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**TEST ID: 53**
**PHYSICS**

1.WAVE THEORY OF LIGHT,7.WAVE OPTICS

**Single Correct Answer Type**

1. The phenomenon of bouncing back of the light energy from the surface of the mirror is
   a) reflection b) refraction
   c) diffraction d) interference
2. The ratio if intensities of two wave producing interference is 9:4, then the ratio of the resultant maximum and minimum intensities will be $\left(\cos\frac{\pi}{3} = \frac{1}{2}\right)$
   a) 25:1 b) 5:1
   c) 9:4 d) 4:9
3. In diffraction experiment, from a single slit, the angular width of the central maxima does NOT depend upon
   a) Wavelength of light used b) Ratio of wavelength and slit width
   c) Distance of the slit from the screen d) Width of the slit
4. On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygen's principle leads us to conclude that as it travels, the light beam
   a) Becomes narrower
   b) Goes horizontally without any deflection
   c) Bends downwards
   d) Bends upwards
5. According to Huygen's principle, every point on a wavefront acts as
   a) a primary source b) a secondary source
   c) a stationary source d) none of these
6. Light enters from air into a medium of refractive index 1.5. Percentage change in its wavelength is
   a) 66.66% b) 50% c) 33.33% d) 25%
7. The intensity at a point is $\left(\frac{1}{4}\right)$th of the maximum intensity in Young's double slit experiment. The angular position at this point is
   $\left(\sin\frac{\pi}{3} = \cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}, \sin\frac{\pi}{6} = \cos\frac{\pi}{3} = \frac{1}{2}\right)$
   a) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ b) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$
   c) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$ d) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$
8. One cannot see through fog because
   a) fog absorbs light
   b) light is scattered by the droplets in fog
   c) light suffers total reflection at the droplets in fog
   d) the refractive index of fog is infinity
9. The ratio of velocities of light in glass to that in water is (refractive index of glass = 1.5 and refractive index of water = 1.33)
   a) 0.8803 : 1 b) 0.8989 : 1
   c) 0.8867 : 1 d) 0.8504 : 1
10. The angle between the original direction of incident ray and reflected ray is
    a) angle of deviation due to reflection
    b) angle of emergence
    c) angle of reflection
    d) angle of refraction
11. A star producing light of wavelength 6000 Å moves away from the earth with a speed of 5 km/s. Due to Doppler effect, the shift in wavelength will be ($c = 3 \times 10^8$ m/s)
    a) 0.1 Å b) 0.05 Å c) 0.2 Å d) 1 Å
12. In case of refraction of light for normal incidence, their is no deviation because
    a) $i = 90°$ then $r = 0$ b) $i = 0$ then $r = 0$
    c) $i = 0$ then $r = 90$ d) none of these
13. Nicol prism is based on the principle of
    a) refraction b) dichroism
    c) scattering d) double refraction
14. When two coherent sources in Young's experiment are far apart, then interference pattern
    a) Is not detected b) Is completely dark
    c) Consists of widely separated bright fringes d) Will be sharp and clear
15. 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

16. Light is incident at an angle I on a glass slab. The reflected ray is completely polarized. The angle of refraction is

a) $90 - i$ b) $180 - i$ c) $90 + i$ d) i

17. In a plane polarised electromagnetic wave, the angle between the planes of vibration and polarisation is

a) 0° b) 30° c) 60° d) 90°

18. If the ratio of amplitude of wave is 2: 1, then the ratio of maximum and minimum intensity is

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

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

a) wider b) narrower
c) brighter d) fainter

20. Huygen's construction is used to determine the position of new

a) spherical wavefront b) plane wavefront
c) cylindrical wavefront d) all of these

21. With what speed should a galaxy move with respect to us so that a certain line at 674 nm is observed at 674.4 nm?

a) 342 $kms^1$ b) 471 $kms^{-1}$
c) 532 $kms^{-1}$ d) 640 $kms^{-1}$

22. The amplitude and frequency of two waves is same, which are from two different sources, overlap at a point. The ratio of intensity when two waves arrive $\left(\frac{\pi}{2}\right)$ out of phase to when they arrive in phase is ($\cos 0^0 = 1, \cos 90^0 = 0$)

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

23. A monochromatic light of wavelength 'λ' is incident on plane reflecting surface. After reflection its wavelength will be

a) Doubled b) reduced to half
c) Same d) quadrupled

24. According to wave theory of light, velocity of light in rarer medium is

a) equal to velocity of light in denser
b) less than velocity of light in denser
c) greater than velocity of light in denser
d) cannot predicated

25. The expression relating pol arising angle and refractive index is

a) $\mu \sin P = 1$ b) $\mu \cot P = 1$
c) $\mu \tan P = 1$ d) $\mu \cos P = 1$

26. In an isotropic medium,

a) Speed of light changes
b) Speed of light remains constant
c) Direction of propagation of light changes
d) Wavelength of light changes

27. The wavelength of the light used in Young's double slit experiment is $\lambda$. 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

28. $V_d$ and $V_r$ be the velocities of light, Huygen assumed that:

a) $V_d > V_r$ b) $V_d < V_r$ c) $V_d = V_r$ d) $V_d \leq v_r$

29. In which of the following cases do we obtain a spherical wavefront?

a) Sunlight focused by a convex lens
b) Light diverging from a straight slit
c) Light of the sun reaching the earth
d) A parallel beam of light reflected from a plane mirror.

30. In plane polarised light the plane of vibration and plane of polarisation are:

a) inclined at 45° b) inclined at 90°
c) inclined at 60° d) inclined at 0°

31. A glass slab of thickness 4 cm contains the same number of waves as X cm of water column when both are transversed by the same monochromatic light. If the refractive indices of glass and water (for that light) are 5/3 and 4/3 respectively, the value of X will be

a) 9/20 cm b) 20/9 cm c) 5/4 cm d) 5 cm

32. When a light wave travels from water to glass, its

a) Wavelength increases
b) Wavelength decreases
c) Frequency increases
d) Velocity increases

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

a) 2.5 b) 3.3

c) 1.5    d) 3.0

34. Refractive index of a medium depends on
a) nature of pair of medium
b) wave length or speed of light
c) temperature
d) all of these

35. The spectral line emitted by a star, has a wavelength of 6800 Å when observed from a lab appears to have a wavelength 6820 Å. Speed of star in the line of light relative to earth for receding or approach is given by
a) $2.42 \times 10^5\ ms^{-1}$ receding
b) $4.64 \times 10^6\ ms^{-1}$ receding
c) $6.86 \times 10^6\ ms^{-1}$ approach
d) $8.79 \times 10^5\ ms^{-1}$ receding

36. In Young's double slit experiment, the two slits are 'd' distance apart. Interference pattern is observed on the screen at a distance 'D' from the slits. First dark fringe is observed on the screen directly opposite to one of the slits. The wavelength of the light is
a) $\frac{D^2}{2d}$    b) $\frac{D^2}{d}$
c) $\frac{d^2}{2D}$    d) $\frac{d^2}{D}$

37. Which of the following is used to improve the colour contrast in old paintings?
a) Polaroids    b) Nicol prism
c) Rectifier    d) Polarometer

38. A ray of light travels normally through a glass plate of thickness x and refractive index, $\mu$. If v is velocity of light in rarer medium then the time taken by it to travel thickness of glass plate is
a) $x\ \mu\ v$    b) $x\ v / \mu$    c) $x / \mu v$    d) $\mu x / v$

39. In an interference experiment, the phase difference between the waves reaching a dark point is
a) $2\pi^c$    b) $\pi^c$
c) Zero    d) $\left(\frac{3\pi}{2}\right)^c$

40. In double slit experiment, the angular width of the fringes is 0.20° for the sodium light ($\lambda =$ 5890Å). In order to increase the angular width of the fringes by 10%, the necessary change in wavelength is
a) zero    b) increased by 6479Å
c) decreased by 589Å    d) increased by 589Å

41. In bi-prism experiment, if $5^{th}$ bright band with wavelength '$\lambda_1$' coincides with $6^{th}$ dark band with wavelength '$\lambda_2$' then the ratio $\left(\frac{\lambda_2}{\lambda_1}\right)$ is
a) $\frac{9}{7}$    b) $\frac{11}{10}$
c) $\frac{7}{9}$    d) $\frac{10}{11}$

42. In Young's double slit experiment, green light is incident on the two slits. The interference pattern is observed on a screen. Which one of the following changes would cause the observed fringes to be more closely spaced?
a) Using red light instead of green light
b) Moving the screen away from the slits
c) Reducing the separation between the slits
d) Using blue light instead of green light

43. In a bi-prism experiment, red light of wavelength 6500Å was used. It was then replaced by green light of wavelength 5200Å. The value of n for which $(n+1)^{th}$ green bright band would coincide with $n^{th}$ red bright band for the same setting is
a) $n = 2$    b) $n = 3$
c) $n = 4$    d) $n = 5$

44. In bi-prism experiment, the distance between $4^{th}$ bright band and $10^{th}$ dark band on the same side of the central bright band, in terms of fringe width 'X' us
a) 6.0 X    b) 5.5 X
c) 4.5 X    d) 5.0 X

45. For a ray of light, which of the following statements holds true?
a) A ray is defined as the path of energy propagation.
b) The wavelength for a ray of light in geometrical optics is assumed to be negligible, standing to zero.
c) A ray of light travels in a straight line.
d) All of the above

46. A ray of light travels from air to glass. It is found that the angle of refraction is half the angle of incidence. Then the angle of incidence is given by
a) $2\cos^{-1}\left(\frac{\mu}{2}\right)$    b) $2\sin^{-1}\left(\frac{\mu}{2}\right)$
c) $2\tan^{-1}\left(\frac{\mu}{2}\right)$    d) $\cos^{-1}\left(\frac{\mu}{2}\right)$

47. Which of the following statement(s) is/are correct?
I. A point source emitting waves uniformly in all directions.

II. In spherical wave, the locus of point which have the same amplitude and vibrate in same phase are spheres.
III. At a small distance from the source, a small portion of sphere can be considered as plane wave.
a) Only I b) Both *I* and II
c) Only III d) All of these

48. We can see object due to :
a) Refraction b) Reflection
c) Diffraction d) Interference

49. Select the WRONG statement
a) According to Huygens' principle, every point on a given wavefront is regarded as a secondary source
b) The new disturbance from secondary source travels in all directions with the velocity of light and is called secondary wavelets
c) The surface of tangency to secondary wavelets in forward direction only gives new wavefront
d) Huygens could explain rectilinear propagation of light

50. When a polaroid is rotated, the intensity of light is not found to vary. The incident light may be
a) Completely plane polarised
b) Partially plane polarised
c) Unpolarised
d) Completely diffracted

51. The refractive index of piece of glass is 1.5 and it accommodates as many waves accommodated in 18 cm width of water column. If the refractive index of water is 1.33, then the thickness of glass piece will be
a) 20 cm b) 10 cm c) 12 cm d) 16 cm

52. A wave of light having frequency $4 \times 10^{14}$Hz and speed of light $3 \times 10^{8}$m/s enters glass of R.I. 1.5. Change in wavelength is
a) $2.5 \times 10^{-7}$Å b) $2.5 \times 10^{-6}$Å
c) $2.5 \times 10^{-8}$Å d) $2.5 \times 10^{-9}$Å

53. When a plane wavefront is incident on a double convex lens, the refracted wavefront is
a) A plane wavefront
b) A cylindrical wavefront
c) A spherical wavefront which is diverging
d) A spherical wavefront which is converging

54. What will be the value of R.I. (μ) for completely transparent material medium to be invisible?
a) Unity b) More than one unit
c) Less than unity d) Equal to 1.33

55. In Young's double slit experiment, with a source of light having wavelength 6300Å, the first maxima will occur when the
a) Path difference is 9200Å b) Phase difference is n radian
c) Phase difference is π/2 radian d) Path difference is 6300Å

56. In the phenomenon of refraction. of light, the deviation (δ) in the incident ray of light from its original direction will be :
a) $90° - \angle i$ b) $\angle i - \angle r$
c) $90° - \angle r$ d) $180° - 2\angle i$

57. When light enters water from the vacuum, then wavelength of light:
a) increases b) decreases
c) becomes zero d) remains constant

58. 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 change

59. Light is
a) Transverse wave
b) Sometimes longitudinal and sometimes transverse wave
c) Neither transverse wave nor longitudinal wave
d) Longitudinal wave

60. According to Huygens, medium through which light waves travel is
a) Vacuum only b) Luminiferous ether
c) Liquid only d) Solid only

61. In interference experiment, intensity at a point is $(1/4)^{\text{th}}$ of the maximum intensity. The angular position of this point is at ($\cos 60^0 = 0.5, \lambda = \text{wavelength of light}, \text{d} = \text{slit width}$)
a) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$ b) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$
c) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ d) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$

62. Green light of wavelength 5460 Å is incident on an air-glass interface. If the refractive index of glass is 1.5, then the wavelength of light in glass would be ($c = 3 \times 10^{8}\ \text{ms}^{-1}$)
a) 3640 Å b) 5460 Å c) 4861 Å d) 3460 Å

63. A ray of light is incident on the surface of a glass plate of refractive index 1.55 at the polarizing angle. The angle of refraction is

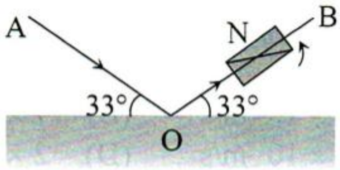
a) $0°$ b) $147°11'$ c) $32°49'$ d) $57°10'$

64. If fringe width is 0.4 mm, the distance between fifth bright and third dark band on same side is
    a) 1 mm b) 2 mm
    c) 3 mm d) 4 mm
65. In Young's double slit experiment, in an interference pattern, a minimum is observed exactly in front of one slit. The distance between the two coherent sources is 'd' and 'D' is the distance between the source and screen. The possible wavelength used are proportional to
    a) D, 5D, 9D, … b) D, 3D, 5D, …
    c) 3D, 4D, 5D, … d) 3D, 7D, 10D, …
66. 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
67. According to Huygens' principle, a wavefront propagates through a medium by
    a) pushing medium particles
    b) propagating through medium with speed of light
    c) carrying particles of same phase along with it
    d) creating secondary wavelets which forms a new wavefront
68. What is the nature of the wavefront associated with a parallel beam of light?
    a) Plane b) Spherical c) Elliptical d) Parabolic
69. The light emerging through a pin hole on a cardboard at finite distance will give:
    a) cylindrical wavefront b) plane wavefront
    c) elliptical wavefront d) spherical wavefront
70. Two coherent waves are represented by $y_1 = A_1 \cos \omega t$ and $y_2 = A_2 \sin \omega t$, superimposed on each other. The resultant intensity is proportional to
    a) $(A_1 + A_2)$ b) $(A_1 - A_2)$
    c) $(A_1^2 + A_2^2)$ d) $(A_1^2 - A_2^2)$
71. According to Huygen's wave theory the luminiferous ether is present in :
    a) Vaccum only
    b) Material body only
    c) Vaccum as well as material body
    d) Air only
72. In single slit diffraction experiment, first minimum observed for wavelength '$\lambda_1$' coincides with first maximum obtained using wavelength '$\lambda_2$'. If $\lambda_1 = 6300Å$, then $\lambda_2$ is
    a) 3150Å b) 5400Å
    c) 4200Å d) 6300Å
73. The angle of incidence is found to be twice the angle of refraction when a ray of light passes from vacuum into a medium of R.I. μ. The angle of incidence will be
    a) $\cos^{-1}(\mu/2)$ b) $2\cos^{-1}(\mu/2)$
    c) $\sin^{-1}(\mu/2)$ d) $2\sin^{-1}(\mu/2)$
74. The ratio of sine of angle of incidence in one medium to sine of angle of refraction in other medium is
    a) refractive index b) dielectric constant
    c) critical angle d) dispersive power
75. Light waves can be polarised because they
    a) have high frequencies
    b) have short wavelength
    c) are transverse
    d) can be reflected
76. The slit of width a is illuminated by white light. The first minimum for red light ($\lambda = 6500Å$) will fall at $\theta = 30^0$ when 'a' will be ($\sin 30^0 = 0.5$)
    a) $2.6 \times 10^{-4}$ cm b) $1.3 \times 10^{-4}$ cm
    c) 3250 Å d) $6.5 \times 10^{-4}$ mm
77. Wave normal is a direction which is
    a) normal at every point on the wavefront
    b) tangential at every point on the wavefront
    c) directed at every point of the wavefront
    d) independent of wavefront
78. For passage of monochromatic beam of light in a medium of refractive index 1.5, the plane wavefront makes an angle of 60° with the refracting surface. The ratio of the width of beam in medium to that in air is
    a) 1:2 b) 1:1 c) 1:5 d) 2:0
79. Wavenormal is :
    a) Normal to a ray of light
    b) Inclined to a ray of light
    c) Along a ray of light
    d) Normal to reflecting surface
80. In double refraction
    a) only the O–ray is polarised
    b) only the E–ray is polarised
    c) both O–ray and E–ray are polarised
    d) neither O–ray nor E–ray is polarised
81. A ray of light travelling in air has wavelength

λ, frequency n, velocity v and intensity I. If this ray enters into water then these parameters are 'λ', n', v' and I' respectively. Which relation is correct from the following?

a) $\lambda = \lambda'$ b) $n = n'$ c) $v = v'$ d) $I = I'$

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




a) The intensity is reduced down to zero and remains zero
b) The intensity reduces down some what and rises again
c) There is no change in intensity
d) The intensity gradually reduces to zero and then again increases

83. A plane glass slab is kept over various coloured letters. The letter which appears the least raised is

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

84. Two coherent sources of wavelength 'λ' produce steady interference pattern. The path difference corresponding to $10^{th}$ order maximum will be

a) 9.5 λ b) 10.5 λ
c) 9 λ d) 10 λ

85. Newton's corpuscular theory was based on

a) Newton's rings
b) Rectilinear propagation of light
c) Thin film colours
d) Dispersion of white light into various colours

86. 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) 4400Å b) 4100Å
c) 4642.8 Å d) 9100 Å

87. Ordinary light incident on a glass slab at the polarising angle suffers a deviation of 34°. The value of the angle of refraction in glass in this case is

a) 28° b) 42° c) 56° d) 68°

88. A light wave of wavelength 'λ' is incident on a slit of width 'd'. The resulting diffraction pattern is observed on a screen at a distance 'D'. If linear width of the principal maxima is equal to the width of the slit, then the distance 'D' is

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

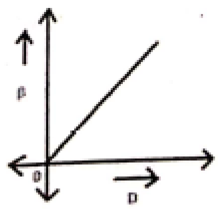
89. During the reflection of light from plane mirror, the incident ray, normal and reflected ray lie

a) parallel to each other
b) perpendicular to each other
c) in same plane
d) in different plane

90. 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 effect b) Interference
c) Diffraction d) Polarisation

91. Graph shows the variation of fringe-width (β) versus distance of the screen from the plane of the slits (D) in Young's double slit experiment. Keeping other parameters same. The wavelength of light used can be calculated as d = distance between the slits




a) Slope of graph × d b) Slope of graph /d
c) Slope of graph × $d^2$ d) d/ slope of graph

92. A shortcoming of Huygens' model could not

a) explaining the absence of the backwave
b) determine the shape of the wavefront for a plane wave
c) explain the point source emitting waves uniformly in all directions
d) All of the above

93. The amplitude and frequency of two waves is same, which are from two different sources, overlap at a point. The ratio of intensity when two waves arrive $(\pi/2)^c$ out of phase to when they arrive in phase is $\cos 0^0 = 1, \cos 90^0 = 0$

a) 3:2 b) 1:2

c) 2:1 d) 2:3

94. In Young's double slit experiment, we get 15 fringes per cm on the screen using light of wavelength 5600Å. For the same setting how many fringes per cm will be obtained with the light of wavelength 7000Å?
a) 18 b) 12
c) 10 d) 15

95. Light waves from two coherent sources arrive at two points on a screen with path difference of zero and $\lambda/2$. The ratio of the intensities at the points is
a) One : two b) One : one
c) Two : one d) Infinity : one

96. 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

97. Unpolarized 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°

98. The locus of all points of the medium having the same phase for particles of light is called
a) wavelength b) wavefront
c) amplitude d) displacement

99. A spectral line $\lambda = 5000$ Å in the light coming from a distant star is observed as 5200 Å. What will be recession velocity of the star?
a) $1.2 \times 10^7$ cm/s b) $1.2 \times 10^7$m/s
c) $1.2 \times 10^7$km/s d) 1.2 km/s

100. Wave theory of light is not initially accepted because
a) it does not explain reflection and refraction processes
b) it does not explain photoelectric effect
c) it does not explain Doppler's effect
d) it does not explain propagation of light through vacuum

101. An optically active compound
a) Rotates the plane polarised light
b) Changes the direction of polarised light
c) Does not allow plane polarised light to pass through
d) None of the above

102. In case of reflection of light phenomenon, the deviation in the incident ray of light from its original direction will be :(If i – angle of incidence, r – angle of reflection)
a) $(\angle i - \angle r)$ b) $(180° - \angle r)$
c) $(180° - \angle i)$ d) $[180° - (\angle i + \angle i)]$

103. H–polaroid is made of
a) nitro cellulose b) polyvinyl alcohol
c) Teflon d) polyvinyl chloride

104. The device to produce plane polarised light is
a) a crystal b) a biprism
c) a grating d) nicol prism

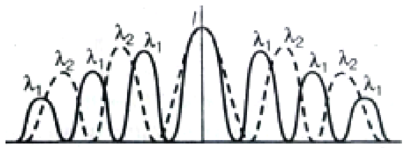
105. Phase difference between incident and reflected rays is 180° in
a) Air and glass b) Water and glass
c) Air and water d) Glass and water

106. Light rays are incident from air on a block of glass (refractive index = 1.5), the reflected and refracted rays are perpendicular to each other. The ratio of the wavelength of the refracted light to that of reflected light is
a) 0.22 b) 0.88
c) 0.33 d) 0.66

107. In Young's double slit experiment the intensity at a point on the screen is 'K' where path difference is 'λ'. What will be the intensity at the point where path difference is $\lambda/4$?
a) Zero b) K
c) $\frac{K}{4}$ d) $\frac{K}{2}$

108. Cylindrical wavefront is obtained from a :
a) Vertical linear source
b) Horizontal linear source
c) Inclined linear source
d) All of the above

109. Following diffraction pattern was obtained using a diffraction grating using two different wavelengths $\lambda_1$ and $\lambda_2$. With the help of the figure, identify which is the longer wavelength and their ratios?




a) $\lambda_2$ is long than $\lambda_1$ and the ratio of the longer to the shorter wavelength is 1.5
b) $\lambda_1$ is longer than $\lambda_2$ and the ratio of the longer to the shorter wavelength is 1.5
c) $\lambda_1$ and $\lambda_2$ are equal and their ratio is 1.0
d) $\lambda_2$ is longer than $\lambda_1$ and the ratio of the longer to the shorter

wavelength is 2.5

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

111. In Young's double 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 the separation between the slits is $10^{-3}$ m, the wavelength of light used is
a) 3000 Å b) 5000 Å
c) 6000 Å d) 4500 Å

112. A spherical wavefront propagating in a medium will change into
a) circular wavefront b) cylindrical wavefront
c) plane wavefront d) elliptical wavefront

113. In diffraction experiment from a single slit, the angular width of the central maxima does not depend upon
a) ratio of wavelength and slit width b) distance of the slit from the screen
c) wavelength of light used d) width of the slit

114. The polarisation of an electromagnetic wave is determined by
a) the electric field only
b) the magnetic field only
c) both the electric and magnetic fields
d) the direction of propagation of electromagnetic waves

115. In diffraction experiment, from a single slit, the angular width of central maximum does NOT depend upon
a) Ratio of wavelength and slit width b) Distance of the slit from the screen
c) Wavelength of light used d) Width of the slit

116. If the ratio of the intensities of two waves producing interference is 49:16, then the ratio of the resultant maximum intensity to minimum intensity will be
a) 49:16 b) 11:3
c) 7:4 d) 121:9

117. When wavefronts pass from denser medium to rarer medium, the width of the wavefront
a) Increases
b) May increase or decrease
c) Decreases
d) Remains unchanged

118. In an interference pattern produced by using a bi-prism, the zeroth order maxima is at a distance of 4.7 mm from a point P on the screen. If the fringe width is 0.2 mm, then the distance of the second minima from the joint P will be
a) Either 4.4 mm or 5 mm depending on the position of point P b) Only 5 mm
c) Only 4.4 mm d) 6 mm

119. Intensity of light at a point is directly proportional to
a) Amplitude of wave b) Wavelength of wave
c) Cube of amplitude of wave d) Square of amplitude of wave

120. Waves that cannot be polarised are
a) Longitudinal b) Transverse
c) electromagnetic d) can not be predicted

121. A Fraunhofer diffraction pattern due to a single slit of width 0.3 mm is obtained on a screen placed at a distance of 3 m from the slit. The first minimum lie at 5.5 mm on either side of the central maximum on the screen. The wavelength of light used is
a) 6000 Å b) 5000 Å
c) 4500 Å d) 5500 Å

122. A parallel beam of monochromatic light falls normally on a single narrow slit. The angular width of the central maximum in the resulting diffraction pattern
a) Decreases with decrease of slit-width b) Decreases with increase of slit-width
c) Increase with increase of slit-width d) May increase or decrease

123. Newton's corpuscular theory of light fails to explain
a) Reflection
b) Refraction
c) Rectilinear propagation of light
d) Interference of light

124. A double slit experiment is immersed in water of refractive index 1.33. The slit separation is 1 mm, distance between slit and screen is 1.33

m. The slits are illuminated by a light of wavelength 6300Å. The fringe width is

a) $6.9 \times 10^{-4}$ m  b) $6.3 \times 10^{-4}$ m
c) $5.8 \times 10^{-4}$ m  d) $8.6 \times 10^{-4}$ m

125. Huygen's wave theory of light could not explain

a) reflection  b) refraction
c) interference  d) polarisation of light

126. A monochromatic beam of light passing through water (refractive index 4/3) has wavelength 5400 Å. When it is refracted in glass (refractive index = 3/2) its wavelength will be

a) 5000 Å  b) 4400 Å
c) 4600 Å  d) 4800 Å

127. Light appears to travel in straight line since:

a) It is not absorbed by atmosphere
b) It is reflected by atmosphere
c) Its wavelength is very small
d) Its velocity is very large

128. When sunlight is scattered by atmospheric atoms and molecules, the amount of scattered light, of wavelength 440 nm, is 'I'. What amount of light of wavelength 660 nm will be scattered?

a) $\frac{16}{81}$I  b) $\frac{9}{4}$I
c) $\frac{4}{9}$I  d) $\frac{81}{16}$I

129. $A$ is an essential condition for coherent sources. Here, A refers to

a) constant phase difference  b) equal amplitude
c) Both (a) and (b) are correct  d) Both (a) and (b) are incorrect

130. The wavefront originating from extended source of light is

a) spherical wavefront  b) plane wavefront
c) cylindrical wavefront  d) all of these

131. $S_1$ and $S_2$ are two coherent sources. The intensity of both sources are same. If the intensity at the point of maxima is $4\text{Wm}^{-2}$, the intensity of each source is

a) $1\text{Wm}^{-2}$  b) $2\text{Wm}^{-2}$
c) $3\text{Wm}^{-2}$  d) $4\text{Wm}^{-2}$

132. In Young's double slit experiment, the distance between the slits is 3 mm and the slits are 2 m away from the screen. Two interference patterns can be obtained on the screen due to light of wavelength 480 nm and 600 nm respectively. The separation on the screen between the 5th order bright fringes on the two interference patterns is

a) $4 \times 10^{-4}$ m  b) $6 \times 10^{4}$ m
c) $12 \times 10^{-4}$ m  d) $8 \times 10^{-4}$ m

133. In a Young's double slit experiment (slit distance d), monochromatic light of wavelength $\lambda$ 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) $\sin^{-1}\left(\frac{\left(n+\frac{1}{2}\right)\lambda}{L}\right)$

134. According to wave theory, different colours of light is due to

a) different wavelengths of light waves
b) different frequencies of light waves
c) different amplitudes of light waves
d) none of these

135. In a single slit diffraction pattern, intensity and width of fringes are

a) unequal width  b) equal width
c) equal width and equal intensity  d) unequal width and unequal intensity

136. The laws of reflection of light are valid for

a) plane mirror only
b) concave mirrors only
c) convex mirror only
d) all reflecting surfaces only

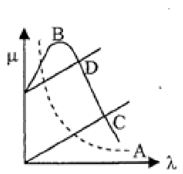
137. In bi-prism experiment, a source of monochromatic light is used for a certain distance between slit and eyepiece. When the distance between two virtual sources is changed from $\text{d}_\text{A}$ to $\text{d}_\text{B}$, then the fringe width is changed from $\text{Z}_\text{A}$ to $\text{Z}_\text{B}$. The ratio $\text{Z}_\text{A}$ to $\text{Z}_\text{B}$ is

a) $\sqrt{\frac{\text{d}_\text{B}}{\text{d}_\text{A}}}$  b) $\left(\frac{\text{d}_\text{A}}{\text{d}_\text{B}}\right)$
c) $\left(\frac{\text{d}_\text{B}}{\text{d}_\text{A}}\right)$  d) $\left(\frac{\text{d}_\text{A}}{\text{d}_\text{B}}\right)^2$

138. Propagation of light is correctly described in the form of

a) longitudinal waves
b) electromagnetic waves
c) transverse electromagnetic waves
d) stationary waves

139. The correct curve between refractive index $\mu$ and wavelength $\lambda$ is



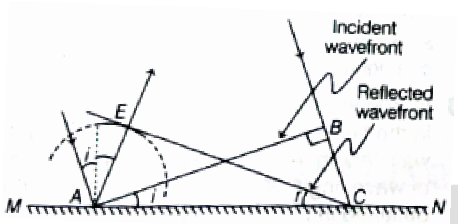

a) A b) D c) B d) C

140. The rays of light which are parallel in nature will form
a) spherical wavefront b) plane wavefront
c) cylindrical wavefront d) circular wavefront

141. Wave theory of light only can explain
a) photoelectric effect b) diffraction
c) compton effect d) black body radiation

142. The polarisation of an electromagnetic wave is determined by
a) The electric field only
b) The magnetic field only
c) Both the electric and magnetic fields
d) The direction of propagation of electromagnetic waves

143. In the given figure, a plane wave $AB$ incident at an angle $i$ on a reflecting surface $MN$.




The reflected wave front is obtained by (Take, $v$ be the speed of light and $t$ be the time taken by it from $B$ to $C$ )
a) drawing a sphere of radius $vt$ from point $A$
b) drawing a sphere of radius $vt$ from point $C$
c) drawing a perpendicular from point $A$
d) drawing a perpendicular from point $C$

144. A light ray of frequency 'v' and wavelength 'λ' enters a liquid of refractive index $\frac{3}{2}$. The ray travels in the liquid with
a) Frequency v and wavelength $\left(\frac{1}{2}\right)\lambda$
b) Frequency v and wavelength $\left(\frac{3}{2}\right)\lambda$
c) Frequency $\left(\frac{3}{2}\right)$ v and wavelength $\lambda$
d) Frequency v and wavelength $\left(\frac{2}{3}\right)\lambda$

145. Huygen's idea of secondary wavelets is used to
a) find the velocity of light
b) find the wavefront
c) explain the polarisation
d) explain the rarefaction

146. A light source approaches the observer with velocity 0.8 c. The Doppler shift for the light of wavelength 5500 Å is
a) 4400 Å b) 1833 Å c) 3667 Å d) 7333 Å

147. A ray of light is incident on a glass slab making an angle of 30° with the surface. The angle of refraction in glass, if the refractive index of glass is 1.6, is
a) 28° b) 18° c) 12° d) 15°

148. In Young's double slit experiment, the intensity at a point where the path difference is '$\frac{\lambda}{4}$' is 'I'. If the maximum intensity is $I_0$ then the ratio $\frac{I_0}{I}$ is
$\left(\cos 45^0 = \frac{1}{\sqrt{2}} = \sin 45^0\right)$
a) 2:1 b) 1:2
c) 1:4 d) 4:1

149. In diffraction experiment, for a single slit, the angular width of the central maximum does not depend upon
a) Ratio of wavelength and slitwidth
b) Width of the slit
c) Distance of slit from the screen
d) Wavelength of light used

150. Two coherent monochromatic light sources are located at two vertices of an equilateral triangle. If the intensity due to each of the sources independently is $1 Wm^{-2}$ at the third vertex, the resultant intensity due to both the sources at that point (i.e. at the third vertex) is (in $Wm^{-2}$ )
a) zero b) $\sqrt{2}$
c) 2 d) 4

151. In Young's double slit experiment, if the slit widths are in the ratio 1: 9. The ratio of the intensity at minima to that at maxima will be
a) 1 b) $\frac{1}{9}$
c) $\frac{1}{4}$ d) $\frac{1}{3}$

152. Wavefront will always moves
a) perpendicular to wave normal
b) parallel to each other
c) perpendicular to each other
d) both 'a' and 'b'

153. An unpolarised beam of transverse waves is one whose vibrations
a) are confined to a single plane
b) occur in all directions
c) have not passed through a polarised disc

d) occur in all directions perpendicular to their direction of motion

154. According to Huygen, undetectability of ether due to

a) zero density
b) perfect transparency
c) perfect elasticity
d) all of these

155. 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) $\pi$
d) $2\pi$

156. A lens having focal length f gives Fraunhoffer type diffraction pattern of a slit having width a. If wavelength of light is λ, the distance of first dark band and next bright band from axis is given by

a) $\frac{a}{\lambda}f$
b) $\frac{\lambda}{a}f$
c) $\frac{\lambda}{af}$
d) $a\lambda f$

157. In Young's experiment, the distance between two slits is halved and the distance between the screen and slit is made three times. Then, width of the fringe

a) becomes half
b) remains the same
c) becomes six times
d) becomes four times

158. Huygens' idea of secondary wavelets is used to

a) Find the velocity of light
b) Find the new position of wavefront
c) Explain the polarisation
d) Explain the rarefaction

159. Light entering in air glass ($\mu = 1.5$) boundary is partly reflected and partly refracted. If the incident and reflected rays are at right angles to each other, the angle of refraction r is given by

a) $\sin r = \frac{\sqrt{2}}{3}$
b) $\sin r = \sqrt{\left(\frac{2}{3}\right)}$
c) $\sin r = \frac{2}{13}$
d) None of these

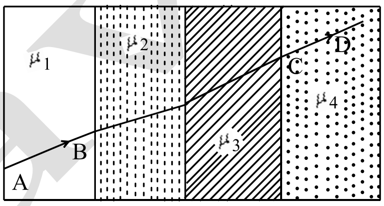
160. In Young's double slit experiment, the 8th maximum with wavelength $\lambda_1$ is at a distance $d_1$ from the central maximum and the 6 th maximum with wavelength $\lambda_2$ is at a distance $d_2$. Then, $d_1/d_2$ is equal to

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) $\frac{3}{4}\left(\frac{\lambda_1}{\lambda_2}\right)$

161. A light wave of wavelength 'λ' is incident on a slit of width 'd'. The resulting diffraction pattern is observed on a screen at a distance 'D'. If linear width of the principal maximum is equal to the width of the slit, then the distance D is

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

162. A ray of light passes through four transparent media with refractive indices $\mu_1, \mu_2, \mu_3$, and $\mu_4$ as shown in figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to incident ray AB, then




a) $\mu_1 = \mu_2$
b) $\mu_2 = \mu_3$
c) $\mu_3 = \mu_4$
d) $\mu_4 = \mu_1$

163. Red light of wavelength 6400 Å in air has a wavelength of 4000 Å in glass. If the wavelength of violet light in air is 4400 Å, then the wavelength in glass is

a) 2570 Å
b) 2750 Å
c) 1600 Å
d) 2560 Å

164. Light of wavelength 'λ' is incident on a single slit of width 'a' and the distance between slit and screen is 'D'. In diffraction pattern, if slit width is equal to the width of the central maximum then 'D' is equal to

a) $a^2/\lambda$
b) $a^2/2\lambda$
c) $a/2\lambda$
d) $a/\lambda$

165. A beam of unpolarised light having flux $10^{-2}$ watt falls normally on a polariser of cross sectional area $3 \times 10^{-4}$ m$^2$. The polariser rotates with an angular frequency of π rad/s. The energy of light passing through the polariser per revolution will be

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

166. The ratio of the intensities of two waves is 16: 9. The ratio of their amplitudes is

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

167. Huygens' principle of secondary wavelets may

be used to

a) find the velocity of light in vacuum
b) explain the particle's behavior of light
c) find the new position of a wavefront
d) explain photoelectric effect

168. The critical angle depends on the

a) refractive, indices of the two media
b) colour of light
c) temperature of light
d) all of these

169. In bi-prism experiment, fringes are obtained using monochromatic light. The distance between 5th bright band and 9th dark band on the same side of the central bright band, in terms of the fringe width 'X' is

a) 3X
b) 3.5X
c) 4X
d) 4.5X

170. 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) $\sqrt{1 - \frac{v^2}{c^2}}$

171. A parallel beam of light of intensity $I_0$ is incident on a cotass 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) $\left(\dfrac{\frac{1}{2} + \sqrt{\frac{3}{8}}}{\frac{1}{2} - \sqrt{\frac{3}{8}}}\right)^2$
b) $\left(\dfrac{\frac{1}{4} + \sqrt{\frac{3}{8}}}{\frac{1}{2} - \sqrt{\frac{3}{8}}}\right)^2$
c) $\frac{5}{8}$
d) $\frac{8}{5}$

172. 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) No shift
d) Shift towards red from one end and shift towards violet from other end

173. Light of wavelength λ. in air enters a medium of refractive index $\mu$. Two points in this medium lying along a path of light are at a distance x apart. The phase difference between these points:

a) $\frac{2\pi\mu}{\lambda x}$
b) $\frac{\lambda x}{2\pi\mu}$
c) $\frac{2\pi x\mu}{\lambda}$
d) $\frac{\lambda}{2\pi x\mu}$

174. The change in wavelength of light of frequency $4 \times 10^{14}$ Hz, when it passes from air to glass, is ($\mu_{glass} = 1.5$)

a) 2500 Å
b) 3500 Å
c) 3000 Å
d) 2000 Å

175. When light enters from air to water, then its

a) Frequency increases and speed decreases
b) Frequency is same but the wavelength is smaller in water than in air
c) Frequency is same but the wavelength in water is greater than in air
d) Frequency decreases and wavelength is smaller in water than in air

176. A monochromatic light of wavelength $\lambda$ is incident on plane reflecting surface. After reflection, its wavelength will be

a) Doubled
b) Reduced to half
c) Same
d) Quadrupled

177. Each and every point of the wavefront acts as

a) primary source of light
b) secondary source of light
c) centre of mass
d) ray of light

178. According to Huygen's construction, tangential envelope which touches all the secondary spheres is the position of

a) original wavefront
b) secondary wavefront
c) geometrical wavefront
d) extended wavefront

179. In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case,

a) there should be no interference fringe
b) there should be an interference pattern for red mixing with one for blue
c) there should be alternate interference patterns of red and blue
d) None of the above

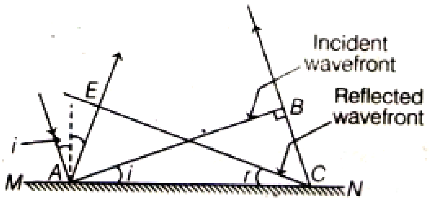
180. In Young's double slit experiment, the ratio of intensities at two points on a screen when waves from the two slits have a path difference of zero and $\frac{\lambda}{4}$ is

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

181. Huygens wave theory is used

a) to determine the velocity of light
b) to find the position of a wavefront
c) to determine the wavelength of light
d) to find the focal length of a lens

182. In case of reflection of a wavefront from a reflecting surface,




I. points $A$ and $E$ are in same phase.
II. points $A$ and $C$ are in same phase.
III. points $A$ and $B$ are in same phase.
IV. points $C$ and $E$ are in same phase.
Which of the following is correct?
a) I and II  b) II and III
c) III and IV  d) I and IV

183. Which one of the following statement is not the property of light?
a) Light requires material medium  b) Light has finite speed
c) Light involves transportation of energy  d) Light can travel through vacuum

184. The points A and B are situated at the same distance from a source of light, but in opposite directions. On passing through A and B, the phase difference will be
a) π/2  b) π
c) zero  d) none of these

185. A monochromatic beam of light passes from a denser medium to a rarer medium. As a result of this
a) Its velocity increases
b) Its velocity decreases
c) Its frequency decreases
d) Its wavelength decreases

186. The Young's double slit experiment is performed with blue and with green light of wavelengths 4360Å and 5460 Å, respectively. If $x$ is the distance of 4 th 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) $x_{(\text{blue})} / x_{(\text{green})} = 5400/4360$

187. Huygen's principle states that
a) wave is transverse wave
b) each point of the wavefront is in different phase
c) each point of the wavefront acts as secondary source
d) all of these

188. For a spherical wavefront, the rays of light are
a) converging on the source
b) diverging from the source
c) parallel to each other
d) circular in nature

189. The optical path difference between two identical light waves arriving at a point is 31.5λ, where 'λ' is the wavelength of light used. The point is [Two light sources are coherent]
a) Alternatively bright and dark  b) Neither bright nor dark
c) Bright  d) Dark

190. Unpolarised light of intensity 32 Wm$^{-2}$ passes through three polarizer such that the transmission axis of the last polarizer is crossed with that of the first. The intensity of final emerging light is 3 Wm$^{-2}$. The intensity of light transmitted by first polarizer will be
a) 32W/m$^{-2}$ b) 16W/m$^{2}$ c) 8W/m$^{-2}$ d) 4W/m$^{-2}$

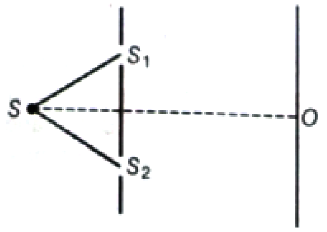
191. Which light is partially polarised when light is incident on a transparent medium at the polarising angle?
a) Incident light
b) Reflected light
c) Refracted light
d) Reflected and incident light

192. Find the thickness of a plate which will produce a change in optical path equal to half the wavelength $\lambda$. of the light passing through it normally. The refractive index of the plate $\mu$ is equal to
a) $\frac{\lambda}{4(\mu-1)}$  b) $\frac{3\lambda}{4(\mu-1)}$
c) $\frac{\lambda}{(\mu-1)}$  d) $\frac{\lambda}{2(\mu-1)}$

193. If the speed of light in glass and water are $2 \times 10^8$ m/s and $2.25 \times 10^8$ m/s respectively, then the refractive index of the water with respect to the glass is
a) 1.125  b) 1.25  c) 1.5  d) 0.89

194. nth bright fringe, if red light $(\lambda_1 = 7500\text{Å})$ coincides with $(n+1)$ th bright fringe of green light $(\lambda_2 = 6000\text{Å})$. The value of $n$ is
a) 4  b) 5
c) 3  d) 2

195. 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
d) Neither dark nor bright

196. In a bi-prism experiment, monochromatic light of wavelength ($\lambda$) is used. The distance between two coherent sources is kept constant. If the distance between slit and eyepiece (D) is varied as $D_1, D_2, D_3$ and $D_4$, the corresponding measured fringe widths are $z_1, z_2, z_3$ and $z_4$ then

a) $z_1\sqrt{D_1} = z_2\sqrt{D_2} = z_3\sqrt{D_3} = z_4\sqrt{D_4}$
b) $z_1 D_1^2 = z_2 D_2^2 = z_3 D_3^2 = z_4 D_4^2$
c) $z_1 D_1 = z_2 D_2 = z_3 D_3 = z_4 D_4$
d) $\frac{z_1}{D_1} = \frac{z_2}{D_2} = \frac{z_3}{D_3} = \frac{z_4}{D_4}$

197. A polariser is used to

a) reduce intensity of light
b) increase intensity of light
c) produce polarised light
d) none of these

198. In an interference pattern the ratio of the intensity of at the central bright point to the intensity at a point one-fourth of the bandwidth measured from the centre of the fringe is

$\left(\cos 45^0 = \frac{1}{\sqrt{2}}, \cos 0^0 = 1\right)$

a) $\frac{1}{2}:1$
b) 4:1
c) 16:1
d) 2:1

199. The smallest angular or linear separation between the two point objects at which they appear to be just resolved is known as

a) Airy's disc
b) Numerical aperture
c) Limit of resolution of an optical instrument
d) Resolving power of optical instrument

200. Time taken by the light to travel through 5cm of glass is same as that through x cm of air. If R.I. of glass is 1.5, then x is

a) 7.5 cm b) 1.33 cm c) 9 cm d) 6 cm

# N.B.Navale

**Date** : 28.03.2025
**Time** : 03:00:00
**Marks** : 200

**TEST ID: 53**
**PHYSICS**

1.WAVE THEORY OF LIGHT,7.WAVE OPTICS

## : ANSWER KEY :

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1) | a | 2) | a | 3) | c | 4) | d | 105) | a | 106) | d | 107) | d | 108) | a |
| 5) | b | 6) | c | 7) | d | 8) | b | 109) | c | 110) | b | 111) | c | 112) | c |
| 9) | c | 10) | a | 11) | a | 12) | b | 113) | b | 114) | b | 115) | b | 116) | d |
| 13) | d | 14) | a | 15) | b | 16) | a | 117) | c | 118) | a | 119) | d | 120) | a |
| 17) | d | 18) | a | 19) | b | 20) | d | 121) | d | 122) | b | 123) | d | 124) | b |
| 21) | d | 22) | b | 23) | c | 24) | c | 125) | d | 126) | d | 127) | c | 128) | a |
| 25) | b | 26) | b | 27) | d | 28) | b | 129) | a | 130) | c | 131) | a | 132) | a |
| 29) | a | 30) | b | 31) | d | 32) | b | 133) | a | 134) | a | 135) | d | 136) | d |
| 33) | c | 34) | d | 35) | d | 36) | d | 137) | c | 138) | c | 139) | a | 140) | b |
| 37) | a | 38) | d | 39) | b | 40) | d | 141) | b | 142) | a | 143) | a | 144) | d |
| 41) | d | 42) | d | 43) | c | 44) | b | 145) | b | 146) | c | 147) | b | 148) | a |
| 45) | d | 46) | a | 47) | b | 48) | b | 149) | c | 150) | d | 151) | c | 152) | d |
| 49) | d | 50) | c | 51) | d | 52) | a | 153) | d | 154) | d | 155) | d | 156) | b |
| 53) | d | 54) | a | 55) | d | 56) | b | 157) | c | 158) | b | 159) | a | 160) | b |
| 57) | b | 58) | a | 59) | a | 60) | b | 161) | a | 162) | d | 163) | b | 164) | b |
| 61) | d | 62) | a | 63) | c | 64) | a | 165) | c | 166) | a | 167) | c | 168) | d |
| 65) | b | 66) | a | 67) | d | 68) | a | 169) | b | 170) | c | 171) | a | 172) | d |
| 69) | b | 70) | c | 71) | c | 72) | c | 173) | c | 174) | a | 175) | b | 176) | c |
| 73) | b | 74) | a | 75) | c | 76) | b | 177) | b | 178) | b | 179) | a | 180) | a |
| 77) | a | 78) | b | 79) | c | 80) | c | 181) | b | 182) | c | 183) | a | 184) | c |
| 81) | b | 82) | d | 83) | d | 84) | d | 185) | a | 186) | c | 187) | c | 188) | b |
| 85) | d | 86) | c | 87) | a | 88) | d | 189) | d | 190) | b | 191) | c | 192) | d |
| 89) | c | 90) | a | 91) | a | 92) | a | 193) | d | 194) | a | 195) | c | 196) | d |
| 93) | b | 94) | b | 95) | d | 96) | a | 197) | c | 198) | d | 199) | c | 200) | a |
| 97) | b | 98) | b | 99) | b | 100) | d | | | | | | | | |
| 101) | a | 102) | d | 103) | b | 104) | d | | | | | | | | |

# N.B.Navale

**Date** : 28.03.2025 **TEST ID: 53**
**Time** : 03:00:00 **PHYSICS**
**Marks** : 200

1.WAVE THEORY OF LIGHT,7.WAVE OPTICS

## : HINTS AND SOLUTIONS :

**Single Correct Answer Type**

2 **(a)**

$$\frac{I_1}{I_2} = \frac{9}{4}$$

$$\therefore \frac{a_1}{a_2} = \frac{3}{2}$$

$$\frac{a_1 + a_2}{a_1 - a_2} = \frac{3+2}{3-2} = \frac{5}{1}$$

$$\therefore \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \frac{25}{1}$$

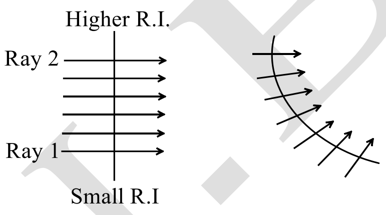
3 **(c)**

Linear width of central maximum $= \frac{2\lambda D}{d}$

$\therefore$ Angular width of central maximum $= \frac{2\lambda}{d}$

4 **(d)**

Consider a plane wavefront travelling horizontally. When it moves, its different parts move with different speeds $\left(\text{as } \mu \propto \frac{1}{v}\right)$. Ray 1 will travel faster than Ray 2. So, its shape will change as shown and beam will bend upward




6 **(c)**

$${}_a\mu_m = \frac{v_a}{v_m} = \frac{\lambda_a}{\lambda_m}$$

$$\therefore \frac{\lambda_a}{\lambda_m} = 1.5 = \frac{3}{2}$$

$$\therefore \frac{\lambda_m}{\lambda_a} = \frac{2}{3} \Rightarrow \frac{\lambda_m - \lambda_a}{\lambda_a} = \frac{2-3}{3} = \frac{-1}{3}$$

$\therefore$ Percentage change $= \frac{1}{3} \times 100 = 33.33\%$ (in magnitude)

7 **(d)**

$$I = I_m \cos^2 \frac{\phi}{2}$$

Where $I_m$ = Maximum Intensity, $\phi$ = phase difference

when $I = \frac{I_m}{4}$, we have $\frac{I_m}{4} = I_m \cos^2 \frac{\phi}{2}$

$$\therefore \cos^2 \frac{\phi}{2} = \frac{1}{4}$$

$$\therefore \cos^2 \frac{\phi}{2} = \frac{1}{2}$$

$$\therefore \frac{\phi}{2} = \frac{\pi}{3}$$

$$\therefore \phi = \frac{2\pi}{3}$$

Path difference $= \frac{\phi}{2\pi}\lambda = \frac{2\pi}{3 \times 2\pi}\lambda = \frac{\lambda}{3}$

If $\theta$ is the angular position then $d \sin\theta = \frac{\lambda}{3}$

$$\therefore \sin\theta = \frac{\lambda}{3d}$$

$$\therefore \theta = \sin^{-1}\frac{\lambda}{3d}$$

9 **(c)**

$${}_g\mu_w = \frac{{}_a\mu_w}{{}_a\mu_g} = \frac{v_g}{v_w}$$

$$\therefore \frac{v_g}{v_w} = \frac{1.33}{1.5} = 0.8867 : 1$$

11 **(a)**

Doppler shift is given by

$$\Delta\lambda = \frac{v\lambda}{c} = \frac{5000 \times 6000}{3 \times 10^8} = 0.1\ \text{Å}$$

15 **(b)**

Here, $\Delta\lambda = 0.5\ \text{nm} = 0.5 \times 10^{-9}\text{m}$

$v = 300\ \text{km s}^{-1} = 300 \times 10^3 \text{ms}^{-1}$

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \quad \therefore \lambda = \frac{\Delta\lambda c}{v}$$

$$\therefore \lambda = \frac{0.5 \times 10^{-9} \times 3 \times 10^8}{300 \times 10^3} = 5 \times 10^{-7}\text{m}$$

$$= 5000 \times 10^{-10}\text{m} = 5000\ \text{Å}$$

18 **(a)**
The ratio of maximum to minimum intensity is given as

$$\frac{I_{\max}}{I_{\min}}=\frac{(a+b)^2}{(a-b)^2}=\frac{(2+1)^2}{(2-1)^2}=\frac{9}{1}$$

19 **(b)**
Fringe width ∝ Wavelength of light.
Since, wavelength of blue color is less than yellow color.
Therefore, fringe will become narrower.

22 **(b)**
If $I_0$ is the intensity of each of the waves, then the resultant intensity is given by

$$I=4I_0\cos^2\frac{\phi}{2}$$

Where $\phi$ is phase difference

when $\phi=\frac{\pi}{2}, I=4I_0\cos^2\frac{\pi}{4}=4I_0\times\frac{1}{2}=2I_0$

when $\phi=0, I'=4I_0$

$$\therefore \frac{I}{I'}=\frac{2I_0}{4I_0}=\frac{1}{2}$$

27 **(d)**
Phase difference, $\phi=\frac{2\pi}{\lambda}\times$ Path difference

$$=\frac{2\pi}{\lambda}\times\frac{\lambda}{6}=\frac{\pi}{3}=60^\circ$$

Intensity, $I=I_0\cos^2\left(\frac{\phi}{2}\right)$

$$\frac{1}{I_0}=\cos^2(30^\circ)=\left(\frac{\sqrt{3}}{2}\right)^2=0.75$$

31 **(d)**
Number of waves,
$N=\frac{t}{\lambda}\Rightarrow\frac{t}{\lambda}=$ constant for same N

$$\therefore \frac{X}{\lambda_\omega}=\frac{4}{\lambda_g}$$

$$\therefore X=4\times\frac{\lambda_\omega}{\lambda_g}=4\times\frac{\mu_g}{\mu_\omega}=4\times\frac{5/3}{4/3}=5\text{ cm}$$

33 **(c)**
For nth dark fringe, the path difference is given by

$$S_1P-S_2P=\left(n-\frac{1}{2}\right)\lambda$$

For $n=3$,

Path difference $=2.5\lambda$

$=2.5\times6\times10^{-7}$ m

$=1.5\times10^{-6}$ m $=1.5$μm

36 **(d)**
Distance of the first dark fringe from the centre

$$=\frac{x}{2}=\frac{\lambda D}{2d}$$

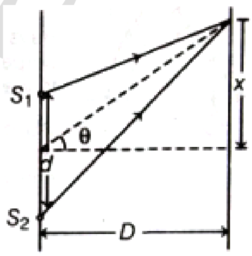
$$\therefore \frac{d}{2}=\frac{\lambda D}{2d}$$

$$\therefore \lambda=\frac{d^2}{D}$$

39 **(b)**
In an interference experiment, the phase difference between the waves reaching a dark point is $\pi^c$.

40 **(d)**
Let $\lambda$ be wavelength of monochromatic light incident on slit $S_1$ and $S_2$, then angular distance between two consecutive fringes, i.e. the angular fringe width is

$\theta=\frac{\lambda}{d}$ ............(i)




where, $d$ is distance between coherent sources.

Given,

So, from Eq.(i), we get

$$\frac{\Delta\lambda}{\lambda}=\frac{\Delta\theta}{\theta}=\frac{10}{100}=0.1$$

$\Rightarrow \Delta\lambda=0.1\lambda=0.1\times5890$Å $=589$Å
(increases)

41 **(d)**

$$y_5=\frac{5\lambda_1D}{d}; y_6'=\frac{11\lambda_2D}{2d}$$

$$5\lambda_1=\frac{11\lambda_2}{2}\Rightarrow\frac{\lambda_1}{\lambda_2}=\frac{11}{10}$$

$$\therefore \frac{\lambda_2}{\lambda_1}=\frac{10}{11}$$

42 **(d)**

Fringe width$\propto \lambda$

43 **(c)**

$\lambda_R = 6500Å$

$\lambda_G = 5200Å$

$\beta = \frac{\lambda d}{D}$

$(n+1)\lambda_G = n\lambda_R$

$(n+1) \times 5200 = n \times 6500$

$\frac{n+1}{n} = \frac{65}{52}$

$\frac{1}{n} = \frac{65}{52} - 1 = \frac{65-52}{52} = \frac{13}{52} = \frac{1}{4}$

$\therefore n = 4$

44 **(b)**

Distance of 4th bright band = 4x

Distance of 10th dark band = 9.5x

$\therefore 9.5x - 4x = 5.5x$

45 **(d)**

A ray is defined as the path of energy propagation in the limit of wavelength tending to zero. It travels in a straight line and defined as the path of energy propagation.

46 **(a)**

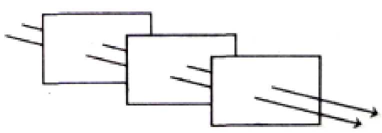
$\mu = \frac{\sin i}{\sin r} = \frac{\sin i}{\sin(i/2)} = \frac{2\sin\frac{i}{2}.\cos\frac{i}{2}}{\sin\left(\frac{i}{2}\right)}$

$\therefore \frac{\mu}{2} = \cos\frac{i}{2} \quad \therefore \frac{i}{2} = \cos^{-1}\left(\frac{\mu}{2}\right)$

$\therefore i = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

47 **(b)**

For a point emitting waves uniformly in all directions, the locus of points which have the same amplitude and vibrate in the same phase are spheres. But at a large distance from the source, the small portion of the sphere can be considered as plane wave as shown in figure.



51 **(d)**

No. of waves $= \frac{\text{thickness}}{\text{wavelength}}$

$\therefore$ Thickness of glass piece $= \frac{18 \times 1.33}{1.5} = 15.96 \approx$ 16 cm

52 **(a)**

Using $c = n\lambda$,

$\lambda_a = \frac{c}{n_a} = \frac{3 \times 10^8}{4 \times 10^{14}} = 0.75 \times 10^{-6}$

$\therefore \lambda_a = 7500$ Å

Now, ${}_a\mu_g = \frac{c}{v_g} = \frac{n_a\lambda_a}{n_g\lambda_g} = \frac{\lambda_a}{\lambda_g}$

$\therefore \lambda_g = \frac{\lambda_a}{{}_a\mu_g} = \frac{7500}{1.5} = 5000$ Å

$\therefore \lambda_a - \lambda_g = 7500 - 5000 = 2500$ Å

$= 2500 \times 10^{-10} = 2.5 \times 10^{-7}$ Å

55 **(d)**

For maxima, path difference$= n\lambda$

For first maximum, $n = 1$

$\therefore$ Path difference, $\lambda = 6300Å$

58 **(a)**

As we know, $\beta = \frac{D\lambda}{d}$ .......(i)

and

$\lambda \propto \frac{1}{\mu}$ .........(ii)

From Eqs. (i) and (ii), we get

$\beta \propto \lambda \propto \frac{1}{\mu}$

$\therefore$ Fringe width will decrease, $\beta \propto \frac{1}{\mu}$

60 **(b)**

Wave theory of light

61 **(d)**

Maximum intensity $I_{max} = I_0$

Where $I_0$ is the intensity of each wave.

$\frac{I_{max}}{4} = I_0; I = 4I_0\cos^2\frac{\phi}{2}$

where $I = I_0$ we have $I_0 = 4I_0\cos^2\frac{\phi}{2}$

$\cos^2\frac{\phi}{2} = \frac{1}{4}$ or $\cos\frac{\phi}{2} = \frac{1}{2}$

$\therefore \frac{\phi}{2} = \frac{\pi}{3}$ or $\phi = \frac{2\pi}{3}$

for one fringe width $X = \frac{\lambda D}{d}$

Angular separation $= \frac{x}{D} = \frac{\lambda}{d}$

For phase difference of $2\pi$, the angular separation is given by

$\sin\theta = \theta = \frac{\lambda}{d}$

For phase difference of $\frac{2\pi}{3}$, the angular separation is given by

$\sin\theta = \frac{\lambda}{3d}$ or $\theta = \sin^{-1}\left(\frac{\lambda}{3d}\right)$

62 **(a)**

$\mu_g = \frac{\lambda_a}{\lambda_g}$

$\therefore \lambda_g = \frac{\lambda_a}{\mu} = \frac{5460}{1.5} = 3640\ \text{Å}$

63 **(c)**

$\tan i_p = \mu = 1.55$

$\therefore i_p = 57°10'$

$r = 90° - i_p = 90° - 57°17' = 32°49'$

64 **(a)**

Given, $\beta = 0.4$ mm

Position of $n$th bright fringe from central maxima,

$x_m = \frac{n_1 \lambda D}{d}$, where $n_1 = 5$

$\therefore\ x_m = \frac{5\lambda D}{d}$

Position of $n$th dark fringe from central maxima,

$x_n = \frac{(2n-1)\lambda D}{2d}$, where $n = 3$

$x_n = \frac{5}{2}\frac{\lambda D}{d} \Rightarrow x_{n_1} - x_n = \frac{2.5\lambda D}{d}$

$= 2.5\beta = 2.5 \times 0.4$

$\Rightarrow x_{n_1} - x_n = 1$ mm

65 **(b)**

If x is the fringe width, then there will be a minimum in front of the slit if

$\frac{d}{2} = \frac{x}{2}, \frac{3x}{2}, \frac{5x}{2}, \ldots$ or $d = x, 3x, 5x$

$\therefore x = d, \frac{d}{3}, \frac{d}{5}, \ldots$

$\lambda = \frac{xd}{D}$

$\therefore \lambda = \frac{d^2}{D}, \frac{d^2}{3D}, \frac{d^2}{5D}$

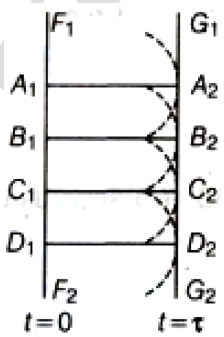
$\therefore \lambda$ is inversely proportional to D, 3D, 5D, ...

66 **(a)**

Light is electromagnetic in nature. It does not require any material for its propagation

67 **(d)**

According to Huygens' principle, each point of the wavefront is the source of a secondary disturbance and the wavelets emanating from these points spread out in all directions with the speed of the wave. These wavelets emanating from the wavefront are usually referred to as secondary wavelets and if we draw a common $D_{1\ t=0}$ tangent to all these spheres, we obtain the new position of the wavefront at a later time.




70 **(c)**

As, $y_1 = A_1\cos\omega t = A_1\sin(\omega t + 90°)$ and $y_2 = A_2\sin\omega t$ $\therefore$ Phase difference, $\phi = 90°$

$R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi} = \sqrt{A_1^2 + A_2^2}$

$\therefore$ Resultant intensity, $I \propto R^2 \Rightarrow I \propto (A_1^2 + A_2^2)$

72 **(c)**

$x = \frac{\lambda_1 D}{d} = \frac{1.5\lambda_2 D}{d}$

$\therefore \lambda_1 = 1.5\lambda_2$

$\therefore \lambda_2 = \frac{\lambda_1}{1.5} = \frac{6300}{1.5} = 4200\text{Å}$

73 **(b)**

$i = 2\,r$

$\therefore \mu = \frac{\sin i}{\sin r} = \frac{\sin i}{\sin 2i} = \frac{\sin i}{2\sin i \cos i} = \frac{1}{2\cos i}$

$\therefore \cos i = \frac{\mu}{2} \Rightarrow i = \cos^{-1}\left(\frac{\mu}{2}\right)$

76 **(b)**
Expression for minimum intensity is,

$a \sin\theta = n\lambda$

$a = \frac{\lambda}{\sin\theta}$

[$\because$ here n = 1]

$a = \frac{6500 \times 10^{-10}}{0.5} = 1.3 \times 10^{-6}$ m

$= 1.3 \times 10^{-4}$ cm

81 **(b)**
Frequency remains same, i.e. $n = n'$

82 **(d)**
In the figure shown, the unpolarised light is incident at polarising angle of $90° - 33° = 57°$. Hence, the reflected light is plane polarized. When plane polarized light is passed through Nicol prism (a polariser or analyser), the intensity gradually reduces to zero and finally increases

84 **(d)**
Path difference for nth maximum is $n\lambda$.

86 **(c)**
Distance of $n$th secondary maxima from central maxima, $x = \frac{(2n+1)\lambda D}{2a}$

For red light, $x = \frac{(4+1)D}{2a} \times 6500$ .........(i)

For unknown of light, $x = \frac{(6+1)D}{2a} \times \lambda$ .........(ii)

By using Eqs. (i) and (ii), $5 \times 6500 = 7 \times \lambda$

Wavelength of light, $\lambda = \frac{5}{7} \times 6500 = 4642.8$A

88 **(d)**

$\beta = \frac{2\lambda D}{d} = d$

$\therefore D = \frac{d^2}{2\lambda}$

90 **(a)**
According to Doppler effect, wherever there is a relative motion between source and observer, the frequency observed is different from that given out by source.

Increase in $\lambda$ indicates that the star is receding

91 **(a)**

$\beta = \frac{\lambda D}{d}$

$\text{slope} = \frac{\beta}{D} = \frac{\lambda}{d}$

$\therefore \lambda = \text{slope} \times d$

92 **(a)**
Huygens argued that the amplitude of the secondary wavelets is maximum in the forward direction and zero in the backward direction, by making this adhoc assumption. He could explain the absence of the backwave. However, this adhoc assumption is not satisfactory and the absence of the backwave is really justified from more rigorous wave theory.

93 **(b)**

$I = I_{max}\frac{\cos^2\phi}{2}$

$I_{resultant1} = I_{max}\cos^2 0 = I_{max}$

$I_{resultant2} = \frac{I_{max}\cos^2\pi}{4} = \frac{I_{max}}{2}$

$\therefore \frac{I_{resultant2}}{I_{resultant1}} = \frac{1}{2}$

94 **(b)**

Fringe width $X = \frac{\lambda D}{d}$

$\therefore \frac{X_2}{X_1} = \frac{\lambda_2}{\lambda_1}$

The number of fringes per cm is inversely proportional to the fringe width

$\therefore \frac{n_2}{n_1} = \frac{x_1}{x_2} = \frac{\lambda_1}{\lambda_2}$

$n_2 = \frac{\lambda_1}{\lambda_2}.n_1 = \frac{5600}{7000} \times 15 = 12$

95 **(d)**
When path difference is zero, the resultant intensity $I = I_0$, where $I_0$ is the intensity of the individual waves.

When the path difference is $\frac{\lambda}{2}$, the intensity $P = 0$

$\therefore \frac{I}{P} = \frac{4I_0}{0} = \infty$

96 **(a)**
Red shift implies that apparent wavelength $\lambda'$ increases and hence apparent frequency $v'$ decreases

97 **(b)**
$I' = \frac{I}{2}\cos^2\theta = \frac{I}{6}$

$\therefore \cos\theta = \frac{1}{\sqrt{3}} \quad \therefore \theta = 55°$

99 **(b)**
$\Delta\lambda = 5200^o - 5000^o = 200$ Å

$\therefore \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c} \Rightarrow v = \frac{c\Delta\lambda}{\lambda_0}$

$\therefore v = \frac{3\times10^8\times200}{5000} = 1.2\times10^7$ m/s

100 **(d)**
The wave theory of light was not initially accepted because light could travel through vacuum and it was felt that a wave would always require a medium to propagate from one point to the other. These two facts contradicts each other.

101 **(a)**
When the plane-polarised light pass through certain substance, the plane of polarisation of the light is rotated about the direction of propagation of light through a certain angle

106 **(d)**
$\lambda_g = \frac{\lambda_a}{1.5}$

$\therefore \frac{\lambda_g}{\lambda_a} = \frac{1}{1.5} = 0.66$

107 **(d)**
The resultant intensity at a point is given by

$I - 4I_0\cos^2\frac{\phi}{2}$

Where $I_0$ is the intensity of each wave and $\phi$ in the phase difference between them.

When path difference is $\lambda$, phase difference will be $2\pi$

$\therefore I = 4I_0\cos^2\pi = 4I_0 = K$

When path difference is $\frac{\lambda}{4}$, phase difference will be $\frac{\pi}{2}$

$\therefore I' = 4I_0\cos^2\frac{\pi}{4} = 4I_0\times\frac{1}{2} = 2I_0 = \frac{K}{2}$

109 **(c)**
The spectral lines will overlap, i.e. they will have the same angle of diffraction of $\lambda_1 = \lambda_2$.

110 **(b)**
Distance between first and sixth minima,

$x = \frac{5\lambda D}{d}$

$d = \frac{5\lambda D}{x} = \frac{5\times5000\times10^{-10}\times0.5}{0.5\times10^{-3}}$

$d = 2.5\times10^{-3}$ m $= 2.5$ mm

111 **(c)**
Fringe width $X = \frac{\lambda D}{d}$

$\therefore X_1 - X_2 = \frac{\lambda(D_1 - D_2)}{d}$

$\therefore \lambda = \frac{(X_1 - X_2)d}{(D_1 - D_2)} = \frac{3\times10^{-5}\times10^{-3}}{5\times10^{-2}}$
$= 6\times10^{-7}\text{m} = 6000$Å

113 **(b)**
In diffraction experiment from a single slit, the angular width of central maxima,

$\theta = \frac{2\lambda}{a}$

where, $\lambda$ = wavelength of light used

and $a$ = width of the slit.

$\therefore$ Angular width does not depend upon the distance of the slit from the screen.

115 **(b)**
Angular width of central maximum

$\theta = \frac{2\lambda}{a}$

Where a is slit width

116 **(d)**
$\frac{I_1}{I_2} = \frac{49}{16}$

$\therefore \frac{A_1}{A_2} = \frac{7}{4}$

$$\therefore \frac{A_1 + A_2}{A_1 - A_2} = \frac{7+4}{7-4} = \frac{11}{3}$$

$$\therefore \frac{I_{max}}{I_{min}} = (11/3)^2 = \frac{121}{9}$$

118 **(a)**
Distance of point P from central maximum is 4.7 mm

Distance of second minimum from the central maximum= $1.5x = 1.5 \times 0.2mm = 0.3mm$

$\therefore$ If the point p and the central maximum are on the same side then the distance between them will be 4.7 – 0.3 = 4.4 mm. If they are on the opposite side, then the distance between them will be 4.7 + 0.3 = 5 mm

119 **(d)**
Intensity is directly proportional to square of the amplitude.

121 **(d)**
$a = 0.3 \text{ mm} = 0.3 \times 10^{-3} \text{ m}, D = 3\text{m}$

$x = 5.5 \text{ mm} = 5.5 \times 10^{-3} \text{ m}$

$$x = \frac{\lambda D}{a}$$

$$\therefore \lambda = \frac{xa}{D}$$

$$\therefore \lambda = \frac{5.5 \times 10^{-3} \times 0.3 \times 10^{-3}}{3} = 5.5 \times 10^{-7}\text{m}$$
$$= 5500\text{Å}$$

122 **(b)**
$X = \frac{2\lambda D}{a}$, X will decrease if a increases

124 **(b)**
fringe width $= X = \frac{\lambda_w D}{d}$

$\lambda_w = \frac{6.3 \times 10^{-7}}{1.33}, D = 1 \text{ m}, d$
$= 10^{-3}$ m [on substituting and solving]

$X = 6.3 \times 10^{-4}$ m

128 **(a)**
$$I \propto \frac{1}{\lambda^4}$$

$$\therefore \frac{I_1}{I_2} = \frac{\lambda_2^4}{\lambda_1^4} \Rightarrow I_2 = \frac{\lambda_1^4}{\lambda_2^4} I = \frac{(44)^4}{(66)^4} = \left(\frac{2}{3}\right)^4 I = \frac{16}{81} I$$

129 **(a)**
Coherent sources of light are those sources of light which emit light waves of same wavelength, same frequency and are in same phase or having constant phase difference.

131 **(a)**
The intensity at a point of maxima, $I_{\max} = 4I_0 = 4\text{Wm}^{-2}$

$\therefore \; I_0 = 1\text{Wm}^{-2}$

132 **(a)**
$d = 3 \text{ mm} = 3 \times 10^{-3}$ m

$D = 1$ m

$\lambda_1 = 480$ nm

$\lambda_2 = 600$ nm

$${}^1y_5 = 5\frac{\lambda_1 D}{d}$$

$${}^2y_5 = 5\frac{\lambda_2 D}{d}$$

$${}^2y_5 - {}^1y_5 = \frac{5D}{d}(600 - 480)\text{nm}$$

$$= \frac{5 \times 2}{3 \times 10^{-3}} \times 120 = 10 \times 10^{-3+1} \times 4$$

$$= 4 \times 10^{5-9} = 4 \times 10^{-4} = 0.4 \text{ mm}$$

133 **(a)**
For constructive interference,
Path difference, $\Delta x = d\sin\theta = n\lambda$
The angular position of bright fringes,

$$\theta = \sin^{-1}\left(\frac{n\lambda}{d}\right)$$

135 **(d)**
In single slit diffraction pattern, intensity and width of fringes are unequal width and unequal intensity.

137 **(c)**
Fringe width is given by $z = \frac{\lambda D}{d}$

$$\therefore \frac{z_A}{z_B} = \frac{d_B}{d_A}$$

139 **(a)**

$\mu \propto \frac{1}{\lambda}$

143 **(a)**

A plane wave $AB$ incident at an angle $i$ on a reflecting surface $MN$, then $t$ be the time taken by the wavefront to advance from point $B$ to $C$. So, from the given figure, the distance,

$BC = vt$

Where, $v$ is the speed of light.

For obtaining reflected wavefront, a sphere of radius vt should be drawn from the point $A$ (see figure given in question). The tangent $CE$ drawn on this sphere represents the reflected wavefront of $AB$.

144 **(d)**

The frequency of light does not change when it enters from one medium to another.

Refractive index $n_2 = \frac{V_1}{V_2} = \frac{v\lambda_1}{v\lambda_2} = \frac{\lambda_1}{\lambda_2}$

$\therefore \frac{3}{2} = \frac{\lambda_1}{\lambda_2}$

$\therefore \lambda_2 = \frac{2}{3}\lambda_1 = \frac{2}{3}\lambda$

146 **(c)**

According to Doppler effect,

$\lambda' = \lambda\sqrt{\frac{1 - v/c}{1 + v/c}}$ for v = c

$\lambda' = 5500\sqrt{\frac{(1 - 0.8)}{1 + 0.8}} = 1833.3$ Å

$\therefore$ Shift$= 5500 - 1833.3 \approx 3667$ Å

147 **(b)**

$\sin r = \frac{\sin 30°}{1.6} = \frac{1}{3.2} = 0.3125$

$\therefore r = 18°$

148 **(a)**

Path difference is $\frac{\lambda}{4}$, then phase difference will be $\frac{\pi}{2}$

Let I' be the intensity of each wave.

The resultant intensity is given by

$I = 4I'\cos^2\frac{\phi}{2}$

$= 4I'\cos^2\frac{\pi}{4} = 4I' \times \frac{1}{2}$

$= 2I'$

Maximum intensity $= 4I' = I_0$

$\therefore \frac{I_0}{I} = \frac{4I'}{2I'} = 2$

149 **(c)**

Angular width of central maximum is given by

$\theta = \frac{2\lambda}{a}$ where a is width of slit

Hence it does not depend on distance of slit from screen.

150 **(d)**

Intensity, $I_1 = I_2 = 1\text{Wm}^{-2}$

So, resultant intensity at third vertex,

$I = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

$= (\sqrt{1} + \sqrt{1})^2 = (1 + 1)^2 = 4\text{Wm}^{-2}$

151 **(c)**

Amplitude of the superimposing waves are

$\frac{a_1}{a_2} = \left(\frac{1}{9}\right)^{\frac{1}{2}} = \frac{1}{3}$

$\Rightarrow \frac{I_{\text{minima}}}{I_{\text{maxima}}} = \frac{(a_1 - a_2)^2}{(a_1 + a_2)^2} = \frac{1}{4}$

155 **(d)**

The phase difference ($\phi$) 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, $\phi = \frac{2\pi}{\lambda}\left(d \times \frac{\lambda}{d}\right) = 2\pi$

157 **(c)**

We know that, fringe width, $\beta = \frac{D\lambda}{d}$ .........(i)

According to the question,

$\beta' = \frac{D'\lambda}{d'} = \frac{3D\cdot\lambda}{d/2} = 6\frac{D\lambda}{d}$ ......(ii)

On dividing Eq. (ii) by Eq. (i), we get

$$\frac{\beta'}{\beta} = \frac{\frac{6D\lambda}{d}}{\frac{D\lambda}{d}} = 6 \Rightarrow \beta' = 6\beta$$

159 **(a)**

$i + i' = 90°$

$\therefore i = 45° \ (\because i = i')$

$\mu = \frac{\sin i}{\sin r} = \frac{3}{2}$

$\therefore \sin r = \frac{2}{3} \times \sin i = \frac{2}{3} \times \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{3}$

160 **(b)**

Position of $n$th maxima from central maxima is given by

$$x_n = \frac{n\lambda D}{d}$$

For 8th maxima, $x_8 = \frac{8\lambda_1 D}{d_1}$

and for 6th maxima, $x_6 = \frac{6\lambda_2 D}{d_2}$

Now, $x_6 = x_8 \Rightarrow \frac{d_1}{d_2} = \frac{8\lambda_1}{6\lambda_2} = \frac{4}{3}\left(\frac{\lambda_1}{\lambda_2}\right)$

161 **(a)**

Width of the central maximum $= \frac{2\lambda D}{d}$

$\therefore \frac{2\lambda D}{d} = d$

$\therefore D = \frac{d^2}{2\lambda}$

162 **(d)**

$\mu_1 \sin\alpha = \mu_2 \ \sin\beta = \mu_3 \sin\gamma = \mu_4 \sin\delta$

As AB and CD are parallel, $\alpha = \delta$

$\therefore \mu_1 = \mu_4$

163 **(b)**

$\mu_g = \frac{(\lambda_r)_{air}}{(\lambda_r)_{glass}} = \frac{6400}{4000} = 1.6$

$\therefore \mu_g = \frac{(\lambda_v)_{air}}{(\lambda_v)_{glass}}$

$\therefore (\lambda_v)_{glass} = \frac{(\lambda_v)_{air}}{\mu_g} = \frac{4400}{1.6} = 2750 \text{ Å}$

164 **(b)**

$\frac{2D\lambda}{a} = a$

$\therefore D = \frac{a^2}{2\lambda}$

166 **(a)**

We know that, $I \propto A^2 \Rightarrow A \propto \sqrt{I}$

$\therefore \frac{A_1}{A_2} = \sqrt{\frac{16}{9}} = \frac{4}{3}$

167 **(c)**

Every point on a given wavefront act as a secondary source of light and emits secondary wavelets which travels in all directions with the speed of light in the medium. A surface touching all these secondary wavelets tangentially in the forward direction, gives new wavefront (new position of wavefront) at that instant of time.

169 **(b)**

$y_5 = \frac{5\lambda D}{d}$

$y'_9 = \frac{17\lambda D}{2d}; X = \frac{\lambda D}{d}$

$\therefore y_5 = 5X$

$y'_9 = \frac{17}{2}X$

$\therefore |y_5 - y'_9| = X\left|5 - \frac{17}{2}\right| = X\frac{7}{2} = 3.5X$

171 **(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 lower surface is

$$I_2 = \frac{3I_0}{4} \times \frac{50}{100} = \frac{3I_0}{8}$$

$$\therefore \frac{I_{\max}}{I_{\min}} = \frac{\left(\sqrt{I_1} + \sqrt{I_2}\right)^2}{\left(\sqrt{I_1} - \sqrt{I_2}\right)^2} = \frac{\left(\frac{1}{2} + \sqrt{\frac{3}{8}}\right)^2}{\left(\frac{1}{2} - \sqrt{\frac{3}{8}}\right)^2}$$

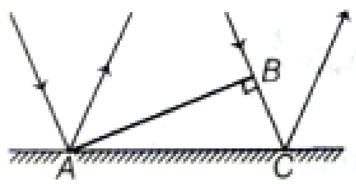
179 **(a)**
There is no interference fringes. Because wavelength of the sources are different.

180 **(a)**

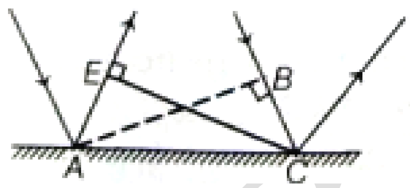
$$\mathrm{I} = 4\mathrm{I}_0 \cos^2 \frac{\phi}{2}; \phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2}$$

$$\frac{\phi}{2} = \frac{\pi}{4}; \frac{\mathrm{I}}{\mathrm{I}_0} = 4\cos^2 \frac{\pi}{4} = \frac{4}{2} = 2:1$$

182 **(c)**
Figure shows $AB$ as incident wavefront, so $A$ and $B$ are in same phase.




By the time $B$ reaches $C$, secondary wavelet from $A$ reaches $E$.




So, points $C$ and $E$ are same time intervals apart as they are in same phase.

183 **(a)**
Light can travel through vacuum. Hence, statement (A) is not correct.

184 **(c)**
At the same difference light from a source reaches at the same time in all the direction.
$\therefore$ Phase difference $= 0$

186 **(c)**
Distance of $n$th maxima, $x = n\lambda \frac{D}{d} \propto \lambda$

$\Rightarrow \lambda_b < \lambda_g$

$\therefore x_{\text{blue}} < x_{\text{green}}$

189 **(d)**

path difference $= 31.5\lambda = 63\dfrac{\lambda}{2}$

Since, path difference is odd integral multiple of half the wavelength, it is a dark point.

190 **(b)**
Intensity of light transmitted by first is half of intensity of unpolarised light $= 16\ \mathrm{W/m^2}$

192 **(d)**
From, $(\mu - 1)t = n\lambda$, we get

$$t = \frac{n\lambda}{(\mu - 1)}$$

When $n\lambda = \frac{\lambda}{2}$, then $t = \frac{\lambda}{2(\mu-1)}$.

193 **(d)**
$\mathrm{v_g} = 2 \times 10^8\ \mathrm{m/s}, \mathrm{v_w} = 2.25 \times 10^8\ \mathrm{m/s}$

$$\therefore {}_{\mathrm{g}}\mu_{\mathrm{w}} = \frac{\mathrm{v_g}}{\mathrm{v_w}} = \frac{2 \times 10^8}{2.25 \times 10^8} = 0.89$$

194 **(a)**
Since, the two bright fringes coincide.

or

$$1 + \frac{1}{n} = \frac{5}{4} \Rightarrow n = 4$$

195 **(c)**
Path difference, $x = (SS_1 + S_1O) - (SS_2 + S_2O)$. If $x = ni$, then central fringe at $O$ will be bright. If $x = (2n-1)\lambda/2$, then central fringe at $O$ will be dark.

196 **(d)**

Fringe with $\mathrm{Z} = \dfrac{\lambda \mathrm{D}}{\mathrm{d}}$

$$\therefore \frac{\mathrm{Z}}{\mathrm{D}} = \frac{\lambda}{\mathrm{d}} = \text{constant, as d is constant}$$

$$\therefore \frac{\mathrm{Z_1}}{\mathrm{D_1}} = \frac{\mathrm{Z_2}}{\mathrm{D_2}} = \frac{\mathrm{z_3}}{\mathrm{D_3}} = \frac{\mathrm{z_4}}{\mathrm{D_4}}$$

198 **(d)**

$$\left(\cos 45^0 = \frac{1}{\sqrt{2}}, \cos 0^0 = 1\right)$$

The intensity at a point is given by

$$\mathrm{I} = 4\mathrm{I}_0 \cos^2 \frac{\phi}{2}$$

Where I is the intensity of each wave and $\phi$ is the phase difference.

For the central point $\phi = 0$

$\therefore I = 4I_0$

At one-fourth of the band width

$\phi = \frac{2\pi}{4} = \frac{\pi^c}{2}$

$\therefore I' = 4I_0 \cos^2\frac{\pi}{4} = 4I_0 \times \frac{1}{2} = 2I_0$

$\therefore \frac{I}{I'} = 2$

200 **(a)**

${}_a\mu_g = \frac{v_a}{v_g} = \frac{d_a/t}{d_g/t} = \frac{d_a}{d_g} = \frac{x}{5}$

$\therefore x = 5 \times 1.5 = 7.5$ cm