dark fringe $d \sin\theta = 2\lambda$

$\Rightarrow 24 \times 10^{-5} \times 10^{-2} \times \sin 30 = 2\lambda$

$\Rightarrow \lambda = 6 \times 10^{-7} m = 6000$ Å

79 **(a)**

The distance between zeroth order maxima and second order minima is

$$y_1 = \frac{\beta}{2} + \beta = \frac{3}{2}\beta$$

$$= \frac{3}{2} \times 0.2 \text{ mm} = 0.3 \text{ mm}$$

$\therefore$ The distance of second maxima from point P is

$$y = (4.8 + 0.3)\text{mm} = 5.1 \text{ mm}$$

80 **(b)**

Angular dispersion of central maximum=angular dispersion of 1st minimum $(= 2\theta)$

From $\sin\theta = \frac{1\lambda}{a} = \frac{2\times10^{-3}}{4\times10^{-3}} = \frac{1}{2}$

$\theta = 30°$

$\therefore 2\theta = 2 \times 30° = 60°$

81 **(d)**

When the approatus is immersed is water the angular width of a fringe $\theta = \frac{\lambda}{d}$ and $\theta = 2°$ and the angular width of a fringe in air

$$\theta' = \frac{\lambda'}{d}$$

$$\frac{1}{\mu_\omega} = \frac{\lambda'}{\lambda}$$

$$\frac{\lambda'}{\alpha} = \frac{3}{4}$$

Now, $\frac{\theta'}{\theta} = \frac{\lambda'}{\alpha}$

$$\theta' = \frac{\lambda'}{\alpha} \times \theta$$

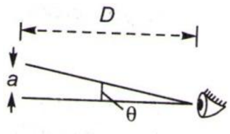
$$\theta' = \frac{3}{4} \times 0.2°$$

$$\theta' = 0.15°$$

82 **(c)**

According to Rayleigh's criterion,

$\theta = 1.22\lambda/d_e$



Where λ = wavelength of light,

d_e = diameter of the pupil of the eye.

$$\therefore \ \theta = \frac{1.22 \times 500 \times 10^{-9}}{2.5 \times 10^{-3}} = 2.44 \times 10^{-4} \text{ rad}$$

But $\theta = \frac{a}{D}$

$\therefore$ distance of separation,

$$a = D \times \theta = 10 \times 10^3 \times 2.44 \times 10^{-4} = 2.44 \text{ m}$$

83 **(d)**

Sound waves and light waves both show interference

84 **(b)**

$d = 1 \text{ mm} = 1 \times 10^{-3} \text{ m}, D = 1 \text{ m}$

$\lambda = 500 \text{ nm} = 500 \times 10^{-9} \text{ m}$

Distance of nth minima from central maxima

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

$$= \frac{(2 \times 3 - 1) \times 500 \times 10^{-9}}{2} \times \frac{1}{1 \times 10^{-3}}$$

$$= 2.5 \times 500 \times 10^{-6}$$

$$= 12.5 \times 10^{-4} \text{ m}$$

$$= 1.25 \text{ mm}$$

85 **(b)**

$\mu = \tan i_p = \tan 54.74° = \sqrt{2}$

$$\because \sqrt{2} = \frac{\sin 40°}{\sin r}$$

$$\Rightarrow \sin r = \frac{1}{2} \Rightarrow r = 30°$$

86 **(b)**

According to principle of diffraction

$a \sin \theta = n\lambda$

Where $n =$ order of secondary minimum

$\therefore a \sin 30° = 1 \times (6500 \times 10^{-10})$

Or $a = 1.3 \times 10^{-6}$ m

Or $a = 1.3$ micron

87 **(a)**

E_x and B_y would generate a plane EM wave travelling in z-direction. $\vec{E}, \vec{B}$ and $\vec{k}$ form a right handed system $\vec{k}$ is along z-axis. As $\hat{\imath} \times \hat{\jmath} = \hat{k}$

$\Rightarrow E_x\hat{\imath} \times B_y\hat{\jmath} = C\hat{k}$ $i.e.$ E is along x-axis and B is along y-$axis$

88 **(c)**

Angular width $= \frac{2\lambda}{d} = \frac{2\times6000\times10^{-10}}{12\times10^{-5}\times10^{-2}} = 1rad$

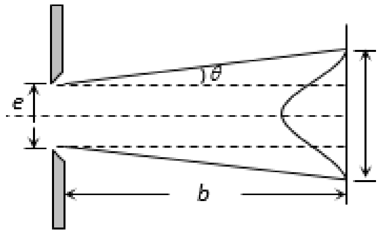
89 **(d)**

As sound waves are longitudinal, therefore, polarization of sound waves is not possible.

90 **(c)**

The direction in which the first minima occurs is θ (say). Then $e \sin \theta = \lambda$ or $e\theta = \lambda$ or, $\theta = \frac{\lambda}{e}$

($\because \theta = \sin\theta$ when θ small)



Width of the central maximum $= 2b\theta + e = 2b.\frac{\lambda}{e} + e$

91 **(c)**

Angular momentum

$$L = \frac{nh}{2\pi}$$

$$U = nhv$$

$$\omega = 2\pi v \Rightarrow v = \frac{\omega}{2\pi}$$

$$\therefore \quad U = \frac{nh\omega}{2\pi}$$

Or $U = L\omega$

$$L = \frac{U}{\omega}$$

93 **(a)**

$\Delta\lambda = \lambda.\frac{v}{c}$ where $v = r\omega = r \times \left(\frac{2\pi}{T}\right)$

$$\therefore \Delta\lambda = \frac{4320 \times 7 \times 10^8 \times 2 \times 3.14}{3 \times 10^8 \times 22 \times 86400} = 0.033Å$$

95 **(b)**

$\tan i_p = \mu = \sqrt{3} \quad \therefore i_p = 60°$

96 **(a)**

$$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{\frac{I_1}{I_2}} + 1}{\sqrt{\frac{I_1}{I_2}} - 1}\right)^2 = \left(\frac{\sqrt{2}+1}{\sqrt{2}-1}\right)^2 = 34; \text{[Given } I_1 = 2I_2]$$

97 **(d)**

Huygen's theory explains propagation of wavefront

98 **(d)**

Resultant intensity $I_R = I_1 + I_2 + 2\sqrt{I_1I_2}\cos\phi$

For maximum $I_R, \phi = 0°$

$\Rightarrow I_R = I_1 + I_1 + 2\sqrt{I_1I_2} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

99 **(c)**

In interference, we use two sources while in diffraction, we use light from two points of the same wavefront.

101 **(b)**

As field of view is same in both cases

$n_1\beta_1 = n_2\beta_2$

Or $n_1\left(\frac{D\lambda_1}{d}\right) = n_2\left(\frac{D\lambda_2}{d}\right)$

Or $\lambda_2 = \left(\frac{n_1}{n_2}\right)\lambda_1$

$\therefore \lambda_2 = \left(\frac{84}{62}\right) \times 4358$

$\lambda_2 = 5904$ Å

102 **(c)**

$\frac{\beta_1}{\beta_2} = \frac{\lambda_1}{\lambda_2}$ or $\frac{1.0}{\beta_2} = \frac{5000}{6000}$ or $\beta_2 = \frac{6000}{5000} = 1.2\ mm$

103 **(c)**

$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = \left(\sqrt{I} + \sqrt{4I}\right)^2 = 9I$

$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2 = \left(\sqrt{I} - \sqrt{4I}\right)^2 = I$

105 **(c)**

$$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{\frac{I_1}{I_2}}+1}{\sqrt{\frac{I_1}{I_2}}-1}\right)^2 = \left(\frac{\sqrt{\frac{9}{1}}+1}{\sqrt{\frac{9}{1}}-1}\right)^2 = \frac{4}{1}$$

106 **(a)**

Distance between two consecutive dark fringes

$$\beta = \frac{\lambda D}{d} = \frac{5000 \times 10^{-10} \times 1}{0.2 \times 10^{-2}} = 0.25\ mm$$

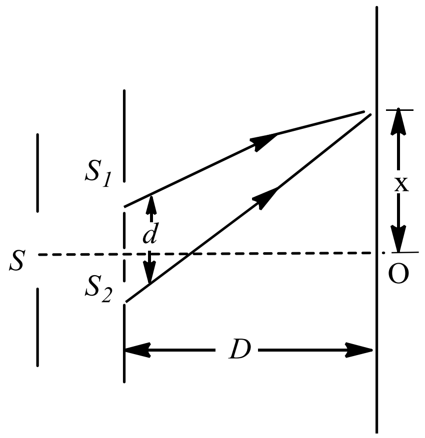
107 **(d)**

If you divide the original slit into N strips and represents the light from each strip, when it reaches the screen, by a phasor, then at the central maximum in the diffraction pattern you add N phasors, all in the same direction and each with the same amplitude. The intensity is therefore N^2. If you double the slit width, you need $2N$ phasors, if they are each to have the amplitude of the phasors you used for the narrow slit. The intensity at the central maximum is proportional to $(2N)^2$ and is, therefore, four times the intensity for the narrow slit

108 **(c)**

In Young's double slit experiment, for maximum intensity (bright fringe)

$$x = m\frac{D\lambda}{d}$$



Where m is path difference, D the distance between screen and coherent sources, d the distance between coherent and λ the wavelength.

Putting $m = 0$, we get the position of the central bright fringe (which is called zero order fringe). Hence, at point O the path difference between two wavelets is zero. Hence, at O there is always a bright fringe. This is called the central fringe.

109 **(a)**

Area of half period zone is independent of order of zone. Therefore, m is equal to zero in n^m

110 **(d)**

$$\Delta\lambda = \frac{v_s}{c}\lambda \Rightarrow v_s = \frac{\Delta\lambda . c}{\lambda} = \frac{47 \times 3 \times 10^8}{4700}$$

$= 3 \times 10^6 m/s$ away from earth

111 **(d)**

$$\beta = \frac{\lambda D}{d} \Rightarrow (4 \times 10^{-3}) = \frac{4 \times 10^{-7} \times D}{0.1 \times 10^{-3}} \Rightarrow D = 1m$$

112 **(b)**

If intensity of each wave is I, then initially at central position $I_o = 4I$. When one of the slits is covered then

Intensity at central position will be I only, $i.e., \frac{I_0}{4}$

113 **(b)**

$$\beta = \frac{(a+b)\lambda}{2a(\mu-1)\alpha}, i.e., \beta \propto \frac{\lambda}{(\mu-1)}$$

When placed in water $\beta' \propto \frac{\frac{\lambda}{\mu'}}{\left(\frac{\mu}{\mu'}-1\right)}$

$i.e., \beta' \propto \frac{\lambda}{(\mu-\mu')}$ but $< \mu$

$$\therefore \frac{\beta'}{\beta} = \frac{(\mu-1)}{(\mu-\mu')} \quad \because \mu' > 1\lambda \ \therefore \beta' > \beta$$

$i.e.$, the fringe width increases

115 **(c)**

$$\tan i = \frac{1}{\sin C}$$

$$\cot i = \sin\left[\sin^{-1}\left(\frac{3}{5}\right)\right]$$

$$\tan i = \frac{5}{3}$$

$$i = \tan^{-1}\left(\frac{5}{3}\right)$$

116 **(b)**

Infrared radiations reflected by low lying clouds and keeps the earth warm

117 **(c)**

Intensity of polarized light from first polarizer $= \frac{100}{2} = 50$

$$I = 50\cos^2 60° = \frac{50}{4} = 12.5$$

118 **(b)**

Average energy density of electric field is given by

$$u_e = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0\left(\frac{E_0}{\sqrt{2}}\right)^2 = \frac{1}{4}\varepsilon_0 E_0^2$$

$$= \frac{1}{4} \times 8.85 \times 10^{-12}(1)^2 = 2.2 \times 10^{-12} J/m^3$$

119 **(a)**

From $\beta = \frac{\lambda D}{d} \Rightarrow \lambda = \frac{\beta d}{D} = \frac{0.06\times10^{-2}\times10^{-3}}{1}$

$= 6 \times 10^{-7}\text{m} = 6000\text{Å}$

120 **(b)**
In case of destructive interference (minima) phase difference is odd multiple of π

122 **(d)**
Direction of wave propagation is given by $\vec{E} \times \vec{B}$

123 **(c)**
In single slit experiment,
Width of central maxima $(y) = 2\lambda D/d$

$$\Rightarrow \frac{y'}{y} = \frac{\lambda'}{d'} \times \frac{d}{\lambda} = \frac{600}{d/2} \times \frac{d}{400} \Rightarrow y' = 3y$$

124 **(c)**
Width of central bright fringe

$$= \frac{2\lambda D}{d} = \frac{2 \times 500 \times 10^{-9} \times 80 \times 10^{-2}}{0.20 \times 10^{-3}}$$
$$= 4 \times 10^{-3}m = 4mm$$

126 **(b)**
Fringe width ∝ wavelength of light.

Therefore fringe will become narrower.

127 **(a)**

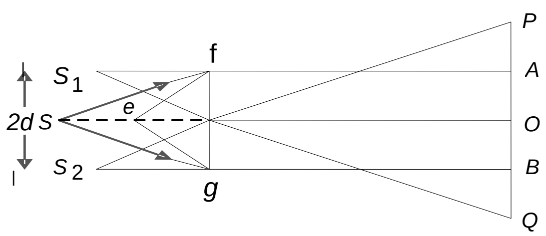
$$S_{av} = \frac{1}{2}\varepsilon_0 c E_0^2 = \frac{P}{4\pi R^2}$$

$$\Rightarrow E_0 = \sqrt{\frac{P}{2\pi R^2 \varepsilon_0 C}}$$

$$= \sqrt{\frac{3}{2 \times 3.14 \times 100 \times 8.85 \times 10^{-12} \times 3 \times 10^8}}$$

$= 1.34V/m$

128 **(b)**
In Fresnel biprism, the virtual images act as two coherent sources and from these two virtual images rays superimposed and interference fringes are formed in overlapping region AB on a screen placed at O.



In order to measure the distance $2d$ between the virtual sources S_1 and S_2. Glaze brook gave a method, known as magnification method due to Glaze brook. If d_1

129 **(d)**
For maximum intensity $\phi = 0°$

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

$= I + I + 2\sqrt{I\,I}\cos 0° = 4I$

130 **(b)**
Colours of thin film are due to interference of light

132 **(a)**

$$v = \frac{C}{\lambda} \Rightarrow v_1 = \frac{3 \times 10^8}{1} = 3 \times 10^8 Hz = 300\ MHz$$

and $v_2 = \frac{3\times10^8}{10} = 3 \times 10^7 Hz = 30MHz$

134 **(b)**
Coherent time $= \frac{\text{Coherence length}}{\text{Velocity of light}} = \frac{L}{c}$

135 **(d)**
By Brewster's law, $\mu = \tan\theta_p$

Or $\mu = \tan 54.74°$

Or $\mu = 1.414$

For an equilateral prism, $\angle A = 60°$

$$\therefore\ \mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Or $1.414 = \frac{\sin\left(\frac{60°+\delta_m}{2}\right)}{\sin\left(\frac{60°}{2}\right)}$

Or $\frac{1.414 \times 1}{2} = \sin\left(\frac{60°+\delta_m}{2}\right)$ $[\because 1.414 = \sqrt{2}]$

Or $\frac{\sqrt{2}}{2} = \sin\left(\frac{60°+\delta_m}{2}\right)$

Or $\frac{1}{\sqrt{2}} = \sin\left(\frac{60°+\delta_m}{2}\right)$

Or $45° = \left(\frac{60°+\delta_m}{2}\right)$

Or $\delta = 30°$

137 **(d)**
As reflected and refracted rays are perpendicular to each other, therefore, $i_p = i = 60°$

$\mu = \tan i_p = \tan 60° = \sqrt{3} = 1.732$

138 **(b)**
Here, $I_1 = I, I_2 = 4I, \theta_1 = \pi/2, \theta_2 = \pi$

$I_A = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\theta_1$

$= I + 4I + 2\sqrt{1 \times 4I} \cos \pi/2 = 5I$

$I_B = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \theta_2$

$= I + 4I + 2\sqrt{I \times 4I} \cos \pi$

$= 5I - 4I = I$

$\therefore \; I_A - I_B = 5I - I = 4I$

139 **(a)**

Multiple focii of zone plate given by $f_p = \frac{r_n^2}{(2p-1)\lambda}$

Where $p = 1, 2, 3 \ldots$

140 **(c)**

$y_1 = a_1 \cos \omega t = a_1 \sin(\omega t + 90°)$

$y_2 = a_2 \sin \omega t$

$\therefore$ Phase difference$= \phi = 90°$

$R = \sqrt{a_1^2 + a_2^2 + 2a_1 a_2 \cos \phi} = \sqrt{a_1^2 + a_2^2}$

$\therefore$ Resultant intensity$I = R^2 = (a_1^2 + a_2^2)$.

141 **(a)**

$\beta \propto \frac{1}{d} \Rightarrow$ If d becomes thrice, then β becomes $\frac{1}{3}$ times

142 **(b)**

$$\frac{I_{\max}}{I_{\min}} = \frac{\left(\frac{a_1}{a_2} + 1\right)^2}{\left(\frac{a_1}{a_2} - 1\right)^2} = \frac{4}{1} \Rightarrow \frac{a_1}{a_2} = \frac{3}{1}$$

143 **(c)**

From Brewster's law $\mu = \tan i_p \Rightarrow \frac{c}{v} = \tan 60° = 3$

$$\Rightarrow v = \frac{c}{\sqrt{3}} = \frac{3 \times 10^8}{\sqrt{3}} = \sqrt{3} \times 10^8 m/s$$

144 **(d)**

Average energy density

$$v_{AV} = \frac{1}{2} \varepsilon_0 E_0^2 = \frac{1}{2} \varepsilon_0 \left(\sqrt{2} E_{rms}\right)^2 = \varepsilon_0 E_{rms}^2$$

$= 8.85 \times 10^{-12} \times (720)^2 = 4.58 \times 10^{-6} J/m^3$

145 **(a)**

According to Doppler's effect, wherever there is a relative motion between source and observer, the frequency observed is different from that given out by source

146 **(a)**

For a given time, optical path remain constant

$\therefore \; \mu_1 x_1 = \mu_2 x_2$

Or $1.5 \times 2 = \mu_2 \times 2.25$

$$\therefore \quad \mu_2 = \frac{1.5 \times 2}{2.25} = \frac{2}{1.5} = \frac{20}{15} = \frac{4}{3}$$

147 **(b)**

In interference phenomenon, when both the waves are in opposite phase, we got destructive interference (or minima). As resultant amplitude of two superimposed wave is

$$R = \sqrt{a_1^2 + a_2^2 + 2a_1 a_2 \cos \phi}$$

And resultat intensity of two superimposed wave is

$I = I_1 + I_2 + 2k a_1 a_2 \cos \phi$

For minima (destructive interference), phase difference should be odd multiple of π.

ie, $\phi = (2n - 1)\pi$

where, $n = 1, 2, 3, \ldots.$

As $\phi = \pi, 3\pi, 5\pi, \ldots$

Hence, $\cos \phi = \cos(2n - 1)\pi = -1$

So, $R_{\min} = \sqrt{a_1^2 + a_2^2 - 2a_1 a_2}$

$= \sqrt{(a_1 - a_2)^2}$

Or $R_{\min} = a_1 - a_2$

Also, $I = I_1 + I_2 - 2k a_1 a_2$

Or $I = I_1 + I_2 - 2a_1 \sqrt{k} a_2 \sqrt{k}$

$= I_1 + I_2 - 2\sqrt{I_1 I_2}$

Hence, $I < I_1 + I_2$

Hence, when the phase difference is odd multiple of π, then destructive interference is obtained. The resultant amplitude is equal to the difference of the individual amplitude and the resultant intensity is less than the sum of individual intensities.

148 **(d)**

Sound waves cannot be polarised as they are longitudinal. Light waves can be polarised as they are transverse.

149 **(d)**

The bending of light round the corners of the obstacles or the aperture is called diffraction. It is a characteristic of wave motion. Since light and sound both travel as waves, hence the phenomenon is observed in both.

153 **(d)**

From $\beta = \frac{\lambda D}{d}$,

$$\lambda = \frac{\beta . d}{D} = \frac{0.3 \times 10^{-2} \times 2 \times 10^{-3}}{1} = 6 \times 10^{-7} \text{m}$$
$$= 6000 \text{ Å}$$

154 **(c)**

When the light rays fall on thin film of oil then rays are reflected from upper and lower layer of the thin films. These reflected rays produce interference pattern due which surface of thin film appears as coloured.

156 **(c)**

Fringe width is $\beta = \frac{D\lambda}{d}$ where D is the distance of the slits from the screen, d is the separation of the slits and λ, the wavelength

158 **(d)**

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

$$\lambda = \frac{2xd}{(2n-1)D} = \frac{2 \times 10^{-3} \times 0.9 \times 10^{-3}}{(2 \times 2 - 1) \times 1}$$

$$6 \times 10^{-7} \text{ m} = 6 \times 10^{-5} \text{ cm}$$

159 **(c)**

$$x = (n+1)\lambda_b = n\lambda_r$$

$$\frac{n+1}{n} = \frac{\lambda_r}{\lambda_b} = \frac{7.8 \times 10^{-5}}{5.2 \times 10^{-5}} = \frac{3}{2}$$

$$1 + \frac{1}{b} = \frac{3}{2}$$

$$n = 2$$

161 **(a)**

For diffraction size of the obstacle must be of the order of wavelength of wave, $i.e. \, a \approx \lambda$

162 **(c)**

When the speed of the electrons is increased, the wavelength decreases. The central maxima extends from $-\lambda/a$ to $+\lambda/a$. As λ decreases, the width decreases. The angular width decreases

163 **(d)**

For interference, λ of both the waves must be same

164 **(a)**

$$\beta' = \frac{\lambda'}{\lambda}\beta = \frac{5000}{6000} \times 0.48 = 0.04 \text{cm}$$

165 **(c)**

Wave impedance $Z = \sqrt{\frac{\mu_r}{\varepsilon_r}} \times \sqrt{\frac{\mu_0}{\varepsilon_0}}$

$$= \sqrt{\frac{50}{2}} \times 376.6 = 1883\Omega$$

166 **(a)**

Angular width of central maxima

$$= \frac{2\lambda}{d} = \frac{2 \times 589.3 \times 10^{-9}}{0.1 \times 10^{-3}} rad$$
$$= 0.0117 \times \frac{180}{\pi} = 0.68°$$

168 **(c)**

According to Plancks hypothesis, black bodies emit radiations in the form of photons

170 **(a)**

When sources are coherent

$$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$$

At middle point of the screen, $\phi = 0°$

$$I_R = I + I + 2\sqrt{II} \cos 0° = 4I$$

When sources are incoherent,

$$I'_R = I_1 + I_2 = I + I + 2I$$

$$\frac{I_R}{I'_R} = \frac{4I}{2I} = 2$$

171 **(d)**

In single slit diffraction, the central fringe has maximum intensity and has the width double than other fringes

172 **(b)**

Distance between first and sixth minima

$$x = \frac{5\lambda D}{d}$$

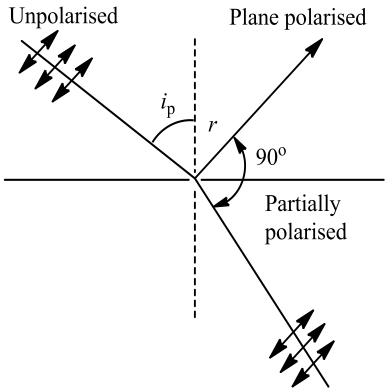
$$\therefore \quad a = \frac{n\lambda D}{x} = \frac{1 \times 500 \times 10^{-10} \times 2}{0.5 \times 10^{-3}}$$

$$d = 2.5 \times 10^{-3} \text{m} = 2.5 \text{ mm}$$

173 **(c)**

From Brewster's law reflected ray is

perpendicular to refracted ray.



The reflected ray so obtained is plane polarised having its electric vector in the plane of incidence.

174 **(b)**

Audible waves are not electromagnetic wave

175 **(b)**

$$v = \frac{c}{\lambda} = \frac{3 \times 10^8}{3000 \times 10^{-10}} = 10^{15} cycle/s$$

177 **(d)**

For a grating $(e + d) \sin \theta_n = n\lambda$

Where $(e + d)$ = grating element

$$\sin \theta_n = \frac{n\lambda}{(e + d)}$$

For $n = 1, \sin \theta_1 = \frac{\lambda}{(e+d)} = \sin 32°$

This is more than 0.5. Now $\sin \theta_2$ will be more than 2×0.5, which is not possible

178 **(b)**

$\Delta\lambda = 5200 - 5000 = 200$Å

Now $\frac{\Delta\lambda}{\lambda'} = \frac{v}{c} \Rightarrow v = \frac{c\Delta\lambda}{\lambda'} = \frac{3\times10^8\times200}{5000}$

$= 1.2 \times 10^7 m/s \approx 1.15 \times 10^7 m/s$

179 **(d)**

Electric field $E = \frac{V}{l} - \frac{iR}{l}$ (R = Resistance of wire)

Magnetic field at the surface of wire $B = \frac{\mu_0 i}{2\pi a}$ (a = radius of wire)

Hence poynting vector, directed radially inward is given

By $S = \frac{EB}{\mu_0} = \frac{iR}{\mu_0 l} . \frac{\mu_0 i}{2\pi a} = \frac{i^2 R}{2\pi a l}$

181 **(d)**

$S_1P - S_2P = 11(\lambda/2)$ =add integral multiple of $\lambda/2$

182 **(c)**

$$\beta = \frac{\lambda D}{d}$$

183 **(d)**

Distance between the first dark fringes on either side of central maxima = width of central maxima

$= \frac{2\lambda D}{d} = \frac{2\times600\times10^{-9}\times2}{1\times10^{-3}} = 2.4\ mm$

184 **(d)**

The coherent source cannot be obtained from two different light sources

185 **(b)**

$$v = \frac{c\Delta\lambda}{\lambda} = \frac{3 \times 10^8 \times (706 - 656)}{656} = \frac{1500}{656} \times 10^7$$

$= 2 \times 10^7 m/s$

186 **(c)**

Position of nth bright fringe $x_1 = \frac{n\lambda D}{d}$

For first bright fringe $n = 1$

$$\therefore\ x_1 = \frac{\lambda D}{d}$$

Position of nth dark fringe $x_2 = \frac{(2n-1)\lambda D}{2d}$

For first dark fringe $n = 1$

$$\therefore x_2 = \frac{\lambda D}{2d}$$

Now, $x_1 - x_2 = \frac{\lambda D}{2d}$

If B is the band width, then

$$x_1 - x_2 = \frac{B}{2}$$

187 **(a)**

Along the optic axis, $\mu_0 = \mu_e$

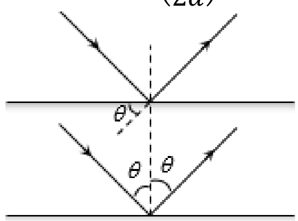
188 **(c)**

Path difference = $2d \sin \theta$

$\therefore$ For constructive interference

$2d \sin \theta = n\lambda$

$$\Rightarrow \theta = \sin^{-1}\left(\frac{n\lambda}{2d}\right)$$



190 **(c)**

$$\lambda' = \lambda\left(1 - \frac{v}{c}\right) = 5890\left(1 - \frac{4.5 \times 10^6}{3 \times 10^8}\right) = 5802\text{Å}$$

192 **(b)**

$E = 9 \times 10^{-4} NC^{-1}$

For electromagnetic waves, $\frac{E}{B} = c$ speed of light in vacuum

$$\Rightarrow \frac{9\times10^{-4}}{B} = 3\times10^{8} ms^{-1} \Rightarrow B = 3\times10^{-12}T$$

193 **(a)**

$r_n = \sqrt{nd\lambda} \Rightarrow r_n \propto \sqrt{n}$

194 **(b)**

$\beta \propto \lambda$

195 **(c)**

Fringe width $\beta = 2$ mm $= 2\times10^{-3}$ m

$\lambda = 6000$ Å

$\mu = 1.33$

$\beta' = ?$

$$\beta' = \frac{\beta}{\mu} = \frac{2}{1.33} = 1.5 \text{ mm}$$

196 **(b)**

Suppose the charge on the capacitor at time t is Q, the electric field between the plates of the capacitor is $E = \frac{Q}{\varepsilon_0 A}$. The flux through the area considered is

$$\phi_E = \frac{Q}{\varepsilon_0 A}.\frac{A}{2} = \frac{Q}{2\varepsilon_0}$$

∴ The displacement current

$$i_d = \varepsilon_0 \frac{d\phi_E}{dt} = \varepsilon_0 \left(\frac{1}{2\varepsilon_0}\right)\frac{dQ}{dt} = \frac{i}{2}$$

197 **(b)**

$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos 0°$

$= 4 + 9 + 2\sqrt{4\times9}$

$= 25$ units

198 **(d)**

When the point source or linear source of light is at very large distance, a small portion of spherical or cylindrical wavefront appears to be plane. Such a wavefront is plane wavefront.

199 **(b)**

According to Newton's corpuscular theory, speed of light in a rarer medium (like air) is lasser than that in a denser medium (like water, glass).

200 **(b)**

Distance of n^{th} minima from central bright fringe

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

For $n = 3$ $i.e.$ 3^{rd} minima

$$x_3 = \frac{(2\times3-1)\times500\times10^{-9}\times1}{2\times1\times10^{-3}}$$

$$= \frac{5\times500\times10^{-6}}{2} = 1.25\times10^{-3}m = 1.25\ mm$$

201 **(d)**

$d\sin\theta = n\lambda$

$0.3\times10^{-3}\times\theta = 6000\times10^{-10}$

$\theta = 2\times10^{-3}$ rad

202 **(a)**

$$I_0 = R^2 = \frac{R_2^2}{4}$$

Number of HPZ covered by the disc at $b = 25cm$

$n_1 b_1 = n_2 b_2$

$$n_2 = \frac{n_1 b_1}{b_2} = \frac{1\times1}{0.25} = 4$$

Hence the intensity at this point is

$$I = R'^2 = \left(\frac{R_5}{2}\right)^2 = \left(\frac{R_5}{R_4}\times\frac{R_4}{R_3}\times\frac{R_3}{R_2}\right)^2\times\left(\frac{R_2}{2}\right)^2$$

$I = (0.9)^6 I_0$

$I_1 = 0.531 I_0$

Hence the correct answer will be (a)

203 **(c)**

$$I = I_{max}\cos^2\left(\frac{\phi}{2}\right)$$

$$\therefore \frac{I_{max}}{4} = I_{max}\cos^2\frac{\phi}{2}$$

$$\cos\frac{\phi}{2} = \frac{1}{2}$$

Or $\frac{\phi}{2} = \frac{\pi}{3}$

$$\therefore\ \phi = \frac{2\pi}{3} = \left(\frac{2\pi}{\lambda}\right).\Delta x \qquad \dots(i)$$

Where $\Delta x = d\sin\theta$

Substituting in Eq. (i) we get,

$$\sin\theta = \frac{\lambda}{3d}$$

Or $\theta = \sin^{-1}\left(\frac{\lambda}{3d}\right)$

204 **(a)**

$\frac{E_0}{B_0} = c$. also $k = \frac{2\pi}{\lambda}$ and $\omega = 2\pi v$

These relation gives $E_0 k = B_0\omega$

205 **(a)**

For diffraction to be observed, size of aperture must be of the same order as wavelength of light

206 **(b)**

Infrasonic waves are mechanical waves

207 **(a)**

$$\beta = \frac{\lambda D}{d} \Rightarrow \beta \propto \lambda$$

208 **(d)**

When two waves of same frenquency, same wavelength and same velocity moves in the same direction. Their superposition results in the interference. The two beams should be monochromatic.

209 **(d)**

Let nth minima of 400 nm coincides with mth minima of 560 nm then

$$(2n-1)400=(2m-1)560 \Rightarrow \frac{2n-1}{2m-1}=\frac{7}{5}=\frac{14}{10}=\frac{21}{15}$$

$i.e.$, 4th minima of 400 nm coincides with 3rd minima of 560 nm

The location of this minima is

$$=\frac{7(1000)(400\times10^{-6})}{2\times0.1}=14\ mm$$

Next, 11th minima of 400nm will coincide with 8th minima of 560 nm

Location of this minima is

$$=\frac{21(1000)(400\times10^{-6})}{2\times0.1}=42\ mm$$

$\therefore$ Required distance $=28\ mm$

210 **(b)**

$$\frac{I_{\max}}{I_{\min}}=\frac{4}{1}\frac{(a_1+a_2)^2}{(a_1-a_2)^2}$$

Or $\frac{a_1+a_2}{a_1-a_2}=\frac{2}{1}$

Or $a_1+a_2=2a_1-2a_2$

Or $a_1=3a_2$

$$\therefore\quad \frac{I_1}{I_2}=\frac{a_1^2}{a_2^2}=\frac{(3a_2)^2}{a_2^2}=\frac{9}{1}$$

$$\therefore\quad \frac{a_1}{a_2}=\frac{3}{1}$$

211 **(c)**

Wave theory of light is given by Huygen

212 **(c)**

Interference fringes are bands on screen XY running parallel to the length of slits. Therefore, the locus of fringes is represented correctly byW_3W_4.

213 **(b)**

The angular distance (θ) is given by

$$\theta=\frac{\lambda}{d}$$

$$\theta=2°=\frac{\pi}{180}\times2, \lambda=6980\ Å$$

$$=6980\times10^{-10}\ \text{m}$$

$$\Rightarrow d=\frac{\lambda}{\theta}=\frac{6980\times10^{-10}\times180}{3.14\times2}$$

$$=1.89\times10^{-5}\ \text{mm}$$

$$\Rightarrow d=2\times10^{-5}\ \text{mm}$$

215 **(a)**

$$\beta=\frac{\lambda D}{d}\Rightarrow(0.06\times10^{-2})=\frac{\lambda\times1}{1\times10^{-3}}\Rightarrow\lambda=6000Å$$

216 **(c)**

Given, $I_1=I$ and $I_2=9I$

Maximum intensity $=\left(\sqrt{I_1}+\sqrt{I_2}\right)^2=\left(\sqrt{I}+\sqrt{9I}\right)^2=16I$

Minimum intensity

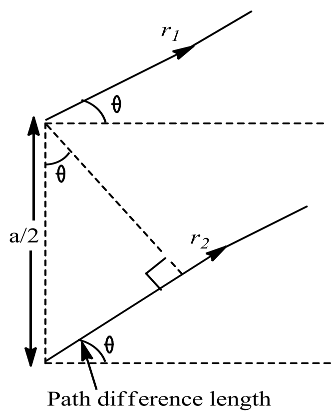
$=\left(\sqrt{I_1}-\sqrt{I_2}\right)^2=\left(\sqrt{I}-\sqrt{9I}\right)^2=4I$

218 **(a)**

The diffraction pattern of light waves of wavelength (λ) diffracted by a single, long narrow slit of width is shown. For first minimum.

$e\sin\theta=\lambda$

$$\sin\theta=\frac{\lambda}{e}$$



When e is decreased for same wavelength, $\sin\theta$ increases, hence θ increases. Thus, width of central maxima will increase.

220 **(d)**

Intensity of EM wave is given by

$$I=\frac{P}{4\pi R^2}=v_{av}.c=\frac{1}{2}\varepsilon_0E_0^2\times c$$

$$\Rightarrow E_0=\sqrt{\frac{P}{2\pi R^2\varepsilon_0 c}}$$

$$= \sqrt{\frac{800}{2 \times 3.14 \times (4)^2 \times 8.85 \times 10^{-12} \times 3 \times 10^8}}$$

$$= 54.77 \frac{V}{m}$$

221 **(c)**

Frequency is independent of medium

222 **(a)**

$$d_1 = 7\lambda_1 \frac{D}{d}$$

And $d_2 = 7\lambda_2 \frac{D}{d}$

$$\therefore \frac{d_1}{d_2} = \frac{\lambda_1}{\lambda_2}$$

224 **(c)**

In 1678 Huygen proposed the wave theory of light. According to Huygen, light travels in the form of waves. These waves after emerging from the light source travel in all directions with the velocity of light. Since, waves require a medium to travel Huygen proposed an all pervading medium ether.

225 **(d)**

$\because n = 3, \therefore 2n\pi = 2 \times 3\pi = 6\pi$

226 **(d)**

Laser beams are perfectly parallel. So that they are very narrow and can travel a long distance without spreading. This is the feature of laser while they are monochromatic and coherent these are characteristics only

227 **(c)**

Position of first minima = position of third maxima *i. e.*,

$$\frac{1 \times \lambda_1 D}{d} = \frac{(2 \times 3 + 1)}{2} \frac{\lambda_2 D}{d} \Rightarrow \lambda_1 = 3.5\lambda_2$$

228 **(a)**

$$S_2P = (d^2 + b^2)^{1/2} = d\left(1 + \frac{b^2}{d^2}\right)^{1/2}$$

$$= d\left(1 + \frac{b^2}{d^2}\right) = d + \frac{b^2}{2d}$$

Path difference$= S_2P - S_1P$

$$x = d + \frac{b^2}{d^2} - d = b^2/2d$$

For missing wavelengths $(2n - 1)\frac{\lambda}{2} = x = \frac{b^2}{2d}$

For $n = 1, \lambda = \frac{b^2}{d}$,

For $n = 2, \lambda = \frac{2b^2}{3d}$,

229 **(d)**

In the arrangement shown, the unpolarised light is incident at polarizing angle of $90° - 33° = 57°$. The reflected light is thus plane polarized light. When plane polarized light is passed through Nicol prism (a polarizer or analyser), the intensity gradually reduces to zero and finally increases

230 **(c)**

Angular fringe width is the ratio of fringe width to distance (*D*) of screen from the source *ie*,

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

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

231 **(a)**

$\lambda_{\gamma-rays} < \lambda_{x-rays} < \lambda_{\alpha-rays} < \lambda_{\beta-rays}$

232 **(d)**

$\lambda_{Radiowave} > \lambda_{IR\ rays} > \lambda_{UV\ rays} > \lambda_{X-rays}$

233 **(d)**

$I = \frac{R_2^2}{4}$ given $n_1 b_1 = n_2 b_2 \Rightarrow 1 \times 200 = n_2 \times 25$

$\therefore n_2 = 8\ HPZ$

$$\therefore I = \left(\frac{R_9}{2}\right)^2$$

$$= \left(\frac{R_9}{R_8} \times \frac{R_8}{R_7} \times \frac{R_7}{R_6} \times \frac{R_6}{R_5} \times \frac{R_5}{R_4} \times \frac{R_4}{R_3} \times \frac{R_3}{R_2} \times \frac{R_2}{R_2}\right)^2$$

$$= \left(\frac{R_9}{R_2}\right)^2 I$$

234 **(a)**

If thin film appears dark

$2\mu t \cos r = n\lambda$ for normal incidence $r = 0°$

$$\Rightarrow 2\mu t = n\lambda \Rightarrow t = \frac{n\lambda}{2\mu}$$

$$\Rightarrow t_{\min} = \frac{\lambda}{2\mu} = \frac{5890 \times 10^{-10}}{2 \times 1} = 2.945 \times 10^{-7} m$$

235 **(c)**

$\theta_P + r = 90°$ or $r = 90° - \theta_P = 90° - 53°4' = 36°56'$

236 **(a)**

$$\beta = \frac{\lambda D}{d}$$

239 **(a)**

$$\Delta\lambda = \lambda . \frac{v}{c} = \frac{1.5 \times 10^6}{3 \times 10^8} \times 5000 = 25Å$$

240 **(d)**

$$\beta = \frac{\lambda D}{d} \Rightarrow d = \frac{\lambda D}{\beta} = \frac{6000 \times 10^{-10} \times (40 \times 10^{-2})}{0.012 \times 10^{-2}}$$
$$= 0.2cm$$

241 **(a)**
Photoelectric effect and Compton effect cannot be explained on the basis of wave nature of light while polarization and optical activity can be explained.

242 **(c)**
For brightness, path difference $= n\lambda = 2\lambda$
So second is bright

243 **(c)**
From Brewster's law,

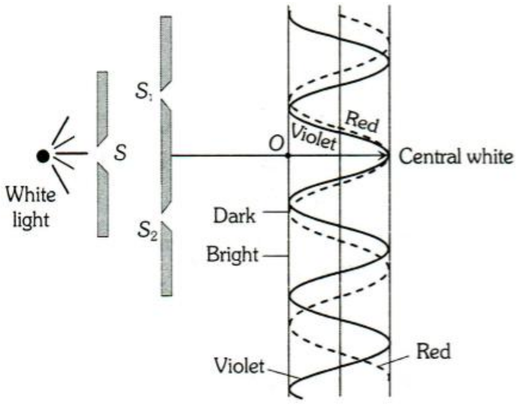
$$\mu = \tan i_p$$

$$\Rightarrow \frac{c}{v} = \tan 60° = \sqrt{3}$$

$$\Rightarrow v = \frac{c}{\sqrt{3}} = \frac{3 \times 10^8}{\sqrt{3}}$$

$$= \sqrt{3} \times \frac{10^8 \text{m}}{\text{s}}$$

244 **(c)**
In Young's double slit experiment, if white light is used in place of monochromatic light, then the central fringe is white and some coloured fringes around the central fringe are formed



Since $\beta_{red} > \beta_{violet}$ etc., the bright fringe of violet colour forms first and that of the red forms later
It may be noted that, the inner edge of the dark fringe is red, while the outer edge is violet. Similarly, the inner edge of the bright fringe is violet and the outer edge is red

245 **(a)**
Corpuscular theory explains refraction of light

246 **(b)**
When path difference is $\lambda, I_{max} = 4I = K$

When path difference is $\frac{\lambda}{4}$, phase difference,

$$\phi = \pi/2$$

$$\therefore \ I_R = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos\phi$$

$$= I + I = 2I = \frac{K}{2}$$

247 **(c)**

$$I = I_0 \left(\frac{\sin\theta}{\theta}\right)^2$$

And $\theta = \frac{\pi}{\lambda}\left(\frac{ay}{D}\right)$

For principal maximum $y = 0$

$\therefore \ \theta = 0$

Hence, intensity will remain same.

248 **(d)**
$$v_{\gamma-rays} > v_{\text{visible radiation}} > v_{\text{Infrared}} > v_{\text{Radio waves}}$$

249 **(d)**
Greater is the wavelength of wave higher will be its degree of diffraction.

250 **(b)**
$\lambda = 6000 \text{ Å} = 6 \times 10^{-7}$ m

Path difference for dark fringe $\Delta x = (2n+1)\frac{\lambda}{2}$

For third dark fringe $n = 2$

$$\therefore \ \Delta x = (2 \times 2 + 1) \times \frac{6 \times 10^{-7}}{2}$$

$$= \frac{5 \times 6 \times 10^{-7}}{2}$$

$$= 15 \times 10^{-7}$$

$$= 1.5 \times 10^{-6} \text{ m} = 1.5\mu$$

251 **(b)**
Distance between n^{th} bright fringe and m^{th} dark fringe $(n > m)$

$$\Delta x = \left(n - m + \frac{1}{2}\right)\beta$$

$$= \left(5 - 3 + \frac{1}{2}\right) \times \frac{6.5 \times 10^{-7} \times 1}{1 \times 10^{-3}}$$

$$= 1.63mm$$

253 **(c)**

According to Malus' law

$$I = I_0 \cos^2 \theta = I_0 (\cos^2 60°) = I_0 \times \left(\frac{1}{2}\right)^2 = \frac{I_0}{4}$$

254 **(d)**

The amplitude will be $A \cos 60° = A/2$

255 **(a)**

Oil floating on water looks coloured only when thickness of oil layer=wavelength of light=10000Å

256 **(b)**

$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \frac{0.05}{100} = \frac{v}{3 \times 10^8} \Rightarrow v = 1.5 \times 10^5 m/s$

(Since wavelength is decreasing, so star is coming closer)

257 **(b)**

$\beta = \frac{\lambda D}{d} \Rightarrow \beta \propto \lambda$

258 **(c)**

$\frac{I_1}{I_2} = \frac{a^2}{b^2} = \frac{9}{1}$

$\therefore \frac{a}{b} = \frac{3}{1}$

$\frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2} = \left(\frac{3+1}{3-1}\right)^2 = 4:1$

260 **(b)**

Distance $= \frac{2\lambda}{b} \times d$

$= \frac{2 \times 0.5 \times 10^{-4}}{2} \times 100 = 0.5 \text{ mm}$

261 **(c)**

Distance of n^{th} maxima, $x = n\lambda\frac{D}{d} \propto \lambda$

As $\lambda_b < \lambda_g$

$\therefore x_{blue} < x_{green}$

262 **(d)**

Wave is uv rays

263 **(b)**

The resultant intensity at any point P is

$$I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$$

$\therefore I_0 = 4I_0 \cos^2 \phi/2$

Or $\cos\frac{\phi}{2} = \frac{1}{2}$

$\therefore \frac{\phi}{2} = \frac{\pi}{3} \text{ or } \phi = \frac{2\pi}{3}$

If Δx is the corresponding value of path difference at P, then

$$\phi = \frac{2\pi}{\lambda}(\Delta x)$$

$\frac{2\pi}{3} = \frac{2\pi}{\lambda}\Delta x.$

As $\Delta x = \frac{xd}{D}$

$\therefore \frac{1}{3} = \frac{1}{\lambda}\frac{xd}{D}$

Or $x = \frac{\lambda}{3d/D} = \frac{6 \times 10^{-7}}{3 \times 10^{-4}} = 2 \times 10^{-3}\text{m}$

$x = 2\text{mm}$

This is the difference of point P from central maximum.

264 **(c)**

Momentum of the electron will increase. So the wavelength ($\lambda = h/p$) of electrons will decrease and fringe width decreases as $\beta \propto \lambda$

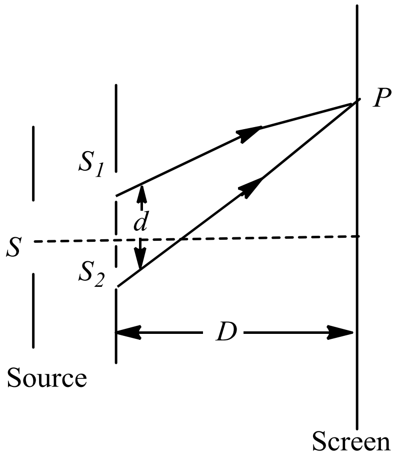
265 **(a)**

As velocity of light is perpendicular to the wavefront, and light is travelling in vacuum along the $y -$ axis, therefore, the wavefront is represented by $y =$ constant.

266 **(a)**

When distance between screen and source is D, and d the distance between coherent sources, then fringe width (W) is given by

$$W = \frac{D\lambda}{d}$$



Where λ is wavelength of monochromatic light.

$$\lambda = \frac{Wd}{D}$$

Given, $D = 1$ m, $d = 1$ mm $= 10^{-3}$ m,

$W = 0.06$ cm $= 0.06 \times 10^{-2}$m

$$\therefore\ \lambda = \frac{0.06 \times 10^{-2} \times 10^{-3}}{1}$$

$= 6 \times 10^{-7}$m $= 6000$ Å

267 **(b)**

From $I_R = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$

When $\phi = 0°, I_R = I + I + 2\sqrt{II} \cos 0° = 4I$

When $\phi = 90°$

$I'_R = I + I + 2\sqrt{II} \cos 90° = 2I$

$$\frac{I_R}{I'_R} = \frac{4I}{2I} = 2:1$$

268 **(c)**

When one slit is closed, amplitude becomes half and intensity becomes 1/4th

ie,$I_0 = \frac{1}{4} I$ or $I = 4I_0$

269 **(b)**

Here, wavelength, $\lambda = 625nm = 625 \times 10^{-9} m$

Number of lines per meter, $N = 2 \times 10^5$

For principal maxima is grating spectra $\frac{\sin\theta}{N} = n\lambda$,

Where $n(= 1,2,3)$ is the order of principal maxima and θ is the angle of diffraction

The maximum value of $\sin\theta$ is 1

$$\therefore n = \frac{1}{N\lambda} = \frac{1}{2 \times 10^5 \times 625 \times 10^{-9}} = 8$$

$\therefore$ Number of maxima $= 2n + 1 = 2 \times 8 + 1 = 17$

270 **(b)**

Here, $n_1 = 12, \lambda_1 = 600$ nm

$n_2 = ?, \lambda_2 = 400$ nm

As $n_1\lambda_1 = n_2\lambda_2$

$$\therefore\quad n_2 = \frac{n_1\lambda_1}{\lambda_2} = \frac{12 \times 600}{400} = 18$$

271 **(d)**

For 5th dark fringe, $x_1 = (2n - 1)\frac{\lambda}{2}\frac{D}{d} = \frac{9\lambda D}{2d}$

For 7th bright fringe, $x_2 = n\lambda\frac{D}{d} = \frac{7\lambda D}{d}$

$$x_2 - x_1 = (\mu - 1)t\frac{D}{d}$$

$$\frac{\lambda D}{d}\left[7 - \frac{9}{2}\right] = (\mu - 1)t\frac{D}{d}$$

$$t = \frac{2.5\lambda}{(\mu - 1)}$$

272 **(d)**

Let it take t *sec* for astronaut to acquire a velocity of 1 ms^{-1}. Then energy of photons $= 10\ t$

Momentum $= \frac{10t}{C} = 80 \times 1$

$$t = \frac{80 \times 1 \times 3 \times 10^8}{10} = 2.4 \times 10^9 sec$$

273 **(b)**

In Young's double slit experiment if white light is used instead of monochromatic light, then we shall get a white fringe at the centre surrounded on either side with some coloured fringes, with violet fringe in the beginning and red fringe in the last.

274 **(b)**

In simple slit diffraction experiment, width of central maxima

$$y = \frac{2\lambda D}{d}$$

$$\therefore \frac{y_1}{y_2} = \frac{\lambda_1}{\lambda_2} \times \frac{d_2}{d_1}$$

$$= \frac{400}{600} \times \frac{d/2}{d} = \frac{1}{3}$$

$$y_2 = 3y_1$$

275 **(a)**

The essential condition for sustained interference is constancy of phase difference

276 **(d)**

Fringe width $\beta = \frac{\lambda D}{d}$

Where D is the distance between slit and screen, d is the distance between two slits, λ is the wavelength of light

$$\therefore \Delta\beta = \frac{\lambda \Delta D}{d}$$

$$\Rightarrow \lambda = \frac{\Delta\beta d}{\Delta D} = \frac{10^{-3} \times 0.03 \times 10^{-3}}{5 \times 10^{-2}}$$

$$= \frac{10^{-3} \times 3 \times 10^{-5}}{5 \times 10^{-2}}$$

$$= 6 \times 10^{-7} m = 6000 Å$$

277 **(a)**

Polarization is shown by only transverse waves

278 **(b)**

Polarizer produces polarized light

279 **(b)**

The magnitude of electric field vector varies periodically with time because it is the form of electromagnetic wave

280 **(b)**

$$I_{max} = I = I_1 + I_2 + 2\sqrt{I_1 I_2}$$

When width of each slit is doubled, intensity from each slit becomes twice *ie,*

$$I_1' = 2I_1 \text{ and } I_2' = 2I_2$$

$$\therefore \; I'_{max} = I' = I_1' + I_2' + 2\sqrt{I_1' \times I_2'}$$

$$= 2I_1 + 2I_2 + 2\sqrt{2I_1 \times 2I_2}$$

$$= 2\left(I_1 + I_2 + 2\sqrt{I_1 \times I_2}\right) = 2I$$

281 **(c)**

Speed of EM waves in vacuum $= \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ = constant

282 **(b)**

$$\frac{I_{\max}}{I_{\min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \left(\frac{3a + a}{3a - a}\right)^2 = \frac{4}{1}$$

283 **(c)**

The intensity of illumination is given by

$$I = \frac{P \cos\theta}{r^2}$$

Where P = power of the source

r = distance between source and point

θ = angle of incidence

When $\theta = 0$, I will be maximum. Hence, the rays from the sun are incident normally on the earth surface

284 **(b)**

$I' = I e^{-\mu x} \Rightarrow x = \frac{1}{\mu}\log_e \frac{I}{I'}$ (where I = original intensity, I' = changed intensity)

$$36 = \frac{1}{\mu}\log_e \frac{I}{I/8} = \frac{3}{\mu}\log_e 2 \quad \text{... (i)}$$

$$x = \frac{1}{\mu}\log_e \frac{I}{I/2} = \frac{1}{\mu}\log_e 2 \quad \text{... (ii)}$$

From equation (i) and (ii), $x = 12mm$

286 **(c)**

Here, $X_3 = X_5$

$$\frac{3D\lambda}{2d} = \frac{5D\lambda'}{2d}$$

$\Rightarrow 3\lambda = 5\lambda'$ or $\frac{\lambda}{\lambda'} = \frac{3}{5}$

$$\lambda' = \frac{3}{5} \times 700 \text{ nm} = 420 \text{ nm}$$

287 **(b)**

Width of the central maximum,

$$\beta_0 = \frac{2D\lambda}{a}$$

$$\beta_0 \propto \frac{1}{a}$$

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

288 **(d)**

The rays of light from two coherent sources superimpose each other on the screen forming alternate maxima (with maximum intensity I_0) and minima (with intensity zero). If two non-coherent sources superimpose, there will be no maxima and minima, instead the intensity will be $\frac{I_0}{2}$ throughout.

289 **(a)**

Distance between two consecutive

Dark fringes $= \frac{\lambda D}{d} = \frac{6000\times10^{-10}\times1}{0.6\times10^{-3}}$

$= 1\times10^{-3}m = 1mm$

291 **(c)**

Transverse waves can be polarized only

293 **(a)**

For interference frequency must be same and phase difference must be constant

294 **(b)**

$\vec{E}\times\vec{B}$ points in the direction of wave propagation

295 **(c)**

In Youngs's double slit experiment half angular width is given by

$$\sin\theta = \frac{\lambda}{d}$$

$$= \frac{589\times10^{-9}}{0.589\times10^{-3}} = 10^{-3}$$

$$\Rightarrow \theta = \sin^{-1}(0.001)$$

296 **(c)**

$I = 4I_0\cos^2(\phi/2) \Rightarrow \phi = 2\pi/3$

$\Rightarrow \Delta x\times(2\pi/\lambda) \Rightarrow 2\pi/3 = \lambda/3$

$\sin\theta = \Delta x/d \Rightarrow \sin\theta = \lambda/3d$

297 **(a)**

$\beta \propto \frac{\lambda}{d}$ as $d \to \frac{d}{3}$ so $\beta \to 3\beta \;\therefore n = 3$

298 **(c)**

Interference is explained by wave nature of light

299 **(b)**

Infrared causes heating effect

300 **(d)**

According to Rayleigh scattering formula,

Intensity of scattered light $I \propto \frac{1}{(\lambda)^4} \propto f^4$

$$\frac{f_1}{f_2} = \left[\frac{I_1}{I_2}\right]^{-1/4}$$

$$= \left[\frac{256}{81}\right]^{-1/4}$$

$$= \frac{4}{3}$$

301 **(a)**

To form circularly polarized light

$E_x = A\sin\omega t$

$E_y = A\cos\omega t$

Resultant amplitude

$$|\vec{E}|^2 = A^2 + A^2 + 2A.A\cos\frac{\pi}{2} \Rightarrow |\vec{E}| = A\sqrt{2}$$

= constant

302 **(a)**

The position of 30^{th} bright fringe

$$y_{30} = \frac{30\lambda D}{d}$$

Now position shift of central fringe is

$$y_0 = \frac{30\lambda D}{d}$$

But we know, $y_0 = \frac{D}{d}(\mu - 1)t$

$$\frac{30\lambda D}{d} = \frac{D}{d}(\mu-1)t$$

$$(\mu - 1) = \frac{30\lambda}{t} = \frac{30\times(6000\times10^{-10})}{(3.6\times10^{-5})} = 0.5$$

$$\therefore \mu = 1.5$$

303 **(b)**

Wavelength of visible spectrum is 3900Å − 7800Å

304 **(a)**

$$f_1 = \frac{r^2}{\lambda} = \frac{(2.3\times10^{-3})^2}{5893\times10^{-10}} = 9m$$

305 **(a)**

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow 1 = \frac{v}{c} \Rightarrow v = c$$

306 **(b)**

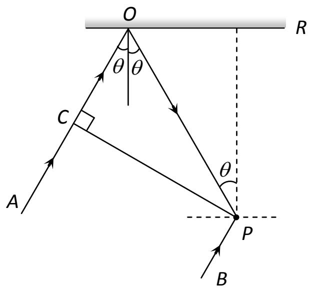
The polarization is the property of electromagnetic waves such as light which describes the direction of their transverse electric field. More generally, the polarization of transverse wave describes the direction of oscillation, in the plane perpendicular to the direction of travel. Longitudinal waves such as sound waves do not exhibit polarization, becomes for these waves the direction of oscillation is along the direction of travel.

307 **(a)**

If unpolarised light is incident at polarising angle, then reflected light is completely, ie, 100% polarized.

308 **(b)**

$\because PR = d \Rightarrow PO = d\sec\theta$ and $CO = PO\cos2\theta = d\sec\theta\cos2\theta$ is



Path difference between the two rays
$\Delta = CO + PO = (d\sec\theta + d\sec\theta\cos 2\theta)$
Phase difference between the two rays is
$\phi = \pi$ (One is reflected, while another is direct)
Therefore condition for constructive interference should be $\Delta = \frac{\lambda}{2}, \frac{3\lambda}{2}$ ....
Or $d\sec\theta\,(1 + \cos 2\theta) = \frac{\lambda}{2}$
Or $\frac{d}{\cos\theta}(2\cos^2\theta) = \frac{\lambda}{2} \Rightarrow \cos\theta = \frac{\lambda}{4d}$

310 **(a)**
Reflection phenomenon is shown by both particle and wave nature of light

311 **(c)**
$n_1\lambda_1 = n_2\lambda_2 \Rightarrow 3 \times 590 = 4 \times \lambda_2 \Rightarrow \lambda_2 = 442.5nm$

312 **(c)**
$$x = \frac{(2n+1)\lambda D}{2a}$$
For red light $x = \frac{(4+1)D}{2a} \times 6500$

For unknown wavelength of light,
$$x = \frac{(6+1)D}{2a} \times \lambda$$
Accordingly
$\therefore 5 \times 6500 = 7 \times \lambda$
$$\Rightarrow \lambda = \frac{5}{7} \times 6500 = 4642.8\ \text{Å}$$

313 **(b)**
Here, $a = 2mm = 2 \times 10^{-3}m$
$\lambda = 500nm = 500 \times 10^{-9}m = 5 \times 10^{-7}m$
$D = 1m$
The distance between the first minima on either side on a screen is
$$= \frac{2\lambda D}{a} = \frac{2 \times 5 \times 10^{-7} \times 1}{2 \times 10^{-3}}$$
$= 5 \times 10^{-4}m = 0.5 \times 10^{-3}m = 0.5mm$

314 **(d)**
Ultrasonic waves are longitudinal waves

315 **(d)**
$\beta = \frac{\lambda D}{d} \Rightarrow$ If D becomes twice and d becomes half so β becomes four times

316 **(b)**
$n\lambda_r = (n+1)\lambda_b$
$$\frac{n+1}{n} = \frac{\lambda_r}{\lambda_b} = \frac{600}{480} = \frac{4}{5}$$
$$\frac{1}{n} = \frac{4}{5} - 1 = \frac{1}{4} n = 4$$

317 **(d)**
$$x = \frac{mD\lambda_1}{d} = \frac{(m+1)D\lambda_2}{d}$$
$\Rightarrow 3 \times 6000 = 4\lambda_2$
Or $\lambda_2 = \frac{3 \times 6000}{4} = 4500\ \text{Å}$

318 **(b)**
$$\beta = \frac{(a+b)\lambda}{2a(\mu-1)\alpha}$$
Where a = distance between source and biprism $= 0.3\ m$
b = distance between biprism and screen $= 0.7\ m$
α = Angle of prism $= 1°, \mu = 1.5, \lambda = 6000 \times 10^{-10}m$
Hence, $\beta = \frac{(0.3+0.7)\times 6\times 10^{-7}}{2\times 0.3(1.5-1)\times\left(1°\times\frac{\pi}{180}\right)}$
$= 1.14 \times 10^{-4}m = 0.0114\ cm$

320 **(d)**
$$\frac{I_{\max}}{I_{\min}} = \left(\frac{\frac{a_1}{a_2}+1}{\frac{a_1}{a_2}-1}\right)^2 \Rightarrow \frac{a_1+a_2}{a_1-a_2} = 6$$
$$\frac{7}{5} = \frac{a_1}{a_2}$$

321 **(a)**
The number of fringes shifting is decided by the extra path difference produced by introducing the glass plate. The extra path difference is
$(\mu - 1)t = n\lambda$
Or $(1.5 - 1) \times 0.1 \times 10^{-3} = n \times 500 \times 10^{-9}$
$\Rightarrow n = 100$

322 **(b)**
The rings observed in reflected light are exactly complementary to those seen in transmitted light. Corresponding to every dark ring in reflected light there is a bright ring in transmitted light. The ray reflected at the upper surface of the air-film suffers no phase change while the ray reflected internally at the lower surface suffers a phase change of π.

323 **(d)**

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

$a = 1 \text{ mm} = 10^{-3}\text{m}, D = 2 \text{ m}$

Distance between the first dark fringes on either side of central bright fringe=width of central maximum

$$= \frac{2\lambda D}{a} = \frac{2 \times 6 \times 10^{-7} \times 2}{10^{-3}}$$

$$= 24 \times 10^{-4}\text{m} = 2.4 \text{ mm}$$

324 **(a)**

$\mu_v = 1$ and $\mu_a = 1.003$

$$\therefore \quad \frac{\lambda_v}{\lambda_a} = \frac{\mu_a}{\mu_v} = 1.0003$$

$$x = \lambda_v n = \lambda_a(n+1)$$

$$\frac{n+1}{n} = \frac{\lambda_v}{\lambda_a} = 1.0003$$

$$1 + \frac{1}{n} = 1.0003, \frac{1}{n} = 0.0003$$

$$n = \frac{1}{0.0003} = \frac{10^4}{3}$$

$$\therefore \quad x = \lambda_a n = 6000 \times 10^{-7}\text{mm} \times \frac{10^4}{3} = 2 \text{ mm}$$

325 **(c)**

Limit of resolution of the telescope

$$a = \frac{1.22\lambda}{a} = \frac{d}{x}$$

Or $d = \frac{1.22\lambda\, x}{a}$

$$= \frac{1.22 \times 5 \times 10^{-7} \times 8 \times 10^{16}}{0.25} = 1.95 \times 10^{11}\text{m}$$

326 **(d)**

$$v = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{3 \times 10^8}{\sqrt{1.3 \times 2.14}} = 1.8 \times 10^8 m/s$$

327 **(b)**

Fringe width $(\beta) \propto \frac{1}{\text{prism Angle } (\alpha)}$

328 **(a)**

Angular spread on either side is $\theta = \frac{\lambda}{a} = \frac{1}{5}$ rad

329 **(a)**

Photoelectric effect explain the quantum nature of light while interference, diffraction and polarization explain the wave nature of light

330 **(b)**

$$\beta = \frac{\lambda D}{d} = \frac{6000 \times 10^{-10} \times 2}{4 \times 10^{-3}}$$

$$= 0.3 \times 10^{-3}\text{m} = 0.3\text{mm}$$

332 **(a)**

If maximum electron density of the ionosphere is $N_{\max}$ per m^3 then the critical frequency f_c is given by $f_c = 9(N_{\max})^{1/2}$

$\Rightarrow 10 \times 10^6 = 9(N)^{1/2} \Rightarrow N = 1.2 \times 10^{12} m^{-3}$

333 **(d)**

Phase difference $= \frac{2\pi}{\lambda} \times$ path difference

ie, $\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{6} = \frac{\pi}{3}$

As, $I = I_{\max} \cos^2\left(\frac{\phi}{2}\right)$

Or $\frac{I}{I_{\max}} = \cos^2\left(\frac{\phi}{2}\right)$

Or $\frac{I}{I_0} = \cos^2\left(\frac{\pi}{6}\right) = \frac{3}{4}$

334 **(c)**

Two coherent source must have a constant phase difference otherwise they can not produce interference

335 **(d)**

$$\beta = \frac{\lambda D}{d} = \frac{600 \times 10^{-9} \times 2}{1 \times 10^{-3}} = 12 \times 10^{-4} \text{ m}$$

So, distance between the first dark fringes on either side of the central bright fringe

$$X = 2\beta$$

$$= 2 \times 12 \times 10^{-4} \text{ m}$$

$$= 24 \times 10^{-4} \text{ m} = 2.4 \text{ mm}$$

336 **(a)**

As the two bright fringes coincide

$$\therefore \quad n\lambda_1 = (n+1)\lambda_2$$

$$\frac{n+1}{n} = \frac{\lambda_1}{\lambda_2} = \frac{7500}{6000} = \frac{5}{4}$$

$$1 + \frac{1}{n} = \frac{5}{4}, n = 4$$

337 **(a)**

When spherical waves are incident on a plane refracting surface, separating two media, the reflected waves have spherical wave fronts

338 **(d)**

Refractive index of a medium

$n = \tan i_p$

Where i_p = Brewster's angle

$\Rightarrow i_p = \tan^{-1}[n]$

339 **(a)**

$\beta \propto \lambda, \therefore \lambda_v$ = minimum

341 **(b)**

Fringe shift is given by $x = \frac{(\mu-1)t\beta}{\lambda}$

For first plate, $x = \frac{(\mu_1-1)t\beta}{\lambda}$

For second plate $\frac{3}{2}x = \frac{(\mu_2-1)t\beta}{\lambda}$

$\Rightarrow \left(\frac{\mu_2-1}{\mu_1-1}\right) = \frac{3}{2} \Rightarrow \left(\frac{\mu_2-1}{1.5-1}\right) = \frac{3}{2}$

$\Rightarrow \mu_2 = 1.75$

342 **(d)**

$y_1 = a\sin\omega t, y_2 = a\cos\omega t = a\sin\left(\omega t + \frac{\pi}{2}\right)$

343 **(d)**

$\phi = \frac{\lambda}{6} = \frac{360°}{6} = 60°$

$$I = I_0\cos^2\theta$$
$$= I_0\cos^2 60°$$
$$= \frac{3}{4} \times I_0$$
$$\frac{I}{I_0} = \frac{3}{4}$$

345 **(d)**

Let nth minima of 400 nm coincides with mth minima of 560 nm, then

$$(2n-1)\left(\frac{400}{2}\right) = (2m-1)\left(\frac{560}{2}\right)$$

Or $\frac{2n-1}{2m-1} = \frac{7}{2} = \frac{14}{10} = \cdots$

ie. 4th minima of 400 nm coincides with 3rd minima of 560 nm.

Location of this minima is,

$$Y_1 = \frac{(2\times4-1)(1000)(400\times10^{-6})}{2\times0.4} = 14 \text{ mm}$$

Next 11th minima of 400 nm will coincide with 8th minima of 560 nm. Location of this minima is ,

$$Y_2 = \frac{(2\times11-1)\,(1000)\,(400\times10^{-6})}{2\times0.1} = 42 \text{ mm}$$

$\therefore$ Required distance= $Y_2 - Y_1 = 28$ mm

346 **(a)**

Amplitude A_1 and A_2 are added as vector. Angle between these vectors is the phase difference $(\beta_1 - \beta_2)$ between them

$$\therefore \quad R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos(\beta_1-\beta_2)}$$

347 **(c)**

The interference fringes for two slits are hyperbolic

348 **(d)**

Momentum transferred in one second

$$p = \frac{2U}{c} = \frac{2S_{av}A}{c} = \frac{2\times6\times40\times10^{-4}}{3\times10^8}$$
$$= 1.6\times10^{-10} kg - m/s^2$$

349 **(d)**

Diffraction shows the wave nature of light and photoelectric effect shows particle nature of light

350 **(d)**

Phase difference, $\phi = \frac{2\pi}{\lambda} \times$ path difference

$$\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{6} = \frac{\pi}{3} = 60°$$

Intensity, $\quad I = I_0\cos^2\left(\frac{\phi}{2}\right)$

$$\frac{I}{I_0} = \cos^2(30°) = \left(\frac{\sqrt{3}}{2}\right)^2 = 0.75$$

351 **(a)**

At any point along the path 1, path difference between the waves is 0

Hence maxima is obtained all along the path 1

At any point along the path 2, path difference is 1.5 λ which is odd multiple of $\frac{\lambda}{2}$, so minima is obtained all along the path 2

353 **(c)**

Let a_1 and a_2 be amplitudes of the two waves.

For maximum intensity

$$I_{\max} = (a_1 + a_2)^2$$

For minimum intensity

$$I_{\min} = (a_1 - a_2)^2$$

Given, $\frac{I_{\max}}{I_{\min}} = \frac{25}{1} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2}$

$\Rightarrow \frac{a_1+a_2}{a_1-a_2} = \frac{5}{1}$

$\Rightarrow \quad \frac{a_1}{a_2} = \frac{3}{2}$

(law of componendo and dividendo)

Also, Intensity $\propto$ (amplitude)^2

$\therefore \frac{I_1}{I_2} = \left(\frac{a_1}{a_2}\right)^2 = \frac{9}{4}$

355 **(a)**

Total phase difference

= Initial phase difference + Phase difference due to path

$= 66° + \frac{360°}{\lambda} \times \Delta x = 66° + \frac{360°}{\lambda} \times \frac{\lambda}{4} = 66° + 90$

$= 156°$

356 **(a)**

Photoelectric effect verifies particle nature of light. Reflection and refraction verify both particle nature and wave nature of light

358 **(a)**

The speed of light $C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = \frac{1}{\sqrt{2 \times 8}} = \frac{1}{4} = 0.25$

359 **(c)**

Path difference, $x = (SS_1 + S_1O) - (SS_2 + S_2O)$

If$x = n\lambda$, the central fringe at O will be bright.

If$x = (2n-1)\lambda/2$, the central fringe at O will be dark.

360 **(c)**

Critical angle, $C = \sin^{-1}(0.6)$

$\sin(C) = 0.6$

$\mu = \frac{1}{\sin C} = \frac{1}{0.6}$

Polarizing angle $i_p = \tan^{-1}(\mu) = \tan^{-1}\left(\frac{1}{0.6}\right)$

$= \tan^{-1}(1.6667)$

361 **(d)**

By using $f_p = \frac{r^2}{(2p-1)\lambda}$

For first HPZ $r = \sqrt{f_p \lambda} = \sqrt{0.6 \times 6000 \times 10^{-10}}$

$= 6 \times 10^{-4} m$

362 **(d)**

For liquid A

$L_1 = 20$ cm, $\theta_1 = 38°$; concentration $= C_1$

Specific rotation $a_1 = \frac{\theta_1}{L_1 C_1} = \frac{38°}{20 \times C_1}$

Similarly, for liquid B

$L_2 = 30$ cm, $\theta_2 = -24°$, concentration $= C_2$

Specific rotation $a_2 = \frac{\theta_2}{L_2 C_2} = \frac{(-24°)}{30 \times C_2}$

The mixture has 1 part of liquid A and 2 parts of liquid B,

$\therefore C_1' : C_2' = 1 : 2$

$\theta = \{a_1 C_1' + a_2 C_2'\} l$

$= \left\{\frac{38°}{20 \times C_1} \times \frac{C_1}{3} + \frac{(-24°)}{30 \times C_2} \times \frac{2C_2}{3}\right\} \times 30$

$= 19° - 16° = 3°$

Thus, the optical rotation of mixture is $+3°$ in right had direction.

363 **(b)**

$c = \frac{E}{B} \Rightarrow B = \frac{E}{c} = \frac{18}{3 \times 10^8} = 6 \times 10^{-8} T$

364 **(a)**

For an electromagnetic wave

Velocity $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3 \times 10^8 ms^{-1}$

Air acts almost as vacuum

$\therefore a = 3$ approximately

365 **(c)**

Here, $\sin = \theta = \left(\frac{y}{D}\right)$

So, $\Delta\theta = \frac{\Delta y}{D}$

Angular fringe width $\theta_0 = \Delta\theta$(width $\Delta y = \beta$)

$\theta_0 = \frac{\beta}{D} = \frac{D\lambda}{d} \times \frac{1}{D} = \frac{\lambda}{d}$

$\theta_0 = 1° = \pi/180$ rad

And $\lambda = 6 \times 10^{-7}$m

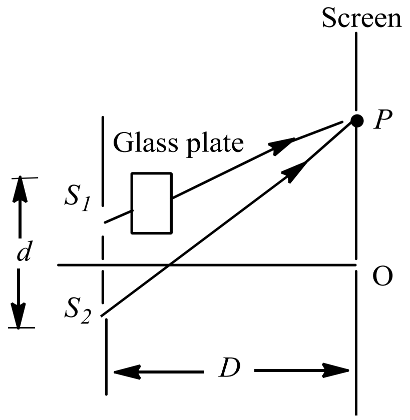
$d = \frac{\lambda}{\theta_0} = \frac{180}{\pi} \times 6 \times 10^{-7}$

$= 3.44 \times 10^{-5}$m

$= 0.03$ mm

366 **(b)**

When a thin glass plate of thickness t is placed over one of the slits, then lateral displacement is given by



$$x = \frac{(\mu - 1)tD}{d}$$

Given, $\mu = 1.5, t = 0.06 \text{ mm} = 6 \times 10^{-5}$ m

$D = 2$ m, $d = 1$ mm $= 1 \times 10^{-3}$ m

Putting the values in the above relation, we get

$$x = \frac{(1.5 - 1) \times 6 \times 10^{-5} \times 2}{1 \times 10^{-3}}$$

$= 0.5 \times 12 \times 10^{-2} = 0.06$ m $=$ 6cm

367 **(d)**
To see interference, we need two sources with the same frequency and with a constant phase difference. In the given waves,

$X_1 = a_1 \sin \omega t$

And $X_4 = a_1 \sin(\omega t + \delta)$

Have a constant phase difference δ, so interference is possible between them.

For $X_1 = a_1 \sin \omega t$

And $X_2 = a_2 \sin 2\omega t$

Frequency is not equal and there is no constant phase difference.

For $X_1 = a_1 \sin \omega t$

And $X_3 = a_1 \sin \omega_1 t$,

Frequency is different and there is no constant phase difference.

368 **(a)**
Intensity, $I_0 = I_1 + I_2 + 2\sqrt{I_1 I_2}$

If $I_1 = I_2 = I$(Let)

Then $I_0 = 4I$

When one slit is covered then $I_2 = 0$

$\therefore I_0' = I = \frac{I_0}{4}$

370 **(a)**
For interference phase difference must be constant

371 **(d)**
$$\beta = \frac{\lambda D}{d} = \frac{600 \times 10^{-9} \times 2}{1 \times 10^{-3}} = 12 \times 10^{-4} \text{ m}$$

So, distance between the first dark fringes on either side of the central bright fringe

$= 2\beta$

$= 2 \times 12 \times 10^{-4}$ m

$= 24 \times 10^{-4}$ m

$= 2.4$ mm

372 **(a)**
$\omega = 6 \times 10^8$

$$k = \frac{\omega}{v} = \frac{6 \times 10^8}{3 \times 10^8} = 2m^{-1}$$

373 **(d)**
If shift is equivalent to n fringes then

$$n = \frac{(\mu - 1)t}{\lambda} \Rightarrow n \propto t \Rightarrow \frac{t_2}{t_1} = \frac{n_2}{n_1} \Rightarrow t_2 = \frac{n_2}{n_1} \times t$$

$$t_2 = \frac{20}{30} \times 4.8 = 3.2mm$$

374 **(c)**
Doppler shift (Source moving towards observer)

$$\lambda' = \lambda\left(1 - \frac{V}{C}\right)$$

$$5400\text{Å} = 6200\text{Å}\left(1 - \frac{V}{C}\right)$$

$$V = \left[1 - \frac{54}{62}\right]C = 3.9 \times 10^7 \text{approx}$$

375 **(b)**
The optical path between any two points is proportional to the time of travel.

The distance traversed by light in a medium of refractive index μ in time t is given by

$d = vt$ ……….(i)

Where v is velocity of light in the medium. The distance traversed by light in a vacuum in this time.

$\Delta = ct$

$= c \cdot \frac{d}{v}$ [From Eq. (i)]

$= d\frac{c}{v} = \mu d$ (ii)

$\left(\text{Since}, \mu = \frac{c}{v}\right)$

This distance is the equivalent distance in vacuum and is called optical path.

Here, optical path for first ray $= n_1 L_1$

Optical path for second ray $= n_2 L_2$

Path difference $= n_1 L_1 - n_2 L_2$

Now, phase difference

$= \frac{2\pi}{\lambda} \times$ path difference

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

376 **(c)**

$\beta = \frac{\beta}{\lambda}(\mu - 1)t$

$\Rightarrow t = \frac{\lambda}{(\mu - 1)} = \frac{\lambda}{(1.5 - 1)} = 2\lambda$

377 **(c)**

The number of fringes on either side of centre C of screen is

$n_1 = \left[\frac{AC}{\beta}\right] = \left[\frac{0.5}{0.021}\right] = [23.8] = 23$

∴ Total number of fringes

$= 2n_1 +$ fringe at centre

$= 2n_1 + 1 = 2 \times 23 + 1$

$= 46 + 1 = 47$

In Young's experiment, the number of fringes should be odd.

378 **(a)**

When unpolarised light is made incident at polarizing angle, the reflected light is plane polarized in a direction perpendicular to the plane of incidence.

Therefore $\vec{E}$ in reflected light will vibrate in vertical plane with respect to plane of incidence

381 **(a)**

In a single slit diffraction experiment, position of minima is given by $d \sin\theta = n\lambda$

So for first minima of red $\sin\theta = 1 \times \left(\frac{\lambda_R}{d}\right)$

and as first maxima is midway between first and second minima, for wavelength λ',

Its position will be

$d \sin\theta' = \frac{\lambda' + 2\lambda'}{2} \Rightarrow \sin\theta' = \frac{3\lambda'}{2d}$

According to given condition $\sin\theta = \sin\theta'$

$\Rightarrow \lambda' = \frac{2}{3}\lambda_R$ so $\lambda' = \frac{2}{3} \times 660 = 440nm = 4400Å$

382 **(c)**

$\sin\theta = \frac{\lambda}{d}$

$= \frac{589 \times 10^{-9}}{0.589 \times 10^{-3}} = 10^{-3} = \frac{1}{1000} = 0.001$

384 **(c)**

Huygen's wave theory fails to explain the particle nature of light ($i.e.$, photoelectric effect)

385 **(b)**

In diffraction pattern, fringe width is proportional to λ. We know that wavelength of violet light is less than that of red light, so on replacing red light with violet light, diffraction pattern would become narrower.

386 **(c)**

Width of the diffraction band is given by

$\beta = \frac{\lambda D}{d}$

Where $D =$ distance between slit and the screen

$\lambda =$ wavelength of light used and

$d =$ width of slit.

Hence, width of the diffraction band varies directly as the distance between the slit and the screen.

388 **(c)**

The equation of nth principal maxima for wavelength λ is given by

$(a + b)\sin\theta = n\lambda$

Where a is the width of transparent portion and b is that of opaque portion. The width $(a + b)$ is called the grating element.

The spectral lines will overlap, *ie*, they will have the same angle of diffraction of

$\lambda_1 = \lambda_2$

When a line of wavelength λ_1 in order n_1 coincides with a line of unknown wavelength λ_2 in order n_2, then

$n_2\lambda_2 = n_1\lambda_1$

Or $\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$

389 **(b)**
Ozone layer absorbs most of the UV rays emitted by sun

390 **(b)**
EM waves carry momentum and hence can exert pressure on surfaces. They also transfer energy to the surface so $p \neq 0$ and $E \neq 0$

391 **(c)**
$K = 0.5 \times 10^3$
$\frac{2\pi}{\lambda} = 0.5 \times 10^3 \Rightarrow \lambda = \frac{2\pi}{0.5} \times 10^{-3}$
$\lambda = 12.76mm$
λ lies in range of microwave

392 **(c)**
In 1903, the American scientists Nicols and Hull measured the radiation pressure of visible light. It was found to be of the order of $7 \times 10^{-6} N/m^2$

393 **(d)**
Interference is shown by electromagnetic as well as mechanical waves

394 **(c)**
As $x = n_1\beta_1 = n_2\beta_2 = n_2\lambda_1 = n_2\lambda_2$

$$\therefore n_2 = \frac{n_1\lambda_1}{\lambda_2} = \frac{60 \times 4000}{6000} = 40$$

395 **(c)**
When a beam of light is used to determine the position of an object, the maximum accuracy is achieved if the light is shorter wavelength, because

Accuracy $\propto \frac{1}{\text{Wavelength}}$

397 **(b)**
$I_{\text{max}} = I_1 + I_2 + 2\sqrt{I_1 I_2}$
So, $I_{\text{max}} = I + 4I + 2\sqrt{I.4I} = 9I$

398 **(b)**
Newton's of oscillations in coherence length

$\frac{l}{\lambda} = \frac{0.024}{5900 \times 10^{-10}}$
$= 40677.9 = 4.068 \times 10^4$

399 **(c)**
When white light is used in a biprism experiment, central spot will be white, while the surronding fringes will be colored.

400 **(d)**
Intensity $\propto \frac{1}{r^2}$
$\frac{I_2}{I_1} = \left(\frac{r_1}{r_2}\right)^2 = \left(\frac{r_1}{r_1(1+2\%)}\right)^2$
$I_2 = I_1(1 + 2\%)^{-2}$
Expanding by binomial theorem $\Rightarrow I_2 = I_1(1 - 4\%)$
$\therefore$ Intensity decreases by 4%

402 **(d)**
Let $I_1 = a^2, I_2 = b^2$

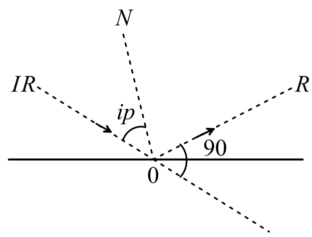
$\therefore \quad I_{max} = (a+b)^2 = a^2 + b^2 + 2ab$

$= I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

403 **(a)**
When light reflects from denser surface phase change of π occurs

404 **(b)**
Direction of wave is perpendicular to the wavefront

405 **(d)**
Required angle
$= 2 \times 57.5 + 90 = 205°$



406 **(c)**
Polarization is not shown by sound waves

407 **(d)**
The phase difference (ϕ) between the wavelets from the top edge and the bottom edge of the slit is $\phi = \frac{2\pi}{\lambda}(d \sin\theta)$ where d is the slit width. The first minima of the diffraction pattern occurs at $\sin\theta = \frac{\lambda}{d}$, so $\phi = \frac{2\pi}{\lambda}\left(d \times \frac{\lambda}{d}\right) = 2\pi$

409 **(d)**

$\frac{\Delta\lambda}{\lambda}=\frac{v}{c}$, Now $\Delta\lambda=\frac{0.5}{100}\lambda \Rightarrow \frac{\Delta\lambda}{\lambda}=\frac{0.5}{100}$

$\therefore v=\frac{0.5}{100}\times c=\frac{0.5}{100}\times 3\times 10^8=1.5\times 10^6 m/s$

Increase in λ indicates that the star is receding

410 **(c)**

Here, $a=10, b=\sqrt{5^2+(5\sqrt{3})^2}=10$

$\therefore \frac{a}{b}=\frac{10}{10}=1:1$

411 **(b)**

Wave nature of light alone can explain the phenomenon like diffraction.

412 **(b)**

Shifting towards violet region shows that apparent wavelength has decreased. Therefore the source is moving towards the earth

413 **(d)**

For destructive interference path difference is odd multiple of $\frac{\lambda}{2}$

415 **(b)**

$\Delta\lambda=\lambda\frac{v}{c}=5700\times\frac{100\times 10^3}{3\times 10^8}=1.90$Å

416 **(d)**

$n_1\lambda_1=n_2\lambda_2$

$\Rightarrow 3\times 700=5\times\lambda_2$

$\Rightarrow \lambda_2=420$ nm

417 **(c)**

$\frac{a_1}{a_2}=\frac{3}{5}$

$\therefore \frac{I_{\max}}{I_{\min}}=\frac{(a_1+a_2)^2}{(a_1-a_2)^2}=\frac{(3+5)^2}{(3-5)^2}=\frac{16}{1}$

418 **(b)**

Lateral displacement of fringes $=\frac{\beta}{\lambda}(\mu-1)t$

$=\frac{1\times 10^{-3}}{600\times 10^{-9}}(1.5-1)\times 0.06\times 10^{-3}=5\,cm$

419 **(a)**

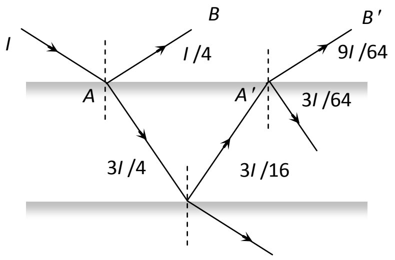
$\beta=\frac{\lambda D}{d}\Rightarrow \beta\propto D$

$\Rightarrow \frac{\beta_1}{\beta_2}=\frac{D_1}{D_2}\Rightarrow\frac{\beta_1-\beta_2}{\beta_2}=\frac{D_1-D_2}{D_2}\Rightarrow\frac{\Delta\beta}{\Delta D}=\frac{\beta_2}{D_2}=\frac{\lambda_2}{d_2}$

$\Rightarrow \lambda_2=\frac{3\times 10^{-5}}{5\times 10^{-2}}\times 10^{-3}=6\times 10^{-7}m=6000$Å

420 **(d)**

From figure $I_1=\frac{I}{4}$ and $I_2=\frac{9I}{64}\Rightarrow\frac{I_2}{I_1}=\frac{9}{16}$



By using $\frac{I_{\max}}{I_{\min}}=\left(\frac{\sqrt{\frac{I_2}{I_1}}+1}{\sqrt{\frac{I_2}{I_1}}-1}\right)^2=\left(\frac{\sqrt{\frac{9}{16}}+1}{\sqrt{\frac{9}{16}}-1}\right)^2=\frac{49}{1}$

422 **(a)**

Plane containing the direction of vibration and wave motion is called plane of polarization. Plane of vibration is perpendicular to the direction of propagation and also perpendicular to the plane of polarization. Therefore, angle between plane of polarization and direction of propagation is 0°.

423 **(a)**

By using $x_n=\frac{n\lambda D}{d}$

$\Rightarrow (5\times 10^{-3})=\frac{10\times\lambda\times 1}{(1\times 10^{-3})}\Rightarrow\lambda=5\times 10^{-7}m$

$=5000$Å

425 **(a)**

If an unpolarised light is converted into plane polarized light by passing through a polaroid its intensity becomes half.

426 **(c)**

Distance of 5th bright fringe from central fringe,

$X_{5B}=\frac{5\lambda D}{d}$ ...(i)

Distance of 3rd dark fringe from central fringe,

$X_{3D}=\frac{(2\times 3-1)\lambda D}{2d}=\frac{5}{2}\frac{\lambda D}{d}$ ... (ii)

From (i) and (ii) required distance

$X_{5B}-X_{3D}=\left(5-\frac{5}{2}\right)\frac{\lambda D}{d}=\frac{5}{2}\times\frac{5\times 10^{-7}\times 1}{1\times 10^{-3}}$

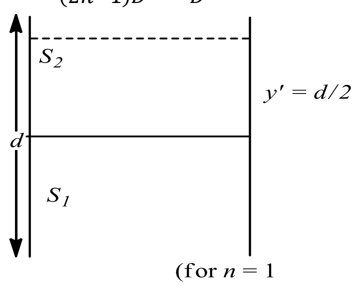
$=1.25\,mm$

428 **(d)**

nth dark fringe

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

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



429 **(b)**

For coherent sources

$$I_1 = 4I_0 \cos^2 \frac{\phi}{2}$$
$$= 4I_0$$

For incoherent sources

$$I_2 = I_0 + I_0 = 2I_0$$
$$\therefore \frac{I_1}{I_2} = 2$$

430 **(b)**

$$\frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2} = 9 \ or \ \frac{a+b}{a-b} = 3$$

Or $3a - 3b = a + b$ or $2a = 4b$;

$$\frac{I_1}{I_2} = \frac{a^2}{b^2} = \frac{4b^2}{b^2} = 4:1$$

431 **(b)**

Angular fringe width $\theta = \frac{\lambda}{d} \Rightarrow \theta \propto \lambda$

$$\lambda_w = \frac{\lambda_a}{\mu_w}$$

So $\theta_w = \frac{\theta_{\text{air}}}{\mu_w} = \frac{0.20}{\frac{4}{3}} = 0.15°$

432 **(b)**

In electromagnetic wave, electric and magnetic fields are in phase

Electromagnetic wave carry energy as they travel through space and this energy is shared equally by electric and magnetic fields

The direction of the propagation of electromagnetic wave is the direction of $\vec{E} \times \vec{B}$

The pressure exerted by the wave is equal to its energy density

In electromagnetic wave, the magnitudes of $\vec{E}$ and $\vec{B}$ are related by $\frac{E}{B}$

433 **(c)**

$I \propto a^2$

434 **(c)**

Position of fourth maxima

$$x_0 = \frac{4D\lambda}{d}$$

Or $x \propto \lambda$

$\therefore$ x(blue) $<$ x(green)

435 **(b)**

Position of n^{th} maxima from central maxima is given by $x_n = \frac{n\lambda D}{d}$

$$\Rightarrow x_n \propto n\lambda \Rightarrow \frac{d_1}{d_2} = \frac{n_1\lambda_1}{n_2\lambda_2} = \frac{8\lambda_1}{6\lambda_2} = \frac{4}{3}\left(\frac{\lambda_1}{\lambda_2}\right)$$

436 **(b)**

The intensity at a point on screen is given by

$I = 4I_0 \cos^2(\phi/2)$

Where ϕ is the phase difference. In this problem ϕ arises (i) due to initial phase difference of $\pi/4$ and (ii) due to path difference for the observation point situated at $\theta = 30°$. Thus

$$\phi = \frac{\pi}{4} + \frac{2\pi}{\lambda}(d \sin\theta) = \frac{\pi}{4} + \frac{2\pi}{\lambda} \cdot \frac{\lambda}{4}(\sin 30°)$$
$$= \frac{\pi}{4} + \frac{\pi}{4} = \frac{\pi}{2}$$

Thus $\frac{\phi}{2} = \frac{\pi}{4}$ and $I = 4I_0 \cos^2(\pi/4) = 2I_0$

437 **(b)**

From $\beta = \frac{\lambda D}{d}$

$$5 \times 10^{-3} = \frac{(5000 \times 10^{-10}) \times 1.0}{d}$$

$$d = \frac{5 \times 10^{-7}}{5 \times 10^{-3}} = 10^{-4}\text{m} = 0.1 \text{ mm}$$

438 **(c)**

For constructive interference path difference is even multiple of $\frac{\lambda}{2}$

439 **(b)**

Electron diffraction is the diffraction of a beam of electrons by atoms or molecules. The fact that electrons can be diffracted in a similar way to light shows the particles can act as waves.

440 **(c)**

Fringe width

$$W = \frac{\Delta\lambda}{d}$$

If the screen is placed at a constant distance from the source, then

$$W \propto \frac{\lambda}{d}$$

Hence, fringe width can be changed either by changing the wavelength of light or by changing the separation between the two slits.

441 **(d)**

Amplitude $= 10 \frac{V}{m}$

$$C = \frac{\omega}{k}$$

$$3 \times 10^8 = \frac{10^7}{k}$$

$$k = \frac{1}{30}$$

$\frac{2\pi}{\lambda} = \frac{1}{30} \Rightarrow \lambda = 188.4m$

443 **(c)**

Distance between two adjacent bright (or dark) fringes is called the fringe width. It is denoted by β, thus

$$\beta = \frac{D\lambda}{d}$$

Where D is the distance between slit source and screen and d is separation of slits.

Since, D and d are increased to same extent, so fringe width (w) will remain unchanged.

444 **(d)**

Ozone hole is depletion of ozone layer in stratosphere because of gases like CFC'S etc.

445 **(d)**

Distance of the n^{th} bright fringe from the centre

$x_n = \frac{n\lambda D}{d}$

$$\Rightarrow x_3 = \frac{3 \times 6000 \times 10^{-10} \times 2.5}{0.5 \times 10^{-3}} = 9 \times 10^{-3}m$$
$$= 9mm$$

446 **(d)**

$\lambda_{Red} > \lambda_{Blue} > \lambda_{X-ray} > \lambda_\gamma$

448 **(b)**

From diffraction at a single alit, size if aperture,

$$a = \frac{\lambda}{\sin\theta}$$
$$a = \frac{3141.59 \times 10^{-10}}{\sin 1°} = 18 \times 10^{-6}\text{m} = 18\mu\text{m}$$

449 **(d)**

$\beta \propto D$

450 **(b)**

Position of 3^{rd} bright fringe $x_3 = \frac{3D\lambda}{d}$

$$\Rightarrow \lambda = \frac{x_3 d}{3D} = \frac{(0.9 \times 10^{-2}) \times (0.28 \times 10^{-3})}{3 \times 1.4}$$
$$= 6000\text{Å}$$

451 **(a)**

P is the position of 11^{th} bright fringe from Q. From central position O, P will be the position of 10^{th} bright fringe

Path difference between the waves reaching at $P = S_1B = 10\lambda = 10 \times 6000 \times 10^{-10} = 6 \times 10^{-6}m$

452 **(a)**

For single slit diffraction pattern $d\sin\theta = \lambda$ ($d =$ slit width)

Angular width $= 2\theta = 2\sin^{-1}\left(\frac{\lambda}{d}\right)$

It is independent of D, *i.e.*, distance between screen and slit

453 **(b)**

$B \propto \lambda$

455 **(c)**

With white light, the rays reaching the centre has zero path difference. So we get white fringe at the centre and coloured near the central fringe

456 **(a)**

Position of nth bright fringe from central maxima

$x_{n1} = \frac{n_1\lambda D}{d}$ here $n_1 = 5$

$\therefore x_{n1} = \frac{5\lambda D}{d}$

Position of n th dark fringe from central maxima

$x_n = \frac{(2n-1)\lambda D}{2d}$, here $n = 3$

$x_n = \frac{5}{2}\frac{\lambda D}{d}$

$x_{n1} - x_n = \frac{2.5\lambda D}{d} = 2.5\,\beta$

Given $\beta = 0.4$ mm

$\Rightarrow x_{n1} - x_n = 1$ mm

459 **(a)**

In vacuum velocity of all EM waves are same but their wavelength are different

460 **(a)**

Optical rotation or optical activity is the rotation of linearly polarized light as it travels through certain materials. It occurs in solutions of chiral molecules (eg, sugar), solids with rotated crystal planes (eg, quartz) and spin polarized gases of atoms or molecules. Any linear polarization of light can be written as an equal combination of right hand (RHC) and left hand (LHC) circularly polarized light.

$$E_{\theta_D} = E_{\text{RHC}} + e^{i2\theta D}\, E_{\text{LHC}}$$

Where E is the electric field of light.

461 **(c)**

At polarizing angle, the reflected and refracted rays are mutually perpendicular to each other

462 **(a)**

Both magnetic and electric fields have zero average value in a plane *e*.m. wave

463 **(c)**

It is given that $r_4 = \sqrt{4b\lambda_1}$ and $r_5 = \sqrt{5b\lambda_2}$ are equal. Therefore $\sqrt{4b\lambda_1} = \sqrt{5b\lambda_2}$

Or $4b\lambda_1 = 5b\lambda_2$

Or $\frac{\lambda_1}{\lambda_2} = \frac{5}{4}$

464 **(b)**

Observed frequency $v' = v\left(1 - \frac{v}{c}\right)$

$\Rightarrow v' = 6 \times 10^{14}\left(1 - \frac{0.8c}{c}\right) = 1.2 \times 10^{14} Hz$

465 **(a)**

Here, $\lambda = 6250$ Å $= 6250 \times 10^{-10}$m

$a = 2 \times 10^{-2}$cm $= 2 \times 10^{-4}$m

$D = 50$ cm $= 0.5$ m

Width of central maximum=$\frac{2\lambda D}{a}$

$= \frac{2 \times 6250 \times 10^{-10} \times 0.5}{2 \times 10^{-4}}$

312.5×10^{-3} cm

466 **(c)**

For maximum contrast, $I_1 = I_2$

467 **(b)**

Fringe visibility

$V = \frac{2\sqrt{I_1 I_2}}{I_1 + I_2}$

Where I_1 and I_2 are intensities of coherent sources.

Given, $\frac{I_1}{I_2} = \frac{1}{4}$

$\therefore I_2 = 4I_1$

$\therefore$ Fringe visibility $= \frac{2\sqrt{I_1 \times 4I_1}}{(I_1 + 4I_1)}$

$= \frac{2 \times 2I_1}{5I_1} = \frac{4}{5}$

$\Rightarrow V = 0.8$

468 **(b)**

The increasing order of given electromagnetic wave is as follows

$\lambda_{\gamma-\text{rays}} < \lambda_{X-\text{rays}} < \lambda_{\text{Infrared}} < \lambda_{\text{microwave}} < \lambda_{\text{radio waves}}$

469 **(c)**

For first minima $\theta = \frac{\lambda}{a}$ or $a = \frac{\lambda}{\theta}$

$\therefore a = \frac{6500 \times 10^{-8} \times 6}{\pi}$ $\left(\text{As } 30° = \frac{\pi}{6} \text{ radian}\right)$

$= 1.24 \times 10^{-4} cm = 1.24$ microns

470 **(a)**

Wavefront is the locus of all the particles which vibrates in the same phase

471 **(c)**

Refractive index $= \sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$

Here μ is not specified so we can consider $\mu = \mu_0$

Then refractive index $= \sqrt{\frac{\varepsilon}{\varepsilon_0}} = 2$

$\therefore$ Speed and wavelength of wave becomes half and frequency remain unchanged

472 **(c)**

Deviation=$i_p - r = 20°$

Also, $i_p = r = 90°$

Solve to get $r = 34°$

474 **(c)**

Distance of n^{th} bright fringe $y_n = \frac{n\lambda D}{d}, i.e., y_n \propto \lambda$

$\therefore \frac{x_{n_1}}{x_{n_2}} = \frac{\lambda_1}{\lambda_2} \Rightarrow \frac{x(\text{Blue})}{x(\text{Green})} = \frac{4360}{5460}$

$\therefore x(\text{Green}) > x(\text{Blue})$

475 **(b)**

$\beta = \frac{\lambda D}{d}$

476 **(d)**

$n\beta_1 = (n+1)\beta_2$

$\Rightarrow \frac{n \times 650 \times 10^{-19} D}{d} = \frac{(n+1) \times 520 \times 10^{-19} \times D}{d}$

$\Rightarrow n = 4$

477 **(c)**

When white light is used in Young's double slit experiment, then different coloures will be split up on the viewing screen according to their wavelength while the central fringe will be white.

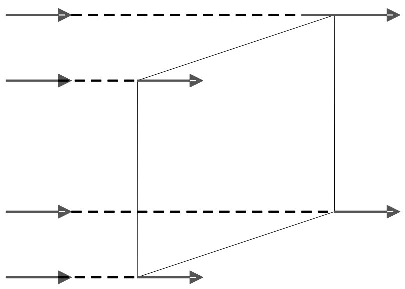
478 **(a)**

Distance covered by T.V. signals $= \sqrt{2hR}$

$\Rightarrow$ maximum distance $\propto h^{1/2}$

479 **(d)**

In the given options none of sources generates plane wavefront, it can be artificially produced by reflection from a mirror or by refraction through a lens.



481 **(c)**

$x=\frac{(2n+1)\lambda D}{2a}$

For red light, $x=\frac{(4+1)D}{2a}\times 6500$Å

For other light, $x=\frac{(6+1)D}{2a}\times \lambda$Å

X is same for each

$\therefore 5\times 6500=7\times\lambda \Rightarrow \lambda=\frac{5}{7}\times 6500=4642.8$Å

482 **(b)**

Rotation produced $\theta=Sic$

Net rotation produced $\theta_r=\theta_1-\theta_2=l(S_1c_1-S_2c_2)$

$=0.29\times[0.01\times 60-0.02\times 30]=0$

483 **(b)**

$\frac{I_1}{I_2}=\frac{1}{4}\Rightarrow I_1=k$ and $I_2=4k$

$\therefore$ Fringe visibility $V=\frac{2\sqrt{I_1I_2}}{(I_1+I_2)}=\frac{2\sqrt{k\times 4k}}{(k+4k)}=0.8$

484 **(b)**

If I_0 is intensity of unpolarized light, then intensity of polarized light from 1st Polaroid=$I_0/2$.

On rotating through 45°, intensity of light from 2nd Polaroid,

$I=\left(\frac{I_0}{2}\right)(\cos 45°)^2=\frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2=\frac{I_0}{4}$

$=25\%\ I_0$

485 **(b)**

Given, $\frac{I_{max}}{I_{min}}=9=\frac{(a_1+a_2)^2}{(a_1-a_2)^2}$

$\therefore \frac{a_1+a_2}{a_1-a_2}=3$

Or $2a_1=4a_2$

Or $a_1=2a_2$

$\Rightarrow \frac{a_1}{a_2}=2$

Again, intensity ratio at the screen due to two slits

$\frac{I_1}{I_2}=\frac{a_1^2}{a_2^2}=\frac{4}{1}$

Hence, amplitude ratio is 2 and intensities at the screen due to two slits are 4 units and 1 unit, respectively.

486 **(c)**

Interference may be seen using two independent lasers.

487 **(d)**

Given, spacing between second dark fringe and central fringe

$=\beta+\frac{\beta}{2}$

Or $\frac{3\beta}{2}=1$ mm

or $\beta=\frac{2}{3}\times 1$ mm

$\frac{\lambda D}{d}=\frac{2}{3}$mm

$\therefore\ \lambda=\frac{2}{3}\times 10^{-3}\times\frac{0.9\times 10^{-3}}{\mathbf{1}}$

$\therefore \lambda=0.6\times 10^{-6}$ m

$\therefore\ \lambda=600\times 10^{-9}$ m

$=600$ m

488 **(b)**

$PR=d$

$PO=d\sec\theta$

And $CO=PO\cot\ 2\theta=d\sec\theta\cos 2\theta$

Path difference between the two rays is,

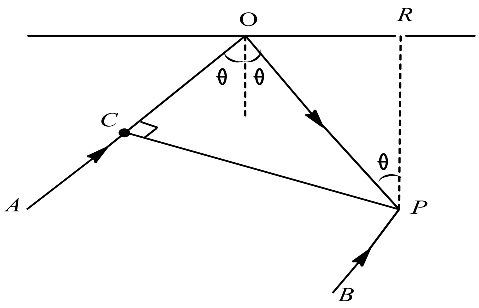
$\Delta x=CO+PO$

$=(d\sec\theta+\ d\sec\theta\cos 2\theta)$

Phase difference between the two rays is

$\Delta\phi=\pi$ (one is reflected, while another is direct)

Therefore condition for constructive interference should be



$$\Delta x = \frac{\lambda}{2}, \frac{3\lambda}{2} \ldots.$$

Or $d \sec\theta\,(1 + \cos 2\theta) = \frac{\lambda}{2}$

Or $\left(\frac{d}{\cos\theta}\right)(2\cos^2\theta) = \frac{\lambda}{2}$

Or $\cos\theta = \frac{\lambda}{4d}$

489 **(a)**

Destructive interference occurs when the path difference is an odd multiple of $\lambda/2$.

Ie. $\frac{xd}{D} = \frac{(2n-1)\lambda}{2}$

Angular width of first dark fringe is

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

Given, $n = 1, \lambda = 4800$ Å $= 4800 \times 10^{-10}$ m,

$d' = 0.6$ mm $= 0.6 \times 10^{-3}$ m

$$\therefore \frac{2x}{D} = \frac{2(2 \times 1 - 1) \times 4800 \times 10^{-10}}{2 \times 0.6 \times 10^{-3}}$$

$= 8 \times 10^{-4}$ rad

490 **(a)**

In the Newton's Ring interference experiment the diameter of the nth dark ring is given by $D_n = 2\sqrt{n.\lambda.R}$ where R is the radius of curvature of the lens and λ is the wavelength

Using the formula we have

$$\lambda = \frac{D_{n+m}^2 - D_n^2}{4m.R} = \frac{D_{20}^2 - D_{10}^2}{4(20-10)R}$$

$$= \frac{(5.82 \times 10^{-3})^2 - (3.36 \times 10^{-3})^2}{4 \times 10 \times 1} = 5646[\text{Å}]$$

491 **(a)**

$$I = \frac{1}{2}\varepsilon_0 C E_0^2$$

$$\Rightarrow E_0 = \sqrt{\frac{2I}{\varepsilon_0 c}} = \sqrt{\frac{2 \times 5 \times 10^{-16}}{8.85 \times 10^{-12} \times 3 \times 10^8}}$$

$$= 0.61 \times 10^{-6}\frac{V}{m}$$

Also $E_0 = \frac{V_0}{d} \Rightarrow V_0 = E_0 d = 0.61 \times 10^{-6} \times 2 = 1.23\mu V$

492 **(d)**

Distance of nth dark fringe from central fringe

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

$$\therefore x_2 = \frac{(2 \times 2 - 1)\lambda D}{2d} = \frac{3\lambda D}{2d}$$

$$\Rightarrow 1 \times 10^{-3} = \frac{3\lambda \times 1}{2 \times 0.9 \times 10^{-3}}$$

$\Rightarrow \lambda = 6 \times 10^{-5}$cm

494 **(d)**

Distance of n^{th} dark fringe from central fringe

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

$$\therefore x_2 = \frac{(2 \times 2 - 1)\lambda D}{2d} = \frac{3\lambda D}{2d}$$

$$\Rightarrow 1 \times 10^{-3} = \frac{3 \times \lambda \times 1}{2 \times 0.9 \times 10^{-3}} \Rightarrow \lambda = 6 \times 10^{-5} cm$$

495 **(d)**

$$\beta \propto \frac{\lambda}{d}$$

496 **(d)**

If I is the final intensity and I_0 is the initial intensity then

$$I = \frac{I_0}{2}(\cos^2 30°)^5 \text{ or } \frac{I}{I_0} = \frac{1}{2} \times \left(\frac{\sqrt{3}}{2}\right)^{10} = 0.12$$

497 **(c)**

Newton's first law of motion states that every particle travels in a straight line with a constant velocity unless disturbed by an external force. So the corpuscles travels in straight lines

498 **(b)**

Position of n^{th} minima $y_n = \frac{n \times D}{d}$

$$\Rightarrow y_3 - y_1 = \frac{D}{d}(3\lambda - \lambda) = \frac{2\lambda D}{d}$$

$$\Rightarrow 3 \times 10^{-3} = \frac{2 \times 6000 \times 10^{-10} \times 0.5}{d}$$

$\Rightarrow d = 0.2 \times 10^{-3} m = 0.2 mm$

500 **(d)**

Using red light $(\lambda = 6600\text{Å})$ 60 fringes are seen.

Hence, range of field of view is

$$\Rightarrow 60 \times w = 60 \times \frac{D\lambda}{d}$$

Using light of wavelength λ', n fringes are seen, then

$$\Rightarrow 60 \times \frac{D\lambda}{d} = n \times \frac{D\lambda'}{d}$$

$$60 \times \lambda = n \times \lambda'$$

$$\Rightarrow n = 60 \times \frac{\lambda}{\lambda'} = 60 \times \frac{6600}{4400} = 90$$

501 **(d)**

$$I = \frac{I_0}{2} \cdot \frac{1}{(4)^4}$$

$$= \frac{I_0}{512} = \frac{1}{512}$$

502 **(a)**

As, $a \sin \theta = n\lambda$

$$\lambda = \frac{a \sin \theta}{n} = \frac{5 \sin 30°}{1} = 2.5 \text{ cm}$$

503 **(b)**

Let I_0 is intensity of light emitted from the source, then

Resultant intensity

$$I = 4I_0 \cos^2 \frac{\phi}{2}$$

$$I_1 = 4I_0 \cos^2 \frac{\phi}{2} = 4I_0$$

Now, $\Delta x = \frac{\lambda}{4}$

$$\phi = \frac{2\pi}{\lambda} \times \Delta x = \frac{2\pi}{\lambda} \times \frac{\lambda}{4}$$

$$\phi = \frac{\pi}{2}$$

And $I_2 = 4I_0 \cos^2 \frac{\pi}{4} = 2I_0$

$I_1 : I_2 = 2 : 1$

504 **(d)**

$$\beta = \frac{\lambda D}{d}$$

$$\beta' = \frac{\lambda D'}{d}$$

$$\beta - \beta' = \frac{\lambda(D - D')}{d}$$

$$3 \times 10^{-5} = \frac{\lambda \times 5 \times 10^{-2}}{10^{-3}}$$

Or $\lambda = \frac{3 \times 10^{-5}}{50} = 6 \times 10^{-7}\text{m} = 6000\text{Å}$

505 **(a)**

$\beta = \frac{\lambda D}{d}$; If λ and d both increase by 10%, there will be no change in fringe width (β)

506 **(a)**

Fresnel distance $Z_F = \frac{a^2}{\lambda} = \frac{(4 \times 10^{-3})^2 m^2}{500 \times 10^{-9} m} = 32m$

507 **(a)**

The film appears bright when the path difference ($2\mu\, t \cos r$) is equal to odd multiple of $\frac{\lambda}{2}$

i.e. $2\mu t \cos r = (2n-1)\lambda/2$ where $n = 1, 2, 3 \ldots$

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

$$= \frac{4 \times 1.4 \times 10{,}000 \times 10^{-10} \times \cos 0}{(2n-1)} = \frac{56000}{(2n-1)}\text{Å}$$

$\therefore \lambda$

$= 56000\text{Å}, 18666\text{Å}, 11200\text{Å}, 8000\text{Å}, 6222\text{Å}, 5091\text{Å}$

The wavelength which are not within specified range are to be refracted

508 **(d)**

When two coherent light beams of intensities I_1 and I_2 superimpose, then maximum intensity is $\left(\sqrt{I_1} - \sqrt{I_2}\right)^2$ and minimum intensity is$\left(\sqrt{I_1} - \sqrt{I_2}\right)^2$. But when two incoherent light beams of intensities I_1 and I_2 superimpose, then maximum intensity is $(I_1 + I_2)$ and minimum intensity is$(I_1 - I_2)$.

$\therefore \quad I_{\max} = 5I, I_{\min} = 3I$

509 **(b)**

In an interference experiment the spacing between successive maxima and minima is called the fringe width and is given by

$\beta = D\lambda/d$

510 **(c)**

If an unpolarised light is converted into plane polarized light by passing through a polaroid, it's intensity becomes half

512 **(d)**

Photoelectric effect states that light travels in the form of bundles or packets of energy, called photons. This effect is explained on the basis of quantum nature of light. So, it clearly explains the particle's nature of light

514 **(d)**

$$\beta = \frac{\lambda D}{d} \Rightarrow \frac{\beta_2}{\beta_1} = \frac{\lambda_2 D_2 d_1}{\lambda_1 D_1 d_2} \Rightarrow \beta_2 = 2.5 \times 10^{-4}m$$

515 **(b)**

Fringe width, $\beta = \frac{\lambda D}{d}$

517 **(a)**

Only transverse waves can be polarized

518 **(c)**

$e \sin\theta = \lambda \Rightarrow \sin\theta \approx \theta = \frac{\lambda}{e}$

$x = f, \theta = \frac{f\lambda}{e}$

$\therefore 2x =$ separation between minima on either side of central maximum'

$= \frac{2f\lambda}{e}$

Hence, $e = \frac{2f\lambda}{2x}$

$= \frac{2 \times 1 \times 600 \times 10^{-9}}{4 \times 10^{-3}} = 0.3$ mm

519 **(c)**

If path difference $\Delta = (SS_1 + S_1O) - (SS_2 + S2O = n\lambda$

$n = 0, 1, 2, 3, \ldots$ the central fringe at O is a bright fringe and if the path difference $\Delta = \left(n - \frac{1}{2}\right)\lambda, n =$ 1,2,3, … the central bright fringe will be a dark fringe

520 **(a)**

If one of slits is closed then interference fringes are not formed on the screen but a fringe pattern is observed due to diffraction from slit

521 **(d)**

From $(\mu - 1)t = n\lambda$

522 **(b)**

As metal as reflecting surface, for reflecting surface radiation pressure

$P_r = \frac{2S}{c} = \frac{2 \times 0.5}{3 \times 10^8} = 0.332 \times 10^{-8}$

523 **(c)**

According to Doppler's principle $\lambda' = \lambda\sqrt{\frac{1-v/c}{1+v/c}}$ for $v = c$

$\lambda' = 5500\sqrt{\frac{(1 - 0.8)}{1 + 0.8}} = 1833.3$

$\therefore$ Shift $= 5500 - 1833.3 = -3666.7$

524 **(b)**

$n_1\lambda_1 = n_2\lambda_2$

$\therefore n_1 \times 420 = n_2 \times 630$

Or $2n_1 = 3n_2$

If $n_2 = 2,$ then $n_1 = 3$

Therefore, thickness of soap solution is given by

$\mu_1 t = n_1 \frac{\lambda_1}{2}$

Or $t = \frac{3 \times 420}{1.4 \times 2} = 450$ nm

525 **(a)**

Condition for constructive interference is

$2\mu t = [2n + 1]\frac{\lambda}{2}$

Where, $n = 0, 1, 2, 3, \ldots \ldots$

For minimum thickness, $n = 0$

$2\mu t = \frac{\lambda}{2}$

$\Rightarrow t = \frac{\lambda}{4\mu} = \frac{600 \times 10^{-9}}{4 \times 1.5} = 100$ nm

526 **(a)**

Shift $= \frac{\beta}{\lambda}(\mu - 1)t = \frac{\beta}{(5000 \times 10^{-10})} \times (1.5 - 1) \times 2 \times 10^{-6}$

$= 2\beta$ *i.e.*, 2 fringes upwards

527 **(c)**

The general condition for Frounhofer diffraction is $\frac{b^2}{L\lambda} \ll 1$.

529 **(a)**

Fringe visibility (V) is given by $V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$

530 **(a)**

As we know

$\beta = \frac{D}{d}\lambda$

$\lambda \propto \frac{1}{\mu}$

From Eqs. (i) and (ii),

$\beta \propto \lambda \propto \frac{1}{\mu}$

$\beta \propto \frac{1}{\mu}$

The refractive index of water is greater than air, therefore fringe width will decrease.

531 **(c)**

Distance between two successive maxima

$\lambda = \frac{0.14}{14}$m $= 10^{-2}$m,

$v = \frac{c}{\lambda} = \frac{3 \times 10^8}{10^{-2}} = 3 \times 10^{10}$H

532 **(d)**

$\frac{I}{I_0} = \cos^2\left(\frac{\phi}{2}\right); \phi = \frac{2\pi}{\lambda}.\Delta x$

533 **(d)**

In the presence of thin glass plate, the fringe pattern shifts, but no change in fringe width occurs

534 **(c)**

Amplitude of the superimposing waves are

$\frac{a_1}{a_2} = \left(\frac{1}{9}\right)^{1/2} = \frac{1}{3}$

$\frac{I_{\text{minima}}}{I_{\text{maxima}}} = \frac{(a_1 - a_2)^2}{(a_1 + a_2)^2} = \frac{1}{4}$

535 **(b)**

The data which represents the music is stored on the compact disc in the form of very small pits arranged in a tightly wound spiral track in silvery surface. The distance between two neighbouring track is 1.6 micrometre. Which is only several times the wavelength of visible light, this small spacing is responsible for the wonderful colours reflected by a CD which works as a diffraction grating. Hence, diffraction is responsible for coloured bands.

536 **(c)**

EM waves travels perpendicular to E and B. Which are also perpendicular to each other

$\vec{v} = \vec{E} \times \vec{B}$

537 **(a)**

For obtaining mth secondary minima at a point on screen, path difference between the diffracted waves $\Delta = d \sin \theta_m = \pm m\lambda$

Where, $m = 1, 2, 3, \ldots$

538 **(a)**

Width of central maximum is given by

$$w = \frac{2f\lambda}{a} \quad \ldots(i)$$

Where f is focal length of lens, a is width of slit and λ is wavelength of light used.

From Eq. (i), it is clear that fringe width

$w \propto \lambda$

So, when blue light is used in the experiment instead of red light, the fringes will become narrower.

539 **(b)**

Amplitude of electric field and magnetic field are related by the relation

$\frac{E_0}{B_0} = c$

Average energy density of the magnetic field is

$v_B = \frac{1}{4}\frac{B_0^2}{\mu_0}$

$= \frac{1}{4}\frac{E_0^2}{\mu_0 c^2} \quad \left[\because B_0 = \frac{E_0}{c}\right]$

$= \frac{1}{4}\varepsilon_0 E_0^2 \quad \left[\because c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}\right]$

$= \frac{1}{4} \times 8.854 \times 10^{-12} \times (2)^2$

$= 8.854 \times 10^{-12} Jm^{-3}$

$= 8.86 \times 10^{-12} Jm^{-3}$

540 **(b)**

Angular width $\beta = \frac{2\lambda}{d} \Rightarrow \beta \propto \lambda$

$\Rightarrow \frac{\beta_1}{\beta_2} = \frac{\lambda_1}{\lambda_2} \Rightarrow \frac{\beta}{\frac{70}{100}\beta} = \frac{6000}{\lambda_2} \Rightarrow 4200 Å$

542 **(c)**

The intensity I is minimum for phase difference,

$\delta = (2n - 1)\pi$

Where $n = 1, 2, 3, \ldots \ldots$

543 **(a)**

Phenomenon of interference of light takes place

544 **(b)**

For possible interference maxima on the screen, the condition is

$d \sin \theta = n\lambda \quad \ldots(i)$

Given : d = slit-width = 2λ

$\therefore \quad 2\lambda \sin \theta = n\lambda$

$\Rightarrow \; 2 \sin \theta = n$

The maximum value of $\sin \theta$ is 1, hence,

$n = 2 \times 1 = 2$

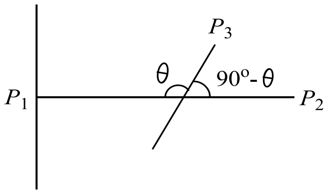
Thus, Eq. (i) must be satisfied by 5 integer values ie, -2 -1, 0, 1, 2. Hence, the maximum number of possible interference maxima is 5.

545 **(b)**

$I = I_0 \cos^2 \theta = I_0 \cos^2 45 = \frac{I_0}{2}$

546 **(a)**

No light is emitted from the second polaroid, so P_1 and P_2 are perpendicular to each other



Let the initial intensity of light is I_0. So Intensity of light after transmission from first polaroid $= \frac{I_0}{2}$

Intensity of light emitted from P_3 $I_1 = \frac{I_0}{2}\cos^2\theta$

Intensity of light transmitted from last polaroid $i.e.$ from

$P_2 = I_1\cos^2(90° - \theta) = \frac{I_0}{2}\cos^2\theta . \sin^2\theta$

$= \frac{I_0}{8}(2\sin\theta\cos\theta)^2 = \frac{I_0}{8}\sin^2 2\theta$

547 **(d)**

$\frac{I_{\max}}{I_{\min}} = \frac{25}{9}$

Or $\left(\frac{a_1+a_2}{a_1-a_2}\right)^2 = \frac{25}{9}$

Where a denotes the amplitude.

Or $\frac{a_1+a_2}{a_1-a_2} = \frac{5}{3}$

Or $\frac{a_1}{a_2} = 4$

As, $(\text{amplitude})^2 \propto$ intensity

Hence, $\frac{I_1}{I_2} = \left(\frac{a_1}{a_2}\right)^2 = 16$

548 **(c)**

$I_{max} = I_1 + I_2 + 2\sqrt{I_1 I_2}$

$= 4I + I + 2\sqrt{2I_1 \times I}$

$= 9I$

$I_{min} = I_1 + I_2 - 2\sqrt{2I_1 I_2}$

$I_{min} = I$

549 **(a)**

Velocity of light

$C = \frac{E}{B} \Rightarrow B = \frac{E}{C} = \frac{9.3}{3\times 10^8} = 3.1 \times 10^{-8}T$

550 **(d)**

$\beta = \frac{\lambda D}{d}$

$\overrightarrow{VIBGYOR}\lambda$ increases

$\lambda_R > \lambda_G > \lambda_B$

So $\beta_R > \beta_G > \beta_B$

551 **(c)**

The angular wave number $k = \frac{2\pi}{\lambda}$; where λ is the wave length. The angular frequency is $w = 2\pi v$

The ratio $\frac{k}{\omega} = \frac{2\pi/\lambda}{2\pi v} = \frac{1}{v\lambda} = \frac{1}{c} =$ constant

552 **(c)**

Resultant intensity $I = 4I_0\cos^2(\phi/2)$

$\Rightarrow \frac{I_1}{I_2} = \frac{\cos^2(\phi_1/2)}{\cos^2(\phi_2/2)} = \frac{\cos^2 0}{\cos^2(90/2)} = \frac{2}{1}$

553 **(d)**

For minima, path difference $\Delta = (2n-1)\frac{\lambda}{2}$

For third minima $n = 3 \Rightarrow \Delta = (2\times 3 - 1)\frac{\lambda}{2} = \frac{5\lambda}{2}$

554 **(a)**

$\beta_{\text{water}} = \frac{B_{air}}{\mu} = \frac{0.4}{4/3} = 0.3mm$

555 **(b)**

$d = \frac{D\lambda}{\beta} = \frac{1\times 5\times 10^{-7}}{5\times 10^{-3}} = 10^{-4}m = 0.1\ mm$

556 **(d)**

Case I : $l_1 = 20cm, \theta_1 = 38°$

Connection $= C_1$

$\therefore$ Specific rotation, $\alpha_1 = \frac{\theta_1}{l_1 C_1} = \frac{(38°)}{20\times C_1}$ Liquid A

Case II : $l_2 = 30cm, \theta_2 = -24°$, concentration $= C_2$

Specific rotation $\alpha_2 = \frac{(-24°)}{30\times C_2}$. Liquid B

The mixture has 1 part A and 2 part B

$\therefore C_1' : C_2' = 1:2$

$\therefore \theta = [\alpha_1 C_1' + \alpha_2 C_2']l$

$= \left\{\frac{38}{20\times C_1}\times\frac{C_1}{3} + \frac{(-24°)}{30\times C_2}\times\frac{2C_2}{3}\right\}\times 30$

$= 19° - 16° = +3°$

The new angle of rotation is +3 in the right hand direction

557 **(d)**

$\mu_0 = 4\pi\times 10^{-7}, \varepsilon_0 = 8.85\times 10^{-12}\frac{N-m^2}{C^2}$

So $c = \frac{1}{\sqrt{\mu_0\varepsilon_0}} = 3\times 10^8\frac{meter}{second}$

560 **(b)**

Molecular spectra due to vibrational motion lie in the microwave region of EM-spectrum. Due to Kirchhoff's law in spectroscopy the same will be absorbed

561 **(a)**

Light is electromagnetic in nature it does not require any material medium for its propagation

562 **(a)**

The intensity of light reflected from upper surface is

$I_1 = I_0 \times 25\%$

$= I_0 \times \frac{25}{100}$

$= \frac{I_0}{4}$

The intensity of transmitted light from upper surface is

$I = I_0 - \frac{I_0}{4} = \frac{3I_0}{4}$

$\therefore$ The intensity of reflected light from upper surface is

$I_2 = \frac{3I_0}{4} \times \frac{50}{100} = \frac{3I_0}{8}$

$\therefore \frac{I_{max}}{I_{min}} = \frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2}$

$\therefore \frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{\frac{I_0}{4}} + \sqrt{\frac{3I_0}{8}}\right)^2}{\left(\sqrt{\frac{I_0}{4}} - \sqrt{\frac{3I_0}{8}}\right)^2}$

$= \frac{\left(\frac{1}{2} + \sqrt{\frac{3}{8}}\right)^2}{\left(\frac{1}{2} - \sqrt{\frac{3}{8}}\right)^2}$

563 **(d)**

$E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{21 \times 10^{-2}} = 0.94 \times 10^{-24}$
$= 10^{-24} J$

564 **(b)**

Contract between the bright and dark fringes will be reduced

565 **(b)**

For maxima $2\pi n = \frac{2\pi}{\lambda}(XO) - 2\pi l$

Or $\frac{2\pi}{\lambda}(XO) = 2\pi(n + l)$ or $(XO) = \lambda(n + l)$

566 **(c)**

Let the wavelength of monochromatic light in glass be $\lambda_g$cm and in water be $\lambda_w$cm.

$\therefore$ Number of waves in 8 cm of glass=$\frac{8}{\lambda_g}$, and

number of waves in 10 cm of glass = $\frac{8}{\lambda_w}$.

$\frac{8}{\lambda_g} = \frac{10}{\lambda_w}$ or $\frac{\lambda_w}{\lambda_g} = \frac{10}{8} = \frac{5}{4}$

Now, $\mu_g = \frac{c}{v_g}$ and $\mu_w = \frac{c}{v_w}$

$\therefore \frac{\mu_g}{\mu_w} = \frac{v_w}{v_g} = \frac{v\lambda_w}{v\lambda_g} = \frac{5}{4}$

$\mu_g = \frac{5}{4}\mu_w = \frac{5}{4} \times \frac{4}{3} = \frac{5}{3}$

567 **(a)**

We know that fringe width $\beta = \frac{D\lambda}{d}$

$\therefore x = \frac{L\lambda}{d} \Rightarrow \lambda = \frac{xd}{L}$

568 **(d)**

We know, $\lambda_m = \frac{a}{\mu}$ and $\mu = \tan\theta$

$\therefore \lambda_m = \frac{\lambda_a}{\tan\theta} = \lambda_a \cot\theta$

569 **(a)**

If magnitude of light vector varies periodically during it's rotation, the tip of vector traces an ellipse and light is said to be elliptically polarized. This does not happen prism

570 **(d)**

Angular position of first dark fringe

$\theta = \frac{\lambda}{d} = \frac{5460 \times 10^{-10}}{0.1 \times 10^{-3}} \times \frac{180}{\pi}$ (in degree)

$= 0.313°$

571 **(b)**

By using phase difference $\phi = \frac{2\pi}{\lambda}(\Delta)$

For path difference λ, phase difference $\phi_1 = 2\pi$ and for path difference $\lambda/4$, phase difference $\phi_2 = \pi/2$

Also by using $I = 4I_0 \cos^2\frac{\phi}{2} \Rightarrow \frac{I_1}{I_2} = \frac{\cos^2(\phi_1/2)}{\cos^2(\phi_2/2)}$

$\Rightarrow \frac{K}{I_2} = \frac{\cos^2(2\pi/2)}{\cos^2\left(\frac{\pi/2}{2}\right)} = \frac{1}{1/2} \Rightarrow I_2 = \frac{K}{2}$

572 **(b)**

$I_A = R_1^2$

$I_B = (R_1 - R_2)^2 = R_1^2\left(1 - \frac{R_2}{R_1}\right)^2 = R_1^2\left(1 - \frac{3}{4}\right)^2$

$= \frac{R_1^2}{16}$

$I_C = (R_1 - R_2 + R_3)^2 = R_1^2\left(1 - \frac{R_2}{R_1} + \frac{R_3}{R_1}\right)^2$

$= R_1^2\left(1 - \frac{R_2}{R_1} + \frac{R_3}{R_2} \times \frac{R_2}{R_1}\right)^2$

$= R_1^2\left(1 - \frac{3}{4} + \frac{3}{4} \times \frac{3}{4}\right)^2 = \left(\frac{13}{16}\right)^2 R_1^2 = \frac{169}{256}R_1^2$

$\therefore I_A : I_B : I_C = R_1^2 : \frac{R_1^2}{16} : \frac{169}{256}R_1^2 = 256 : 16 : 169$

573 **(c)**

In double refraction light rays always splits into two rays (O-ray & E-ray). O-ray has same velocity in all direction but E-ray has different velocity in different direction

For calcite $\mu_e < \mu_0 \Rightarrow v_e > v_0$

For quartz $\mu_e > \mu_0 \Rightarrow v_0 > v_e$

574 **(c)**

Path difference $= \frac{\lambda}{2\pi} \times$ phase difference

$= \frac{\lambda}{2\pi} \times 100\pi = 50\lambda$

576 **(b)**

The amplitudes of the waves are

$a_1 = 10\ \mu m, a_2 = 4\ \mu m$ and $a_3 = 7 \mu m$

and the phase difference between 1st and 2nd wave is $\frac{\pi}{2}$ and that between 2nd and 3rd is $\frac{\pi}{2}$. Therefore, phase difference between 1st and 3rd is π.

Combining 1st with 3rd, their resultant amplitude is given by

$A_1^2 = a_1^2 + a_3^2 + 2a_1a_3\cos\phi$

Or $A_1 = \sqrt{10^2 + 7^2 + 2 \times 10 \times 7\cos\pi} = \sqrt{100 + 49 - 140}$

$= \sqrt{9} = 3\mu m$ in the direction of first

Now combining this with 2nd wave we have, the resultant amplitude

$A^2 = A_1^2 + a_2^2 + 2A_1a_2\cos\frac{\pi}{2}$

Or $A = \sqrt{3^2 + 4^2 + 2 \times 3 \times 4\cos 90°} = \sqrt{9 + 16} = 5\mu m$

577 **(b)**

The intensity of plane polarised light is$=2a^2$.

$\therefore$ Intensity of polarised light from first nicol prism

$= \frac{I_0}{2} = \frac{1}{2} \times 2a^2 = a^2$

578 **(a)**

$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

$I_0 = I + I + I + 2I\cos 0° = 4I$

When one of the slits is closed, intensity on the same spot

$= I = I_0/4$

579 **(d)**

In the diffraction due to narrow slit, the first minimum on either side on the central maximum in the direction θ is given by

$e\sin\theta = \pm\lambda$

When slit is narrowed that is e is reduced, the angle θ increases which means that the central maximum becomes wider.

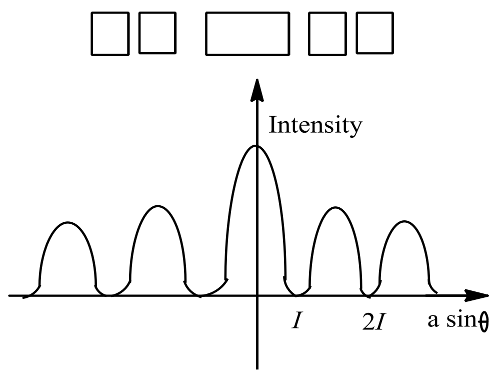
581 **(c)**

Speed of light of vacuum $c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$ and in another medium $v = \frac{1}{\sqrt{\mu\varepsilon}}$

$\therefore \frac{c}{v} = \sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}} = \sqrt{\mu_r K} \Rightarrow v = \frac{c}{\sqrt{\mu_r K}}$

582 **(c)**

For a slit of width a, light of wavelength λ, when light falls on the slit, the diffraction patterns so obtained as



Central diffraction maximum

The first diffraction minimum occurs at the angles given by

$\sin\theta = \frac{\lambda}{a}$

From the equation, it is clear that width of the central diffraction maximum is inversely proportional to the width of the slit. On increasing the width size$a$, the angle θ at which the intensity first becomes zero decreases, resulting in a narrower central band and if the slit width is made smaller, the angle θ increases, giving a wider central band.

583 **(a)**
A wave can transmit energy from one place to another

585 **(b)**

$$I_D = \varepsilon_0 \frac{d\phi_E}{dt} = \varepsilon_0 \frac{EA}{t} = \varepsilon_0 \left(\frac{V}{d}\right).\frac{A}{t}$$

$$= \frac{8.85 \times 10^{-12} \times 400 \times 60 \times 10^{-4}}{2 \times 10^{-3} \times 10^{-6}}$$

$$= 1.602 \times 10^{-2} amp$$

586 **(b)**
Shift in the fringe pattern $x = \frac{(\mu-1)t.D}{d}$

$$= \frac{(1.5-1) \times 2.5 \times 10^{-5} \times 100 \times 10^{-2}}{0.5 \times 10^{-3}} = 2.5\ cm$$

587 **(b)**
EM waves transport energy, momentum and information but not charge. EM waves are unchanged

589 **(b)**

$$\theta = a + \frac{b}{\lambda^2}$$

$30 = a + \frac{b}{(5000)^2}$ and $50 = a + \frac{b}{(4000)^2}$

Solving for a, we get $a = -\frac{50°}{9} per\ mm$

590 **(b)**
For dark fringe at P

$S_1P - S_2P = \Delta = (2n-1)\lambda/2$

Here $n = 3$ and $\lambda = 6000Å$

So, $\Delta = \frac{5\lambda}{2} = 5 \times \frac{6000Å}{2} = 15000Å = 1.5\ micron$

592 **(a)**

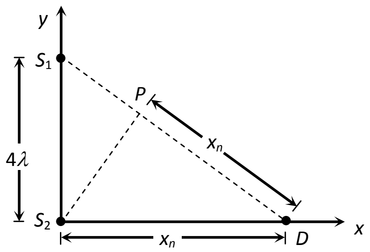
$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \frac{(401.8 - 393.3)}{393.3} = \frac{v}{3 \times 10^8}$$

$\Rightarrow v = 6.48 \times 10^6 m/s = 6480 km/s$

593 **(b)**
From ΔS_1S_2D,

$(S_1D)^2 = (S_1S_2)^2 + (S_2D)^2$

$(S_1P + PD)^2 = (S_1S_2)^2 + (S_2D)^2$



Here S_1P is the path difference $= n\lambda$ for maximum intensity

$\therefore (n\lambda + x_n)^2 = (4\lambda)^2 + (x_n)^2$

Or $x_n = \frac{16\lambda^2 - n^2\lambda^2}{2n\lambda}$

Then $x_1 = \frac{16\lambda^2 - \lambda^2}{2\lambda} = 7.5\lambda$

$$x_2 = \frac{16\lambda^2 - 4\lambda^2}{4\lambda} = 3\lambda$$

$$x_3 = \frac{16\lambda^2 - 9\lambda^2}{6\lambda} = \frac{7}{6}\lambda$$

$x_4 = 0$

∴ Number of points for maxima becomes 3

594 **(a)**
Specific rotation

$$(\alpha) = \frac{\theta}{lc} \Rightarrow c = \frac{\theta}{\alpha l} = \frac{0.4}{0.01 \times 0.25} = 160 kg/m^3$$

Now percentage purity of sugar solution

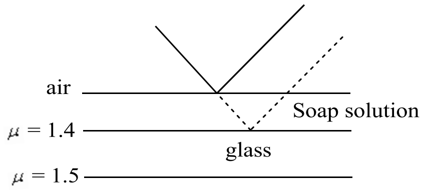
$$= \frac{160}{200} \times 100 = 80\%$$

596 **(d)**

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow v = \frac{\Delta\lambda}{\lambda}.c = \frac{5}{6563} \times (3 \times 10^8)$$

$$= 2.29 \times 10^5 m/sec$$

597 **(b)**
For reflection at the air-soap solution interface, the phase difference is π



For reflection at the interface of soap solution to glass also there will be a phase difference of π

∴ The condition for max. intensity $= 2\mu t = n\lambda$

For $n, n\lambda_1 = (n-1)\lambda_2$

$n\ 420nm = (n-1)630\ nm$

$n(630 - 420) = 630, \therefore n(210) = 630\ nm$

$$\therefore n = \frac{630}{210} = 3$$

This is the maximum order where they coincide

$$2 \times 1.4 \times t = 3 \times 420 \Rightarrow t = \frac{3 \times 420}{2 \times 1.40} = 450\ nm$$

598 **(a)**
The electromagnetic theory of light failed to explain photoelectric effect

599 **(c)**
β-rays are beams of fast electrons

600 **(a)**
According to Brewster's law, when a beam of ordinary light ($i.e.$, unpolarised) is reflected from a transparent medium (like glass), the reflected light is completely plane polarized at certain angle of incidence called the angle of polarization

601 **(b)**
Energy is conserved in the interference of light

602 **(b)**

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

$= \frac{\lambda}{d} = \frac{4800 \times 10^{-10}}{0.6 \times 10^{-3}} = 8 \times 10^{-4}$ rad

603 **(d)**

Given single slit of width $d = 0.1$ mm

$d = 0.1 \times 10^{-3}$ m

Or $d = 1 \times 10^{-4}$ m

Light of wavelength $a = 600$ Å

Or $\alpha = 6 \times 10^{-7}$ m

The angle of diffraction

$$\theta = \frac{n\lambda}{d}$$

$$\theta = \frac{2 \times 6 \times 10^{-7}}{1 \times 10^{-4}}$$

$\theta = 12 \times 10^{-3}$

$\theta = 0.012$ rad

605 **(c)**

Here $A^2 = a_1^2 + a_2^2 + 2a_1a_2 \cos\delta$

$\because a_1 = a_2 = a$

$$\therefore A^2 = 2a^2(1+\cos\delta) = 2a^2\left(1 + 2\cos^2\frac{\delta}{2} - 1\right)$$

$$\Rightarrow A^2 \propto \cos^2\frac{\delta}{2}$$

Now, $I \propto A^2 \;\; \therefore I \propto A^2 \propto \cos^2\frac{\delta}{2}$

$$\therefore I \propto \cos^2\frac{\delta}{2}$$

606 **(d)**

Let $A_1 = A_0$, Then $A_2 = 2A_0$

Intensity $I \propto A^2$

Hence $I_1 = I_0, I_2 = 4I_0$

We have $I = I_0 + 4I_0 + 2\sqrt{I_0 \times 4I_0}\cos\phi$

For $I_{\max}$, $\cos\phi = 1$

Hence $I_m = 9I_0$ or $I_0 = \frac{I_m}{9}$

When phase difference is ϕ then

$$I = I_0 + 4I_0 + 2\sqrt{4I_0^2}\cos\phi$$

$$= I_0 + 4I_0(1+\cos\phi)$$

$$= I_0\left(1 + 8\cos^2\frac{\phi}{2}\right) \quad \left[\because 1+\cos\phi = 2\cos^2\frac{\phi}{2}\right]$$

$$= \frac{I_m}{9}(1 + 8\cos^2\phi/2)$$

607 **(a)**

When two plane-polarised waves are superimposed, then under certain conditions, the resultant light vector rotates with a constant magnitude in a plane perpendicular to the direction of propagation. The tip of the vector traces a circle and the light is said to be circularly polarized.

To form circularly polarized light

$$E_x = E_0 \sin\omega t$$

$$E_y = E_0 \cos\omega t = E_0 \sin\left(\omega t + \frac{\pi}{2}\right)$$

Where, E_0 is amplitude.

Resultant amplitude

$$|\mathbf{E}|^2 = E_0^2 + E_0^2 + 2E_0 . E_0 \cos\frac{\pi}{2}$$

$$|\mathbf{E}| = E_0\sqrt{2} = \text{constant}$$

Hence, the correct graph will be option (a).

608 **(a)**

$$\beta = \frac{\lambda D}{d} = \frac{\lambda}{d/D} = \frac{\lambda}{\theta}$$

609 **(c)**

Photoelectric effect does not support the wave theory of light.

610 **(c)**

For the first minima $d\sin\theta = \lambda$

$$\Rightarrow \sin\theta = \frac{\lambda}{d} \Rightarrow \theta = \sin^{-1}\left(\frac{5000 \times 10^{-10}}{0.001 \times 10^{-3}}\right) = 30°$$

611 **(c)**

In Huygen's wave theory, the locus of all points in the same state of vibration is called a wavefront.

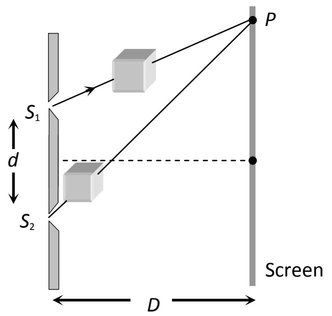
613 **(a)**

$\beta = \frac{\lambda.D}{d}$ where D = distance of screen from wire,

d = diameter of wire

614 **(a)**

Shift $\Delta x = \frac{\beta}{\lambda}(\mu - 1)t$



Shift due to one plate $\Delta x_1 = \frac{\beta}{\lambda}(\mu_1 - 1)t$

Shift due to another path $\Delta x_2 = \frac{\beta}{\lambda}(\mu_2 - 1)t$

Net shift $\Delta x = \Delta x_2 - \Delta x_1 = \frac{\beta}{\lambda}(\mu_2 - \mu_1)t$ ... (i)

Also it is given that $\Delta x = 5\beta$ ....(ii)

Hence $5\beta = \frac{\beta}{\lambda}(\mu_1 - \mu_2)t$

$$\Rightarrow t = \frac{5\lambda}{(\mu_2 - \mu_1)} = \frac{5 \times 4800 \times 10^{-10}}{(1.7 - 1.4)}$$
$$= 8 \times 10^{-6} m = 8 \mu m$$

615 **(b)**

$$\lambda = \frac{c}{v} = \frac{3 \times 10^8}{100} = 3 \times 10^6 m$$

616 **(c)**

If I_0 is intensity of unpolarized light,

Then from 1st nicol, $I_1 = \frac{I_0}{2}$

From 2nd nicol, $I_2 = I_1 \cos^2(90° - 60°)$

$$= \frac{I_0}{2}\left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3}{8} I_0$$

$$= \frac{I_2}{I_0} = 37.5\%$$

617 **(d)**

$$\Delta\lambda = \frac{v}{c}\lambda = \frac{3600 \times 10^3}{3 \times 10^8} \times 5896 = 70.75 \text{Å}$$

So the increased wavelength of light is observed

618 **(b)**

When a Young's double slit set up for interference is shifted from air to within water then the fringe width decreases.

619 **(b)**

$\beta \propto \lambda$, and $\lambda \propto \frac{1}{\mu}$ [β decreases]

620 **(c)**

Two beams having the same wavelength, monochromatic or white radiation, having the same initial phase (coherent sources), can give interference pattern by superposition. But when their vibrations are perpendicular to each other, interference will not be possible

621 **(d)**

A grating which would be most suitable for construction a spectrometer for the visible and ultraviolet region should have 1000000 lines cm^{-1}.

622 **(b)**

Given, $d = 0.28$ mm $= 0.28 \times 10^{-3}$m,

$D = 1.4$ m,

$\beta = 0.9$ cm $= 0.9 \times 10^{-2}$ m

$$\beta = 3\frac{D\lambda}{d}$$

Or $\lambda = \frac{\beta d}{3D}$

Or $\lambda = \frac{0.9 \times 10^{-2} \times 0.28 \times 10^{-3}}{3 \times 1.4}$

Or $\lambda = 6 \times 10^{-7}$ m $= 6000$ Å

623 **(a)**

If the surface absorbs all the incident energy then the total momentum delivered to the surface is

$p = \frac{U}{c}$ (for complete absorption)

If the surface is a perfect reflector, then the total momentum delivered to the surface is

$P = \frac{2U}{c}$ (for complete reflection)

624 **(c)**

Light appears to travel along straight lines because its wavelength is very small.

625 **(b)**

$\lambda_{\text{Blue}} < \lambda_{\text{Red}}$. Therefore fringe pattern will contract because fringe width $\propto \lambda$

626 **(a)**

$a \sin\theta = n\lambda$

$$\frac{ax}{f} = 3\lambda \text{ or } \lambda = \frac{ax}{3f} = \frac{0.3 \times 10^{-3} \times 5 \times 10^{-3}}{3 \times 1}$$

$= 5 \times 10^7$ m $= 5000$ Å

627 **(c)**

When the arrangement is dipped in water,

$$\beta' = \frac{\beta}{\mu} = \frac{x}{4/3} = \frac{3}{4}x = 0.75x$$

628 **(d)**

The refractive index of air is slightly more than 1. When chamber is evacuated, refractive index decreases and hence the wavelength increases and fringe width also increases

630 **(d)**

Here, $\frac{I_1}{I_2} = \frac{16}{9}$

Since, intensity $\propto$ (amplitude)^2

$$\therefore \frac{I_1}{I_2} = \left(\frac{A_1}{A_2}\right)^2 = \frac{16}{9}$$

Or $\frac{A_1}{A_2} = \sqrt{\frac{16}{9}} = \frac{4}{3}$

$$\frac{I_{\text{max}}}{I_{\text{min}}} = \frac{(A_1 + A_2)^2}{(A_1 - A_2)^2} = \frac{\left(\frac{A_1}{A_2} + 1\right)^2}{\left(\frac{A_1}{A_2} - 1\right)^2}$$

$$= \frac{\left(\frac{4}{3} + 1\right)^2}{\left(\frac{4}{3} - 1\right)^2} = \frac{49}{1}$$

631 **(c)**

Path difference at point $P = \frac{xd}{D}$

Phase difference at point $P = \frac{2\pi}{\lambda}\frac{xd}{D} = \frac{2\pi x}{\beta}$

$I_0 = 4I_1$, intensity at point P

$I = I_1 + I_1 + 2I_1 \cos\frac{2\pi x}{\beta} = 2I_1\left[1 + \cos\frac{2\pi x}{\beta}\right]$

$= I_0 \cos^2\frac{\pi x}{\beta}$

632 **(a)**

$I = I_0 \cos^2 \theta$

Intensity of polarized light $= \frac{I_0}{2}$

$\therefore$ Intensity of untransmitted light $= I_0 - \frac{I_0}{2} = \frac{I_0}{2}$

633 **(b)**

Optical path for 1st ray$=n_1L_1$

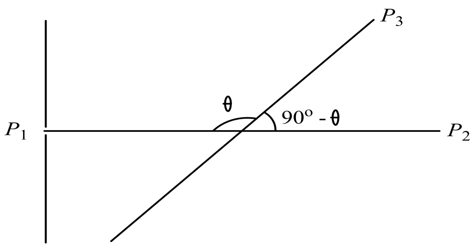
Optical path for 2nd ray$= n_2L_2$

$\therefore$Phase difference, $\phi = \frac{2\pi}{\lambda}\Delta x$

$= \frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$

634 **(a)**

Let initial intensity of light is I_0. So intensity of light after transmission from first Polaroid $= \frac{I_0}{2}$.



Intensity of light emitted from P_3

$I_1 = \frac{I_0}{2}\cos^2\theta$

Intensity of light transmitted from last Polaroid

$P_2 = I_1\, cos^2(90° - \theta)$

$P_2 = \frac{I_0}{2}\cos^2\theta\sin^2\theta$

$P_2 = \frac{I_0}{8}(2\sin\theta\cos\theta)^2$

$P_2 = \frac{I_0}{8}\sin^2 2\,\theta$

635 **(a)**

As $\beta = \frac{D\lambda}{d} \Rightarrow \frac{\beta_1}{\beta_2} = \left(\frac{D_1}{D_2}\right)\left(\frac{\lambda_1}{\lambda_2}\right)\left(\frac{d_2}{d_1}\right)$

$\Rightarrow 1 = \left(\frac{D_1}{D_2}\right)\times\left(\frac{1}{2}\right)\times\left(\frac{1}{2}\right) \Rightarrow \frac{D_1}{D_2} = \frac{4}{1}$

636 **(c)**

When the source and observer approach each other, apparent frequency increases and hence wavelength decreases

637 **(a)**

Here $E_0 = 100\ V/m, B_0 = 0.265\ A/m$

$\therefore$ Maximum rate of energy flow $S = \frac{E_0 \times B_0}{\mu_0}$

$= 100 \times 0.265 = 26.5\ W/m^2$

638 **(b)**

$\beta = \frac{\lambda D}{d} = \frac{6000 \times 10^{-10} \times 2}{4 \times 10^{-3}} = 3 \times 10^{-4} m$

$= 0.3\ mm$

639 **(c)**

$3\lambda_1 = 4\lambda_2$

$\Rightarrow \quad \lambda_2 = \frac{3}{4}\lambda_1 = \frac{3}{4} \times 590 = \frac{1770}{4} = 442.5\text{ nm}$

640 **(d)**

The phase difference (ϕ) between the wavelets from the top edge and the bottom edge of the slit is $\phi = \frac{2\pi}{\lambda}(d\sin\theta)$ where d is the slit width. The first minima of the diffraction pattern occurs at $\sin\theta = \frac{\lambda}{d}$ so $\phi = \frac{2\pi}{\lambda}\left(d \times \frac{\lambda}{d}\right) = 2\pi$

641 **(b)**

For maxima $\Delta = d\sin\theta = n\lambda$

$\Rightarrow 2\lambda\sin\theta = n\lambda \Rightarrow \sin\theta = \frac{n}{2}$

Since value of $\sin\theta$ can not be greater 1

$\therefore n = 0, 1, 2$

Therefore only five maximas can be obtained on both side of the screen

643 **(b)**

For principal maxima in grating spectra

$\frac{\sin\theta}{N} = n\lambda$

Where, $n = (1, 2, 3)$ is the order of principal maxima and θ is the angle of diffraction.

$n = \frac{1}{\lambda N} = \frac{1}{6.25 \times 10^{-7} \times 2 \times 10^5} = 8$

$\therefore$ Number of maxima $= 2n + 1 = 2 \times 8 + 1 = 17$

644 **(c)**

Monochromatic wave means of single wavelength not the single colour

645 **(c)**

The locus of all particles in a medium vibrating in the same phase is called wave front

646 **(b)**

$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} = \frac{6 \times 10^7}{3 \times 10^8} = 0.2$

$\Delta\lambda = \lambda' - \lambda = 0.2\lambda \Rightarrow \lambda' = 1.2\lambda = 1.2 \times 4600$
$= 5520\text{Å}$

647 **(b)**
All components of electromagnetic spectrum travel in vacuum with velocity $3 \times 10^8\ m/s$

649 **(b)**
Visibility $V = \frac{I_{\max}-I_{\min}}{I_{\max}+I_{\min}} = \frac{2\sqrt{I_1 I_2}}{(I_1+I_2)}$

$= \frac{2\sqrt{I_1/I_2}}{\left(\frac{I_1}{I_2}+1\right)} = \frac{2\sqrt{P}}{(P+1)}$

650 **(a)**
When the plane-polarised light passes through certain substance, the plane of polarization of the light is rotated about the direction of propagation of light through a certain angle

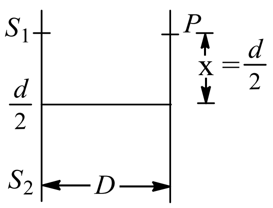
651 **(b)**
As $\beta = \frac{\lambda D}{d}$

$\therefore\ \beta \propto 1/d$

652 **(c)**
According to the Maxwell's EM theory, the EM waves propagation contains electric and magnetic field vibration in mutually perpendicular direction. Thus the changing of electric field give rise to magnetic field

653 **(d)**
For dark fringe,

$$\frac{xd}{D} = (2m-1)\frac{\lambda}{2}$$



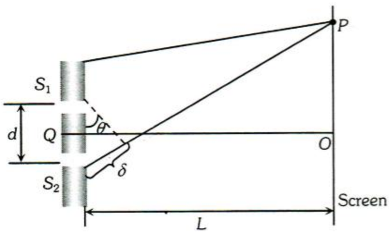
Here, $m = 5, x = \frac{d}{2}$

$$\therefore\ \frac{d}{2}.\frac{d}{D} = (2 \times 5 - 1)\frac{\lambda}{2}$$

Or $\frac{d^2}{D} = 9\lambda$

$$\therefore\quad \lambda = \frac{d^2}{9D}$$

654 **(a)**



The condition for bright fringes is,
Path difference, $\delta = d \sin\theta_{\text{bright}} = N\lambda$
Where, $N = 0, \pm 1, \pm 2$
The angular position of the bright fringes is
$\theta_{\text{bright}} = \sin^{-1}\left(\frac{N\lambda}{d}\right)$

655 **(c)**
For destructive interference, path difference= $\frac{\lambda}{2}$.

Therefore, phase difference= $\frac{2\pi}{\lambda}.\frac{\lambda}{2} = \pi$ radian=180°.

656 **(c)**
For 2π phase difference → Path difference is λ
∴ For ϕ phase difference → Path difference is $\frac{\lambda}{2\pi} \times \phi$

658 **(a)**
For secondary maxima $d \sin\theta = \frac{5\lambda}{2}$

$$\Rightarrow d\theta = d.\frac{x}{D(\approx f)} = \frac{5\lambda}{2}$$

$$\Rightarrow 2x = \frac{5\lambda f}{d} = \frac{5 \times 0.8 \times 6 \times 10^{-7}}{4 \times 10^{-4}} = 6 \times 10^{-3} m$$
$$= 6mm$$

659 **(c)**
Suppose slit width's are equal, so they produces waves of equal intensity say I'. Resultant intensity at any point $I_R = 4I' \cos^2\phi$ where ϕ is the phase difference between the waves at the point of observation
For maximum intensity $\phi = 0° \Rightarrow I_{\max} = 4I' = I$ ...(i)
If one of slit is closed. Resultant intensity at the same point will be I' only, $i.e., I' = I_O$ ...(ii)
Comparing equations (i) and (ii) we get
$I = 4I_O$

660 **(c)**
$\beta \propto \lambda$

661 **(c)**
$$\beta = \frac{\lambda D}{d} = \frac{500 \times 10^{-10} \times 1}{0.1 \times 10^{-3}} m = 5 \times 10^{-3} m$$
$$= 0.5\ cm$$

662 **(b)**
With reference to this theory the velocity of the observer is neglected $w.r.t.$ the light velocity

663 **(c)**

$\beta = \frac{\lambda D}{d} = \frac{5 \times 10^{-7} \times 2}{10^{-3}} m = 10^{-3} m = 1.0\, mm$

664 **(c)**

$y_1 = 4 \sin \omega t$

$y_2 = 3 \sin(\omega t + \pi/3)$

Here, $a = 4, b = 3, \phi = \pi/3$

$R = \sqrt{a^2 + b^2 + 2ab \cos \phi}$

$= \sqrt{4^2 + 3^2 + 2 \times 4 \times 3 \cos \pi/3}$

$= \sqrt{37} = 6$

665 **(d)**

If a third slit is made between the double slits, then contrast between bright and dark fringes is reduced.

668 **(b)**

Velocity of EM waves $= \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3 \times 10^8 m/s =$ velocity of light

669 **(a)**

Position of n^th^ minima $x_n = \frac{n\lambda D}{d}$

$\Rightarrow 5 \times 10^{-3} = \frac{1 \times 5000 \times 10^{-10} \times 1}{d}$

$\Rightarrow d = 10^{-4} m = 0.1\, mm$

670 **(c)**

For viewing interference in oil films or soap bubble, thickness of film is of the order of wavelength of light

671 **(d)**

Intensity $\propto \frac{1}{(\text{Distance})^2}$

672 **(a)**

Distance between the fringe=fringe width

$x = \beta = \frac{\lambda D}{d} = \frac{6 \times 10^{-7} \times 2}{0.05 \times 10^{-2}}$

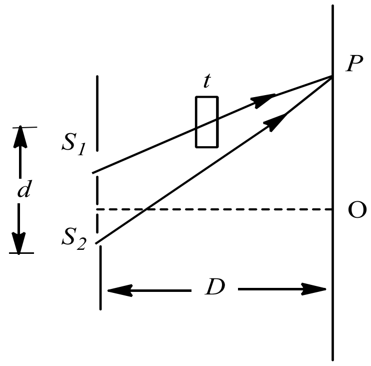
$= 24 \times 10^{-4}$ m $= 0.24$ cm

673 **(b)**

Diffraction refers to various phenomenon associated with wave propagation, such as bending spreading and interference of waves emerging from aperture. While diffraction always occurs its effects are generally only noticeable for waves where the wavelength is of the order of the feature size of the diffraction objects or apertures.

674 **(a)**

When a mica sheet is introduced in the path of one of the two interfering beams, then entire fringe pattern is displaced towards the beam is the path of which plate is introduce, but fringe width is not changed.



$x_0 = \frac{D}{d}(\mu - 1)t \quad \ldots (i)$

Also fringe width is

$W = \frac{D\lambda}{d}$

$\therefore \frac{W}{\lambda} = \frac{D}{d} \quad \ldots (ii)$

Using Eq. (ii) we get Eq. (i) as

$x_0 = \frac{W}{\lambda}(\mu - 1)t$

Given, $x_0 = 1.89 \times 10^{-3}$m, $W = 0.431 \times 10^{-3}$m,

$\mu = 1.59, \quad \lambda = 5.89 \times 10^{-7}$m.

$1.89 \times 10^{-3} = \frac{0.431 \times 10^{-3}}{5.89 \times 10^{-7}}(1.59 - 1)t$

$\Rightarrow \quad t = \frac{5.89 \times 10^{-7} \times 1.89 \times 10^{-3}}{0.431 \times 0.59 \times 10^{-3}}$

$\Rightarrow \quad t = 4.38 \times 10^{-6}$m

675 **(d)**

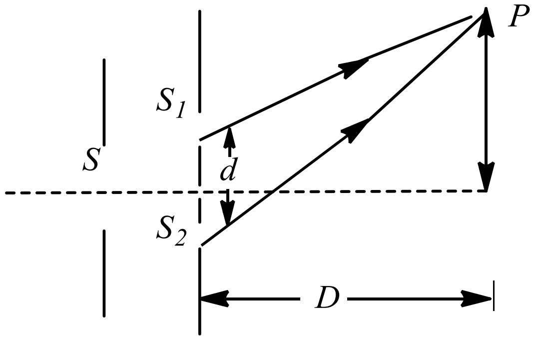
$E_0 = 66 V m^{-1}$

$B_0 = \frac{E_0}{C} = \frac{66}{3 \times 10^8} = 2.2 \times 10^{-7} T$

Since electromagnetic wave is of transverse nature. Hence if electric field is along y-axis, then magnetic field must be in z-axis. Since propagation is x-axis. Hence correct option is (d)

676 **(c)**

Let S be a slit illuminated by monochromatic light of wavelength(λ), let S_1, S_2 be coherent sources and distance between them be d and distance between source and screen is D. then, fringe width (W) is given by



$$W = \frac{D\lambda}{d}$$

When, $d_2 = \frac{d}{2}, D_2 = 2D$

$$\therefore W_2 = \frac{(2D)\lambda}{d/2} = 4\frac{D\lambda}{d} = 4W$$

The fringe width is quadrupled.

677 **(a)**

$$\beta = \frac{\lambda D}{d}$$
$$\Rightarrow \beta \propto D$$
$$\Rightarrow \frac{\beta_1}{\beta_2} = \frac{D_1}{D_2}$$
$$\Rightarrow \frac{\beta_1 - \beta_2}{\beta_2} = \frac{D_1 - D_2}{D_2}$$
$$\Rightarrow \frac{\Delta\beta}{\Delta D} = \frac{\beta_2}{D_2} = \frac{\lambda_2}{d_2}$$
$$\Rightarrow \lambda_2 = \frac{3 \times 10^{-5}}{5 \times 10^{-2}} \times 10^{-3}$$
$$= 6 \times 10^{-7}\text{m} = 6000\text{Å}$$

678 **(b)**

$A = n\pi d\lambda \Rightarrow nd = \frac{A}{\pi\lambda} = \text{constant}$

$\Rightarrow n \propto \frac{1}{d}$ (n = number of blocked HPZ) on decreasing d, n increases, hence intensity decreases

680 **(d)**

$\mu m = \tan\theta_p \Rightarrow \theta_p = \tan^{-1} n$

681 **(b)**

$$I = \frac{P}{4\pi r^2} \propto A^2 \Rightarrow A \propto \frac{1}{r}$$

682 **(a)**

$$I = 4I_0 \cos^2\frac{\phi}{2}$$

At central position $I_1 = 4I_0$ ...(i)

Since the phase difference between two successive fringes is 2π, the phase difference between two points separated by a distance equal to one quarter of the distance between the two, successive fringes is equal to

$\delta = (2\pi)\left(\frac{1}{4}\right) = \frac{\pi}{2}$ radian

$\Rightarrow I_2 = 4I_0 \cos^2\left(\frac{\frac{\pi}{2}}{2}\right) = 2I_0$ ...(ii)

Using (i) and (ii), $\frac{I_1}{I_2} = \frac{4I_0}{2I_0} = 2$

683 **(a)**

Distance between the slits,

$$d = \sqrt{d_1 d_2} = \sqrt{4.05 \times 10^{-3} \times 2.90 \times 10^{-3}}$$

$$= 3.427 \times 10^{-3}\text{m}$$

684 **(b)**

For first diffraction minimum

$$a \sin\theta = \lambda$$

$$\Rightarrow a = \frac{\lambda}{\sin\theta}$$

For first secondary maximum

$$a \sin\theta' = \frac{3\lambda}{2}$$

Or $\sin\theta' = \frac{3\lambda}{2} \times \frac{1}{a} = \frac{36\lambda}{2} \times \frac{\sin\theta}{\lambda}$

$$= \frac{3}{2} \times \sin 30° = \frac{3}{4}$$

Or $\theta' = \sin^{-1}\left(\frac{3}{4}\right)$

685 **(a)**

$\theta = \frac{\lambda}{d}$; θ can be increased by increasing λ, so here λ has to be increased by 10%

$i.e.$, % Increase $= \frac{10}{100} \times 5890 = 589\text{Å}$

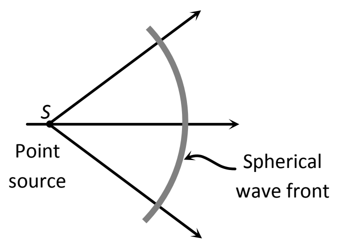
686 **(b)**

Wave theory of light was first proposed by Christiar. Huygens.

687 **(b)**

Ultrasonic waves cannot be polarized.

688 **(b)**



691 **(a)**

From $x = n\lambda\frac{D}{d}$

$$d_1 = 7\lambda_1\frac{D}{d}$$

$$d_2 = 7\lambda_2\frac{D}{d}$$

$$\therefore \frac{d_1}{d_2} = \frac{\lambda_1}{\lambda_2}$$

692 **(c)**
As velocity (or momentum) of electron is increased, the wavelength $\left(\lambda = \frac{h}{p}\right)$ will decrease. Hence, fringe width will decrease $(\omega \propto \lambda)$

694 **(a)**
To see the diffraction pattern, wavelength of radiation must be of the order of the dimensions of the slit. But here slit width 0.6 mm is very much large in comparison to wavelength of X-ray $\left(\lambda = 1\text{ Å or } 10^{-7}\text{mm}\right)$. Therefore no diffraction pattern is observed.

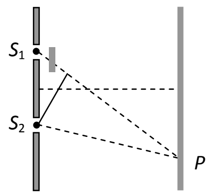
695 **(c)**
Slit width ratio $= 4:9$; hence $I_1 : I_2 = 4:9$

$$\therefore \frac{a_1^2}{a_2^2} = \frac{4}{9} \Rightarrow \frac{a_1}{a_2} = \frac{2}{3}$$

$$\therefore \frac{I_{\max}}{I_{\min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \frac{25}{1}$$

697 **(c)**
It is caused due to turning of light around corners

698 **(b)**
Path difference at $P\Delta = (S_1P + (\mu - 1)t) - S_2P$
$= (S_1P - S_2P) + (\mu - 1)t$



699 **(a)**
In the normal adjustment of Young's double slit experiment, path difference between the waves at central location is always zero, so maxima is obtained at central position

700 **(a)**
At a point of maxima

$$\therefore\ I_{\max} = 4I_0 = 4\text{ Wm}^{-2}$$

$$\therefore I_0 = 1\text{ Wm}^{-2}$$

701 **(a)**
As we know

$\beta = \frac{D}{d}\lambda$ ....(i)

And $\lambda \propto \frac{1}{\mu}$ ....(ii)

From Eqs. (i) and (ii),

$$\beta \propto \lambda \propto \frac{1}{\mu}$$

$$\therefore\ \beta \propto \frac{1}{\mu}$$

The refractive index of water is greater than air, therefore fringe width will decrease.

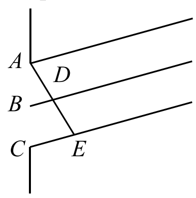
702 **(d)**
$I = a_1^2 + a_2^2 + 2a_1a_2\cos\phi$
Put $a_1^2 + a_2^2 = A$ and $a_1a_2 = B$; $\therefore I = A + B\cos\phi$

703 **(b)**
In interference energy is redistribution

704 **(c)**
Newton considered light as made up of particle called corpuscles. The corpuscles of light were assumed to be almost point like particles without any mass. They travel with a tremendously high speed, so they experience a negligible force of gravity. As a result, the corpuscles travel in a straight line.

705 **(c)**
In interference of light the energy is transferred from the region of destructive interference to the region of constructive interference. The average energy being always equal to the sum of the energies of the interfering waves. Thus the phenomenon of interference is in complete agreement with the law of conservation of energy

706 **(d)**
To have the first minimum, the path difference between the waves from A and $B = BD = \frac{a}{2}.\sin\theta = \frac{\lambda}{2}$. The path difference between the waves from A and C at the same point should be λ or phase difference is 2π



707 **(d)**
Let I_0 be the intensity of incident light

Then the intensity of light from the 1st polaroid is

$$I_1 = \frac{I_0}{2}$$

Intensity of light from the 2nd polaroid is

$$I_2 = I_1 \cos^2 60° = \frac{I_0}{2}\left(\frac{1}{2}\right)^2 = \frac{I_0}{8}$$

Intensity of light from the 3rd polaroid is

$$I_3 = I_2 \cos^2 60° = \frac{I_0}{8}\left(\frac{1}{2}\right)^2 = \frac{I_0}{32}$$

Intensity of light from the 4th polaroid is

$$I_4 = I_3 \cos^2 60° = \frac{I_0}{32}\left(\frac{1}{2}\right)^2 = \frac{I_0}{128}$$

Intensity of light from the 5th polaroid is

$$I_5 = I_4 \cos^2 60° = \frac{I_0}{128}\left(\frac{1}{2}\right)^2 = \frac{I_0}{512}$$

Therefore, the fraction of the incident light that passes through the system is

$$\frac{I_5}{I_0} = \frac{1}{512}$$

708 **(a)**

The direction of EM wave is given by the direction of $\vec{E} \times \vec{B}$

709 **(a)**

For constructive interference

Path difference $\Delta = d \sin \theta = n\lambda$

$$\Rightarrow \quad \theta = \sin^{-1}\left[\frac{n\lambda}{d}\right]$$

710 **(c)**

Intensity of light from $C_2 = I_0$

On rotating through 60°,

$I = I_0 \cos^2 60°$ (law of Malus)

$$= I_0\left(\frac{1}{2}\right)^2 = I_0/4$$

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