Chapter 18. Optics

1. The ratio of resolving powers of an optical microscope for two wavelengths $\lambda_1 = 4000$ Å and $\lambda_2 = 6000$ Å is
(a) 9 : 4 (b) 3 : 2
(c) 16 : 81 (d) 8 : 27
(NEET 2017)

2. Young's double slit experiment is first performed in air and then in a medium other than air. It is found that 8^{th} bright fringe in the medium lies where 5^{th} dark fringe lies in air. The refractive index of the medium is nearly
(a) 1.59 (b) 1.69
(c) 1.78 (d) 1.25 *(NEET 2017)*

3. A beam of light from a source L is incident normally on a plane mirror fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source L. When the mirror is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is given by
(a) $\frac{y}{x}$ (b) $\frac{x}{2y}$
(c) $\frac{x}{y}$ (d) $\frac{y}{2x}$ *(NEET 2017)*

4. A thin prism having refracting angle 10° is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be
(a) 6° (b) 8°
(c) 10° (d) 4° *(NEET 2017)*

5. Two polaroids P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1. A third polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45° with that of P_1. The intensity of transmitted light through P_2 is
(a) $\frac{I_0}{4}$ (b) $\frac{I_0}{8}$
(c) $\frac{I_0}{16}$ (d) $\frac{I_0}{2}$ *(NEET 2017)*

6. Two identical glass ($\mu_g = 3/2$) equiconvex lenses of focal length f each are kept in contact. The space between the two lenses is filled with water ($\mu_w = 4/3$). The focal length of the combination is
(a) $f/3$ (b) f
(c) $4f/3$ (d) $3f/4$
(NEET-II 2016)

7. An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is
(a) 8 (b) 10
(c) 12 (d) 16
(NEET-II 2016)

The interference pattern is obtained with two coherent light sources of intensity ratio n. In the interference pattern, the ratio $\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ will be
(a) $\frac{\sqrt{n}}{n+1}$ (b) $\frac{2\sqrt{n}}{n+1}$
(c) $\frac{\sqrt{n}}{(n+1)^2}$ (d) $\frac{2\sqrt{n}}{(n+1)^2}$
(NEET-II 2016)

9. A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be
(a) convex, +2.25 diopter
(b) concave, –0.25 diopter
(c) concave, –0.2 diopter
(d) convex, +0.15 diopter *(NEET-II 2016)*

10. A linear aperture whose width is 0.02 cm is placed immediately in front of a lens of focal length 60 cm. The aperture is illuminated normally by a parallel beam of wavelength 5×10^{-5} cm. The distance of the first dark band of the diffraction pattern from the centre of the screen is

(a) 0.10 cm (b) 0.25 cm
(c) 0.20 cm (d) 0.15 cm

(NEET-II 2016)

11. Match the corresponding entries of **column 1** with **column 2**. [Where m is the magnification produced by the mirror]

Column 1	Column 2
(A) $m = -2$	(p) Convex mirror
(B) $m = -\frac{1}{2}$	(q) Concave mirror
(C) $m = +2$	(r) Real image
(D) $m = +\frac{1}{2}$	(s) Virtual image

(a) A → p and s; B → q and r; C → q and s; D → q and r
(b) A → r and s; B → q and s; C → q and r; D → p and s
(c) A → q and r; B → q and r; C → q and s; D → p and s
(d) A → p and r; B → p and s; C → p and q, D → r and s

(NEET-I 2016)

12. In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of

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

(NEET-I 2016)

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

(a) $\frac{3}{4}I_0$ (b) $\frac{I_0}{2}$
(c) I_0 (d) $\frac{I_0}{4}$

(NEET-I 2016)

14. A astronomical telescope has objective and eyepiece of focal lengths 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance

(a) 50.0 cm (b) 54.0 cm
(c) 37.3 cm (d) 46.0 cm

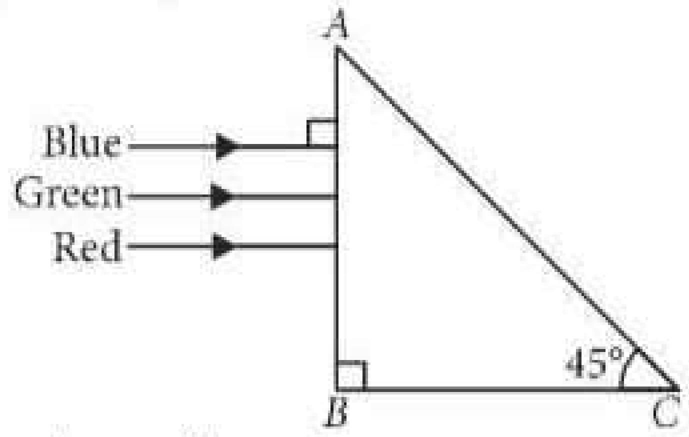
(NEET-I 2016)

15. The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are

(a) $45°; \sqrt{2}$ (b) $30°; \frac{1}{\sqrt{2}}$
(c) $45°; \frac{1}{\sqrt{2}}$ (d) $30°; \sqrt{2}$

(NEET-I 2016)

16. A beam of light consisting of red, green and blue colours is incident on a right angled prism. The refractive index of the material of the prism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively.



The prism will

(a) not separate the three colours at all
(b) separate the red colour part from the green and blue colours
(c) separate the blue colour part from the red and green colours
(d) separate all the three colours from one another

(2015)

17. At the first minimum adjacent to the central maximum of a single-slit diffraction pattern, the phase difference between the Huygen's wavelet from the edge of the slit and the wavelet from the midpoint of the slit is

(a) π radian (b) $\frac{\pi}{8}$ radian
(c) $\frac{\pi}{4}$ radian (d) $\frac{\pi}{2}$ radian

(2015)

18. In an astronomical telescope in normal adjustment a straight black line of length L is drawn on inside part of objective lens. The eye-piece forms a real image of this line. The length of this image is I. The magnification of the telescope is

(a) $\frac{L+I}{L-I}$ (b) $\frac{L}{I}$

(c) $\frac{L}{I}+1$ (d) $\frac{L}{I}-1$ *(2015)*

19. Two slits in Young's experiment have widths in the ratio 1 : 25. The ratio of intensity at the maxima and minima in the interference pattern, $\frac{I_{max}}{I_{min}}$ is

(a) $\frac{49}{121}$ (b) $\frac{4}{9}$

(c) $\frac{9}{4}$ (d) $\frac{121}{49}$ *(2015)*

20. For a parallel beam of monochromatic light of wavelength 'λ', diffraction is produced by a single slit whose width 'a' is of the order of the wavelength of the light. If 'D' is the distance of the screen from the slit, the width of the central maxima will be

(a) $\frac{Da}{\lambda}$ (b) $\frac{2Da}{\lambda}$

(c) $\frac{2D\lambda}{a}$ (d) $\frac{D\lambda}{a}$

(2015 Cancelled)

21. Two identical thin plano-convex glass lenses (refractive index 1.5) each having radius of curvature of 20 cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is

(a) –50 cm (b) 50 cm

(c) –20 cm (d) –25 cm

(2015 Cancelled)

22. The refracting angle of a prism is A, and refractive index of the material of the prism is cot (A/2). The angle of minimum deviation is

(a) $90° - A$ (b) $180° + 2A$

(c) $180° - 3A$ (d) $180° - 2A$

(2015 Cancelled)

23. In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maxima of single slit pattern?

(a) 0.5 mm (b) 0.02 mm

(c) 0.2 mm (d) 0.1 mm

(2015 Cancelled)

24. A beam of light of $\lambda = 600$ 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 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 *(2014)*

25. In the Young's double slit experiment, the intensity of light at a point on the screen where the path difference λ is K, (λ being the wavelength of light used). The intensity at a point where the path difference is $\lambda/4$ will be

(a) K (b) $K/4$

(c) $K/2$ (d) zero *(2014)*

26. If the focal length of objective lens is increased then magnifying power of

(a) microscope will increase but that of telescope decrease.

(b) microscope and telescope both will increase.

(c) microscope and telescope both will decrease.

(d) microscope will decrease but that of telescope will increase. *(2014)*

27. The angle of a prism is A. One of its refracting surfaces is silvered. Light rays falling at an angle of incidence $2A$ on the first surface returns back through the same path after suffering reflection at the silvered surface. The refractive index μ, of the prism is

(a) $2\sin A$ (b) $2\cos A$

(c) $\frac{1}{2}\cos A$ (d) $\tan A$ *(2014)*

28. A plano convex lens fits exactly into a plano concave lens. Their plane surfaces are parallel to each other. If lenses are made of different materials of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then the focal length of the combination is

(a) $\frac{R}{(\mu_1-\mu_2)}$ (b) $\frac{2R}{(\mu_2-\mu_1)}$

(c) $\frac{R}{2(\mu_1+\mu_2)}$ (d) $\frac{R}{2(\mu_1-\mu_2)}$

(NEET 2013)

29. In Young's double slit experiment, the slits are 2 mm apart and are illuminated by photons of two wavelengths $\lambda_1 = 12000$ Å and $\lambda_2 = 10000$ Å. At what minimum distance from the common central bright fringe on the screen 2 m from the slit will a bright fringe from one interference pattern coincide with a bright fringe from the other?

(a) 4 mm (b) 3 m
(c) 8 mm (d) 6 mm

(NEET 2013)

30. For a normal eye, the cornea of eye provides a converging power of 40 D and the least converging power of the eye lens behind the cornea is 20 D. Using this information, the distance between the retina and the cornea-eye lens can be estimated to be

(a) 1.67 cm (b) 1.5 cm
(c) 5 cm (d) 2.5 cm

(NEET 2013)

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

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

(NEET 2013)

32. In Young's double slit experiment the distance between the slits and the screen is doubled. The separation between the slits is reduced to half. As a result the fringe width

(a) is halved
(b) becomes four times
(c) remains unchanged
(d) is doubled *(Karnataka NEET 2013)*

33. A parallel beam of light of wavelength λ is incident normally on a narrow slit. A diffraction pattern formed on a screen placed perpendicular to the direction of the incident beam. At the second minimum of the diffraction pattern, the phase difference between the rays coming from the two edges of slit is

(a) 2π (b) 3π
(c) 4π (d) $\pi\lambda$

(Karnataka NEET 2013)

34. The reddish appearance of the sun at sunrise and sunset is due to

(a) the scattering of light
(b) the polarisation of light
(c) the colour of the sun
(d) the colour of the sky

(Karnataka NEET 2013)

35. Two plane mirrors are inclined at 70°. A ray incident on one mirror at angle, θ after reflection falls on second mirror and is reflected from there parallel to first mirror. The value of θ is

(a) 45° (b) 30°
(c) 55° (d) 50°

(Karnataka NEET 2013)

36. When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index

(a) equal to that of glass
(b) less than one
(c) greater than that of glass
(d) less than that of glass *(2012)*

37. A ray of light is incident at an angle of incidence i, on one face of a prism of angle A (assumed to be small) and emerges normally from the opposite face. If the refractive index of the prism is μ, the angle of incidence i, is nearly equal to

(a) μA (b) $\frac{\mu A}{2}$
(c) $\frac{A}{\mu}$ (d) $\frac{A}{2\mu}$ *(2012, 1989)*

38. A concave mirror of focal length f_1 is placed at a distance of d from a convex lens of focal length f_2. A beam of light coming from infinity and falling on this convex lens – concave mirror combination returns to infinity. The distance d must equal

(a) $f_1 + f_2$ (b) $-f_1 + f_2$
(c) $2f_1 + f_2$ (d) $-2f_1 + f_2$ *(2012)*

39. The magnifying power of a telescope is 9. When it is adjusted for parallel rays the distance between the objective and eyepiece is 20 cm. The focal length of lenses are

(a) 10 cm, 10 cm (b) 15 cm, 5 cm
(c) 18 cm, 2 cm (d) 11 cm, 9 cm

(2012)

40. For the angle of minimum deviation of a prism to be equal to its refracting angle, the prism must be made of a material whose refractive index

(a) lies between $\sqrt{2}$ and 1
(b) lies between 2 and $\sqrt{2}$
(c) is less than 1
(d) is greater than 2 *(Mains 2012)*

41. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is
(a) 10 cm (b) 15 cm
(c) 2.5 cm (d) 5 cm
(Mains 2012)

42. Which of the following is not due to total internal reflection?
(a) Working of optical fibre
(b) Difference between apparent and real depth of a pond
(c) Mirage on hot summer days
(d) Brilliance of diamond *(2011)*

43. A biconvex lens has a radius of curvature of magnitude 20 cm. Which one of the following options describe best the image formed of an object of height 2 cm placed 30 cm from the lens?
(a) Virtual, upright, height = 1 cm
(b) Virtual, upright, height = 0.5 cm
(c) Real, inverted, height = 4 cm
(d) Real, inverted, height = 1 cm *(2011)*

44. A thin prism of angle 15° made of glass of refractive index $\mu_1 = 1.5$ is combined with another prism of glass of refractive index $\mu_2 = 1.75$. The combination of the prisms produces dispersion without deviation. The angle of the second prism should be
(a) 5° (b) 7°
(c) 10° (d) 12°
(Mains 2011)

45. A converging beam of rays is incident on a diverging lens. Having passed through the lens the rays intersect at a point 15 cm from the lens on the opposite side. If the lens is removed the point where the rays meet will move 5 cm closer to the lens. The focal length of the lens is
(a) 5 cm (b) –10 cm
(c) 20 cm (d) –30 cm
(Mains 2011)

46. A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45°. For which of the following value of μ the ray can undergo total internal reflection?
(a) $\mu = 1.33$ (b) $\mu = 1.40$
(c) $\mu = 1.50$ (d) $\mu = 1.25$
(2010)

47. A lens having focal length f and aperture of diameter d forms an image of intensity I. Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively
(a) f and $\frac{I}{4}$ (b) $\frac{3f}{4}$ and $\frac{I}{2}$
(c) f and $\frac{3I}{4}$ (d) $\frac{f}{2}$ and $\frac{I}{2}$
(2010)

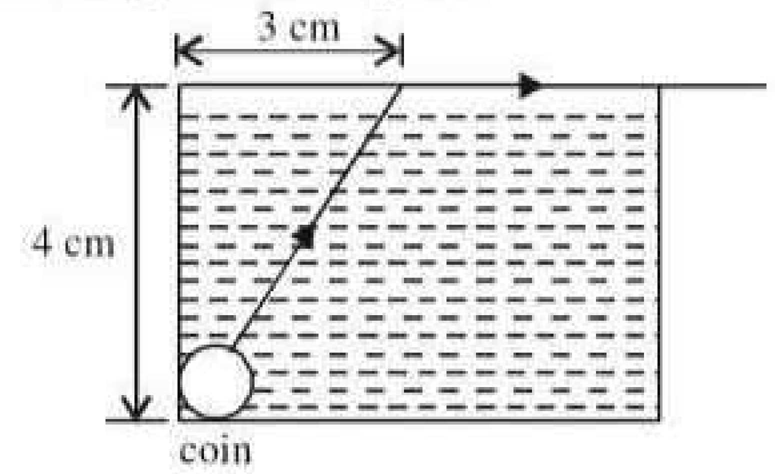
48. The speed of light in media M_1 and M_2 are 1.5×10^8 m/s and 2.0×10^8 m/s respectively. A ray of light enters from medium M_1 to M_2 at an incidence angle i. If the ray suffers total internal reflection, the value of i is
(a) Equal to $\sin^{-1}\left(\frac{2}{3}\right)$
(b) Equal to or less than $\sin^{-1}\left(\frac{3}{5}\right)$
(c) Equal to or greater than $\sin^{-1}\left(\frac{3}{4}\right)$
(d) Less than $\sin^{-1}\left(\frac{2}{3}\right)$ *(Mains 2010)*

49. A ray of light is incident on a 60° prism at the minimum deviation position. The angle of refraction at the first face (*i.e.*, incident face) of the prism is
(a) zero (b) 30°
(c) 45° (d) 60°
(Mains 2010)

50. Two thin lenses of focal lengths f_1 and f_2 are in contact and coaxial. The power of the combination is
(a) $\frac{f_1 + f_2}{2}$ (b) $\frac{f_1 + f_2}{f_1 f_2}$
(c) $\sqrt{\frac{f_1}{f_2}}$ (d) $\sqrt{\frac{f_2}{f_1}}$ *(2008)*

51. A boy is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length 10 cm. The diameter of the sun is 1.39×10^9 m and its mean distance from the earth is 1.5×10^{11} m. What is the diameter of the sun's image on the paper?
(a) 6.5×10^{-5} m (b) 12.4×10^{-4} m
(c) 9.2×10^{-4} m (d) 6.5×10^{-4} m
(2008)

52. A small coin is resting on the bottom of a beaker filled with liquid. A ray of light from the coin travels upto the surface of the liquid and moves along its surface. How fast is the light travelling in the liquid?



(a) 2.4×10^8 m/s (b) 3.0×10^8 m/s
(c) 1.2×10^8 m/s (d) 1.8×10^8 m/s. *(2007)*

53. The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000 Å. The refractive index of material will be
(a) 1.50 (b) 3.00
(c) 1.33 (d) 1.40 *(2007)*

54. A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again?
(a) 2 cm upward (b) 1 cm upward
(c) 4.5 cm downward
(d) 1 cm downward. *(2006)*

55. A convex lens and a concave lens, each having same focal length of 25 cm, are put in contact to form a combination of lenses. The power in diopters of the combination is
(a) zero (b) 25
(c) 50 (d) infinite. *(2006)*

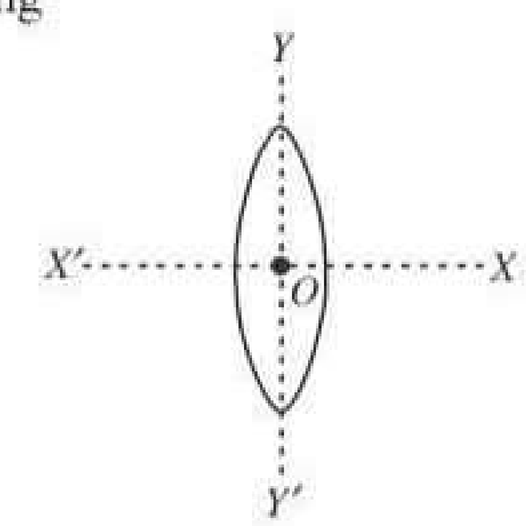
56. The angular resolution of a 10 cm diameter telescope at a wavelength of 5000 Å is of the order of
(a) 10^6 rad (b) 10^{-2} rad
(c) 10^{-4} rad (d) 10^{-6} rad. *(2005)*

57. A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometre from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000 Å, is of the order of
(a) 0.5 m (b) 5 m
(c) 5 mm (d) 5 cm *(2004)*

58. The refractive index of the material of a prism is $\sqrt{2}$ and its refracting angle is 30°. One of the refracting surfaces of the prism is made a mirror inwards. A beam of monochromatic light entering the prism from the other face will retrace its path after reflection from the mirrored surface if its angle of incidence on the prism is
(a) 45° (b) 60°
(c) 0 (d) 30° *(2004)*

59. A beam of light composed of red and green ray is incident obliquely at a point on the face of rectangular glass slab. When coming out on the opposite parallel face, the red and green ray emerge from
(a) Two points propagating in two different non parallel directions
(b) Two points propagating in two different parallel directions.
(c) One point propagating in two different directions.
(d) One point propagating in the same directions. *(2004)*

60. An equiconvex lens is cut into two halves along (i) XOX' and (ii) YOY' as shown in the figure. Let f, f', f'' be the focal lengths of the complete lens, of each half in case (i), and of each half in case (ii), respectively.
Choose the correct statement from the following



(a) $f' = f, f'' = 2f$ (b) $f' = 2f, f'' = f$
(c) $f' = f, f'' = f$ (d) $f' = 2f, f'' = 2f$ *(2003)*

61. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will
(a) become zero (b) become infinite
(c) become small, but non-zero
(d) remain unchanged *(2003)*

62. A bulb is located on a wall. Its image is to be obtained on a parallel wall with the help of convex lens. The lens is placed at a distance d ahead of second wall, then required focal length will be
(a) only $\frac{d}{4}$ (b) only $\frac{d}{2}$

(c) more than $\frac{d}{4}$ but less than $\frac{d}{2}$

(d) less than $\frac{d}{4}$. *(2002)*

63. Diameter of human eye lens is 2 mm. What will be the minimum distance between two points to resolve them, which are situated at a distance of 50 meter from eye. The wavelength of light is 5000 Å

(a) 2.32 m (b) 4.28 mm
(c) 1.25 cm (d) 12.48 cm. *(2002)*

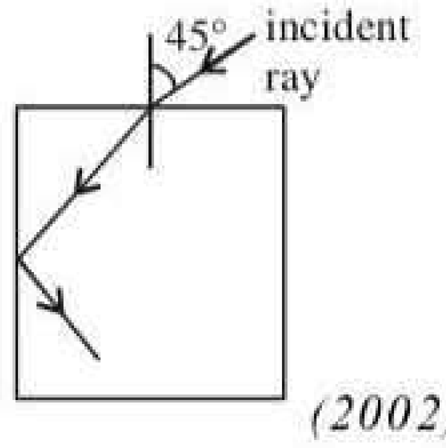
64. For the given incident ray as shown in figure, the condition of total internal refraction of this ray the required refractive index of prism will be

(a) $\frac{\sqrt{3}+1}{2}$

(b) $\frac{\sqrt{2}+1}{2}$

(c) $\sqrt{\frac{3}{2}}$

(d) $\sqrt{\frac{7}{6}}$. *(2002)*



65. Optical fibre are based on
(a) total internal reflection
(b) less scattering (c) refraction
(d) less absorption coefficient. *(2001)*

66. A ray of light travelling in air have 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 following?
(a) $\lambda = \lambda'$ (b) $n = n'$
(c) $v = v'$ (d) $I = I'$. *(2001)*

67. A disc is placed on a surface of pond which has refractive index 5/3. A source of light is placed 4 m below the surface of liquid. The minimum radius of disc needed so that light is not coming out is,
(a) ∞ (b) 3 m
(c) 6 m (d) 4 m. *(2001)*

68. A bubble in glass slab (μ = 1.5) when viewed from one side appears at 5 cm and 2 cm from other side, then thickness of slab is
(a) 3.75 cm (b) 3 cm
(c) 10.5 cm (d) 2.5 cm. *(2000)*

69. A tall man of height 6 feet, want to see his full image. Then required minimum length of the mirror will be
(a) 12 feet (b) 3 feet
(c) 6 feet (d) any length. *(2000)*

70. For a plano convex lens (μ = 1.5) has radius of curvature 10 cm. It is silvered on its plane surface. Find focal length after silvering
(a) 10 cm (b) 20 cm
(c) 15 cm (d) 25 cm. *(2000)*

71. Rainbow is formed due to
(a) scattering and refraction
(b) internal reflection and dispersion
(c) reflection only
(d) diffraction and dispersion. *(2000)*

72. A plano convex lens is made of refractive index 1.6. The radius of curvature of the curved surface is 60 cm. The focal length of the lens is
(a) 200 cm (b) 100 cm
(c) 50 cm (d) 400 cm *(1999)*

73. Colours appear on a thin soap film and on soap bubbles due to the phenomenon of
(a) interference (b) dispersion
(c) refraction (d) diffraction *(1999)*

74. If the refractive index of a material of equilateral prism is $\sqrt{3}$, then angle of minimum deviation of the prism is
(a) 60° (b) 45°
(c) 30° (d) 75° *(1999)*

75. A luminous object is placed at a distance of 30 cm from the convex lens of focal length 20 cm. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature 10 cm be placed in order to have an upright image of the object coincident with it?
(a) 50 cm (b) 30 cm
(c) 12 cm (d) 60 cm *(1998)*

76. Light enters at an angle of incidence in a transparent rod of refractive index n. For what value of the refractive index of the material of the rod the light once entered into it will not leave it through its lateral face whatsoever be the value of angle of incidence?
(a) $n = 1.1$ (b) $n = 1$
(c) $n > \sqrt{2}$ (d) $n = 1.3$ *(1998)*

77. An astronomical telescope of tenfold angular magnification has a length of 44 cm. The focal length of the objective is
(a) 44 cm (b) 440 cm
(c) 4 cm (d) 40 cm. *(1997)*

78. The focal length of converging lens is measured for violet, green and red colours. It is respectively f_v, f_g, f_r. We will get
(a) $f_v < f_r$ (b) $f_g > f_r$
(c) $f_v = f_g$ (d) $f_g > f_r$. *(1997)*

79. An electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively

(a) n, 2λ and $\frac{v}{\mu}$ (b) $\frac{2n}{\mu}$, $\frac{\lambda}{\mu}$ and v

(c) $\frac{n}{\mu}$, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$ (d) n, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$.

(1997)

80. If a convex lens of focal length 80 cm and a concave lens of focal length 50 cm are combined together, what will be their resulting power?

(a) +7.5 D (b) – 0.75 D

(c) +6.5 D (d) – 6.5 D. *(1996)*

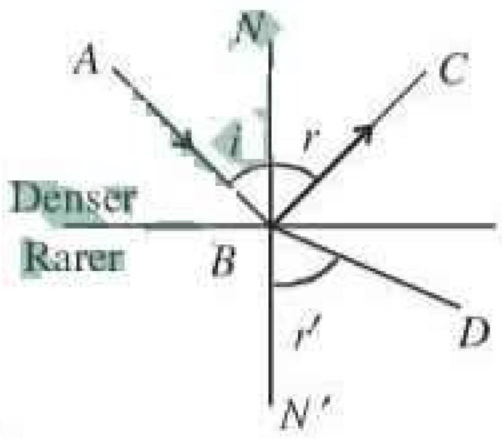
81. The refractive index of water is 1.33. What will be the speed of light in water?

(a) 4×10^8 m/s (b) 1.33×10^8 m/s

(c) 3×10^8 m/s (d) 2.25×10^8 m/s.

(1996)

82. A ray of light from a denser medium strikes a rare medium as shown in figure. The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are r and r'. The critical angle would be



(a) $\sin^{-1}(\tan r)$ (b) $\sin^{-1}(\sin r)$

(c) $\cos^{-1}(\tan r)$ (d) $\tan^{-1}(\sin r)$

(1996)

83. If f_V and f_R are the focal lengths of a convex lens for violet and red light respectively and F_V and F_R are the focal lengths of a concave lens for violet and red light respectively, then we must have

(a) $f_V > f_R$ and $F_V > F_R$

(b) $f_V < f_R$ and $F_V > F_R$

(c) $f_V > f_R$ and $F_V < F_R$

(d) $f_V < f_R$ and $F_V < F_R$. *(1996)*

84. Light travels through a glass plate of thickness t and having a refractive index μ. If c is the velocity of light in vacuum, the time taken by light to travel this thickness of glass is

(a) $\frac{t}{\mu c}$ (b) $\frac{\mu t}{c}$

(c) $t\mu c$ (d) $\frac{tc}{\mu}$. *(1996)*

85. A lens is placed between a source of light and a wall. It forms images of area A_1 and A_2 on the wall, for its two different positions. The area of the source of light is

(a) $\frac{A_1 - A_2}{2}$ (b) $\frac{1}{A_1} + \frac{1}{A_2}$

(c) $\sqrt{A_1 A_2}$ (d) $\frac{A_1 + A_2}{2}$.

(1995)

86. Exposure time of camera lens at $f/2.8$ setting is 1/200 second. The correct time of exposure at $f/5.6$ is

(a) 0.20 second (b) 0.40 second

(c) 0.02 second (d) 0.04 second.

(1995)

87. 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) 13 cm (b) 14 cm

(c) 12.5 cm (d) 12 cm. *(1995)*

88. Four lenses of focal length ±15 cm and ± 150 cm are available for making a telescope. To produce the largest magnification, the focal length of the eyepiece should be

(a) +15 cm (b) +150 cm

(c) – 150 cm (d) – 15 cm.

(1994)

89. The blue colour of the sky is due to the phenomenon of

(a) scattering (b) dispersion

(c) reflection (d) refraction.

(1994)

90. Ray optics is valid, when characteristic dimensions are
(a) much smaller than the wavelength of light
(b) of the same order as the wavelength of light
(c) of the order of one millimetre
(d) much larger than the wavelength of light. *(1994, 1989)*

91. A small source of light is 4 m below the surface of water of refractive index 5/3. In order to cut off all the light, coming out of water surface, minimum diameter of the disc placed on the surface of water is
(a) 6 m (b) ∞
(c) 3 m (d) 4 m. *(1994)*

92. 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 focussed by a convex lens on a screen placed in focal plane. The first minimum will be formed for the angle of diffraction equal to
(a) 0° (b) 15°
(c) 30° (d) 50° *(1993)*

93. Interference was observed in interference chamber where 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 brighter bands
(c) interference with dark bands
(d) interference with larger width *(1993)*

94. Time taken by sunlight to pass through a window of thickness 4 mm whose refractive index is $\frac{3}{2}$ is
(a) 2×10^{-4} s (b) 2×10^{8} s
(c) 2×10^{-11} s (d) 2×10^{11} s *(1993)*

95. There is a prism with refractive index equal to $\sqrt{2}$ and the refractive angle equal to 30°. One of the refractive surface of the prism is polished. A beam of monochromatic light will be retrace its path if its angle of indence over the refracting surface of the prism is
(a) 0° (b) 30°
(c) 45° (d) 60° *(1992)*

96. If yellow light emitted by sodium lamp in Young's double slit expt is replaced by monochromatic blue of light of the same intensity
(a) fringe width will decrease
(b) fringe width will increase
(c) fringe width will remain unchanged
(d) fringes will becomes less intense *(1992)*

97. In Young's double slit experiment carried out with light of wavelength (λ) = 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 *(1992)*

98. A beam of monochromatic light is refracted from vacuum into a medium of refractive index 1.5. The wavelength of refracted light will be
(a) depend on intensity of refracted light
(b) same
(c) smaller
(d) larger *(1992, 1991)*

99. Green light wavelength 5460 Å is incident on an air-glass interface. If the refractive index of glass is 1.5, the wavelength of light in glass would be ($c = 3 \times 10^8$ ms^{-1})
(a) 3640 Å (b) 5460 Å
(c) 4861 Å (d) none of these *(1991)*

100. Ratio of intensities of two waves are given by 4 : 1. Then ratio of the amplitudes of the two waves is
(a) 2 : 1 (b) 1 : 2
(c) 4 : 1 (d) 1 : 4 *(1991)*

101. In Young's experiment, two coherent sources are placed 0.90 mm apart and fringe are observed one metre away. If it produces second dark fringe at a distance of 1 mm from central fringe, the wavelength of monochromatic light is used would be
(a) 60×10^{-4} cm (b) 10×10^{-4} cm
(c) 10×10^{-5} cm (d) 6×10^{-5} cm *(1991)*

102. In 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 $\frac{4}{3}$, without disturbing the geometrical arrangement, the new fringe width will be

(a) 0.30 mm (b) 0.40 mm
(c) 0.53 mm (d) 450 microns *(1990)*

103. 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 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) $\frac{x(\text{blue})}{x(\text{green})} = \frac{5460}{4360}$ *(1990)*

104. Interference is possible in
(a) light waves only
(b) sound waves only
(c) both light and sound waves
(d) neither light nor sound waves *(1989)*

105. Which of the phenomenon is not common to sound and light waves ?
(a) Interference (b) Diffraction
(c) Coherence (d) Polarisation *(1988)*

106. 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 *(1988)*

107. Focal length of a convex lens of refractive index 1.5 is 2 cm. Focal length of lens when immersed in a liquid of refractive index of 1.25 will be
(a) 10 cm (b) 2.5 cm
(c) 5 cm (d) 7.5 cm *(1988)*

Answer Key

1. (b)	2. (c)	3. (d)	4. (a)	5. (b)	6. (d)	7. (c)	8. (b)	9. (b)	10. (d)
11. (c)	12. (b)	13. (b)	14. (b)	15. (d)	16. (b)	17. (a)	18. (b)	19. (c)	20. (c)
21. (a)	22. (d)	23. (c)	24. (d)	25. (c)	26. (d)	27. (b)	28. (a)	29. (d)	30. (a)
31. (a)	32. (b)	33. (c)	34. (a)	35. (d)	36. (a)	37. (a)	38. (c)	39. (c)	40. (b)
41. (d)	42. (b)	43. (c)	44. (c)	45. (d)	46. (c)	47. (c)	48. (c)	49. (b)	50. (b)
51. (c)	52. (d)	53. (b)	54. (b)	55. (a)	56. (c)	57. (c)	58. (a)	59. (b)	60. (a)
61. (b)	62. (b)	63. (c)	64. (c)	65. (a)	66. (b)	67. (b)	68. (c)	69. (b)	70. (a)
71. (b)	72. (b)	73. (a)	74. (a)	75. (a)	76. (c)	77. (d)	78. (a)	79. (d)	80. (b)
81. (d)	82. (a)	83. (b)	84. (b)	85. (c)	86. (c)	87. (d)	88. (a)	89. (a)	90. (d)
91. (a)	92. (c)	93. (d)	94. (c)	95. (c)	96. (a)	97. (b)	98. (c)	99. (a)	100. (a)
101. (d)	102. (a)	103. (c)	104. (c)	105. (d)	106. (d)	107. (c)			

EXPLANATIONS

1. **(b)** : The resolving power of an optical microscope,

$$RP = \frac{2\mu \sin\theta}{\lambda}$$

For wavelength $\lambda_1 = 4000$ Å, resolving power will be

$$RP_1 = \frac{2\mu \sin\theta}{4000} \quad \text{...(i)}$$

For wavelength $\lambda_2 = 6000$ Å, resolving power will be

$$RP_2 = \frac{2\mu \sin\theta}{6000} \quad \text{...(ii)}$$

On dividing eqn. (i) by eqn. (ii)

$$= \frac{RP_1}{RP_2} = \frac{6000}{4000} = \frac{3}{2}$$

2. **(c)** : Position of 8th bright fringe in medium,

$$x = \frac{8\lambda_m D}{d}$$

Position of 5th dark fringe in air,

$$x' = \frac{\left(5 - \frac{1}{2}\right)\lambda_{air} D}{d}$$

$$x' = \frac{4.5\,\lambda_{air} D}{d}$$

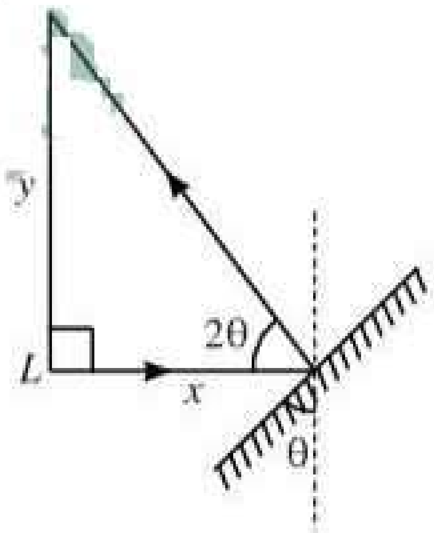
Given $x = x'$

$$\therefore \frac{8\lambda_m D}{d} = \frac{4.5\lambda_{air} D}{d}$$

$$\mu_m = \frac{\lambda_{air}}{\lambda_m} = \frac{8}{4.5} = 1.78$$

3. **(d)** : When mirror is rotated by θ angle reflected ray will be rotated by 2θ.

For small angle θ,



$$\tan 2\theta \approx 2\theta = \frac{y}{x}$$

$$\therefore \theta = \frac{y}{2x}$$

4. **(a)** : The condition for dispersion without deviation is given as $(\mu - 1)A = (\mu' - 1)A'$

Given $\mu = 1.42$, $A = 10°$, $\mu' = 1.7$, $A' = ?$

$\therefore$ $(1.42 - 1) \times 10 = (1.7 - 1)A'$

$(0.42) \times 10 = 0.7 \times A'$

or $A' = \frac{0.42 \times 10}{0.7} = 6°$

5. **(b)** : The intensity of transmitted light through P_1,

$$I_1 = \frac{I_0}{2}$$

The intensity of transmitted light through P_3,

$$I_2 = I_1 \cos^2 45° = \frac{I_o}{2}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_o}{2}\cdot\frac{1}{2} = \frac{I_o}{4}$$

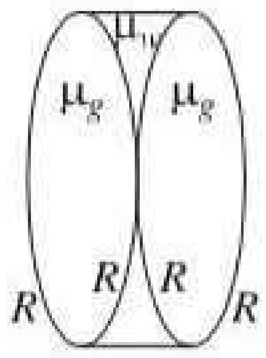
Angle between polaroids P_3 and $P_2 = (90° - 45°) = 45°$

$\therefore$ Intensity of transmitted light through P_2,

$$I_3 = I_2 \cos^2 45° = \frac{I_o}{4}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_o}{8}$$

6. **(d)** : Here, $\mu_g = \frac{3}{2}$, $\mu_w = \frac{4}{3}$

Focal length (f) of glass convex lens is given by



$$\frac{1}{f} = (\mu_g - 1)\left(\frac{2}{R}\right)$$

or $\frac{1}{f} = \left(\frac{3}{2} - 1\right)\frac{2}{R} = \frac{1}{R}$ or $f = R$ ...(i)

Focal length (f') of water filled concave lens is given by

$$\frac{1}{f'} = (\mu_w - 1)\left(-\frac{2}{R}\right) \text{ or } \frac{1}{f'} = \left(\frac{4}{3} - 1\right)\left(-\frac{2}{R}\right)$$

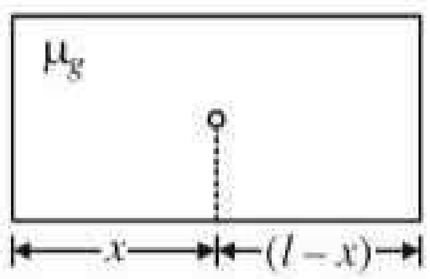
$$= -\frac{2}{3R} = -\frac{2}{3f} \quad \text{[Using eqn. (i)]}$$

Equivalent focal length (f_{eq}) of lens system

$$\frac{1}{f_{eq}} = \frac{1}{f} - \frac{2}{3f} + \frac{1}{f} = \frac{3 - 2 + 3}{3f} = \frac{4}{3f}$$

$$\therefore f_{eq} = \frac{3f}{4}$$

7. **(c)**: Here $\mu = 1.5$



l = length of the slab

x = position of air bubble from one side

As per question, total apparent length of slab = 5 + 3

or $\frac{x}{\mu}+\frac{(l-x)}{\mu}=8$ or $\frac{l}{\mu}=8$ $\therefore$ $l=8\mu=8\times 15=12$ cm

8. **(b) :** Here, $\frac{I_1}{I_2}=n$

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

$$\frac{I_{max}-I_{min}}{I_{max}+I_{min}}=\frac{\frac{I_{max}}{I_{min}}-1}{\frac{I_{max}}{I_{min}}+1}$$

$$=\frac{\left(\frac{\sqrt{n}+1}{\sqrt{n}-1}\right)^2-1}{\left(\frac{\sqrt{n}+1}{\sqrt{n}-1}\right)^2+1}=\frac{(\sqrt{n}+1)^2-(\sqrt{n}-1)^2}{(\sqrt{n}+1)^2+(\sqrt{n}-1)^2}$$

$$=\frac{4\sqrt{n}}{2(n+1)}=\frac{2\sqrt{n}}{n+1}$$

9. **(b) :** Here, u = 400 cm = 4 m, $v=\infty$, f = ?

Using lens formula, $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

or $\frac{1}{\infty}-\frac{1}{4}=\frac{1}{f}$ or $f=-4$ m

Lens should be concave.

Power of lens $=\frac{1}{f}=\frac{1}{-4}=-0.25$ D

10. **(d) :** Here, $a=0.02$ cm $=2\times 10^{-4}$ m

$\lambda=5\times 10^{-5}$ cm $=5\times 10^{-7}$ m

$D=60$ cm $=0.6$ m

Position of first minima on the diffraction pattern,

$$y_1=\frac{D\lambda}{a}=\frac{0.6\times 5\times 10^{-7}}{2\times 10^{-4}}=15\times 10^{-4}\text{ m}=0.15\text{ cm}$$

11. **(c) :** Magnification in the mirror, $m=-\frac{v}{u}$

$m=-2\Rightarrow v=2u$

As v and u have same signs so the mirror is concave and image formed is real.

$m=-\frac{1}{2}\Rightarrow v=\frac{u}{2}\Rightarrow$ Concave mirror and real image.

$m=+2\Rightarrow v=-2u$

As v and u have different signs but magnification is 2 so the mirror is concave and image formed is virtual.

$m=+\frac{1}{2}\Rightarrow v=-\frac{u}{2}$

As v and u have different signs with magnification $\left(\frac{1}{2}\right)$ so the mirror is convex and image formed is virtual.

12. **(b) :** For first minimum,
the path difference between extreme waves,

$a\sin\theta=\lambda$

Here $\theta=30°\Rightarrow\sin\theta=\frac{1}{2}$

$\therefore\ a=2\lambda$ ...(i)

For first secondary maximum, the path difference between extreme waves

$a\sin\theta'=\frac{3}{2}\lambda$ or $(2\lambda)\sin\theta'=\frac{3}{2}\lambda$ [Using eqn (i)]

or $\sin\theta'=\frac{3}{4}$ $\therefore$ $\theta'=\sin^{-1}\left(\frac{3}{4}\right)$

13. **(b) :** Here, $d=5\lambda$, $D=10d$, $y=\frac{d}{2}$.

Resultant Intensity at $y=\frac{d}{2}$, $I_y=?$

The path difference between two waves at $y=\frac{d}{2}$

$$\Delta x=d\tan\theta=d\times\frac{y}{D}=\frac{d\times\frac{d}{2}}{10d}=\frac{d}{20}=\frac{5\lambda}{20}=\frac{\lambda}{4}$$

Corresponding phase difference, $\phi=\frac{2\pi}{\lambda}\Delta x=\frac{\pi}{2}$.

Now, maximum intensity in Young's double slit experiment,

$I_{max}=I_1+I_2+2I_1I_2$

$I_0=4I$ $(\because\ I_1=I_1=I)$

$\therefore\ I=\frac{I_0}{4}$.

Required intensity,

$$I_y=I_1+I_2+2I_1I_2\cos\frac{\pi}{2}=2I=\frac{I_0}{2}$$

14. **(b) :** Here $f_o=40$ cm, $f_e=4$ cm

Tube length(l) = Distance between lenses = v_o+f_e

For objective lens,

$u_o=-200$ cm, v_o = ?

$\frac{1}{v_0}-\frac{1}{u_0}=\frac{1}{f_0}$ or $\frac{1}{v_0}-\frac{1}{-200}=\frac{1}{40}$

or $\frac{1}{v_0}=\frac{1}{40}-\frac{1}{200}=\frac{4}{200}$ $\therefore$ $v_0=50$ cm

$\therefore\ l=50+4=54$ cm

15. (d) : Given, $i = 45°, A = 60°$

Since the ray undergoes minimum deviation, therefore, angle of emergence from second face, $e = i = 45°$

$\therefore \quad \delta_m = i + e - A = 45° + 45° - 60° = 30°$

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{60°+30°}{2}\right)}{\sin\left(\frac{60°}{2}\right)}$$

$$= \frac{\sin 45°}{\sin 30°} = \frac{1}{\sqrt{2}} \times \frac{2}{1} = \sqrt{2}$$

16. (b) : As beam of light is incident normally on the face AB of the right angled prism ABC, so no refraction occurs at face AB and it passes straight and strikes the face AC at an angle of incidence , $i = 45°$.

For total reflection to take place at face AC,

$i > i_c$ or $\sin i > \sin i_c$

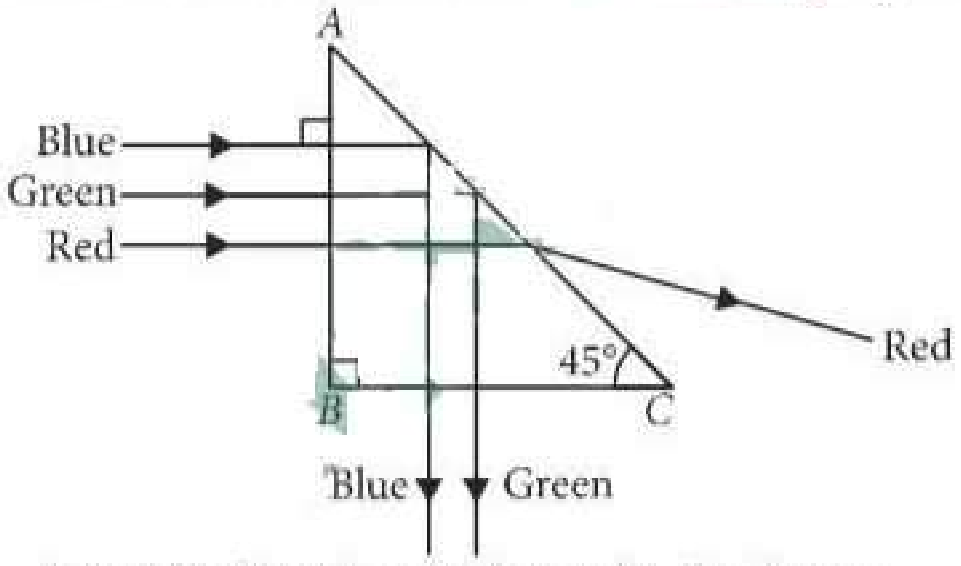
where i_c is the critical angle.

But as here $i = 45°$ and $\sin i_c = \frac{1}{\mu}$

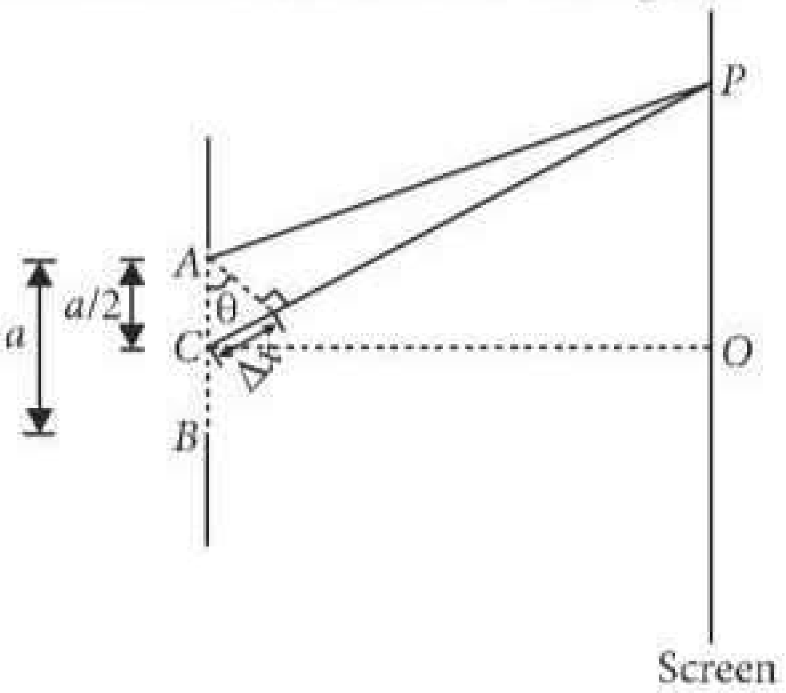
$\therefore \quad \sin 45° > \frac{1}{\mu}$ or $\frac{1}{\sqrt{2}} > \frac{1}{\mu}$ or $\mu > \sqrt{2} = 1.414$

As $\mu_{red} (= 1.39) < \mu (= 1.414)$ while $\mu_{green} (= 1.44)$ and $\mu_{blue} (= 1.47) > \mu\ (= 1.414)$, so only red colour will be transmitted through face AC while green and blue colours will suffer total internal reflection.

So the prism will separate red colour from the green and blue colours as shown in the following figure.



17. (a) : The situation is shown in the figure.



In figure A and B represent the edges of the slit AB of width a and C represents the midpoint of the slit. For the first minimum at P,

$a\sin\theta = \lambda$ ...(i)

where λ is the wavelength of light.

The path difference between the wavelets from A to C is

$$\Delta x = \frac{a}{2}\sin\theta = \frac{1}{2}(a\sin\theta) = \frac{\lambda}{2} \quad \text{(using (i))}$$

The corresponding phase difference $\Delta\phi$ is

$$\Delta\phi = \frac{2\pi}{\lambda}\Delta x = \frac{2\pi}{\lambda} \times \frac{\lambda}{2} = \pi$$

18. (b)

19. (c) : As, intensity $I \propto$ width of slit W

Also, intensity $I \propto$ square of amplitude A

$$\therefore \quad \frac{I_1}{I_2} = \frac{W_1}{W_2} = \frac{A_1^2}{A_2^2}$$

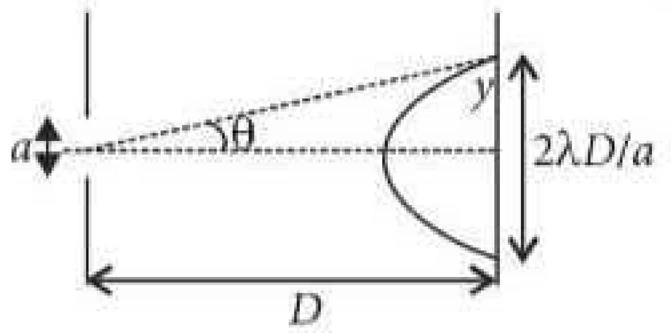
But $\frac{W_1}{W_2} = \frac{1}{25}$ (given)

$$\therefore \quad \frac{A_1^2}{A_2^2} = \frac{1}{25} \quad \text{or} \quad \frac{A_1}{A_2} = \sqrt{\frac{1}{25}} = \frac{1}{5}$$

$$\therefore \quad \frac{I_{max}}{I_{min}} = \frac{(A_1 + A_2)^2}{(A_1 - A_2)^2} = \frac{\left(\frac{A_1}{A_2} + 1\right)^2}{\left(\frac{A_1}{A_2} - 1\right)^2}$$

$$= \frac{\left(\frac{1}{5} + 1\right)^2}{\left(\frac{1}{5} - 1\right)^2} = \frac{\left(\frac{6}{5}\right)^2}{\left(-\frac{4}{5}\right)^2} = \frac{36}{16} = \frac{9}{4}$$

20. (c) : Given situation is shown in the figure.



For central maxima, $\sin\theta = \frac{\lambda}{a}$

Also, θ is very-very small so

$$\sin\theta \approx \tan\theta = \frac{y}{D}$$

$$\therefore \quad \frac{y}{D} = \frac{\lambda}{a}, \qquad y = \frac{\lambda D}{a}$$

Width of central maxima $= 2y = \frac{2\lambda D}{a}$.

21. (a)

22. (d) : As $\mu = \dfrac{\sin\left(\dfrac{A+\delta}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

$$\cot\frac{A}{2} = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\left(\frac{A}{2}\right)} \qquad \left[\because\ \mu = \cot\frac{A}{2}\right]$$

$$\frac{\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\sin\left(\frac{\pi}{2}-\frac{A}{2}\right) = \sin\left(\frac{A}{2}+\frac{\delta}{2}\right); \frac{\pi}{2}-\frac{A}{2} = \frac{A}{2}+\frac{\delta}{2}$$

$$\therefore \quad \delta = \pi - 2A = 180° - 2A$$

23. (c) : For double slit experiment,

$d = 1$ mm $= 1\times10^{-3}$ m, $D = 1$ m, $\lambda = 500\times10^{-9}$ m

Fringe width $\beta = \dfrac{D\lambda}{d}$

Width of central maxima in a single slit

As per question, width of central maxima of single slit pattern = width of 10 maxima of double slit pattern

$$\frac{2\lambda D}{a} = 10\left(\frac{\lambda D}{d}\right)$$

$$a = \frac{2d}{10} = \frac{2\times10^{-3}}{10} = 0.2\times10^{-3}\text{ m} = 0.2\text{ mm}$$

24. (d) : Here, $\lambda = 600$ nm $= 600\times10^{-9}$ m

$a = 1$ mm $= 10^{-3}$ m, $D = 2$ m

Distance between the first dark fringes on either side of the central bright fringe is also the width of central maximum.

Width of central maximum $= \dfrac{2\lambda D}{a}$

$$= \frac{2\times600\times10^{-9}\text{ m}\times2\text{ m}}{10^{-3}\text{ m}}$$

$= 24\times10^{-4}$ m $= 2.4\times10^{-3}$ m $= 2.4$ mm

25. (c) : Intensity at any point on the screen is

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

where I_0 is the intensity of either wave and ϕ is the phase difference between two waves.

Phase difference, $\phi = \dfrac{2\pi}{\lambda}\times$ Path difference

When path difference is λ, then

$$\phi = \frac{2\pi}{\lambda}\times\lambda = 2\pi$$

$$\therefore \quad I = 4I_0\cos^2\left(\frac{2\pi}{2}\right) = 4I_0\cos^2(\pi) = 4I_0 = K \quad ...(i)$$

When path difference is $\dfrac{\lambda}{4}$, then

$$\phi = \frac{2\pi}{\lambda}\times\frac{\lambda}{4} = \frac{\pi}{2}$$

$$\therefore \quad I = 4I_0\cos^2\left(\frac{\pi}{4}\right) = 2I_0 = \frac{K}{2} \qquad \text{[Using (i)]}$$

26. (d) : Magnifying power of a microscope,

$$m = \left(\frac{L}{f_o}\right)\left(\frac{D}{f_e}\right)$$

where f_o and f_e are the focal lengths of the objective and eyepiece respectively and L is the distance between their focal points and D is the least distance of distinct vision.

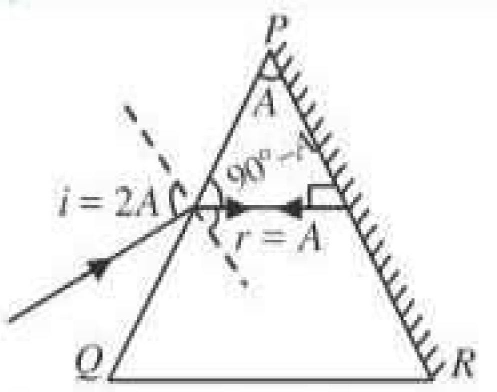
If f_o increases, then m will decrease.

Magnifying power of a telescope, $m = \dfrac{f_o}{f_e}$

where f_o and f_e are the focal lengths of the objective and eyepiece respectively.

If f_o increases, then m will increase.

27. (b) :



On reflection from the silvered surface, the incident ray will retrace its path, if it falls normally on the surface.

By geometry, $r = A$

Applying Snell's law at surface PQ,

$1\sin i = \mu\sin r$

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

28. (a) : The combination of two lenses 1 and 2 is as shown in figure.

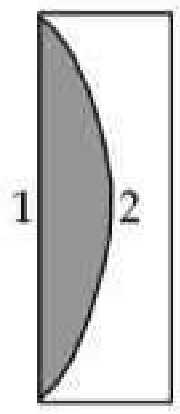
$$\therefore \quad \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

According to lens maker's formula

$$\frac{1}{f_1} = (\mu_1 - 1)\left(\frac{1}{\infty} - \frac{1}{-R}\right) = \frac{(\mu_1 - 1)}{R}$$

$$\frac{1}{f_2} = (\mu_2 - 1)\left(\frac{1}{-R} - \frac{1}{\infty}\right)$$

$$= (\mu_2 - 1)\left(-\frac{1}{R}\right) = -\frac{(\mu_2 - 1)}{R}$$



$\therefore \quad \frac{1}{f} = \frac{(\mu_1 - 1)}{R} - \frac{(\mu_2 - 1)}{R}$

$\frac{1}{f} = \frac{(\mu_1 - \mu_2)}{R}; \quad f = \frac{R}{(\mu_1 - \mu_2)}$

29. (d) : Let n_1 bright fringe of λ_1 coincides with n_2 bright fringe of λ_2. Then

$\frac{n_1 \lambda_1 D}{d} = \frac{n_2 \lambda_2 D}{d}$ or $n_1\lambda_1 = n_2\lambda_2$

$\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} = \frac{10000}{12000} = \frac{5}{6}$

Let x be given distance.

$\therefore \quad x = \frac{n_1 \lambda_1 D}{d}$

Here, $n_1 = 5$, $D = 2$ m, $d = 2$ mm $= 2 \times 10^{-3}$ m

$\lambda_1 = 12000$ Å $= 12000 \times 10^{-10}$ m $= 12 \times 10^{-7}$ m

$x = \frac{5 \times 12 \times 10^{-7}\text{ m} \times 2\text{ m}}{2 \times 10^{-3}\text{ m}} = 6 \times 10^{-3}\text{ m} = 6\text{ mm}$

30. (a) : Converging power of cornea, $P_c = +40$ D

Least converging power of eye lens, $P_e = +20$ D

Power of the eye-lens, $P = P_c + P_e$

$= 40\text{ D} + 20\text{ D} = 60\text{ D}$

Power of the eye lens

$P = \frac{1}{\text{Focal length of the eye lens }(f)}$

$f = \frac{1}{P} = \frac{1}{60\text{ D}} = \frac{1}{60}\text{ m} = \frac{100}{60}\text{ cm} = \frac{5}{3}\text{ cm}$

Distance between the retina and cornea-eye lens

= Focal length of the eye lens

$= \frac{5}{3}\text{ cm} = 1.67\text{ cm}$

31. (a)

32. (b) : Fringe width, $\beta = \frac{\lambda D}{d}$

where D is the distance between slits and screen and d is the distance between the slits.

When D is doubled and d is reduced to half, then fringe width becomes

$\beta' = \frac{\lambda(2D)}{(d/2)} = \frac{4\lambda D}{d} = 4\beta$

33. (c) : For the second minimum,

Path difference $= 2\lambda$

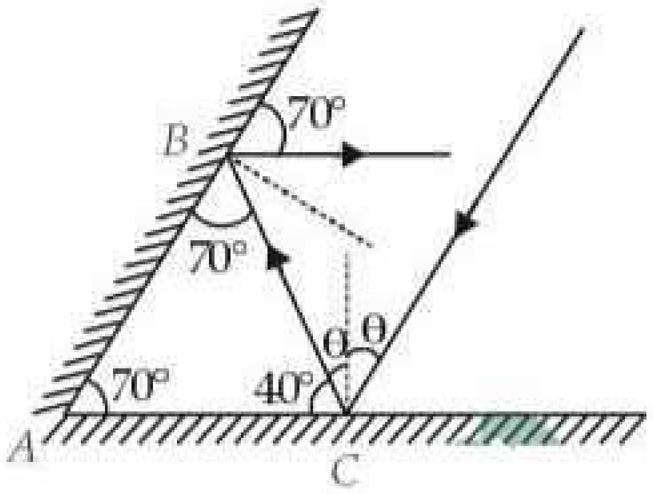
Therefore, corresponding value of phase difference is

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

$\therefore \quad \Delta\phi = \frac{2\pi}{\lambda} \times 2\lambda = 4\pi$

34. (a) : The reddish appearance of the sun at sunrise and sunset is due to the scattering of light.

35. (d) : Different angles as shown in the figure.



$\theta + 40° = 90°$

$\therefore \quad \theta = 90° - 40° = 50°$

36. (a) : According to lens maker's formula

$\frac{1}{f} = \left(\frac{\mu_g}{\mu_L} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

where μ_g is the refractive index of the material of the lens and μ_L is the refractive index of the liquid in which lens is dipped.

As the biconvex lens dipped in a liquid acts as a plane sheet of glass, therefore

$f = \infty \Rightarrow \frac{1}{f} = 0$

$\therefore \quad \frac{\mu_g}{\mu_L} - 1 = 0$ or $\mu_g = \mu_L$

37. (a) : As the emergent ray emerges normally from the opposite face,

$\therefore \quad e = 0, r_2 = 0$ As $r_1 + r_2 = A$

$\therefore \quad r_1 = A$

Applying Snell's law for incident ray

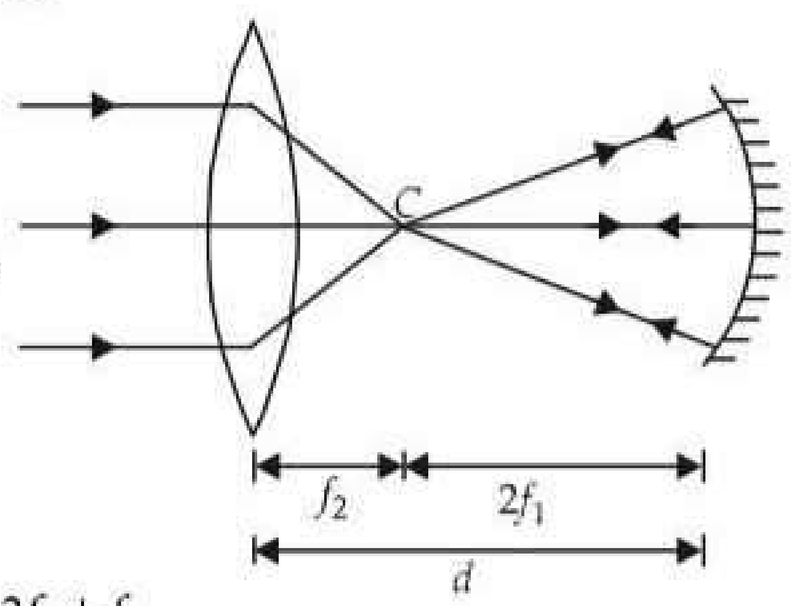
$1\sin i = \mu \sin r_1 = \mu \sin A$

or $\quad \mu = \frac{\sin i}{\sin A}$

For small angle, $\sin i \approx i$, $\sin A \approx A$

$\therefore \quad \mu = \frac{i}{A}$ or $i = \mu A$

38. (c) :



$\therefore \quad d = 2f_1 + f_2$

39. (c) : Magnifying power, $m = \frac{f_o}{f_e} = 9$ ...(i)

where f_o and f_e are the focal lengths of the objective and eyepiece respectively

Also $f_o + f_e = 20$ cm ...(ii)

On solving (i) and (ii), we get

$f_o = 18$ cm, $f_e = 2$ cm

40. (b) : As $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$$\mu = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin A}{\sin\left(\frac{A}{2}\right)} \quad (\because \delta_m = A(\text{Given}))$$

$$= \frac{2\sin\left(\frac{A}{2}\right)\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = 2\cos\left(\frac{A}{2}\right)$$

As $\delta = i + e - A$

At minimum deviation, $\delta = \delta_m$, $i = e$

$\therefore \quad \delta_m = 2i - A$

$2i = \delta_m + A$

$$i = \frac{\delta_m + A}{2} = \frac{A+A}{2} = A \quad (\because \delta_m = A(\text{given}))$$

$i_{min} = 0° \Rightarrow A_{min} = 0°$

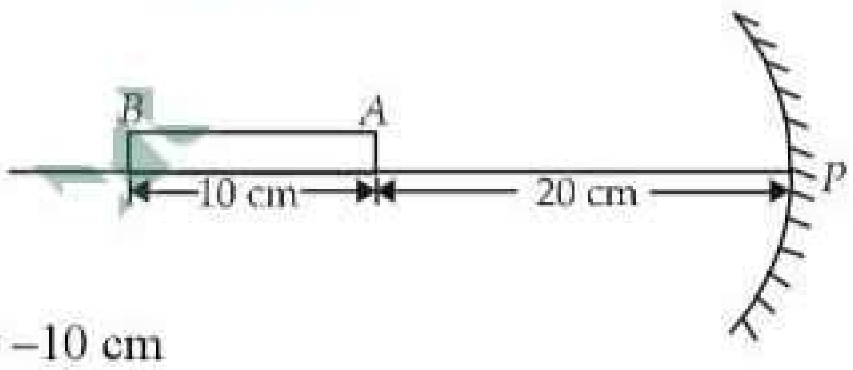
Then, $\mu_{max} = 2\cos 0° = 2$

$\because \; i_{max} = \frac{\pi}{2} \Rightarrow A_{max} = \frac{\pi}{2}$

Then, $\mu_{min} = 2\cos 45° = 2 \times \frac{1}{\sqrt{2}} = \sqrt{2}$

So refractive index lies between 2 and $\sqrt{2}$.

41. (d) :



Here, $f = -10$ cm

For end A, $u_A = -20$ cm

Image position of end A,

$$\frac{1}{v_A} + \frac{1}{u_A} = \frac{1}{f}$$

$$\frac{1}{v_A} + \frac{1}{(-20)} = \frac{1}{(-10)} \text{ or } \frac{1}{v_A} = \frac{1}{-10} + \frac{1}{20} = -\frac{1}{20}$$

$v_A = -20$ cm

For end B, $u_B = -30$ cm

Image position of end B,

$$\frac{1}{v_B} + \frac{1}{u_B} = \frac{1}{f}$$

$$\frac{1}{v_B} + \frac{1}{(-30)} = \frac{1}{(-10)} \text{ or } \frac{1}{v_B} = \frac{1}{-10} + \frac{1}{30} = -\frac{2}{30}$$

$v_B = -15$ cm

Length of the image

$= |v_A| - |v_B| = 20 \text{ cm} - 15 \text{ cm} = 5 \text{ cm}$

42. (b) : Difference between apparent and real depth of a pond is due to refraction. Other three are due to total internal reflection.

43. (c)

44. (c) : For dispersion without deviation

$\delta_1 + \delta_2 = 0$

$(\mu_1 - 1)A_1 + (\mu_2 - 1)A_2 = 0$

$$A_2 = -\frac{(\mu_1 - 1)A_1}{(\mu_2 - 1)}$$

Substituting the given values, we get

$$A_2 = -\frac{(1.5-1)15°}{(1.75-1)} = -10°$$

–ve sign shows that two prisms must be joined in opposition.

45. (d) : Here, $v = +15$ cm, $u = +(15 - 5) = +10$ cm

According to lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{15} - \frac{1}{10} = \frac{1}{f} \quad \Rightarrow f = -30 \text{ cm}$$

46. (c) : For total internal reflection, $\sin i > \sin C$

where, i = angle of incidence, C = critical angle

But, $\sin C = \frac{1}{\mu} \quad \therefore \quad \sin i > \frac{1}{\mu}$ or $\mu > \frac{1}{\sin i}$

$\mu > \frac{1}{\sin 45°} \qquad (i = 45° \text{ (Given)})$

$\mu > \sqrt{2}$

Hence, option (c) is correct.

47. (c) : Focal length of the lens remains same. Intensity of image formed by lens is proportional to area exposed to incident light from object.

i.e. Intensity $\propto$ area

or $\frac{I_2}{I_1} = \frac{A_2}{A_1}$

Initial area, $A_1 = \pi\left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$

After blocking, exposed area,

$$A_2 = \frac{\pi d^2}{4} - \frac{\pi(d/2)^2}{4} = \frac{\pi d^2}{4} - \frac{\pi d^2}{16} = \frac{3\pi d^2}{16}$$

$\therefore \quad \frac{I_2}{I_1} = \frac{A_2}{A_1} = \frac{\frac{3\pi d^2}{16}}{\frac{\pi d^2}{4}} = \frac{3}{4}$

or $\quad I_2 = \frac{3}{4}I_1 = \frac{3}{4}I \qquad (\because I_1 = I)$

Hence, focal length of a lens = f, intensity of the image $= \frac{3I}{4}$

48. (c) : Refractive index for medium M_1 is

$$\mu_1 = \frac{c}{v_1} = \frac{3\times10^8}{1.5\times10^8} = 2$$

Refractive index for medium M_2 is

$$\mu_2 = \frac{c}{v_2} = \frac{3\times10^8}{2.0\times10^8} = \frac{3}{2}$$

For total internal reflection, $\sin i \geq \sin C$

where i = angle of incidence, C = critical angle

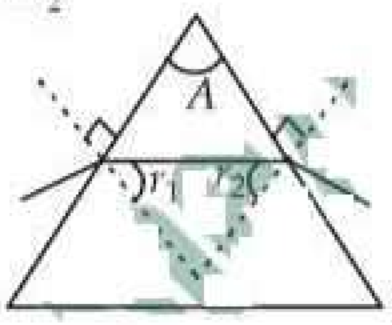
But $\sin C = \frac{\mu_2}{\mu_1}$

$$\sin i \geq \frac{\mu_2}{\mu_1} \geq \frac{3/2}{2} \Rightarrow i \geq \sin^{-1}\left(\frac{3}{4}\right)$$

49. (b) : Angle of prism, $A = r_1 + r_2$

For minimum deviation

$r_1 = r_2 = r \quad \therefore A = 2r$



Given, $A = 60°$

Hence, $r = \frac{A}{2} = \frac{60°}{2} = 30°$

50. (b) : $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$; $\quad \therefore$ Power $P = \frac{f_1 + f_2}{f_1 f_2}$

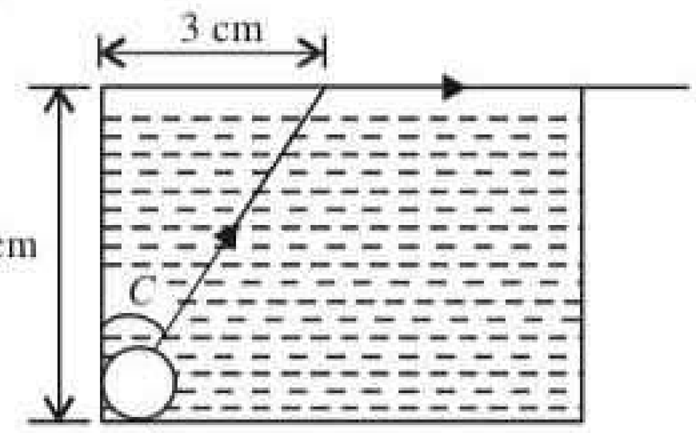
51. (c) : $\frac{\text{size of image}}{\text{size of object}} = \left|\frac{v}{u}\right|$

$\Rightarrow$ size of the image $= \frac{1.39\times10^9\times10^{-1}}{1.5\times10^{11}} = 0.92\times10^{-3}$ m

$= 0.92 \times 10^{-3}$ m.

size of the image $= 9.2 \times 10^{-4}$ m

52. (d) :



From figure, $\sin C = \frac{3}{\sqrt{(4)^2+(3)^2}} = \frac{3}{5}$

where C is the critical angle.

Also, $\sin C = {}^l\mu_a$

$\sin C = \frac{1}{{}^a\mu_l} \quad \left[\text{since } {}^l\mu_a = \frac{1}{{}^a\mu_l}\right]$

Also $\; {}^a\mu_l = \frac{\text{velocity of light in air } (c)}{\text{velocity of light in liquid } (v)}$

$\therefore \quad \sin C = \frac{v}{c} = \frac{v}{3\times10^8}$

or, $\quad v = 3\times10^8\times\frac{3}{5} = 1.8\times10^8$ ms^{-1}.

53. (b) : $\mu = \frac{\text{velocity of light in vacuum } (c)}{\text{velocity of light in medium } (v)}$

$\therefore \quad v = \upsilon\lambda = 2\times10^{14}\times5000\times10^{-10}$

In the medium, $v = 10^8$ m/s

$\therefore \quad \mu = \frac{v_{\text{vac}}}{v_{\text{med}}} = \frac{3\times10^8}{10^8} = 3.$

54. (b) : Apparent depth $= \frac{\text{real depth}}{\mu} = \frac{3}{1.5} = 2$ cm

As image appears to be raised by 1 cm, therefore, microscope must be moved upwards by 1 cm.

55. (a) : Focal length of convex lens $f_1 = 25$ cm

Focal length of concave lens $f_2 = -25$ cm

Power of combination in dioptres,

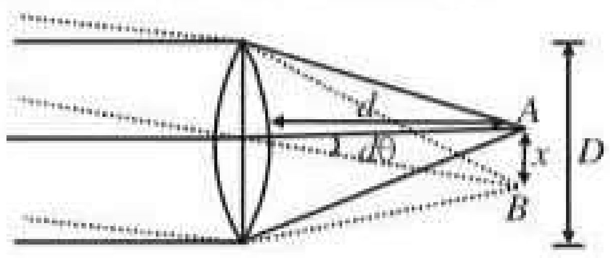
$$P = P_1 + P_2 = \frac{100}{f_1} + \frac{100}{f_2} = \frac{100}{25} - \frac{100}{25} = 0.$$

56. (c) : R.P. $= 1/\Delta\theta$

The angular resolution, $\Delta\theta = \frac{1.22\lambda}{D}$

$$= \frac{1.22\times5000\times10^{-8}}{0.1} = 6.1\times10^{-4} \simeq 10^{-4}.$$

57. (c) : Resolution of telescope



$d\theta = 1.22\frac{\lambda}{D} = 1.22\times\frac{5000\times10^{-8}}{10} \quad \tan\theta \simeq d\theta$

$x = d\theta \times d$

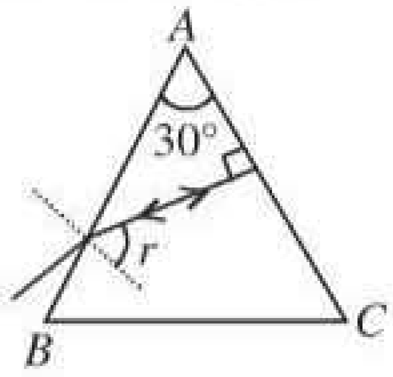
$= \frac{1.22\times5000\times10^{-8}\times10^5}{10} \; [d = 10^5 \text{ cm}] \simeq 5$ mm

58. (a) : $\angle r = 30°$ (using law of triangle)

$\Rightarrow \mu = \frac{\sin i}{\sin r}$

$\Rightarrow \sqrt{2}\times\sin 30 = \sin i$

$\Rightarrow \sin i = \frac{1}{\sqrt{2}} \Rightarrow i = 45°$

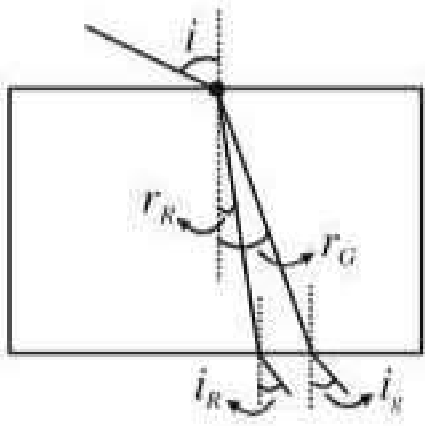


59. (b) : The velocities of different colours is different in a given medium. Red and green are refracted at different angle of refraction.

$$\frac{\sin i}{\sin r_R} = \mu \quad \text{...(i)}$$

$$\frac{\sin i}{\sin r_G} = \mu \quad \text{...(ii)}$$

$$\frac{\sin r_p}{\sin i_p} = \mu \quad \text{...(iii)}$$



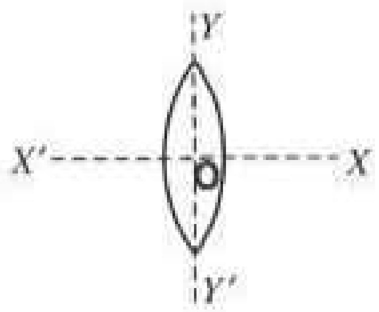
From equation (i), (ii) and (iii)

$\Rightarrow i = i_R = i_G$

Thus two point propagation in two different parallel direction.

60. (a) : Since the lens is equiconvex, the radius of curvature of each half is same, say R. We know from Lens maker's formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$



(considering the lens to be placed in air). Here $R_1 = R$

$R_2 = -R$ by convection

$$\therefore \frac{1}{f} = (\mu - 1)\frac{2}{R} \Rightarrow (\mu - 1)\frac{1}{R} = \frac{1}{2f} \quad \text{...(i)}$$

If we cut the lens along XOX' then the two halves of the lens will be having the same radii of curvature and so, focal length $f' = f$

But when we cut it along YOY' then, we will have

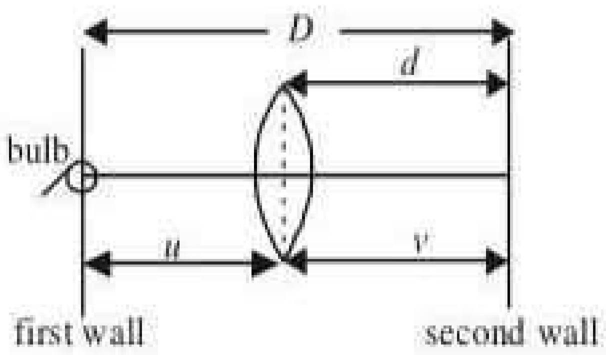
$R_1 = R$ but $R_2 = \infty$

$$\therefore \frac{1}{f''} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right) = (\mu - 1)\frac{1}{R} = \frac{1}{2f}$$

$\Rightarrow f'' = 2f.$

61. (b) : When refractive index of lens is equal to the refractive index of liquid, the lens behave like a plane surface with focal length infinity.

62. (b) : A real image is to be formed on the 2^{nd} wall of the bulb placed on the first wall by the convex lens. The lens is placed at a distance of d from the 2^{nd} wall.



Now, we know that to form a real image of an object on a screen by a convex lens, the distance between the source and the screen (D) should be equal to $4f$, where f is the focal length of the lens.

In that case, $u = v = D/2 = d$.

$\therefore f = D/4 = d/2$.

63. (c) : Resolving power of eyelens

$$= \frac{d}{\lambda} = \frac{2\times10^{-1}}{5000\times10^{-8}} = \frac{1}{d\theta}$$

[Given d = diameter of lens = 2 mm = 2×10^{-1} cm,

$\lambda = 5000$ Å $= 5000 \times 10^{-8}$ cm].

Let S be the minimum distance between two points so that it may be resolved.

$\therefore S = rd\theta$. Here $r = 50$ m = 5000 cm.

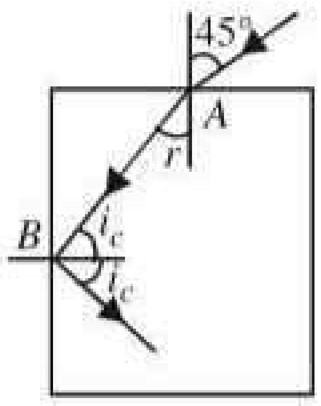
$$\therefore S = 5000\times\frac{5000\times10^{-8}}{2\times10^{-1}} = 1.25 \text{ cm}.$$

64. (c) : Applying Snell's law of refraction at A, we get

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin 45^\circ}{\sin r}$$

$\therefore \sin r = 1/\sqrt{2}\mu$

$$\therefore r = \sin^{-1}\left(\frac{1}{\sqrt{2}\mu}\right) \quad \text{... (i)}$$



Applying the condition of total internal reflection at B, we get

$i_c = \sin^{-1}(1/\mu)$ ... (ii)

where i_c is the critical angle.

Now, $r + i_c = 90° = \pi/2$.

$$\therefore \sin^{-1}\frac{1}{\sqrt{2}\mu} = \frac{\pi}{2} - \sin^{-1}\frac{1}{\mu}$$

$$\text{or, } \sin^{-1}\frac{1}{\sqrt{2}\mu} = \cos^{-1}\frac{1}{\mu}$$

$$\therefore \frac{1}{\sqrt{2}\mu} = \frac{\sqrt{\mu^2-1}}{\mu} \text{ or } \frac{1}{2} = \mu^2 - 1. \therefore \mu = \sqrt{3/2}.$$

65. (a)

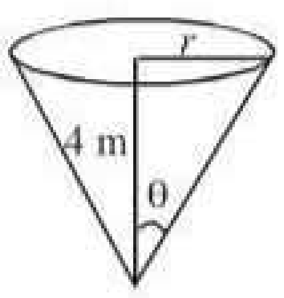
66. (b) : Frequency remains same.

67. (b) : θ is the critical angle.

$\therefore \theta = \sin^{-1}(1/\mu) = \sin^{-1}(3/5)$

or, $\sin\theta = 3/5$.

$\therefore \tan\theta = 3/4 = r/4$ or, $r = 3$ m.



68. (c) : Total apparent depth,

$y = y_1 + y_2 = 5 + 2 = 7$ cm.

If x is real depth = thickness of slab, then as

$$\mu = \frac{\text{real depth}}{\text{apparent depth}} = \frac{x}{y}$$

or, $x = \mu y = 1.5 \times 7 = 10.5$ cm.

69. (b) : The minimum mirror length should be half of the height of man.

70. (a) : $\frac{1}{f}=(\mu-1)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$

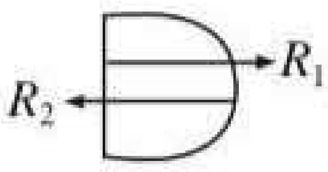
$=(1.5-1)\left[\frac{1}{\infty}-\frac{1}{(-10)}\right]=0.5\left[\frac{1}{10}\right]\Rightarrow f=20 \text{ cm}$

When plane surface is silvered, $F=\frac{f}{2}=\frac{20}{2}=10$ cm.

71. (b) : The rainbow is an example of the dispersion of sunlight by the water drops in the atmosphere. This is a phenomenon due to a combination of the refraction of sunlight by spherical water droplets and of internal (not total) reflection.

72. (b) : $R_1=+\infty$

$R_2=-60$ cm



$\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$\frac{1}{f}=(1.6-1)\left(\frac{1}{\infty}-\frac{1}{-60}\right)$ or $f=100$ cm.

73. (a)

74. (a) : $A=60°, \mu=\sqrt{3}, \delta_m=?$

$\mu=\frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}}$ $\therefore \delta_m=60°$

75. (a) : For lens, $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

$u=-30, f=20, v=60$ cm

To have an upright image of the object, coincide with it, image should tend to form at centre of curvature of convex mirror. Therefore, the distance of convex mirror from the lens $=60-10=50$ cm.

76. (c) : $n>\frac{\sin r}{\sin i}$

i.e., $n>\frac{\sin 90°}{\sin 45°}\Rightarrow n>\sqrt{2}$

77. (d) : Length of astronomical telescope $(f_o+f_e)=44$ cm and ratio of focal length of the objective lens to that of the eye piece $\frac{f_o}{f_e}=10$.

From the given ratio, we find that $f_o=10f_e$.

Therefore $10f_e+f_e=44$ or $f_e=4$ cm

and focal length of the objective (f_o)

$=44-f_e=44-4=40$ cm.

78. (a) : $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

Since the refractive index of violet colour (μ_v) is greater than the refractive index of red colour (μ_r), therefore focal length of violet colour is less than the focal length of red colour or in other words, $f_v<f_r$.

79. (d) : Frequency $=n$; Wavelength $=\lambda$; Velocity of air $=v$ and refractive index of glass slab $=\mu$. Frequency of light remains the same, when it changes the medium. Refractive index is the ratio of wavelengths in vacuum and in the given medium. Similarly refractive index is also the ratio of velocities in vacuum and in the given medium.

80. (b) : Focal length $(f_1)=80$ cm and $(f_2)=-50$ cm (Minus sign due to concave lens)

Power of the combination (P)

$=P_1+P_2=\frac{100}{f_1}+\frac{100}{f_2}=\frac{100}{80}-\frac{100}{50}=-0.75$ D.

81. (d) : Refractive index of water $(\mu_2)=1.33$.

$\frac{v_2}{v_1}=\frac{\mu_1}{\mu_2}=\frac{1}{1.33}$

Therefore $v_2=\frac{v_1}{1.33}=\frac{3\times10^8}{1.33}=2.25\times10^8$ m/s.

82. (a) : According to Snell's law,

$\mu=\frac{\sin i}{\sin r'}=\frac{\sin i}{\sin(90°-r)}=\frac{\sin i}{\cos r}$

From law of reflection, $i=r$.

$\therefore \quad \mu=\frac{\sin r}{\cos r}=\tan r$

Critical angle $=\sin^{-1}(\mu)=\sin^{-1}(\tan r)$.

83. (b) : For a convex lens, $f_R>f_V$ or $f_V<f_R$. For a concave lens, focal length is negative.

$\therefore \quad |F_V|<|F_R|$ or $F_V>F_R$ as the smaller negative value is bigger.

84. (b) : Time $=\frac{\text{distance}}{\text{velocity}}=\frac{t}{v}=\frac{t}{c/\mu}=\frac{\mu t}{c}$

85. (c) : By displacement method, size of object $(O)=\sqrt{I_1\times I_2}$.

Therefore area of source of light $(A)=\sqrt{A_1A_2}$.

86. (c) : Time of exposure $t\propto(f\text{-number})^2$

$\therefore \quad \frac{t}{\left(\frac{1}{200}\right)}=\left(\frac{5.6}{2.8}\right)^2=4$ or $t=0.02$ s

87. (d) : Separations between the slits $(d_1)=16$ cm and $(d_2)=9$ cm.

Actual distance of separation

$(d)=\sqrt{d_1d_2}=\sqrt{16\times9}=12$ cm.

88. (a) : Magnifying power of telescope, $M=f_o/f_e$

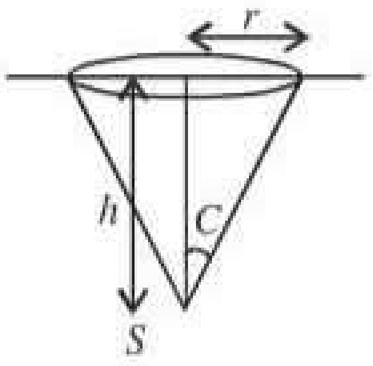
To produce largest magnifications $f_o>f_e$ and f_o and

f_e both should be positive (convex lens).
Therefore $f_e = +15$ cm.

89. (a) : According to Rayleigh, the amount of scattering is inversely proportional to the fourth power of the wavelength.

90. (d)

91. (a) : In order to cut off all the light coming out of water surface, angle C should be equal to critical angle.



i.e. $\sin C = \frac{1}{\mu} = \frac{1}{5/3} = \frac{3}{5}$.

$\therefore \quad \tan C = 3/4$.

Now, $\tan C = \frac{r}{h}$;

$r = h\tan C = 4 \times \frac{3}{4} = 3$ m

Diameter of disc $= 2r = 6$ m.

92. (c) : For first minimum, $a\sin\theta = n\lambda = 1\lambda$

$$\sin\theta = \frac{\lambda}{a} = \frac{5000\times10^{-10}}{0.001\times10^{-3}} = 0.5$$

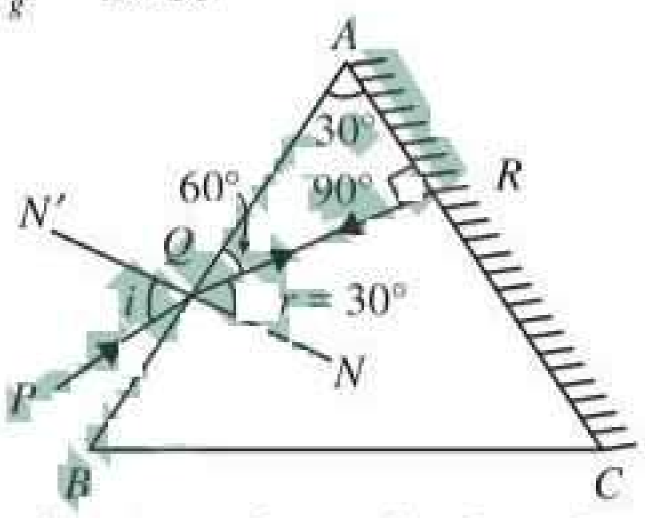
$\theta = 30°$.

93. (d) : In vacuum, λ increases very slightly compared to that in air. As $\beta \propto \lambda$, therefore, width of interference fringe increases slightly.

94. (c) : $v_g = \frac{c}{\mu} = \frac{3\times10^8}{\frac{3}{2}} = 2\times10^8$ m/s

$$t = \frac{x}{v_g} = \frac{4\times10^{-3}}{2\times10^8} = 2\times10^{-11}\text{ s}$$

95. (c) :



The ray will retrace the path when the refrated ray QR is incident normally on the polished surface AC. Thus angle of refraction $r = 30°$

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

$\therefore \quad \sin i = \mu \times \sin r = \sqrt{2}\times\sin 30°$

$$\sin i = \sqrt{2}\times\frac{1}{2} = \frac{1}{\sqrt{2}} \text{ or } i = \sin^{-1}\frac{1}{\sqrt{2}} = 45°$$

96. (a) : As $\beta = \frac{\lambda D}{d}$ and $\lambda_b < \lambda_y$,

$\therefore \quad$ Fringe width β will decrease

97. (b) : $x = (n)\lambda\frac{D}{d} = 3\times5000\times10^{-10}\times\frac{2}{0.2\times10^{-3}}$

$= 1.5\times10^{-2}$ m $= 1.5$ cm

98. (c) : λ' of refracted light is smaller, because $\lambda' = \frac{\lambda}{\mu}$

99. (a) : $\lambda_g = \frac{\lambda_a}{\mu} = \frac{5460}{1.5} = 3640$ Å

100. (a) : $\frac{I_1}{I_2} = \frac{a^2}{b^2} = \frac{4}{1} \quad \therefore \frac{a}{b} = \frac{2}{1}$

101. (d) : For dark fringe $x = (2n-1)\frac{\lambda D}{2d}$

$$\therefore \quad \lambda = \frac{2xd}{(2n-1)D} = \frac{2\times10^{-3}\times0.9\times10^{-3}}{(2\times2-1)\times1}$$

$\lambda = 0.6\times10^{-6}$ m $= 6\times10^{-5}$ cm

102. (a) : $\beta' = \frac{\beta}{\mu} = \frac{0.4}{\frac{4}{3}} = 0.3$ mm

103. (c) : Distance of n^{th} maxima $x = n\lambda\frac{D}{d} \propto \lambda$

As $\lambda_b = \lambda_g$

$\therefore \quad x(\text{blue}) < x(\text{green})$.

104. (c) : Interference is a wave phenomenon shown by both the light waves and sound waves.

105. (d) : Sound waves can not be polarised as they are longitudinal. Light waves can be polarised as they are transverse.

106. (d) : Huygen's construction of wavefront does not apply to origin of spectra which is explained by quantum theory.

107. (c) : $$\frac{f_a}{f_e} = \frac{\left(\frac{\mu_g}{\mu_l} - 1\right)}{(\mu_g - 1)} = \frac{\left(\frac{1.5}{1.25} - 1\right)}{1.5 - 1} = \frac{\frac{1}{5}}{\frac{1}{2}} = \frac{2}{5}$$

$$f_e = \frac{5}{2}f_a = \frac{5}{2}\times2 = 5\text{ cm}$$