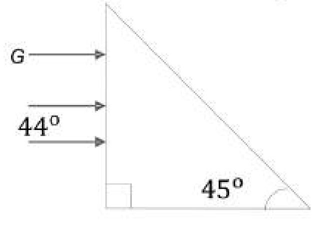
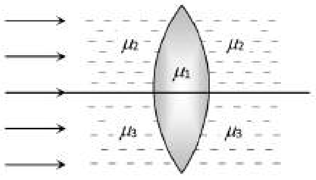
RAY OPTICS AND OPTICAL INSTRUMENTS

Single Correct Answer Type

1. For a compound microscope, the focal lengths of object lens and eye lens are f_o and f_e respectively, then magnification will be done by microscope when
a) $f_o = f_e$ b) $f_o > f_e$ c) $f_o < f_e$ d) None of these
2. The length of the tube of a microscope is 10 cm. The focal lengths of the objective and eye lenses are 0.5 cm and 1.0 cm. The magnifying power of the microscope is about
a) 5 b) 23 c) 166 d) 500
3. A spectrum is formed by a prism of dispersive power $'\omega'$. If the angle of deviation is 'δ', then the angular dispersion is
a) ω/δ b) δ/ω c) $1/\omega\delta$ d) $\omega\delta$
4. Refractive index for a material for infrared light is
a) Equal to that of ultraviolet light b) Less than for ultraviolet light
c) Equal to that for red colour of light d) Greater than that for ultraviolet light
5. Figure shows a mixture of blue, green and red coloured rays incident normally on a right angled prism. The critical angles of the material of the prism for red, green and blue are 46°, 44° and 43° respectively. The arrangement will separate



a) Red colour from blue and green b) Blue colour from red and green
c) Green colour from red and blue d) All the three colours
6. A telescope has an objective of focal length 50 cm and an eye piece of focal length 5 cm. The least distance of distinct vision is 25 cm. The telescope is focussed for distinct vision on a scale 200 cm away. The separation between the objective and the eye-piece is
a) 75 cm b) 60 cm c) 71 cm d) 74 cm
7. Four convergent lenses have focal lengths 100 cm, 10 cm, 4 cm and 0.3 cm. For a telescope with maximum possible magnification, we choose the lenses of focal length
a) 100 cm, 0.3 cm b) 10 cm, 0.3 cm c) 10 cm, 4 cm d) 100 cm, 4 cm
8. With a concave mirror, an object is placed at a distance x_1 from the principal focus, on the principal axis. The image is formed at a distance x_2 from the principal focus. The focal length of the mirror is
a) x_1x_2 b) $\frac{x_1 + x_2}{2}$ c) $\sqrt{\frac{x_1}{x_2}}$ d) $\sqrt{x_1x_2}$
9. If two mirrors are kept at 60° to each other, then the number of images found by them is
a) 5 b) 6 c) 7 d) 8
10. A double convex lens, lens made of a material of refractive index μ_1, is placed inside two liquids or refractive indices μ_2 and μ_3, as shown. $\mu_2 > \mu_1 > \mu_3$. A wide, parallel beam of light is incident on the lens from the left. The lens will give rise to



a) A single convergent beam
b) Two different convergent beams
c) Two different divergent beams
d) A convergent and a divergent beam

11. A double convex thin lens made of refractive index 1.6 has radii of curvature 15 cm each. The focal length of this lens when immersed in a fluid of refractive index 1.63, is
a) 25 cm
b) 125 cm
c) 250 cm
d) -407.5 cm

12. Let the $x - z$ plane be the boundary between two transparent media. Medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with $z < 0$ has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\mathbf{A} = 6\sqrt{3}\hat{\imath} + 8\sqrt{3}\hat{\jmath} - 10\,\hat{\boldsymbol{k}}$ is incident on the plane of separation. The angle of refraction in medium 2 is
a) 45°
b) 60°
c) 75°
d) 30°

13. An object is placed first at infinity and then at 20 cm from the object side focal plane of the convex lens. The two images thus formed are 5 cm apart. The focal length of the lens is
a) 5cm
b) 10 cm
c) 15 cm
d) 20 cm

14. When the convergent nature of a convex lens will be less as compared with air
a) In water
b) In oil
c) In both (a) and (b)
d) None of these

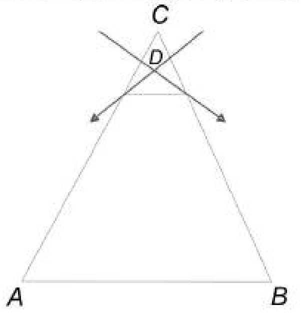
15. When a ray of light is incident normally on a surface, then
a) Total internal reflection takes place
b) It passes undeviated
c) It undergoes dispersion
d) It gets absorbed by the surface

16. Correct exposure for a photographic print is 10 *seconds* at a distance of one metre from a point source of 20 *candela*. For an equal fogging of the print placed at a distance of 2 m from a 16 *candela* source, the necessary time for exposure is
a) 100 s
b) 25 s
c) 50 s
d) 75 s

17. The refractive index of water, glass and diamond are 1.33,1.50,2.40 respectively. The refractive index of diamond relative to water and of glass relative to diamond, respectively are nearly
a) 1.80, 0.625
b) 0.554, 0.625
c) 1.80, 1.6
d) 0.554, 1.6

18. **The focal length of the lens of refractive index ($\mu = 1.5$) in air is 10 cm. If air is replaced by water of $\mu = \frac{4}{3}$, its focal length is**
a) 20 cm
b) 30 cm
c) 40 cm
d) 25 cm

19. In the given figure, what is the angle of prism?

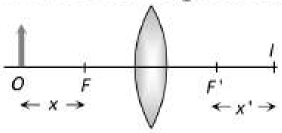


a) A
b) B
c) C
d) D

20. A man runs towards a mirror at a speed 15 m/s. The speed of the image relative to the man is
a) 15 ms^{-1}
b) 30 ms^{-1}
c) 35 ms^{-1}
d) 20 ms^{-1}

21. The aperture of a telescope is made large, because
a) To increase the intensity of image
b) To decrease the intensity of image
c) To have greater magnification
d) To have lesser resolution

22. An object is placed at a point distance x from the focus of a convex lens and its image is formed is I as shown in the figure. The distances x, x' satisfy the relation

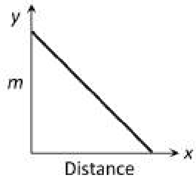


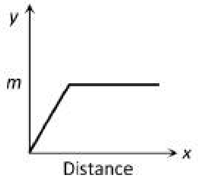
a) $\frac{x+x'}{2} = f$ b) $f = xx'$ c) $x + x' \leq 2f$ d) $x + x' \geq 2f$

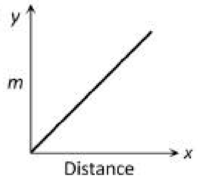
23. A hypermetropic person has to use a lens of power +5 D to normalize his vision. The near point of the hypermetropic eye is

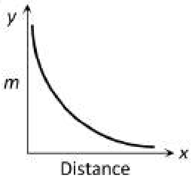
a) 1 m b) 1.5 m c) 0.5 m d) 0.66 m

24. Which of the following graphs is the magnification of a real image against the distance from the focus of a concave mirror

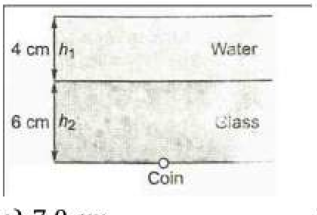
a) 

b) 

c) 

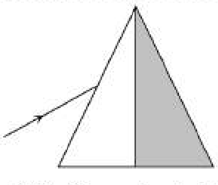
d) 

25. A 4 cm thick layer of water covers a 6 cm thick glass slab. A coin is placed at the bottom of the slab and is being observed from the air side along the normal to the surface. Find the apparent position of the coin from



a) 7.0 cm b) 8.0 cm c) 10 cm d) 5 cm

26. A light ray is incident upon a prism in minimum deviation position and suffers a deviation of 34°. If the shaded half of the prism is knocked off, the ray will



a) Suffer a deviation of 34° b) Suffer a deviation of 68°

c) Suffer a deviation of 17° d) Not come out of the prism

27. When the power of eye lens increases, the defect of vision is produced. The defect is known as

a) Shortsightedness b) Longsightedness c) Colourblindness d) None of the above

28. For a prism, its refractive index is $\cos\frac{A}{2}$. Then minimum angle of deviation is

a) $180° - A$ b) $180° - 2A$ c) $90° - A$ d) $\frac{A}{2}$

29. The plane surface of a plano-convex lens of focal length f is silvered. It will behave as

a) Plane mirror b) Convex mirror of focal length 2 f

c) Concave mirror of focal length $\frac{f}{2}$ d) None of the above

30. A light bulb is at a depth of D below the surface of water. An opaque disc of radius R is placed on the surface of water just above the bulb. The bulb is not at all seen through the surface of water, then (n = Refractive index of water)

a) $R = \frac{D}{\sqrt{n^2-1}}$ b) $R > \frac{D}{\sqrt{n^2-1}}$ c) $R < \frac{D}{\sqrt{n^2-1}}$ d) $R = D\sqrt{n^2-1}$

31. A slab of glass, of thickness 6 cm and refractive index 1.5, is placed in front of a concave mirror, the faces of the slab being perpendicular to the principal axis of the mirror. If the radius of curvature of the mirror is 40 cm and the reflected image coincides with the object, then the distance of the object from the mirror is

a) 30 cm b) 22 cm c) 42 cm d) 28 cm

32. The diameter of the eye-ball of a normal eye is about 2.5 cm. The power of the eye lens varies from

a) 2 D to 10 D b) 40 D to 32 D c) 9 D to 8 D d) 44 D to 40 D

33. The angular magnification of a simple microscope can be increased by increasing

a) Focal length of lens b) Size of object c) Aperture of lens d) Power of lens

34. An astronomical telescope has a converging eye-piece of focal length 5 cm and objective of focal length 80 cm. When the final image is formed at the least distance of distinct vision (25 cm), the separation between the two lenses is

a) 75.0 cm b) 80.0 cm c) 84.2 cm d) 85.0 cm

35. Speed of light is maximum in

a) Water b) Air c) Glass d) Diamond

36. Radius of curvature of concave mirror is 40cm and the size of image is twice as that of object, then the object distance is

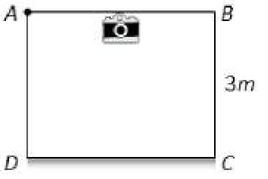
a) 60 cm b) 20 cm c) 40 cm d) 30 cm

37. An object is placed at a distance of 40 cm in front of a concave mirror of focal length 20 cm. The nature of image is

a) Real and inverted and of same size b) Virtual and erect and of same size

c) Real and erect and of same size d) Virtual and inverted and of same size

38. Figure shows a cubical room $ABCD$ with the wall CD as a plane mirror. Each side of the room is 3m. We place is camera at the midpoint of the wall AB. At what distance should the camera be focused to photograph an object placed at A



a) 1.5 m b) 3 m c) 6 m d) More than 6 m

39. A thin oil layer floats on water. A ray of light making an angle of incidence of 40° shines on oil layer. The angle of refraction of light ray in water is ($\mu_{oil} = 1.45, \mu_{\text{water}} = 1.33$)

a) 36.1° b) 44.5° c) 26.8° d) 28.9°

40. Which of the prism is used to see infrared spectrum of light

a) Rock salt b) Nicol c) Flint d) Crown

41. The focal length of the objective and eye-piece of a telescope are respectively 100 cm and 2 cm. The moon subtends an angle of 0.5° at the eye. If it is looked through the telescope, the angle subtended by the moon's image will be

a) 100° b) 50° c) 25° d) 10°

42. A small object is placed 10 cm in front of a plane mirror. If you stand behind the object, 30 cm from the mirror and look at its image, for what distance must you focus your eyes?

a) 20 cm b) 60 cm c) 80 cm d) 40 cm

43. The magnifying power of telescope is high if

a) Both objective and eye-piece have short focal length

b) Both objective and eye-piece have long focal length

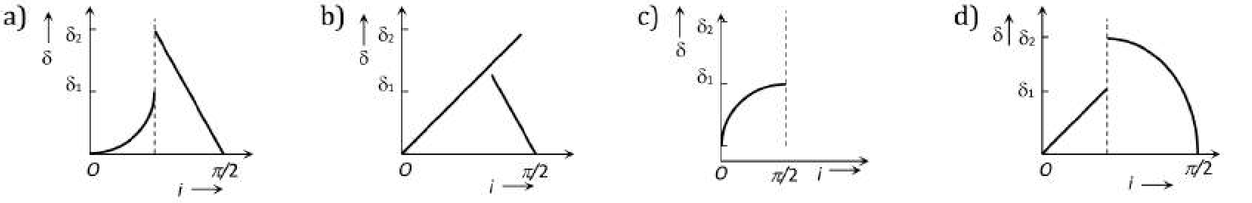
c) The objective has a long focal length and the eye piece has a short focal length

d) The objective has a short focal length and the eye piece has a long focal length

44. An astronaut is looking down on earth's surface from a space shuttle at an altitude of 400 km. Assuming that the astronaut's pupil diameter is 5 mm and the wavelength of visible light is 500 nm. The astronaut will be able to resolve linear object of the size of about

a) $0.5\ m$ b) $5\ m$ c) $50\ m$ d) $500\ m$

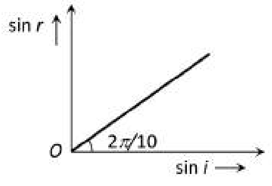
45. A ray of light travels from a medium of refractive index μ to air. Its angle of incidence in the medium is i, measured from the normal to the boundary, and its angle of deviation is δ. δ is plotted against i which of the following best represents the resulting curve



46. The length of an astronomical telescope for normal vision (relaxed eye) (f_o = focal length of objective lens and f_e = focal length of eye lens) is

a) $f_o \times f_e$ b) $\frac{f_o}{f_e}$ c) $f_o + f_e$ d) $f_o - f_e$

47. The graph between sine of angle of refraction ($\sin r$) in medium 2 and sine of angle of incidence ($\sin i$) in medium 1 indicates that ($\tan 36° \approx \frac{3}{4}$)



a) Total internal reflection can take place
b) Total internal reflection cannot take place
c) Any of (a) and (b)
d) Data is incomplete

48. What will be the height of the image when an object of 2mm is placed at a distance 20 cm in front of the axis of a convex mirror of radius of curvature 40 cm?

a) 20 mm b) 10 mm c) 6 mm d) 1 mm

49. The magnifying power of a simple microscope is 6. The focal length of its lens in *metres* will be, if least distance of distinct vision is 25 *cm*

a) 0.05 b) 0.06 c) 0.25 d) 0.12

50. If the luminous intensity of a 100 W unidirectional bulb is 100 candela, then total luminous flux emitted from the bulb is

a) 861 *lumen* b) 986 *lumen* c) 1256 *lumen* d) 1561 *lumen*

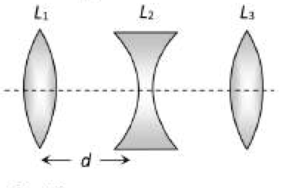
51. A parallel beam of light emerges from the opposite surface of the sphere when a point source of light lies at the surface of the sphere. The refractive index of the sphere is

a) $\frac{3}{2}$ b) $\frac{5}{3}$ c) 2 d) $\frac{5}{2}$

52. A prism of certain angles deviates the red and blue rays by $8°$ and $12°$ respectively. Another prism of the same angle deviates the red and blue rays by $10°$ respectively. The prisms are small angled and made of different materials. The dispersive powers of the materials of the prism are in the ratio

a) 5 : 6 b) 9 : 11 c) 6 : 5 d) 11 : 9

53. Three lenses L_1, L_2, L_3 are placed co-axially as shown in figure. Focal length's of lenses are given $30\ cm$, $10\ cm$ and $5\ cm$ respectively. If a parallel beam of light falling on lens L_1, emerging L_3 as a convergent beam such that it converges at the focus of L_3. Distance between L_1 and L_2 will be



a) $40\ cm$ b) $30\ cm$ c) $20\ cm$ d) $10\ cm$

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

a) $3 \times 10^8\ m/s$ b) $2.25 \times 10^8\ m/s$ c) $4 \times 10^8\ m/s$ d) $1.33 \times 10^8\ m/s$

55. When white light enters a prism, it gets split into its constituent colours. This is due to
a) High density of prism material
b) Because μ is different for different λ
c) Diffraction of light
d) Velocity changes for different frequencies

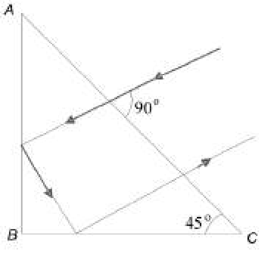
56. A person 6 feet in length can see his full size erect image in a mirror 2 feet in length. This mirror has to be
a) Plane or convex b) Plane or concave
c) Necessarily convex d) Necessarily concave

57. When sunlight is incident on a prism, it produces a spectrum due to
a) Interference of light
b) Diffraction of light
c) Total internal reflection
d) Variation in speeds of different colours of light in the prism

58. The dispersive powers of crown and flint glasses are 0.02 and 0.04 respectively. In an achromatic combination of lenses the focal length of flint glass lens is 40 cm. The focal length of crown glass lens will be
a) $-20\ cm$ b) $+20\ cm$ c) $-10\ cm$ d) $+10\ cm$

59. An astronomical telescope has a large aperture to
a) Reduce spherical aberration b) Have high resolution
c) Increase span of observation d) Have low dispersion

60. A ray falls on a prism ABC $(AB = BC)$ and travels as shown in figure. The minimum refractive of the prism material should be



a) $\frac{4}{3}$ b) $\sqrt{2}$ c) 1.5 d) $\sqrt{3}$

61. The time required for making a print a distance of 0.25 m from a 60 W lamp is 5 s. If the distance is increased to 40 cm, the time required in second to make a similar print is
a) 3.1 b) 8 c) 12.8 d) 16

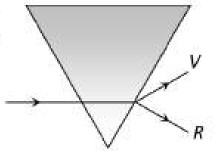
62. For an angle of incidence θ on an equilateral prism of refractive index $\sqrt{3}$, the ray refracted is parallel to the base inside the prism. The value of θ is
a) 30° b) 45° c) 60° d) 75°

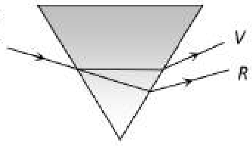
63. If the angle of minimum deviation is of 60° for an equilateral prism, then the refractive index of the material of the prism is
a) 1.41 b) 1.5 c) 1.6 d) 1.73

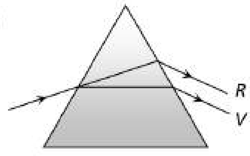
64. An object is placed at a distance 20 cm from the pole of a convex mirror of focal length 20 cm. The image is produced at
a) 13.3 cm b) 20 cm c) 25 cm d) 10 cm

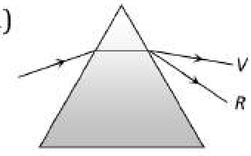
65. Angular resolving power of human eye is
a) 3.6×10^3 b) 3.6×10^2 c) 3.6×10^4 d) 3.6×10^6

66. Which of the following diagrams shows correctly the dispersion of white light by a prism

a) 

b) 

c) 

d) 

67. 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 means distance from the earth is $1.5 \times 10^{11} m$. What is the diameter of the Sun's image on the paper

a) $6.5 \times 10^{-5} m$ b) $12.4 \times 10^{-4} m$ c) $9.2 \times 10^{-4} m$ d) $6.5 \times 10^{-4} m$

68. The radius of curvature of convex surface of a thin plano-convex lens is 15 cm and refractive index of its material is 1.6. The power of the lens will be

a) $+1\ D$ b) $-2\ D$ c) $+3\ D$ d) $+4\ D$

69. For the myopic eye, the defect cured by

a) Convex lens b) Concave lens c) Cylindrical lens d) Toric lens

70. When the object is self-luminous, the resolving power of a microscope is given by the expression

a) $\frac{2\mu \sin\theta}{1.22\,\lambda}$ b) $\frac{\mu \sin\theta}{\lambda}$ c) $\frac{2\mu \cos\theta}{1.22\,\lambda}$ d) $\frac{2\mu}{\lambda}$

71. A prism of angle 30° is silvered at one side. A ray of light incident at an angle 45° is reflected back from the silvered surface. The refractive index is

a) $\sqrt{2}$ b) $2\sqrt{2}$ c) $\sqrt{3}$ d) $5\sqrt{3}$

72. A compound microscope has two lenses. The magnifying power of one is 5 and the combined magnifying power is 100. The magnifying power of the other lens is

a) 10 b) 20 c) 50 d) 25

73. A converging lens is used to form an image on a screen. When upper half of the lens is covered by an opaque screen

a) Half the image will disappear
b) Complete image will be formed of same intensity
c) Half image will be formed of same intensity
d) Complete image will be formed of decreased intensity

74. The magnification produced by the objective lens and the eye lens of a compound microscope are 25 and 6 respectively. The magnification of this microscope is

a) 25 b) 50 c) 150 d) 200

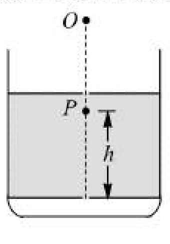
75. In a compound microscope, the focal length of the objective and the eye lens are 2.5 cm and 5 cm respectively. An object is placed at 3.75 cm before the objective and image is formed at the least distance of distinct vision, then the distance between two lenses will be ($i.e.$ length of the microscopic tube)

a) 11.67 cm b) 12.67 cm c) 13.00 cm d) 12.00 cm

76. The resolving power of an astronomical telescope is 0.2 seconds. If the central half portion of the objective lens is covered, the resolving power will be

a) 0.1 sec b) 0.2 sec c) 1.0 sec d) 0.6 sec

77. A plane mirror is placed at the bottom of a tank containing a liquid of refractive index μ. P is a small object at a height h above the mirror. An observer O- vertically above P outside the liquid sees P and its image in a mirror. The apparent distance between these two will be



a) $2\,\mu\,h$ b) $\frac{2h}{\mu}$ c) $\frac{2h}{\mu - 1}$ d) $h\left(1 + \frac{1}{\mu}\right)$

78. Angle of a prism is 30° and its refractive index is $\sqrt{2}$ and one of the surface is slivered. At what angle of incidence, a ray should be incident on one surface so that after reflection from the silvered surface, it retraces its path

a) 30°
b) 60°
c) 45°
d) $\sin^{-1}\sqrt{1.5}$

79. A wave has velocity u in medium P and velocity $2u$ in medium Q.If the wave is incident in medium P at an angle 30°,then the angle of refraction will be

a) 30°
b) 45°
c) 60°
d) 90°

80. The spectrum of iodine gas under white light will be

a) Only violet
b) Bright lines
c) Only red lines
d) Some black bands is continuous spectrum

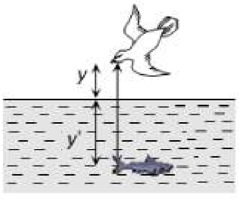
81. The reason for shining of air bubble in water is

a) Diffraction of light
b) Dispersion of light
c) Scattering of light
d) Total internal reflection of light

82. If a parallel beam of white light is incident on a converging lens, the colour which is brought to focus nearest to the lens is

a) Violet
b) Red
c) The mean colour
d) All the colours together

83. A fish rising vertically up towards the surface of water with speed 3 ms^{-1} observes a bird diving vertically down towards it with speed 9 ms^{-1}. The actual velocity of bird is



a) 4.5 ms^{-1}
b) 5. ms^{-1}
c) 3.0 ms^{-1}
d) 3.4 ms^{-1}

84. The refractive index of glass is 1.520 for red light and 1.525 for blue light. Let D_1 and D_2 be angles of minimum deviation for red and blue light respectively in a prism of this glass. Then ,

a) $D_1 < D_2$
b) $D_1 = D_2$
c) D_1 can be less than or greater than D_2 depending upon the angle of prism
d) $D_1 > D_2$

85. The refractive indices of glass and quartz w.r.t. air are 3/2 and 12/5 respectively. The refractive index of quartz w.r.t. glass is

a) 8/5
b) 5/8
c) 5/18
d) 18/5

86. A real object is placed at a distance f from the pole of a convex mirror, in front of the convex mirror. If focal length of the mirror is f , then distance of the image from the pole of the mirror is

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

87. A person can see clearly only upto a distance of 25 cm. He wants to read a book placed at a distance of 50 cm. What kind of lens does he require for his spectacles and what must be its power

a) Concave, -1.0 D
b) Convex, $+1.5$ D
c) Concave, -2.0 D
d) Convex, $+2.0$ D

88. The wavelength of sodium light in air is 5890 Å. The velocity of light in air is $3 \times 10^8 ms^{-1}$. The wavelength of light in a glass of refractive index 1.6 would be close to

a) 5890 Å
b) 3681 Å
c) 9424 Å
d) 15078 Å

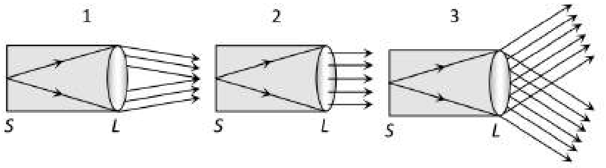
89. Two plane mirrors are inclined at an angleθ. It is found that a ray incident on one mirror at any angle is rendered parallel to itself after reflection from both the mirrors. The value of θ is

a) 30°
b) 60°
c) 90°
d) 120°

90. Two thin lenses when in contact, produce a combination of power $+10$ D. When they are 0.25 m apart, the power reduces to $+6D$. The focal lengths of the lenses (in m) are

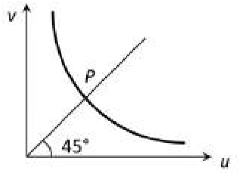
a) 0.125 and 0.5 b) 0.125 and 0.125 c) 0. 5 and 0.75 d) 0.125 and 0.75

91. The slit of a collimator is illuminated by a source as shown in the adjoining figures. The distance between the slit S and the collimating lens L is equal to the focal length of the lens. The correct direction of the emergent beam will be as shown is figure



a) 1 b) 3 c) 2 d) None of the figures

92. The graph shows variation of v with change in u for a mirror. Points plotted above the point P on the curve are for values of v



a) Smaller then f b) Smaller then $2f$ c) Larger then $2f$ d) Larger then f

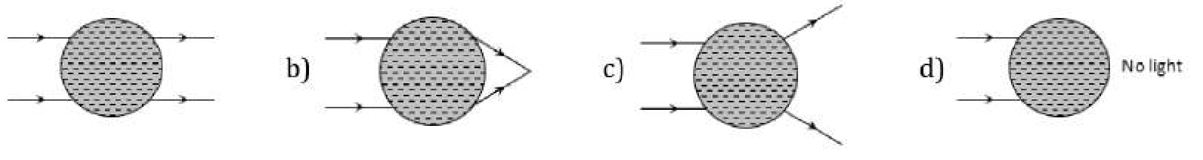
93. A prism of refractive index μ and angle A is placed in the minimum deviation position. If the angle of minimum deviation is A, then the value of A in terms of μ is

a) $\sin^{-1}\left(\frac{\mu}{2}\right)$ b) $\sin^{-1}\sqrt{\frac{\mu-1}{2}}$ c) $2\cos^{-1}\left(\frac{\mu}{2}\right)$ d) $\cos^{-1}\left(\frac{\mu}{2}\right)$

94. A beaker containing a liquid appears to be half when it is actually two third full.The refractive index of liquid

a) 7/6 b) 6/5 c) 3/2 d) 4/3

95. A water drop in air refractes the light ray is



96. 1% of light of a source with luminous intensity 50 *candela* is incident on a circular surface of radius 10 *cm*. The average illuminance of surface is

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

97. The spectrum obtained from an electric lamp or red hot heater is

a) Line spectrum b) Band spectrum
c) Absorption spectrum d) Continuous spectrum

98. The splitting of white light into several colours on passing through a glass prism is due to

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

99. A plano-convex lens when silvered in the plane side behaves like a concave mirror of focal length 30*cm*. However, when silvered on the convex side it behaves like a concave mirror of focal length 10 *cm*. Then the refractive index of its material will be

a) 3.0 b) 2.0 c) 2.5 d) 1.5

100. A ray is reflected in turn by three plane mirrors mutually at right angles to each other. The angle between the incident and the reflected rays is

a) 90° b) 60° c) 180° d) none of these

101. If a thin prism of glass is dipped into water then minimum deviation (with respect to air) of light produced by prism will be left $\left({}_a\mu_g = \frac{3}{2} \text{ and } {}_a\mu_w = \frac{4}{3}\right)$

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

102. The distance travelled by light in glass (refractive index = 1.5) in a nanosecond will be

a) 45 cm b) 40 cm c) 30 cm d) 20 cm

103. An object 2.4 m in front of a lens forms a sharp image on a film 12 cm behind the lens. A glass plate 1cm thick, of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance (from lens) should object shifted to be in sharp focus on film

a) 7.2m b) 2.4m c) 3.2m d) 5.6m

104. A double convex lens of focal length 20 cm is made of glass of refractive index 3/2. When placed completely in water (${}_a\mu_\omega = 4/3$), its focal length will be

a) 80 cm b) 15 cm c) 17.7 cm d) 22.5 cm

105. A monochromatic beam of light passes from a denser medium into a rarer medium. As a result

a) Its velocity increases b) Its velocity decreases

c) Its frequency decreases d) Its wavelength decreases

106. We use flint glass prism to disperse polychromatic light because light of different colours

a) Travel with same speed

b) Travel with same speed but deviate differently due to the shape of the prism

c) Have different anisotropic properties while travelling through the prism

d) Travel with different speeds

107. For a prism of refractive index 1.732, the angle of minimum deviation is equal to the angle of prism. Then the angle of the prism is

a) 50° b) 60° c) 70° d) None of these

108. A plano-convex lens has a thickness of 4 cm. When placed on a horizontal table, with the curved surface in contact with it, the apparent depth of the bottom most point of the lens is found to be 3 cm. If the lens is inverted such that the plane face is in contact with the table, the apparent depth of the centre of the plane face is found to be 25/8 cm. Find the focal length of the lens. Assume thickness to be negligible

a) 85 cm b) 59 cm c) 75 cm d) 7.5 cm

109. To increase the magnifying power of telescope (f_o = focal length of the objective and f_e = focal length of the eye lens)

a) f_o should be large and f_e should be small

b) f_o should be small and f_e should be large

c) f_o and f_e both should be large

d) f_o and f_e both should be small

110. A convex lens of focal length 30 cm produces 5 times magnified real image of an object. What is the object distance?

a) 36 cm b) 25 cm c) 30 cm d) 150 cm

111. What is the ratio of luminous intensity of two sources, which produce shadows of equal intensities at distance 25 cm and 50 cm from the photometer screen?

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

112. 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 or light is

a) $\frac{A_1 + A_2}{2}$ b) $\left[\frac{1}{A_1} + \frac{1}{A_2}\right]^{-1}$ c) $\sqrt{A_1 A_2}$ d) $\left[\frac{\sqrt{A_1} + \sqrt{A_2}}{2}\right]^2$

113. For a colour of light the wavelength for air is 6000 Å and in water the wavelength is 4500 Å. Then the speed of light in water will be

a) $5.0 \times 10^{14}\ m/s$ b) $2.25 \times 10^8\ m/s$ c) $4.0 \times 10^8\ m/s$ d) Zero

114. If the distance of the far point for a myopia patient is doubled, the focal length of the lens required to cure it will become

a) Half b) Double

c) The same but a convex lens d) The same but a concave lens

115. Our eye is most sensitive for which of the following wavelength

a) 4500 Å
b) 5500 Å
c) 6500 Å
d) Equally sensitive for all wave lengths of visible spectrum

116. A mark at the bottom of a liquid appears to rise by 0.1 m. The depth of the liquid is 1 m. The refractive index of the liquid is

a) 1.33 b) $\frac{9}{10}$ c) $\frac{10}{9}$ d) 1.5

117. The separation between the screen and a plane mirror is $2r$. An isotopic point source of light is placed exactly mid way between the mirror and the screen. Assume that mirror reflects 100% of incident light. Then the ratio of illuminance on the screen with and without the mirror is

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

118. An object is approaching a plane mirror at 10 cms^{-1}. A stationary observer sees the image. At what speed will the image approach the stationary observer?

a) 10 cms^{-1} b) 5 cms^{-1} c) 20 cms^{-1} d) 15 cms^{-1}

119. In Ramsden eyepiece, the two planoconvex lenses each of focal length f are separated by a distance 12 cm. The equivalent focal length (in cm) of the eyepiece is

a) 10.5 b) 12.0 c) 13.5 d) 15.5

120. An experiment is performed to find the refractive index of glass using a travelling microscope. In this experiment distance are measured by

a) A vernier scale provided on the microscope
b) A standard laboratory scale
c) A meter scale provided on the microscope
d) A screw gauge provided on the microscope

121. The power of an achromatic convergent lens of two lenses is +2 D. The power of convex lens is +5 D. The ratio of dispersive power of convex and concave lenses will be

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

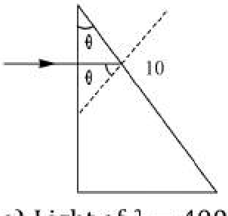
122. An electron microscope is superior to an optical microscope in

a) Having better resolving power
b) Being easy to handle
c) Low cost
d) Quickness of observation

123. Parallel beam containing light of $\lambda = 400$nm and 500 nm is incident on a prism as shown in figure. The refractive index μ of the prism is given by the relation

$$\mu(\lambda) = 1.20 + \frac{0.8 \times 10^{-14}}{\lambda^2}$$

Which of the following statement is correct?

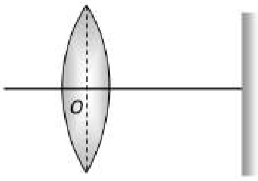


a) Light of $\lambda = 400$ nm undergoes total internal reflection
b) Light of $\lambda = 500$ nm undergoes total internal reflection
c) Neither of two wavelength undergoes total internal reflection
d) Both wavelengths undergoes total internal reflection

124. A achromatic combination is made with a lens of focal length f and dispersive power ω with a lens having dispersive power of 2ω. The focal length of second will be

a) $2f$ b) $f/2$ c) $-f/2$ d) $-2f$

125. The distance between a convex lens and a plane mirror is 10 cm. The parallel rays incident on the convex lens after reflection from the mirror form image at the optical centre of the lens. Focal length of lens will be



a) 10 cm
b) 20 cm
c) 30 cm
d) Cannot be determined

126. Four lenses are made from the same type of glass. The radius of curvature of each face is given below. What will have the greatest positive power
a) 10 cm convex and 15 cm concave
b) 5 cm convex and 10 cm concave
c) 15 cm convex and plane
d) 20 cm convex and 30 cm concave

127. The black lines in the solar spectrum during solar eclipse can be explained by
a) Planck's law
b) Kirchoff's law
c) Boltzmann's law
d) Solar disturbances

128. The focal lengths of convex lens for red and blue light are 100 cm and 96.8 cm respectively. The dispersive power of material of lens is
a) 0.325
b) 0.0325
c) 0.98
d) 0.968

129. A small piece of wire bent into an L shape with upright and horizontal portions of equal lengths, is placed with the horizontal portion along the axis of the concave mirror whose radius of curvature is 10 cm. If the bend is 20 cm from the pole of the mirror, then the ratio of the lengths of the images of the upright and horizontal portions of the wire is
a) 1 : 2
b) 3 : 1
c) 1 : 3
d) 2 : 1

130. The frequency of light in air is 5×10^{14} Hz. What will be the frequency of light, when it enters in the water?
a) 2.5×10^{14} Hz
b) 5×10^{14} Hz
c) 10^{15} Hz
d) 2.5×10^{12} Hz

131. The focal length of a simple convex lens used as a magnifier is 10 cm. For the image to be formed at a distance of distinct vision ($D = 25$ cm), the object must be placed away from the lens at a distance of
a) 0.5 cm
b) 7.14 cm
c) 7.20 cm
d) 16.16 cm

132. The solar spectrum during a complete solar eclipse is
a) Continuous
b) Emission line
c) Dark line
d) Dark band

133. It is necessary to illuminate the bottom of a well by reflected solar beam when the light is incident at an angle of $\alpha = 40°$ to the vertical. At what angle β to the horizontal should a plane mirror be placed?
a) 70°
b) 20°
c) 50°
d) 40°

134. Two thin lenses of focal length 20 cm and 25 cm are placed in contact .The effective power of the combination is
a) 9 D
b) 2 D
c) 3 D
d) 7 D

135. The relative luminosity of wavelength 600 nm is 0.6. Find the radiant flux of 600 nm needed to produce the same brightness sensation as produced by 120 W of radiant flux at 555 nm
a) 50W
b) 72W
c) $120 \times (0.6)^2 W$
d) 200W

136. If in a plano-convex lens, the radius of curvature of the convex surface is 10 cm and the focal length of the lens is 30 cm, then the refractive index of the material of lens will be
a) 1.5
b) 1.66
c) 1.33
d) 3

137. If light travels a distance x in t_1 sec in air and 10 x distance in t_2 in a medium, the critical angle of the medium will be
a) $\tan^{-1}\left(\frac{t_1}{t_2}\right)$
b) $\sin^{-1}\left(\frac{t_1}{t_2}\right)$
c) $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$
d) $\tan^{-1}\left(\frac{10t_1}{t_2}\right)$

138. A thin equiconvex lens is made of glass of refractive index 1.5 and its focal length is 0.2 m, if it acts as a concave lens of 0.5 m focal length when dipped in a liquid, the refractive index of the liquid is
a) $\frac{17}{8}$
b) $\frac{15}{8}$
c) $\frac{13}{8}$
d) $\frac{9}{8}$

139. A point object is placed at a distance of 10 cm and its real image is formed at a distance of 20 cm from a concave mirror. If the object is moved by 0.1 cm towards the mirror, the image will shift by about

a) 0.4 cm away from the mirror
b) 0.4 cm towards the mirror
c) 0.8 cm away from the mirror
d) 0.8 cm towards the mirror

140. When seen in green light, the saffron and green portions of our National Flag will appear to be
a) Black
b) Black and green respectively
c) Green
d) Green and yellow respectively

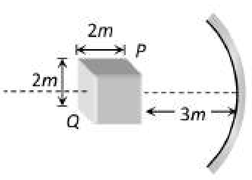
141. In the position of minimum deviation when a ray of yellow light passes through the prism, then its angle of incidence is
a) Less than the emergent angle
b) Greater than the emergent angle
c) Sum of angle incidence and emergent angle is 90°
d) Equal to the emergent angle

142. A beam of monochromatic blue light of wavelength 4200 Å in air travels in water ($\mu = 4/3$). Its wavelength in water will be
a) 2800 Å
b) 5600 Å
c) 3150 Å
d) 4000 Å

143. The refractive index of a certain glass is 1.5 for light whose wavelength in vacuum is 6000 Å. The wavelength of this light when it passes through glass is
a) 4000 Å
b) 6000 Å
c) 9000 Å
d) 15000 Å

144. Why sun has elliptical shape on the time when rising and setting? It is due to
a) Refraction
b) Reflection
c) Scattering
d) Dispersion

145. A cube of side 2 m is placed in front of a concave mirror focal length 1m with its face P at a distance of 3 m and face Q at a distance of 5 m from the mirror. The distance between the images of face P and Q and height of images of P and Q are



a) 1 m, 0.5 m, 0.25 m
b) 0.5 m, 1 m, 0.25 m
c) 0.5 m, 0.25 m, 1 m
d) 0.25 m, 1 m, 0.5 m

146. Two thin equiconvex lenses each of focal length 0.2 m are placed coaxially with their optic centers 0.5 m apart. Then the focal length of the combination is
a) -0.4 m
b) 0.4 m
c) -0.1 m
d) 0.1 m

147. A small lamp is hung at a height of 8 feet above the centre of a round table of diameter 16 $feet$. The ratio of intensities of illumination at the centre and at points on the circumference of the table will be
a) 1 : 1
b) 2 : 1
c) $2\sqrt{2} : 1$
d) 3 : 2

148. One surface of a lens is convex and the other is concave. If the radii of curvature are r_1 and r_2 respectively, the lens will be convex, if
a) $r_1 > r_2$
b) $r_1 = r_2$
c) $r_1 < r_2$
d) $r_1 = 1/r_2$

149. Amount of light entering into the camera depends upon
a) Focal length of the objective lens
b) Product of focal length and diameter of the objective lens
c) Distance of the object from camera
d) Aperture setting of the camera

150. Material Ahas critical angle i_A, and material B has critical angle $i_B (i_b > i_A)$. Then which of the following is true?
(i) Light can be totally internally reflected when it passes from B to A
(ii) Light can be totally internally reflected when it passes from A to B
(iii) Critical angle for total internal reflection is
$i_B - i_A$

(iv) Critical angle between A and B is $\sin^{-1}\left(\frac{\sin i_A}{\sin i_B}\right)$

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

151. Monochromatic light is refracted from air into the glass of refractive index μ. The ratio of the wavelength of incident and refracted waves is

a) $1 : \mu$ b) $1 : \mu^2$ c) $\mu : 1$ d) $1 : 1$

152. Sparking of diamond is due to

a) Reflection b) Dispersion
c) Total internal reflection d) High refractive index of diamond

153. A room (cubical) is made of mirrors. An insect is moving along the diagonal on the floor such that the velocity of image of insect on two adjacent wall mirrors is $10\ cms^{-1}$. The velocity of image of insect in celling mirror is

a) $10\ cms^{-1}$ b) $20\ cms^{-1}$ c) $\frac{10}{\sqrt{2}} cms^{-1}$ d) $10\sqrt{2}\ cms^{-1}$

154. A ray of light strikes a material's slab at an angle of incidence 60°.If the reflected and refracted rays are perpendicular to each other, the refractive index of the materials is

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

155. The ratio of thickness of plates of two transparent mediums A and B is $6 : 4$. If light takes equal time in passing through them, then refractive index of B with respect to A will be

a) 1.4 b) 1.5 c) 1.75 d) 1.33

156. An object of height 1.5 cm is placed on the axis of a convex lens of focal length 25 cm. A real image is formed at a distance of 75 cm from the lens. The size of the image will be

a) 4.5 cm b) 3.0 cm c) 0.75 cm d) 0.5 cm

157. A light wave has a frequency of $4 \times 10^{14}\ Hz$ and a wavelength of $5 \times 10^{-7}\ metres$ in a medium. The refractive index of the medium is

a) 1.5 b) 1.33 c) 1.0 d) 0.66

158. A parallel beam of light is incident on a solid transparent sphere of a material of refractive index n.If a point image is produced at the back of the sphere, the refractive index of the material of sphere is

a) 2.5 b) 1.5 c) 1.25 d) 2.0

159. A concave lens of focal length 20 cm product an image half in size of the real object. The distance of the real object is

a) 20 cm b) 30cm c) 10cm d) 60cm

160. Sun subtends an angle of 0.5° at the centre of curvature of a concave mirror of radius of curvature 15 m. The diameter of the image of the sum formed by the mirror is

a) 8.55 cm b) 7.55 cm c) 6.55 cm d) 5.55 cm

161. The focal length of convex lens is 30 cm and the size of image is quarter of the object, then the object distance is

a) 150 cm b) 60 cm c) 30 cm d) 40 cm

162. A parallel beam of monochromatic light is incident at one surface of an equilateral prism. Angle of incidence is 55° and angle of emergence is 46°. The angle of minimum deviation will be

a) Less than 41° b) Equal to 41° c) More than 41° d) None of the above

163. If the critical angle for total internal reflection from a medium to vacuum is 30°, the velocity of light in the medium is

a) $3 \times 10^8\ m/s$ b) $1.5 \times 10^8\ m/s$ c) $6 \times 10^8\ m/s$ d) $\sqrt{3} \times 10^8\ m/s$

164. Which of the following is a wrong statement?

a) $D = 1/f$ where, f is the focal length and D is called the refractive power of a lens
b) Power is expressed in a diopter when f is in metre
c) Power is expressed in diopter and does not depend on the system of unit used to measure f
d) D is positive for convergent lens and negative for divergent lens

165. Convex lens made up of glass $(\mu_g = 1.5)$ and radius of curvature $R$is dipped into water. Its focal length will be (Refractive index of water = 4/3)

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

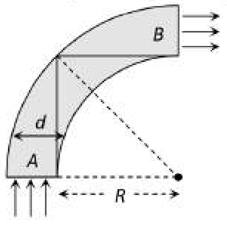
166. A ray of light falls on a transparent glass slab with refractive index (relative to air) of 1.62. The angle of incidence for which the reflected and refracted rays are mutually perpendicular is

a) $\tan^{-1}(1.62)$ b) $\sin^{-1}(1.62)$ c) $\cos^{-1}(1.62)$ d) None of these

167. A ray is incident at an angle of incidence i on one surface of a prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, the angle of incidence i is nearly equal to

a) A/μ b) $A/2\mu$ c) μA d) $\mu A/2$

168. A rod of glass ($\mu = 1.5$) and of square cross section is bent into the shape shown in the figure. A parallel beam of light falls on the plane flat surface A as shown in the figure. If d is the width of a side and R is the radius of circular arc then for what maximum value of $\frac{d}{R}$ light entering the glass slab through surface A emerges from the glass through B



a) 1.5 b) 0.5 c) 1.3 d) None of these

169. The diameter of the objective lens of a telescope is 5.0 m and wavelength of light is 6000 Å. The limit of resolution of this telescope will be

a) 0.03 sec b) 3.03 sec c) 0.06 sec d) 0.15 sec

170. A point source of light is kept below the surfaces of water in a pond

a) Light emerges from every point of the surface of the pond
b) No light is transmitted from the surface of the pond
c) All the light emitted by the source emerges from a circular region of the pond
d) Some of the light emitted by the source emerges from a circular region of pond

171. A car is fitted with a convex mirror of focal length 20 cm. A second car 2 m broad and 1.6 m height is 6 cm away from the first car. The position of the second car as seen in the mirror or the first car is

a) 19.35 cm b) 17.45 cm c) 21.48 cm d) 15.49 cm

172. A ray of light passes an equilateral prism such that an angle of incidence is equal to the angle of emergence and the latter is equal to $\frac{3}{4}$th the angle of prism. The angle of deviation is

a) 45° b) 39° c) 20° d) 30°

173. The index of refraction of diamond is 2.0, velocity of light in diamond in cm/s is approximately

a) 6×10^{10} b) 3.0×10^{10} c) 2×10^{10} d) 1.5×10^{10}

174. When diameter of the aperture of the objective of an astronomical telescope is increased, its

a) Magnifying power is increased and resolving power is decreased
b) Magnifying power and resolving power both are increased
c) Magnifying power remains the same but resolving power is increased
d) Magnifying power and resolving power both are decreased

175. A person cannot see distinctly at the distance less than one metre. Calculate the power of the lens that he should use to read a book at a distance of 25 cm

a) +3.0 D b) +0.125 D c) −3.0 D d) +4.0 D

176. It is desired to make a converging achromatic combination of mean focal length 50 cm by using two lenses of materials A and B. If the dispersive power of A and B are in ratio 1:2, the focal lengths of the convex and the concave lenses are respectively

a) 25 cm and 50 cm b) 50 cm and 25 cm c) 50 cm and 100 cm d) 100 cm and 50 cm

177. A parallel beam of light is incident on a converging lens parallel to its principal axis. As one moves away from the lens on the other side of the principal axis, the intensity of light

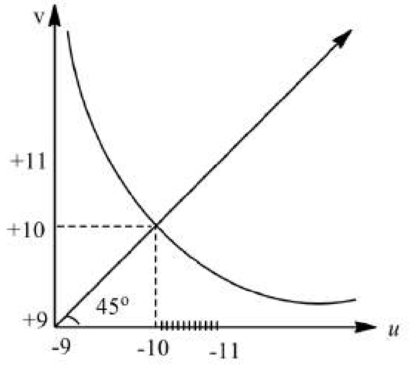
a) First decreases and then increases b) Continuously increases

c) Continuously decreases d) First increases and then decreases

178. A virtual image three times the size of the object is obtained with a concave mirror of curvature 36 cm. The distance of the object from the mirror is

a) 5 cm b) 12 cm c) 10 cm d) 20 cm

179. The graph between object distance $u$and image distance v for lens is given below. The focal length of the lens is



a) 5 ± 0.1 b) 5 ± 0.05 c) 0.5 ± 0.1 d) 0.5 ± 0.05

180. The apparent depth of water in cylindrical water tank of diameter $2R$ cm is reducing at the rate of x cm/minute when water is being drained out at a constant rate. The amount of water drained in $c.c.$ per minute is (n_1 = refractive index of air, n_2 = refractive index of water)

a) $x \pi R^2 n_1/n_2$ b) $x \pi R^2 n_2/n_1$ c) $2 \pi R n_1/n_2$ d) $\pi R^2 x$

181. An object is placed infront of a convex mirror at a distance of 50 cm. A plane mirror is introduced covering the lower half of the convex mirror. If the distance between the object and plane mirror is 30 cm, it is found that there is no parallax between the images formed by two mirrors. Radius of curvature of mirror will be

a) 12.5 cm b) 25 cm c) $\frac{50}{3} cm$ d) 18 cm

182. An object is immersed in a fluid. In order that the object becomes invisible, it should

a) Behave as a perfect reflector

b) Absorb all light falling on it

c) Have refractive index one

d) Have refractive index exactly matching with that of the surrounding fluid

183. To a fish under water, viewing obliquely a fisherman standing on the bank of the lake, the man looks

a) Taller than what he actually is

b) Shorter that what he actual is

c) The same height as he actually is

d) Depends on the obliquity

184. The instrument used by doctors for endoscopy works on the principle of

a) Total internal reflection b) Reflection

c) Refraction d) None of the above

185. In an equilateral prism if incident angle is 45° then minimum deviation is

a) 30° b) 60° c) 45° d) 90°

186. A biconvex lens of focal length 15 cm is in front of a plane mirror. The distance between the lens and the mirror is 10 cm. A small object is kept at a distance of 30 cm from the lens. The final image is

a) Virtual and at a distance of 16 cm from the mirror
b) Real and at a distance of 16 cm from the mirror
c) Virtual and at a distance of 20 cm from the mirror
d) None of the above

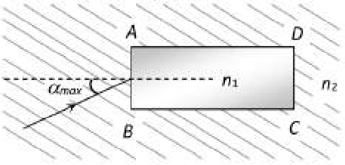
187. Refractive index of glass is $\frac{3}{2}$ and refractive index of water is $\frac{4}{3}$. If the speed of light in glass is 2.00×10^8 m/s, the speed in water will be

a) $2.67 \times 10^8\ m/s$ b) $2.25 \times 10^8\ m/s$ c) $1.78 \times 10^8\ m/s$ d) $1.50 \times 10^8\ m/s$

188. The far point of a myopia eye is at 40 cm. For removing this defect, the power of lens required will be

a) 40 D b) $-4\ D$ c) $-2.5\ D$ d) 0.25 D

189. A rectangular glass slab $ABCD$, of refractive index n_1, is immersed in water of refractive index $n_2(n_1 > n_2)$. A ray of light in incident at the surface AB of the slab as shown. The maximum value of the angle of incidence α_{max} such that the ray comes out only from the other surface CD is given by



a) $\sin^{-1}\left[\frac{n_1}{n_2}\cos\left(\sin^{-1}\frac{n_2}{n_1}\right)\right]$ b) $\sin^{-1}\left[n_1\cos\left(\sin^{-1}\frac{1}{n_2}\right)\right]$

c) $\sin^{-1}\left(\frac{n_1}{n_2}\right)$ d) $\sin^{-1}\left(\frac{n_2}{n_1}\right)$

190. If the speed of light in vacuum is $C\ m/sec$, then the velocity of light in a medium of refractive index 1.5

a) Is $1.5 \times C$ b) Is C
c) Is $\frac{C}{1.5}$ d) Can have any velocity

191. Five $lumen/watt$ is the luminous efficiency of a lamp and its luminous intensity is 35 $candela$. The power of the lamp is

a) 80 W b) 176 W c) 88 W d) 36 W

192. A beam of light is converging towards a point I on a screen. A plane glass plate whose thickness in the direction of the beam $= t$, refractive index $= \mu$, is introduced in the path of the beam. The convergence point is shifted by

a) $t\left(1-\frac{1}{\mu}\right)$ away b) $t\left(1+\frac{1}{\mu}\right)$ away c) $t\left(1-\frac{1}{\mu}\right)$ nearer d) $t\left(1+\frac{1}{\mu}\right)$ nearer

193. Two beams of red and violet colours are made to pass separately through a prism (angle of the prism is 60°).In the position of minimum deviation, the angle of refraction will be

a) 30° for both the colours b) Greater for the violet colour
c) Greater for the red colour d) Equal but not 30° for both the colours

194. A 60 $watt$ bulb is hung over the center of a table $4\ m \times 4\ m$ at height of 3 m. The ratio of the intensities of illumination at a point on the centre of the edge and on the corner of the table is

a) $(17/13)^{3/2}$ b) 2/1 c) 17/13 d) 5/4

195. An eye specialist prescribes spectacles having a combination of convex lens of focal length 40 cm in contact with a concave lens of focal length 25 cm. The power of this lens combination in dioptres is

a) +1.5 b) −1.5 c) +6.67 d) −6.67

196. Focal length of objective and eyepiece of telescope are 200 cm and 4 cm respectively. What is length of telescope for normal adjustment?

a) 196 cm b) 204 cm c) 250 cm d) 225 cm

197. The focal length of an objective of a telescope is 3 *metre* and diameter 15 *cm*. Assuming for a normal eye, the diameter of the pupil is 3 *mm* for its complete use, the focal length of eye piece must be

a) 6 *cm* b) 6.3 *cm* c) 20 *cm* d) 60 *cm*

198. A person uses spectacles of power + 2 D. He is suffering from

a) Myopia b) Presbyopia c) Astigmatism d) Hypermetropia

199. In a grease spot photometer, light from a lamp with dirty chimney is exactly balanced by a point source distance 10 cm from the grease spot. On clearing the dirty chimney, the point source is moved 2 cm to obtain a balance again. Then the percentage of light absorbed by the dirty chimney is nearly

a) 64% b) 36% c) 44% d) 56%

200. If the refractive indices of a prism for red, yellow and violet colours be 1.61, 1.63 and 1.65 respectively, then the dispersive power of the prism will be

a) $\frac{1.65-1.62}{1.61-1}$ b) $\frac{1.62-1.61}{1.65-1}$ c) $\frac{1.65-1.61}{1.63-1}$ d) $\frac{1.65-1.63}{1.61-1}$

201. A source emits light of wavelength 4700Å, 5400Å and 6500Å. The light passes through red glass before being tested by a spectrometer. Which wavelength in seen in the spectrum

a) 6500 Å b) 5400 Å c) 4700 Å d) All the above

202. Total flux produced by a source of 1 *cd* is

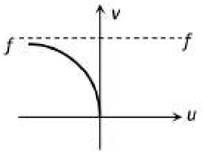
a) $1/4\pi$ b) 8π c) 4π d) $1/8\pi$

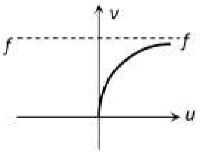
203. A lens forms a virtual image 4 cm away from it when an object is placed 10 cm away from it. The lens is a.... lens of focal length..

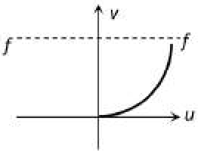
a) Concave, 6.67 cm b) Concave, 2.86 cm

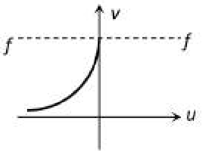
c) Convex, 2.86 cm d) May be concave or convex, 6.67 cm

204. The graph between u and v for a convex mirror is

a) 

b) 

c) 

d) 

205. The angle of minimum deviation for a prism is 40° and the angle of the prism is 60°. The angle of incidence in this position will be

a) 30° b) 60° c) 50° d) 100°

206. Light travels in two media A and B with speeds $1.8\times10^8 ms^{-1}$ and $2.4\times10^8 ms^{-1}$ respectively. Then the critical angle between them is

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

207. Under which of the following conditions will a convex mirror of focal length f produce an image that is erect, diminished and virtual

a) Only when $2f > u > f$ b) Only when $u = f$

c) Only when $u < f$ d) Always

208. In vacuum the speed of light depends upon

a) Frequency b) Wave length

c) Velocity of the source of light d) None of these

209. The sky would appear red instead of blue if

a) Atmospheric particles scatter blue light more than red light

b) Atmospheric particles scatter all colours equally

c) Atmospheric particles scatted red light more than the blue light

d) The sun was much hotter

210. Two beams of red and violet colours are made to pass separately through a prism of $A = 60°$.In the minimum deviation position, the angle of refraction inside the prism will be

a) Greater for red colour b) Equal but not 30°for both the colours

c) Greater for violet colour d) 30°for both the colours

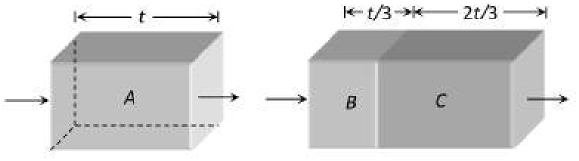
211. A Galilean telescope has an objective of focal length 100 cm and magnifying power 50. The distance between the two lenses in normal

a) 98 cm b) 100 cm c) 150 cm d) 200 cm

212. The plane faces of two identical plano-convex lenses each having focal length of 40 cm are pressed against each other to form a usual convex lens. The distance from this lens, at which an object must be placed to obtain a real, inverted image with magnification one is

a) 80 cm b) 40 cm c) 20 cm d) 162 cm

213. Two transparent slabs have the same thickness as shown. One is made of material A of refractive index 1.5. The other is made of two material B and C with thickness in the ratio 1 : 2. The refractive index C is 1.6. If a monochromatic parallel beam passing through the slabs has the same number of waves inside both, the refractive index of B is



a) 1.1 b) 1.2 c) 1.3 d) 1.4

214. In a compound microscope cross-wires are fixed at the point

a) Where the image is formed by the objective
b) Where the image is formed by the eye-piece
c) Where the focal point of the objective lies
d) Where the focal point of the eye-piece lies

215. Spherical aberration in a lens

a) Is minimum when most of the deviation is at the first surface
b) Is minimum when most of the deviation is at the second surface
c) Is minimum when the total deviation is equally distributed over the two surfaces
d) Does not depend on the above considerations

216. A telescope using light having wavelength 5000 Å and using lenses of focal 2.5 and 30 cm. If the diameter of the aperture of the objective is 10 cm, then the resolving limit and magnifying power of the telescope is respectively

a) $6.1 \times 10^{-6} rad$ and 12 b) $5.0 \times 10^{-6} rad$ and 12
c) $6.1 \times 10^{-6} rad$ and 8.3×10^{-2} d) $5.0 \times 10^{-6} rad$ and 8.3×10^{-2}

217. White light is passed through a prism whose angle is 5°. If the refractive indices for rays of red and blue colour are respectively 1.64 and 1.66, the angle of deviation between the two colours will be

a) 0.1 $degree$ b) 0.2 $degree$ c) 0.3 $degree$ d) 0.4 $degree$

218. If the lower half of a concave mirror's reflecting surface is made opaque, which of the following statements describe the image of an object placed infront of the mirror

S1: Intensity of the image will increase
S2: The image will show only half of the object
S3: No change in the image
S4: Intensity of the image will be reduced to half

a) S1 only b) S2 only c) S2 and S3 d) S4 only

219. Blue colour of sea water is due to

a) Interference of sunlight reflected from the water surface
b) Scattering of sunlight by the water molecules
c) Image of sky in water
d) Refraction of sunlight

220. Emission spectrum of CO_2 gas

a) Is a line spectrum b) Is a band spectrum
c) Is a continuous spectrum d) Does not fall in the visible region

221. A ray of light is incident on a plane mirror along the direction given by vector$A = 2\hat{\imath} - 3\hat{\jmath} + 4\hat{\mathbf{k}}$. Find the unit vector along reflected ray. Take normal to mirror along the direction of vector $B = 3\hat{\imath} - 6\hat{\jmath} + 2\hat{\mathbf{k}}$.

a) $\frac{-94\hat{\imath} + 237\hat{\jmath} + 68\hat{\mathbf{k}}}{49\sqrt{29}}$ b) $\frac{-94\hat{\imath} + 68\hat{\jmath} - 273\hat{\mathbf{k}}}{49\sqrt{29}}$ c) $\frac{3\hat{\imath} + 6\hat{\jmath} - 2\hat{\mathbf{k}}}{7}$ d) None of these

222. When objects at different distances are seen by the eye, which of the following remains constant

a) The focal length of the eye lens b) The object distance from the eye lens
c) The radii of curvature of the eye lens d) The image distance from the eye lens

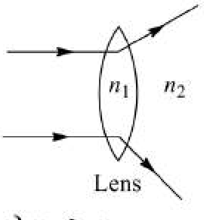
223. An astronomical telescope of ten-fold angular magnification has a length of 44 *cm*. The focal length of the objective is

a) 4 *cm* b) 40 *cm* c) 44 *cm* d) 440 *cm*

224. A plano convex lens fits exactly into a plano concave lens. Their plane surfaces are parallel to each other. If the 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 focal length of the combination is

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

225. The relation between n_1 and n_2 if the behavior of light ray is as shown in the figure



a) $n_2 > n_1$ b) $n_1 \gg n_2$ c) $n_1 > n_2$ d) $n_1 = n_2$

226. A person wears glasses of power $-2.0\ D$. The defect of the eye and the far point of the person without the glasses will be

a) Nearsighted, 50 *cm* b) Farsighted, 50 *cm* c) Nearsighted, 250 *cm* d) Astigmatism, 50 *cm*

227. Which of the following is not a correct statement

a) The wavelength of red light is greater than the wavelength of green light
b) The wavelength of blue light is smaller than the wavelength of orange light
c) The frequency of green light is greater than the frequency of blue light
d) The frequency of violet light is greater than the frequency of blue light

228. A fish at a depth of 12 cm in water is viewed by an observer on the bank of a lake. To what height the image of the fish is raised?
(Refractive index of like water=4/3)

a) 9 cm b) 12 cm c) 3.8 cm d) 3 cm

229. A boy 1.5 m tall with his eye level at 1.38 m stands before a mirror fixed on a wall. The minimum length of mirror required to view the complete image of boy is

a) 0.75 m b) 0.06 m c) 0.69 m d) 0.12 m

230. A plane mirror produces a magnification of

a) Zero b) -1 c) +1 d) Between 0 and +1

231. The critical angle of a medium with respect to air is 45°. The refractive index of that medium will be

a) 1.72 b) 1.414 c) 2.12 d) 1.5

232. An object 2.5 *cm* high is placed at a distance of 10 *cm* from a concave mirror of radius of curvature 30 *cm*. The size of the image is

a) 9.2 *cm* b) 10.5 *cm* c) 5.6 *cm* d) 7.5 *cm*

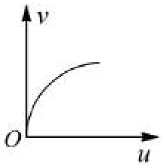
233. A ray of light suffers minimum deviation when incident at 60° prism of refractive index$\sqrt{2}$.The angle of incidence is

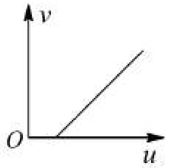
a) $\sin^{-1}(0.8)$ b) 60° c) 45° d) 30°

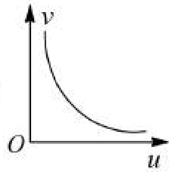
234. The plano-convex lens of focal length 20 cm and 30 cm are placed together to form a double convex lens. The final focal length will be

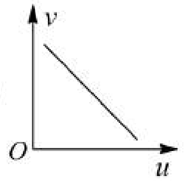
a) 12 cm b) 60 cm c) 20 cm d) 30 cm

235. For a convex mirror, the variation of u *versus* v is given by

a) 

b) 

c) 

d) 

236. The length of a telescope is 36 cm. The focal lengths of its lenses can be

a) $30\ cm, 6\ cm$ b) $-30\ cm, -6\ cm$ c) $30\ cm, -6\ cm$ d) $-30\ cm, 6\ cm$

237. A convex lens of crown glass ($n = 1.525$) will behave as a divergent lens if immersed in

a) Water ($n = 1.33$) b) In a medium of $n = 1.525$

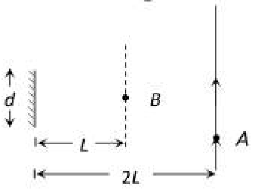
c) Carbon disulphide $n = 1.66$ d) It cannot act as a divergent lens

238. A concave mirror and a converging lens (glass with $\mu = 1.5$) both have a focal length of 3 cm when in air. When they are in water $\left(\mu = \frac{4}{3}\right)$, their new focal lengths are

a) $f_{\text{Lens}} = 12\ cm, f_{\text{Mirror}} = 3cm$ b) $f_{\text{Lens}} = 3\ cm, f_{\text{Mirror}} = 12cm$

c) $f_{\text{Lens}} = 3\ cm, f_{\text{Mirror}} = 3cm$ d) $f_{\text{Lens}} = 12\ cm, f_{\text{Mirror}} = 12cm$

239. A point source of light B is placed at a distance L in front of the centre of a mirror width d hung vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance $2L$ from it as shown. The greater distance over which he can see the image of the light source in the mirror is



a) $d/2$ b) d c) $2d$ d) $3d$

240. A concave mirror of focal length 100cm is used to obtain the image of the sun which subtends an angle of 30′. The diameter of the image of the sun will be

a) 1.74cm b) 0.87cm c) 0.435cm d) 100cm

241. Two point white does are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. Approximately, what is the maximum distance at which these dots can be resolved by the eye? [Take wavelength of light = 500 nm]

a) 5 m b) 1 m c) 6 m d) 3 m

242. Consider telecommunication through optical fibres. Which of the following statements is not true

a) Optical fibres may have homogeneous core with a suitable cladding

b) Optical fibres can be of graded refractive index

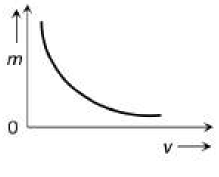
c) Optical fibres are subject to electromagnetic interference from outside

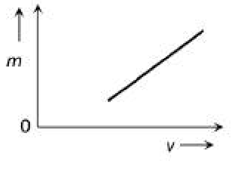
d) Optical fibres have extremely low transmission loss

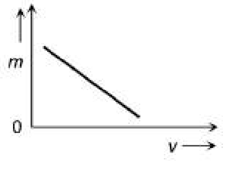
243. A concave mirror of focal length 'f_1' is placed at a distance of 'd' from a convex lens of focal length 'f_2'. A beam of light coming from infinity and falling on this convex lens-concave mirror combination returns to infinity. The distance 'd' must equal

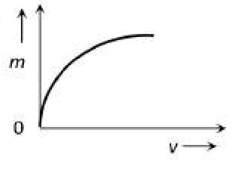
a) $f_1 + f_2$ b) $-f_2 + f_2$ c) $2f_1 + f_2$ d) $-2f_1 + f_2$

244. The graph between the lateral magnification (m) produced by a lens and the distance of the image (v) is given by

a) 

b) 

c) 

d) 

245. A prism of a certain angle deviation the red and blue rays by 8° and 12° respectively. Another prism of the same angle deviates the red and blue rays by 10° and 14° respectively. The prisms are small angled and made of different materials. The dispersive powers of the materials of the prisms are in the ratio

a) 5 : 6 b) 9 : 11 c) 6 : 5 d) 11 : 9

246. The radius of the convex surface of plano-convex lens is 20 *cm* and the refractive index of the material of the lens is 1.5. The focal length of the lens is

a) 30 *cm* b) 50 *cm* c) 20 *cm* d) 40 *cm*

247. A compound microscope has an objective and eye-piece as thin lenses of focal lengths 1 cm and 5 cm respectively. The distance between the objective and the eye-piece is 20 cm. The distance at which the object must be placed infront of the objective if the final image is located at 25 cm from the eye-piece, it numerically

a) 95/6 cm b) 5 cm c) 95/89 cm d) 25/6 cm

248. An object of length 6 *cm* is placed on the principal axis of a concave mirror of focal length f at a distance of $4f$. The length of the image will be

a) 2 *cm* b) 12 *cm* c) 4 *cm* d) 1.2 *cm*

249. If ε_0 and μ_0 are respectively, the electric permittivity and the magnetic permeability of free space, ε and μ the corresponding quantities in a medium, the refractive index of the medium is

a) $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$ b) $\frac{\mu\varepsilon}{\mu_0\varepsilon_0}$ c) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$ d) $\sqrt{\frac{\mu\mu_0}{\varepsilon\,\varepsilon_0}}$

250. The magnifying power of a telescope is 9. When it is adjusted for parallel rays, the distance between the objective and the eye-piece is found to be 20 cm. The focal lengths of the lenses are

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

251. A lamp is hanging along the axis of a circular table of radius r. At what height should the lamp be placed above the table, so that the illuminance at the edge of the table is $\frac{1}{8}$ of that at its center

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

252. The radius of curvature for a convex lens is 40 *cm*, for each surface. Its refractive index is 1.5. The focal length will be

a) 40 *cm* b) 20 *cm* c) 80 *cm* d) 30 *cm*

253. The image of a small electric bulb fixed on the wall of a room is to be obtained on the opposite wall 4 m away by means of a large convex lens. The maximum possible focal length of the lens required for this purpose will be

a) 0.5 m b) 1.0 m c) 1.5 m d) 2.0 m

254. If the refractive angles of two prisms made of crown glass are 10° and 20° respectively, then the ratio of their colour deviation powers will be

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

255. Brilliance of diamond is due to

a) Shape b) Cutting
c) Reflection d) Total internal reflection

256. A point object is placed at a distance of 25 cm from a convex lens of focal length 20 cm. If a glass slab of thickness t and refractive index 1.5 is inserted between the lens and the object, the image is formed at infinity. The thickness t is

a) 15 cm b) 5 cm c) 10 cm d) 20 cm

257. The ratio of angle of minimum deviation of a prism in air and when dipped in water will be (${}_a\mu_g = 3/2$ and ${}_a\mu_\omega = 4/3$)

a) 1/8 b) 1/2 c) 3/4 d) 1/4

258. The number of lenses in a terrestrial telescope is

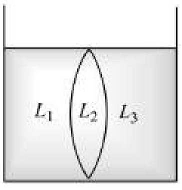
a) Two b) Three c) Four d) Six

259. When light is refracted from air into glass

a) Its wavelength and frequency both increase
b) Its wavelength increases but frequency remains unchanged
c) Its wavelength decreases but frequency remains unchanged
d) Its wavelength and frequency both decrease

260. The ratio of the refractive index of red light to blue light in air is
a) Less than unity
b) Equal to unity
c) Greater than unity
d) Less as well as greater than unity depending upon the experimental arrangement

261. As shown in figure, the liquid, L_1, L_2 and L_3 have refractive indices 1.55, 1.50 and 1.20 respectively. Therefore, the arrangement corresponds to



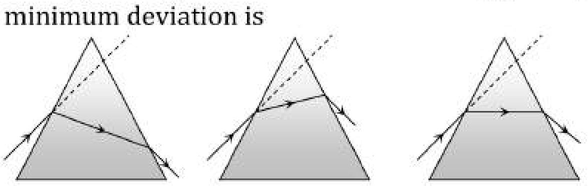
a) Biconvex lens
b) Biconcave lens
c) Concave-convex lens
d) Convexo-concave lens

262. A virtual image twice as long as the object is formed by a convex lens when the object is 10 cm away from it. A real image twice as long as the object will be formed when it is placed at a distance.....from the length
a) 40 cm
b) 30 cm
c) 20 cm
d) 15 cm

263. Colour of the sky is blue due to
a) Scattering of light
b) Total internal reflection
c) Total emission
d) None of the above

264. If the apertaure of a telescope is decreased the resolving power will
a) Increase
b) Decrease
c) Remain same
d) Zero

265. The figures represent three cases of a ray passing through a prism of angle A. The case corresponding to minimum deviation is



(1) (2) (3)

a) 1
b) 2
c) 3
d) None of these

266. Two point light sources are 24 cm apart. Where should a convex lens of focal length 9 cm be put in between them from one source so that the images of both the sources are formed at the same place
a) 6 cm
b) 9 cm
c) 12 cm
d) 15 cm

267. An object 5 cm tall is placed 1 m from a concave spherical mirror which has a radius of curvature of 20 cm. The size of the image is
a) 0.11 cm
b) 0.50 cm
c) 0.55 cm
d) 0.60 cm

268. By placing the prism in minimum deviation position, images of the spectrum
a) Becomes inverted
b) Becomes broader
c) Becomes distinct
d) Becomes intensive

269. The principal section of a glass prism is an isosceles triangle ABC with $AB = AC$. The face AC is silvered. A ray of light is incident normally on the face AB and after tworeflections, it emerges from the base BC perpendicular to the base. Angle BAC of the prism is
a) 30°
b) 36°
c) 60°
d) 72°

270. A point object is moving on the principal axis of a concave mirror focal length 24 cm towards the mirror. When it is at a distance of 60cm from the mirror, its velocity is 9cm/sec. What is the velocity of the image at that instant
a) 5cm/sec towards the mirror
b) 4cm/sec towards the mirror

c) $4 cm/sec$ away from the mirror
d) $9 cm/sec$ away from the mirror

271. A convergent beam of light is incident on a convex mirror so as to converge to a distance 12 cm from the pole of the mirror. An inverted image of the same size is formed coincident with the virtual object. What is the focal length of the mirror

a) 24 cm
b) 12 cm
c) 6 cm
d) 3 cm

272. The refractive index of the material of a prism is $\sqrt{2}$ and the angle of prism is $30°$. One of its refracting faces is polished. The incident beam of lift will retrace back for angle of incidence

a) $0°$
b) $45°$
c) $60°$
d) $90°$

273. The phenomenon utilised in an optical fibre is

a) Refraction
b) Interference
c) Polarization
d) Total internal reflection

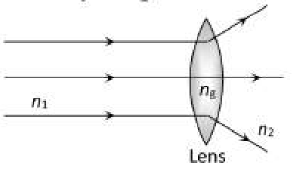
274. A plano convex lens is made of glass of refractive index 1.5. The radius of curvature of its convex surface is R. Its focal length is

a) $\frac{R}{2}$
b) R
c) $2R$
d) $1.5 R$

275. Critical angle for light going from medium (i) to (ii) is θ. The speed of light in medium (i) is v then speed in medium (ii) is

a) $v(1-\cos\theta)$
b) $v/\sin\theta$
c) $v/\cos\theta$
d) $v(1-\sin\theta)$

276. The ray diagram could be correct



a) If $n_1 = n_2 = n_3$
b) If $n_1 = n_2$ and $n_1 < n_g$
c) If $n_1 = n_2$ and $n_1 > n_g$
d) Under no circumstances

277. A concave lens with unequal radii a curvature made of glass ($\mu_g = 1.5$) has a focal length of 40 cm. If it is immersed in a liquid of refractive index μ_l=2, then

a) It behave like a convex lens of 80 cm focal length
b) It behave like a concave lens of 20 cm focal length
c) Its focal length becomes 60 cm
d) Nothing can be said

278. A beaker contains water up to a height h_1 and kerosene of height h_2 above water so that the total height of (water +kerosene) is $(h_1 + h_2)$. Refractive index of water is u_1 and that of kerosene is u_2. The apparent shift in the position of the bottom of the beaker when viewed from above is

a) $\left(1-\frac{1}{u_1}\right)h_2 + \left(1-\frac{1}{u_2}\right)h_1$
b) $\left(1+\frac{1}{u_1}\right)h_1 + \left(1+\frac{1}{u_2}\right)h_2$
c) $\left(1-\frac{1}{u_1}\right)h_2 + \left(1-\frac{1}{u_2}\right)h_2$
d) $\left(1+\frac{1}{u_1}\right)h_2 - \left(1+\frac{1}{u_2}\right)h_1$

279. Microscope is an optical instrument which

a) Enlarges the object
b) Increases the visual angle formed by the object at the eye
c) Decreases the visual angle formed by the object at the eye
d) Brings the object nearer

280. Near and far points of human eye are

a) 25 cm and infinite
b) 50 cm and 100 cm
c) 25 cm and 50 cm
d) 0 cm and 25 cm

281. A plano-concave lens is made up of glass of refractive index 1.5 and the radius of the curvature of its curved face is 100 cm. What is the power of the lens?

a) + 0.5 D | b) −0.5 D | c) −2 D | d) +2 D

282. The mean distance of sun from the earth is $1.5 \times 10^8 Km$ (nearly). The time taken by the light to reach earth from the sun is

a) 0.12 *min* b) 8.33 *min* c) 12.5 *min* d) 6.25 *min*

283. A convex mirror has a focal length f. A real object is placed at a distance f in front of it from the pole produces an image at

a) Infinity b) f c) $f/2$ d) $2f$

284. If in compound microscope m_1 and m_2 be the linear magnification of the objective lens and eye lens respectively, then magnifying power of the compound microscope will be

a) $m_1 - m_2$ b) $\sqrt{m_1 + m_2}$ c) $(m_1 + m_2)/2$ d) $m_1 \times m_2$

285. A ray of light falls on a transparent glass slab of refractive index 1.62.If the reflected ray and the refracted ray are mutually perpendicular, the angle of incidence is

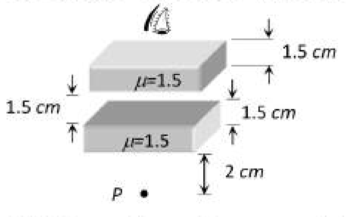
a) $\tan^{-1}(1.62)$ b) $\tan^{-1}\left(\frac{1}{1.62}\right)$ c) $\tan^{-1}(1.33)$ d) $\tan^{-1}\left(\frac{1}{1.33}\right)$

286. Line spectra are due to

a) Hot solids b) Atoms in gaseous state

c) Molecules in gaseous state d) Liquid at low temperature

287. The image of point P when viewed from top of the slabs will be



a) 2.0 *cm* above P b) 1.5 *cm* above P c) 2.0 *cm* below P d) 1 *cm* above P

288. Two parallel pillars are 11 *km* away from an observer. The minimum distance between the pillars so that they can be seen separately will be

a) 3.2 *m* b) 20.8 *m* c) 91.5 *m* d) 183 *m*

289. Image of an object approaching a convex mirror of radius of curvature 20 m along its optical axis is observed to move from $\frac{25}{3}$ m to $\frac{50}{7}$ m in 30 s. What is the speed of the object in kmh^{-1}?

a) 3 b) 4 c) 5 d) 6

290. Wavelength of given light waves in air and in a medium are 6000 Å and 4000 Å respectively. The critical angle is

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

291. Two parallel light rays are incident at one surface of a prism of refractive index 1.5 as shown in figure. The angle between the emergent rays is nearly

a) 19° b) 37° c) 45° d) 49°

292. Image formed on retina of eye is proportional to

a) Size of object b) Area of object c) $\frac{\text{Size of object}}{\text{Size of image}}$ d) $\frac{\text{Size of image}}{\text{Size of object}}$

293. If the focal length of objective and eye lens are 1.2 *cm* and 3 *cm* respectively and the object is put 1.25 *cm* away from the objective lens and the final image is formed at infinity. The magnifying power of the microscope is

a) 150 b) 200 c) 250 d) 400

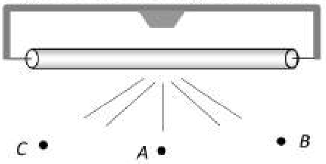
294. To focal length of a concave mirror is 12 cm. Where should an object length 4 cm be placed so that an image 1 cm long is formed?

a) 48 cm b) 3 cm c) 60 cm d) 15 cm

295. A person sees his virtual image by holding a mirror very close to the face. When he moves the mirror away from his face, the image becomes inverted. What type of mirror he is using?

a) Plane mirror b) Convex mirror c) Concave mirror d) None of these

296. Figure shows a glowing mercury tube. The illuminances at point A, B and C are related as



a) $B > C > A$ b) $A > C > B$ c) $B = C > A$ d) $B = C < A$

297. An achromatic convergent doublet of two lenses in contact has a power of +2D. The convex lens has power +5 D. What is the ratio of the dispersive powers of the convergent and divergent lenses?

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

298. A biconvex lens has a radius of curvature of magnitude 20cm. 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) Real, inverted, height = 1 cm b) Virtual, upright, height = 1 cm

c) Virtual, upright, height = 0.5 cm d) Real, inverted, height = 4 cm

299. Two points, separated by a distance of 0.1 mm, can just be inspected on a microscope when light of wavelength 6000 Å is used. If the light of wavelength 4800Å is used, the limit of resolution is

a) 0.8 mm b) 0.08 mm c) 0.1 mm d) 0.04 mm

300. A piece of plane glass is placed on a word with letters of different colours. The letters which appear minimum raised are

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

301. A convex lens is in contact with concave lens. The magnitude of the ratio of their focal length is 2/3. Their equivalent focal length is 30 cm. What are their individual focal lengths?

a) -75, 50 b) -10, 15 c) 75, 50 d) -15, 10

302. A diver inside water ($\mu = 1.33$) should see the sun set at an angle of

a) 60° b) 90° c) 0° d) 49°

303. A plano convex lens of ($f = 20$ cm) is silvered at plane surface. New f will be

a) 20 cm b) 40 cm c) 30 cm d) 10 cm

304. If I_1 and I_2 be the size of the images respectively for the two positions of lens in the displacement method, then the size of the object is given by

a) I_1/I_2 b) $I_1 \times I_2$ c) $\sqrt{I_1 \times I_2}$ d) $\sqrt{I_1/I_2}$

305. The plane faces of two identical plano-convex lenses each having a focal length of 50 cm are placed against each other to form a usual biconvex lens. The distance from this lens combination at which an object must be placed to obtain a real, inverted image which has the same size as the object is

a) 50 cm b) 25 cm c) 100 cm d) 40 cm

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

a) Mercury light b) Sunlight c) Infrared light d) Ultraviolet light

307. An astronomical telescope has objective and eye-piece lenses of powers 0.5 D and 20 D respectively. What will be its magnifying power?

a) 30 b) 10 c) 40 d) 20

308. The focal lengths of the objective and eyelenses of a microscope are 1.6 cm and 2.5 cm respectively. The distance between the two lenses is 21.7 cm. If the final image is formed at infinity, the distance between the object and the objective lens is

a) 1.8 cm b) 1.70 cm c) 1.65 cm d) 1.75 cm

309. On which of the following does the magnifying power of a telescope depends

a) The focal length of the objective only

b) The diameter of aperture of the objective only

c) The focal length of the objective and that of the eye piece

d) The diameter of aperture of the objective and that of the eye piece

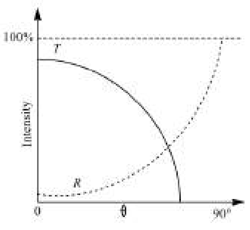
310. The minimum distance between an object and its real image formed by a convex lens is

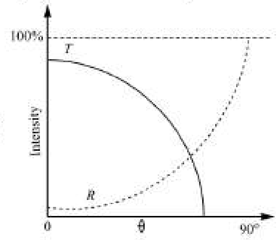
a) 1.5 f b) 2 f c) 2.5 f d) 4 f

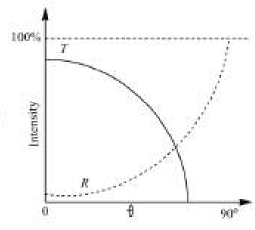
311. A symmetric double convex lens is cut in two equal parts by a plane perpendicular to the principle axis. If the power of the original lens is 4D, the power of a cut lens will be

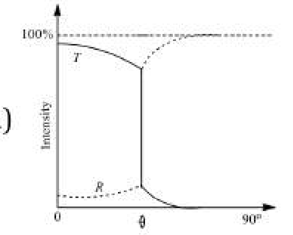
a) 2D b) 3D c) 4D d) 5D

312. A light ray travelling in glass medium is incident on glass-air interface at an angle of incidenceθ. The reflected (R) and transmitted (T) intensities, both as function of θ, are plotted. The correct sketch is

a) 

b) 

c) 

d) 

313. An object is placed at 15 cm from a convex lens of focal length 10 cm. Where should another convex mirror of radius 12 cm be placed such that image will coincide with the object.

a) 19.3 cm b) 18 cm c) 33 cm d) 22 cm

314. A lens made of glass whose index of refraction is 1.60 has a focal length of +20 cm in air. Its focal length in water, whose refractive index is 1.33, will be

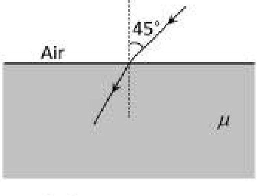
a) Three times longer than in air b) Two times longer than in air

c) Same as in air d) None of the above

315. The frequency of a light ray is $6 \times 10^{14} Hz$. Its frequency when it propagates in a medium of refractive index 1.5, will be

a) $1.67 \times 10^{14} Hz$ b) $9.10 \times 10^{14} Hz$ c) $6 \times 10^{14} Hz$ d) $4 \times 10^{14} Hz$

316. In the figure shown, for an angle of incidence 45°, at the top surface, what is the minimum refractive index needed for total internal reflection at vertical face



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

317. A lens behaves as a converging lens in air and a diverging lens in water. The refractive index of the material is

a) Equal to unity b) Equal to 1.33

c) Between unity and 1.33 d) Greater than 1.33

318. Which one of the following alternative is FALSE for a prism placed in a position of minimum deviation

a) $i_1 = i_2$ b) $r_1 = r_2$ c) $i_1 = r_1$ d) All of these

319. Lux is equal to

a) 1 $lumen/m^2$ b) 1 $lumen/cm^2$ c) 1 $candela/m^2$ d) 1 $candela/cm^2$

320. Which of the following is a correct relation

a) ${}_a\mu_r = {}_a\mu_\omega \times {}_r\mu_\omega$ b) ${}_a\mu_r \times {}_r\mu_\omega = {}_\omega\mu_a$ c) ${}_a\mu_r \times {}_r\mu_a = 0$ d) ${}_a\mu_r / {}_\omega\mu_r = {}_a\mu_\omega$

321. A point objects is placed at the centre of a glass sphere of radius 6 cm and refractive index 1.5. The distance of the virtual image from the surface of the sphere is

a) 2 cm b) 4 cm c) 6 cm d) 12 cm

322. The angel of prism is 5° and its refractive indices for red and violet colours are 1.5 and 1.6 respectively. The angular dispersion produced by the prism is

a) 7.75° b) 5° c) 0.5° d) 0.17°

323. Light takes t_1 second to travel a distance x in vaccum and the same light takes t_2 second to travel 10 x cm in a medium. Critical angle for corresponding medium will be

a) $\sin^{-1}\left(\frac{10t_2}{t_1}\right)$ b) $\sin^{-1}\left(\frac{t_2}{10t_1}\right)$ c) $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$ d) $\sin^{-1}\left(\frac{t_1}{10t_2}\right)$

324. The focal length of a convex mirror is 20 cm its radius of curvature will be

a) 10 cm b) 20 cm c) 30 cm d) 40 cm

325. Which of the following is not correct regarding the ratio telescope

a) It can not work at night
b) It can detect a very faint radio signal
c) It can be operated even in cloudy weather
d) It is much cheaper than optical telescope

326. When a glass slab is placed on a cross made on a sheet, the cross appears raised by 1 cm. The thickness of the glass is 3 cm. The critical angle for glass is

a) $\sin^{-1}(0.33)$ b) $\sin^{-1}(0.5)$ c) $\sin^{-1}(0.67)$ d) $\sin^{-1}(\sqrt{3}/2)$

327. An object is placed at 15 cm infront of a concave mirror whose focal length is 10 cm. The image formed will be

a) Magnified and inverted b) Magnified and erect
c) Reduced in size and inverted d) Reduced in size and erect

328. A hollow double concave lens is made of very thin transparent material. It can be filled with air or either of two liquids L_1 and L_2 having refractive indices n_1 and n_2 respectively ($n_2 > n_1 > 1$). The lens will diverge a parallel beam of light if it is filled with

a) Air and placed in air b) Air and immersed in L_1
c) L_1 and immersed in L_2 d) L_2 and immersed in L_1

329. Which of the following is not the case with the image formed by a concave lens?

a) It may be erect or inverted
b) It may be magnified and diminished
c) It may be real or virtual
d) Real image may be between the pole and focus or beyond focus

330. A short sighted person can see distinctly only those objects which lie between 10 cm and 100 cm from him. The power of the spectacle lens required to see a distant object is

a) $+0.5\ D$ b) $-1.0\ D$ c) $-10\ D$ d) $+4.0\ D$

331. A lens of refractive index n is put in a liquid of refractive index n'. If focal length of lens in air is f, its focal length in liquid will be

a) $\frac{fn'(n-1)}{n'-n}$ b) $\frac{f(n'-n)}{n'(n-1)}$ c) $\frac{n'(n-1)}{f(n'-n)}$ d) $\frac{fn'n}{n-n'}$

332. A concave lens of glass, refractive index 1.5, has both surfaces of same radius of curvature R. On immersion in a medium of refractive index 1.75, it will behave as a

a) Convergent lens of focal length 3.5 R b) Convergent lens of focal length 3.0 R
c) Divergent lens of focal length 3.5 R d) Divergent lens of focal length 3.0 R

333. The light gathering power of a camera lens depends on

a) Its diameter only b) Ratio of diameter and focal length
c) Product of focal length and diameter d) Wavelength of light used

334. The plane faces of two identical plano convex lenses, each with focal length f are pressed against each other using an optical glue to form a usual convex lens. The distance from the optical centre at which an object must be placed to obtain the image same as the size of object is

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

335. Check the correct statements on scattering of light

S1 : Rayleigh scattering is responsible for the bluish appearance of sky

S2 : Rayleigh scattering is proportional to $1/\lambda^4$ when the size of the scatter is much less than λ
S3 : Clouds having droplets of water (large scattering objects) scatter all wavelengths are almost equal and so are generally white
S4 : The sun looks reddish at sunset and sunrise due to Rayleigh scattering

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

336. A ray of light travelling inside a rectangular glass block of refractive index $\sqrt{2}$ is incident on the glass-air surface at an angle of incidence of 45°. The refractive index of air is 1. Under these conditions the ray
a) Will emerge into the air without any deviation
b) Will be reflected back into the glass
c) Will be absorbed
d) Will emerge into the air with angle of refraction equal to 90°

337. The spectrum obtained from a sodium vapour lamp is an example of
a) Absorption spectrum b) Emission spectrum c) Continuous spectrum d) Band spectrum

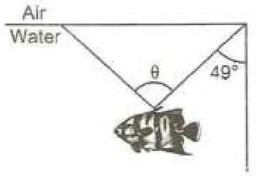
338. A short linear object of a length b lies along the axis of a concave mirror of focal length f at a distance u from the pole of the mirror. The size of the image is equal to
a) $b\left(\frac{u-f}{f}\right)^{1/2}$ b) $b\left(\frac{f}{u-f}\right)^{1/2}$ c) $b\left(\frac{u-f}{f}\right)$ d) $b\left(\frac{f}{f-u}\right)$

339. Rising and setting sun appears to be reddish because
a) Diffraction sends red rays to earth at these times
b) Scattering due to dust particles and air molecules are responsible
c) Refraction is responsible
d) Polarization is responsible

340. An astronomical telescope has a magnifying power 10, the focal length of the eye-piece is 20 cm. The focal length of the objective is
a) $\frac{1}{200}$ cm b) $\frac{1}{2}$ cm c) 200 cm d) 2 cm

341. The two surfaces of a biconvex lens has same radii of curvatures. This lens is made of glass of refractive index 1.5 and has a focal length 10 cm in air. The lens is cut into two equal halves along a plane perpendicular to its principle axis to yield two plano-convex lenses. The two pieces are glued such that the convex surfaces touch each other. If this combination lens is immersed in water (refractive index = 4/3), its focal length (in cm) is
a) 5 b) 10 c) 20 d) 40

342. A fish is a little away below the surface of a lake. If the critical angle is 49°, then the fish could see things above water surface within an angular range of θ° where



a) $\theta = 49°$ b) $\theta = 98°$ c) $\theta = 24\frac{1}{4}°$ d) $\theta = 90°$

343. A thin equiconvex lens of refractive index 3/2 and radius of curvature 30 m is put in water (refractive index $=\frac{4}{3}$). Its focal length is
a) 0.15 m b) 0.30 m c) 0.45 m d) 1.20 m

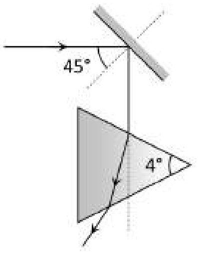
344. A concave mirror of focal length 15 *cm* forms an image having twice the linear dimensions of the object. The position of the object when the image is virtual will be
a) 22.5 *cm* b) 7.5 *cm* c) 30 *cm* d) 45 *cm*

345. A planoconvex lens has a maximum thickness of 6 cm. When placed on a horizontal table with the curved surface in contact with the table surface, the apparent depth of the bottommost point of the lens is found to be 4 cm. If the lens is inverted such that the plane face of the lens is in contact with the surface of the

table, the apparent depth of the centre of the plane face is found to be $\left(\frac{17}{4}\right)$ cm. The radius of curvature of the lens is

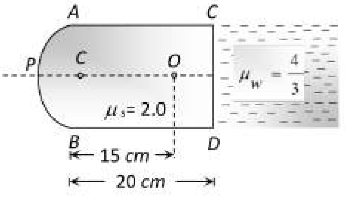
a) 34 cm b) 128 cm c) 75 cm d) 68 cm

346. A ray of light strikes a plane mirror M at an angle of 45° as shown in the figure. After reflection, the ray passes through a prism of refractive index 1.5 whose apex angle is 4°. The total angle through which the ray is deviated is



a) 90° b) 91° c) 92° d) 93°

347. The slab of a material of refractive index 2 shown in figure has curved surface APB of radius of curvature 10 cm and a plane surface CD. On the left of APB is air and on the right of CD is water with refractive indices as given in figure. An object O is placed at a distance of 15 cm from pole P as shown. The distance of the final image of O from P, as viewed from the left is

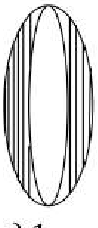


a) 20 cm b) 30 cm c) 40 cm d) 50 cm

348. The diameter of the objective of a telescope is a, its magnifying power is m and wavelength of light is λ. The resolving power of the telescope is

a) $(1.22\lambda)/a$ b) $(1.22a)/\lambda$ c) $\lambda m/(1.22a)$ d) $a/(1.22\lambda)$

349. A convex lens is made of 3 layers of glass of 3 different materials as in the figure. A point object is placed on its axis. The number of images of the object are



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

350. Transmission of light to large distances through optical fibres is based on

a) Dispersion b) Refraction
c) Total internal reflection d) Interference

351. A ray of light is incident at an angle of 60° on one face of a prism of angle 30°. The ray emerging out of the prism makes an angle of 30° with the incident ray. The emergent ray is

a) Normal to the face through which it emerges
b) Inclined at 30° to the face through which it emerges
c) Inclined at 60° to the face through which it emerges
d) None of these

352. The head lights of a jeep are 1.2 m apart. If the pupil of the eye of an observer has a diameter of 2mm and light of wavelength 5896 Å is used, what should be the maximum distance of the jeep from the observer if the two head lights are just separated?

a) 33.9 km b) 33.9 m c) 3.34 km d) 3.39 m

353. An under water swimmer is at a depth of 12 m below the surface of water. A bird is at a height of 18 m from the surface of water, directly above his eyes. For the swimmer the bird appears to be a distance from the surface of water equal to (Refractive Index of water is $\frac{4}{3}$)

a) 24 m b) 12 m c) 18 m d) 9 m

354. When light rays from the sun fall on a convex lens along a direction parallel to its axis

a) Focal length for all colours is the same
b) Focal length for violet colour is the shortest
c) Focal length for yellow colour is the longest
d) Focal length red colour is the shortest

355. To an observer on the earth the starts appear to twinkle. This can be ascribed to

a) The fact that stars do not emit light continuously
b) Frequent absorption of star light by their own atmosphere
c) Frequent absorption of star light by the earth's atmosphere
d) The refractive index fluctuations in the earth's atmosphere

356. The path of a refracted ray of light in a prism is parallel to the base of the prism only when the

a) Light is of a particular wavelength b) Ray is incident normally at one face
c) Ray undergoes minimum deviation d) Prism is made of a minimum deviation

357. For a real object, which of the following can produced a real image?

a) Plane mirror b) Concave lens c) Convex mirror d) Concave mirror

358. A light ray of 5895Å wavelength travelling in vacuum enters a medium of refractive index 1.5. The speed of light in the medium is

a) $3 \times 10^8 \text{ms}^{-1}$ b) $2 \times 10^8 \text{ ms}^{-1}$ c) $1.5 \times 10^8 \text{ ms}^{-1}$ d) $6 \times 10^8 \text{ ms}^{-1}$

359. Resolving power of a microscope depends upon

a) Wavelength of light used, directly b) Wavelength of light used, inversely
c) Frequency of light used d) Focal length of objective

360. 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

a) $f_v < f_r$ and $F_v > F_r$ b) $f_v < f_R$ and $F_v < F_r$ c) $f_c > f_r$ and $F_v > F_r$ d) $f_v > f_r$ and $F_v < F_r$

361. Line spectrum contains information about

a) The atoms of the prism b) The atoms of the source
c) The molecules of the source d) The atoms as well as molecules of the source

362. Convergence of concave mirror can be decreased by dipping in

a) Water b) Oil c) Both d) None of these

363. Two thin lenses, one of focal length +60 cm and the other of focal length −20 cm are put in contact. The combined focal length is

a) + 15 cm b) −15cm c) + 30 cm d) −30 cm

364. A spherical mirror forms an image of magnification 3. The object distance, if focal length of mirror is 24 cm, may be

a) 32 cm, 24 cm b) 32 cm, 16 cm c) 32 cm only d) 16 cm only

365. A candle is placed before a thick plane mirror. When looked obliquely in the mirror, a number of images are seen from the surfaces of the plane mirror. Then

a) first image is brightest b) second image is brightest
c) third image is brightest d) all images beyond second are brightest

366. A square wire of side 1 cm is placed perpendicular to the principle axis of a concave mirror of focal length 15 cm at a distance of 20 cm. The area enclosed by the image of the wire is

a) 4 cm^2 b) 6 cm^2 c) 2 cm^2 d) 9 cm^2

367. When an object is kept at a distance of 30 cm from a concave mirror, the image is formed at a distance of 10 cm. If the object is moved with a speed of 9 ms^{-1}, the speed with which images moved is

a) 0.1 ms^{-1} b) 1 ms^{-1} c) 3 ms^{-1} d) 9 ms^{-1}

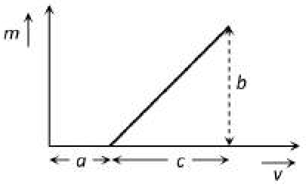
368. A convex mirror forms an image one-fourth the size of the object. If object is at a distance of 0.5 m from the mirror, the focal length of mirror is

a) 0.17 m b) −1.5 m c) 0.4 m d) −0.4 m

369. The wavelength of light in two liquids 'x' and 'y' is 3500 Å and 7000 Å, then the critical angle of x relative to y will be

a) 60° b) 45° c) 30° d) 15°

370. The graph shows how the magnification m produced by a convex thin lens varies with image distance v. What was the focal length of the used lines



a) b/c b) b/ca c) bc/a d) c/b

371. The aperture of the objective lens of a telescope is made large so as to

a) Increase the resolving power of the telescope

b) Increase the magnifying power of the telescope

c) To focus on distant objects

d) Make image aberrationless

372. In a movie hall, the distance between the projector and the screen is increased by 1% illuminates on the screen is

a) Increased by 1% b) Decreased by 1% c) Increased by 2% d) Decreased by 2%

373. Pick the correct statement from the following

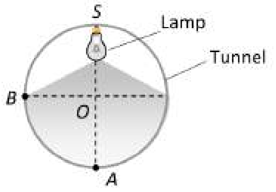
a) Primary rainbow is a virtual image and secondary rainbow is a real image

b) Primary rainbow is a real image and secondary rainbow is a virtual image

c) Both primary and secondary rainbows are virtual images

d) Both primary and secondary rainbows are real images

374. An electric lamp is fixed at the ceiling of a circular tunnel as shown is figure. What is the ratio the intensities of light at base A and a point B on the wall



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

375. Refractive index of air is 1.0003. The correct thickness of air column which will have one more wavelength of yellow light (6000 Å) than in the same thickness in vacuum is

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

376. A camera objective has an aperture diameter d. If the aperture is reduced to diameter $d/2$, the exposure time under identical conditions of light should be made

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

377. A glass lens is placed in a medium in which it is found to behave like a glass plate. Refractive index of the medium will be

a) Greater than the refractive index of glass

b) Smaller than the refractive index of glass

c) Equal to refractive index of glass

d) No case will be possible from above

378. A double convex lens ($R_1 = R_2 = 100$ cm) having focal length equal to the focal length of a concave mirror. The radius of the concave mirror is

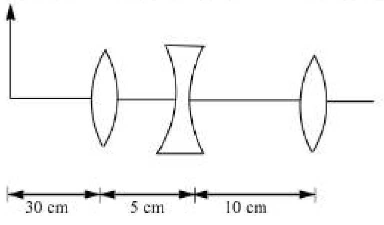
a) 10 cm b) 20 cm c) 40 cm d) 15 cm

379. A candle placed 25 *cm* from a lens, forms an image on a screen placed 75 *cm* on the other end of the lens. The focal length and type of the lens should be
a) +18.75 *cm* and convex lens b) −18.75 *cm* and concave lens
c) +20.25 *cm* and convex lens d) −20.25 *cm* and concave lens

380. If sound travelling at 340 ms^{-1} enters water where its speed becomes 1480 ms^{-1}, then critical angle for total internal reflection is
a) 13.3° b) 89.7° c) 86.7° d) 10.3°

381. The power of two convex lenses A and B are 8 *dioptres* and 4 *dioptres* respectively. If they are to be used as a simple microscope, the magnification of
a) B will be greater than A b) A will be greater than B
c) The information is incomplete d) None of the above

382. The position of final image formed by the given lens combination from the third lens will be at a distance of $[f_1 = +10 \text{ cm}, f_2 = -10 \text{ cm}, f_3 = +30 \text{ cm}]$



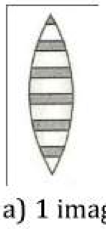
a) 15 cm b) Infinity c) 45 cm d) 30 cm

383. A thin prism P_1 with angle 4° made from a glass of refractive index 1.54 is combined with another thin prism P_2 made from glass of refractive index 1.72 to produce dispersion without deviation. The angle of the prism P_2 is
a) 5.33° b) 4° c) 3° d) 2.6°

384. The plane face of a planoconvex lens is silvered. If μ be the refractive index and R, the radius of curvature of curved surface, then the system will behave like a concave mirror of radius of curvature
a) μR b) $\frac{R}{(\mu - 1)}$ c) $\frac{R^2}{\mu}$ d) $\left[\frac{(\mu + 1)}{(\mu - 1)}\right] R$

385. The refractive index of water and glycerine are 1.33 and 1.47 respectively. What is the critical angle for a light ray going from the latter to the former?
a) 60°48′ b) 64°48′ c) 74°48′ d) None of these

386. A layered lens as shown in figure is made of two types of transparent materials indicated by different shades. A point object is placed on its axis. The object will form



a) 1 image b) 2 images c) 3 images d) 9 images

387. When the light enters from air to glass, for which colour the angle for deviation ismaximum?
a) Red b) Yellow c) Blue d) Violet

388. A neon sign does not produce
a) Line spectrum b) An emission spectrum
c) An absorption spectrum d) Photos

389. Image formed by a convex mirror is
a) Virtual b) Real c) Enlarged d) Inverted

390. Monochromatic light of frequency 5×10^{14} Hz travelling in vaccum enters a medium of refractive index 1.5. It wavelength in the medium is
a) 4000Å b) 5000Å c) 6000Å d) 5500Å

391. If two +5 D, lenses are mounted at some distance apart, the equivalent power will always be negative, if the distance is

a) Greater than 40 cm   b) Equal to 10 cm   c) Equal to 10 cm   d) Less than 10 cm

392. When a ray of light emerges from a block of glass, the critical angle is

a) Equal to the angle of reflection

b) The angle between the refracted ray and the normal

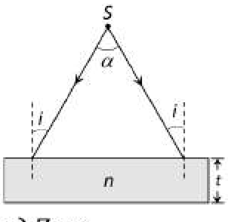
c) The angle of incidence for which the refracted ray travels along the glass-air boundary

d) The angle of incidence

393. The magnifying power of a telescope is m. If the focal length of the eye-piece is halved, then its magnifying power is

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

394. A diverging beam of light from a point source 5 having divergence angle α, falls symmetrically on a glass slab as shown. The angles of incidence of the two extreme rays are equal. If the thickness of the glass slab is t and the refractive index n, then the divergence angle of the emergent beam is



a) Zero   b) α c) $\sin^{-1}(1/n)$ d) $2\sin^{-1}(1/n)$

395. When white light passes through a glass prism, one gets spectrum on the other side of the prism. In the emergent beam, the ray which is deviating least is

or

Deviation by a prism is lowest for

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

396. A beam of parallel rays is brought to focus by a plano-convex lens. A then concave lens of the same focal length is joined to the first lens. The effect of this is

a) The focus shifts to infinity

b) The focal point shifts towards the lens by a small distance

c) The focal point shifts away from the lens by a small distance

d) The focus remains undisturbed

397. In a compound microscope, if the objective produces an image I_o and the eye piece produces an image I_e, then

a) I_o is virtual but I_e is real   b) I_o is real but I_e is virtual

c) I_o and I_e are both real   d) I_o and I_e are both virtual

398. A person is suffering from myopic defect. He is able to see clear objects placed at 15 cm. What type and of what focal length of lens he should use to see clearly the object placed 60 cm away

a) Concave lens of 20 cm focal length   b) Convex lens of 20 cm focal length

c) Concave lens of 12 cm focal length   d) Convex lens of 12 cm focal length

399. A 2.0 cm tall object is placed 15 cm in front of a concave mirror of focal length 10 cm. What is the size and nature of the image

a) 4 cm, real   b) 4 cm, virtual   c) 1.0 cm, real   d) None of these

400. The numerical aperture for a human eye is of the order of

a) 1   b) 0.1   c) 0.01   d) 0.001

401. In compound microscope, magnifying power is 95 and the distance of object from objective lens is $\frac{1}{3.8}$ cm. The focal length of objective lens is $\frac{1}{4}$ cm. What is the magnification of eye piece?

a) 5   b) 10   c) 100   d) 200

402. 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) $\frac{n}{\mu}, \frac{\lambda}{\mu}, \frac{v}{\mu}$ b) $n, \frac{\lambda}{\mu}, \frac{v}{\mu}$ c) $n, \lambda, \frac{v}{\mu}$ d) $\frac{n}{\mu}, \frac{\lambda}{\mu}, v$

403. In a plano-convex lens the radius of curvature of the convex lens is 10 cm. If the plane side is polished, then the focal length will be (Refractive index = 1.5)

a) 10.5 cm b) 10 cm c) 5.5 cm d) 5 cm

404. A thin convex lens of focal length 10 cm is placed in contact with a concave lens of same material and of same focal length. The focal length of combination will be

a) Zero b) Infinity c) 10 cm d) 20 cm

405. Consider an equiconvex lens of radius of curvature R and focal length f. If $f > R$, the refractive index μ of the material of the lens

a) Is greater than zero but less than 1.5 b) Is greater than 1.5 but less than 2.0
c) Is greater than one but less than 1.5 d) None of the above

406. A convex lens of focal length f produces a virtual image n times the size of the object. Then the distance of the object from the lens is

a) $(n-1)f$ b) $(n+1)f$ c) $\left(\frac{n-1}{n}\right)f$ d) $\left(\frac{n+1}{n}\right)f$

407. An object moving at a speed of 5 m/s towards a concave mirror of focal length $f = 1$ mis at a distance of 9 m. The average speed of the image is

a) $\frac{1}{5}$m/s b) $\frac{1}{10}$m/s c) $\frac{5}{9}$m/s d) $\frac{4}{10}$m/s

408. A man can see the objects upto a distance of one metre from his eyes. For correcting his eye sight so that he can see an object at infinity, he requires a lens whose power is

Or

A man can see upto 100 cm of the distant object. The power of the lens required to see far objects will be

a) $+0.5\ D$ b) $+1.0\ D$ c) $+2.0\ D$ d) $-1.0\ D$

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

a) $\pi + 2A$ b) $\pi - 2A$ c) $\frac{\pi}{2} + A$ d) $\frac{\pi}{2} - A$

410. The wavelength of red light from He-Ne laser is 633nm in air but 474 nm in the aqueous humor inside the eye ball. Then the speed of red light through the aqueous humor is

a) $3 \times 10^8 ms^{-1}$ b) $1.34 \times 10^8 ms^{-1}$ c) $2.25 \times 10^8 ms^{-1}$ d) $2.5 \times 10^8 ms^{-1}$

411. The magnifying power of an astronomical telescope is 10 and the focal length of its eye-piece is 20 cm. The focal length of its object will be

a) 200 cm b) 2 cm c) 0.5 cm d) 0.5×10^{-2}cm

412. The distance between a point source of light and a screen which is 60 cm is increased to 180 cm. The intensity on the screen as compared with the original intensity will be

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

413. If a ray of light in a denser medium enters into a rarer medium at an angle of incidence i, the angle of reflection and reflection are respectively r and r'.If the reflected and refracted rays are at right angles to each other, the critical angle for the given pair of media is

a) $\sin^{-1}(\tan r')$ b) $\sin^{-1}(\tan r)$ c) $\tan^{-1}(\sin i)$ d) $\cot(\tan i)$

414. The objective lens of a compound microscope produces magnification of 10. In order to get an overall magnification of 100 when image is formed at 25 cm from the eye, the focal length of the eye lens should be

a) 4 cm b) 10 cm c) $\frac{25}{9}$ cm d) 9 cm

415. An object is placed asymmetrically between two plane mirrors inclined at an angle of 72°. The number of images formed is

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

416. A convex mirror of radius of curvature 1.6 m has an object placed at a distance of 1 m from it. The image is formed at a distance of

a) 8/13 m in front of the mirror b) 8/13 m behind the mirror
c) 4/9 m in front of the mirror d) 4/9 m behind the mirror

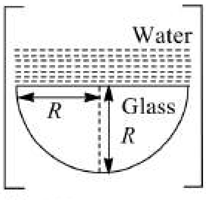
417. A thin glass (refractive index 1.5) lens has optical power of -5 D in air. Its optical power in a liquid medium with refractive index 1.6 will be

a) 1 D b) -1 D c) 25 D d) -25 D

418. The refractive index of a prism for a monochromatic wave is $\sqrt{2}$ and its refracting angle is 60°. For minimum deviation, the angle of incidence will be

a) 30° b) 45° c) 60° d) 75°

419. A ray of light travelling in glass $\left(\mu = \frac{3}{2}\right)$ is incident on a horizontal glass air surface at the critical angle θ_c. If thin layer of water $\left(\mu = \frac{4}{3}\right)$ is now poured on the glass air surface, the angle at which the ray emerges into air the water-air surface is



a) 60° b) 45° c) 90° d) 180°

420. A convex lens is placed between object and a screen. The size of object is 3 cm and an image of height 9 cm is obtained on the screen. When the lens is displaced to a new position, what will be the size of image on the screen?

a) 2 cm b) 6 cm c) 4 cm d) 1 cm

421. An object is viewed through a compound microscope and appears in focus when it is 5 mm away from the objective lens. When a sheet of transparent material 3 mm thick is placed between the objective and the microscope, the objective lens has to be moved 1 mm to bring the object back into the focus. The refractive index of the transparent material is

a) 1.5 b) 1.6 c) 1.8 d) 2.0

422. An achromatic prism is made by combining two prisms $P_1(\mu_v = 1.523, \mu_r = 1.515)$ and $P_2(\mu_v = 1.666, \mu_r = 1.650)$; where μ represents the refractive index. If the angle of the prism P_1 is 10°, then the angle of the prism P_2 will be

a) 5° b) 7.8° c) 10.6° d) 20°

423. Two thin lenses of focal length 20 cm and 25 cm are in contact. The effective power of the combination is

a) 4.5 D b) 18 D c) 45 D d) 9 D

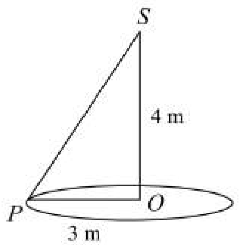
424. A lens is made of flint glass (refractive index = 1.5). When the lens is immersed in a liquid of refractive index 1.25, the focal length

a) Increase by a factor of 1.25 b) Increases by a factor of 2.5
c) Increases by a factor of 1.2 d) Decreases by a factor of 1.2

425. A student can distinctly see the object upto a distance 15 cm. He wants to see the black board at a distance of 3 m. Focal length and power of lens used respectively will be

a) $-4.8\ cm, -3.3\ D$ b) $-5.8\ cm, -4.3\ D$ c) $-7.5\ cm, -6.3\ D$ d) $-15.8\ cm, -6.3\ D$

426. A source is at 4m height above the centre of a circular table of a circular table of radius 3m. The ratio of illuminance at O and P will be



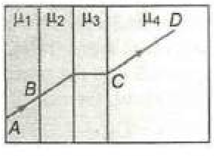
a) $\frac{64}{125}$ b) $\frac{125}{64}$ c) 1 d) $\frac{16}{25}$

427. At the time of total solar eclipse, the spectrum of solar radiation would be
a) A large number of dark Fraunhoffer lines
b) A less number of dark Fraunhoffer lines
c) No lines at all
d) All Fraunhoffer lines changed into brilliant colours

428. Sir C.V. Raman was awarded Nobel Prize for his work connected with which of the following phenomenon of radiation
a) Scattering b) Diffraction c) Interference d) Polarization

429. A rectangular tank of depth 8 meter is full of water ($\mu = 4/3$), the bottom is seen at the depth
a) 6 m b) 8/3 cm c) 8 cm d) 10 cm

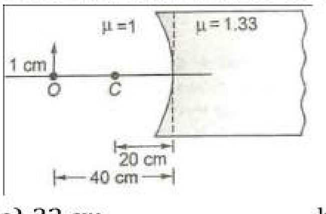
430. A ray of light passes through four transparent medium with refractive indices $\mu_1, \mu_2, \mu_3$and μ_4 as shown in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB. We must have



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

431. A lamp is hanging at a height of 40 cm from the centre of the table. If its height is increased y 10 cm, the illuminance of the lamp will decreased by
a) 10% b) 20% c) 27% d) 36%

432. For a optical arrangement shown in the figure. Find the position and nature of images



a) 32 cm b) 0.6 cm c) 6 cm d) 0.5 cm

433. In a compound microscope, the intermediate image is
a) Virtual erect and magnified
b) Real, erect and magnified
c) Real, inverted and magnified
d) Virtual, erect and reduced

434. The index of refraction of diamond is 2.0. The velocity of light in diamond is approximately
a) 1.5×10^{10}cms^{-1} b) 2×10^{10}cms^{-1} c) 3.0×10^{10}cms^{-1} d) 6×10^{10}cms^{-1}

435. The speed of light in media M_1 and M_2 is 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 $\sin^{-1}\left(\frac{2}{3}\right)$

436. An air bubble in sphere having 4 cm diameter appears 1 cm from surface nearest to eye when looked along diameter. If ${}_a\mu_g = 1.5$, the distance of bubble from refracting surface is

a) 1.2 cm b) 3.2 cm c) 2.8 cm d) 1.6 cm

437. The refractive index of a material of a planoconcave lens is 5/3, the radius of curvature is 0.3 m. The focal length of the lens in air is

a) -0.45m b) -0.6m c) -0.75m d) -1.0m

438. The angle of minimum deviation for an incident light ray on an equilateral prism is equal to its refracting angle. The refractive index of its material is

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

439. When a white light passes through a hollow prism, then

a) There is no dispersion and no deviation

b) Dispersion but no deviation

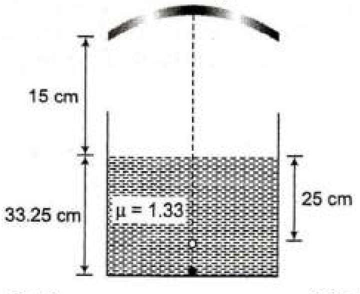
c) Deviation but no dispersion

d) There is dispersion and deviation both

440. A point source of light moves in a straight line parallel to a plane table. Consider a small portion of the table directly below the line of movement of the source. The illuminance at this portion varies with this distance r from the source as

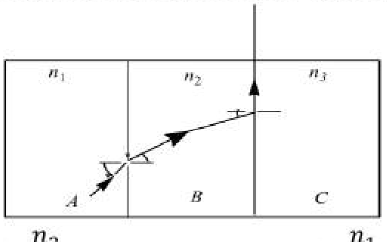
a) $\propto \frac{1}{r}$ b) $\propto \frac{1}{r^2}$ c) $\propto \frac{1}{r^3}$ d) $\propto \frac{1}{r^4}$

441. A container is filled with water($\mu = 1.33$) up to a height of 33.25 cm. A concave mirror is placed 15 cm above the water level and the image of an object placed at the bottom is formed 25 cm below the water level. The focal length of the mirror is



a) 10 cm b) 15 cm c) 20 cm d) 25 cm

442. A, B and $C$are the parallel sided transparent media of refractive indices n_1, n_2andn_3 respectively. They are arranged as shown in the figure. A ray is incident at an angle i on the surface of separation of A and B which is as shown in the figure. After the refraction into the medium B, the ray grazes the surface of separation of the media B and C. Then, sin i equal to



a) $\frac{n_3}{n_1}$ b) $\frac{n_1}{n_3}$ c) $\frac{n_2}{n_3}$ d) $\frac{n_1}{n_2}$

443. An object is placed 30 cm to the left of a diverging lens whose focal length is of magnitude 20 cm. Which one of the following correctly states the nature and position of the virtual image formed?

Nature of image **Distance from lens**

a) Inverted, enlarged 60 cm to the right

b) Erect, diminished 12 cm to the left

c) Inverted, enlarged 60 cm to the left

d) Erect, diminished 12 cm to the right

444. The focal lengths of the objective and the eye piece of telescope are 100 cm and 10 cm respectively. The magnification of the telescope when final image is formed at infinity is

a) 0.1 b) 10 c) 100 d) ∞

445. Chromatic aberration of lens can be corrected by

a) Reducing its aperture
b) Proper polishing of its two surfaces
c) Suitably combining it with another lens
d) Providing different suitable curvature to its two surfaces

446. A person using a lens as a simple microscope sees an
a) Inverted virtual image
b) Inverted real magnified image
c) Upright virtual image
d) Upright real magnified image

447. In order to obtain a real image of magnification 2 using a converging lens of focal length 20 cm, where should an object be placed
a) 50 cm
b) 30 cm
c) -50 cm
d) -30 cm

448. A biconvex lens form a real image of an object placed perpendicular to its principal axis. Suppose the radii of curvature of the lens tend to infinity. Then the image would
a) Disappear
b) Remain as real image still
c) Be virtual and of the same size as the object
d) Suffer from aberrations

449. An object 1cm tall is placed 4 cm infront of a mirror. In order to produce an upright image of 3 cm height one needs a
a) Convex mirror of radius of curvature 12 cm
b) Concave mirror of radius of curvature 12 cm
c) Concave mirror of radius of curvature 4 cm
d) Plane mirror of height 12 cm

450. A man runs towards mirror at a speed of 15m/s. What is the speed of his image
a) 7.5 m/s
b) 15 m/s
c) 30 m/s
d) 45 m/s

451. A beaker containing liquid is placed on a table, underneath a microscope which can be moved along a vertical scale. The microscope is focussed, through the liquid onto a mark on the table when the reading on the scale is a. It is next focused on the upper surface of the liquid and the reading is b. More liquid is added and the observations are repeated, the corresponding readings are c and d. The refractive index of the liquid is
a) $\frac{d-b}{d-c-b+a}$
b) $\frac{b-d}{d-c-b+a}$
c) $\frac{d-c-b+a}{d-b}$
d) $\frac{d-b}{a+b-c-d}$

452. In absorption spectrum of Na the missing wavelength (s) are
a) 589 nm
b) 589.6 nm
c) Both
d) None of these

453. The optical path a monochromatic light is same if it goes through 4.0 cm of glass of 4.5 cm of water. If the refractive index of glass is 1.53, the refractive index of the water is
a) 1.30
b) 1.36
c) 1.42
d) 1.46

454. A square card of side length 1mm is being seen through a magnifying lens of focal length 10 cm. The card is placed at a distance of9 cm from the lens. The apparent area of the card through the lens is
a) 1 cm^2
b) 0.81 cm^2
c) 0.27 cm^2
d) 0.60 cm^2

455. The focal length of objective and eye-piece of a microscope are 1 cm and 5 cm respectively. If the magnifying power for relaxed eye is 45, then length of the tube is
a) 9 cm
b) 15 cm
c) 12 cm
d) 6 cm

456. Two plane mirrors are inclined to each other at an angle θ. A ray of light is reflected first at one mirror and then at the other. The total deviation of the ray is
a) 2θ
b) $240° - 2\theta$
c) $360° - 2\theta$
d) $180° - \theta$

457. How should people wearing spectacles work with a microscope
a) They cannot use the microscope at all
b) They should keep on wearing their spectacles
c) They should take off spectacles
d) (b) and (c) is both way

458. Two thin lenses of focal lengths f_1 and f_2 are placed in contact with each other. The focal length of the combination is

a) $\frac{f_1+f_2}{2}$ b) $\sqrt{f_1 f_2}$ c) $\frac{f_1 f_2}{f_1+f_2}$ d) $\frac{f_1 f_2}{f_1-f_2}$

459. In an astronomical telescope in normal adjustment, a straight black line of length L is drawn on the objective lens. The eyepiece forms a real image of this line. The length of this image is l. The magnification of the telescope is

a) $\frac{L}{l}$ b) $\frac{L}{l}+1$ c) $\frac{L}{l}-1$ d) $\frac{L+l}{L-l}$

460. An object 15 cm high is placed 10 cm from the optical centre of a thin lens. Its image is formed 25 cm from the optical centre on the same side of the lens as the object. The height of the image is

a) 2.5 cm b) 0.2 cm c) 16.7 cm d) 37.5 cm

461. Light takes 8 min 20 s to reach from sun on the earth. If the whole atmosphere is filled with water, the light will take the time $({}_a\mu_\omega = 4/3)$

a) 8 min 20 s b) 8 min c) 6 min 11 s d) 11 min 6 s

462. The wavelength of a certain colour in air is 600 nm. What is the wavelength and speed of this colour in glass of refractive index 1.5?

a) 500 nm and 2×10^{10}cms^{-1} b) 400 nm and 2×10^8ms^{-1}
c) 300 nm and 3×10^9cms^{-1} d) 700 nm and 1.5×10^9ms^{-1}

463. The combination of a convex lens $(f = 18\ cm)$ and a thin concave lens $(f = 9\ cm)$ is

a) A concave lens $(f = 18\ cm)$ b) A convex lens $(f = 18\ cm)$
c) A convex lens $(f = 6\ cm)$ d) A concave lens $(f = 6\ cm)$

464. Under minimum deviation condition in a prism, if a ray is incident at an angle 30°, the angle between the emergent ray and the second refracting surface of the prism is

a) 0° b) 30° c) 45° d) 60°

465. A normally incident ray reflected at an angle of 90°. The value of critical angle is

a) 45° b) 90° c) 65° d) 43.2°

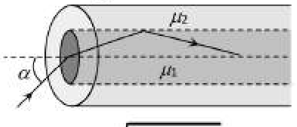
466. Red colour is used for danger signals because

a) It causes fear b) It undergoes least scattering
c) It undergoes maximum scattering d) It is in accordance with international convention

467. A convex mirror and a concave mirror has radii of curvature 10 cm each are placed 15 cm apart facing each other. An object is placed midway between them. If the reflection first takes place in the concave mirror and then in convex mirror, the position of the final image is

a) on the pole of the convex mirror b) on the pole of the concave mirror
c) at a distance of 10 cm from convex mirror d) at a distance of 5 cm from concave mirror

468. An optical fibre consists of core of μ_1 surrounded by a cladding of $\mu_2 < \mu_1$. A beam of light enters form air at an angle α with axis of fibre. The highest α for which ray can be travelled through fibre is



a) $\cos^{-1}\sqrt{\mu_2^2-\mu_1^2}$ b) $\sin^{-1}\sqrt{\mu_1^2-\mu_2^2}$ c) $\tan^{-1}\sqrt{\mu_1^2-\mu_2^2}$ d) $\sec^{-1}\sqrt{\mu_1^2-\mu_2^2}$

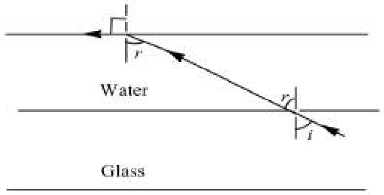
469. The sun (diameter d) subtends an angle θ radian at the pole of a concave mirror of focal length f. The diameter of the image of sun formed by mirror is

a) θf b) $\frac{\theta}{2} f$ c) $2\theta f$ d) $\frac{\theta}{\pi} f$

470. The diameter of the objective of the telescope is 0.1 $metre$ and wavelength of light is 6000 Å. Its resolving power would be approximately

a) $7.32 \times 10^{-6} rad$ b) $1.36 \times 10^6 rad$ c) $7.32 \times 10^{-5} rad$ d) $1.36 \times 10^5 rad$

471. A ray of light is incident at the glass-water interface at an angle $i$it emerges finally parallel to the surface of water, then the value of μ_g would be



a) $(4/3)\ sin\, i$ b) $1/sin\, i$ c) $4/3$ d) 1

472. Angle of deviation (δ) by a prism (refractive index $= \mu$ and supposing the angle of prism A to be small) can be given by

a) $\delta = (\mu - 1)A$ b) $\delta = (\mu + 1)A$ c) $\delta = \frac{\sin\frac{A+\delta}{2}}{\sin\frac{A}{2}}$ d) $\delta = \frac{\mu - 1}{\mu + 1}A$

473. A compound microscope is used to enlarge an object kept at a distance $0.03m$ from it's objective which consists of several convex lenses in contact and has focal length $0.02m$. If a lens of focal length $0.1m$ is removed from the objective, then by what distance the eye-piece of the microscope must be moved to refocus the image

a) 2.5 cm b) 6 cm c) 15 cm d) 9 cm

474. A cut diamond sparkles because of its

a) Hardness b) High refractive index
c) Emission of light by the diamond d) Absorption of light by the diamond

475. In an optics experiments, with the position of the object fixed, a student varies the position of a convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance u and the image distance v, from the lens, is plotted using the same scale for the two axes. A straight line passing through the origin and making an angle of 45° with the x-axis meets the experimental curve at P. The coordinates of Pwill be

a) $(2f, 2f)$ b) $\left(\frac{f}{2}, \frac{f}{2}\right)$ c) (f, f) d) $(4f, 4f)$

476. A compound microscope has an eyepiece of focal length 10 cm and an objective of focal length 4 cm. Calculate the magnification, if an object is kept at a distance of 5 cm from the objective, so that final image is formed at the least distance of distinct vision 20 cm.

a) 12 b) 11 c) 10 d) 13

477. A lamp is hanging at a height of $4m$ above a table. The lamp is lowered by $1m$. The percentage increase in illuminance will be

a) 40% b) 64% c) 78% d) 92%

478. A person who can see things most clearly at a distance of 10 cm. Requires spectacles to enable to him to see clearly things at a distance of 30 cm. What should be the focal length of the spectacles

a) 15 cm (Concave) b) 15 cm (Convex) c) 10 cm d) 0

479. The spectrum of an oil flame is an example for

a) Line emission spectrum b) Continuous emission spectrum
c) Line absorption spectrum d) Band emission spectrum

480. A biconvex lens of focal length $f$forms a circular image of radius $r$of sun in focal plane. Then which option is correct?

a) $\pi r^2 \propto f$
b) $\pi r^2 \propto f^2$
c) If lower half part is covered by black sheet, then area of the image is equal to $\pi r^2 / 2$
d) If $f$is doubled, intensity will increase

481. Focal length of a convex lens of refractive index 1.5 in 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

482. When a plane electromagnetic wave enters a glass slab, then which of the following will not change?

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

483. A thick plane mirror shows a number of images of the filament of an electric bulb. Of these, the brightest image is the

a) First b) Second c) Fourth d) Last

484. To get three images of a single object, one should have two plane mirrors at an angel of

a) 60° b) 90° c) 120° d) 30°

485. When the length of a microscope tube increases, its magnifying power

a) Decreases b) Increases

c) Does not change d) May decrease or increase

486. Focal length of a convex lens will be maximum for

a) Blue light b) Yellow light c) Green light d) Red light

487. The focal lengths of the objective and of the eye-piece of a compound microscope are f_0 and f_e respectively. If L is the tube length and D, the least distance of distinct vision, then its angular magnification, when the image is formed at infinity, is

a) $\left(1-\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$ b) $\left(1+\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$ c) $\frac{L}{f_0}\left(1-\frac{D}{f_e}\right)$ d) $\frac{L}{f_0}\left(\frac{D}{f_e}\right)$

488. Given the width of aperture = 3 mm and $\lambda = 500$ nm. For what distance ray optics is good approximation?

a) 18 m b) 18 mm c) 18 Å d) 18 light years

489. A fish in water (refractive index n) looks at a bird vertically above in the air.If y is the height of the bird and x is the depth of the fish from the surface, then the distance of the bird as estimated by the fish is

a) $x + y\left(1-\frac{1}{n}\right)$ b) $x + ny$ c) $x + y\left(1+\frac{1}{n}\right)$ d) $y + x\left(1-\frac{1}{n}\right)$

490. A man standing in a swimming pool looks at a stone lying at the bottom. The depth of the swimming pool is h. At what distance from the surface of water is the image of the stone formed (Line of vision is normal; Refractive index of water is n)

a) h/n b) n/h c) h d) hn

491. A thin prism P of refracting angle 3° and refractive index 1.5 is combined with another thin prism $Q$of refractive index 1.6 to produce dispersion without deviation. Then the angle of prism Q is

a) 3° b) 4° c) 3.5° d) 2.5°

492. The communication using optical fibres is based on the principle of

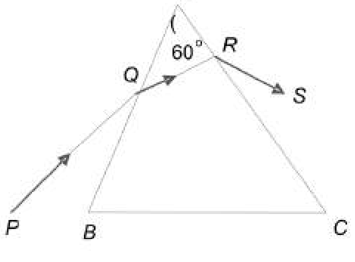
a) Total internal reflection b) Brewster angle

c) Polarization d) Resonance

493. The light ray is incidence at angle of 60° on a prism of angle 45°. When the light ray falls on the other surface at 90°, the refractive index of the material of prism μ and the angle of deviation δ are given by

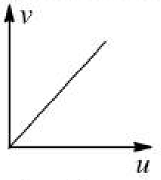
a) $\mu = \sqrt{2}, \delta = 30°$ b) $\mu = 1.5, \delta = 15°$ c) $\mu = \frac{\sqrt{3}}{2}, \delta = 30°$ d) $\mu = \sqrt{\frac{3}{2}}, \delta = 15°$

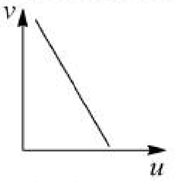
494. A ray PQ incident on the refracting face $BA$is refracted in the prism BACas shown in the figure and emerges from the other refracting face ACas RS,such that $AQ = AR$.If the angle of prism $A = 60°$ and the refractive index of the material of prism is $\sqrt{3}$, then the angle of deviation of the ray is

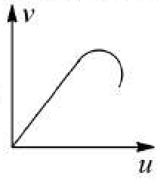


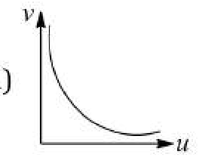
a) 60° b) 45° c) 30° d) None of these

495. The distance v of the real image formed by a convex lens is measured for various object distance u. A graph is plotted between v and u. Which one of the following graphs is correct?

a)


b)


c)


d)


496. The focal length of the field lens (which is an achromatic combination of two lenses) of telescope is 90 cm. The dispersive powers of the two lenses in the combination are 0.024 and 0.036. The focal lengths of two lenses are

a) 30 cm and 60 cm b) 30 cm and -45 cm c) 45 cm and 90 cm d) 15 cm and 45 cm

497. F_1andF_2 are focal lengths of objective and eyepiece respectively of the telescope. The angular magnification for the given telescope is equal to

a) $\frac{F_1}{F_2}$ b) $\frac{F_2}{F_1}$ c) $\frac{F_1 F_2}{F_1 + F_2}$ d) $\frac{F_1 + F_2}{F_1 F_2}$

498. Continuous emission spectrum is produced by

a) Incandescent electric lamp b) Mercury vapour lamp
c) Sodium vapour lamp d) The sun

499. A ray of light falls on the surface of a spherical glass paper weight making an angle α with the normal and is refracted in the medium at an angle β. The angle of deviation of the emergent ray from the direction of the incident ray

a) $(\alpha - \beta)$ b) $2(\alpha - \beta)$ c) $(\alpha - \beta)/2$ d) $(\beta - \alpha)$

500. A convex lens

a) Converges light rays b) Diverges light rays
c) Form real images always d) Always forms virtual images

501. The resolving limit of healthy eye is about

a) 1' or $\left(\frac{1}{60}\right)^{o}$ b) $1''$ c) $1°$ d) $\frac{1}{60}''$

502. 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

503. The focal length of the objective lens of a compound microscope is

a) Equal to the focal length of its eye piece b) Less than the focal length of eye piece
c) Greater than the focal length of eye piece d) Any of the above three

504. The focal length of a convex lens depends upon

a) Frequency of the light ray b) Wavelength of the light ray
c) Both (a) and (b) d) None of these

505. The power of a biconvex lens is 10 dioptre and the radius of curvature of each surface is 10 cm. Then the refractive index of the material of the lens is

a) 3/2 b) 4/3 c) 9/8 d) 5/3

506. The working of which of the following is similar to that of a slide projector

a) Electron microscope b) Scanning electron microscope
c) Transmission electron microscope d) Atomic force microscope

507. If the focal length of the eye piece of a telescope is double, its magnifying power m_1 will be

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

508. A ray of light is incident at 60° on one face of a prism which has angle 30°. The angle between the emergent ray and incident ray is 30°. What is the angle between the ray and the face from which its emerg?

a) 0° b) 30° c) 60° d) 90°

509. Critical angle of light passing from glass of water is minimum for

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

510. Which of the following element was discovered by study of Fraunhoffer line

a) Hydrogen b) Oxygen c) Helium d) Ozone

511. One face of a rectangular glass plate 6 cm thick is silvered. An object held 8 cm in front of the first face, forms an image 12 cm behind the silvered face. The refractive index of the glass is

a) 0.4 b) 0.8 c) 1.2 d) 1.6

512. Pick out the correct statements about optical fibres from the following

S1 : Optical fibres are used for the transmission of optical signals only

S2 : Optical fibres are used for transmitting and receiving electrical signals

S3 : The intensity of light signals sent through optical fibres suffer very small loss

S4 : Optical fibres effectively employ the principle of multiple total internal reflections

S5 : Optical fibres are glass fibres coated with a thin layer of a material with lower refractive index

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

513. The least angle of deviation for a glass prism is equal to its refracting angle. The refractive index of glass is 1.5. Then the angle of prism is

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

514. In an experiment to determine the focal length (f) of a concave mirror by the $u-v$ method, a student places the object pin Aon the principle axis at a distance x from the pole P. The student looks at the pin and its inverted image from a distance keeping his/her eye in line with PA. When the student shifts his/her eye towards left, the image appears to the right of the object pin. Then

a) $x<f$ b) $f<x<2f$ c) $x=2f$ d) $x>2f$

515. Two convex lenses of focal lengths 0.03 m and 0.05 m are used to make a telescope. The distance kept between the two in order to obtain an image at infinity is

a) 0.35 cm b) 0.25 cm c) 0.175 m d) 0.15 m

516. A thin lens made of glass of refractive index 1.5 has a front surface $+11\ D$ power and back surface $-6\ D$. If this lens is submerged in a liquid of refractive index 1.6, the resulting power of the lens is

a) $-0.5\ D$ b) $+0.5\ D$ c) $-0.625\ D$ d) $+0.625\ D$

517. For unit magnification, the distance of an object from a concave mirror of focal length 20 cm will be

a) 20 cm b) 10 cm c) 40 cm d) 60 cm

518. The critical angle of the medium with respect to vacuum is 30°. If the velocity of light in vacuum is 3×10^{8} ms^{-1}, the velocity of light in medium is

a) 2×10^{8} ms^{-1} b) 1.5×10^{8} ms^{-1} c) 3×10^{8} ms^{-1} d) $\sqrt{2}\times10^{8}$ ms^{-1}

519. Large aperture of telescope are used for

a) Large image b) Greater resolution

c) Reducing lens aberration d) Ease of manufacture

520. If the focal length of the objective lens is increased then

a) Magnifying power of microscope will increase but that of telescope will decrease

b) Magnifying power of microscope and telescope both will increase

c) Magnifying power of microscope and telescope both will decrease

d) Magnifying power of microscope will decrease but that of telescope will increase

521. A lens of power +2 *dioptres* is placed in contact with a lens of power −1 *dioptre*. The combination will behave like

a) A divergent lens of focal length 50 cm

b) A convergent lens of focal length 50 cm

c) A convergent lens of focal length 100 cm

d) A divergent lens of focal length 100 cm

522. The sensation of vision in the retina is carried to the brain by

a) Ciliary muscles b) Blind spot c) Cylindrical lens d) Optic nerve

523. 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) A/μ d) $A/2\mu$

524. The dispersive powers of glasses of lenses used in an achromatic pair are in the ratio 5 : 3. If the focal length of the concave lens is 15 cm, then the nature and focal length of the other lens would be

a) Convex, 9 cm b) Concave, 9 cm c) Convex, 25 cm d) Concave, 25 cm

525. Monochromatic light of wavelength 589 nm is incident from air on a water surface. The refractive index of water is 1.33. The wavelength of the refracted light is

a) 589 nm b) 443 nm c) 333 nm d) 221 nm

526. The Cauchy's dispersion formula is

a) $n = A + B\lambda^{-2} + C\lambda^{-4}$ b) $n = A + B\lambda^{2} + C\lambda^{-4}$ c) $n = A + B\lambda^{-2} + C\lambda^{4}$ d) $n = A + B\lambda^{2} + C\lambda^{4}$

527. Which source is associated with a line emission spectrum

a) Electric fire b) Neon street sign c) Red traffic light d) Sun

528. Dark lines on solar spectrum are due to

a) Lack of certain elements
b) Black body radiation
c) Absorption of certain wavelengths by outer layers
d) Scattering

529. A convex lens of focal length 10 cm and image formed by it, is at least distance of distinct vision then the magnifying power is

a) 3.5 b) 2.5 c) 1.5 d) 1.4

530. Given a point source of light, which of the following can produce a parallel beam of light

a) Convex mirror b) Concave mirror
c) Concave lens d) Two plane mirrors inclined at an angle of 90°

531. Missing lines in a continuous spectrum reveal

a) Defects of the observing instrument
b) Absence of some elements in the light source
c) Presence in the light source of hot vapours of some elements
d) Presence of cool vapours of some elements around the light source

532. Where should a person stand straight from the pole of a convex mirror of focal length 2.0 m on its axis so that the image formed become half of his original height?

a) -2.60m b) -4.0m c) -0.5m d) -2.0m

533. An infinitely long rod lies along the axis of concave mirror of focal length f. The near end of the rod is at a distance $x > f$ from the mirror. Then the length of the image of the rod is

a) $\frac{f^2}{x+f}$ b) $\frac{f^2}{x}$ c) $\frac{xf}{x-f}$ d) $\frac{f^2}{x-f}$

534. The bottom of a container filled with liquid appear slightly raised because of

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

535. If the focal length of a double convex lens for red light is f_R, its focal length for the violet light is

a) f_R b) Greater than f_R c) Less than f_R d) 2 f_R

536. A beam of light propagating in medium A with index of refraction $n(A)$ passes across an interface into medium B with index of refraction $n(B)$. The angle of incidence is greater than the angle of refraction; $v(A)$ and $v(B)$ denote the speed of light in A and B. Then which of the following is true

a) $v(A) > v(B)$ and $n(A) > n(B)$ b) $v(A) > v(B)$ and $n(A) < n(B)$
c) $v(A) < v(B)$ and $n(A) > n(B)$ d) $v(A) < v(B)$ and $n(A) < n(B)$

537. For compound microscope $f_0 = 1$ cm, $f_e = 2.5$ cm. An object is placed at distance 1.2 cm from object lens. What should be length of microscope for normal adjustment?

a) 8.5 cm b) 8.3 cm c) 6.5 cm d) 6.3 cm

538. A person's near point is 50 cm and his far point is 3 m. Power of the lenses he requires for
(i) reading and
(ii) for seeing distant stars are

a) $-2\ D$ and $0.33\ D$ b) $2\ D$ and $-0.33\ D$ c) $-2\ D$ and $3\ D$ d) $2\ D$ and $-3\ D$

539. If the refractive indices of crown glass for red, yellow and violet colours are 1.5140, 1.5170 and 1.5318 respectively and for flint glass these are 1.6434, 1.6499 and 1.6852 respectively, then the dispersive powers for crown and flint glass are respectively

a) 0.034 and 0.064 b) 0.064 and 0.034 c) 1.00 and 0.064 d) 0.034 and 1.0

540. The respective angles of the flint and crown glass prisms are A' and A. They are to be used for dispersion without deviation, then the ratio of their angles A'/A will be

a) $-\frac{(\mu_y - 1)}{(\mu_y{}' - 1)}$ b) $\frac{(\mu_y{}' - 1)}{(\mu_y - 1)}$ c) $(\mu_y{}' - 1)$ d) $(\mu_y - 1)$

541. Venus looks brighter than other stars because

a) It has higher density than other stars
b) It is closer to the earth than other stars
c) It has no atmosphere
d) Atomic fission takes place on its surface

542. In Gallilean telescope, if the powers of an objective and eye lens are respectively $+1.25\ D$ and $-20\ D$, then for relaxed vision, the length and magnification will be

a) 21.25 cm and 16 b) 75 cm and 20 c) 75 cm and 16 d) 8.5 cm and 21.25

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

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

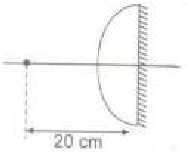
544. Refractive index of the material of a prism is 1.5. If $\delta_m = A$, what will be a value of angle of the given prism?
(where δ_m = minimum deviation; A = angle of prism)

a) 82.8° b) 41.4° c) 48.6° d) 90°

545. The minimum temperature of a body at which it emits light is

a) 1200°C b) 1000°C c) 500°C d) 200°C

546. A point object is placed at distance of 20 cm from a thin planoconvex lens of focal length 15 cm. The plane surface of the lens is now silvered. The image created by the system is at



a) 60 cm to the left of the system
b) 60 cm to the right of the system
c) 12 cm to the left of the system
d) 12 cm to the right of the system

547. A circular disc of which 2/3 part is coated with yellow and 1/3 part is with blue. It is rotated about its central axis with high velocity, then it will be seen as

a) Green b) Brown c) White d) Violet

548. The maximum magnification that can be obtained with a convex lens of focal length 2.5 cm is (the least distance of distinct vision is 25 cm)

a) 10 b) 0.1 c) 62.5 d) 11

549. The spectrum of light emitted by a glowing solid is

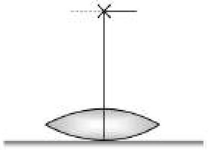
a) Continuous spectrum
b) Line spectrum
c) Band spectrum
d) Absorption spectrum

550. Resolving power of a microscope depends upon

a) The focal length and aperture of the eye lens

b) The focal lengths of the objective and the eye lens
c) The apertures of the objective and the eye lens
d) The wavelength of light illuminating the object

551. A lens when placed on a plane mirror then object needle and its image coincide at 15 *cm*. The focal length of the lens is



a) 15 *cm* b) 30 *cm* c) 20 *cm* d) ∞

552. A point source of light is placed 4 m below the surface of water of refractive index 5/3. The minimum diameter of a disc, which should be placed over the source, on the surface of water to cut-off all light coming out of water

a) Infinite b) 6 m c) 4 m d) 3m

553. A vessel of depth 2d *cm* is half filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2. The apparent depth of the vessel seen perpendicularly is

a) $d\left(\frac{\mu_1\mu_2}{\mu_1+\mu_2}\right)$ b) $d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$ c) $2d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$ d) $2d\left(\frac{1}{\mu_1\mu_2}\right)$

554. A man is suffering from colour blindness for green colour. To remove this defect, he should use goggles of

a) Green colour glasses b) Red colour glasses c) Smoky colour glasses d) none of the above

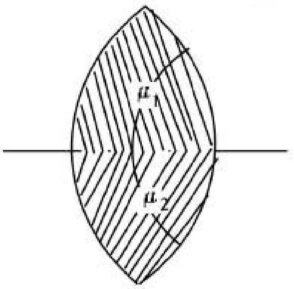
555. A point object O is placed on the principal axis of a convex lens of focal length 20 *cm* at a distance of 40 cm to the left of it. The diameter of the lens is 10 *cm*. If the eye is placed 60 *cm* to the right of the lens at a distance h below the principal axis, then the maximum value of h to see the image will be

a) 0 b) 5 *cm* c) 2.5 *cm* d) 10 *cm*

556. An endoscope is employed by a physician to view the internal parts of a body organ. It is based on the principle of

a) Refraction b) Reflection
c) Total internal reflection d) Dispersion

557. Which of the following is true for rays coming from infinity?



a) Two images are formed
b) Continuous image is formed between focal points of upper and lower lens
c) One image is formed
d) None of the above

558. Ability of the eye to see objects at all distances is called

a) Binocular vision b) Myopia c) Hypermetropia d) Accommodation

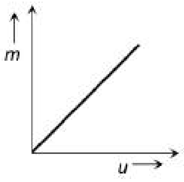
559. The length of the compound microscope is 14 *cm*. The magnifying power for relaxed eye is 25. If the focal length of eye lens is 5 *cm*, then the object distance for objective lens will be

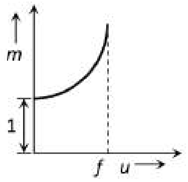
a) 1.8 *cm* b) 1.5 *cm* c) 2.1 *cm* d) 2.4 *cm*

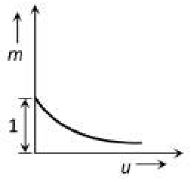
560. A Gallilean telescope has objective and eye-piece of focal lengths 200 *cm* and 2 *cm* respectively. The magnifying power of the telescope for normal vision is

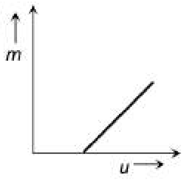
a) 90 b) 100 c) 108 d) 198

561. For a concave mirror, if virtual image is formed, the graph between m and u is of the form

a) 

b) 

c) 

d) 

562. A bi-convex lens made of glass (refractive index 1.5) is put in a liquid of refractive index 1.7. Its focal length will

a) Decrease and change sign
b) Increase and change sign
c) Decrease and remain of the same sign
d) Increase and remain of the same sign

563. An object is puts at a distance of 5 cm from the first focus of a convex lens of focal length 10 cm. If a real image is formed, its distance from the lens will be

a) 15 cm
b) 20 cm
c) 25 cm
d) 30 cm

564. A simple magnifying lens is used in such a way that an image is formed at 25 *cm* away from the eye. In order to have 10 *times* magnification, the focal length of the lens should be

a) 5 *cm*
b) 2 *cm*
c) 25 *mm*
d) 0.1 *mm*

565. A combination of two thin convex lenses of focal length 0.3 m and 0.1 m will have minimum spherical and chromatic aberrations if the distance between them is

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

566. A man with defective eyes cannot see distinctly object at the distance more than 60 *cm* from his eyes. The power of the lens to be used will be

a) $+60\ D$
b) $-60\ D$
c) $-1.66\ D$
d) $\frac{1}{1.66}D$

567. A concave and convex lens have the same focal length of 20 cm and are put into contact to form a lens combination. The combination is used to view an object of 5 *cm* length kept at 20 cm from the lens combination. As compared to the object, the image will be

a) Magnified and inverted
b) Reduced and erect
c) Of the same size as the object and erect
d) Of the same size as the object but inverted

568. The fine powder of a coloured glass is seen as

a) Coloured
b) White
c) That of the glass colour
d) Black

569. The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000Å. The refractive index of material will be

a) 1.40
b) 1.50
c) 3.00
d) 1.33

570. In human eye the focussing is done by

a) To and fro movement of eye lens
b) To and fro movement of the retina
c) Change in the convexity of the lens surface
d) Change the refractive index of the eye fluids

571. What is the time taken (in *seconds*) to cross a glass of thickness 4 *mm* and $\mu = 3$ by light

a) 4×10^{-11}
b) 2×10^{-11}
c) 16×10^{-11}
d) 8×10^{-10}

572. A terrestrial telescope is made by introducing an erecting lens of focal length f between the objective and eye piece lenses of an astronomical telescope. This causes the length of the telescope tube to increase by an amount equal to

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

573. The critical angle for diamond (refractive index = 2) is

a) About 20°
b) 60°
c) 45°
d) 30°

574. A convex lens of focal length f is placed some where in between an object and a screen. The distance between object and screen is x. If numerical value of magnification produced by lens is m, focal length of lens is

a) $\frac{mx}{(m+1)^2}$ b) $\frac{mx}{(m-1)^2}$ c) $\frac{(m+1)^2}{m}x$ d) $\frac{(m-1)^2}{m}x$

575. If aperture of lens is halved then image will be

a) No effect on size
b) Intensity of image decreases
c) Both (a) and (b)
d) None of these

576. A lamp rated at 100 cd hangs over the middle of a round table with diameter 3 m at a height of 2 m. It is replaced by a lamp of 25 cd and the distance to the table is changed so that theillumination at the centre of the table remains as before. The illumination at edge of the table becomes X times the original. Then X is

a) 1/3 b) 16/27 c) 1/4 d) 1/9

577. A plane mirror produces a magnification of

a) -1 b) +1 c) Zero d) Infinite

578. A diver in a swimming pool wants to signal his distress to a person lying on the edge of the pool by flashing his water proof flash light

a) He must direct the beam vertically upwards
b) He has to direct the beam horizontally
c) He has to direct the beam at an angle to the vertical which is slightly less than the critical angle of incidence for total internal reflection
d) He has to direction the beam at an angle to the vertical which is slightly more than the critical angle of incidence for the total internal reflection

579. In order to increase the angular magnification of a simple microscope, one should increase

a) The object size
b) The aperture of the lens
c) The focal length of the lens
d) The power of the lens

580. A ray of light is incident normally on one of the face of a prism of angle 30° and refractive index $\sqrt{2}$. The angle of deviation will be

a) 26° b) 0° c) 23° d) 15°

581. Inverse square law for illuminance is valid for

a) Isotropic point source
b) Cylindrical source
c) Search light
d) All type of sources

582. The refractive index and the permeability of a medium are respectively 1.5 and $5 \times 10^{-7} Hm^{-1}$. The relative permittivity of the medium is nearly

a) 25 b) 15 c) 81 d) 6

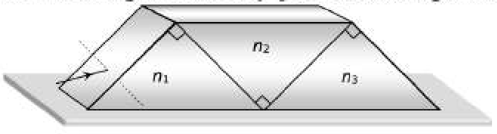
583. Deviation of 5° is observed from a prism whose angle is small and whose refractive index is 1.5. The angle of prism is

a) 7.5° b) 10° c) 5° d) 3.3°

584. An object is placed at a distance of 10cm from a convex lens of power 5D. Find the position of the image

a) -20 cm b) 30 cm c) 20 cm d) -30 cm

585. Three right angled prisms of refractive indices n_1, n_2 and n_3 are fixed together using an optical glue as shown in figure. If a ray passes through the prisms without suffering any deviation, then



a) $n_1 = n_2 = n_3$ b) $n_1 = n_2 \neq n_3$ c) $1 + n_1 = n_2 + n_3$ d) $1 + n_2^2 = n_1^2 = n_3^2$

586. A double convex lens made out of glass (refractive index $\mu = 1.5$) has both radii of curvature of magnitudes 20 cm. Incident light rays parallel to the axis of this lens will converge at a distance d such that

a) $d = 10$ cm b) $d = \frac{20}{3}$ cm c) $d = 40$ cm d) $d = 20$ cm

587. A dentist has a small mirror of focal length 16 mm. He views the cavity in the tooth of a patient by holding the mirror at a distance of 8 mm from the cavity. The magnification is

a) 1 b) 1.5 c) 2 d) 3

588. A thin lens of glass ($\mu = 1.5$) of focal length +10 cm is immersed in water ($\mu = 1.33$).The new focal length is

a) 20 cm b) 40 cm c) 48 cm d) 12 cm

589. When a ray of light is incident normally on one refracting surface of an equilateral prism (Refractive index of the material of the prism = 1.5)

a) Emerging ray is deviated by 30°

b) Emerging ray is deviated by 45°

c) Emerging ray just grazes the second refracting surface

d) The ray undergoes total internal reflection at the second refracting surface

590. Which has more luminous efficiency

a) A 40 W bulb b) A 40 W fluorescent tube

c) Both have same d) Cannot say

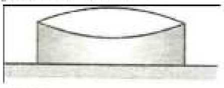
591. For total internal reflection to take place, the angle of incidence i and the refractive index μ of the medium must satisfy the inequality

a) $\frac{1}{\sin i} < \mu$ b) $\frac{1}{\sin i} > \mu$ c) $\sin i < \mu$ d) $\sin i > \mu$

592. The focal length of a convex lens is 10 cm and its refractive index is 1.5. If the radius of curvature of one surface is 7.5 cm, the radius of curvature of the second surface will be

a) 7.5 cm b) 15.0 cm c) 75 cm d) 5.0 cm

593. A convex lens is placed with a mirror as shown in figure. If the space between them is filled with water is power will



a) Decrease

b) Increase

c) Remain unchanged

d) Increase or decrease depending on the focal length

594. Two plane mirrors are at right angles to each other. A man stands between them and combs his hair with his right hand. In how many of the images will he be seen using his right hand

a) None b) 1 c) 2 d) 3

595. For a given lens, the magnification was found to be twice as large as when the object was 0.15 m distant from it as when the distance was 0.2 m. The focal length of the lens is

a) 1.5 m b) 0.20 m c) 0.10 m d) 0.05 m

596. Dispersion of light is due to

a) Wavelength b) Intensity of light c) Density of medium d) None of these

597. A point object is placed mid-way between two plane mirrors distance 'a' apart. The plane mirror forms an infinite number of images due to multiple reflection. The distance between the nth order image formed in the two mirrors is

a) na b) $2na$ c) $na/2$ d) n^2a

598. If luminous efficiency of a lamp is 2 lumen/watt and its luminous intensity is 42 candela, then power of the lamp is

a) 62 W b) 76 W c) 1.38 W d) 264 W

599. A plane mirror reflects a pencil of light to form a real image. Then the pencil of light incident on the mirror is

a) parallel b) convergent c) divergent d) Any of these

600. A ray of light incident normally on one face of a right angled isosceles prism. It them grazes the hypotenuse. The refractive index of the material of the prism is

a) 1.33 b) 1.414 c) 1.5 d) 1.732

601. A glass slab of thickness 3 cm and refractive index $3/2$ of placed on ink mark on a piece of paper. For a person looking at the mark at a distance 5.0 cm above it, the distance of the mark will appear to be

a) 3.0 cm b) 4.0 cm c) 4.5 cm d) 5.0 cm

602. A source of light emits a continuous stream of light energy which falls on a given area. Luminous intensity is defined as

a) Luminous energy emitted by the source per second
b) Luminous flux emitted by source per unit solid angle
c) Luminous flux falling per unit area of a given surface
d) Luminous flux coming per unit area of an illuminated surface

603. Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror and parallel to the second is reflected from the second mirror parallel to the first mirror. The angel between the two mirrors is

a) 30° b) 45° c) 60° d) 75°

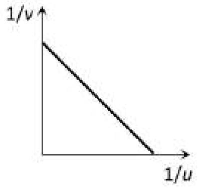
604. A defective eye cannot see close objects clearly because their image is formed

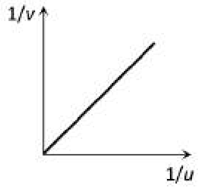
a) On the eye lens
b) Between eye lens and retina
c) On the retina
d) Beyond retina

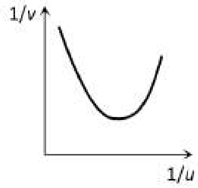
605. If the red light is replaced by blue light illuminating object in a microscope the resolving power of the microscope

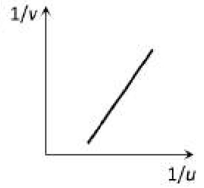
a) Decreases b) Increases c) Gets halved d) Remains unchanged

606. For a concave mirror, if real image is formed the graph between $\frac{1}{u}$ and $\frac{1}{v}$ is of the form

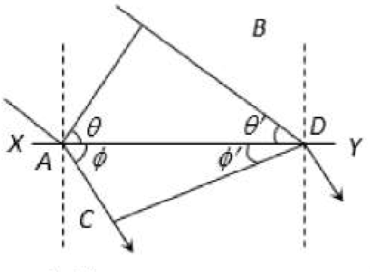
a) 

b) 

c) 

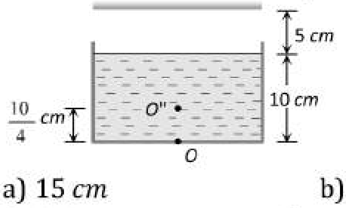
d) 

607. In the adjoining diagram, a wavefront AB, moving in air is incident on a plane glass surface XY. Its position CD after refraction through a glass slab is shown also along with the normal drawn at A and D. The refractive index of glass with respect to air ($\mu = 1$) will be equal to



a) $\frac{\sin\theta}{\sin\theta'}$ b) $\frac{\sin\theta}{\sin\phi'}$ c) $\frac{\sin\phi'}{\sin\theta}$ d) $\frac{AB}{CD}$

608. Consider the situation shown in figure. Water $\left(\mu_w = \frac{4}{3}\right)$ is filled in a beaker upto a height of 10 cm. A plane mirror fixed at a height of 5 cm from the surface of water. Distance of image from the mirror after reflection from it of an object O at the bottom of the beaker is



a) 15 cm b) 12.5 cm c) 7.5 cm d) 10 cm

609. A sitting sun appears to be at an altitude higher than it really is. This is because of

a) Absorption of light b) Refection of light c) Refraction of light d) Dispersion of light

610. The minimum magnifying power of a telescope is M, If the focal length of its eye lens is halved, the magnifying power will become

a) $M/2$ b) $2M$ c) $3M$ d) $4M$

611. The time required for the light to pass through a glass slab (refractive index =1.5) of thickness 4mm is...($c = 3 \times 10^8$ ms^{-1},speed of light in free space).

a) 2×10^{-5} s b) 2×10^{11} s c) 2×10^{-11} s d) 10^{-11}s

612. Find the luminous intensity of the sun if it produces the same illuminance on the earth as produced by a bulb of 10000 *candela* at a distance 0.3 m. The distance between the sun and the earth is $1.5 \times 10^{11} m$

a) $25 \times 10^{22} cd$ b) $25 \times 10^{18} cd$ c) $25 \times 10^{26} cd$ d) $25 \times 10^{36} cd$

613. A ray of light passes through an equilateral prism such that the angle of incidence is equal to the angle of emergence and the latter is equal to $\frac{3}{4}$the angle of prism. The angle of deviation is

a) 25° b) 30° c) 45° d) 35°

614. Solar spectrum is an example for

a) Band absorption spectrum b) Line absorption spectrum
c) Line emission spectrum d) Continuous emission spectrum

615. If there had been one eye of the man, then

a) Image of the object would have been inverted
b) Visible region would have decreased
c) Image would have not been seen three dimensional
d) (b) and (c) both

616. The focal lengths for violet, green and red light rays are f_V, f_G and f_R respectively. Which of the following is the true relationship

a) $f_R < f_G < f_V$ b) $f_V < f_G < f_R$ c) $f_G < f_R < f_V$ d) $f_G < f_V < f_R$

617. A thin lens has focal length f_1 and its aperture has diameter d. It forms an image of intensity I. Now the central part of the aperture upto diameter $\frac{d}{2}$ is blocked by an opaque paper. The focal length and image intensity will change to

a) $\frac{f}{2}$ and $\frac{I}{2}$ b) f and $\frac{I}{4}$ c) $\frac{3f}{4}$ and $\frac{I}{2}$ d) f and $\frac{3I}{4}$

618. In a laboratory four convex lenses L_1, L_2, L_3andL_4 of focal length 2, 4, 6 and 8 cm respectively are available. Two of these lenses from a telescope of length 10 cm and magnifying power 4. The objective and eye lenses are respectively

a) L_2, L_3 b) L_1, L_4 c) L_1, L_2 d) L_4, L_1

619. A ray of light passes from vacuum into a medium of refractive indexμ, the angle of incidence is found to be twice the angle of refraction. The angle of incidence is

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

620. The sun's diameter is $1.4 \times 10^9 m$ and its distance from the earth is $10^{11} m$. The diameter of its image, formed by a convex lens of focal length $2m$ will be

a) 0.7 *cm* b) 1.4 *cm*
c) 2.8 *cm* d) Zero (*i.e.* point image)

621. The human eye has a lens which has a

a) Soft portion at its centre b) Hard surface
c) Varying refractive index d) Constant refractive index

622. There is an equiconvex glass lens with radius of each face as R and ${}_a\mu_g = 3/2$ and ${}_a\mu_w = 4/3$. If there is water in object space and air in image space, then the focal length is

a) $2R$ b) R c) $3R/2$ d) R^2

623. A convex and a concave lens separated by distance $d$are then put in contact. The focal length of the combination

a) Decreases b) Increases c) Becomes zero d) Remains the same

624. A convex mirror is used to form the image of an object. Then which of the following statements is wrong

a) The image lies between the pole and the focus
b) The image is diminished in size
c) The image is erect
d) The image is real

625. What will be the colour of sky as seen from the earth, if there were no atmosphere

a) Black b) Blue c) Orange d) Red

626. A prism having refractive index 1.414 and refractive angle 30°has one of the refracting surfaces silvered. A beam of light incident on the other refracting surface will retrace its path, if the angle of incidence is

a) 45° b) 60° c) 30° d) 0°

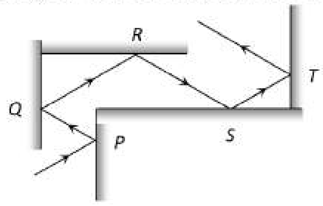
627. Three prisms of crown glass, each have angle of prism 9° and two prisms of flint glass are used to make direct vision spectroscope. What will be the angle of flint glass prisms if μ for flint is 1.60 and μ for crown glass is 1.53

a) 11.9° b) 16.0° c) 15.3° d) 9.11°

628. The velocity of light in a medium is half its velocity in air. If ray of light emerges from such a medium into air, the angle of incidence, at which it will be totally internally reflected, is

a) 15° b) 30° c) 45° d) 60°

629. Following figure shows the multiple reflections of a light ray along a glass corridor where the walls are either parallel or perpendicular to one another. If the angle of incidence at point P is 30°, what are the angles of reflection of the light ray at points Q, R, S and T respectively



a) 30°, 30°, 30°, 30° b) 30°, 60°, 30°, 60° c) 30°, 60°, 60°, 30° d) 60°, 60°, 60°, 60°

630. The focal lengths of the objective and the eye-piece of a compound microscope are 2.0 cm and 3.0 cm respectively. The distance between the objective and the eye-piece is 15.0 cm. The final image formed by the eye-piece is at infinity. The two lenses are thin. The distances in cm of the object and the image produced by the objective measured from the objective lens are respectively

a) 2.4 and 12.0 b) 2.4 and 15.0 c) 2.3 and 12.0 d) 2.3 and 3.0

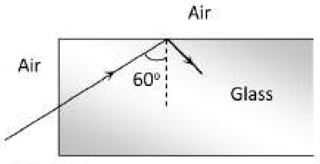
631. An object is at a distance of 0.5 m in front of a plane mirror. Distance between the object and image is

a) 0.5 m b) 1 m c) 0.25 m d) 1.5 m

632. Glass has refractive index μ with respect to air and the critical angle for a ray of light going from glass to air is θ. If a ray of light is incident from air on the glass with angle of incidence θ, the corresponding angle of refraction is

a) $\sin^{-1}\left(\frac{1}{\sqrt{\mu}}\right)$ b) 90° c) $\sin^{-1}\left(\frac{1}{\mu^2}\right)$ d) $\sin^{-1}\left(\frac{1}{\mu}\right)$

633. A light ray from air is incident (as shown in figure) at one end of a glass fibre (refractive index $\mu = 1.5$) making an incidence angle of 60° on the lateral surface, so that it undergoes a total internal reflection. How much time would it take to traverse the straight fibre of length 1 km



a) 3.33 μ s b) 6.67 μ s c) 5.77 μ s d) 3.85 μ s

634. The refractive index of the material of a double convex lens is 1.5 and its focal length is 5 cm. If the radii of curvature are equal, the value of the radius of curvature (in cm) is

a) 5.0 b) 6.5 c) 8.0 d) 9.5

635. In a compound microscope the objective of f_o and eyepiece of f_e are placed at distance L such that L equals

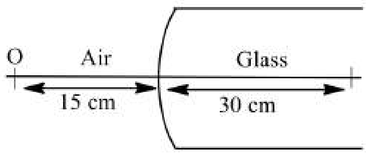
a) $f_o + f_e$

b) $f_o - f_e$

c) Much greater than f_o or f_e

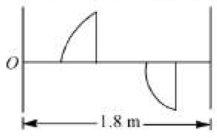
d) Much less than f_o or f_e

636. A point object O is placed in front of a glass rod having spherical end of radius of curvature 30cm. The image would be formed at



a) 30 cm left
b) Infinity
c) 1 cm to the right
d) 18 cm to the left

637. A thin plano-convex lens of focal f is split into two halves. One of the halves is shifted along the optical axis. The separation between object and image plane is 1.8 m. The magnification of the image formed by one of the half lens is 2. Find the focal-length of the lens and separation between the two halves



a) 0.1 m
b) 0.4 m
c) 0.9 m
d) 1 m

638. The earth radiates in the infra-red region of the spectrum. The spectrum is correctly given by

a) Rayleigh Jeans law

b) Planck's of law of radiation

c) Stefan's law of radiation

d) Wien's law

639. A plane 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) 50 cm
b) 100 cm
c) 200 cm
d) 400 cm

640. The radius of curvature of the convex face of a planoconvex lens is 15 cm and the refractive index of the material is 1.4. Then the power of the lens in diopter is

a) 1.6
b) 1.66
c) 2.6
d) 2.66

641. Wavelength of light used in an optical instrument are $\lambda_1 = 4000$ Å and $\lambda_2 = 5000$Å, then ratio of their respective resolving powers (corresponding to λ_1 and λ_2) is

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

642. On heating a liquid, the refractive index generally

a) Decreases

b) Increases or decreases depending on the rate of heating

c) Does not change

d) Increases

643. Two mirrors at an angle θ produce 5 images of a point. The number of images produced when θ is decreased to 30° is

a) 9
b) 10
c) 11
d) 12

644. Total internal reflection of a ray of light is possible when the (i_c = critical angle, i = angle of incidence)

a) Ray goes from denser medium to rarer medium and $i < i_c$

b) Ray goes from denser medium to rarer medium and $i > i_c$

c) Ray goes from rarer medium to denser medium and $i > i_c$

d) Ray goes from rarer medium to denser medium and $i < i_c$

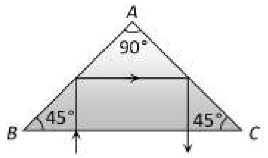
645. Beams of red, green and violet light are falling on the refracting face of a prism, all at the same angle of incidence, if their angles of deviation are θ_1, θ_2 and θ_3 respectively, then

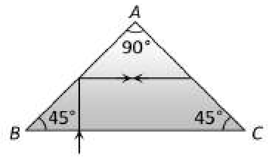
a) $\theta_1 = \theta_2 = \theta_3$
b) $\theta_1 < \theta_2 < \theta_3$
c) $\theta_1 > \theta_2 > \theta_3$
d) $\theta_2 > \theta_1 > \theta_3$

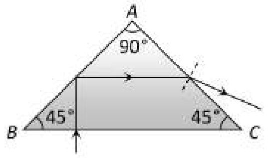
646. The deviation caused in red, yellow and violet colours for crown glass prism are 2.84°, 3.28° and 3.72° respectively. The dispersive power of prism material is

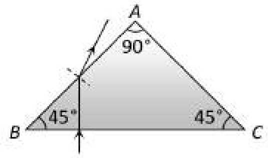
a) 0.268
b) 0.368
c) 0.468
d) 0.568

647. The refractive index of a material of a prism of angles 45° − 45° − 90° is 1.5. The path of the ray of light incident normally on the hypotenuse side is shown in

a) 

b) 

c) 

d) 

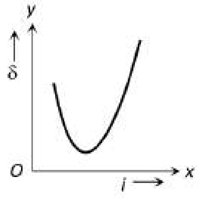
648. A ray incident at 15° on one refracting surface of a prism of angle 60°, suffers a deviation of 55°. What is the angle of emergence

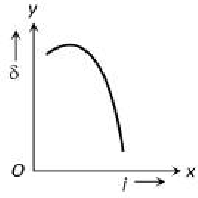
a) 95°
b) 45°
c) 30°
d) None of these

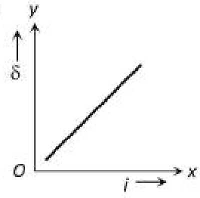
649. A transparent plastic bag filled with air forms a concave lens. Now, if this bag is completely immersed in water, then it behaves as

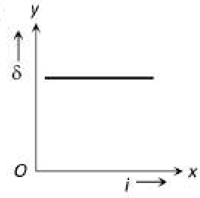
a) Divergent lens
b) Convergent lens
c) Equilateral prism
d) Rectangular slab

650. A graph is plotted between angle of deviation (δ) and angle of incidence (i) for a prism. The nearly correct graph is

a) 

b) 

c) 

d) 

651. At Kavalur in India, the astronomers using a telescope whose objective had a diameter of one metre started using telescope of diameter 2.54 m. This resulted in

a) The increase in the resolving power by 2.54 times for the sameλ
b) The increase in the limiting angle by 2.54 times for the sameλ
c) Decrease in the resolving power
d) No effect on the limiting angle

652. In a pond of water, a flame is held 2 m above the surface of water. A fish is at depth of 4 m from water surface. Refractive index of water is$\frac{4}{3}$. The apparent height of the flame from the eyes of fish is

a) 5.5 m
b) 6 m
c) $\frac{8}{3}$ m
d) $\frac{20}{3}$ m

653. In the visible region the dispersive powers and the mean angular deviations for crown and flint glass prisms are ω, ω' and d, d' respectively. The condition for getting deviation without dispersion when the two prisms are combined is

a) $\sqrt{\omega d} + \sqrt{\omega' d'} = 0$
b) $\omega' d + \omega d' = 0$
c) $\omega d + \omega' d' = 0$
d) $(\omega d)^2 = (\omega' d')^2 = 0$

654. The twinkling effect of star light is due to

a) Total internal reflection
b) High dense matter of star
c) Constant burning of hydrogen in the star
d) The fluctuating apparent position of the star being slightly different from of the star being different from the actual position of the star

655. Which of the following is not due to total internal reflection

a) Brilliance of diamond
b) Working of optical fibre
c) Difference between apparent and real depth of a pond
d) Mirage on hot summer days

656. A convex lens A of focal length 20 cm and a concave lens B of focal length 56 cm are kept along the same axis with the distance d between them. If a parallel beam of light falling on A leaves B as a parallel beam, then distances d in cm will be

a) 25 b) 36 c) 30 d) 50

657. A man can see the object between 15 cm and 30 cm. He uses the lens to see the far objects. Then due to the lens used, the near point will be at

a) $\frac{10}{3} cm$ b) 30 cm c) 15 cm d) $\frac{100}{3} cm$

658. Image formed by a convex lens is virtual and erect when the object is placed

a) At F
b) Between F and the lens
c) At $2F$
d) Beyond $2F$

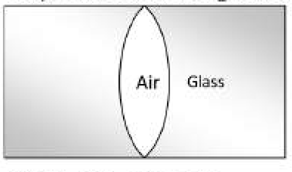
659. A combination of two thin lenses with focal lengths f_1 and f_2 respectively forms an image of distant object at distance 60 cm when lenses are in contact. The position of this image shift by 30 cm towards the combination when two lenses are separated by 10 cm. The corresponding values of f_1 and f_2 are

a) $30\ cm, -60\ cm$ b) $20\ cm, -30\ cm$ c) $15\ cm, -20\ cm$ d) $12\ cm, -15\ cm$

660. If μ_0 be the relative permeability and K_0 the dielectric constant of a medium, its refractive index is given by

a) $\frac{1}{\sqrt{\mu_0 K_0}}$ b) $\frac{1}{\mu_0 K_0}$ c) $\sqrt{\mu_0 K_0}$ d) $\mu_0 K_0$

661. In the figure, an air lens of radii of curvature 10 cm ($R_1 = R_2 = 10\ cm$) is cut in a cylinder of glass ($\mu = 1.5$). The focal length and the nature of the lens is



a) 15 cm, concave
b) 15 cm, convex
c) ∞, neither concave nor convex
d) 0, concave

662. Two plane mirrors inclined to each other at an angle 72°, what is the number of image formed?

a) 3 b) 5 c) 9 d) 7

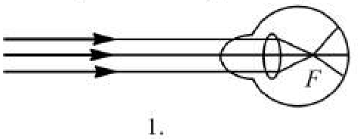
663. A light beam is being reflected by using two mirrors, as in a periscope used in submarines. If one of the mirrors rotates by an angle θ, the reflected light will deviate from its original path by the angle

a) 2θ b) 0° c) θ d) 4θ

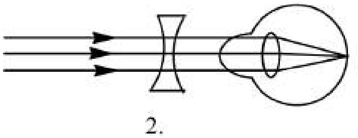
664. With diaphragm of the camera lens set at $f/2$, the correct exposure time is 1/100s. Then with diaphragm set at $f/8$, the correct exposure time is

a) 1/100 s b) 1/400 s c) 1/200 s d) 16/100 s

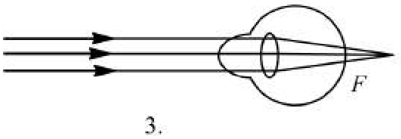
665. Identify the wrong description of the below figures



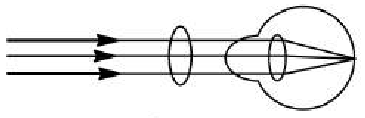
1.



2.



3.



4.

a) 1 represents far-sightedness
b) 2 correction for short-sightedness
c) 3 represents far-sightedness
d) 4 correction for far-sightedness

666. If a lens is cut into two pieces perpendicular to the principal axis and only one part is used, the intensity of the image

a) Remains same
b) $\frac{1}{2}$ times
c) 2 times
d) Infinite

667. A ray of light travelling from glass to air (refractive index of glass=1.5). The angle of incidence is 50°.The deviation of the ray is

a) 0°
b) 80°
c) $50° - \sin^{-1}\left[\frac{\sin 50°}{1.5}\right]$
d) $\sin^{-1}\left[\frac{\sin 50°}{1.5}\right] - 50°$

668. Relation between critical angles of water and glass is

a) $C_\omega > C_g$
b) $C_\omega < C_g$
c) $C_\omega = C_g$
d) $C_\omega = C_g = 0$

669. Dispersive power depends on the following

a) Material of the prism
b) Shape of the prism
c) Size of the prism
d) Size, shape and material of the prism

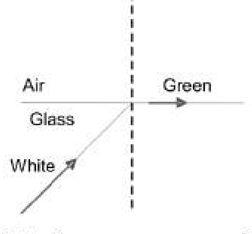
670. The focal length of a concave mirror is f and the distance from the object to the principle focus is x. The ratio of the size of the image to the size of the object is

a) $\frac{f+x}{f}$
b) $\frac{f}{x}$
c) $\sqrt{\frac{f}{x}}$
d) $\frac{f^2}{x^2}$

671. What cause chromatic aberration?

a) Non-paraxial rays
b) Paraxial rays
c) Variation of focal length with colour
d) Difference in radii of curvature of the bounding surface of the lens

672. While light is incident on the interface of glass and air as shown in the figure. If green light is just totally internally reflected then the emerging ray in air contains



a) Yellow, orange, red
b) Violet,indigo,blue
c) All colours
d) All colours except green

673. The distance between an object and the screen is 100 cm. A lens produces an image on the screen when placed at either of the position 40 cm apart. The power of the lens is

a) ≈ 3 *dioptres*
b) ≈ 5 *dioptres*
c) ≈ 7 *dioptres*
d) ≈ 9 *dioptres*

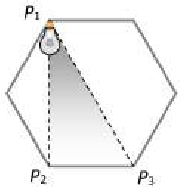
674. A fish, looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is 4/3 and the fish is 12 cm below the surface of water, the radius of the circle in centimetre is

a) $\frac{12 \times 3}{\sqrt{5}}$
b) $12 \times 3 \times \sqrt{5}$
c) $\frac{12 \times 3}{\sqrt{7}}$
d) $12 \times 3 \times \sqrt{7}$

675. Diameter of a plano-convex lens is 6 cm and thickness at the centre is 3 mm. If the speed of light in the material of the lens is $2 \times 10^8 m/s$, the focal length of the lens is

a) 15 *cm* b) 20 *cm* c) 30 *cm* d) 10 *cm*

676. A light source is located at P_1 as shown in the figure. All sides of the polygon are equal. The intensity of illumination at P_2 is I_0. What will be the intensity of illumination at P_3



a) $\frac{3\sqrt{3}}{8}I_0$ b) $\frac{I_0}{8}$ c) $\frac{3}{8}I_0$ d) $\frac{\sqrt{3}}{8}I_0$

677. A diminished image of an object is to be obtained on a screen 1.0 m away from it. This can be achieved by approximately placing

a) A convex mirror of suitable focal length b) A concave mirror of suitable focal length
c) A convex lens of focal length less than 0.25 m d) A concave lens of suitable focal length

678. A ball is dropped from a height of 20m above the surface of water in a lake. The refractive index of water is$\frac{4}{3}$. A fish inside the lake, in the line of fall of the ball, is looking at the ball. At an instant, when the ball is 12.8 m above the water surface, the fish sees the speed of ball as

a) 9 ms^{-1} b) 12 ms^{-1} c) 16 ms^{-1} d) 21.33 ms^{-1}

679. A vessel of height $2d$ is half-filled with a liquid of refractive index $\sqrt{2}$ and the other half with a liquid of refractive index n (the given liquids are immiscible). Then the apparent depth of the inner surface of the bottom of the vessel (neglecting the thickness of the bottom of the vessel) will be

a) $\frac{n}{d(n+\sqrt{2})}$ b) $\frac{d(n+\sqrt{2})}{n\sqrt{2}}$ c) $\frac{\sqrt{2}n}{d(n+\sqrt{2})}$ d) $\frac{nd}{(d+\sqrt{2n})}$

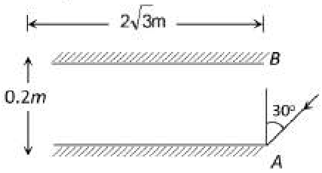
680. A point source of 3000 *lumen* is located at the center of a cube of side length $2m$. The flux through one side is

a) 500 *lumen* b) 600 *lumen* c) 750 *lumen* d) 1500 *lumen*

681. Which one of the following statements is true

a) An object situated at the principle focus of a concave lens will have its image formed at infinity
b) Concave mirror can give diminished virtual image
c) Given a point source of light, a convex mirror can produce a parallel beam of light
d) The virtual image formed in a plane mirror can be photographed

682. Two plane mirrors A and B are aligned parallel to each other, as shown in the figure. A light ray is incident at an angle of 30° at a point just inside one end of A. The plane of incidence coincides with the plane of the figure. The maximum number of times the ray undergoes reflection (including the first one) before it emerges out is



a) 28 b) 30 c) 32 d) 34

683. Minimum deviation is observed with a prism having angle of prism A, angle of deviation δ, angle of incidence i and angle of emergence e. We then have generally

a) $i > e$ b) $i < e$ c) $i = e$ d) $i = e = \delta$

684. A beam of monochromatic blue light of wavelength 4200 Å in air travels in water of refractive index 4/3. Its wavelength in water will be

a) 4200 Å b) 5800 Å c) 4150 Å d) 3150 Å

685. We combined a convex lens of focal length f_1 and concave lens of focal lengths f_2 and their combined focal length was F. The combination of these lenses will behave like a concave lens, if

a) $f_1 > f_2$ b) $f_1 < f_2$ c) $f_1 = f_2$ d) $f_1 \leq f_2$

686. A ray of light is incident on a surface of glass slab at an angle 45°.If the lateral shift produced per unit thickness is $\frac{1}{\sqrt{3}}$ m, the angle of refraction produced is

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

687. Which one of the following is not associated with total internal reflection

a) The mirage formation b) Optical fiber communication

c) The glittering of diamond d) Dispersion of light

688. The radius of curvature of concave mirror is 24 cm and the image is magnified by 1.5 times. The object distance is

a) 20 cm b) 8 cm c) 16 cm d) 24 cm

689. A telescope consists of two thin lenses of focal lengths 0.3 m and 3 cm respectively. It is focused on moon which subtends on angle of 0.5° at the objective. Then, the angle subtended at the eye by the final image will be

a) 5° b) 0.25° c) 0.5° d) 0.35°

690. Magnifying power of a simple microscope is (when final image is formed at $D = 25\ cm$ from eye)

a) $\frac{D}{f}$ b) $1+\frac{D}{f}$ c) $1+\frac{f}{D}$ d) $1-\frac{D}{f}$

691. A magnifying glass is to be used at the fixed object distance of 1 *inch*. If it is to produce an erect image magnified 5 *times* its focal length should be

a) 0.2 *inch* b) 0.8 *inch* c) 1.25 *inch* d) 5 *inch*

692. The maximum illumination on a screen at a distance of 2 *m* from a lamp is 25 *lux*. The value of total luminous flux emitted by the lamp is

a) 1256 *lumen* b) 1600 *lumen* c) 100 *candela* d) 400 *lumen*

693. Retina of eye acts like …….. of camera

a) Shutter b) Film c) Lens d) None of these

694. The field of view is maximum for

a) Plane mirror b) Concave mirror c) Convex mirror d) Cylindrical mirror

695. A person can see objects clearly only upto a maximum distance of 50 cm. His eye defect, nature of the corrective lens and its focal length are respectively

a) Myopia, concave, 50 cm b) Myopia, convex, 50 cm

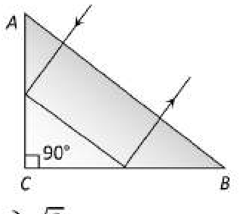
c) Hypermetropia, concave, 50 cm d) Catract, convex, 50 cm

696. When white light passes through the achromatic combination of prisms, then what is observed

a) Only deviation b) Only dispersion

c) Deviation and dispersion d) None of the above

697. A ray of light incident normally on an isosceles right angled prism travels as shown in the figure. The least value of the refractive index of the prism must be



a) $\sqrt{2}$ b) $\sqrt{3}$ c) 1.5 d) 2.0

698. A thin double convex lens has radii of curvature each of magnitude 40 cm and is made of glass with $\mu =$ 1.65. The focal length of the lens in nearly

a) 30 cm b) 31 cm c) 40 cm d) 41 cm

699. A transparent cube of 2.1 m edge contains a small air bubble. Its apparent distance when viewed through one face of the cube is 0.10 m and when viewed from the opposite face is 0.04 m. The actual distance of the bubble from the second face of the cube is

a) 0.06 m b) 0.17 m c) 0.05 m d) 0.04 m

700. A 16 cm long image of an object is formed by a convex lens on a screen. On moving the lens towards the screen, without changing the positions of the object and the screen, a 9 cm long image is formed again on the screen. The size of the object is

a) 9 cm b) 11 cm c) 12 cm d) 13 cm

701. An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and the eye-piece is 36 cm and the final image is formed at infinity. The focal length f_0 of the objective and the focal length f_e of the eye-piece are

a) $f_0 = 45$ cm and $f_e = -9$ cm b) $f_0 = -7.2$ cm and $f_e = 5$ cm

c) $f_0 = 50$ cm and $f_e = 10$ cm d) $f_0 = 30$ cm and $f_e = 6$ cm

702. A lens (focal length 50 cm) forms the image of a distant object which subtends an angle of 1 *milliradian* at the lens. What is the size of the image

a) 5 mm b) 1 mm c) 0.5 mm d) 0.1 mm

703. When sunlight is scattered by atmospheric atoms and molecules, the amount of scattering of light of wavelength 440 nm is A. The amount of scattering for the light of wavelength 660 nm is approximately

a) $\frac{4}{9}A$ b) 2.25 A c) 1.5 A d) $\frac{A}{5}$

704. Focal length of a converging lens in air is R. If it is dipped in water of refractive index 1.33, then its focal length will be around (Refractive index of lens material is 1.5)

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

705. The size of the image of an object, which is at infinity, as formed by a convex lens of focal length 30 cm is 2 cm. If a concave lens of focal length 20 cm is placed between the convex lens and the image at a distance of 26 cm from the convex lens, calculate the new size of the image

a) 1.25 cm b) 2.5 cm c) 1.05 cm d) 2 cm

706. Astigmatism (for a human eye) can be removed by using

a) Concave lens b) Convex lens c) Cylindrical lens d) Prismatic lens

707. When light emitted by a white hot solid is passed through a sodium flame, the spectrum of the emergent light will show

a) The D_1 and D_2 bright yellow lines of sodium

b) Two dark lines in the yellow region

c) All colours from violet to red

d) No colours at all

708. Velocity of light in a medium is $1.5 \times 10^8 m/s$. Its refractive index will be

a) 8 b) 6 c) 4 d) 2

709. A focal length of a thin biconvex lens is 20 cm. When an object is moved from a distance of 25cm in front of it to 50cm, the magnification of its image changes from m_{25} to m_{50}.The ration $\frac{m_{25}}{m_{50}}$ is

a) 6 b) 7 c) 8 d) 9

710. Absolute refractive indices of glass and water are $\frac{3}{2}$ and $\frac{4}{3}$. The ratio of velocity of light in glass and water will be

a) 4 : 3 b) 8 : 7 c) 8 : 9 d) 3 : 4

711. If ${}_i\mu_j$ represents refractive index when a light ray goes from medium i to medium j, then the product ${}_2\mu_1 \times {}_3\mu_2 \times {}_4\mu_3$ is equal to

a) ${}_3\mu_1$ b) ${}_3\mu_2$ c) $\frac{1}{{}_1\mu_4}$ d) ${}_4\mu_2$

712. A parallel beam of white light falls on a convex lens. Images of blue, yellow and red light are formed on other side of the lens at a distance of 0.20 m, 0.205 m and 0.214 m respectively. The dispersive power of the material of the lens will be

a) 619/1000 b) 9/200 c) 14/205 d) 5/214

713. Two point sources A and B of luminous intensities 1 cd and 16 cd respectively are placed 100 cm apart. A grease spot screen is placed between the two sources. For the grease spot to become indistinguishable from both the sides, it should be placed at

a) 80 cm from 16 cd lamp and 20 cm from 1 cd
b) 20 cm from the 16 cd and 80 cm from 1 cd
c) $\frac{400}{3}$ cm from 16 cd and $\frac{100}{3}$ cm from 1 cd
d) $\frac{100}{3}$ cm from 16 cd and $\frac{400}{3}$ cm from 1 cd

714. A photograph of the moon was taken with telescope. Later on, it was found that a housefly was sitting on the objective lens of the telescope. In photograph

a) The image of housefly will be reduced
b) There is a reduction in the intensity of the image
c) There is an increase in the intensity of the image
d) The image of the housefly will be enlarged

715. Consider the following two statements A and B and identify the correct choice in the given answers

A: Line spectra is due to atoms in gaseous state

B: Band spectra is due to molecules

a) Both A and B are false
b) A is true and B is false
c) A is false and B is true
d) Both A and B are true

716. The intensity of direct sunlight on a surface normal to the rays is I_0. What is the intensity of direct sunlight on a surface, whose normal makes an angle of 60° with the rays of the sun

a) I_0 b) $I_0\left(\frac{\sqrt{3}}{2}\right)$ c) $\frac{I_0}{2}$ d) $2I_0$

717. We wish to see inside an atom. Assuming the atom to have a diameter of 100 pm, this means that one must be able to resolved a width of say 10 pm. If an electron microscope is used, the minimum electron energy required is about

a) 1.5 keV b) 15 keV c) 150 keV d) 1.5 keV

718. A plano-convex lens of refractive index 1.5 and radius of curvature 30 cm is silvered at the curved surface. Now, this lens has been used to from the image of an object. At what distance from this lens, an object be placed in order to have a real image of the size of the object?

a) 20 cm b) 30 cm c) 60 cm d) 80 cm

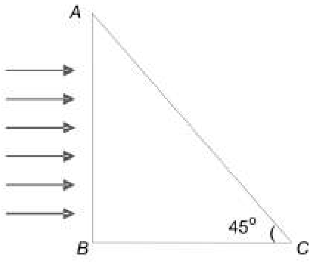
719. Two media having speeds of light 2×10^8 ms^{-1} and 2.4×10^8ms^{-1}, are separated by a plane surface. What is the angle for a ray going from medium I to medium II?

a) $\sin^{-1}\left(\frac{5}{6}\right)$ b) $\sin^{-1}\left(\frac{5}{12}\right)$ c) $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ d) $\sin^{-1}\left(\frac{1}{2}\right)$

720. A ray of light passes through an equilateral prism such that the angle of incidence and the angle of emergence are both equal to 3/4th of the angle of prism. The angle of minimum deviation is

a) 15° b) 30° c) 45° d) 60°

721. A beam of light consisting of red, green and blue colours is incident on a right-angled prism ABC.The refractive indices of the material of the prism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The colour/colours transmitted through the face AC of the prism will be



a) Red only b) Red and green c) All the three d) None of these

722. A lens of focal power 0.5 D is
a) A convex lens of focal length 0.5 m
b) A concave lens of focal length 0.5 m
c) A convex lens of focal length 2 m
d) A concave lens of focal length 2 m

723. A ray of light is incident at 50° on the middle of one of the two mirrors arranged at an angle of 60° between them. The ray then touches the second mirror, gets reflected back to the first mirror, making an angle of incidence
a) 50° b) 60° c) 70° d) 80°

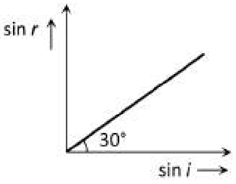
724. In a given direction, the intensities of the scattered light by a scattering substance for two beams of light are in the ratio of 256 : 81. The ratio of the frequency of the first beam to the frequency of the second beam is
a) 64 : 127 b) 4 : 3 c) 64 : 27 d) 2 : 1

725. A object is placed at a distance of $f/2$ from a convex lens of focal length f. The image will be
a) At one of the foci, virtual and double its size
b) Is greater than 1.5 but less than 2.0
c) At $2f$,virtual and erect
d) None of the above

726. The dispersive power of the material of lens of focal length 20 cm is 0.08. The longitudinal chromatic aberration of the lens is
a) 0.08 cm b) 0.08/20 cm c) 1.6 cm d) 0.16 cm

727. Maximum lateral displacement of a ray of light incident on a slab of thickness t is
a) $\frac{t}{2}$ b) $\frac{t}{3}$ c) $\frac{t}{4}$ d) t

728. A medium shows relation between i and r as shown. If speed of light in the medium is nc then value of n is

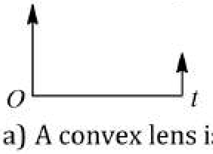


a) 1.5 b) 2 c) 2^{-1} d) $3^{-1/2}$

729. Ray optics is valid, when characteristic dimensions are
a) Of the same order as the wavelength of light
b) Much smaller than the wavelength of light
c) Of the order of one millimeter
d) Much larger than the wavelength of light

730. A thin rod of length $f/3$ lies along the axis of a concave mirror of focal length f. One end of its magnified image touches an end of the rod. The length of the image is
a) f b) $\frac{1}{2}f$ c) $2f$ d) $\frac{1}{4}f$

731. As shown in figure position of an images I of an object O formed by lens. This is possible if



a) A convex lens is placed to the left of O
b) A concave lens is placed to the left of O

c) A convex lens is placed between O and I d) A concave lens is placed to the right of I

732. A man has a concave shaving mirror of focal length 0.2 m. How far should the mirror be held from his face in order to give an image of two fold magnification?

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

733. In a thin prism of glass (refractive index 1.5), which of the following relations between the angle of minimum deviations δ_m and angle of refraction r will be correct

a) $\delta_m = r$ b) $\delta_m = 1.5r$ c) $\delta_m = 2r$ d) $\delta_m = \frac{r}{2}$

734. A substance is behaving as convex lens in air and concave in water, then its refractive index is

a) Smaller than air b) Greater than both air and water

c) Greater than air but less than water d) Almost equal to water

735. A man's near point is 0.5 m and far point is 3 m. Power spectacle lenses repaired for

(i) reading purposes

(ii) seeing distant objects, respectively

a) −2 D and + 3 D b) +2 D and −3 D

c) +2 D and – 0.33 D d) −2 D and + 0.33D

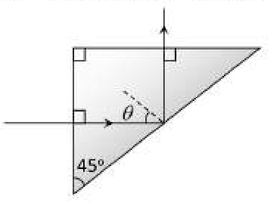
736. An astronaut in a spaceship see the outer space as

a) White b) Black c) Blue d) Red

737. When a lens of refractive index n_1 is placed in a liquid of refractive index n_2, the lens looks to be disappeared only, if

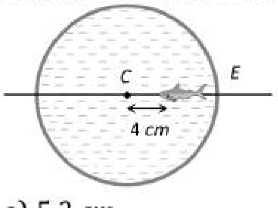
a) $n_1 = n_2/2$ b) $n_1 = 3n_2/4$ c) $n_1 = n_2$ d) $n_1 = 5n_2/4$

738. A triangular prism of glass is shown in the figure. A ray incident normally to one face is totally reflected, if $\theta = 5°$. The index of refraction of glass is



a) Less than 1.41 b) Equal to 1.41 c) Greater than 1.41 d) None of the above

739. In a thin spherical fish bowl of radius 10 cm filled with water of refractive index 4/3 there is a small fish at a distance of 4 cm from the centre C as shown in figure. Where will the image of fish appear, if seen from E



a) 5.2 cm b) 7.2 cm c) 4.2 cm d) 3.2 cm

740. An achromatic combination of lenses is formed by joining

a) 2 convex lenses b) 2 concave lenses

c) 1 convex lens and 1 concave lens d) Convex lens and plane mirror

741. The wavelength of light in air and some other medium are respectively λ_a and λ_m. The refractive index of medium is

a) λ_a/λ_m b) λ_m/λ_a c) $\lambda_a \times \lambda_m$ d) None of these

742. If an object is placed 10 cm infront of a concave mirror of focal length 20 cm, the image will be

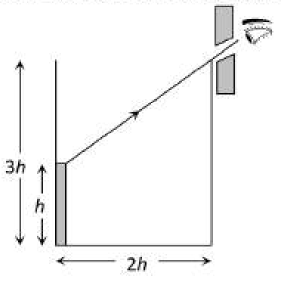
a) Diminished, upright, virtual b) Enlarged, upright, virtual

c) Diminished, inverted, real d) Enlarged, upright, real

743. If the wavelength of light in vacuum be λ, the wavelength in a medium of refractive index n will be

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

744. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is $3h$ and its radius h. When the beaker is filled with a liquid up to a height $2h$, he can see the lower end of the rod. Then the refractive index of the liquid is



a) 5/2
b) $\sqrt{(5/2)}$
c) $\sqrt{(3/2)}$
d) 3/2

745. Light rays from a source are incident on a glass prism of index of refraction μ and angle of prism α. At near normal incidence, the angle of deviation of the emerging rays is

a) $(\mu - 2)\alpha$
b) $(\mu - 1)\alpha$
c) $(\mu + 1)\alpha$
d) $(\mu + 2)\alpha$

746. A concave mirror is placed on a horizontal table with its axis directed vertically upwards. Let O be the pole of the mirror and C its centre of curvature. A point object is placed at C. It has a real image, also located at C. If the mirror is now filled with water, the image will be

a) Real and will remain at C
b) Real, and located at a point between C and ∞
c) Virtual and located at a point between C and O
d) Real, and located at a point between C and O

747. For which of the following colour, the magnifying power of a microscope will be maximum

a) White colour
b) Red colour
c) Violet colour
d) Yellow colour

748. An opera glass (Gallilean telescope) measures 9 cm from the objective to the eyepiece. The focal length of the objective is 15 cm. Its magnifying power is

a) 2.5
b) 2/5
c) 5/3
d) 0.4

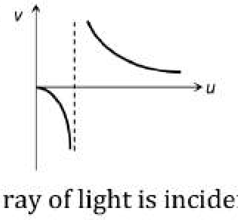
749. If $\hat{\imath}$ denotes a unit vector along incident light ray, $\hat{r}$ a unit vector along refracted ray into a medium of refractive index μ and $\hat{n}$ unit vector normal to boundary of medium directed towards incident medium, then law of refraction is

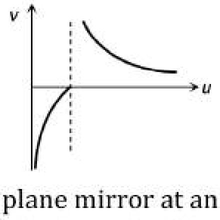
a) $\hat{\imath}.\hat{n} = \mu(\hat{r}.\hat{n})$
b) $\hat{\imath} \times \hat{n} = \mu(\hat{n} \times \hat{r})$
c) $\hat{\imath} \times \hat{n} = \mu(\hat{r} \times \hat{n})$
d) $\mu(\hat{\imath} \times \hat{n}) = \hat{r} \times \hat{n}$

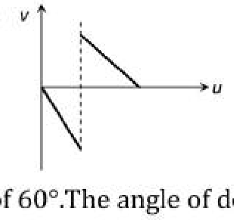
750. An object is placed 12 cm to the left of a converging lens of focal length 8 cm. Another converging of 6 cm focal length is placed at a distance of 30 cm to the right of the first lens. The second lens will produce

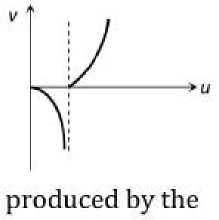
a) No image
b) A virtual enlarged image
c) A real enlarged image
d) A real smaller image

751. As the position of an object (u) reflected from a concave mirror is varied, the position of the image (v) also varies. By letting the u changes from 0 to $+\infty$ the graph between v versus u will be

a)


b)


c)


d)


752. A ray of light is incident on a plane mirror at an angle of 60°.The angle of deviation produced by the mirror is

a) 120°
b) 30°
c) 60°
d) 90°

753. A combination of two thin lenses of the same material with focal length f_1 and f_2, arranged on a common axis minimizes chromatic aberration. If the distance between them is

a) $\frac{(f_1 + f_2)}{4}$
b) $\frac{(f_1 + f_2)}{2}$
c) $(f_1 + f_2)$
d) $2(f_1 + f_2)$

754. A boat has green light of wavelength $\lambda = 500$ nm on the mast. What wavelength would be measured and what colour would be observed for this light as seen by a diver submerged in water by the side of the boat?

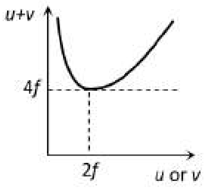
Given, $n_w = \frac{4}{3}$.

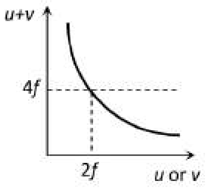
a) Green of wavelength 376 nm
b) Red of wavelength 665 nm
c) Green of wavelength 500 nm
d) Blue of wavelength 376 nm

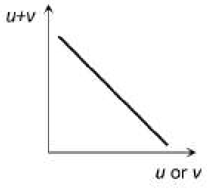
755. A leaf which contains only green pigments, is illuminated by a laser light of wavelength 0.632 μm. It would appear to be

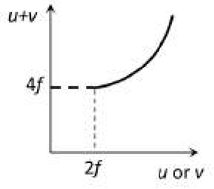
a) Brown
b) Black
c) Red
d) Green

756. For a convex lens, if real image is formed the graph between $(u + v)$ and u or v is as follows

a)


b)


c)


d)


757. 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) 12°
b) 5°
c) 7°
d) 10°

758. Two vertical plane mirrors are inclined at an angle of 60° with each other. A ray of light travelling horizontally is reflected first from one mirror and then from the other. The resultant deviation is

a) 60°
b) 120°
c) 180°
d) 240°

759. A point object is placed at a distance of 30 cm from a convex mirror of a focal length 30 cm. The image will form at

a) Infinity
b) Pole
c) 15 cm behind the mirror
d) No image will be formed

760. When a ray of light enters a glass slab from air

a) Its wavelength decreases
b) Its wavelength increases
c) Its frequency increases
d) Neither its wavelength nor its frequency changes

761. If eye is kept at a depth h inside water of refractive index and viewed outside, then the diameter of the circle through which the outer objects become visible, will be

a) $\frac{h}{\sqrt{\mu^2 - 1}}$
b) $\frac{h}{\sqrt{\mu^2 + 1}}$
c) $\frac{2h}{\sqrt{\mu^2 - 1}}$
d) $\frac{h}{\sqrt{\mu^2}}$

762. The distance between an object and a divergent lens is m times the focal length of the lens. The linear magnification produced by the lens is

a) m
b) $1/m$
c) $m + 1$
d) $\frac{1}{m + 1}$

763. Four lenses of focal length $+15\ cm$, $+20\ cm$, $+150\ cm$ and $+250\ cm$ are available for making an astronomical telescope. To produce the largest magnification, the focal length of the eye-piece should be

a) $+15\ cm$
b) $+20\ cm$
c) $+150\ cm$
d) $+250\ cm$

764. A convex lens, a glass slab, a glass prism and a solid sphere all are made of the same glass, the dispersive power will be

a) In the glass slab and prism
b) In the lens and solid sphere
c) Only in prism
d) In all the four

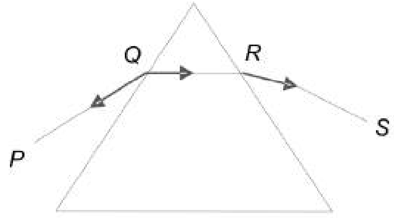
765. Which of the following spectrum have all the frequencies from high to low frequency range

a) Band spectrum
b) Continuous spectrum
c) Line spectrum
d) Discontinuous spectrum

766. A car is fitted with a convex side view mirror of focal length 20 cm. A second car 2.8 m behind the first car is overtaking the first car is a relative speed of 15 m/s. The speed of the image of the second car as seen in the mirror of the first one is

a) $\frac{1}{15}$ m/s b) 10 m/s c) 15 m/s d) $\frac{1}{10}$ m/s

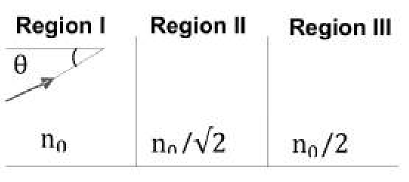
767. A ray of light is incident on an equilateral glass prism placed on a horizontal table. For minimum deviation which of the following is true?



a) PQ is horizontal b) QR is horizontal

c) RS is horizontal d) Either PQ or RS is horizontal

768. A beam of light is travelling from region II to region III (see the figure). The refractive index in region I, II and III are$n_0, \frac{n_0}{\sqrt{2}}$, and$\frac{n_0}{2}$respectively. The angle of incidence θ for which the beam just misses entering region III is



a) 30° b) 45° c) 60° d) $\sin^{-1}(\sqrt{2})$

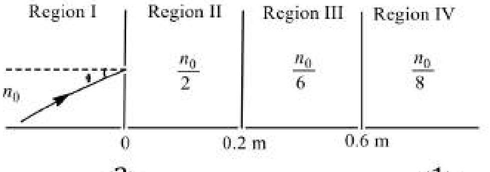
769. The refractive indices of the crown glass for blue and red light are 1.51 and 1.49 respectively and those of the flint glass area 1.77 and 1.73 respectively. An isosceles prism of angle 6° is made of crown glass. A beam of white light is incident at a small angle on this prism. The other flint glass isosceles prism is combined with the crown glass prism such that there is no deviation of the incident light

(i)Determine the angle of the flint glass prism

(ii)Calculate the net dispersion of the combined system

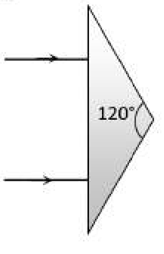
a) −4°, 0.04°, b) 4°, 0.04 c) 5°, 0.04 d) −5,0.04°

770. A light beam is travelling from Region I to Region IV (refer figure). The refractive index in Region I, II, III and IV are $n_0, \frac{n_0}{2}, \frac{n_0}{6}$ and $\frac{n_0}{8}$, respectively. The angle of incidence θ for which the beam just misses entering Region IV is



a) $\sin^{-1}\left(\frac{3}{4}\right)$ b) $\sin^{-1}\left(\frac{1}{8}\right)$ c) $\sin^{-1}\left(\frac{1}{4}\right)$ d) $\sin^{-1}\left(\frac{1}{3}\right)$

771. An isosceles prism of angle 120° has a refractive index of 1.44. Two parallel monochromatic rays enter the prism parallel to each other in air as shown. The rays emerging from the opposite faces



a) Are parallel to each other

b) Are diverging

c) Make an angle $2\sin^{-1}(0.72)$ with each other

d) Make an angle $2\{\sin^{-1}(0.72) - 30°\}$ with each other

772. A person suffering from 'presbyopia' (myopia and hyper metropia both defects) should use

a) A concave lens

b) A convex lens

c) A bifocal lens whose lower portion is convex

d) A bifocal lens whose upper portion is convex

773. The sun makes $0.5°$ angle of earth surface. Its image is made by convex lens of 50 cm focal length. The diameter of the image will be

a) 5 mm b) 4.36 mm c) 7 mm d) None of these

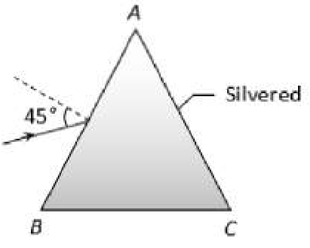
774. A hypermetropic person having near point at a distance of 0.75 m puts on spectacles of power 2.5 D. The near point now is at

a) 0.75 m b) 0.83 m c) 0.26 cm d) 0.26 m

775. Focal length of a plane mirror is

a) Zero b) Infinite c) Very less d) Indefinite

776. A prism ABC of angle $30°$ has its face AC silvered. A ray of light incident at an angle of $45°$ at the face AB retraces its path after refraction at face AB and reflection at face AC. The refractive index of the material of the prism is



a) 1.5 b) $3/\sqrt{2}$ c) $\sqrt{2}$ d) 4/3

777. A convex lens makes a real image 4 cm long on a screen. When the lens is shifted to a new position without disturbing the object, we again get a real image on the screen which is 16 cm tall. The length of the object must be

a) 1/4 cm b) 8 cm c) 12 cm d) 20 cm

778. From which source a continuous emission spectrum and a line absorption spectrum are simultaneously obtained

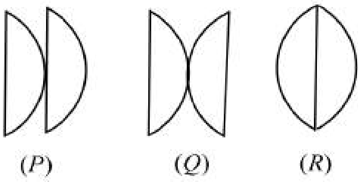
a) Bunsen burner flame

b) The sun

c) Tube light

d) Hot filament of an electric bulb

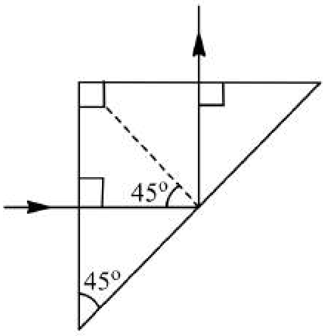
779. Given figures show the arrangements of two lenses, The radii of curvature of all the curved surfaces are same. The ratio of the equivalent focal length of combinations P, Q and R is



(P) (Q) (R)

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

780. A light ray is incident perpendicular to one face of a $90°$ prism and is totally internally reflected at the glass-air interface. If the angle of reflection is $45°$, we conclude that the refractive index n

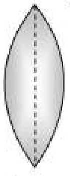


a) $n < \frac{1}{\sqrt{2}}$ b) $n > \sqrt{2}$ c) $n > \frac{1}{\sqrt{2}}$ d) $n < \sqrt{2}$

781. What should be the angle between two plane mirrors so that whatever be the angle of incidence, the incident ray and the reflected ray from the two mirrors be parallel to each other

a) 60° b) 90° c) 120° d) 175°

782. A convex lens has a focal length f. If is cut into two parts along the dotted line as shown in the figure. The focal length of each part will be



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

783. The chromatic aberration in lenses becomes due to

a) Disimilarity of main axis of rays
b) Disimilarity of radii of curvature
c) Variation of focal length of lenses with wavelength
d) None of these

784. A simple telescope, consisting of an objective of focal length 60 cm and a single eye lens of focal length 5 cm is focussed on a distant object is such a way that parallel rays come out from the eye lens. If the object subtends an angle 2° at the objective, the angular width of the image

a) 10° b) 24° c) 50° d) 1/6°

785. An electric bulb illuminates a plane surface. The intensity of illumination on the surface at a point 2 m away from the bulb 5×10^{-4} phot (lumen cm^{-2}). The line joining the bulb to the point makes an angle of 60° with the normal to the surface. The intensity of the bulb in candela (candle power) is

a) 40×10^{-4} b) 40 c) $40\sqrt{3}$ d) 20

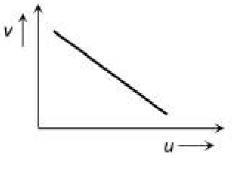
786. Magnification at least distance of distinct vision of a simple microscope having its focal length 5 cm is

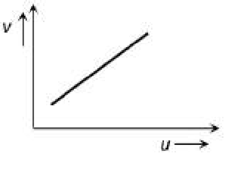
a) 2 b) 4 c) 5 d) 6

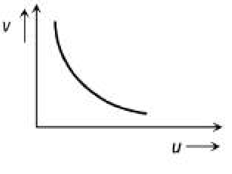
787. Two lenses of power – 15D and +5 D are in contact with each other. The focal length of the combination is

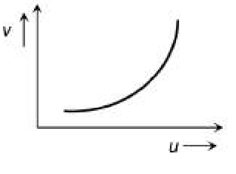
a) -20 cm b) -10 cm c) +20 cm d) +10 cm

788. In an experiment to find the focal length of a concave mirror a graph is drawn between the magnitudes of u and v. The graph looks like

a) 

b) 

c) 

d) 

789. A person is in a room whose ceiling and two adjacent walls are mirrors. How many images are formed

a) 5 b) 6 c) 7 d) 8

790. All of the following statements are correct except

a) The total length of an astronomical telescope is the sum of the focal lengths of its two lenses

b) The image formed by the astronomical telescope is always erect because the effect of the combination of the two lenses is divergent
c) The magnification of an astronomical telescope can be increased by decreasing the focal length of the eye-piece
d) The magnifying power of the refracting type of astronomical telescope is the ratio of the focal length of the objective to that of the eye-piece

791. A film projector magnifies a 100 cm^2 film strip on a screen. If the linear magnification is 4, the area of magnified film on the screen is

a) 1600 cm^2 b) 400 cm^2 c) 800 cm^2 d) 200 cm^2

792. When light travels from one medium to the other of which the refractive index is different, then which of the following will change

a) Frequency, wavelength and velocity b) Frequency and wavelength
c) Frequency and velocity d) Wavelength and velocity

793. At sun rise or sunset, the sun looks more red than at mid-day because

a) The sun is hottest at these times b) Of the scattering of light
c) Of the effect of refraction d) Of the effect of diffraction

794. White light is incident on one of the refracting surfaces of a prism of angle 5°. If the refractive indices for red and blue colours are 1.641 and 1.659 respectively, the angular separation between these two colours when they emerge out of the prism is

a) 0.9° b) 0.09° c) 1.8° d) 1.2°

795. The focal length of objective and eye lens of an astronomical telescope are respectively 2 m and 5 cm. Final image is format at (1) least distance of distinct vision (2) infinity. Magnifying powers in two cases will be

a) $-48, -40$ b) $-40, 48$ c) $-40, +48$ d) $-48 + 40$

796. 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) 12 cm b) 30 cm c) 50 cm d) 60 cm

797. Optical fibres are related with

a) Communication b) Light c) Computer d) None of these

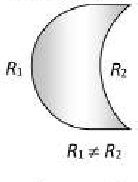
798. When light enters water from the vacuum, then the wavelength of light

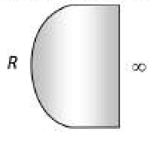
a) Decreases b) Increases c) Remain constant d) Becomes zero

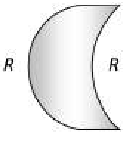
799. Light travels with a speed of $2 \times 10^8 ms^{-1}$ in crown glass of refractive index 1.5. Whatis the speed of light in dense flint glass of refractive index 1.8?

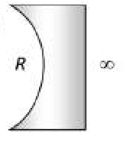
a) $1.33 \times 10^8 ms^{-1}$ b) $1.67 \times 10^8 ms^{-1}$ c) $2.0 \times 10^8 ms^{-1}$ d) $3.0 \times 10^8 ms^{-1}$

800. Which one of the following spherical lenses does not exhibit dispersion? The radii of curvature of the surfaces of the lenses are as given in the diagrams

a) 

b) 

c) 

d) 

801. Two plane mirrors are perpendicular to each other. A ray after suffering reflection from the two mirrors will be

a) Perpendicular to the original ray b) Parallel to the original ray
c) Parallel to the first mirror d) At 45° to the original ray

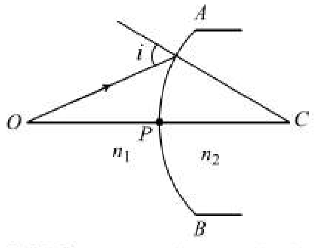
802. In a photometer, two sources of light when placed at 30 cm and 50 cm respectively produce shadows of equal intensities. Their candle powers are in the ratio of

a) $\frac{9}{25}$ b) $\frac{16}{25}$ c) $\frac{3}{5}$ d) $\frac{5}{3}$

803. A diver at a depth of 12m in water$\left(\mu = \frac{4}{3}\right)$ sees the sky in a cone of semivertical angle

a) $\sin^{-1}\left(\frac{4}{3}\right)$ b) $\tan^{-1}\left(\frac{4}{3}\right)$ c) $\sin^{-1}\left(\frac{3}{4}\right)$ d) $90°$

804. A point object O is kept at a distance of $OP = u$. The radius of curvature of the spherical surface APB is $CP = R$. The refractive index of the media are n_1 and n_2 which are as shown in diagram. Then,



(1) If $n_1 > n_2$, image is virtual for all values of u

(2) If $n_2 = 2n_1$, image is virtual when $R > u$

(3) The image is real for all values of u, n_1 and n_2. Here, the correct statements is/are

a) Only (2) b) Both (1) and (2) c) Only (1) d) (1), (2) and (3)

805. When sunlight is scattered by minute particles of atmosphere, the intensity of light scattered away is proportional to

a) (wavelength of light)^4 b) (frequency of light)^4 c) (wavelength of light)^2 d) (frequency of light)^2

806. A ray of light from a denser medium strikes a rarer medium at angle of incidence i. The reflected and refracted rays make an angle of $90°$ with each other. The angles of reflection and refraction are r and r' respectively. The critical angle is

a) $\sin^{-1}(\tan r')$ b) $\sin^{-1}(\tan r)$ c) $\tan^{-1}(\tan r')$ d) $\tan^{-1}(\tan i)$

807. How many images are formed by the lens shown, if an object is kept on its axis?

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

808. Rainbow is formed due to

a) Total internal reflection b) Scattering

c) Refraction d) Dispersion and total internal reflection

809. A concave mirror is placed at the bottom of an empty tank with face upwards and axis vertical. When sunlight falls normally on the mirror, it is focussed at distance of 32 cm from the mirror. If the tank filled with water $\left(\mu = \frac{4}{3}\right)$ upto a height of 20 cm, then the sunlight will now get focussed at

a) 16 cm above water level b) 9 cm above water level

c) 24 cm below water level d) 9 cm below water level

810. A person cannot see properly beyond 2 m. Power of the lens is

a) 0.5 D b) 1.5 D c) -2.5 D d) -0.5 D

811. A telescope of diameter $2m$ uses light of wavelength 5000 Å for viewing stars. The minimum angular separation between two stars whose image is just resolved by this telescope is

a) $4 \times 10^{-4}\ rad$ b) $0.25 \times 10^{-6}\ rad$ c) $0.31 \times 10^{-6}\ rad$ d) $5.0 \times 10^{-3}\ rad$

812. The phenomena of total internal reflection is seen when angle of incidence is

a) $90°$ b) Greater than critical angle

c) Equal to critical angle d) $0°$

813. To increase both the resolving power and magnifying power of a telescope

a) Both the focal length and aperture of the objective has to be increased

b) To focal length of the objective has to be increased

c) The aperture of the objective has to be increased

d) The wavelength of light has to be decreased

814. When a plane mirror is placed horizontally on a level ground at a distance of $60m$ from the foot of a tower, the top of the tower and its image in the mirror subtend an angle of $90°$ at the *eye*. The height of the tower will be

a) $30m$ b) $60m$ c) $90m$ d) $120m$

815. Formula for dispersive power is (where symbols have their usual meanings)

or

If the refractive indices of crown glass for red, yellow and violet colours are respectively μ_r, μ_y and μ_v, then the dispersive power of this glass would be

a) $\frac{\mu_v - \mu_v}{\mu_r - 1}$ b) $\frac{\mu_v - \mu_r}{\mu_v - 1}$ c) $\frac{\mu_r - \mu_v}{\mu_v - \mu_r}$ d) $\frac{\mu_v - \mu_r}{\mu_v} - 1$

816. A diminished virtual image can be formed only in

a) Plane mirror b) A concave mirror
c) A convex mirror d) Concave-parabolic mirror

817. A converging lens is to project the image of a lamp 4 times the size of the lamp on a wall at a distance of 10 m from the lamp. The focal length of the lens is

a) 1.6 m b) 2.67 m c) 4.4 m d) -1.6 m

818. An object has image thrice of its original size when kept at 8 cm and 16 cm from a convex lens. Focal length of the lens is

a) 8 cm b) 16 cm
c) Between 8 cm and 16 cm d) Less than 8 cm

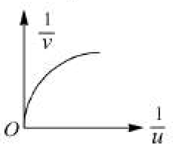
819. A monochromatic light is passed through a prism………..colours shows minimum deviation

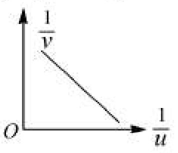
a) Red b) Violet c) Yellow d) Green

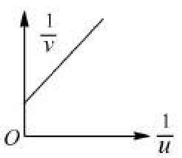
820. The refractive index of a piece of transparent quartz is the greatest for

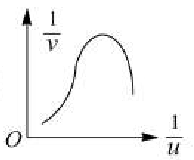
a) Red light b) Violet light c) Green light d) Yellow light

821. From a spherical mirror, the graph of $1/v$ *versus* $1/u$ is

a) 

b) 

c) 

d) 

822. A medium is said to be dispersive, if

a) Light of different wavelengths propagate at different speeds
b) Light of different wavelengths propagate at same speed but has different frequencies
c) Light is gradually bent rather than sharply refracted at an interface between the medium and air
d) Light is never totally internally reflected

823. The refractive index of a material of a planoconcave lens is 5/3, the radius of curvature is 0.3 m. The focal length of the lens in air is

a) -0.45 m b) -0.6 m c) -0.75 m d) -1.0 m

824. The focal lengths of the objective and eye lenses of a telescope are respectively 200 cm and 5 cm. The minimum magnifying power of the telescope will be

a) -40 b) -48 c) -60 d) -100

825. When monochromatic red right is used instead of blue light in a convex lens, its focal length will

a) Does not depend on colour of light b) Increase
c) Decrease d) Remain same

826. The nature of sun's spectrum is

a) Continuous spectrum with absorption lines b) Line spectrum
c) The spectrum of the helium atom d) Band spectrum

827. Dispersive power depends upon

a) The shape of prism b) Material of prism c) Angle of prism d) Height of the prism

828. A lens of focal f projects m times magnified image of an object on a screen. The distance of the screen from the lens is

a) $\frac{f}{(m-1)}$ b) $\frac{f}{(m+1)}$ c) $f(m-1)$ d) $f(m+1)$

829. A bucket contains some transparent liquid and its depth is 40 cm. On looking from above, the bottom appears to be raised up by 8 cm. The refractive index of the liquid is

a) 5/4 b) 5 c) 4/5 d) 8/5

830. An object is placed at a distance of 10 cm from a concave mirror of radius of curvature 0.6 m. Which of the following statements is incorrect?

a) The image is formed at a distance for 15 cm from the mirror

b) The image formed is real

c) The image is 0.5 times the size of the object

d) The image is 1.5 times the size of the object

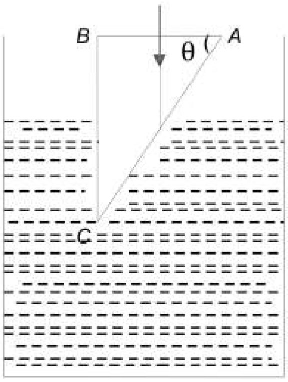
831. A lamp of 250 candela power is hanging at a distance of 6 m from a wall. The illuminance at a point on the wall at a minimum distance from lamp will be

a) 9.64 lux b) 4.69 lux c) 6.94 lux d) None of these

832. A glass slab ($\mu = 1.5$) of thickness 6 m is placed over a paper. What is the shift in the shift in the letters?

a) 4 cm b) 2 cm c) 1 cm d) None of the above

833. A glass prism of refractive index 1.5 is immersed in water$\left(\mu = \frac{4}{3}\right)$.Refer figure.



A light beam incident normally on the face $AB$is totally reflected to reach the face BCif

a) $2/3 < \sin\theta < 8/9$ b) $\sin\theta \le 2/3$ c) $\cos\theta \ge 8/9$ d) $\sin\theta > 8/9$

834. A simple microscope consists of a concave lens of power −10D and a convex lens of power +20D in contact. If the image is formed at infinity, then the magnifying power

$CD = 25$ cm is

a) 2.5 b) 3.5 c) 2.0 d) 3.0

835. Fraunhoffer lines are obtained in

a) Solar spectrum

b) The spectrum obtained from neon lamp

c) Spectrum from a discharge tube

d) None of the above

836. The exposure time of a camera lens at the $\frac{f}{2.8}$ setting is $\frac{1}{200}$ second. The correct time of exposure at $\frac{f}{5.6}$ is

a) 0.4 s b) 0.02 s c) 0.002 s d) 0.04 s

837. A light ray is incident by grazing one of the face of a prism and after refraction ray does not emerge out, what should be the angle of prism while critical angle is C

a) Equal to $2C$ b) Less than $2C$ c) More than $2C$ d) None of the above

838. Stars are not visible in the day time because

a) Stars hide behind the sun

b) Stars do not reflect sun rays during day

c) Stars vanish during the day

d) Atmosphere scatters sunlight into a blanket of extreme brightness through which faint stars cannot be visible

839. In order to increase the magnifying power of a compound microscope
a) The focal lengths of the objective and the eye piece should be small
b) Objective should have small focal length and the eye piece large
c) Both should have large focal lengths
d) The objective should have large focal length and eye piece should have small

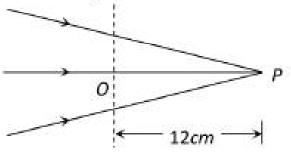
840. A small source of light is to be suspended directly above the centre of a circular table of radius R. What should be the height of the light source above the table so that the intensity of light is maximum at the edges of the table compared to any other height of the source
a) $\frac{R}{2}$ b) $\frac{R}{\sqrt{2}}$ c) R d) $\sqrt{2}R$

841. The light takes in travelling a distance of 500 m in water. Given that μ for water is 4/3 and the velocity of light in vacuum is 3×10^{10} cms^{-1}. Calculate equivalent optical path
a) 566.64 m b) 666.64 m c) 586.45 m d) 576.64 m

842. In refraction, light waves are bent on passing from one medium to the second medium, because, in the second medium
a) The frequency is different
b) The coefficient of elasticity is different
c) The speed is different
d) The amplitude is smaller

843. The dispersion for a medium of wavelength λ is D, then the dispersion for the wavelength 2λ will be
a) $D/8$ b) $D/4$ c) $D/2$ d) D

844. Figure given below shows a beam of light converging at point P. When a concave lens of focal length 16 cm is introduced in the path of the beam at a place O shown by dotted line such that OP becomes the axis of the lens, the beam converges at a distance x from the lens. The value x will be value to



a) 12 cm b) 24 cm c) 36 cm d) 48 cm

845. A thin lens made of glass of refractive index $\mu = 1.5$ has a focal length equals is 12 cm in air. It is now immersed in water $\left(\mu = \frac{4}{3}\right)$. Its new focal length is
a) 48 cm b) 36 cm c) 24 cm d) 12 cm

846. If the ratio of amounts of scattering of two light waves is 1:4, the ratio of their wavelength is
a) 1 : 2 b) $\sqrt{2}$: 1 c) 1 : $\sqrt{2}$ d) 1 : 1

847. In a simple microscope, if the final image is located at infinity then its magnifying power is
a) $\frac{25}{f}$ b) $\frac{D}{26}$ c) $\frac{f}{25}$ d) $\frac{f}{D+1}$

848. The focal length of an equi-convex lens is greater than the radius of curvature of any of the surfaces. Then the refractive index of the material of the lens is
a) Greater than zero but less than 1.5
b) Greater than 1.5 but less than 2.0
c) Greater than 2.0 but less than 2.5
d) Greater than 2.5 but less than 2.0

849. With respect to air critical angle in a medium for light of red colour (λ_1) is θ. Other facts remaining same, critical angle for light of yellow colour $[\lambda_2]$ will be
a) θ b) More than θ c) Less than θ d) $\frac{\theta\lambda_1}{\lambda_2}$

850. A satisfactory photographic print is obtained when the exposure time is 10 s at a distance of 2 m from a 60 cd lamp. The time of exposure required for the same quality print at a distance of 4 m from a 120 cd lamp is
a) 5 s b) 10 s c) 15 s d) 20 s

851. Angle of prism is A and its one surface is silvered. Light rays falling at an angle of incidence 2A on first surface return back through the same path after suffering reflection at second silvered surface. Refractive index of the material of prism is

a) $2 \sin A$ b) $2 \cos A$ c) $\frac{1}{2} \cos A$ d) $\tan A$

852. The astronomical telescope consists of objective and eye-piece. The focal length of the objective is

a) Equal to that of the eye-piece
b) Greater than that of the eye-piece
c) Shorter than that of the eye-piece
d) Five times shorter than that of the eye-piece

853. A watch shows time as 3 : 25 when seen through a mirror, time appeared will be

a) 8 : 35 b) 9 : 35 c) 7 : 35 d) 8 : 25

854. When a convergent beam of light is incident on a plane mirror, the image formed is

a) upright and real b) upright and virtual
c) inverted and virtual d) inverted and real

855. An achromatic combination of lenses produces

a) Images in black and white
b) Coloured images
c) Images unaffected by variation of refractive index with wavelength
d) Highly enlarged images are formed

856. A light moves from denser to rarer medium. Which of the following is correct?

a) Energy increases b) Frequency increases
c) Phase changes by 90° d) Velocity increases

857. A man is $180cm$ tall and his eyes are $10cm$ below the top of his head. In order to see his entire height right from toe to head, he uses a plane mirror kept at a distance of $1m$ from him. The minimum length of the plane mirror required is

a) $180cm$ b) $90cm$ c) $85cm$ d) $170cm$

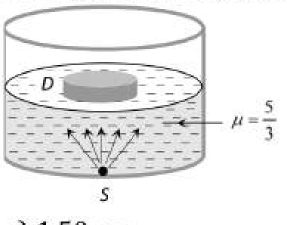
858. In an eye-piece, field lens and eye lens have focal lengths 7.5 cm and 7.3 cm. To eliminate spherical aberration, distance between them would be

a) 0.2 cm b) 0.4 cm c) 0.1 cm d) 0.5 cm

859. A ray of monochromatic light is incident on one refracting face of a prism of angle 75°. It passes through the prism and is incident on the other face at the critical angle. If the refractive index of the material of the prism is $\sqrt{2}$, the angle of incidence on the first face of the prism is

a) 30° b) 45° c) 60° d) 0°

860. A point source of light S is placed at the bottom of a vessel containing a liquid of refractive index 5/3. A person is viewing the source from above the surface. There is an opaque disc D of radius 1 cm floating on the surface of the liquid. The centre of the disc lies vertically above the source S. The liquid from the vessel is gradually drained out through a tap. The maximum height of the liquid for which the source cannot be seen at all from above is



a) 1.50 cm b) 1.64 cm c) 1.33 cm d) 1.86 cm

861. Two lenses having $f_1 : f_2 = 2 : 3$ has combination to make no dispersion. Find the ratio of dispersive power of glasses used

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

862. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at a point O, and $PO = OQ$. The distance PO is equal to

a) $5\,R$ b) $3\,R$ c) $2\,R$ d) $1.5\,R$

863. Fraunhoffer spectrum is

a) Line absorption spectrum b) Band absorption spectrum
c) Line emission spectrum d) Band emission spectrum

864. The maximum refractive index of a prism which permits the passage of light through it, when the refracting angle of the prism is 90°,is

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

865. A thin rod of $5cm$ length is kept along the axis of a concave mirror of $10cn$ focal length such that its image is real and magnified and one end touches the rod. Its magnification

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

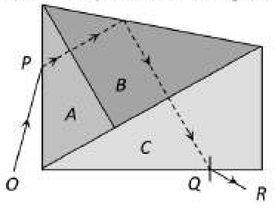
866. When a glass lens with $n = 1.47$ is immersed in a trough of liquid, it looks to be disappeared. The liquid in the trough could be

a) Water b) Kerosene c) Glycerin d) Alcohol

867. If F_o and F_e are the focal length of the objective and eye piece respectively of a telescope, then its magnifying power will be

a) $F_o + F_e$ b) $F_o \times F_e$ c) F_o/F_e d) $\frac{1}{2}(F_o + F_e)$

868. Three glass prisms A, B and C of same refractive index are placed in contact with each other as shown in figure, with no air gap between the prisms. Monochromatic ray of light OP passes through the prism assembly and emerges as QR. The conditions of minimum deviation is satisfied in the prisms



a) A and C b) B and C
c) A and B d) In all prisms A, B and C

869. Circular part in the centre of retina is called

a) Blind spot b) Yellow spot c) Red spot d) None of the above

870. A concave mirror of focal length f (in air) is immersed in water ($\mu = 4/3$). The focal length of the mirror in water will be

a) f b) $\frac{4}{3}f$ c) $\frac{3}{4}f$ d) $\frac{7}{3}f$

871. The resolving power of a telescope depends on

a) Focal length of eye lens b) Focal length of objective lens
c) Length of the telescope d) Diameter of the objective lens

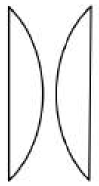
872. In a compound microscope, the focal lengths of two lenses are 1.5 cm and 6.25 cm An object is placed at 2 cm form objective and the final image is formed is 25 cm from eye lens. The distance between the two lenses is

a) 6.00 cm b) 7.75 cm c) 9.25 cm d) 11.00 cm

873. Which mirror is to be used to obtain a parallel beam of light from a small lamp?

a) Plane mirror b) Convex mirror c) Concave mirror d) Any one of these

874. If the space between the lenses in the lens combination shows were filled with water, what would happen to the focal length and power of the lens combination?



Focal Length **Power**

a) Decreased Increased
b) Decreased Unchanged
c) Increased Unchanged
d) Increased Decreased

875. If both the object and image are at infinite distance from a refracting telescope its magnifying power will be equal to
a) The sum of the focal lengths of the objective and the eyepiece
b) The different of the focal lengths of the two lenses
c) The ratio of the focal length of the objective and eyepiece
d) The ratio of the focal length of the eyepiece and objective

876. Lenses of power 3 D and -5 D are combined to from a compound lens. An object is placed at a distance of 50 cm from this lens. Its image will be formed at a distance from the lens, will be
a) 25 cm b) 20 cm c) 30 cm d) 40 cm

877. The magnifying power of a microscope with an objective of 5 mm focal length is 400. The length of its tube is 20 cm. Then the focal length of the eye-piece is
a) 200 cm b) 160 cm c) 2.5 cm d) 0.1 cm

878. Relative difference of focal lengths of objective and eye lens in the microscope and telescope is given as
a) It is equal in both b) It is more in telescope
c) It is more in microscope d) It may be more in any one

879. In the measurement of the angle of a prism using a spectrometer, the readings of first reflected image are Vernier 1: $320° 40'$; Vernier II : $140° 30'$ and those of the second reflected image are Vernier I : $80° 38'$; Vernier II : $260° 24'$. Then the angle of the prism is
a) $59° 58'$ b) $59° 56'$ c) $60° 2'$ d) $60° 4'$

880. When light travels from glass to air, the incident angle is θ_1 and the refracted angle is θ_2. The true relation is
a) $\theta_1 = \theta_2$ b) $\theta_1 < \theta_2$ c) $\theta_1 > \theta_2$ d) Not predictable

881. The minimum distance between the object and its real image for concave mirror is
a) f b) $2f$ c) $4f$ d) Zero

882. In Huygen's eyepiece
a) The cross wires are outside the eyepiece
b) Condition for achromatism is satisfied
c) Condition for minimum spherical aberration is not satisfied
d) The image formed by the objective is a virtual image

883. A convex lens forms an image of an object placed 20 cm away from it at a distance of 20 cm on the other side of the lens. If the object is moved 5 cm towards the lens, the image will move
a) 5 cm towards the lens b) 5 cm away from the lens
c) 10 cm towards the lens d) 10 cm away from the lens

884. The power of the combination of a convex lens of focal length 50 cm and concave lens of focal length 40 cm is
a) +1 D b) -1 D c) Zero d) -0.5 D

885. How much water should be filled in a container 21 cm in height, so that it appears half filled when viewed from the top of the container (given that ${}_a\mu_\omega = 4/3$)
a) 8.0 cm b) 10.5 cm c) 12.0 cm d) None of the above

886. A ray of light travels from an optically denser to rarer medium. The critical angle for the two media is C. The maximum possible deviation of the ray will be

a) $\left(\frac{\pi}{2} - C\right)$ b) $2C$ c) $\pi - 2C$ d) $\pi - C$

887. 60° prism has$\mu = \sqrt{2}$. Angle of incidence for minimum deviation is

a) 45° b) 30° c) 60° d) 90°

888. Magnification of a compound microscope is 30. Focal length of eye-piece is 5 cm and the image is formed at a distance of distinct vision of 25 cm. The magnification of the objective lens is

a) 6 b) 5 c) 7.5 d) 10

889. The diameter of objective of a telescope is 1 m. its resolving limit for the light of wavelength 4538 Å, will be

a) 5.54×10^{-7} rad b) 2.54×10^{-4} rad c) 6.54×10^{-7} rad d) None of the above

890. Band spectrum is obtained when the source emitted light is in the form of **or**
Band spectrum is characteristic of

a) Atoms b) Molecules c) Plasma d) None of the above

891. Refractive index of glass with respect to medium is$\frac{4}{3}$. If the differences between velocities of light in medium and glass is $6.25 \times 10^7 \text{ms}^{-1}$, then velocity of light in medium is

a) $2.5 \times 10^8 \text{ms}^{-1}$ b) $0.125 \times 10^8 \text{ms}^{-1}$ c) $1.5 \times 10^8 \text{ms}^{-1}$ d) $3 \times 10^8 \text{ms}^{-1}$

892. In fog, photographs of the objects taken with infrared radiations are more clear than those obtained during visible light because

a) $I - R$ radiation has lesser wavelength than visible radiation
b) Scattering of $I - R$ light is more than visible light
c) The intensity of $I - R$ light from the object is less
d) Scattering of $I - R$ light is less than visible light

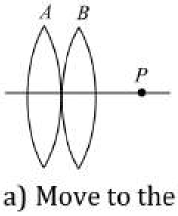
893. A double convex lens of glass of $\mu = 1.5$ has radius of curvature of each of its surface is 0.2 m. The power of the lens is

a) +10 $dioptres$ b) −10 $dioptres$ c) −5 $dioptres$ d) +5 $dioptres$

894. A ray of light is incident on the surface of separation of a medium at an angle 45° and is refracted in the medium at an angle 30°. What will be the velocity of light in the medium

a) $1.96 \times 10^8\ m/s$ b) $2.12 \times 10^8\ m/s$ c) $3.18 \times 10^8\ m/s$ d) $3.33 \times 18^8\ m/s$

895. Two convex lenses placed in contact form the image of a distant object at P. If the lens B is moved to the light, the image will



a) Move to the left
b) Move to the right
c) Remain at P
d) Move either to the left to right, depending upon focal length of the lenses

896. The separation between two microscopic particles is measured P_A and P_B by two different lights of wavelength 2000 Å and 3000 Å respectively, then

a) $P_A > P_B$ b) $P_A < P_B$ c) $P_A < 3/2P_B$ d) $P_A = P_B$

897. If h_1 and h_2 are the heights of the images in conjugate position of a convex lens , then the height of the object is

a) $h_1 + h_2$ b) $h_1 - h_2$ c) h_1/h_2 d) $\sqrt{h_1 h_2}$

898. When a glass prism of refracting angle 60° is immersed in a liquid its angle of minimum deviation is 30°. The critical angle of glass with respect to the liquid medium is

a) 42° b) 45° c) 50° d) 52°

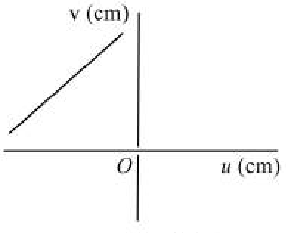
899. An object is placed in front of a convex mirror of focal length f. Find the maximum and minimum distance of two object from the mirror such that the image is real and magnified.

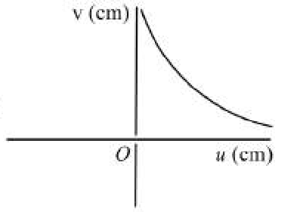
a) 20 and ∞ b) f and $2f$ c) f and 0 d) None of these

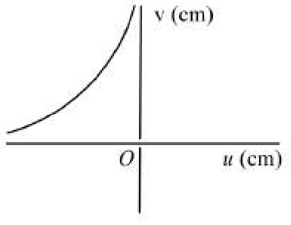
900. An object is kept at a distance of 16 cm from a thin lens and the image formed is real. If the object is kept at a distance of 6 cm from the same lens, the image formed is virtual. If the sizes of the images formed are equal the focal length of the lens will be

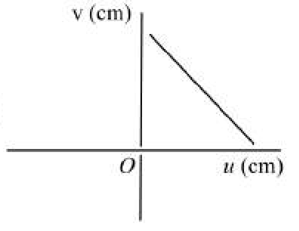
a) 21 cm b) 11 cm c) 15 cm d) 17 cm

901. A student measures the focal length of a convex lens by putting an object pin at a distance $u$from the lens and measuring the distance v of the image pin. The graph between $u$and v plotted by the student should look like

a) 

b) 

c) 

d) 

902. When a plane mirror is rotated through an angle θ then the reflected ray turns through the angle 2θ then the size of the image

a) Is doubled b) Is halved c) Remains the same d) Becomes infinite

903. Each quarter of a vessel of depth H is filled with liquids of the refractive indices n_1, n_2, n_3 and n_4 from the bottom respectively. The apparent depth of the vessel when looked normally is

a) $\frac{H(n_1+n_2+n_3+n_4)}{4}$ b) $\frac{H\left(\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}+\frac{1}{n_4}\right)}{4}$ c) $\frac{(n_1+n_2+n_3+n_4)}{4H}$ d) $\frac{H\left(\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}+\frac{1}{n_4}\right)}{2}$

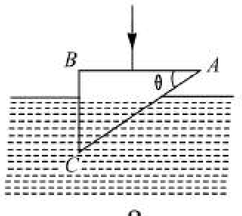
904. One of the refracting surfaces of a prism of angle 30° is silvered. A ray of light incident at an angle of 60° retraces its path. The refractive index of the material of prism is

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

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

a) $\frac{t}{nc}$ b) tnc c) $\frac{nt}{c}$ d) $\frac{tc}{n}$

906. A glass prism ABC (refractive index 1.5), immersed in water (refractive index 4/3). A ray of light is incident normally on face AB. If it is totally reflected at face AC then



a) $\sin\theta \geq \frac{8}{9}$ b) $\sin\theta \geq \frac{2}{3}$ c) $\sin\theta = \frac{\sqrt{3}}{2}$ d) $\frac{2}{3} < \sin\theta < \frac{8}{9}$

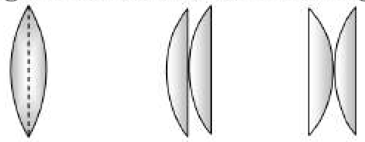
907. A microscope is focused on a coin lying at the bottom of a beaker. The microscope is now raised up by 1 cm. To what depth should the water be poured into the beaker so that coin is again in focus? (Refractive index of water is $\frac{4}{3}$)

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

908. 'Mirage' is a phenomenon due to

a) Reflection of light
b) Refraction of light
c) Total internal reflection of light
d) Diffraction of light

909. Two similar plano-convex lenses are combined together in three different ways as shown in the adjoining figure. The ratio of the focal lengths in three cases will be



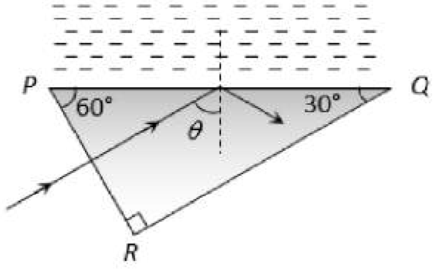
a) 2 : 2 : 1
b) 1 : 1 : 1
c) 1 : 2 : 2
d) 2 : 1 : 1

910. The unit of focal power of a lens is
a) Watt
b) Horse power
c) Dioptre
d) Lux

911. The refractive index of water is 1.33. The direction in which a man under water should look to see the setting sun is
a) $49°$ to the horizontal
b) $90°$ with the vertical
c) $49°$ to the vertical
d) Along the horizontal

912. The critical angle between an equilateral prism and air is $45°$. If the incident ray is perpendicular to the refractive surface, then
a) After deviation it will emerge from the second refracting surface
b) It is totally reflected on the second surface and emerges out perpendicularly from third surface in air
c) It is totally reflected from the second and third refracting surfaces and finally emerges out from the first surface
d) It is totally reflected from all the three sides of prism and never emerges out

913. PQR is a right angled prism with other angles as $60°$ and $30°$. Refractive index of prism is 1.5. PQ has a thin layer of liquid. Light falls normally on the face PR. For total internal reflection, maximum refractive index of liquid is



a) 1.4
b) 1.3
c) 1.2
d) 1.6

914. In the formation of primary rainbow, the sunlight rays emerge at minimum deviation from rain-drop after
a) One internal reflection and one refraction
b) One internal reflection and two refraction
c) Two internal reflection and one refraction
d) Two internal reflection and one refraction

915. A ray of light enters from a rarer to a denser medium. The angle of incidence is i. Then the reflected and refracted rays are mutually perpendicular to each other. The critical angle for the pair of media is
a) $\sin^{-1}(\tan i)$
b) $\tan^{-1}(\sin i)$
c) $\sin^{-1}(\cot i)$
d) $\cos^{-1}(\tan i)$

916. The focal length of the objective and the eye-piece of a microscope are 4 mm and 25 mm respectively. If the final image is formed at infinity and the length of the tube is 16 cm, then the magnifying power of microscope will be
a) −337.5
b) −3.75
c) 3.375
d) 33.75

917. A glass convex lens ($\mu_g = 1.5$) has a focal length of 8 cm when placed in air. What would be the focal length of the lens what it is immersed in water ($\mu_\omega = 1.33$)
a) 2 m
b) 4 cm
c) 16 cm
d) 32 cm

918. If a flint lens glass of dispersive power 0.0666 renders achromatic to a convex lens of crown glass of focal length 60 cm and dispersive power 0.033, then its focal length is

a) -60 cm b) +60 cm c) -120 cm d) +120 cm

919. Two lamps of luminous intensity of 8 Cd and 32 Cd respectively are lying at a distance of 1.2 m from each other. Where should a screen be placed between two lamps such that its two faces are equally illuminated due to two sources

a) 10 cm from 8 Cd lamp b) 10 cm from 32 Cd lamp
c) 40 cm from 8 Cd lamp d) 40 cm from 32 Cd lamp

920. Two thin lenses have a combined power of + 9D. When they are separated by a distance of 20 cm, their equivalent power becomes $+\frac{27}{5}$ D. Their individual powers (in dioptre) are

a) 4, 5 b) 3, 6 c) 2, 7 d) 1, 8

921. When light waves suffer reflection at the interface between air and glass, the change of phase of the reflected wave is equal to

a) Zero b) $\frac{\pi}{2}$ c) π d) 2π

922. Least distance of distinct vision is 25 cm. Magnifying power of simple microscope of focal length 5 cm is

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

923. A screen receives 3 $watt$ of radiant flux of wavelength 6000 Å. One lumen is equivalent to $1.5 \times 10^{-3} watt$ of monochromatic light of wavelength 5550 Å. If relative luminosity for 6000 Å is 0.685 while that for 5550 Å is 1.00, then the luminous flux of the source is

a) $4 \times 10^3 lm$ b) $3 \times 10^3 lm$ c) $2 \times 10^3 lm$ d) $1.37 \times 10^3 lm$

924. A lamp is hanging 1 m above the centre of a circular table of diameter 1m. The ratio of illuminaces at the centre and the edge is

a) $\frac{1}{2}$ b) $\left(\frac{5}{3}\right)^{\frac{3}{2}}$ c) $\frac{4}{3}$ d) $\frac{4}{5}$

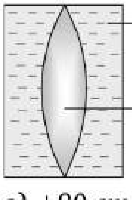
925. The diameter of moon is 3.5×10^3 km and its distance from the earth is 3.8×10^5 km. The focal length of the objective and eye-piece are 4 m and 10 cm respectively. The diameter of the image of the moon will be approximately

a) 2° b) 21° c) 40° d) 50°

926. The cross-section of a glass prism has the form of an isosceles triangle. One of the refracting faces is silvered. A ray of light falls normally on the other refracting face. After being reflected twice, it emerges through the base of the prism perpendicular it. The angles of the prism are

a) 54°, 54°, 72° b) 72°, 72°, 36° c) 45°, 45°, 90° d) 57°, 57°, 76°

927. Shown in the figure here is a convergent lens placed inside a cell filled with a liquid. The lens has focal length + 20 cm when in air and its material has refractive index 1.50. If the liquid has refractive index 1.60, the focal length of the system is



a) +80 cm b) −80 cm c) −24 cm d) −100 cm

928. The focal lengths of the lenses of an astronomical telescope are 50 cm and 5 cm. The length of the telescope when the image is formed at the least distance of distinct vision is

a) 45cm b) 55 cm c) $\frac{275}{6} cm$ d) $\frac{325}{6} cm$

929. For a telescope to have large resolving power the

a) Focal length of its objective should be large
b) Focal length of its eye piece should be large
c) Focal length of its eye piece should be small
d) Aperture of its objective should be large

930. All of the following statements are correct except

a) The magnification produced by a convex mirror is always less than one
b) A virtual, erect, same-sized image can be obtained using a plane mirror
c) A virtual, erect, magnified image can be formed using a concave mirror
d) A real, inverted, same-sized image can be formed using a convex mirror

931. A beam of light composed of red and green rays is incident obliquely at a point on the face of a rectangular glass slab. Whencoming out on the opposite parallel face, the red and green rays emerge from
a) Two points propagating in two different non-parallel directions
b) Two point propagating in two different parallel directions
c) One point propagating in two different directions
d) One point propagating in the same direction

932. The wavelength of light diminishes μ times ($\mu = 1.33$ for water) in a medium. A diver from inside water looks at an object whose natural colour is green. He sees the object as
a) Green b) Blue c) Yellow d) Red

933. A virtual image larger than the object can be obtained by
a) Concave mirror b) Convex mirror c) Plane mirror d) Concave lens

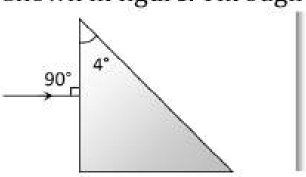
934. As the wavelength is increased from violet to red, the luminosity
a) Continuously increases b) Continuously decreases
c) Increases then decreases d) Decreases then increases

935. A prism ($\mu = 1.5$) has the refracting angle of $30°$. The deviation of a monochromatic ray incident normally on its one surface will be ($\sin 48°\ 36' = 0.75$)
a) $18°36'$ b) $20°\ 30'$ c) $18°$ d) $22°1'$

936. A man having height 6 m, observes image of 2 m height erect, then mirror used is
a) Concave b) Convex c) Plane d) None of the above

937. A spherical mirror forms diminished virtual image of magnification 1/3. Focal length is 18 cm. The distance of the object is
a) 18 cm b) 36 cm c) 48 cm d) Infinite

938. A prism having an apex angle 4° and refraction index 1.5 is located in front of a vertical plane mirror as shown in figure. Through what total angle is the ray deviated after reflection from the mirror



a) 176° b) 4° c) 178° d) 2°

939. A thin convex lens of crown glass having refractive index 1.5 has power 1 D. What will be the power of similar convex lens refractive index 1.6?
a) 0.6 D b) 0.8 D c) 1.2 D d) 1.6 D

940. A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometer 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

941. The two lenses of an achromatic doublet should have
a) Equal powers
b) Equal dispersive powers
c) Equal ratio of their power and dispersive power
d) Sum of the product of their powers and dispersive power equal to zero

942. A large glass slab $\left(\mu = \frac{5}{3}\right)$ of thickness 8 cm is placed over a point source of light on a plane surface. It is seen that light emerges out of the top surface of the slab from a circular area of radius R cm. What is the value of R?
a) 6 cm b) 7 cm c) 8 cm d) 9 cm

943. The light reflected by a plane mirror may form a real image
a) If the rays incident on the mirror are diverging
b) If the rays incident on the mirror are converging
c) If the object is placed very close to the mirror
d) Under no circumstances

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

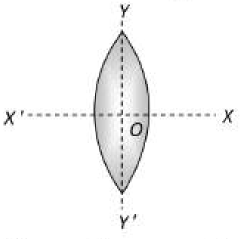
945. Monochromatic light of wavelength λ_1 travelling in medium of refractive index n_1 enters a denser medium of refractive index n_2. The wavelength in the second medium is
a) $\lambda_1\left(\frac{n_1}{n_2}\right)$ b) $\lambda_1\left(\frac{n_2}{n_1}\right)$ c) λ_1 d) $\lambda_1\left(\frac{n_2-n_1}{n_1}\right)$

946. The wavelength of emission line spectrum and absorption line spectrum of a substance are related as
a) Absorption has larger value b) Absorption has smaller value
c) They are equal d) No relation

947. What is the angle of incidence for an equilateral prism of refractive index $\sqrt{3}$ so that the ray is parallel to the base inside the prism?
a) 30° b) 45° c) 60° d) Either 30° or 60°

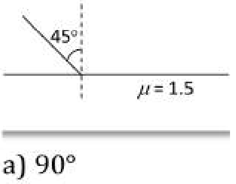
948. Two thin lenses whose powers are $+2D$ and $-4D$ respectively combine, then the power of combination is
a) $-2D$ b) $+2D$ c) $-4D$ d) $+4D$

949. 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.



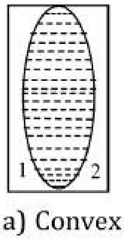
Choose the correct statement from the following
a) $f' = 2f, f'' = f$ b) $f' = f, f'' = f$ c) $f' = 2f, f'' = 2f$ d) $f' = f, f'' = 2f$

950. One side of a glass slab is silvered as shown. A ray of light is incident on the other side at angle of incidence $i = 45°$. Refractive index of glass is given as 1.5. the deviation of the ray of light from its initial path when it comes out of the slab is



a) 90° b) 180° c) 120° d) 45°

951. Two plano-concave lenses (1 and 2) of glass of refractive index 1.5 have radii of curvature 25 cm and 20 cm. They are placed in contact with their curved surfaces towards each other and the space between them is filled with liquid of refractive index $\frac{4}{3}$. Then the combination is



a) Convex of focal length 70 cm b) Concave of focal length 70 cm
c) Concave of focal length 66.6 cm d) Convex of focal length 66.6 cm

952. Why is refractive index in a transparent medium greater than one?

a) Because the speed of light in vacuum is medium
b) Because the speed of light in vacuum is always greater than speed in a transparent medium
c) Frequency of wave changes when it crosses medium
d) None of the above

953. An equiconvex lens of glass of focal length 0.1 metre is cut along a plane perpendicular to principal axis into two equal parts. The ratio of focal length of new lenses formed is
a) 1 : 1 b) 1 : 2 c) 2 : 1 d) $2 : \frac{1}{2}$

954. A point object is placed on the axis of the concave mirror at a distance of 60 cm from the focal point of the mirror. Its image is formed at the point of object, then focal length of the mirror is
a) 15 cm b) 30 cm c) 60 cm d) 120 cm

955. A ray of light is incident on a plane mirror at an angle 57°. The resultant polarized light vibrates in a plane which makes an angle with the reflecting surface
a) 0° b) 90° c) 57° d) 33°

956. Critical angle is that angle of incidence in the denser medium for which the angle of reflection in rarer medium is
a) 0° b) 57° c) 90° d) 180°

957. The focal length of a plano convex lens is f and its refractive index is 1.5. It is kept over a plane glass plate with its curved surface touching the glass plate is filled by a liquid. As a result, the effective focal length of the combination becomes $2f$. Then the refractive index of the liquid is
a) 1.5 b) 2 c) 1.25 d) 1.33

958. The critical angle for a medium is 60°. The refractive index of the medium is
a) $\frac{2}{\sqrt{3}}$ b) $\frac{\sqrt{2}}{3}$ c) $\sqrt{3}$ d) $\frac{\sqrt{3}}{2}$

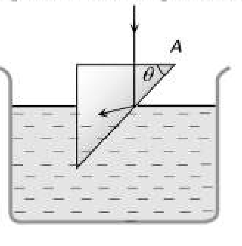
959. A man of length h requires a mirror, to see his own complete image of length at least equal to
a) $h/4$ b) $h/3$ c) $h/2$ d) h

960. An object placed 10 cm in front of a lens has an image 20 cm behind the lens. What is the power of the lens (in $dioptres$)
a) 1.5 b) 3.0 c) −15.0 d) +15.0

961. The angle of minimum deviation measured with a prism is 30° and the angle of prism is 60°. The refractive index of prism material is
a) $\sqrt{2}$ b) 2 c) 3/2 d) 4/3

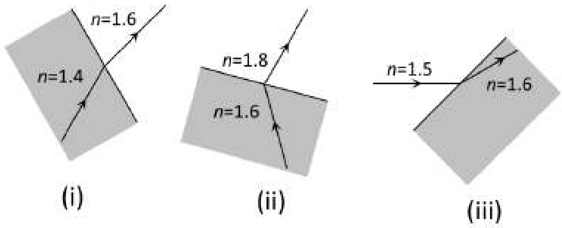
962. A convex lens made of glass has focal length 0.15 m in air. If the refractive index of glass is $\frac{3}{2}$ and that of water is $\frac{4}{3}$, the focal length of lens when immersed in water is
a) 0.45 m b) 0.15 m c) 0.30 m d) 0.6 m

963. The refractive index of the material of the prism and liquid are 1.56 and 1.32 respectively. What will be the value of θ for the following refraction



a) $\sin\theta \geq \frac{13}{11}$ b) $\sin\theta \geq \frac{11}{13}$ c) $\sin\theta \geq \frac{\sqrt{3}}{2}$ d) $\sin\theta \geq \frac{1}{\sqrt{2}}$

964. Which of the following ray diagram show physically possible refraction



a) (i) b) (ii) c) (iii) d) None of these

965. A point source of light is kept at a depth of h in water of refractive index 4/3. The radius of the circle at the surface of water through which light emits is
a) $\frac{3}{\sqrt{7}}h$ b) $\frac{\sqrt{7}}{3}h$ c) $\frac{\sqrt{3}}{7}h$ d) $\frac{7}{\sqrt{3}}h$

966. A biconvex lens with equal radii curvature has refractive index 1.6 and focal length 10 cm. Its radius of curvature will be
a) 20 cm b) 16 cm c) 10 cm d) 12 cm

967. A divergent lens will produce
a) Always a virtual image
b) Always real image
c) Sometimes real and sometimes virtual
d) None of the above

968. Two lenses of power +12 and −2 dioptres are placed in contact. What will the focal length of combination
a) 10 cm b) 12.5 cm c) 16.6 cm d) 8.33 cm

969. An achromatic prism is made by crown glass prism ($A_c = 19°$) and flint glass prism ($A_F = 6°$). If ${}^C\mu_v =$ 1.5 and ${}^F\mu_v = 1.66$, then resultant deviation for red coloured ray will be
a) 1.04° b) 5° c) 0.96° d) 13.5°

970. A ray of light strikes a transparent rectangular slab (of refractive index $\sqrt{2}$) at an angle of incidence of 45°. The angle between the reflected and refracted rays is
a) 75° b) 90° c) 105° d) 120°

971. A person is suffering from the defect astigmatism. Its main reason is
a) Distance of the eye lens from retina is increased
b) Distance of the eye lens from retina is decreased
c) The cornea is not spherical
d) Power of accommodation of the eye is decreased

972. A boy stands straight infront of a mirror at a distance of 30cm away from it. He sees his erect image whose height is $1/5^{th}$ of his real height. The mirror he is using is
a) Plane mirror b) Convex mirror c) Concave mirror d) Plano-convex mirror

973. 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) $n > \sqrt{2}$ b) $n = 1$ c) $n = 1.1$ d) $n = 1.3$

974. The no. of wavelengths in the visible spectrum
a) 4000 b) 6000 c) 2000 d) Infinite

975. A ray of light on the surface of a glass plate of thickness t. If the angle of incidence θis small,the emerging ray would be displaced sideways by an amount
(Take n =refractive index of glass)
a) $t\,\theta\, n/(n+1)$ b) $t\,\theta\,(n-1)/n$ c) $t\,\theta\, n/(n-1)$ d) $t\,\theta\,(n+1)/n$

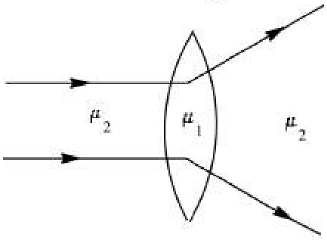
976. If the angle of prism is 60° and the angle of minimum deviation is 40°, the angle of refraction will be
a) 30° b) 60° c) 100° d) 120°

977. When light of wavelength λ is incident on an equilateral prism kept in its minimum deviation position, it is found that the angle of deviation equals the angle of the prism itself. The refractive index of the material of the prism for the wavelength λ is, then
a) $\sqrt{3}$ b) $\frac{\sqrt{3}}{2}$ c) 2 d) $\sqrt{2}$

978. 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) $-30\ cm$ b) $5\ cm$ c) $-10\ cm$ d) $20\ cm$

979. A convex lens made up of a material of refractive index μ_1 is immersed in a medium of refractive index μ_2 as shown in the figure. The relation between μ_1 and μ_2 is



a) $\mu_1 < \mu_2$ b) $\mu_1 > \mu_2$ c) $\mu_1 = \mu_2$ d) $\mu_1 = \sqrt{\mu_2}$

980. A small plane mirror placed at the centre of a spherical screen of radius R. A beam of light is falling on the mirror. If the mirror makes n revolution per second, the speed of light on the screen after reflection from the mirror will be

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

981. Two lenses are placed in contact with each other and the focal length of combination is 80 *cm*. If the focal length of one is 20 *cm*, then the power of the other will be

a) $1.66\ D$ b) $4.00\ D$ c) $-1.00\ D$ d) $-3.75\ D$

982. Light from sodium lamp is passed through cold sodium vapours, the spectrum of transmitted light consists of

a) A line at 5890 Å b) A line at 5896 Å c) Sodium doublet lines d) No spectral features

983. At what distance from a convex lens of focal length 30 cm, an object should be placed, so that the size of the image be $\frac{1}{2}$th of the object?

a) 30 cm b) 60 cm c) 15 cm d) 90 cm

984. If tube length of astronomical telescope is 105 *cm* and magnifying power is 20 for normal setting, calculate the focal length of objective

a) 100 *cm* b) 10 *cm* c) 20 *cm* d) 25 *cm*

985. A plane mirror is approaching you at 10 cms^{-1}. Your image shall approach you will a speed of

a) $+10\ cms^{-1}$ b) $-10\ cms^{-1}$ c) $+20\ cms^{-1}$ d) $-20\ cms^{-1}$

986. The reason of seeing the Sun a little before the sunrise is

a) Reflection of the light b) Refraction of the light
c) Scattering of the light d) Dispersion of the light

987. The focal length (f) of a spherical (concave or convex) mirror of radius of curvature R is

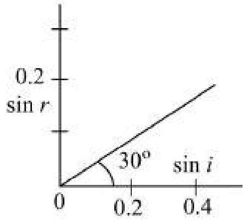
a) $\frac{R}{2}$ b) R c) $\left(\frac{3}{2}\right)R$ d) $2R$

988. A double convex thin lens made of glass (refractive index $\mu = 1.5$) has both radii of curvature of magnitude 20 cm. Incident light rays parallel to the axis of the lens, will converge at a distance L such that

a) $L = \frac{20}{3}$ cm b) $L = 40$ cm c) $L = 20$ cm d) $L = 10$ cm

989. Light is incident from a medium X at an angle of incidence i and is refracted into a medium Y at angle of refraction r. The graph sin i *versus* sin r is shown in figure. Which of the following conclusions would fit the situation?

1. Speed of light in medium Y is $\sqrt{3}$ times that in medium X
2. Speed of light in medium Y is $1/\sqrt{3}$ times that in medium X
3. Total internal reflection will occur above a certain i value

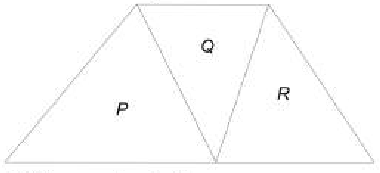


a) 2 and 3 b) 1 and 3 c) 2 only d) 3 only

990. A ray of light propagates from glass (refractive index= $\frac{3}{2}$) to water (refractive index = $\frac{4}{3}$).The value of the critical angle is

a) $\sin^{-1}\left(\frac{1}{2}\right)$ b) $\sin^{-1}\left(\sqrt{\frac{9}{8}}\right)$ c) $\sin^{-1}\left(\frac{8}{9}\right)$ d) $\sin^{-1}\left(\frac{5}{7}\right)$

991. A given ray of light suffers minimum deviation in an equilateral prism P.Additional prisms Q and of identical shape and material are now added to P,as shown in the figure. The ray will suffer



a) Same deviation
b) Greater deviation
c) Total internal reflection
d) No deviation

992. Refractive index of a medium is μ. The incidence angle is twice that of refracting angle. The angle of incidence is

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

993. A plane mirror makes an angle of 30° with horizontal. If a vertical ray strikes the mirror, find the angle between mirror and reflected ray

a) 30° b) 45° c) 60° d) 90°

994. A microscope is focused on an ink mark on the top of a table. If we place a glass slab of 3 cm thick on it, how should the microscope be moved to focus the ink spot again? The refractive index of glass is 1.5.

a) 2 cm upwards b) 2 cm downwards c) 1 cm upwards d) 1 cm downwards

995. A ray of light makes an angle of 10° with the horizontal above it and strikes a plane mirror which is inclined at an angle θ to the horizontal. The angle θ for which the reflected ray becomes vertical is

a) 40° b) 50° c) 80° d) 100°

996. Image is formed for the short sighted person at

a) Retina
b) Before retina
c) Behind the retina
d) Image is not formed at all

997. P is a point on the axis of a convex mirror. The image of P formed by the mirror, coincides with P. A rectangular glass slab of thickness t and refractive index μ is now introduced between P and the mirror. For the image of P to coincide with P again, the mirror must be moves

a) Towards P by $(\mu-1)t$
b) Away from P by $(\mu-1)t$
c) Towards P by $t\left(1-\frac{1}{\mu}\right)$
d) Away from P by $t\left(1-\frac{1}{\mu}\right)$

998. If angle of incidence is twice the angle of refraction in a medium of refractive index μ, then angle of incidence is

a) $2\cos^{-1}\left[\frac{\mu}{2}\right]$ b) $2\sin^{-1}\left[\frac{\mu}{2}\right]$ c) $2\cos^{-1}[\mu]$ d) $2\sin^{-1}[\mu]$

999. A wire mesh consisting of very small squares is viewed at a distance of 8 cm through a magnifying converging lens of focal length 10cm, kept close to the eye. The magnification produced by the lens is

a) 5 b) 8 c) 10 d) 20

1000. A concave lens of focal length 20 cm placed in contact with a plane mirror acts as a convex mirror of focal length

a) 10 cm b) 40 cm c) 60 cm d) 20 cm

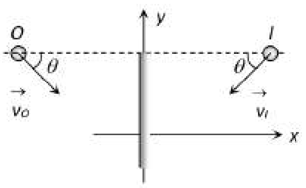
1001. Which of the following colours suffers maximum deviation in a prism

a) Yellow b) Blue c) Green d) Orange

1002. The band spectra (characteristic of molecular species) is due to emission of radiation

a) Gaseous state b) Liquid state c) Solid state d) All of three states

1003. If an object moves towards a plane mirror with a speed v at an angle θ to the perpendicular to the plane of the mirror, find the relative velocity between the object and the image



a) v b) $2v$ c) $2v\cos\theta$ d) $2v\sin\theta$

1004. The dispersive power is maximum for the material

a) Flint glass b) Crown glass c) Mixture of both d) None of the above

1005. A convex lens is immersed in a liquid, whose refractive index is equal to the refractive index of the material of the lens. Then its focal length will

a) Decrease b) Become zero c) Become infinite d) Increase

1006. The impact of an image on the retina remains for

a) 0.1 s b) 0.5 s c) 10 s d) 15 s

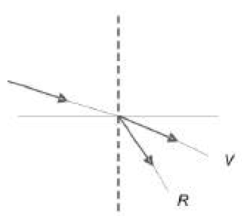
1007. Two lenses have focal lengths f_1 and f_2 and their dispersive powers are ω_1 and ω_2 respectively. They will together from an achromatic combination if

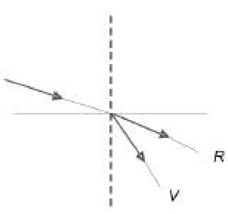
a) $\omega_1 f_1 = \omega_2 f_2$ b) $\omega_1 f_2 + \omega_2 f_1 = 0$ c) $\omega_1 + f_1 = \omega_2 + f_2$ d) $\omega_1 - f_1 = \omega_2 - f_2$

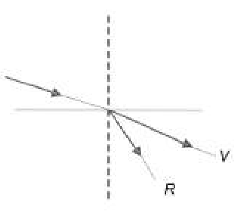
1008. A ray of light is incidenting normally on a plane mirror. The angle of reflection will be

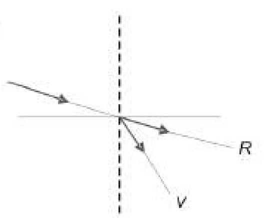
a) 0° b) 90° c) Will not be reflected d) None of the above

1009. A ray of light coming. Which of the following figures, shows dispersion of light?

a)


b)


c)


d)


1010. Immiscible transparent liquids A, B, C, D and E are placed in a rectangular container of glass with the liquids making layers according to their densities. The refractive index of the liquids are shown in the adjoining diagram. The container is illuminated from the side and small piece of glass having refractive index 1.61 is gently dropped into the liquid layer. The glass piece as it descends downwards will not be visible in

A	1.51
B	1.53
C	1.61
D	1.52
E	1.65

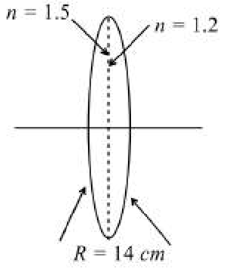
a) Liquid A and B only
b) Liquid C only
c) Liquid D and E only
d) Liquid A, B, D and E

1011. Three prisms 1, 2 and 3 have the prism angle $A = 60°$, but their refractive indices are respectively 1.4, 1.5 and 1.6. If $\delta_1, \delta_2, \delta_3$ be their respective angles of deviation then
a) $\delta_3 > \delta_2 > \delta_1$ b) $\delta_1 > \delta_2 > \delta_3$ c) $\delta_1 = \delta_2 = \delta_3$ d) $\delta_2 > \delta_1 > \delta_3$

1012. A ray of light travelling in water is incident on its surface open to air. The angle of incidence isθ, which is less than the critical angle. Then there will be
a) Only a reflected ray and no reflected ray
b) Only a reflected ray and no reflected ray
c) A reflected ray and a refracted ray and the angle between then would be less than $108° - 2\theta$
d) A reflected ray and a refracted ray and the angle between then would be greater than $108° - 2\theta$

1013. A ray of light is incident on the hypotenuse of a right-angled prism after travelling parallel to the base inside the prism. If μ is the refractive index of the material of the prism, the maximum value of the base angle for which light is totally reflected from the hypotenuse is
a) $\sin^{-1}\left(\frac{1}{\mu}\right)$ b) $\tan^{-1}\left(\frac{1}{\mu}\right)$ c) $\sin^{-1}\left(\frac{\mu-1}{\mu}\right)$ d) $\cos^{-1}\left(\frac{1}{\mu}\right)$

1014. A bi-convex lens is formed with two thin plano-convex lenses as shown in the figure. Refractive index n of the first lens is 1.5 and that of the second lens is 1.2. Both the curved surfaces are of the same radius of curvature $R = 14\ cm$. For this bi-convex lens, for an object distance of $40cm$, the image distance will be



a) $-280.0cm$ b) $40.0\ cm$ c) $21.5\ cm$ d) $13.3\ cm$

1015. The hyper-metropia is a
a) Short-side defect b) Long-side defect
c) Bad vision due to old age d) None of these

1016. The wavelength of sodium light in air is 5890Å. The velocity of light in air is 3×10^{-8} ms^{-1}. The wavelength of light in a glass of refractive index 1.6 would be close to
a) 5890Å b) 3681Å c) 9424Å d) 15078Å

1017. A thin plano-convex lens acts like a concave mirror of focal length 0.2 m when silvered from its plane surface. The refractive index of the material of the lens is 1.5. The radius of curvature of the convex surface the lens will be
a) 0.1 m b) 0.75 m c) 0.4 m d) 0.2 m

1018. A ray of light passes through an equilateral prism such that an angle of incidence is equal to the angle of emergence and the latter is equal to $\frac{3}{4}$th the angle of prism. The angle of deviation is
a) 45° b) 39° c) 20° d) 30°

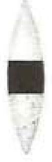
1019. The magnification of the image when an object is placed at a distance x from the principle focus of a mirror of focal length f is

a) $\frac{x}{f}$ b) $1+\frac{f}{x}$ c) $\frac{f}{x}$ d) $1-\frac{f}{x}$

1020. A convex lens of focal length 30 cm and a concave lens of 10 cm focal length are placed so as to have the same axis. If a parallel beam of light falling on convex lens leaves concave lens as a parallel beam, then the distance between two lenses will be

a) 40 cm b) 30 cm c) 20 cm d) 10 cm

1021. How will the image formed by a convex lens be affected, if the central portion of the lens is wrapped in blank paper, as shown in the figure



a) No image will be formed
b) Full image will be formed but is less bright
c) Full image will be formed but without the central portion
d) Two images will be formed, one due to each exposed half

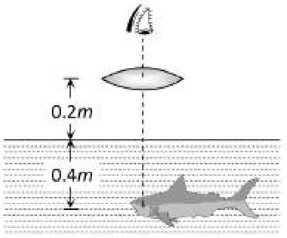
1022. A convex lens forms a real image of a point object placed on its principal axis. If the upper half of the lens is painted black, the image will

a) Be shifted downwards b) Be shifted upwards
c) Not be shifted d) Shift on the principal axis

1023. A telescope has an objective lens of focal length 200 cm and an eye piece with focal length 2 cm. If this telescope is used to see a 50 $meter$ tall building at a distance of 2 km, what is the height of the image of the building formed by the objective lens

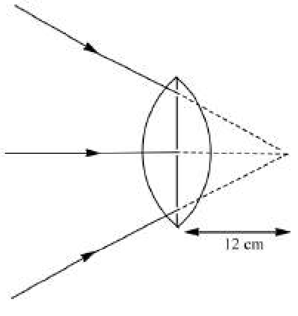
a) 5 cm b) 10 cm c) 1 cm d) 2 cm

1024. A small fish 0.4 m below the surface of a lake, is viewed through a simple converging lens of focal length 3 m. The lens is kept at 0.2 m above the water surface such that fish lies on the optical axis of the lens. The image of the fish seen by observer will be at $\left(\mu_{water}=\frac{4}{3}\right)$



a) A distance of 0.2 m from the water surface
b) A distance of 0.6 m from the water surface
c) A distance of 0.3 m from the water surface
d) The same location of fish

1025. If the focal length of the lens is 20 cm, what is the distance of the image from the lens in the following figure?



a) 5.5 cm b) 7.5 cm c) 12.0 cm d) 20.0 cm

1026. Angle of minimum deviation for a prism of refractive index 1.5 is equal to the angle of the prism. The angle of the prism is (given $\cos 41° - 24' - 36'' = 0.75$)

a) $82° - 49' - 12''$ b) $72° - 48' - 30''$ c) $41° - 24' - 36''$ d) $31° - 49' - 30''$

1027. Dispersion can take place for

a) Transverse waves only but not for longitudinal waves
b) Longitudinal waves only but not for transverse waves
c) Both transverse and longitudinal waves
d) Neither transverse nor longitudinal

1028. Lens used to remove long sightedness (hypermetropia) is **or**
A person suffering from hypermetropia requires which type of spectacle lenses

a) Concave lens b) Plano-concave lens
c) Convexo-concave lens d) Convex lens

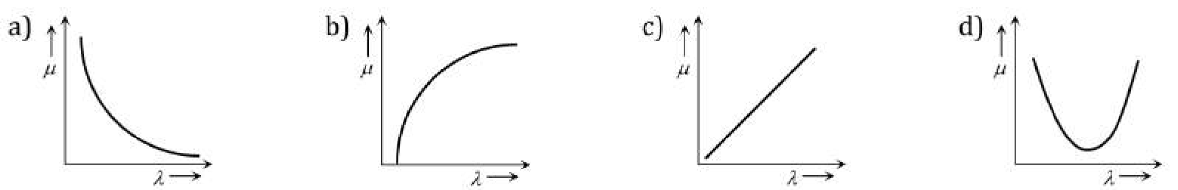
1029. Which of the following statement is true

a) Velocity of light is constant in all media
b) Velocity of light in vacuum is maximum
c) Velocity of light is same in all reference frames
d) Laws of nature have identical form in all reference frames

1030. A concave mirror is used to focus the image of a flower on a nearby well 120 *cm* from the flower. If a lateral magnification of 16 is desired, the distance of the flower from the mirror should be

a) 8 *cm* b) 12 *cm* c) 80 *cm* d) 120 *cm*

1031. Which of the following graphs show appropriate variation of refractive index μ with wavelength λ



1032. The image formed by an objective of a compound microscope is

a) Virtual and diminished b) Real and diminished
c) Real and enlarged d) Virtual and enlarged

1033. For a convex lens the distance of the object is taken on X, axis and the distance of the image is taken on Y-axis, the nature of the graph so obtained is

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

1034. A bulb of 100 *watt* is hanging at a height of one meter above the centre of a circular table of diameter 4 *m*. If the intensity at a point on its rim is I_0, then the intensity at the centre of the table will be

a) I_0 b) $2\sqrt{5}I_0$ c) $2I_0$ d) $5\sqrt{5}I_0$

1035. A book can be read if it is placed at a distance of 50 cm from a source of 1 cd. At what distance should the book placed if the source is of 16 cd?

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

1036. A concave mirror gives an image three times as large as the object placed at a distance of 20 *cm* from it. For the image to be real, the focal length should be

a) 10 *cm* b) 15 *cm* c) 20 *cm* d) 30 *cm*

1037. The focal length of a concave mirror is 20 cm. Where an object must be placed to form an image magnified two times when the image is real?

a) 30 cm from the mirror b) 10 cm from the mirror
c) 20 cm from the mirror d) 15 cm from the mirror

1038. Myopia is due to

a) Elongation of eye ball
b) Irregular change in focal length
c) Shortening of eye ball
d) Older age

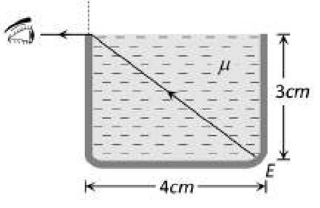
1039. A convex lens of focal length $\frac{1}{3}$ m forms a real, inverted image twice in size of the object. The distance of the object form the lens is

a) 0.5 m
b) 0.166 m
c) 0.33 m
d) 1 m

1040. A white screen illuminated by green and red light appears to be

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

1041. When the rectangular metal tank is filled to the top with an unknown liquid, as observer with eyes level with the top of the tank can just see the corner E; a ray that refracts towards the observer at the top surface of the liquid is shown. The refractive index of the liquid will be



a) 1.2
b) 1.4
c) 1.6
d) 1.9

1042. A glass hemisphere of radius 0.04 m and $R.I.$ of the material 1.6 is placed centrally over a cross mark on a paper (i) with the flat face; (ii) with the curved face in contact with the paper. In each case the cross mark is viewed directly from above. The position of the images will be

a) (i) 0.04 m from the flat face; (ii) 0.025 m from the flat face
b) (i) At the same position of the cross mark; (ii) 0.025 m below the flat face
c) (i) 0.025 m from the flat face; (ii) 0.04 m from the flat face
d) For both (i) and (ii) 0.025 m from the highest point of the hemisphere

1043. The power of a thin convex lens (${}_an_g = 1.5$) is $+$ 0.5 D. When it is placed in a liquid of refractive index ${}_an_l,$ then it behaves as a concave lens of focal length 100 cm. The refractive index of the liquid ${}_an_l$ will be

a) 5/3
b) 4/3
c) $\sqrt{3}$
d) 5/4

1044. Velocity of light in glass whose refractive index with respect to air is 1.5 is 2×10^8 m/s and in certain liquid the velocity of light found to be 2.5×10^8 m/s. The refractive index of the liquid with respect to air is

a) 0.64
b) 0.80
c) 1.20
d) 1.44

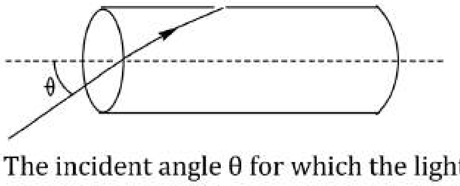
1045. "Lux" is a unit of

a) Luminous intensity of a source
b) Illuminance on a surface
c) Transmission coefficient of a surface
d) Luminous efficiency of source of light

1046. An movie projector forms an image 3.5m long of an object 35mm. Supposing there is negligible absorption of light by aperture then illuminance on slide and screen will be in the ratio of

a) 100 : 1
b) 10^4 : 1
c) 1 : 100
d) 1 : 10^4

1047. A transparent solid cylindrical rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air. A light ray is incident at the mid-point of one end of the rod as shown in the figure.



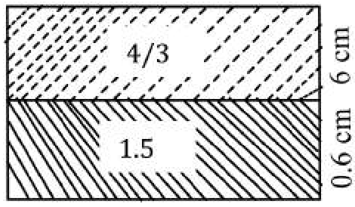
The incident angle θ for which the light ray grazes along the wall of the rod is

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

1048. To remove myopia (short sightedness) a lens of power 0.66 D is required. The distance point of the eye is approximately

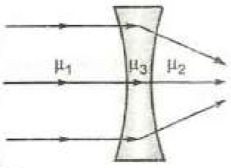
a) 100 cm b) 150 cm c) 50 cm d) 25 cm

1049. Two immiscible liquids of refractive indices 1.5 and $\frac{4}{3}$ are filled in glass jar each of length 6 cm. A light of source S is at the bottom of the jar, the apparent depth of light source will be



a) 12.5 cm b) 17 cm c) 12 cm d) 8.5 cm

1050. What is the relation between refractive indices μ_1, μ_2, and μ_3 if the behavior of light rays is as shown in figure



a) $\mu_3 < \mu_2, \mu_2 = \mu_1$ b) $\mu_2 < \mu_1, \mu_2 = \mu_3$ c) $\mu_3 < \mu_2 < \mu_1$ d) $\mu_3 > \mu_2 > \mu_1$

1051. For normal vision, what is distance of object from eye?

a) 30 cm b) 25 cm c) Infinite d) 40 cm

RAY OPTICS AND OPTICAL INSTRUMENTS

: ANSWER KEY :

1)	c	2)	d	3)	d	4)	b	165)	a	166)	a	167)	c	168)	b
5)	a	6)	c	7)	a	8)	d	169)	a	170)	d	171)	a	172)	d
9)	a	10)	d	11)	d	12)	a	173)	d	174)	c	175)	a	176)	a
13)	b	14)	c	15)	b	16)	c	177)	d	178)	b	179)	b	180)	b
17)	c	18)	c	19)	c	20)	b	181)	b	182)	d	183)	b	184)	a
21)	a	22)	d	23)	a	24)	d	185)	a	186)	b	187)	b	188)	c
25)	a	26)	c	27)	a	28)	b	189)	a	190)	c	191)	c	192)	a
29)	c	30)	b	31)	c	32)	d	193)	a	194)	a	195)	b	196)	b
33)	d	34)	c	35)	b	36)	d	197)	a	198)	d	199)	b	200)	c
37)	a	38)	d	39)	d	40)	a	201)	a	202)	c	203)	a	204)	a
41)	c	42)	d	43)	c	44)	c	205)	c	206)	d	207)	d	208)	d
45)	a	46)	c	47)	b	48)	d	209)	c	210)	d	211)	a	212)	b
49)	a	50)	c	51)	c	52)	c	213)	c	214)	a	215)	c	216)	a
53)	c	54)	b	55)	b	56)	c	217)	a	218)	d	219)	b	220)	b
57)	d	58)	a	59)	b	60)	b	221)	a	222)	d	223)	b	224)	c
61)	c	62)	c	63)	d	64)	d	225)	a	226)	a	227)	c	228)	d
65)	a	66)	b	67)	c	68)	d	229)	a	230)	c	231)	b	232)	d
69)	b	70)	a	71)	a	72)	b	233)	c	234)	a	235)	c	236)	a
73)	d	74)	c	75)	a	76)	a	237)	c	238)	a	239)	d	240)	b
77)	b	78)	c	79)	d	80)	d	241)	a	242)	c	243)	c	244)	c
81)	d	82)	a	83)	a	84)	a	245)	c	246)	d	247)	c	248)	a
85)	a	86)	b	87)	c	88)	b	249)	a	250)	a	251)	d	252)	a
89)	c	90)	a	91)	c	92)	c	253)	b	254)	d	255)	d	256)	a
93)	c	94)	d	95)	b	96)	b	257)	d	258)	b	259)	c	260)	a
97)	d	98)	a	99)	d	100)	c	261)	c	262)	b	263)	a	264)	a
101)	b	102)	d	103)	c	104)	a	265)	c	266)	a	267)	c	268)	c
105)	a	106)	c	107)	b	108)	c	269)	b	270)	c	271)	c	272)	b
109)	a	110)	a	111)	a	112)	c	273)	d	274)	c	275)	b	276)	c
113)	b	114)	b	115)	b	116)	c	277)	a	278)	c	279)	b	280)	a
117)	c	118)	a	119)	c	120)	c	281)	b	282)	b	283)	c	284)	d
121)	b	122)	a	123)	a	124)	d	285)	a	286)	b	287)	d	288)	a
125)	b	126)	b	127)	b	128)	b	289)	a	290)	b	291)	b	292)	a
129)	b	130)	b	131)	b	132)	a	293)	b	294)	c	295)	b	296)	d
133)	a	134)	a	135)	d	136)	c	297)	b	298)	d	299)	b	300)	a
137)	c	138)	b	139)	a	140)	b	301)	d	302)	d	303)	c	304)	c
141)	d	142)	c	143)	a	144)	a	305)	a	306)	d	307)	c	308)	d
145)	d	146)	a	147)	c	148)	c	309)	c	310)	d	311)	a	312)	c
149)	d	150)	d	151)	c	152)	c	313)	b	314)	a	315)	c	316)	b
153)	d	154)	d	155)	b	156)	b	317)	c	318)	c	319)	a	320)	d
157)	a	158)	d	159)	a	160)	c	321)	c	322)	c	323)	c	324)	d
161)	a	162)	a	163)	b	164)	c	325)	a	326)	c	327)	a	328)	d

329)	d	330)	b	331)	a	332)	a	529)	a	530)	b	531)	d	532)	d
333)	a	334)	c	335)	d	336)	d	533)	d	534)	a	535)	c	536)	b
337)	b	338)	d	339)	b	340)	c	537)	b	538)	b	539)	a	540)	a
341)	d	342)	b	343)	d	344)	b	541)	b	542)	c	543)	d	544)	a
345)	a	346)	c	347)	b	348)	d	545)	c	546)	c	547)	a	548)	d
349)	a	350)	c	351)	a	352)	c	549)	a	550)	d	551)	a	552)	b
353)	a	354)	b	355)	d	356)	c	553)	b	554)	d	555)	c	556)	c
357)	d	358)	b	359)	b	360)	b	557)	a	558)	d	559)	a	560)	b
361)	b	362)	d	363)	d	364)	b	561)	b	562)	b	563)	d	564)	c
365)	b	366)	d	367)	b	368)	a	565)	c	566)	c	567)	c	568)	b
369)	c	370)	d	371)	a	372)	d	569)	c	570)	c	571)	a	572)	d
373)	c	374)	d	375)	a	376)	d	573)	d	574)	a	575)	c	576)	a
377)	c	378)	b	379)	a	380)	a	577)	b	578)	c	579)	d	580)	d
381)	b	382)	d	383)	c	384)	b	581)	a	582)	d	583)	b	584)	a
385)	b	386)	b	387)	d	388)	c	585)	d	586)	d	587)	c	588)	b
389)	a	390)	a	391)	a	392)	c	589)	d	590)	b	591)	a	592)	b
393)	b	394)	b	395)	c	396)	a	593)	a	594)	b	595)	c	596)	a
397)	b	398)	a	399)	a	400)	d	597)	b	598)	d	599)	b	600)	b
401)	a	402)	b	403)	b	404)	b	601)	b	602)	b	603)	c	604)	d
405)	c	406)	c	407)	a	408)	d	605)	b	606)	a	607)	b	608)	b
409)	b	410)	c	411)	a	412)	a	609)	d	610)	b	611)	c	612)	c
413)	b	414)	c	415)	a	416)	d	613)	b	614)	b	615)	d	616)	b
417)	a	418)	b	419)	c	420)	d	617)	d	618)	d	619)	b	620)	c
421)	a	422)	a	423)	d	424)	b	621)	c	622)	c	623)	a	624)	d
425)	d	426)	b	427)	d	428)	a	625)	a	626)	a	627)	a	628)	b
429)	a	430)	a	431)	d	432)	b	629)	c	630)	a	631)	b	632)	c
433)	c	434)	a	435)	c	436)	a	633)	d	634)	a	635)	c	636)	a
437)	a	438)	b	439)	a	440)	c	637)	b	638)	a	639)	b	640)	d
441)	c	442)	a	443)	b	444)	b	641)	d	642)	a	643)	c	644)	b
445)	c	446)	c	447)	d	448)	c	645)	b	646)	a	647)	a	648)	d
449)	b	450)	b	451)	a	452)	c	649)	b	650)	a	651)	a	652)	d
453)	b	454)	a	455)	b	456)	c	653)	c	654)	d	655)	c	656)	b
457)	c	458)	c	459)	a	460)	d	657)	b	658)	b	659)	b	660)	c
461)	d	462)	b	463)	a	464)	d	661)	a	662)	b	663)	a	664)	d
465)	b	466)	b	467)	a	468)	b	665)	a	666)	a	667)	b	668)	a
469)	a	470)	d	471)	b	472)	a	669)	a	670)	b	671)	c	672)	a
473)	d	474)	b	475)	a	476)	a	673)	b	674)	c	675)	c	676)	a
477)	c	478)	a	479)	b	480)	b	677)	c	678)	c	679)	b	680)	a
481)	c	482)	b	483)	b	484)	b	681)	d	682)	b	683)	c	684)	d
485)	a	486)	d	487)	d	488)	a	685)	a	686)	b	687)	d	688)	a
489)	b	490)	a	491)	d	492)	a	689)	a	690)	b	691)	c	692)	a
493)	d	494)	a	495)	d	496)	b	693)	b	694)	c	695)	a	696)	a
497)	a	498)	a	499)	b	500)	a	697)	a	698)	b	699)	a	700)	c
501)	a	502)	a	503)	b	504)	b	701)	d	702)	c	703)	d	704)	c
505)	a	506)	c	507)	c	508)	d	705)	b	706)	c	707)	b	708)	d
509)	d	510)	c	511)	c	512)	d	709)	a	710)	c	711)	c	712)	c
513)	a	514)	b	515)	a	516)	c	713)	a	714)	b	715)	d	716)	c
517)	c	518)	b	519)	b	520)	d	717)	b	718)	a	719)	a	720)	b
521)	c	522)	d	523)	a	524)	a	721)	a	722)	c	723)	c	724)	b
525)	b	526)	a	527)	b	528)	c	725)	a	726)	c	727)	d	728)	d

729)	d	730)	b	731)	d	732)	a
733)	a	734)	c	735)	c	736)	b
737)	c	738)	c	739)	a	740)	c
741)	a	742)	b	743)	b	744)	b
745)	b	746)	d	747)	c	748)	a
749)	c	750)	c	751)	a	752)	c
753)	b	754)	d	755)	b	756)	a
757)	d	758)	d	759)	c	760)	a
761)	c	762)	d	763)	a	764)	d
765)	b	766)	a	767)	b	768)	a
769)	a	770)	b	771)	d	772)	c
773)	b	774)	d	775)	b	776)	c
777)	b	778)	b	779)	a	780)	b
781)	b	782)	d	783)	c	784)	b
785)	b	786)	d	787)	b	788)	c
789)	c	790)	b	791)	a	792)	d
793)	b	794)	b	795)	a	796)	c
797)	a	798)	a	799)	b	800)	c
801)	b	802)	a	803)	c	804)	b
805)	b	806)	b	807)	a	808)	d
809)	b	810)	d	811)	c	812)	b
813)	a	814)	b	815)	b	816)	c
817)	a	818)	c	819)	a	820)	b
821)	b	822)	a	823)	a	824)	b
825)	b	826)	a	827)	b	828)	d
829)	a	830)	a	831)	c	832)	b
833)	d	834)	a	835)	a	836)	b
837)	c	838)	d	839)	a	840)	b
841)	b	842)	c	843)	a	844)	d
845)	a	846)	b	847)	a	848)	a
849)	c	850)	d	851)	b	852)	b
853)	a	854)	a	855)	c	856)	d
857)	b	858)	a	859)	b	860)	c
861)	a	862)	a	863)	a	864)	b
865)	b	866)	c	867)	c	868)	c
869)	b	870)	a	871)	d	872)	d
873)	c	874)	d	875)	c	876)	a
877)	c	878)	b	879)	a	880)	b
881)	d	882)	b	883)	d	884)	d
885)	c	886)	c	887)	b	888)	b
889)	a	890)	b	891)	a	892)	c

893)	d	894)	b	895)	b	896)	b
897)	d	898)	b	899)	b	900)	b
901)	c	902)	c	903)	b	904)	b
905)	c	906)	a	907)	d	908)	c
909)	b	910)	c	911)	c	912)	b
913)	b	914)	b	915)	c	916)	a
917)	d	918)	c	919)	c	920)	b
921)	c	922)	d	923)	d	924)	b
925)	b	926)	b	927)	d	928)	d
929)	d	930)	d	931)	b	932)	a
933)	a	934)	c	935)	a	936)	b
937)	b	938)	c	939)	c	940)	c
941)	d	942)	a	943)	b	944)	c
945)	a	946)	c	947)	c	948)	a
949)	d	950)	a	951)	c	952)	b
953)	a	954)	c	955)	d	956)	c
957)	c	958)	a	959)	c	960)	d
961)	a	962)	d	963)	b	964)	a
965)	a	966)	d	967)	a	968)	a
969)	d	970)	c	971)	c	972)	b
973)	a	974)	d	975)	b	976)	a
977)	a	978)	a	979)	a	980)	a
981)	d	982)	d	983)	d	984)	a
985)	c	986)	b	987)	a	988)	c
989)	c	990)	c	991)	a	992)	c
993)	c	994)	c	995)	a	996)	b
997)	c	998)	a	999)	a	1000)	a
1001)	b	1002)	a	1003)	c	1004)	a
1005)	c	1006)	a	1007)	b	1008)	a
1009)	d	1010)	b	1011)	a	1012)	c
1013)	d	1014)	b	1015)	b	1016)	b
1017)	d	1018)	d	1019)	c	1020)	c
1021)	b	1022)	c	1023)	a	1024)	d
1025)	b	1026)	a	1027)	c	1028)	d
1029)	b	1030)	a	1031)	a	1032)	c
1033)	d	1034)	d	1035)	c	1036)	b
1037)	a	1038)	a	1039)	a	1040)	c
1041)	a	1042)	b	1043)	a	1044)	c
1045)	b	1046)	b	1047)	d	1048)	b
1049)	a	1050)	a	1051)	b		

RAY OPTICS AND OPTICAL INSTRUMENTS

: HINTS AND SOLUTIONS :

1 **(c)**

Magnification will be done by compound microscope only when $f_o < f_e$

2 **(d)**

$m \simeq \frac{LD}{f_o f_e} \Rightarrow m = \frac{10 \times 25}{0.5 \times 1} = 500$

3 **(d)**

We know that $\frac{\delta_v - \delta_r}{\delta_{mean}} = \omega$

$\Rightarrow$ Angular dispersion $= \delta_v - \delta_r = \theta = \omega \delta_{mean}$

4 **(b)**

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

5 **(a)**

Condition of no emergence is

$A > C$

As angle of prism is greater than critical angle for blue and green coloured rays, total internal reflection will take place at second surface and hence the arrangement will separate red colour from blue and green.

6 **(c)**

$f_o = 50\ cm, f_e = 5\ cm, D = 25\ cm$ and $u_o = 200\ cm.$

Separation between the objective and the eye lens is

$$L = \frac{u_o f_o}{(u_o - f_o)} + \frac{f_e D}{(f_e + D)}$$

$$= \frac{200 \times 50}{(200 - 50)} + \frac{5 \times 25}{(5 + 25)} = 71\ cm$$

7 **(a)**

$m = -\frac{f_o}{f_e}$

8 **(d)**

$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{f - x_1} + \frac{1}{f - x_2} = \frac{1}{f}$

Or $\frac{f - x_2 + f - x_1}{(f - x_1)(f - x_2)} = \frac{1}{f}$

Or $f^2 - fx_2 - fx_1 + x_1 x_2 = 2f^2 - f(x_1 + x_2)$

Or $f^2 = x_1 x_2$ or $f = \sqrt{x_1 x_2}$

This is Newton's mirror formula

9 **(a)**

Number of images $n = \frac{360°}{\theta} - 1$

Where, θ = angle between mirrors

Thus, $\theta = 60°$

So, number of images

$n = \frac{360°}{60°} - 1 = 5$

10 **(d)**

As $\mu_2 > \mu_1$, the upper half of the lens will become diverging

As $\mu_1 > \mu_3$, the lower half of the lens will become converging

11 **(d)**

Focal length of lens in given by

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

$= \left(\frac{1.6}{1.63} - 1\right)\left(\frac{1}{15} + \frac{1}{15}\right)$

$= -\frac{0.03 \times 2}{1.63 \times 15} = \frac{-6}{1.63 \times 15}$

$so, \quad f_w = -\frac{815}{2}$

$= -407.5\ cm$

12 **(a)**

As refractive index for $z > 0$ and $z \le 0$ is different $X - Y$ plane should be boundary between two media

Angle of incidence,

$$\cos i = \left| \frac{A_z}{\sqrt{A_x^2 + A_y^2 + A_z^2}} \right| = \frac{1}{2}$$

$\therefore i = 60°$

From Snell's law

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

$\Rightarrow r = 45°$

13 **(b)**

For first case : $\frac{1}{f} = \frac{1}{v} - \frac{1}{\infty} \Rightarrow f = v$

For second case $\frac{1}{f} = \frac{1}{(f+5)} - \frac{1}{-(f+20)} \Rightarrow f = 10\ cm$

Alternative sol. $-f^2 = x_1 x_2 \Rightarrow f = 10\ cm$

14 **(c)**

In liquids converging ability (power) of convex lens decreases

15 **(b)**

From Hugen's principle, if the incident wavefront be parallel to the interface of the two media ($i = 0$), then the refracted wavefront will also be parallel to the interface ($r = 0$).

In other words, if light rays fall normally on the interface, then on passing to the second medium they will not deviate from their original path.

16 **(c)**

For equal fogging $I_2 \times t_2 = I_2 \times t_2$

$\Rightarrow \frac{L_2}{r_2^2} \times t_2 = \frac{L_1}{r_1^2} \times t_1 \Rightarrow \frac{16}{4} \times t_2 = \frac{20}{1} \times 10$

$\Rightarrow t_2 = 50s$

17 **(c)**

The refractive index of glass with respect to water is

$${}_w\mu_g = \frac{{}_a\mu_g}{{}_a\mu_w}$$

Given, ${}_a\mu_g = 1.5$, ${}_a\mu_w = 1.33$

${}_w\mu_g = \frac{1.5}{1.33} = 1.80$

Also ${}_w\mu_d = \frac{{}_a\mu_d}{{}_a\mu_w}$

Given, ${}_a\mu_d = 2.4$, ${}_a\mu_w = 1.33$

$\therefore {}_w\mu_d = \frac{2.4}{1.33} = 1.6$

18 **(c)**

$$\frac{f_{w_w}}{f_{a^a}} = \frac{\mu - 1}{\frac{\mu_w}{\mu_a} - 1}$$

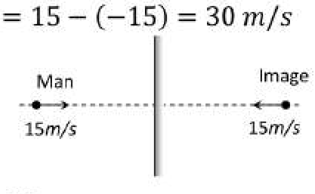
$$\frac{f_{w_w}}{10} = \frac{1.5 - 1}{1/8}$$

$$f_{w_w} = \frac{0.5 - 10}{1/8} = 40 \text{ cm}$$

20 **(b)**

Relative velocity of image $w.r.t$ man

$= 15 - (-15) = 30\ m/s$



21 **(a)**

For greater aperture of lens light passing through lens is more and so intensity of image increases

22 **(d)**

From the figure for real image formation

$x + x' + 2f \geq 4f \Rightarrow x + x' \geq 2f$

23 **(a)**

$f = \frac{1}{P} = \frac{1}{5}\text{m} = 20 \text{ cm}$

Now, $\frac{1}{v} - \frac{1}{u} = \frac{1}{20}$

Or $\frac{1}{v} - \frac{1}{-25} = \frac{1}{20}$ or $\frac{1}{v} = \frac{1}{20} - \frac{1}{25}$

Or $\frac{1}{v} = \frac{5-4}{100}$ or $\frac{1}{v} = \frac{1}{100}$

Or $d = 100 \text{ cm} = 1 \text{ m}$

24 **(d)**

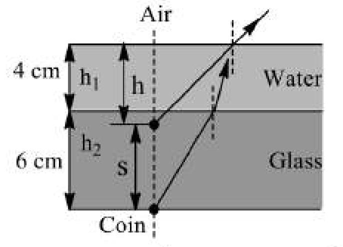
For concave mirror $m = \frac{f}{f-u}$

For real image $m = -\frac{f}{(u-f)} = -\frac{f}{x}$

$= -\frac{f}{(\text{Distance of object from focus})} \Rightarrow m \propto \frac{1}{x}$

25 **(a)**

Using equation, the total apparent shift is



$$s = h_1\left(1 - \frac{1}{\mu_1}\right) + h_2\left(1 - \frac{1}{\mu_2}\right)$$

Or $s = 4\left(1 - \frac{1}{4/3}\right) + 6\left(1 - \frac{1}{3/2}\right)$

$= 3.0 \text{ cm}$

Thus, $h = h_1 + h_2 - s = 4 + 6 - 3$

$= 7.0 \text{ cm}$

26 **(c)**

By formula $\delta = (\mu - 1)A \Rightarrow 34 = (\mu - 1)A$ and in the second position $\delta' = (\mu - 1)\frac{A}{2}$

$\therefore \frac{34}{\delta'} = \frac{(\mu - 1)A}{(\mu - 1)\frac{A}{2}}$ or $\delta' = \frac{34}{2} = 17°$

27 **(a)**

In short sightedness, the focal length of eye lens decreases and so the power of eye lens increases

28 **(b)**

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

$$\cot\frac{A}{2} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}}$$

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

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

Or $\frac{\pi}{2} - \frac{A}{2} = \frac{A}{2} + \frac{\delta_m}{2}$

Or $\frac{\pi}{2} - A = \frac{\delta_m}{2}$

$$\frac{\pi - 2A}{2} = \frac{\delta_m}{2}$$

$\therefore\ \delta_m = 180° - 2A$

29 **(c)**

Focal length of effective lens

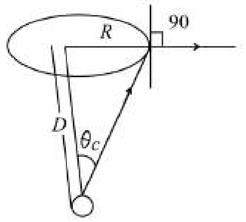
$$\frac{1}{F} = \frac{2}{f_l} + \frac{1}{f_m} = \frac{2}{f_l} + \frac{1}{\infty} \Rightarrow F = \frac{f_l}{2}$$

30 **(b)**

$$\frac{\sin\theta_c}{\sin 90} = \frac{1}{\mu}$$

$$\sin\theta_c = \frac{1}{\mu}$$

$$\Rightarrow \sin\theta_c = \frac{1}{n}$$



$$\Rightarrow \frac{R}{\sqrt{R^2 + D^2}} = \frac{1}{n} \Rightarrow \frac{R^2 + D^2}{R^2} = \frac{n^2}{1}$$

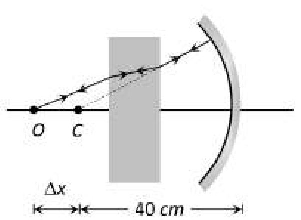
$$\Rightarrow 1 + \frac{D^2}{R^2} = n^2 - 1 \Rightarrow R^2 = \frac{D^2}{n^2 - 1}$$

$$R = \frac{D}{\sqrt{n^2 - 1}}$$

If the bulb is not at seen through the surface R must be greater than

$$\frac{D}{\sqrt{n^2 - 1}} \quad R > \frac{D}{\sqrt{n^2 - 1}}$$

31 **(c)**



$$\Delta x = \left(1 - \frac{1}{\mu}\right)t$$

$$= \left(1 - \frac{1}{1.5}\right) \times 6 = 2\ cm$$

Distance of object from mirror $= 42\ cm$

32 **(d)**

An eye sees distant objects with full relaxation

So $\frac{1}{2.5\times10^{-2}} - \frac{1}{-\infty} = \frac{1}{f}$ or $P = \frac{1}{f} = \frac{1}{2.5\times10^{-2}} = 40D$

An eye sees an object at 25 cm with strain

So $\frac{1}{2.5\times10^{-2}} - \frac{1}{-25\times10^{-2}} = \frac{1}{f}$

or $P = \frac{1}{f} = 40 + 4 = 44D$

33 **(d)**

$$m \propto \frac{1}{f} \propto P$$

34 **(c)**

Separation $= f_0 + \frac{f_e D}{f_e + D}$

$$= 80 + \frac{5 \times 25}{5 + 25} = 80 + \frac{125}{30}$$

$= 84.16$ cm $= 84.2$ cm

35 **(b)**

$v \propto \frac{1}{\mu}$, μ is smaller for air than water, glass and diamond

36 **(d)**

$f = \frac{R}{2} = 20\ cm, m = 2$. For real image; $m = -2$

By using $m = \frac{f}{f-u}, -2 = \frac{-20}{-20-u} \Rightarrow u = -30cm$

For virtual image; $m = +2$

So, $+2 = \frac{-20}{-20-u} \Rightarrow u = -10\ cm$

37 **(a)**

According to new cartesian sign convention,

Object distance $u = -40$ cm

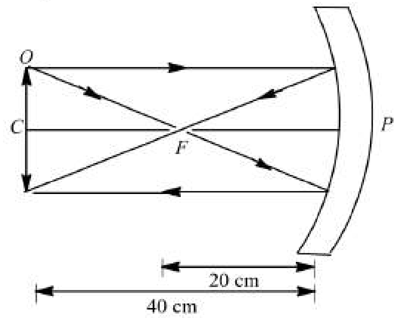


Image distance $v = ?$

Focal length $f = -20$ cm

∴ From mirror formula

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

Or $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

Or $\frac{1}{v} = \frac{1}{-20} - \frac{1}{(-40)} = -\frac{1}{40}$

Or $v = -40$ cm

∴ The image is on the same side of the object.

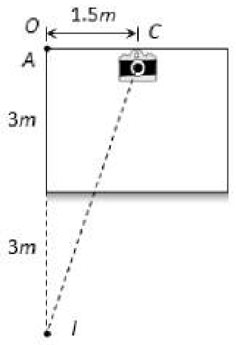
Now, magnification $m = \frac{v}{u} = -\frac{(-40)}{(-20)} = -2$

Hence, the image is real, inverted and of same sie.

38 **(d)**

According to the following figure distance of image I from camera

$= \sqrt{(6)^2 + (1.5)^2} = 6.18\ m$



39 **(d)**

Refraction at air-oil point $\mu_{oil} = \frac{\sin i}{\sin r_1}$

$\therefore \sin r_1 = \frac{\sin 40}{1.45} = 0.443$

Refraction at oil-water point ${}_{oil}\mu_{water} = \frac{\sin r_1}{\sin r}$

$\therefore \frac{1.33}{1.45} = \frac{0.443}{\sin r}$ or $\sin r = \frac{0.443 \times 1.45}{1.33} \Rightarrow r$
$= 28.9°$

40 **(a)**

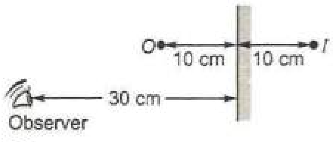
Rock salt prism is used to see infrared radiations

41 **(c)**

$\frac{\beta}{\alpha} = \frac{f_o}{f_e} \Rightarrow \frac{\beta}{0.5°} = \frac{100}{2} \Rightarrow \beta = 25°$

42 **(d)**

Clearly, the distance of image from observer is 40 cm



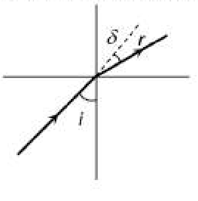
44 **(c)**

$\frac{x}{r} = \frac{1.22\,\lambda}{d} \Rightarrow x = \frac{1.22\,\lambda r}{d}$

$= \frac{1.22 \times 500 \times 10^{-9} \times 400 \times 10^{3}}{5 \times 10^{-3}} = 50\,m$

45 **(a)**

The ray of light is refracted at the plane surface. However, since the ray is travelling from a denser to a rarer medium, for an angle of incidence (i) greater than the critical angle (c) the ray will be totally internally reflected

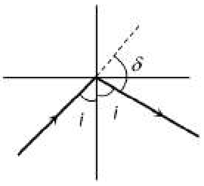


For $i < c$; deviation $\delta = r - i$ with $\frac{1}{\mu} = \frac{\sin i}{\sin r}$

Hence $\delta = \sin^{-1}(\mu \sin i) - i$

This is a non-linear relation. The maximum value of δ is $\delta_1 = \frac{\pi}{2} - C$

Where $i = c$ and $\mu = \frac{1}{\sin c}$



For $i > c$, deviation $\delta = \pi - 2i$

δ decreases linearly with i

$\delta_2 = \pi - 2\,c = 2\delta_1$

47 **(b)**

From graph, slope $= \tan\left(\frac{2\pi}{10}\right) = \frac{\sin r}{\sin i}$

Also $u_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r} = \frac{1}{\tan\left(\frac{2\pi}{10}\right)} = \frac{4}{3} \Rightarrow \mu_2 > \mu_1$

It means that medium 2 is denser medium. So total internal reflection cannot occur

48 **(d)**

$O = 2$ mm, $u = -20$ cm

$f = \frac{R}{2} = \frac{40}{2} = 20$ cm

From mirror formula,

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{20} = \frac{1}{v} + \frac{1}{-20}$

$\frac{1}{v} = \frac{1}{20} + \frac{1}{20}$

$\Rightarrow v = 10$ cm

$\therefore \frac{I}{O} = \frac{v}{u}$

$\frac{I}{2} = \frac{10}{20}$

$\Rightarrow I = 1$ mm

Height of image = 1 mm

49 **(a)**

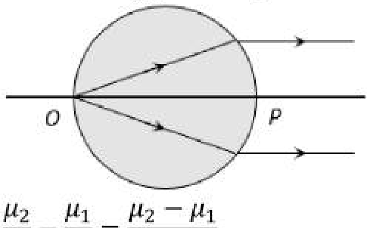
$m = 1 + \frac{D}{f} \Rightarrow 6 = 1 + \frac{25}{f} \Rightarrow f = 5\,cm = 0.05\,m$

50 **(c)**

$\phi = 4\pi L = 4 \times 3.14 \times 100 = 1256\ lumen$

51 **(c)**

Considering pole at P, we have



$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\Rightarrow \frac{1}{\infty} - \frac{u}{(-2R)} = \frac{1-\mu}{(-R)}$

$\Rightarrow \frac{\mu}{2R} = \frac{1-\mu}{(-R)} \Rightarrow \mu = 2$

52 **(c)**

Dispersive power, $\omega = \frac{\delta_B - \delta_R}{\delta}$

$for\ 1st\ prism, \omega_1 = \frac{\delta_B - \delta_R}{\delta} = \frac{12° - 8°}{10°} = \frac{2}{5}$

Where $\delta = \frac{\delta_B + \delta_R}{2}$

Similarly for second prism,

$\omega_2 = \frac{14° - 10°}{12} = \frac{1}{3}$

$\therefore \frac{\omega_1}{\omega_2} = \frac{2}{5} \times \frac{3}{1} = \frac{6}{5}$

53 **(c)**

According to the problem, combination of L_1 and L_2 act a simple glass plate. Hence according to formula

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

$\frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2} = 0 \Rightarrow \frac{1}{f_1} + \frac{1}{f_2} = \frac{d}{f_1 f_2}$

$\Rightarrow \frac{1}{30} - \frac{1}{10} = \frac{d}{30 \times -10} \Rightarrow \frac{-20}{30 \times 10} = -\frac{d}{30 \times 10}$

$\Rightarrow d = 20\ cm$

54 **(b)**

$v = \frac{c}{\mu} = \frac{3 \times 10^8}{1.33} = 2.25 \times 10^8 m/s$

55 **(b)**

For different colours μ change so deviation of different colour's also different

56 **(c)**

The image is erect and diminished. So, the mirror in necessarily convex

57 **(d)**

When sunlight is incident on a prism, it produces spectrum due to refraction of light. Refraction is the change in direction of a wave due to a chance in its velocity. Glass has a higher refractive index than air and the different frequencies of light travel at different speeds (dispersion), causing them to be refracted at different angles. The different frequencies correspond to different colours observed.

58 **(a)**

By using $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0 \Rightarrow \frac{0.02}{f_1} + \frac{0.04}{40} = 0$

$f_1 = -20\ cm$

60 **(b)**

For total internal reflection to take place

$i > \theta c$

Taking sine on both sides, we get

$\sin i > \sin \theta c$

[as angle i at both face will be 45°]

$\Rightarrow \frac{1}{\sqrt{2}} > \frac{1}{\mu}$

$\Rightarrow \mu > \sqrt{2}$

61 **(c)**

$\frac{I}{r_1^2} t_1 = \frac{I}{r_2^2} t_2 \Rightarrow t_2 = \frac{r_2^2}{r_1^2} t_1 = \left(\frac{40}{25}\right)^2 \text{s} = \left(\frac{8}{5}\right)^2 \text{s}$

$= \frac{64}{5} \text{s} = 12.8 \text{ s}$

62 **(c)**

Here, angle of prism $A = 60°$

Refractive index, $\mu = \sqrt{3}$

At the minimum deviation δ_m, the refracted ray inside the prism becomes parallel to its base

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

$\sqrt{3} = \frac{\sin\left(\frac{60° + \delta_m}{2}\right)}{\sin\left(\frac{60°}{2}\right)} \Rightarrow \sqrt{3} \sin 30° = \sin\left(\frac{60° + \delta_m}{2}\right)$

$\frac{\sqrt{3}}{2} = \sin\left(\frac{60° + \delta_m}{2}\right) \Rightarrow \sin 60° = \sin\left(\frac{60° + \delta_m}{2}\right)$

$60° = \frac{60° + \delta_m}{2} \Rightarrow \delta_m = 60°$

As $\delta_m = 2i - A$, where i is the angle of incidence

Hence, $i = \theta$

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

63 **(d)**

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

For equilateral prism, $\angle A = 60°$

$\mu = \frac{\sin\left(\frac{60° + 60°}{2}\right)}{\sin\frac{60°}{2}} = \frac{\sin 60°}{\sin 30°} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3} = 1.73$

64 **(d)**

$u = -20$ cm, $f = 20$ cm

From mirror formula,

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{20} = \frac{1}{v} + \frac{1}{-20}$

$\frac{1}{v} = \frac{1}{20} + \frac{1}{20}$

$\frac{1}{v} = \frac{2}{20} \Rightarrow v = 10$ cm

66 **(b)**

Because in dispersion of white light, the rays of different colours are not parallel to each other. Also deviation takes place in same direction

67 **(c)**

$d = \frac{D \times f}{r_1} = \frac{1.39 \times 10^9 \times 10 \times 10^{-2}}{1.5 \times 10^{11}}$

$= 9.26 \times 10^{-4} m$

68 **(d)**

$f = \frac{R}{(\mu - 1)} = \frac{15}{(1.6 - 1)} = 25\ cm$

$\therefore P = \frac{100}{f} = \frac{100}{25} = +4D$

69 **(b)**

In myopia, $u = \infty, v = d =$ distance of far point

By $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, we get $f = -d$

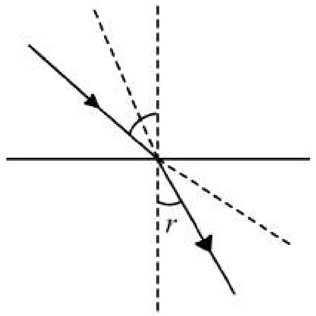
Since f is negative, hence the lens used is concave

71 **(a)**

$A = r + 0 \Longrightarrow r = 30°$

From Snell's law at surface AB

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



or $\mu = \frac{\sin 45°}{\sin 30°} = \frac{2}{\sqrt{2}} = \sqrt{2}$

72 **(b)**

$m = m_o \times m_e \Rightarrow 100 = 5 \times m_e \Rightarrow m_e = 20$

73 **(d)**

Because to form the complete image only two rays are to be passed through the lens and moreover, since the total amount of light released by the object is not passing through the lens, therefore image is faint (intensity in decreased)

74 **(c)**

Given $M_0 = 25\ M_e = 6$

$\therefore$ magnification of this microscope is

$M = M_0 \times M_e = 25 \times 6 = 150$

75 **(a)**

$L_D = v_o + u_e$ and for objective lens $\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$

Putting the values with proper sign convention

$\frac{1}{+2.5} = \frac{1}{v_o} - \frac{1}{(-3.75)} \Rightarrow v_o = 7.5\ cm$

For eye lens $\frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e}$

$\Rightarrow \frac{1}{+5} = \frac{1}{(-25)} - \frac{1}{u_e} \Rightarrow u_e = -4.16\ cm$

$\Rightarrow |u_e| = 4.16\ cm$

Hence $L_D = 7.5 + 4.16 = 11.67\ cm$

76 **(a)**

Resolving power $= \frac{a}{1.22\lambda}$

77 **(b)**

Note that image formation by a mirror does not depend on the medium. As P is at a height h above the mirror, image of P will be at a depth h below the mirror

If d is depth of liquid in the tank, apparent depth of P,

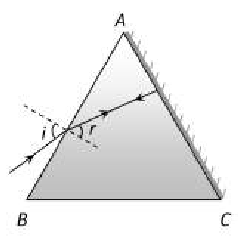
$x_1 = \frac{d - h}{\mu}$

$\therefore$ Apparent distance between P and its image

$= x_2 - x_1 = \frac{d + h}{\mu} - \frac{d - h}{\mu} = \frac{2h}{\mu}$

78 **(c)**

$A = r + 0 \Rightarrow r = 30°$



From Snell's law at surface AB

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

$\Rightarrow \sqrt{2} = \frac{\sin i}{\sin 30°} \Rightarrow i = 45°$

79 **(d)**

From Snell's law, refractive index (μ) is given by

$\mu = \frac{\sin i}{\sin r}$ ... (i)

Where i is angle of incidence and r of refraction.

Also, $\mu = \frac{v_1}{v_2}$ ... (ii)

Equating Eqs, (i) and (ii), we get

$\mu = \frac{\sin i}{\sin r} = \frac{v_1}{v_2}$

$\Rightarrow \sin r = \frac{v_2}{v_1} . \sin i$

Given, $v_2 = 2u, v_1 = u, i = 30°, \sin 30° = \frac{1}{2}$

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

$\Rightarrow r = 90°$

82 **(a)**

Focal length for violet is minimum

83 **(a)**

Here optical distance between fish and the bird is

$s = y' + \mu y$

Differentiating $w.r.t.$ we get $\frac{ds}{dt} = \frac{dy'}{dt} + \frac{\mu dy}{dt}$

$\Rightarrow 9 = 3 + \frac{4}{3}\frac{dy}{dt} \Rightarrow \frac{dy}{dt} = 4.5\ m/s$

84 **(a)**

$D = (\mu - 1)A$

For blue light μ is greater than that for red light,

So $D_2 > D_1$

85 **(a)**

Given that, ${}_a\mu_g = \frac{3}{2}$ and ${}_a\mu_q = \frac{12}{5}$

So, we get

$\therefore {}_g\mu_q = \frac{\mu_q}{\mu_a} \cdot \frac{\mu_a}{\mu_g} = \frac{\mu_q}{\mu_g}$

$= \frac{12}{5} \times \frac{2}{3} = \frac{8}{5}$

86 **(b)**

Distance of object from the pole of convex mirror $u = -f$.

Distance of image from the pole of convex mirror $v = ?$

The Focal length

$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

Or $\frac{1}{f} = \frac{1}{-f} + \frac{1}{v}$

Or $\frac{1}{v} = \frac{1}{f} + \frac{1}{f}$

Or $\frac{1}{v} = \frac{2}{f} \Rightarrow v = \frac{f}{2}$

87 **(c)**

For correcting myopia, concave lens is used and for lens.

$u =$ wants to see $= -50\ cm$

$v =$ can see $= -25\ cm$

From $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-25} - \frac{1}{(-50)} \Rightarrow f = -50\ cm$

So power $P = \frac{100}{f} = \frac{100}{-50} = -2D$

88 **(b)**

$\lambda_g = \frac{\lambda_a}{\mu_g} = \frac{5890}{1.6} = 3681\ \text{Å}$

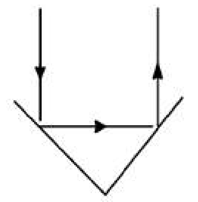
89 **(c)**

Incident ray and finally reflected ray are parallel to each other means $\delta = 180°$

From $\delta = 360° - 2\theta$

$\Rightarrow \quad 180° = 360° - 2\theta$

$\Rightarrow \quad \theta = 90°$



90 **(a)**

When lenses are in contact

$P = \frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} \Rightarrow 10 = \frac{1}{f_1} + \frac{1}{f_2}$ ... (i)

When they are distance d apart

$P' = \frac{1}{F'} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2} \Rightarrow 6$

$= \frac{1}{f_1} + \frac{1}{f_2} - \frac{0.25}{f_1 f_2}$ ... (ii)

From equation (i) and (ii) $f_1 f_2 = \frac{1}{16}$ ...(iii)

From equation (i) and (iii) $f_1 + f_2 = \frac{5}{8}$ ...(iv)

Also $(f_1 - f_2)^2 = (f_2 + f_2)^2 - 4f_1 f_2$

Hence $(f_1 - f_2)^2 = \left(\frac{5}{8}\right)^2 - 4 \times \frac{1}{16} = \frac{9}{64}$

$\Rightarrow f_1 - f_2 = \frac{3}{8}$ ... (v)

On solving (iv) and (v) $f_1 = 0.5\ m$ and $f_2 = 0.125\ m$

91 **(c)**

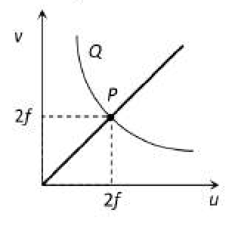
In case of convex lens if rays are coming from the focus, then the emergent rays after refraction are parallel to principal axis

92 **(c)**

At $P, u = v$ which happened only when $u = 2f$

At another point Q on the graph (above P)

$v > 2f$



93 **(c)**

Given $\delta_m = A$, as $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$\Rightarrow \mu = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = 2\cos\frac{A}{2} \Rightarrow A = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

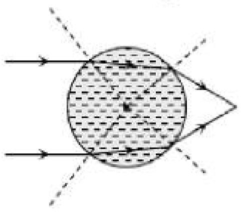
94 **(d)**

$$\mu = \frac{\frac{2}{3}h}{\frac{1}{2}h} = \frac{4}{3}$$

h being depth of beaker.

95 **(b)**

A water drop in air behaves as converging lens



96 **(b)**

$\phi = 4\pi L = 200\,\pi\ lumen$

So $I = \frac{\phi}{100\,A} = \frac{200\,\pi}{100\times\pi r^2} = \frac{2}{(0.1)^2} = 200\ lux$

97 **(d)**

Light from lamp or electric heater gives continuous spectrum

98 **(a)**

Dispersion is caused due to refraction as μ depends on λ

99 **(d)**

Here $\frac{1}{F} = \frac{2}{f} + \frac{1}{f_m}$

Plano-convex lens silvered on plane side has $f_m = \infty$

$$\therefore \frac{1}{F} = \frac{2}{f} + \frac{1}{\infty} \Rightarrow \frac{1}{30} = \frac{2}{f} \Rightarrow f = 60\ cm$$

Plano-convex lens silvered on convex side has $f_m = \frac{R}{2}$

$$\therefore \frac{1}{F} = \frac{2}{f} + \frac{2}{R} \Rightarrow \frac{1}{10} = \frac{2}{60} + \frac{2}{R} \Rightarrow R = 30\ cm$$

Now using $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R}\right)$, we get $\mu = 1.5$

100 **(c)**

Ray after reflection from three mutually perpendicular mirrors becomes anti-parallel

101 **(b)**

$$\frac{\delta_a}{\delta_\omega} = \frac{({}_a\mu_g - 1)}{({}_\omega\mu_g - 1)} = \frac{\left(\frac{3}{2} - 1\right)}{\left(\frac{3/2}{4/3} - 1\right)} = 4 \Rightarrow \delta_\omega = \frac{\delta_a}{4}$$

102 **(d)**

Distance $= v \times t = \frac{c}{\mu} \times t = \frac{3\times10^8}{1.5} \times 10^{-9}$

$= 0.2\ m = 20\ cm$

103 **(c)**

$$\frac{1}{f} = \frac{1}{12} + \frac{1}{240} = \frac{20+1}{240} \Rightarrow f = \frac{240}{21} m$$

Shift $= 1\left(1 - \frac{2}{3}\right) = \frac{1}{3}$

Now $v' = 12 - \frac{1}{3} = \frac{35}{3} cm$

$$\therefore \frac{21}{240} = \frac{3}{35} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{u} = \frac{3}{35} - \frac{21}{240} = \frac{1}{5}\left(\frac{3}{7} - \frac{21}{48}\right)$$

$$\frac{5}{u} = \left|\frac{144 - 147}{48 \times 7}\right|$$

$u = 560cm = 5.6m$

Hence shifting of object $= 5.6 - 2.4 = 3.2m$

104 **(a)**

$f_{water} = 4 \times f_{air}$, air lens is made up of glass

105 **(a)**

$v \propto \frac{1}{\mu}, \mu_{rarer} < \mu_{denser}$

107 **(b)**

Given, refractive index of prism $\mu = 1.732$

Let the angle of prism is A.

The angle of minimum deviation = The angel of prism

$\delta_m = A$

The refractive index of prism

$$\mu = \frac{\sin\left[\frac{A+\delta_m}{2}\right]}{\sin\frac{A}{2}}$$

Or $\mu = \frac{\sin\left[\frac{A+A}{2}\right]}{\sin\frac{A}{2}}$

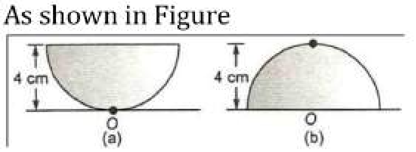
Or $1.732 = \frac{\sin A}{\sin\frac{A}{2}}$

Or $\sqrt{3} = \frac{2\sin\frac{A}{2}.\cos\frac{A}{2}}{\sin\frac{A}{2}}$

Or $A = 60°$

108 **(c)**

As shown in Figure



In this case refraction of the rays starting from t_0 takes place from a plane surface. So, we can use

$d_{app} = \frac{d_{actual}}{\mu}$

Or $3 = \frac{4}{\mu}$

Or $\mu = \frac{4}{3}$

As shown in Fig (b). In this case refraction takes place from a spherical surface. Hence, applying

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

We have,

$$\frac{1}{(-25/8)} - \frac{4/3}{-4} = \frac{1 - 4/3}{-R}$$

Or $\frac{1}{3R}=\frac{1}{3}-\frac{8}{25}=\frac{1}{75}$

$\therefore R=25$ cm

Now, to find the focal length we will use the lens maker formula

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

$=\left(\frac{4}{3}-1\right)\left(\frac{1}{\infty}-\frac{1}{-25}\right)=\frac{1}{75}$

$\therefore f=75$ cm

109 **(a)**

By formula $m=\frac{f_o}{f_e}$

110 **(a)**

$\frac{1}{5u}-\left(\frac{1}{-u}\right)=\frac{1}{30}$

$\frac{1}{5u}+\frac{1}{u}=\frac{1}{30}$

$\frac{5+1}{5u}=\frac{1}{30}$

$u=36$ cm

111 **(a)**

$\frac{I_1}{I_2}=\frac{r_1^2}{r_2^2}=\left(\frac{25}{50}\right)^2=\frac{1}{4}$

112 **(c)**

$m_1=\frac{A_1}{O}$ and $m_2=\frac{A_2}{O}\Rightarrow m_1m_2=\frac{A_1A_2}{O^2}$

Also it can be proved that $m_1m_2=1$

So $O=\sqrt{A_1A_2}$

113 **(b)**

$v\propto\lambda\Rightarrow\frac{v_1}{v_2}=\frac{\lambda_1}{\lambda_2}$

$\therefore v_2=\frac{v_1}{\lambda_1}\times\lambda_2=3\times10^8\times\frac{4500}{6000}$

$=2.25\times10^8 m/s$

114 **(b)**

Focal length = − (Defected far point)

116 **(c)**

Real depth $=1\ m$

Apparent depth $=1-0.1=0.9\ m$

Refractive index $\mu=\frac{Real\ depth}{Apparent\ depth}=\frac{1}{0.9}=\frac{10}{9}$

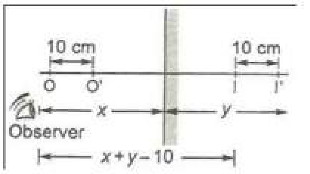
117 **(c)**

$E_1=\frac{I}{r^2}, E_2=\frac{I}{r^2}+\frac{I}{9r^2}$

$\therefore\frac{E_1}{E_2}=\frac{I}{r^2}\times\frac{9r^2}{10I}$

Or $\frac{E_2}{E_1}=\frac{10}{9}$

118 **(a)**



As is clear from figure the distance of image with reference to observer reduces by 10 cm in one second

119 **(c)**

$d=\frac{2f}{3}$

$or\ f=\frac{3d}{2}=\frac{3\times12}{2}=18\ cm$

Equivalent focal length is

$f'=\frac{f_1f_2}{f_1+f_2}+\frac{f}{4}=\frac{18\times18}{18+18}+\frac{18}{4}$

$=9+4.5=13.5$ cm

121 **(b)**

Here, $P_1+P_2=2D\ and\ P_1=5D$

So $P_2=-3\ D$

For an achromatic combination

$\omega_1P_1+\omega_2P_2=0$

$or\ \frac{\omega_1}{\omega_2}=\left(-\frac{P_2}{P_1}\right)=-\frac{(-3)}{2}=\frac{3}{5}$

122 **(a)**

In election microscope, electron beam $(\lambda=\text{Å})$is used so its resolving power is approx. 5000 times more than that of ordinary microscope ($\lambda=5000\text{Å}$)

123 **(a)**

$\mu_1=1.20+\frac{0.8\times10^{-14}}{(400\times10^{-9})^2}$

Or $\mu_1=1.20+\frac{0.8\times10^{-14}}{400\times400\times10^{-18}}$

Or $\mu_1=1.20+\frac{0.8}{16}$

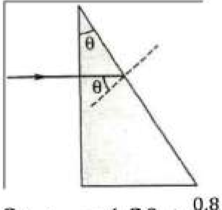
Or $\mu_1=1.20+0.05$

Or $\mu_1=1.25$

Or $\sin i_c=\frac{1}{1.25}=0.8$

Or $i_c=53.13°$

Again, $\mu_2=1.20+\frac{0.8\times10^{-14}}{(500\times10^{-9})^2}$



Or $\mu_2=1.20+\frac{0.8}{25}$ or $\mu_2=1.20+0.32$

Or $\mu_2=1.232$

Or $\sin i_c=\frac{1}{1.232}=0.81$

Or $i_c=\sin^{-1}0.81$

$= 54.26°$

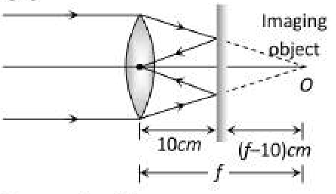
Now, $\sin\theta = 0.8$ or $\theta = 53.13°$

This angle is clearly greater than critical angle corresponding to wavelength 400 nm. So, light of 400 nm wavelength under goes total internal reflection

124 **(d)**

$\omega/f = -\omega/f' \Rightarrow f' = -2f$

125 **(b)**



From the figure,

Using property of plane mirror

Image distance = Object distance

$f - 10 = 10 \Rightarrow f = 20\ cm$

126 **(b)**

Applying the lens maker's formula

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

We know that the greater positive power is for that material for which $\frac{1}{R_1} - \frac{1}{R_2}$ is maximum and positive. For this condition R_1 and R_2 should be small as possible but still it must be positive, therefore we must select the combination which has less radius of curvature for convex lens.

Hence, option (b) is correct

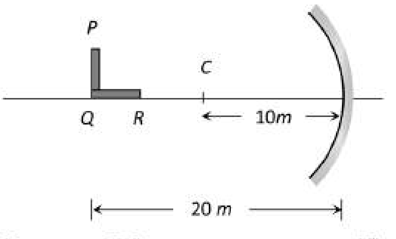
128 **(b)**

$$\omega = \frac{f_R - f_V}{f_y} = \frac{f_R - f_V}{\sqrt{f_V f_R}}$$

Putting value of f_V and f_R we get $\omega = 0.0325$

129 **(b)**

Focal length of mirror $f = \frac{R}{2} = \frac{10}{2} = 5cm$



For part PQ: transverse magnification

length of image $L_1 = \left(\frac{f}{f-u}\right) \times L_0$

$$= \left(\frac{-5}{-5-(-20)}\right) \times L_0 = \frac{-L_0}{3}$$

For part QR: longitudinal magnification

Length of image $L_2 = \left(\frac{f}{f-u}\right)^2 L_0$

$$= \left(\frac{-5}{-5-(-20)}\right)^2 \times L_0 = \frac{L_0}{9} \Rightarrow \frac{L_1}{L_2} = \frac{3}{1}$$

130 **(b)**

When light enters from air or vacuum, *ie*, when light goes from one medium to other, then its frequency does not change *ie*, remains unchanged.

Hence, frequency of light will remain 5×10^{14} Hz

131 **(b)**

Given that, focal length of a convex lens $f = 10$ cm, since the lens is used as magnifier, so the object is placed between focal point and lens and image is formed towards the object so

$v = -25\ cm$

From lens formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{10} = \frac{1}{-25} - \frac{1}{u}$$

$$\frac{1}{u} = -\frac{1}{25} - \frac{1}{10} = -\frac{7}{50}$$

$$\Rightarrow u = -\frac{50}{7} cm = -7.14\ cm$$

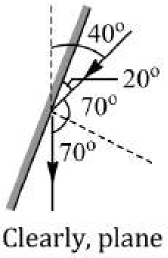
132 **(a)**

At the time of solar eclipse light is received from chromosphere. The bright lines appear exactly at the places where dark lines were there. Hence at the time of solar eclipse continuous spectrum is obtained

133 **(a)**

Clearly, $i + r = i + i = 140°$

Or $i = 70°$



Clearly, plane mirror makes as angle of 20° with vertical and 70° with horizontal

134 **(a)**

$P = P_1 + P_2$

$$= \frac{1}{f_1} + \frac{1}{f_2} = \frac{100}{20} + \frac{100}{25}$$

$= 5 + 4 = 9D$

135 **(d)**

If η is the luminous efficiency of the bulb then luminous flux by 120 *watt* at 555 $nm = \eta \times 120$

Let bulb of P watt at 600 nm produces the same luminous flux as by 120 $watt$ at 555 nm then

$$\eta \times 120 = \eta P \times 0.6 \Rightarrow P = \frac{120}{0.6} = 200\ watt$$

136 **(c)**

$$f = \frac{R}{(\mu - 1)} \Rightarrow 30 = \frac{10}{(\mu - 1)} = \mu = 1.33$$

137 **(c)**

From the formula $\sin C = \frac{1}{{}_1\mu_2} \Rightarrow \sin C = {}_2\mu_1$

$$= \frac{\mu_1}{\mu_2} = \frac{v_2}{v_1} \Rightarrow \sin C = \frac{10x/t_2}{x/t_1}$$

$$\Rightarrow \sin C = \frac{10t_1}{t_2} \Rightarrow C = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$$

138 **(b)**

$$\frac{f_l}{f_a} = \frac{{}_a\mu_g - 1}{{}_l\mu_g - 1} \Rightarrow \frac{-0.5}{0.2} = \frac{1.5 - 1}{{}_l\mu_g - 1} \Rightarrow {}_l\mu_g - 1$$

$$= -0.2$$

$$\Rightarrow {}_l\mu_g = 0.8 = \frac{4}{5} \Rightarrow \frac{{}_a\mu_g}{{}_a\mu_l} = \frac{4}{5} \Rightarrow \frac{1.5}{{}_a\mu_l} = \frac{4}{5}$$

$$\Rightarrow {}_a\mu_l = \frac{15}{8}$$

139 **(a)**

Mirror formula

$\frac{1}{f} = \frac{1}{v} = \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-20} + \frac{1}{(-10)} \Rightarrow f = \frac{-20}{3} cm$. If object moves towards the mirror by $0.1m$ then. $u = (10 - 0.1) = 9.9cm$. Hence again from mirror formula $\frac{1}{-20/3} = \frac{1}{v'} + \frac{1}{-9.9} \Rightarrow v' = -20.4\ cm$ *i.e.*, image shifts away from the mirror by 0.4 cm

141 **(d)**

In minimum deviation position $\angle i = \angle e$

142 **(c)**

$$\mu \propto \frac{1}{\lambda} \Rightarrow \frac{1}{4/3} = \frac{x}{4200} \Rightarrow x = 3150\text{Å}$$

143 **(a)**

$$\lambda_{medium} = \frac{\lambda_{air}}{\mu} = \frac{6000}{1.5} = 4000\ \text{Å}$$

144 **(a)**

In the morning or evening, the sun is at the horizon and refractive index in the atmosphere of the earth decreases with height. Due to this, the light reaching the earth's atmosphere, bends unequally, and the image of the sun get's distorted and it appears elliptical and larger

145 **(d)**

For surface $P, \frac{1}{v_1} = \frac{1}{-f} - \frac{1}{(-u)} = -1 + \frac{1}{3} = -\frac{2}{3}$

$$\Rightarrow v_1 = -\frac{3}{2}m$$

For surface $Q, \frac{1}{v_2} = \frac{1}{-f} + \frac{1}{u} = -1 + \frac{1}{5} = -\frac{4}{5}$

$$\Rightarrow v_2 = -\frac{5}{4}m \therefore v_1 - v_2 = 0.25m$$

Magnification of $P = \frac{v_1}{u} = \frac{3/2}{3} = \frac{1}{2}$

$\therefore$ Height of $P = \frac{1}{2} \times 2 = 1m$

Magnification of $Q = \frac{v_2}{u} = \frac{5/4}{5} = \frac{1}{4}$

$\therefore$ Height of $Q = \frac{1}{4} \times 2 = 0.5m$

146 **(a)**

Equivalent focal length (F) of two lenses separated by distance d is given by

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$

$$= \frac{1}{0.2} + \frac{1}{0.2} - \frac{0.5}{(0.2)(0.2)}$$

$$= 5 + 5 - 0.5 \times 5 \times 5$$

$$= 10 - 12.5$$

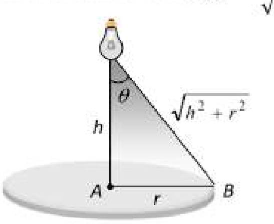
$$= -2.5$$

$$F = -\frac{1}{2.5} = -0.4\ m$$

147 **(c)**

Illuminance at $A, I_A = \frac{L}{h^2}$

Illuminance at $B, I_B = \frac{L}{\sqrt{(h^2+r^2)^2}} \cos\theta$



$$= \frac{Lh}{(r^2 + h^2)^{3/2}}$$

$$\therefore \frac{I_A}{I_B} = \left(1 + \frac{r^2}{h^2}\right)^{3/2} = \left(1 + \frac{8^2}{8^2}\right)^{3/2} = 2^{3/2}$$

$$= 2\sqrt{2}: 1$$

148 **(c)**

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

For lens to be concave, $\left(\frac{1}{r_1} - \frac{1}{r_2}\right) > 0$

Or $\frac{1}{r_1} > \frac{1}{r_2}$ or $r_1 < r_2$

150 **(d)**

From Snell's law

$$\mu = \frac{1}{\sin i_C}$$

Since, $i_B > i_A$

$\sin i_{:B} > \sin i_A$

$\Rightarrow \mu_B < \mu_A$

When angle of incidence in the denser medium is increased even very slightly beyond the critical angle, then the ray of light is reflected back completely in the denser medium and total internal reflection takes place. Let θ be critical angle from medium A to B, then

$${}_{B}\mu_{A} = \frac{1}{\sin\theta}$$

$$\Rightarrow \sin\theta = \frac{1}{{}_{B}\mu_{A}}\frac{\mu_B}{\mu_A}$$

$$= \frac{1}{\sin i_B} \times \frac{\sin i_A}{1}$$

$$\Rightarrow \theta = \sin^{-1}\left[\frac{\sin i_A}{\sin i_B}\right]$$

151 **(c)**

$$\lambda \propto \frac{1}{\mu} \Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{\mu_2}{\mu_1} = \frac{\mu}{1}$$

152 **(c)**

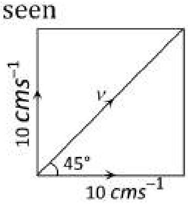
Diamond sparkles more compared to ordinary glass, because of the phenomenon of total internal reflection of light, depending on the critical angle of the incidence of light in a material medium at its bounding surface with air.

The higher the refractive index of a transparent medium, the smaller is the critical angle and hence, the larger is the range of angles of incidence for more light to be totally reflected. A diamond has a large refractive index (2.417) and very small critical angle compared to say glass, hence diamond sparkles most.

153 **(d)**

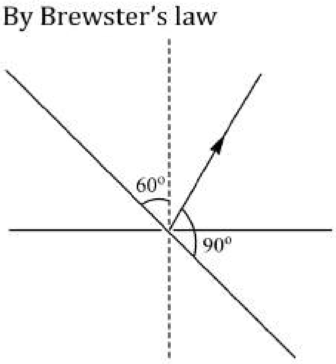
$v\cos 45° = 10\ v = 10\sqrt{2}\ cms^{-1}$

In the ceiling mirror be original velocity will be seen



154 **(d)**

By Brewster's law



$\mu = \tan i_p = \tan 60° = \sqrt{3}$

155 **(b)**

Time taken by light to travel distance x through a medium of refractive index μ is

$$t = \frac{\mu x}{c} \Rightarrow \frac{\mu_B}{\mu_A} = \frac{x_A}{x_B} = \frac{6}{4} \Rightarrow {}_{A}\mu_{B} = \frac{3}{2} = 1.5$$

156 **(b)**

$$\frac{I}{O} = \frac{f-v}{f} \Rightarrow \frac{I}{+1.5} = \frac{(25-75)}{25} = -2 \Rightarrow I$$

$$= -3\ cm$$

157 **(a)**

$$\mu = \frac{c}{v} = \frac{c}{v\lambda} = \frac{3\times 10^8}{4\times 10^{14}\times 5\times 10^{-7}} = 1.5$$

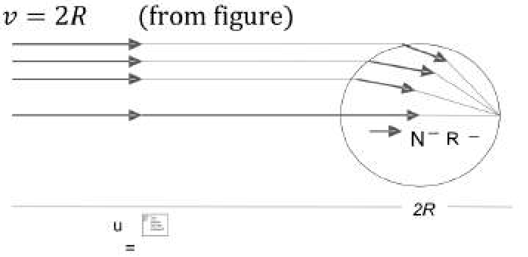
158 **(d)**

The parallel beam of light forms a point image at the back of a sphere of refraction index n as shown in figure.

If R is the radius of sphere,

Then $u = \infty$

$v = 2R$ (from figure)



Since,

$$\frac{n}{v} - \frac{1}{u} = \frac{n-1}{R}$$

Putting values, we get

$$\frac{n}{2R} = \frac{1}{\infty} = \frac{n-1}{R}$$

$$\frac{n}{2R} = \frac{n-1}{R}$$

$$n = 2n - 2$$

$$\therefore n = 2$$

159 **(a)**

$$m = \frac{f}{f+u}$$

$$\frac{1}{2} = \frac{-20}{-20+u} \text{ or } -20 + u = -40$$

Or $u = -40 + 20$ or $u = -20$ cm

160 **(c)**

$$\theta = \frac{1}{2} \times \frac{\pi}{180}\ \text{rad}$$

$$\frac{\text{diametar of image}}{\text{focal length}} = \theta$$

Or diameter of image

$$= \frac{1}{2} \times \frac{\pi}{180} \times \frac{15}{2} \times 100\ \text{cm} = 6.55\ \text{cm}$$

161 **(a)**

$$m = \frac{f}{f+u} \Rightarrow -\frac{1}{4} = \frac{30}{30+u} \Rightarrow u = -150\ cm$$

162 **(a)**

By the hypothesis, we know that

$i_1 + i_2 = A + \delta \Rightarrow 55° + 46° = 60° + \delta \Rightarrow \delta = 41°$

But $\delta_m < \delta$, so $\delta_m < 41°$

163 **(b)**

$$\mu = \frac{1}{\sin C} = \frac{1}{\sin 30} = 2$$

$$\therefore v = \frac{3 \times 10^8}{2} = 1.5 \times 10^8 m/s$$

165 **(a)**

Here, $\mu_g = 1.5 = \frac{3}{2}, \mu_{w_v} = \frac{4}{3}$

$R_1 = R, \Rightarrow R_2 = -R$

From, lens maker's formula

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

$$\therefore \frac{1}{f_{aa}} = \left(\frac{\mu_g}{\mu_{aa}} - 1\right)\left(\frac{1}{R} - \frac{1}{(-R)}\right)$$

$$\text{Or } \frac{1}{f_{aa}} = \left(\frac{3/2}{1} - 1\right)\frac{2}{R}$$

$$\Rightarrow \frac{1}{f_a} = \frac{1}{R}$$

Also

$$\frac{1}{f_{w_v}} = \left(\frac{\mu_g}{\mu_{wa}} - 1\right)\left(\frac{1}{R} - \frac{1}{(-R)}\right)$$

$$\frac{1}{f_2} = \left(\frac{3/2}{4/3} - 1\right)\frac{2}{R}$$

$$\text{Or } \frac{1}{f_w} = \frac{1}{4R}$$

Or $f_{w_v} = 4R$

166 **(a)**

We know that

$$\mu = \frac{\sin i}{\sin r} \text{ and } i + r = 90°$$

Or $r = 90° - i$

$$\mu = \frac{\sin i}{\sin(90° - i)} = \tan i$$

Or $i = \tan^{-1}(\mu) = \tan^{-1}(1.62)$

167 **(c)**

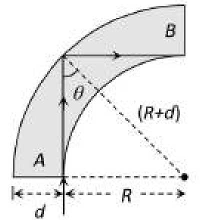
Since the ray emerges normally, therefore $e = 0$

According to relation $A + \delta = i + e$, we get $i = A + \delta$

Hence by $\delta = (\mu - 1)A$, we get $i = \mu A$

168 **(b)**

Consider the figure if smallest angle of incidence θ is greater than critical angle then all light will emerge out of B



$$\Rightarrow \theta \geq \sin^{-1}\left(\frac{1}{\mu}\right) \Rightarrow \sin\theta \geq \frac{1}{\mu}$$

From figure $\sin\theta = \frac{R}{R+d}$

$$\Rightarrow \frac{R}{R+d} \geq \frac{1}{\mu} \Rightarrow \left(1 + \frac{d}{R}\right) \leq \mu$$

$$\Rightarrow \frac{d}{R} \leq \mu - 1 \Rightarrow \left(\frac{d}{R}\right)_{\max} = 0.5$$

169 **(a)**

Limit of resolution $= \frac{1.22\,\lambda}{a} \times \frac{180}{\pi}$ (in degree)

$$= \left(\frac{1.22 \times (6000 \times 10^{-10})}{5} \times \frac{180}{\pi}\right)^o = 0.03\ sec$$

171 **(a)**

$$\frac{1}{v} + \frac{1}{-600} = \frac{1}{20} \text{ or } \frac{1}{v} = \frac{31}{600}$$

Or $v = \frac{600}{31}$ cm $= 19.35$

172 **(d)**

Angle of incidence = angle of emergence,

Ie, $i = i'$

Also, $i' = \frac{3}{4} \times$angle of equilateral prism

$= \frac{3}{4} \times 60° = 45°$

Thus, angle of deviation

$= i + i' - A$

$= (45° + 45° - 60°) = 30°$

173 **(d)**

Refractive index, $\mu_d = \frac{c}{v_d}$

Hence, $v_d = \frac{c}{\mu_d} = \frac{3 \times 10^8}{2}$

$= 1.5 \times 10^8 \text{ms}^{-1} = 1.5 \times 10^{10} \text{cms}^{-1}$

175 **(a)**

$$P = \frac{1}{f} = -\frac{1}{v} + \frac{1}{u} = -\frac{1}{100} + \frac{1}{25} = \frac{3}{100} = +3\ D$$

176 **(a)**

$$\frac{\omega_1}{\omega_2} = \frac{1}{2}$$

Now, $\frac{f_1}{f_2} = -\frac{\omega_1}{\omega_2} = -\frac{1}{2}$

Or $f_2 = -2f_1$

Now, $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{50} = \frac{1}{f_1} + \frac{1}{-2f_1}$

Or $50f = \frac{-2+1}{-2f_1} = \frac{1}{2f_1}$

Or $2f_1 = 50$ or $f_1 = 25$ cm

Again $f_2 = -2 \times 25$ cm$= -50$ cm

177 **(d)**

Beam first converges and then diverges

178 **(b)**

Image is virtual so $m = +3$ and $f = \frac{R}{2} = 18\ cm$

So from $m = \frac{f}{f-u} \Rightarrow 3 = \frac{(-18)}{(-18)-u} \Rightarrow u = -12\ cm$

179 **(b)**

From the lens formula

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ *we have,*

$\frac{1}{f} = \frac{1}{10} - \frac{1}{-10}$

$or\ f = +5$

Further, $\Delta u = 0.1$

And $\Delta v = 0.1$(from the graph)

Now, differentiating the lens formula we have,

$\frac{\Delta f}{f^2} = \frac{\Delta v}{v^2} + \frac{\Delta u}{u^2}$

$or\ \ \Delta f = \left(\frac{\Delta v}{v^2} + \frac{\Delta u}{u^2}\right) f^2$

Substituting the values we have

$\Delta f = \left(\frac{0.1}{10^2} + \frac{0.1}{10^2}\right)(5)^2 = 0.05$

$\therefore f \pm \Delta f = 5 \pm 0.05$

180 **(b)**

Apparent depth $h' = \frac{h}{{}_{air}\mu_{\text{liquid}}}$

$\Rightarrow \frac{dh'}{dt} = \frac{1}{{}_a\mu_\omega} \frac{dh}{dt} \Rightarrow x = \frac{1}{{}_a\mu_\omega} \frac{dh}{dt} \quad \left[\because \frac{dh'}{dt} = x\right]$

$\Rightarrow \frac{dh}{dt} = {}_a\mu_\omega x$

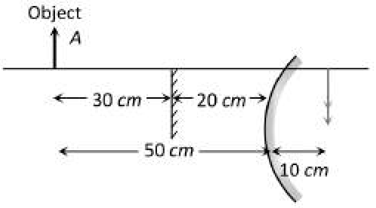
Now volume of water $V = \pi R^2 h$

$\Rightarrow \frac{dV}{dt} = \pi R^2 \frac{dh}{dt} = \pi R^2 \cdot {}_a\mu_\omega x$

$= {}_a\mu_\omega \pi R^2 x = \frac{\mu_\omega}{\mu_a} \pi R^2 x = \left(\frac{n_2}{n_1}\right) \pi R^2 x$

181 **(b)**

Since there is no parallax, it means that both images (By plane mirror and convex mirror) coinciding each other



According to property of plane mirror it will form image at a distance of 30 cm behind it. Hence for convex mirror $u = -50\ cm, v = +10\ cm$

By using $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{+10} + \frac{1}{-50} = \frac{4}{50}$

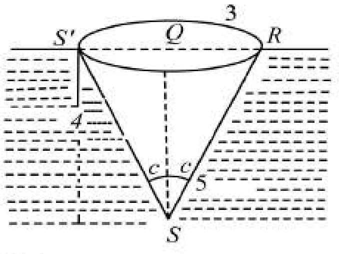
$\Rightarrow f = \frac{25}{2} cm \Rightarrow R = 2f = 25cm$

182 **(d)**

Objects are invisible in liquid of R.I. equal to that of object

183 **(b)**

When a ray from main O in air (rarer medium) goes to water (denser medium), then it bends towards the normal. Extent MN backwards meet at point O'. Therefore, it appears to the fish as if the man is taller than what he actually is



184 **(a)**

An optical fibre is a transparent thin fibre, usually made of glass or plastic for transmitting light. Optical fibres are used in imagine optics, and work on the principle of total internal reflection of light. Bundles of fibres are used along with lenses for long, thin imagine devices called endoscopes, which are used to view objects through a small hole. Medical endoscopes are used for minimally invasive exploratory or surgical procedures (endoscopy).

185 **(a)**

Here, $i = 45°, A = 60°$

Angle of minimum deviation

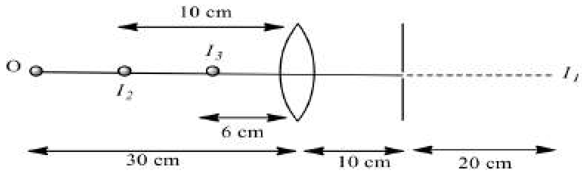
$\delta_m = 2i - A = 2 \times 45° - 60° = 30°$

186 **(b)**

Object is placed at distance $2f$ from the lens. So first image I will be formed at distance $2f$ on other side. This image I_1 will behave like a virtual object for mirror. The second image I_2 will be formed at distance 20 cm in front of the mirror, or at distance 10 cm to the left hand side of the lens.

Now applying lens formula

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$



$\therefore \frac{1}{v} - \frac{1}{+10} = \frac{1}{+15}$

or $v = 16$ cm

Therefore, the final image is at distance 16 cm from the mirror. But, this image will be real.

This is because ray of light is travelling from right to left.

187 **(b)**

$\mu \propto \frac{1}{v} \Rightarrow \frac{\mu_g}{\mu_w} = \frac{v_w}{v_g} \Rightarrow \frac{3/2}{4/3} = \frac{v_w}{2 \times 10^8}$

$\Rightarrow v_w = 2.25 \times 10^8 m/s$

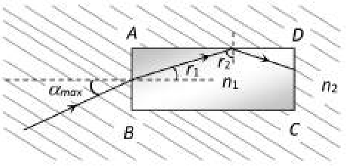
188 **(c)**

For myopic eye $f = -$ (defected far point)

$\Rightarrow f = -40\ cm \Rightarrow P = \frac{100}{-40} = -2.5\ D$

189 **(a)**

Ray comes out from CD, means rays after refraction from AB get, total intensity reflected at AD



$\frac{n_1}{n_2} = \frac{\sin \alpha_{\max}}{\sin r_1} \Rightarrow \alpha_{\max} = \sin^{-1}\left[\frac{n_1}{n_2} \sin r_1\right]$ ... (i)

Also $r_1 + r_2 = 90° \Rightarrow r_1 = 90 - r_2 = 90 - C$

$\Rightarrow r_1 = 90 - \sin^{-1}\left(\frac{1}{{}_2\mu_1}\right) \Rightarrow r_1$

$= 90 - \sin^{-1}\left(\frac{n_2}{n_1}\right)$ ... (ii)

Hence from equation (i) and (ii)

$\alpha_{\max} = \sin^{-1}\left[\frac{n_1}{n_2} \sin\left(90 - \sin^{-1}\frac{n_2}{n_1}\right)\right]$

$= \sin^{-1}\left[\frac{n_1}{n_2} \cos\left(\sin^{-1}\left(\frac{n_2}{n_1}\right)\right)\right]$

190 **(c)**

$\mu = \frac{C}{C_m} \Rightarrow C_m = \frac{C}{1.5}$

191 **(c)**

Efficiency of light source

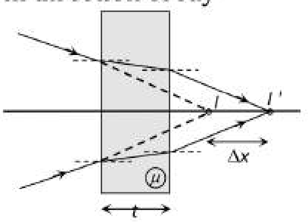
$\eta = \frac{\phi}{P}$ ...(i) and $L = \frac{\phi}{4\pi}$ ...(ii)

From equation (i) and (ii)

$\Rightarrow P = \frac{4\pi L}{\eta} = \frac{4\pi \times 35}{5} \approx 88\ W$

192 **(a)**

Normal shift $\Delta x = \left(1 - \frac{1}{\mu}\right) t$ and shift takes place in direction of ray



193 **(a)**

At minimum deviation $(\delta = \delta_m)$

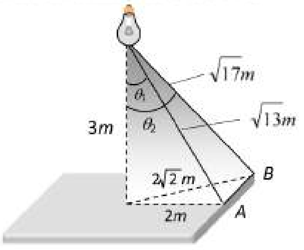
$r_1 = r_2 = \frac{A}{2} = \frac{60°}{2} = 30°$ (for both colours)

194 **(a)**

The illuminance at A is

$I_A = \frac{1}{(\sqrt{13})^2} \times \cos\theta_1 = \frac{L}{13} \times \frac{3}{\sqrt{13}} = \frac{3L}{(13)^{3/2}}$

The illuminance at B is



$I_B = \frac{L}{(\sqrt{17})^2} \times \cos\theta_2$

$= \frac{L}{17} \times \frac{3}{\sqrt{17}} = \frac{3L}{(17)^{3/2}}$

$\therefore \frac{I_A}{I_B} = \left(\frac{17}{13}\right)^{3/2}$

195 **(b)**

Power of convex lens $P_1 = \frac{100}{40} = 2.5\ D$

Power of concave lens $P_2 = -\frac{100}{25} = -4\ D$

Now $P = P_1 + P_2 = 2.5\ D - 4\ D = -1.5\ D$

196 **(b)**

In normal adjustment of telescope tube, final image is formed at infinity, ie, $u_e = f_e$

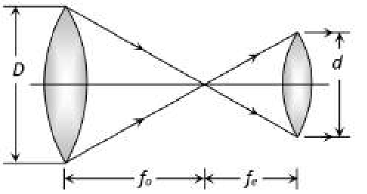
Hence, length of telescope tube

Here, $f_0 = 100$cm, $f_e = 4$ cm

$\therefore L = 200 + 4 = 204$ cm

197 **(a)**

Full use of resolving power means whole aperture of objective in use. And for relaxed vision



$\frac{f_o}{f_e} = \frac{D}{d} \Rightarrow \frac{300}{f_e} = \frac{15}{0.3} \Rightarrow f_e = 6\ cm$

199 **(b)**

$r_1 = 10$ cm, $r_2 = 8$ cm

$\frac{I_1}{I_2} = \frac{64}{100}, 1 - \frac{I_1}{I_2} = 1 - \frac{64}{100}$

Or $\frac{I_2 - I_1}{I_2} = \frac{36}{100}$

Or $\frac{I_2 - I_1}{I_2} \times 100 = 36\%$

200 **(c)**

$\omega = \frac{\mu_V - \mu_R}{\mu_V - 1} = \frac{1.65 - 1.61}{1.63 - 1}$

201 **(a)**

Only red colour will be seen in spectrum

202 **(c)**

Luminous intensity $L = \frac{\phi}{4\pi} \Rightarrow 1 = \frac{\phi}{4\pi} \Rightarrow \phi = 4\pi$

203 **(a)**

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{f} = \frac{1}{-4} - \frac{1}{-10}$

Or $\frac{1}{f} = \frac{1}{10} - \frac{1}{4}$

Or $\frac{1}{f} = \frac{2-5}{20} = -\frac{3}{20}$

Or $f = -\frac{20}{3}$ cm $= -6.67$ cm

The negative sign indicates that the lens is concave

204 **(a)**

As u goes from 0 to $-\infty$, v goes from $+0$ to $+f$

205 **(c)**

$i = \frac{A + \delta_m}{2} = 50°$

206 **(d)**

Here, $v_A = 1.8 \times 10^8 ms^{-1}$

$v_B = 2.4 \times 10^8 ms^{-1}$

Light travels slower in denser medium. Hence medium A is a denser medium and medium B is a rarer medium. Here, light travels from medium A to medium B.

Let C be the critical angle between them

$\therefore \sin C = {}^A\mu_B = \frac{1}{{}^B\mu_A}$

Refractive index of medium B w.r.t medium A is

${}^A\mu_B = \frac{\text{Velocity of light in medium } A}{\text{Velocity of light in medium } B} = \frac{v_A}{v_B}$

$\therefore \sin C = \frac{v_A}{v_B} = \frac{1.8 \times 10^8}{2.4 \times 10^8} = \frac{3}{4}$

$\Rightarrow C = \sin^{-1}\left(\frac{3}{4}\right)$

207 **(d)**

Image formed by convex mirror is always. Erect diminished and virtual

208 **(d)**

In vacuum speed of light is constant and is equal to $3 \times 10^8 m/s$

209 **(c)**

The blue colour of sky is due to Rayleight's scattering $\left(\propto \frac{1}{\lambda^4}\right)$

As light moves through the atmosphere, most of the longer wavelengths pass straight through, little of the red, orange and yellow light is affected by air. However, much of the shorter wavelength light (blue) is absorbed by the gas molecules. The absorbed blue light is then radiated in different directions. It gets scattered all around the sky and hence sky appears blue. In order, that sky appears red will be possible if atmospheric particles scatter red light more than blue light.

210 **(d)**

Here, Angle of prism, $A = 60°$

For minimum deviation, $A = 2r$

Or $r = \frac{A}{2} = \frac{60°}{2} = 30°$ for both colours

211 **(a)**

In Galiean telescope a convergent lens is used as the objective and a divergent lens as the eyepiece. Magnifying power and length of telescope are written as

$M = \frac{f_0}{u_e}$ and $L = f_0 - u_e$

In normal adjustment, ie, in relaxed eye state

$u_e = f_e$

So, $M_\infty = \frac{f_0}{f_e} = 50$

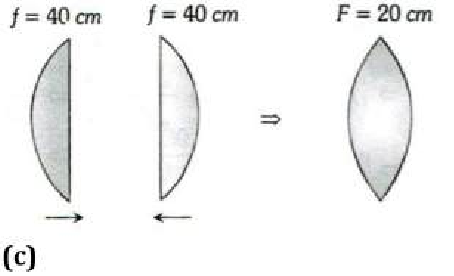
or $f_e = \frac{f_0}{50} = \frac{100}{50} = 2\ cm$

And $L_\infty = f_0 - f_e$

$\therefore L_\infty = 100\text{-}2 = 98$ cm

212 **(b)**

To obtain, an inverted and equal size image, object must be paced at a distance of $2f$ from lens, $i.e.$ 40 cm in this case



213 **(c)**

For A

Total number of waves $= \frac{(1.5)t}{\lambda}$ ... (i)

$\because \binom{\text{Total number}}{\text{of waves}} = \left(\frac{\text{optical path length}}{\text{wavelength}}\right)$

For B and C

Total number of waves $= \frac{n_B\left(\frac{t}{3}\right)}{\lambda} + \frac{(1.6)\left(\frac{2t}{3}\right)}{\lambda}$ ... (ii)

Equating (i) and (ii) $n_B = 1.3$

214 **(a)**

Cross wire arrangement is used to make measurements

215 **(c)**

The aberration of lens due to which all the rays passing through the lens are not focused at a single point and image of point object formed is blurred is called spherical aberration. It is reduced by a using two plano convex lenses separated by a distance. If the distance between the two plano convex lenses is equal to the difference in their focal lengths and the incident rays fall upon the lens of large focal length, then this combination is almost free from spherical aberration. In this divided at all the surfaces of the two lenses and so, the spherical aberration is almost removed. This method is used in removing spherical aberration in eyepieces.

216 **(a)**

$$m = \frac{f_0}{f_e} = \frac{30}{2.5} = 12$$

Resolving limit $= \frac{1.22\,\lambda}{a} = \frac{1.22 \times (5000 \times 10^{-10})}{0.1}$

$= 6.1 \times 10^{-6} rad$

217 **(a)**

$\theta = (\mu_v - \mu_r)A = 0.02 \times 5° = 0.1°$

218 **(d)**

As laws of reflection to be true for all points of the remaining part of the mirror, the image will be that of the whole object. However, as the area of the reflecting surface has been reduced, the intensity of the image will reduce (in this case half)

219 **(b)**

Blue colour of sea water is due to scattering of sunlight by water molecules.

221 **(a)**

Unit vector along incident ray

$$\hat{\text{I}} = \frac{(2\hat{\text{i}} - 3\hat{\text{j}} + 4\hat{\text{k}})}{\sqrt{29}}$$

Unit vector along normal $\hat{\mathbf{N}} = \frac{(3\hat{\text{i}} - 6\hat{\text{j}} + 2\hat{\text{k}})}{7}$

Unit vector along reflected ray

$$\hat{\mathbf{R}} = \hat{\mathbf{i}} - 2(\hat{\mathbf{i}}\,.\hat{\mathbf{j}})\hat{\mathbf{N}}$$

$$\Rightarrow \hat{\mathbf{R}} = \frac{(2\hat{\text{i}} - 3\hat{\text{j}} + 4\hat{\text{k}})}{\sqrt{29}} - 2\left(\frac{32}{7\sqrt{29}}\right) \times \left[\frac{(3\hat{\text{i}} - 6\hat{\text{j}} + 2\hat{\text{k}})}{7}\right]$$

$$\Rightarrow \hat{\mathbf{R}} = \frac{(-94\hat{\text{i}} + 237\hat{\text{j}} + 68\hat{\text{k}})}{49\sqrt{29}}$$

222 **(d)**

Because for healthy eye image is always formed at retina.

223 **(b)**

$L = f_o + f_e = 44$ and $|m| = \frac{f_o}{f_e} = 10$

This gives $f_o = 40\ cm$

224 **(c)**

The combination of two lenses is

As $\frac{4}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

$$\therefore \frac{1}{F} = (u_1 - 1)\left(\frac{1}{\infty} + \frac{1}{R}\right) + (u_2 - 1)\left(\frac{1}{-R} - \frac{1}{\infty}\right)$$

$$= \frac{u_1 - 1}{R} + \frac{u_2 - 1}{R}$$

$$\frac{1}{F} = \frac{u_1 - u_2}{R}$$

Or $F = \frac{R}{u_1 - u_2}$

225 **(a)**

When convex lens is surrounded by denser medium, it behaves like a diverging lens

226 **(a)**

The defect is myopia (near sightedness)

As we know for myopic person $f = -$(defected far point)

$\Rightarrow$ Defected far point $= -f = -\frac{1}{P} = \frac{1}{(-2)} = 0.5\ m$

$= 50\ cm$

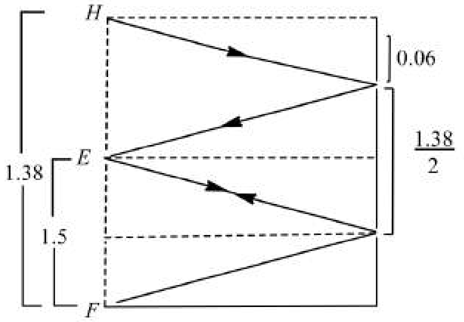
228 **(d)**

Apparent raise $= d\left(1 - \frac{1}{_a\mu_w}\right)$

$$= 12 \times \left(1 - \frac{3}{4}\right) = 12 \times \frac{1}{4} = 3 \text{ cm}$$

229 **(a)**

From the figure, it is clear that eye is at 1.38 m from the foot. Rays from foot can enter eye after reflection at M_2, whose height from ground



Again, eye is at 1.5 – 1.38 = 0.12 m from heat.
Rays from head can enter eye after reflection at M_1, whose height above eye is
$\frac{0.12}{2} = 0.06$ m
∴ Minimum length of mirror
$= 0.69 + 0.06 = 0.75$ m

230 **(c)**
In a plane mirror, the image formed is erect and of same size as of object. Thus, magnification of plane mirror is 1.

231 **(b)**
$$_1\mu_2 = \frac{1}{\sin c} = \frac{1}{\sin 45°}$$
$$= \frac{1}{1/\sqrt{2}} = \sqrt{2} = 1.414$$

232 **(d)**
$R = -30cm \Rightarrow f = -15cm$
$O = +2.5cm, u = -10\ cm$
By mirror formula $\frac{1}{-15} = \frac{1}{v} + \frac{1}{(-10)} \Rightarrow v = 30\ cm$
Also $\frac{I}{O} = -\frac{v}{u} \Rightarrow \frac{I}{(+2.5)} = -\frac{30}{(-10)} \Rightarrow I = +7.5\ cm$

233 **(c)**
For minimum deviation through a prism, the refractive index of material of prism is given by
$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$
$given, A = 60°, \mu = \sqrt{2}$
$$\therefore\ \sqrt{2} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{60°}{2}\right)}$$
$$or\ \sin\left(\frac{A+\delta_m}{2}\right) = \sqrt{2}\sin 30°$$
$$or\ \sin\left(\frac{A+\delta m}{2}\right) = \sqrt{2} \times \frac{1}{2} = \frac{1}{\sqrt{2}}$$
$$or\ \sin\left(\frac{A+\delta_m}{2}\right) = \sin 45°$$
$$or\ \frac{A+\delta_m}{2} = 45°$$
But we know angle of incidence
$$i = \frac{A+\delta_m}{2} = 45°$$

234 **(a)**
Equivalent focal length
$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$
$$= \frac{1}{20} + \frac{1}{30}$$
$$\therefore F = \frac{20 \times 30}{20 + 30}$$
$$= \frac{600}{50} = 12cm$$

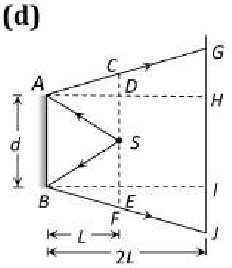
235 **(c)**
Think in terms of rectangular hyperbola

236 **(a)**
Total length $L = f_o + f_e$ and both lenses are convex

237 **(c)**
A lens shows opposite behavior if $\mu_{\text{medium}} > \mu_{\text{lens}}$

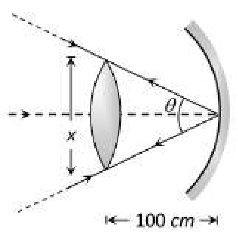
238 **(a)**
Focal length of lens will increase by four times $(i.e.\ 12\ cm)$ while focal length of mirror will not affected by medium

239 **(d)**



$HI = AB = d$
and $DS = CD = \frac{d}{2}$
$\because AH = 2AD$
$$\Rightarrow GH = 2CD = \frac{2d}{2} = d$$
Similarly $IJ = d$ so $GJ = GH + HI + IJ = d + d + d = 3d$

240 **(b)**
The angle subtended by the image of the sun at the mirror



$$= 30' = \left(\frac{1}{2}\right)^o = \frac{\pi}{360} rad$$
If x be the diameter of the image of the sun, then

$$\frac{\text{Arc}}{\text{Radius}} = \frac{x}{100} = \frac{\pi}{360}$$

$$\Rightarrow x = \frac{100\pi}{360} = 0.87\ cm$$

241 **(a)**

We know,

$$\frac{y}{D} \geq 1.22\frac{\lambda}{d}$$

$$\Longrightarrow D \leq \frac{yd}{1.22\lambda}$$

$$= \frac{10^{-3} \times 3 \times 10^{-3}}{1.22 \times 5 \times 10^{-7}}$$

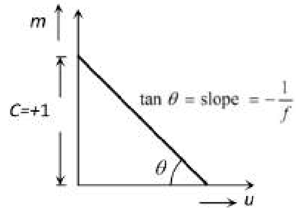
$$= \frac{30}{6.1} = 5\ m$$

$\therefore\ D_{\max} = 5m$

244 **(c)**

For a lens $m = \frac{f-v}{f} \Rightarrow m = \left(-\frac{1}{f}\right)v + 1$

Comparing this equation with $y = mx + c$ (equation of straight line)



245 **(c)**

For one prism, $\omega_1 = \frac{\delta_B-\delta_R}{\delta} = \frac{12-8}{10}\ \left[\because \delta = \frac{\delta_B+\delta_R}{2}\right]$

$$\Rightarrow \omega_1 = \frac{4}{10}$$

For other prism, $\omega_2 = \frac{\delta_B-\delta_R}{\delta} = \frac{14-10}{12}\left[\because \delta = \frac{14+10}{2}\right]$

$$\Rightarrow\ \omega_2 = \frac{4}{12} = \frac{1}{3}$$

$$\because \frac{\omega_1}{\omega_2} = \frac{4 \times 3}{10 \times 1}\ \text{or}\ \frac{\omega_1}{\omega_2} = \frac{12}{10} = \frac{6}{5}$$

246 **(d)**

$$\frac{1}{F} = (1.5 - 1)\left(\frac{1}{20} - \frac{1}{\infty}\right) \Rightarrow F = 40\ cm$$

247 **(c)**

For the eye-piece

$v_e = -25$ cm, $f_e = 5$ cm

$$\frac{1}{-25} - \frac{1}{u_e} = \frac{1}{5}$$

Or $\frac{1}{u_e} = -\frac{1}{25} - \frac{1}{5}$ or $\frac{1}{u_e} = -\frac{-1-5}{25}$

Or $u_e = -\frac{25}{6}$

Now, $v_o = L - |u_e| = 20 - \frac{25}{6}$

$$= \frac{120 - 25}{6}\text{cm} = \frac{95}{6}\text{cm}$$

Now, $\frac{1}{95/6} - \frac{1}{u_o} = \frac{1}{1}$ or $\frac{1}{u_o} = \frac{6}{95} - 1$

Or $u_0 = -\frac{95}{89}$cm or $|u_o| = \frac{95}{89}$ cm

248 **(a)**

$$\frac{I}{O} = \frac{f}{f-u} \Rightarrow \frac{I}{+6} = \frac{-f}{-f-(-4f)} \Rightarrow I = -2\ cm$$

249 **(a)**

$$\mu = \frac{c}{v} = \frac{1/\sqrt{\mu_o\varepsilon_o}}{1/\sqrt{\mu\varepsilon}} = \sqrt{\frac{\mu\varepsilon}{\mu_o\varepsilon_o}}$$

250 **(a)**

$$M = \frac{f_0}{f_e}$$

$9 = \frac{f_0}{f_e}$ or $f_0 = 9f_e$

Also, $L = f_o + f_e$ or $20 = f_o + f_e$

Or $20 = 9f_e + f_e$ or $20 = 10\ f_e$

Or $f_e = 2$ cm

$\therefore f_o = 9 \times 2$ cm $= 18$ cm

251 **(d)**

$$\frac{I_{\text{center}}}{I_{\text{edge}}} = \frac{(r^2 + h^2)^{3/2}}{h^3}$$

$$\Rightarrow 8 = \frac{(r^2 + h^2)^{3/2}}{h^3} \Rightarrow 2h = (r^2 + h^2)^{1/2}$$

$$\Rightarrow 4h^2 = r^2 + h^2 \Rightarrow 3h^2 = r^2 \Rightarrow h = \frac{r}{\sqrt{3}}$$

252 **(a)**

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

$$= (1.5 - 1)\left(\frac{1}{40} + \frac{1}{40}\right) = 0.5 \times \frac{1}{20} = \frac{1}{40}$$

$\therefore f = 40\ cm$

253 **(b)**

Let a large convex lens is placed between two walls at a distance x from wall on which an electric bulb is fixed.

Using

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$= \frac{1}{4-x} - \frac{1}{-x} \qquad (\because u = -x, v = 4 - x)$$

$$= \frac{x + 4 - x}{(4-x)(x)}$$

$$= \frac{4}{(4-x)(x)}$$

$$or\ f = \frac{(4-x)x}{4} \qquad \ldots\ldots (i)$$

Now magnification $m = \frac{v}{u} = \frac{4-x}{x}$

$$\Longrightarrow 1 = \frac{4-x}{x}$$

$\Rightarrow x = 4 - x$

$\Rightarrow 2x = 4$

$\Rightarrow x = 2m$

From eq. (i)

$$f = \frac{(4-2)(2)}{4} = \frac{2 \times 2}{4} = 1m$$

254 **(d)**

$$\frac{\delta_1}{\delta_2} = \frac{A_1}{A_2}$$

256 **(a)**

In the situation given, the image will be formed at infinity, if the object is at focus of the lens *ie*, at 20 cm from the lens. Hence, shift in position of object

$$x = 25 - 20 = \left(1 - \frac{1}{\mu}\right) t$$

$$5 = \left(1 - \frac{1}{1.5}\right) t$$

$t = 15$ cm

257 **(d)**

$$\frac{\delta_\omega}{\delta_a} = \frac{({}_\omega\mu_g - 1)}{({}_a\mu_g - 1)} = \frac{\left(\frac{9}{8} - 1\right)}{\left(\frac{3}{2} - 1\right)} = \frac{1}{4}$$

258 **(b)**

Three lenses are → objective, eye piece and erecting lens

260 **(a)**

$\mu_{blue} > \mu_{red}$

261 **(c)**

As seen from a rarer medium (L_2 or L_3) the interface L_1L_2 is concave and L_1L_3 is convex. The divergence produced by concave surface is much smaller than the convergence due to the convex surface. Hence, the arrangement corresponds to concave-convex lens

262 **(b)**

$$m = \frac{f}{f+u}$$

Now ,$+2 = \frac{f}{f-10}$

Or $2f - 20 = f$ or $f = 20$ cm

Again $-2 = \frac{20}{20+u}$ or $-40 - 2u = 20$

Or $-2u = 20 + 40$ or $u = -30$ cm

263 **(a)**

Intensity of scattered light $I \propto \frac{1}{\lambda^4}$, since λ_{blue} is least that's why sky looks blue

266 **(a)**

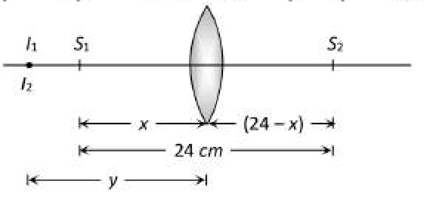
The given condition will be satisfied only if one source (S_1) placed on one side such that $u < f$ (*i.e.*, it lies under the focus). The other source (S_2) is placed on the other side of the lens such that $u > f$ (*i.e.*, it lies beyond the focus)

It S_1 is the object for lens then $\frac{1}{f} = \frac{1}{-y} - \frac{1}{-x}$

$$\Rightarrow \frac{1}{y} = \frac{1}{x} - \frac{1}{f} \quad \text{... (i)}$$

If S_2 is the object for lens then

$$\frac{1}{f} = \frac{1}{+y} - \frac{1}{-(24-x)} \Rightarrow \frac{1}{y} = \frac{1}{f} - \frac{1}{(24-x)} \quad \text{... (ii)}$$



From equations (i) and (ii)

$$\frac{1}{x} - \frac{1}{f} = \frac{1}{f} - \frac{1}{(24-x)} \Rightarrow \frac{1}{x} + \frac{1}{(24-x)} = \frac{2}{f} = \frac{2}{9}$$

$\Rightarrow x^2 - 24x + 108 = 0$. After solving the equation

$x = 18\ cm, 6\ cm$

267 **(c)**

$f = -10$ cm, $O = 5$ cm,

$u = -100$ cm, $I = ?$

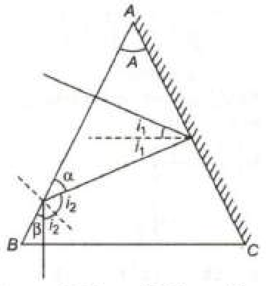
$$\frac{I}{O} = \frac{f}{f-u}$$

$$I = \frac{-10}{-10-(-100)} \times 5 = \frac{-10}{90} \times 5 \text{ cm}$$

$= -0.55$ cm

269 **(b)**

From the figure



$i_1 = 90° - (90° - A) = A$

and $\propto = 90° - 2i_1 = 90° - 2A$

$\therefore i_2 = 90° - \alpha = 90° - (90° - 2A) = 2A$

$\therefore \beta = 90° - i_2 = 90° - 2A$

From the geometry of the figure

$A + 2A + 2A = 180°$

$\therefore A = 36°$

270 **(c)**

$$v_i = -\left(\frac{f}{f-u}\right)^2 . v_o = -\left(\frac{-24}{-24-(-60)}\right)^2 \times 9$$

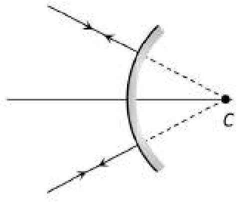
$$= -4\ cm/s$$

271 **(c)**

Here object and image are at the same position so this position must be centre of curvature

$\therefore R = 12\ cm$

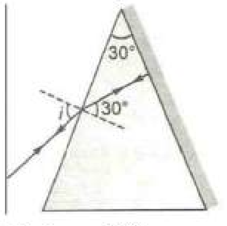
$\Rightarrow f = \frac{R}{2}$



272 **(b)**

$A = r_1 + r_2$

$\therefore 30° = r_1 + 0°$



or $r_1 = 30°$

Now, $\frac{\sin i}{\sin 30°} = \sqrt{2}$

or $\sin i = \sqrt{2} \times \frac{1}{2}$

Or $\sin i = \frac{1}{\sqrt{2}}$

Or $i = 45°$

274 **(c)**

$$f = \frac{R}{(\mu - 1)} = \frac{R}{(1.5 - 1)} = 2R$$

275 **(b)**

$${}_2\mu_1 = \frac{1}{\sin\theta} \Rightarrow \frac{\mu_1}{\mu_2} = \frac{1}{\sin\theta} \Rightarrow \frac{v_2}{v_1} = \frac{1}{\sin\theta} \Rightarrow \frac{v_2}{v} = \frac{1}{\sin\theta}$$

$$\Rightarrow v_2 = \frac{v}{\sin\theta}$$

276 **(c)**

If $n_l > n_g$ then the lens will be in more denser medium. Hence its nature will change and the convex lens will behave a concave lens

277 **(a)**

$$-\frac{1}{40} = (1.5 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{R_1} - \frac{1}{R_2} = -\frac{1}{20}$$

Now, $\frac{1}{f} = \left(\frac{1.5}{2} - 1\right)\left(-\frac{1}{20}\right)$

Or $\frac{1}{f} = -\frac{0.5}{2}\left(-\frac{1}{20}\right)$

Or $\frac{1}{f} = \frac{1}{80}$ or $f = 80$ cm

It behave like a convex lens of focal length 80 cm

278 **(c)**

Apparent shift $h = \left(1 - \frac{1}{\mu}\right)h$

$\therefore$ Apparent shift produced by water

$$\Delta h_1 = \left(1 - \frac{1}{\mu_1}\right)h_1$$

And apparent shift produced by kerosene

$$\Delta h_2 = \left(1 - \frac{1}{\mu_2}\right)h_2$$

$$\Delta h = \Delta h_1 + \Delta h_2 = \left(1 - \frac{1}{\mu_1}\right)h_1 + \left(1 - \frac{1}{\mu_2}\right)h_2$$

279 **(b)**

In microscope final image formed is enlarged which in turn increases the visual angle

280 **(a)**

Our eye lens has a power to adjust its focal length to see the nearer and father objects, this process of adjusting focal length is called accommodation. However, if the object is brought too close or bring too far from the eye, the focal length cannot be adjusted to from the image on the retina. Thus, there is minimum or maximum distance for the clever vision of an object. For a normal eye, near point or least distant vision $D = 25$ cm and far point $= \infty$

281 **(b)**

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

$$= (1.5 - 1)\left(\frac{1}{\infty} - \frac{1}{1}\right)$$

$$= 0.5(-1)$$

$$P = -0.5\ \text{D}$$

282 **(b)**

$$t = \frac{s}{v} = \frac{1.5 \times 10^8 \times 10^3}{3 \times 10^8} = 500\ s = 8.33\ min$$

283 **(c)**

Here focal length $= f$ and $u = -f$

On putting these values in $\frac{1}{f} = \frac{f}{u} + \frac{1}{v}$

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

284 **(d)**

Magnification of a compound microscope is given by

$$m = -\frac{v_o}{u_o} \times \frac{D}{u_e} \Rightarrow |m| = m_o \times m_e$$

285 **(a)**

Brewster discovered that when a beam of unpolarised light is reflected from a transparent medium (refractive index $= \mu$), the reflected light is completely plane polarized at a certain angle of incidence (called the angle of polarization θ_p)

Also, $\mu = \tan\theta_p$

$\therefore$ Here, $\theta_p = \theta_1 = \tan^{-1}(1.62)$

287 **(d)**

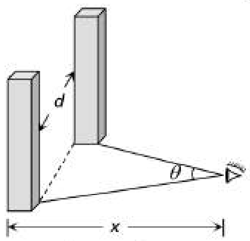
The two slabs will shift the image a distance

$$d = 2\left(1 - \frac{1}{\mu}\right)t = 2\left(1 - \frac{1}{1.5}\right)(1.5) = 1\ cm$$

Therefore, final image will be 1 cm above point P

288 **(a)**

As limit of resolution of eye is $\left(\frac{1}{60}\right)^o$, the pillars will be seen distinctly if $\theta > \left(\frac{1}{60}\right)^o$



$$i.e., \frac{d}{x} > \left(\frac{1}{60}\right) \times \frac{\pi}{180}$$

$$\Rightarrow d > \frac{\pi \times x}{60 \times 180}$$

$$\Rightarrow d > \frac{3.14 \times 11 \times 10^3}{60 \times 180} \Rightarrow d > 3.2\ m$$

289 **(a)**

Using mirror formula,

$$\frac{1}{+25/3} + \frac{1}{-u_1} = \frac{1}{+10}$$

Or $\frac{1}{u_1} = \frac{3}{25} - \frac{1}{10}$

Or $u_1 = 50$ m

And $\frac{1}{(+50/7)} + \frac{1}{-u_1} = \frac{1}{+10}$

$$\therefore \frac{1}{u_2} = \frac{7}{50} - \frac{1}{10}$$

Or $u_2 = 25$ m

Speed of object $= \frac{u_1 - u_2}{\text{time}}$

$$= \frac{25}{30}\text{ms}^{-1}$$

$= 3\ \text{kmh}^{-1}$

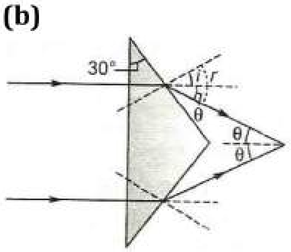
290 **(b)**

$$\frac{n_2}{n_1} = \frac{1}{\sin C}$$

$$\frac{1}{\sin C} = \frac{\lambda_1}{\lambda_2} = \frac{6000}{4000} = \frac{3}{2}$$

$$C = \sin^{-1}\left(\frac{2}{3}\right)$$

291 **(b)**



Following arguments lead us easily to the right choice

(i) Angle between any two lines is the same as the angle between their perpendiculars

$\therefore i = 30°$

(ii) $\frac{1}{1.5} = \frac{\sin 30°}{\sin r}$

Or $\sin r = \frac{1.5}{2} = 0.75$

Or $r = 48.6°$

(iii) $\theta = r - i = 18.6°$

Required angle $= 2 \times 18.6 = 37.2°$

292 **(a)**

For large objects, large image is formed on retina

293 **(b)**

$$m_\infty = -\frac{v_o}{u_o} \times \frac{D}{f_e}$$

From $\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$

$$\Rightarrow \frac{1}{(+1.2)} = \frac{1}{v_o} - \frac{1}{(-1.25)} \Rightarrow v_o = 30\ cm$$

$$\therefore |m_\infty| = \frac{30}{1.25} \times \frac{25}{3} = 200$$

294 **(c)**

$$m = \frac{f}{f - u}$$

$$-\frac{1}{4} = \frac{-12}{-12 - u} = \frac{12}{12 + u}$$

Or $12 + u = -48$ or $u = -60$ cm

295 **(b)**

Plane mirror and convex mirror always from erect images. Image formed by concave mirror may be erected or inverted depending on position of object.

296 **(d)**

By the symmetry of the rays and location of the points

297 **(b)**

The condition for achromatism is

$\omega_1 P_1 + \omega_2 P_2 = 0$

$\omega_1 P_1 = -\omega_2 P_2$

$$\Rightarrow \frac{\omega_1}{\omega_2} = -\frac{P_2}{P_1}$$

Now, $P_1 + P_2 = 2$D

Or $5 + P_2 = 2$ or $P_2 = -3$D

$$\therefore \frac{\omega_1}{\omega_2} = -\frac{-3}{5} = \frac{3}{5}$$

298 **(d)**

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

If $R_1 = R, R_2 = -R$

$$f = \frac{R}{2(\mu - 1)} = \frac{20}{2(1.5 - 1)} = 20\ cm$$

$$\because \frac{I}{O} = \frac{f}{f + u}$$

$$\frac{I}{2} = \frac{20}{20 - 30} = -2$$

$$\Rightarrow I = -4\ cm$$

Image is Real and inverted

299 **(b)**

$$\frac{\lambda_2}{\lambda_1} = \frac{4800}{6000} = 0.8$$

New resolution limit = 0.8 × 0.1 mm = 0.08 mm

300 **(a)**

$$\text{Refractive index } (\mu) = \frac{\text{real depth}}{\text{apparent depth}}$$

$$\Rightarrow \mu \propto \frac{1}{\text{apparent depth}}$$

Since, violet light is refracted the maximum and red light are least, the refractive index is maximum for violet colour and minimum for red colour. Hence, letter which appears minimum raised are red.

301 **(d)**

Let focal length of convex lens is $+f$ then focal length of concave lens would be $-\frac{3}{2}f$.

From the given condition,

$$\frac{1}{30} = \frac{1}{f} - \frac{2}{3f} = \frac{1}{3f}$$

$$\therefore f = 10 \text{ cm}$$

Therefore, focal length of convex lens = + 10 cm and that of concave lens = -15 cm.

302 **(d)**

Semi-vertical angle = critical angle

Hence, $i_C = \sin^{-1}\left(\frac{1}{1.33}\right) = 48.75 \approx 49°$

303 **(c)**

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

$$\therefore \frac{1}{20} = (1.5 - 1)\left(\frac{1}{\infty} - \frac{1}{R}\right)$$

$\frac{1}{20} = \frac{-1}{2R}, R = -10$ cm

Refraction from rarer to denser medium

$-\frac{\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$, where $u = \infty, v = f$

$$\therefore 0 + \frac{1.5}{f} = \frac{1.5 - 1}{10} = \frac{1}{20}, f = 30 \text{ cm}$$

304 **(c)**

$\frac{I_1}{O} = \frac{v}{u}$ and $\frac{I_2}{O} = \frac{u}{v} \Rightarrow O^2 = I_1 I_2$

305 **(a)**

The focal length of combination is

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

Given, $f_1 = 50\ cm, f_2 = 50\ cm$

$$\therefore \frac{1}{F} = \frac{1}{50} + \frac{1}{50} = \frac{2}{50}$$

$$\Rightarrow F = \frac{50}{2} = 25\ cm$$

Object when placed at center of curvature forms a real, inverted image of same size as object = $(2 \times 25 = 50\ cm)$

307 **(c)**

Given , the power of objective lens,

$P_0 = 0.5\ D$

The power of eye-piece lens,

$P_e = 20\ D$

The magnifying power of an astronomical telescope

$$M = \frac{f_0}{f_e}$$

$$or\ M = \frac{P_e}{P_0} \qquad \left(\because P = \frac{1}{f}\right)$$

$$= \frac{20}{0.5} = 40$$

308 **(d)**

$L = v_0 + f_e \Rightarrow v_0 = L - f_e$

Or $v_0 = 19.2$ cm

$$\frac{1}{19.2} - \frac{1}{u_0} = \frac{1}{1.6}$$

Or $-\frac{1}{u_o} = \frac{10}{16} - \frac{10}{192}$

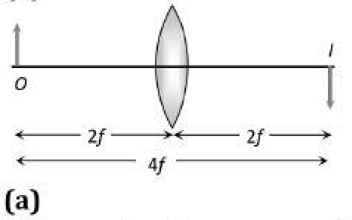
Or $-\frac{1}{u_o} = \frac{120-10}{192} = \frac{100}{192}$

Or $u_o = -\frac{192}{110}$ cm $= -1.75$ cm

309 **(c)**

$$m = \frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right)$$

310 **(d)**



311 **(a)**

Biconvex lens is cut perpendicularly to the principle axis, it will become a plano-convex lens.

Focal length of biconvex lens

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

$$\frac{1}{f} = (n - 1)\frac{2}{R} \qquad (\because R_1 = R, R_2 = -R)$$

$$\Rightarrow f = \frac{R}{2(n - 1)} \qquad \ldots\ldots(i)$$

For plano-convex lens

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

$$f^1 = \frac{R}{(n-1)} \quad \dots\dots\dots\dots(ii)$$

Comparing Eqs. (i) and (ii), we see that focal length becomes double.

Power of lens P $\propto \frac{1}{focal\ length}$

Hence, power will become half.

New power $= \frac{4}{2} = 2\ D$

312 **(c)**

After critical angle reflection will be 100% and transmission is 0 %. Options (b) and (c) satisfy this condition. But option (c) is the correct option. Because in option (b) transmission is given 100% at θ = 0°, which is not true

∴ Correct answer is (c).

314 **(a)**

Given that, the refractive index of the lens wrt air, $_a\mu_w = 1.60$

And the refractive index of water wrt air $_a\mu_w = 1.33$

The focal length of the lens in air, $f = 20cm$

We know that for a lens

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

When the lens is in the air

$$\frac{1}{20} = (\ _a\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$or\ \frac{1}{20} = (1.60 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$or\ \frac{1}{20} = 0.60 \times \left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \dots (i)$$

When the lens is in the water

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

$$or\ \frac{1}{f'} = \left(\frac{_a\mu_g}{_a\mu_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$or\ \frac{1}{f'} = \left(\frac{_a\mu_g - _a\mu_w}{_a\mu_w}\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\therefore \frac{1}{f'} = \left(\frac{1.60 - 1.33}{1.33}\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$or\ \frac{1}{f'} = \frac{27}{133}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \dots\dots\dots(ii)$$

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

$$\frac{f'}{20} = \frac{0.60 \times 1.33}{27}$$

$$or\ \ f' = 20 \times 2.95\ cm \approx 60cm$$

315 **(c)**

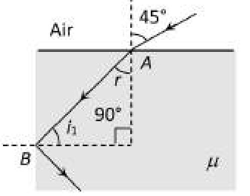
Frequency remain unchanged

316 **(b)**

At point A, by Snell's law

$$\mu = \frac{\sin 45}{\sin r} \Rightarrow \sin r = \frac{1}{\mu\sqrt{2}} \quad \dots (i)$$

At point B, for total internal reflection $\sin i_1 = \frac{1}{\mu}$



From figure, $i_1 = 90 - r$

$$\therefore \sin(90° - r) = \frac{1}{\mu}$$

$$\Rightarrow \cos r = \frac{1}{\mu} \quad \dots (ii)$$

Now $\cos r = \sqrt{1 - \sin^2 r} = \sqrt{1 - \frac{1}{2\mu^2}}$

$$= \sqrt{\frac{2\mu^2 - 1}{2\mu^2}} \quad \dots (iii)$$

From equation (ii) and (iii), $\frac{1}{\mu} = \sqrt{\frac{2\mu^2-1}{2\mu^2}}$

Squaring both side and then solving, we get $\mu = \sqrt{\frac{3}{2}}$

317 **(c)**

$\mu_{air} < \mu_{lens} < \mu_{water}$ $i.e.,\ 1 < \mu_{lens} < 1.33$

318 **(c)**

In minimum deviation position $\angle i_1 = \angle i_2$ and $\angle r_1 = \angle r_2$

319 **(a)**

$$I = \frac{L}{r^2}$$

320 **(d)**

$$\frac{_a\mu_r}{_w\mu_r} = \frac{\mu_r/\mu_a}{\mu_r/\mu_w} = \frac{\mu_w}{\mu_a} = {_a\mu_w}$$

321 **(c)**

When the object is placed at the center of the glass sphere, the rays from the object fall normally on the surface of the sphere and emerge undeviated.

322 **(c)**

$$\theta = (\mu_v - \mu_R)R = (1.6 - 1.5) \times 5 = 0.5°$$

323 **(c)**

$$c = \frac{x}{t_1}, v = \frac{10x}{t_2}$$

$$\sin C' = \frac{1}{\mu} = \frac{v}{c} = \frac{10x}{t_2} \times \frac{t_1}{x}$$

$$C' = \sin^{-1}\left(\frac{10\,t_1}{t_2}\right) \quad \dots (i)$$

324 **(d)**

$f=\frac{R}{2}\Rightarrow R=40cm$

325 **(a)**

Radio, waves can pass through dust, clouds, fog, etc, in a radio, telescope. It can detect very faint radio signal due to enormous size of its reflection. So it can be used at night and even in cloudy weather

326 **(c)**

$\mu=1=3\left(1-\frac{1}{\mu}\right)$

Or $1-\frac{1}{\mu}=\frac{1}{3}$ or $\frac{1}{\mu}=1-\frac{1}{3}=\frac{2}{3}$ or $\mu=\frac{2}{3}$

Now, $\frac{1}{\sin i_c}=\frac{3}{2}$

Or $\sin i_c=\frac{2}{3}$ or $i_c=\sin^{-1}\left(\frac{2}{3}\right)$

Or $i_c=\sin^{-1}(0.67)$

327 **(a)**

According to Cartesian sign convention

Object distance, $u=-15\ cm$

Focal length, $f=-10cm$

Using mirror formula $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}\Rightarrow\frac{1}{(-15)}+\frac{1}{v}=\frac{1}{(-10)}$

$\frac{1}{v}=\frac{1}{(-10)}-\frac{1}{(-15)}+\frac{1}{(-10)}+\frac{1}{(15)}$ or $v=-30cm$

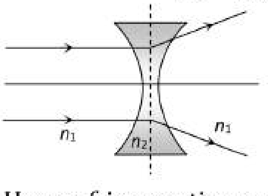
This image is 30 cm from the mirror on the same side of the object

Magnification, $m=-\frac{v}{u}=-\frac{(-30\ cm)}{(-15cm)}=-2cm$

The image is magnified, real and inverted

328 **(d)**

$\frac{1}{f}=\left(\frac{n_2}{n_1}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ where n_2 and n_1 are the refractive indices of the material of the lens and of the surroundings respectively. For a double concave lens, $\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ is always negative



Hence f is negative only when $n_2>n_1$

329 **(d)**

A concave lens always produces a virtual and erect image on the same side of the lens, which is smaller in size.

330 **(b)**

$f=-d=-100\ cm=-1\ m$

$\therefore P=\frac{1}{f}=\frac{1}{-1}=-1\ D$

331 **(a)**

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

$\frac{1}{f_1}=\left(\frac{n}{n'}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

Dividing, $\frac{f_1}{f}=\frac{(n-1)n'}{n-n'}$

Or $f_1=-\frac{fn'(n-1)}{n'-n}$

332 **(a)**

$\frac{f_l}{f_a}=\frac{{}_a\mu_g-1}{{}_l\mu_g-1}=\frac{1.5-1}{\frac{1.5}{1.75}-1}=-\frac{1.75\times0.50}{0.25}=-3.5$

$\therefore f_l=-3.5\ f_a\Rightarrow f_l=+3.5R\ [\because f_a=R]$

Hence on immersing the lens in the liquid, it behaves as a converging lens of focal length 3.5 R

333 **(a)**

A camera is a device used to take pictures, either singly or in sequence. Camera's have a lens positioned in front of the camera's opening together the incoming light and to focus the image or part of the image on the recording surface. The size of aperture (its diameter) controls the brightness of the scene control and the amount of light that enters the camera during a period of time, and the shutter controls the length of time that the light hits the recording surface.

A diameter of an aperture is measured in f- stops. A lower f- stops number opens the aperture admits more light onto the camera sensor. Higher f – stop numbers make the cameras aperture smaller so less light hits the sensor.

334 **(c)**

Two plano-convex lens of focal length f, when combined will give rise to a convex lens of focal length $f/2$

The image will be of same size if object is placed at $2f$ *i.e.*, at a distance f from optical centre

336 **(d)**

Since ${}_a\mu_g=\sqrt{2}$, so ${}_g\mu_a=\frac{\sin i}{\sin r}=\frac{1}{\sqrt{2}}$

$\therefore\sin r=1\Rightarrow r=90°$

337 **(b)**

Sodium light gives emission spectrum having two yellow lines

338 **(d)**

Length of image $=\left(\frac{f}{f-u}\right)b$

339 **(b)**

At the time of sunrise and sunset, the sun is near the horizon. The rays from the sun have to travel a larger part of the atmosphere. As $\lambda_b<\lambda_r$, and intensity of scattered light $\propto \frac{1}{\lambda^4}$, therefore, most of the blue light is scattered away, only red colour, which is least scattered enters our eyes and appears to come from the sun. Hence, the sun looks red both at the time of sunrise and sunset.

341 **(d)**

If a lens of focal length f is divided into two equal parts as shown in figure (i) and each has a focal length f' then

$$\frac{1}{f}=\frac{1}{f'}+\frac{1}{f'}\ ie, f'=2f$$

ie, each part will have focal length $2f$

Now if these parts are put in contact as in figure (2), then resultant focal length of the combination will be

$$\frac{1}{F}=\frac{1}{2f}+\frac{1}{2f} ie, F=f\ (initial\ value)$$

For this combination,

$$\frac{1}{F}=\left({}_a\mu_g-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad \ldots\ldots\ldots\ldots(i)$$

Now, if this combination is immersed in liquid, then

$$\frac{1}{F'}=\left({}_1\mu_g-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad \ldots\ldots(ii)$$

$$\frac{F'}{f}=\frac{\left({}_a\mu_g-1\right)}{\left({}_1\mu_g-1\right)}=\frac{(1.5)-1)}{\left(\frac{\frac{3}{2}}{\frac{4}{3}}-1\right)}$$

$$or\ \frac{F'}{f}=\frac{0.5}{\left(\frac{9}{8}-1\right)}=0.5\times 8$$

$\therefore$ F′$=0.5\times 8\times 10=40cm$

342 **(b)**

The angular range is clearly twice the critical angle

343 **(d)**

$$\frac{1}{f}=\left(\frac{\mu_1}{\mu_2}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\frac{1}{f}=\left(\frac{3/2}{4/3}-1\right)\left(\frac{1}{0.3}+\frac{1}{0.3}\right)$$

Or $\frac{1}{f}=\left(\frac{9}{8}-1\right)\left(\frac{2}{0.3}\right)$

Or $\frac{1}{f}=\frac{1}{8}\times\frac{2}{0.3}$ or $f=1.20$ m

344 **(b)**

$f=-15cm, m=+2$ [Positive because image is virtual]

$\because m=-\frac{v}{u}\Rightarrow v-2u.$ By using mirror formula

$$\frac{1}{-15}=\frac{1}{(-2u)}+\frac{1}{u}\Rightarrow u=-7.5\ cm$$

345 **(a)**

$$n=\frac{\text{Real depth}}{\text{Apparent depth}}=\frac{6}{4}=\frac{3}{2}$$

$$\frac{n_1}{u}+\frac{n_2}{v}=\frac{n_1\sim n_2}{R}$$

$$\frac{1.5}{6}-\frac{4}{17}=\frac{1.5-1}{R}$$

$R=34$ cm

346 **(c)**

$\delta_{net}=\delta_{mirror}+\delta_{prism}$

$=(180-2i)+(\mu-1)A$

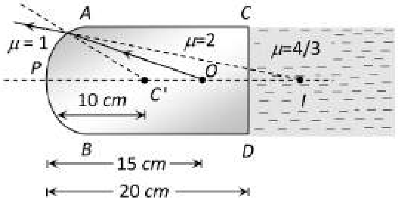
$=(180-2\times 45)+(1.5-1)\times 4=92°$

347 **(b)**

In case of refraction from a curved surface, we have

$$\frac{\mu_2}{v}-\frac{\mu_1}{u}=\frac{\mu_2-\mu_1}{R}\Rightarrow\frac{1}{v}-\frac{2}{(-15)}=\frac{(1-2)}{-10}\Rightarrow v$$

$=-30\ cm$



$i.e.$, the curved surface will form virtual image I at distance of 30 cm from P. Since the image is virtual there will be no refraction at the plane surface CD (as the rays are not actually passing through the boundary), the distance of final image I from P will remain 30 cm

349 **(a)**

A lens made of three different materials as shown has only one focal length. Thus, for a given object there is only on image.

350 **(c)**

The optical fibres are used to transmit light signals from one place to another without any practical loss in the intensity of light signal. It works on the principle of total internal reflection.

351 **(a)**

We know that $\delta=i+e-A\Rightarrow e=\delta+A-i$

$=30°+30°-60°=0°$

$\therefore$ Emergent ray will be perpendicular to the face. Therefore it will make an angle of 90° with the face through which it emerges

352 **(c)**

Distance of jeep, $x=\frac{D\times d}{1.22\times\lambda}$

Where D = diameter of lens

d = separation between sources.

$$\Rightarrow x=\frac{(2\times 10^{-3})\times 1.2}{1.22\times 5896\times 10^{-10}}$$

$= 3337\ m$

$\Rightarrow x = 3.34\ km$

353 **(a)**

$\mu = \frac{h'}{h} \Rightarrow h' = \mu h = \frac{4}{3} \times 18 = 24\ cm$

354 **(b)**

Focal length for violet colour is minimum

357 **(d)**

Out of the given choices concave mirror can produce real image.

Provided the object is not placed between the pole and focus of concave mirror.

358 **(b)**

Speed of light is given by

$v = \frac{c}{n} = \frac{3 \times 10^8}{1.5} = 2 \times 10^8\ \mathrm{ms^{-1}}$

359 **(b)**

Resolving power of microscope $\propto \frac{1}{\lambda}$

360 **(b)**

According to lens makers formula

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

Since $\mu_{\text{Red}} < \mu_{\text{violet}} \Rightarrow f_v < f_r$ and $F_v < F_r$

Note: Always keep in mind that whenever you are asked to compared (greater than or less than) u, v or f you must not apply sign conventions for comparison

362 **(d)**

Convergence (or power) is independent of medium for mirror

363 **(d)**

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{60} + \frac{1}{(-20)} \Rightarrow F = -30$

364 **(b)**

$m = \frac{f}{f - u}$

If $m = +3$, then

$3 = \frac{-24}{-24 - u}$

Or $-24 - u = -8$ or $u + 24 = 8$

Or $u = 8 - 24\ \mathrm{cm} = -16\ \mathrm{cm}$

If $m = -3$, then

$-3 = \frac{-24}{-24 - u}$

$u + 24 = -8$

Or $u = -32\mathrm{cm}$

365 **(b)**

The first images is due to reflection from the front surface *ie* unpolised surface of the mirror. So, only a small fraction is the incident light energy is reflected. The second image is due to reflection from polished surface. So, a major portion of light is reflected. Thus, the second image is the brightest

366 **(d)**

Given focal length of concave mirror

$f = -15$ cm

$u = -20$ cm

Magnification $m = \frac{f}{u - f} = \frac{-15}{-20 + 15}$

$m = 3$ cm

The area enclosed by the image of the wire

$= m^2 = 9\ \mathrm{cm^2}$

367 **(b)**

$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$-\frac{du}{u^2} - \frac{dv}{v^2} = 0$

or $-\frac{dv}{v^2} = \frac{du}{u^2}$

Or $\frac{dv}{dt} = -\frac{v^2}{u^2}\frac{du}{dt} = -\frac{10 \times 10}{30 \times 30} \times 9\ \mathrm{ms^{-1}} = -1\ \mathrm{ms^{-1}}$

368 **(a)**

$\frac{f}{f - u} = \frac{1}{4} = \frac{f}{f - (-0.5)}$

Or $4f = f + 0.5$ or $3f = 0.5$

Or $f = \frac{0.5}{3}\mathrm{m} = 0.17\mathrm{m}$

369 **(c)**

The critical angle C is given by

$\sin C = \frac{n_2}{n_1} = \frac{\lambda_1}{\lambda_2} = \frac{3500}{7000} = \frac{1}{2} \Rightarrow C = 30°$

370 **(d)**

For a lens $m = \frac{f - v}{f} = -\frac{1}{f}v + 1$

Comparing it with $y = mx + c$

Slope $= m = -\frac{1}{f}$

From graph, slope of the line $= \frac{b}{c}$

Hence $-\frac{1}{f} = \frac{b}{c} \Rightarrow |f| = \frac{c}{b}$

372 **(d)**

$I = \frac{L}{r^2}$

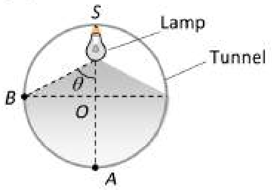
$\Rightarrow \frac{dI}{I} = -\frac{2dr}{r}$ $\quad [\because L = \text{constant}]$

$\Rightarrow \frac{dI}{I} \times 100 = -\frac{2 \times dr}{r} \times 100 = -2 \times 1 = -2\%$

373 **(c)**

The rainbow is seen as a virtual image in the form of a coloured are centered on the anti-solar point that is the point below the horizon, directly opposite the sun in the sky. When conditions are favorable two rainbows are seen the brighter is the primary and a fainter second one with the colours reversed. Hence, both primary and secondary rainbow are virtual images.

374 **(d)**



$I_A = \frac{L}{(2r)^2}$ and $I_B = \frac{L}{(r\sqrt{2})^2}\cos\theta$

$= \frac{L}{2r^2}\cdot\frac{r}{r\sqrt{2}} = \frac{L}{2\sqrt{2}\,r^2}$

$\therefore \frac{I_A}{I_B} = \frac{2\sqrt{2}}{4} = \frac{1}{\sqrt{2}}$

375 **(a)**

For vacuum $t = n\,\lambda_o$ ...(i)

For air $t = (n+1)\lambda_a$ ...(ii)

From equation (i) and (ii)

$t = \frac{\lambda}{\mu - 1} = \frac{6\times10^{-7}}{1.0003 - 1}\left(\mu = \frac{\lambda_o}{\lambda_a}\right)$

$= 2\times10^{-3}m = 2mm$

376 **(d)**

Time of exposure $\propto \frac{1}{(\text{Aperture})^2}$

377 **(c)**

$\frac{f_l}{f_a} = \frac{({}_a\mu_g - 1)}{({}_l\mu_g - 1)} \Rightarrow f_l = \infty$ if ${}_l\mu_g = 1 \Rightarrow {}_a\mu_l = {}_a\mu_g$

378 **(b)**

Focal length of convex lens

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

$R_1 = 10$ cm, $R_2 = -10$ cm, $\mu = 1.5$ (for glass)

$\frac{1}{f} = (1.5 - 1)\left(\frac{1}{10} - \frac{1}{-10}\right)$

$= 0.5\left(\frac{2}{10}\right)$

$f = \frac{10}{2\times0.5}$

$\Rightarrow f = 10$ cm

$\therefore$ Focal length of concave mirror

$= 10$ cm

$\therefore$ Radius of curvature $= 2\times10 = 20$ cm

379 **(a)**

$u = -25\ cm, v = +75\ cm$

$\Rightarrow \frac{1}{f} = \frac{1}{+75} - \frac{1}{-25} \Rightarrow f = +18.75\ cm$; convex lens

380 **(a)**

We have

$\sin C = \frac{1}{\mu}$

But $\mu = \frac{v_2}{v_1} = \frac{1480}{340}$

$\therefore \sin C = \frac{340}{1480}$

Or $C = \sin^{-1}\left(\frac{340}{1480}\right)$

$= 13.28° \approx 13.3°$

381 **(b)**

$m = 1 + \frac{D}{f} = 1 + DP$ [m increases with P]

382 **(d)**

For first lens, $\mu_1 = -30cm, f_1 = 10cm$

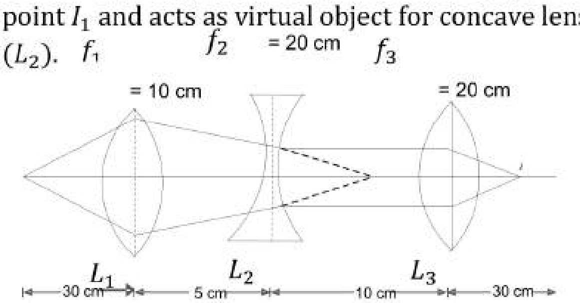
$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$or\ \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$

$or\ \frac{1}{v} = \frac{1}{10} - \frac{1}{30} = \frac{1}{15}$

$or\ v = 15\ cm$

Therefore, image formed by convex lens (L_1) is at point I_1 and acts as virtual object for concave lens (L_2).



The image I_1 is formed at focus of concave lens (as shown) and so emergent rays will be parallel to the principle axis. For lens L_2 , μ_2 =15-5=10 cm, f_2=-10cm. These parallel rays are incident on the third convex lens (L_3) and will be brought to convergence at the focus of the lens (L_3)

Hence , distance of final image from third lens L_3

$v_2 = f_3 = 30\ cm$

383 **(c)**

For no deviation,

$(\mu - 1)A + (\mu' - 1)A' = 0$

$\Rightarrow A' = -\frac{(\mu - 1)A}{(\mu' - 1)} = \frac{(1.54 - 1)4°}{(1.72 - 1)} = -3°$

Negative sign implies that two prisms should be connected in opposition.

384 **(b)**

When an object is placed in front of such a lens, the rays are first of all refracted from the convex surface and again refracted from convex surface. Let f_1, f_m be focal lengths of convex surface and mirror (plane polished surface) respectively, then effective focal length is

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_m}+\frac{1}{f_1}=\frac{2}{f_1}+\frac{1}{f_m}$$

Since,

$$f_m=\frac{R}{2}=\infty$$

$$\therefore \frac{1}{F}=\frac{2}{f_1}$$

From lens formula

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

$$\therefore \frac{1}{F}=\frac{2(\mu-1)}{R}$$

$$\Rightarrow F=\frac{R}{2(\mu-1)}$$

$$or\ R_{eq}=2F=\frac{R}{(\mu-1)}$$

385 **(b)**

When a ray of light passes from glycerine (denser, $\mu=1.47$) to water (rarer, $\mu=1.33$) the angle of refraction (r) is greater than angle of incidence (i), then from Snell's law

$$\frac{\sin i}{\sin r}=\frac{\mu_2}{\mu_1}<1$$

When $r=90°$, corresponding angle of incidence is known as critical angel, *ie*, $i=\theta_C$

$$\therefore \frac{\sin\theta_C}{\sin 90°}=\frac{\mu_2}{\mu_1}$$

$$\Rightarrow \sin\theta_C=\frac{\mu_2}{\mu_1}$$

$$\Rightarrow \theta_C=\sin^{-1}\left(\frac{\mu_2}{\mu_1}\right)$$

$$=\sin^{-1}\left(\frac{1.33}{1.47}\right)$$

$$\theta_C=64°48'$$

386 **(b)**

Note that two refractive indices are involves. Therefore, two images will be formed

389 **(a)**

Image formed by convex mirror is virtual for real object placed anywhere

390 **(a)**

Wavelength in vacuum,

$$\lambda=\frac{3\times10^8}{5\times10^{14}}\times10^{10}Å=0.6\times10^4Å$$

$=6000Å$

Now, $\mu=\frac{\lambda}{\lambda'}$

Or $\lambda'=\frac{\lambda}{\mu}=\frac{6000}{1.5}Å=4000\ Å$

391 **(a)**

When two lenses are separated by some distance x, then equivalent power

$$P=P_1+P_2-xP_1P_2$$

$$\therefore P=5+5-x\times5\times5$$

$$or\ P=10-25x$$

Power P will be negative, if 10-25x will be negative

ie, $25x>10$

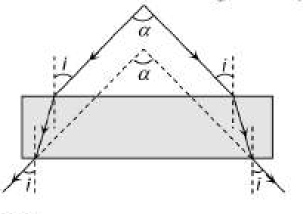
$$or\ x>\frac{10}{25}$$

$$or\ x>\frac{10}{25}\times100\ cm$$

$$or\ x>40\ cm$$

394 **(b)**

Since rays after passing through the glass slab just suffer lateral displacement hence we have angle between the emergent rays as α



395 **(c)**

$\delta\propto(\mu-1)\Rightarrow\mu_R$ is least so δ_R is least

396 **(a)**

The combined focal length of plano-convex lens

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}$$

Given, $f_1=\infty(for\ plane\ surface), f_2=f(say)$

$$\therefore \frac{1}{F}=\frac{1}{\infty}+\frac{1}{f}$$

$$\Rightarrow F=f$$

Now when concave lens of same focal length is joined to first lens , then combined focal length

$$\frac{1}{F'}=\frac{1}{F_1}+\frac{1}{F_2}$$

$$=\frac{1}{f}-\frac{1}{f}\qquad(\because F_1=f, F_2=-f)$$

$=0$

$F'=\infty$

Thus, the image can be focused on infinity (∞) or focus shifts to infinity.

397 **(b)**

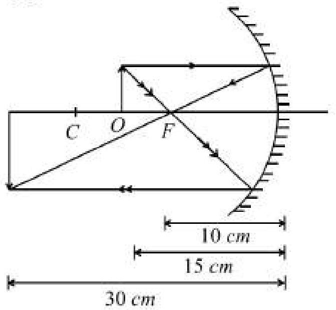
In compound microscope objective forms real image while eye piece forms virtual image

398 **(a)**

For viewing far objects, concave lenses are used and for concave lens

u = wants to see $= -60cm$; v = can see $=$ $-15\ cm$ so from $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow f = -20\ cm$

399 **(a)**



According to New Cartesian sign convention,

Object distance $u = -15\ cm$

Focal length of a concave lens, $f = -10\ cm$

Height of the object $h_o = 2.0\ cm$

According to mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

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

This image is formed 30 cm from the mirror on the same side of the object. It is a real image

Magnification of the mirror, $m = \frac{-v}{u} = \frac{h_I}{h_O}$

$$\Rightarrow \frac{-(-30)}{-15} = \frac{h_I}{2} \Rightarrow h_I = -4\ cm$$

Negative sign shows that image is inverted

The image is real, inverted, of size 4 cm at a distance 30 cm in front of the mirror

401 **(a)**

For the objective, $\frac{1}{v_o} - \frac{1}{-1/3.8} = \frac{1}{1/4}$

Or $\frac{1}{v_o} + 3.8 = 4$ or $\frac{1}{v_o} = 0.2 = \frac{1}{5}$

or $v_0 = 5$ cm

Now, $M_0 = \frac{5}{-\frac{1}{3.8}} = -19$

Again, $M = M_O \times M_e$

$-95 = -19 \times M_e$ or $M_e = \frac{95}{19} = 5$

402 **(b)**

Frequency does not change with medium but wavelength and velocity decrease with the increase in refractive index

403 **(b)**

$$f = \frac{R}{\mu - 1} = \frac{10}{(1.5-1)} = 20\ cm$$

$$\frac{1}{f} = \frac{2}{f_1} + \frac{1}{f_m}, f_m = \infty \Rightarrow f = \frac{f_1}{2} = \frac{20}{2} = 10\ cm$$

404 **(b)**

$$f = \frac{f_1 f_2}{f_1 + f_2} = \frac{10(-10)}{10 + (-10)} = \frac{-100}{10 - 10} = \infty$$

405 **(c)**

$$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right) \text{ or } f = \frac{R}{2(\mu - 1)}$$

Now ,$f > R$

$$\therefore \frac{R}{2(\mu - 1)} > R$$

Or $\frac{1}{2(\mu-1)} > 1$ or $2(\mu - 1) < 1$

Or $\mu - 1 < \frac{1}{2}$ or $\mu < \left(1 + \frac{1}{2}\right)$

Or $\mu < 1.5$

406 **(c)**

$$n = \frac{f}{f + u}$$

$$f + u = \frac{f}{n}$$

Or $u = \frac{f}{n} - f = \left(\frac{1-n}{n}\right) f$

Or $u = -\left(\frac{n-1}{n}\right) f, |u| = \frac{n-1}{n} f$

407 **(a)**

According to mirror formula

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

Here $u = -9$ m and $f = -1$ m

$$\frac{1}{(-1)} - \frac{1}{(-9)} = \frac{1}{v}$$

$$\Rightarrow v = -\frac{9}{8}\text{m}$$

As the object moves at a constant speed of 5 m/s after 1 s the new position of image is

$$u' = -9\text{ m} + 5\text{ m} = -4\text{ m}$$

$$\therefore \frac{1}{(-1)} - \frac{1}{(-4)} = \frac{1}{v'}$$

$$\Rightarrow v' = -\frac{4}{3}\text{m}$$

The shift in the position of image in 1 s is

$$v - v' = -\frac{9}{8} + \frac{4}{3} = \frac{1}{5}$$

$\therefore$ Average speed of image $= \frac{1}{5}$m/s

408 **(d)**

The image of object at infinity should be formed at 100 cm from the eye

$$\frac{1}{f}=\frac{1}{\infty}-\frac{1}{100}=-\frac{1}{100}$$

So the power $=\frac{-100}{100}=-1\ D$

[Distance is given in cm but $P=\frac{1}{f}$ in $metres$]

409 **(b)**

$$\mu=\cot\frac{A}{2}=\frac{\sin(\frac{A+\delta m}{2})}{\sin A/2}$$

$$or\ \frac{\cos\frac{A}{2}}{\sin\frac{A}{2}}=\frac{\sin(\frac{A+\delta m}{2})}{\sin A/2}$$

$$or\ \sin\left(90°-\frac{A}{2}\right)=\sin\left(\frac{A+\delta m}{2}\right)$$

$$or\ 90°-\frac{A}{2}=\left(\frac{A+\delta m}{2}\right)$$

$$or\ 180°-A=A+\ \delta m$$

$$\delta m=180°-2A=\pi-2A$$

410 **(c)**

$$\frac{\text{Speed of light in air}}{\text{Speed of light in aqueous humor}}$$

$$=\frac{\text{Wavelength of light in air}}{\text{Wavelength of light in aqueous humor}}$$

$$\Rightarrow\frac{v_1}{v_2}=\frac{\lambda_1}{\lambda_2}$$

$$\text{Or } v_2=\frac{\lambda_2}{\lambda_1}\times v_1=\frac{474}{633}\times 3\times 10^8$$

$$=2.25\times 10^8\text{ms}^{-1}$$

411 **(a)**

$$M=\frac{f_o}{f_e},10=\frac{f_o}{20},f_0=200\text{ cm}$$

412 **(a)**

$$I\propto\frac{1}{r^2}\Rightarrow\frac{I_2}{I_1}=\frac{r_1^2}{r_2^2}=\frac{60^2}{180^2}=\frac{1}{9}$$

413 **(b)**

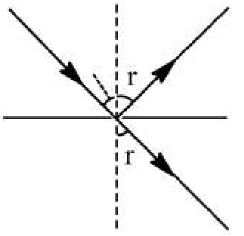
Here $i=r$

$r'=90°-r$

So, $\mu=\frac{\sin r'}{\sin r}=\frac{\sin(90°-r)}{\sin r}$

$$\mu=\frac{\cos r}{\sin r}=\frac{1}{\tan r}$$

But $\mu=\frac{1}{\sin C}$



Where C is the critical angle.

So, $\frac{1}{\sin C}=\frac{1}{\tan r}$

$\Rightarrow\sin C=\tan r$

Or $C=\sin^{-1}(\tan r)$

414 **(c)**

$$m=m_o\times m_e\Rightarrow m=m_o\times\left(1+\frac{D}{f_e}\right)$$

$$\Rightarrow 100=10\times\left(1+\frac{25}{f_e}\right)\Rightarrow f_e=\frac{25}{9}cm$$

415 **(a)**

$$n=\frac{360°}{72°}=5$$

Note that $\frac{360}{\theta}$ is odd and object line asymmetrically

416 **(d)**

$$f=\frac{1.6}{2}\text{m}=0.8\text{m},u=-1\text{ m}$$

$$\frac{1}{v}=\frac{1}{0.8}-\frac{1}{-1}=\frac{10}{8}+1=\frac{18}{8}=\frac{9}{4}$$

Or $v=\frac{4}{9}$m

417 **(a)**

$$\frac{1}{f_a}=(\mu-1)(\frac{1}{R_1}-\frac{1}{R_2})$$

$$=(1.5-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)\quad\ldots\ldots\ldots\ldots(i)$$

$$and\ \frac{1}{f_m}=\frac{\mu_g-\mu_m}{\mu_m}(\frac{1}{R_1}-\frac{1}{R_2})$$

$$\frac{1}{f_m}=\left(\frac{1.5}{1.6}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)\quad\ldots\ldots\ldots(ii)$$

Thus,

$$\frac{f_m}{f_a}=\frac{(1.5-1)}{\left(\frac{1.5}{1.6}-1\right)}=-8$$

$$f_m=-8\times f_a$$

$$=-8\times\frac{-1}{5}\qquad\left(\because f_a=\frac{1}{p}=-\frac{1}{5}m\right)$$

$$=1.6\ m$$

$$\therefore P_m=\frac{\mu}{f_m}$$

$$=\frac{1.6}{1.6}=1D$$

418 **(b)**

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

$$\sqrt{2} = \frac{\sin\left(\frac{60^\circ+\delta_m}{2}\right)}{\sin\frac{60^\circ}{2}}$$

$$\frac{1}{\sqrt{2}} = \sin\left(\frac{60^\circ+\delta_m}{2}\right)$$

Or $\sin 45^\circ = \sin\left(\frac{60^\circ+\delta_m}{2}\right)$

$\delta_m = 30^\circ$

Or $i = \frac{A+\delta_m}{2}$

$$= \frac{60+30}{2} = \frac{90}{2} = 45^\circ$$

419 **(c)**

$\mu_g \sin\theta_c = \mu_1 \sin 90^\circ$

Or $\mu_g \sin\theta_c = 1$

When water is poured,

$\mu_w \sin r = \mu_s \sin\theta_c$ or $\mu_w \sin r = 1$

Again, $\mu_a \sin\theta = \mu_w \sin r$

Or $\mu_a \sin\theta = 1$

Or $\sin\theta = 1$ or $\theta = 90^\circ$

420 **(d)**

Form displacement method size of object, $O = \sqrt{I_1 I_2}$

Here, $O = 3$ cm, $I_1 = 9$ cm

$\therefore 3 = \sqrt{9I_2}$

Or $I_2 = 1$ cm

421 **(a)**

Shift $= t\left(1 - \frac{1}{\mu}\right)$

$1 = 3\left(1 - \frac{1}{\mu}\right)$ or $\frac{1}{3} = 1 - \frac{1}{\mu}$

Or $\frac{1}{\mu} = 1 - \frac{1}{3} = \frac{2}{3}$ or $\mu = \frac{3}{2} = 1.5$

422 **(a)**

$A(\mu_v - \mu_r) + A'(\mu'_v - \mu'_r) = 0^\circ \Rightarrow A' = 5^\circ$

423 **(d)**

$P_1 = \frac{100}{20} = 5\,D, P_2 = \frac{100}{25} = 4D$

Effective power $P = P_1 + P_2$

$= 5 + 4 = 9$ D

424 **(b)**

Lens-maker's formula is given by

$$\frac{1}{f} = ({}_a\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \qquad \text{... (i)}$$

If the lens is immersed in a liquid of refractive index μ_1 then

$$\frac{1}{f_1} = ({}_l\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \qquad \text{... (ii)}$$

Here, ${}_l\mu_g$ is refractive index of glass w.r.t liquid

Dividing Eq. (i) by Eq. (ii), we have

$$\frac{f_1}{f} = \frac{({}_a\mu_g - 1)}{({}_l\mu_g - 1)}$$

$$\Rightarrow \frac{f_1}{f} = \left(\frac{1.5 - 1}{\frac{1.5}{1.25} - 1}\right)$$

$$\Rightarrow \frac{f_1}{f} = \frac{0.5 \times 1.25}{0.25} = 2.5$$

Hence, focal length increases by a factor of 2.5.

425 **(d)**

$v = -15cm, u = -300cm$

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

$$\Rightarrow \frac{1}{f} = \frac{1}{-15} - \frac{1}{-300} = \frac{-19}{300}$$

$$\Rightarrow f = \frac{-300}{19} = -15.8\ cm$$

and power $P = \frac{100}{f_{in\ cm}} = \frac{-100\times19}{300}$

$= -6.33\ D$

426 **(b)**

$$E_0 = \frac{I}{r^2} = \frac{I}{(4)^2} = \frac{I}{16}$$

$$E_p = \frac{I\cos\theta}{r'^2} = \frac{I \times (415)}{(5)^2}$$

$$= \frac{4I}{125}$$

$$\therefore \frac{E_0}{E_p} = \frac{I}{16} \times \frac{125}{4I} = \frac{125}{64}$$

429 **(a)**

$$\mu = \frac{h}{h'} \Rightarrow h' = \frac{8}{4/3} = 6\ m$$

430 **(a)**

As there is no deflection between medium 1 and 2. Therefore, $\mu_1 = \mu_2$

431 **(d)**

$$\frac{I'}{I} = \frac{40 \times 40}{50 \times 50} = \frac{16}{25}$$

$$1 - \frac{I'}{I} = 1 - \frac{16}{25} = \frac{9}{25}$$

or $\frac{I-I'}{I} \times 100 = \frac{9}{25} \times 100 = 36\%$

432 **(b)**

According to Cartesian sign convention

$u = -40$ cm, $R = -20$ cm

$\mu_1 = 1,\ \mu_2 = 1.33$

Applying equation for refraction through spherical surface, we get

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

$$\frac{1.33}{v} - \frac{1}{-40} = \frac{1.33}{-20}$$

After solving, $v = -32$ cm

The magnification is $m = \frac{h_2}{h_1} = \frac{\mu_1 v}{\mu_2 u}$

$\therefore \frac{h_2}{1} = -\frac{1(32)}{1.33(-40)}$

Or $h_2 = 0.6$ cm

The positive sign shows that the image is erect

433 **(c)**

Power of spectacles, $P = 2\ D$

Since, power is positive so lens used is convex which is used for the purpose of removing hypermetropia.

434 **(a)**

Refractive index of diamond is

$\mu = \frac{\text{velocity of light in air}}{\text{velocity of light in diamond}}$

$2 = \frac{3.0 \times 10^{10}}{\text{velocity of light in diamond}}$

So, velocity of light in diamond is

$= \frac{3.0 \times 10^{10}}{2} = 1.5 \times 10^{10} \text{cms}^{-1}$

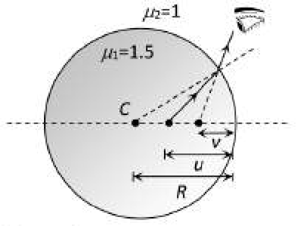
435 **(c)**

$\mu_1 = 2, \mu_2 = \frac{3}{2}$

$2 \sin i \geq \frac{3}{2} \sin 90° \Rightarrow \sin i \geq \frac{3}{4} \Rightarrow i \geq \sin^{-1}\left(\frac{3}{4}\right)$

436 **(a)**

$v = 1\ cm, R = 2\ cm$



By using

$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\frac{1}{-1} - \frac{1.5}{u} = \frac{1 - 1.5}{-2}$

$\Rightarrow u = -1.2\ cm$

437 **(a)**

Lens maker's formula

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

Where , $R_2 = \infty, R_1 = 0.3$ m

$\therefore \frac{1}{f} = \left(\frac{5}{3} - 1\right)\left(\frac{1}{0.3} - \frac{1}{\infty}\right)$

$\Rightarrow \frac{1}{f} = \frac{2}{3} \times \frac{1}{0.3}$

Or $f = 0.45$ m

438 **(b)**

For an equilateral prism, angle of prism of refracting angle $A = 60°$

Here, $\delta_m = A = 60°$

$\therefore$ Refractive index,

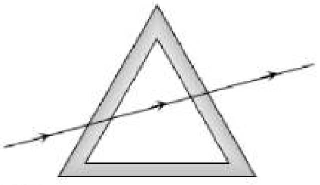
$\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\frac{A}{2}} = \frac{\sin\left(\frac{60° + 60°}{2}\right)}{\sin\left(\frac{60°}{2}\right)}$

$= \frac{\sin 60°}{\sin 30°} = \frac{\sin 60°}{\cos 60°}$

$= \tan 60° = \sqrt{3}$

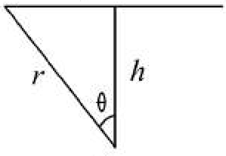
439 **(a)**

Effectively there is no deviation or dispersion



440 **(c)**

$E = \frac{I \cos\theta}{r^2} \Rightarrow E = \frac{Ih}{r^3}$



Or $E \propto \frac{1}{r^3}$

441 **(c)**

Distance of object from mirror $= 15 + \frac{33.25}{1.33} =$ 40 cm

Distance of image from mirror $= 15 + \frac{25}{1.33} =$ 33.8 cm

For the mirror, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

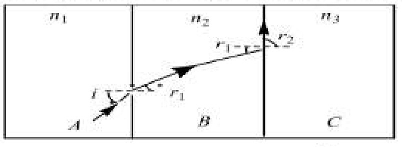
$\therefore \frac{1}{-33.8} + \frac{1}{-40} = \frac{1}{f}$

$\therefore f = -18.3$ cm

$\therefore$ Most suitable answer is (c).

442 **(a)**

Applying Snell's law between the surfaces A and B



$n_1 \sin i = n_2 \sin r_1$ ... (i)

Again applying Snell's law between surfaces B and C

$n_2 \sin r_1 = n_3 \sin r_2$ ... (ii)

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

$n_1 isn\ i = n_3 \sin r_2$

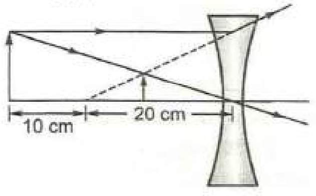
Here, $r_2 = 90°$

$\therefore n_1 \sin i = n_3$

$\Rightarrow \sin i = \frac{n_3}{n_1}$

443 **(b)**

When an object is placed between $2f$ and f (focal length) of the diverging lens, the image is virtual, erect and diminished as shown in the graph. To calculate the distance of the image from the lens, we apply



$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{-20} = \frac{1}{v} - \frac{1}{30}$

$\Rightarrow v = -\frac{(20)(30)}{20+30}$

$= -12$ cm (to the left to the diverging lens.)

444 **(b)**

For a telescope, magnification when final image is formed at infinity

$m_\infty = \frac{f_0}{f_e} = \frac{100}{10} = 10$

446 **(c)**

A simple microscope is just a convex lens with object lying between optical centre and focus of the lens

447 **(d)**

For real image $m = -2$

$\therefore m = \frac{f}{u+f} \Rightarrow -2 = \frac{f}{u+f} = \frac{20}{u+20} \Rightarrow u$

$= -30\ cm$

448 **(c)**

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

For biconvex lens $R_2 = -R_1$ $\therefore \frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right)$

Given $R = \infty$ $\therefore f = \infty$, so no focus at real distance

449 **(b)**

Erect and enlarged image can produced by concave mirror

$\frac{I}{O} = \frac{f}{f-u} \Rightarrow \frac{+3}{+1} = \frac{f}{f-(-4)} \Rightarrow f = -6\ cm$

$\Rightarrow R = 2f = -12\ cm$

451 **(a)**

The real depth $= \mu$ [apparent depth]

$\Rightarrow$ In first case, the real depth $h_1 = \mu(b - a)$

Similarly in the second case, the real depth $h_2 = \mu(d - c)$

Since $h_2 > h_1$, the difference of real depths

$= h_2 - h_1 = \mu(d - c - b + a)$

Since the liquid is added in second case,

$h_2 - h_1 = (d - b) \Rightarrow \mu = \frac{(d-b)}{(d-c-b+a)}$

453 **(b)**

Optical path $\mu x =$ constant

$i.e., \mu_1 x_1 = \mu_2 x_2$

$\Rightarrow 1.53 \times 4 = \mu_2 \times 4.5$

$\Rightarrow \mu_w = \frac{1.53 \times 4}{4.5} = 1.36$

454 **(a)**

Focal length of converging lens $f = +10$ cm

$u = -9$ cm

From lens formula

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

or $\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{10} + \frac{1}{(-9)}$

$\frac{1}{v} = \frac{1}{10} - \frac{1}{9}$

Or $v = -90\ cm$

Magnification, $m = \frac{v}{u} = \frac{-90}{-9} = 10$m

$\therefore$ Apparent area of card through lens

$= 10 \times 10 \times 1 \times 1 = 100\ mm^2 = 1\ cm^2$

455 **(b)**

For the relaxed eye, magnifying power is

$M = -\frac{v_0}{u_0}\frac{D}{f_e}$

$\therefore -45 = -\frac{v_0}{u_0} \times \frac{25}{5}, \frac{v_0}{u_0} = 9$

For objective lens, image is real

$\therefore v_0 = +v_0, u_0 = -\frac{v_0}{9}$

Given, $f_0 = 1$ cm

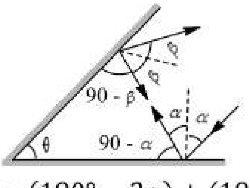
Form $\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$

$\frac{1}{v_0} + \frac{9}{v_0} = \frac{1}{1}$; $v_0 = 10$ cm

Length of the tube $= v_0 + f_e = 10 + 5 = 15$ cm

456 **(c)**

Total deviation



$= (180° - 2\alpha) + (180° - 2\beta)$

$= 360° - 2(\alpha + \beta)$

But $90° - \alpha + 90° - \beta + \theta = 180°$

Or $\theta = \alpha + \beta$

$\therefore$ Total deviation $= 360° - 2\theta$

457 **(c)**

If eye is kept at a distance d then $MP = \frac{L(D-d)}{f_o f_e}$, MP decreases

458 **(c)**

When f_1 and f_2 are focal lengths of lenses combined together, image formation takes place as follows

From lens formula

$$\frac{1}{v'} - \frac{1}{u} = \frac{1}{f_1} \quad \ldots\ldots\ldots (i)$$

$$\frac{1}{v} - \frac{1}{v'} = \frac{1}{f_2} \quad \ldots\ldots (ii)$$

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

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2}$$

If this lens is replaced by a single lens, then focal length of combination is

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow F = \frac{f_1 f_2}{f_1 + f_2}$$

459 **(a)**

Here we treat the line on the objective as the object and the eyepiece as the lens

Hence $u = -(f_o + f_e)$ and $f = f_e$

Now $\frac{1}{v} - \frac{1}{-(f_o+f_e)} = \frac{1}{f_e}$

Solving we get $v = \frac{(f_o+f_e)f_e}{f_o}$

Magnification $= \left|\frac{v}{u}\right| = \frac{f_e}{f_o} = \frac{\text{Image size}}{\text{Object size}} = \frac{l}{L}$

$\therefore$ Magnification of telescope in normal adjustment

$$= \frac{f_o}{f_e} = \frac{L}{l}$$

460 **(d)**

$$\frac{I}{O} = \frac{v}{u}$$

$$\frac{I}{15} = \frac{-25}{-10}$$

$I = 15 \times 2.5 \text{ cm} = 37.5 \text{ cm}$

461 **(d)**

$$\mu = \frac{c_a}{c_w} = \frac{t_w}{t_a} \Rightarrow t_w = \frac{25}{3} \times \frac{4}{3} = 11\frac{1}{9} = 11 \text{ min } 6\, s$$

462 **(b)**

Wavelength of a certain colour in air $\lambda_{air} =$ 600 nm.

Wavelength of a certain colour in glass of refractive index $\mu = 1.5$

$$\therefore \lambda_{glass} = \frac{\lambda_{air}}{\mu_{glass}} = \frac{600}{1.5}$$

$\lambda_{glass} = 400$ nm

Also, $v_{glass} = \frac{v_{air}}{\mu_{glass}} = \frac{3 \times 10^8}{1.5}$

$v_{glass} = 2.0 \times 10^8 \text{ ms}^{-1}$

463 **(a)**

$\frac{1}{F} = \frac{1}{+18} + \frac{1}{(-19)} \Rightarrow F = -18\, cm$ (*i.e.*, concave lens)

464 **(d)**

In minimum deviation $i = e = 30°$, so angle between emergent ray and second refracting surface is $90° - 30 = 60°$

465 **(b)**

Critical angle C is equal to incident angle if ray reflected normally $\therefore C = 90°$

466 **(b)**

Red light is used in danger signals so that the danger signals can be seen distinctly up to large distances. The light used in the danger signals should not get scattered much, while passing through the atmosphere. Since, the red colour is scattered through a small amount due to its longer wavelength, the danger signals make use of red light.

467 **(a)**

For concave mirror

$u = -\frac{15}{2}$ cm, $v = ?$

$f = -\frac{10}{2}$ cm $= -5$ cm

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-5} - \frac{1}{-15/2}$$

$$= -\frac{1}{5} + \frac{2}{15} = \frac{-1}{15}$$

Or $v = -15$ cm

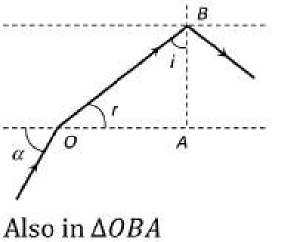
Clearly, the position of the final image is on the pole of the convex mirror

468 **(b)**

Here the requirement is that $i > c$

$\Rightarrow \sin i > \sin c \Rightarrow \sin i > \frac{\mu_2}{\mu_1}$ ... (i)

From Snell's law $\mu_1 = \frac{\sin \alpha}{\sin r}$ ...(ii)



Also in ΔOBA

$r + i = 90° \Rightarrow r = (90 - i)$

Hence from equation (ii)

$\sin\alpha = \mu_1 \sin(90 - i)$

$\Rightarrow \cos i = \frac{\sin\alpha}{\mu_1}$

$\sin i = \sqrt{1-\cos^2 i} = \sqrt{1-\left(\frac{\sin\alpha}{\mu_1}\right)^2}$ ... (iii)

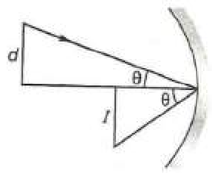
From equation (i) and (iii) $\sqrt{1-\left(\frac{\sin\alpha}{\mu_1}\right)^2} > \frac{\mu_2}{\mu_1}$

$\Rightarrow \sin^2\alpha < (\mu_1^2 - \mu_2^2) \Rightarrow \sin\alpha < \sqrt{\mu_1^2-\mu_2^2}$

$\alpha_{max} = \sin^{-1}\sqrt{\mu_1^2-\mu_2^2}$

469 **(a)**

$\frac{I}{d} = \frac{f}{u}$



Or $I = \frac{d}{u} f$ or $I = \theta f$

470 **(d)**

Resolving power $= \frac{d}{1.22\,\lambda} = \frac{0.1}{1.22\times 6000\times 10^{-10}}$

$\equiv 1.36\times 10^5 radian$

471 **(b)**

For glass-water interface ${}_g\mu_w = \frac{\sin i}{\sin r}$

For water air interface ${}_w\mu_a = \frac{\sin r}{\sin 90^\circ}$

$\Rightarrow {}_g\mu_w \times {}_w\mu_a = \frac{\sin i}{\sin r}\times\frac{\sin r}{\sin 90^\circ} = \sin i$

or $\frac{\mu_w}{\mu_g}\times\frac{\mu_a}{\mu_w} = \sin i$

$\Rightarrow \mu_g = \frac{1}{\sin i}$

473 **(d)**

If initially the objective (focal length F_o) forms the image at distance v_o then $v_o = \frac{u_o f_o}{u_o - f_o} = \frac{3\times 2}{3-2} = 6\ cm$

Now as in case of lenses in contact

$\frac{1}{F_o} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \cdots = \frac{1}{f_1} + \frac{1}{F_o'}$

$\left\{\text{where} \frac{1}{F_o'} = \frac{1}{f_2} + \frac{1}{f_3} + \cdots\right\}$

So if one of the lens is removed, the focal length of the remaining lens system

$\frac{1}{F_o'} = \frac{1}{F_0} - \frac{1}{f_1} = \frac{1}{2} - \frac{1}{10} \Rightarrow F_o' = 2.5\ cm$

This lens will form the image of same object at a distance v_o' such that

$v_o' = \frac{u_o F_o'}{u_o - F_o'} = \frac{3\times 2.5}{(3-2.5)} = 15\ cm$

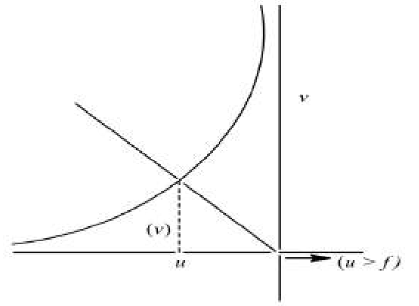
So to refocus the image, eye-piece must be moved by the same distance through which the image formed by the objective has shifted *i.e.* $15 - 6 = 9\ cm$

474 **(b)**

Due to high refractive index its critical angle is very small so that most of the light incident on the diamond is total internally reflected repeatedly and diamond sparkles

475 **(a)**

It is possible when object kept at center of curvature.

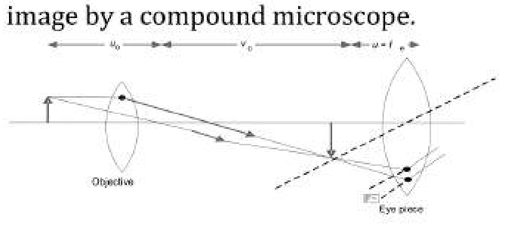


$u = v$

$u = 2f, v = 2f.$

476 **(a)**

The following ray diagram shows the formation of image by a compound microscope.



Given, $f_e = 10$ cm, $f_0 = 4$ cm, $u_0 = -5$ cm, $D = 20$ cm

For objective lens

$\frac{1}{f_0} = \frac{1}{v_0} - \frac{1}{u_0}$

$\frac{1}{4} = \frac{1}{v_0} - \frac{1}{-5}$

$\Rightarrow \frac{1}{v_0} = \frac{1}{4} - \frac{1}{5} = \frac{1}{20}$

$\Rightarrow v^0 = 20cm$

Magnification $M = -\frac{v_0}{u_0} = \left(1 + \frac{D}{f_e}\right)$

$= -\frac{20}{-5}\left(1 + \frac{20}{10}\right) = 4(1+2) = 12$

477 **(c)**

$I_1 = \frac{L}{r_1^2} = \frac{L}{16}$ and $I_2 = \frac{L}{r_2^2} = \frac{L}{9}$

% increase in illuminance

$= \frac{I_2 - I_1}{I_1} \times 100 = \left(\frac{16}{9} - 1\right) \times 100 \approx 78\%$

478 **(a)**

For lens $u =$ wants to see $= -30\ cm$

And $v =$ cab see $= -10\ cm$

$\therefore \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{(-30)} \Rightarrow f = -15\ cm$

480 **(b)**

$r = f\tan\theta$

Or $r \propto f$

$\therefore \quad \pi r^2 \propto f^2$

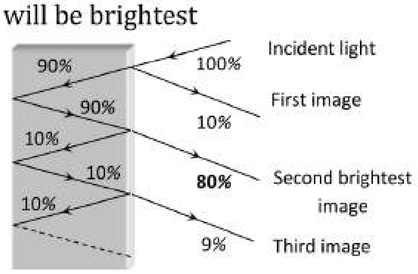
481 **(c)**

$\frac{f_l}{f_a} = \frac{_a\mu_g - 1}{_l\mu_g - 1} = \frac{_a\mu_g - 1}{\frac{_a\mu_g}{_a\mu_l} - 1} \Rightarrow \frac{f_1}{2} = \frac{1.5 - 1}{\frac{1.5}{1.25} - 1} \Rightarrow f_1$

$= 5cm$

483 **(b)**

Several images will be formed but second image will be brightest



484 **(b)**

$n = \frac{360°}{\theta} - 1$

$3 = \frac{360°}{\theta} - 1$

$\theta = 90°$

485 **(a)**

For a microscope $|m| = \frac{v_o}{u_o} \times \frac{D}{u_e}$ and $L = v_o + u_e$

For a given microscope, with increase in L, u_e will increase and hence magnifying power (m) will decrease

486 **(d)**

$f = \frac{1}{(\mu - 1)}$ and $\mu \propto \frac{1}{\lambda}$. Hence $f \propto \lambda$ and $\lambda_r > \lambda_v$

488 **(a)**

$D_F = \frac{d^2}{\lambda}$

$D_F = \frac{3 \times 10^{-3}(3 \times 10^{-3})}{500 \times 10^{-9}} = \frac{90}{5}\text{m} = 18\text{m}$

489 **(b)**

When object is in rarer medium and observer is in denser medium.

Normal shift, $d = (n - 1)h$

Where $h =$ real depth

Here, $h = y$

Now, apparent depth or the apparent height of the bird from the surface of the water $= y + (n - 1)y = ny$

The total distance of the bird as estimated by fish is$x + ny$.

490 **(a)**

$\mu = \frac{h}{h'} \Rightarrow h' = \frac{h}{n}$

491 **(d)**

Given refracting angle of prism P

$A_P = 3°$

And refractive index of prism P

$\mu_P = 1.5$

And refractive index of prism Q

$\mu = 1.6$

$(\mu_P - 1)A_P = (\mu_0 - 1)A_Q$

$(1.5 - 1)3° = (1.6 - 1)A_Q$

Or $0.5 \times 3 = 0.6 \times A_Q$

Or $A_Q = \frac{0.5 \times 3}{0.6}$

Or $A_Q = 2.5°$

492 **(a)**

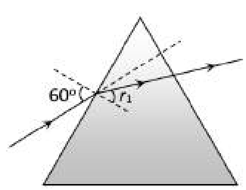
The communication using optical fibres is based on the principle of total internal reflection.

493 **(d)**

From figure it is clear that $\angle e = \angle r_2 = 0$

From $A = r_1 + r_2 \Rightarrow r_1 = A = 45°$

$\therefore \mu = \frac{\sin i}{\sin r_1} = \frac{\sin 60}{\sin 45} = \sqrt{\frac{3}{2}}$



Also from $i + e = A + \delta \Rightarrow 60 + 0 = 45 + \delta \Rightarrow \delta = 15°$

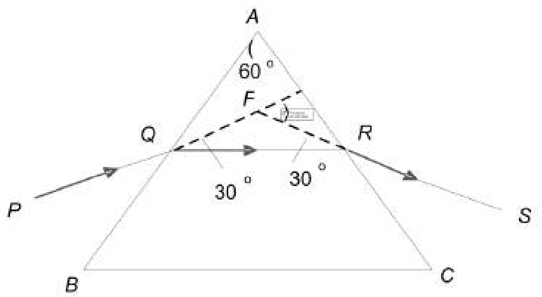
494 **(a)**

For a given prism, the angle of deviation depends upon the angel of incidence of the light rays falling on the prism

Taking triangle $F\ PQR$, we have

$S = \angle FQR + \angle FRQ$

Since, ΔAQR is an equilateral triangle, therefore,



$\angle FQR = \dfrac{60°}{2} = 30° = \angle FRQ$

$\therefore\ \delta = 30° + 30° = 60°$

Hence, angle of deviation of the ray is 60°.

495 **(d)**

Think in terms of rectangular hyperbola

496 **(b)**

For achromatic combination $\frac{f_1}{f_2} = -\frac{\omega_2}{\omega_1} = -\frac{0.036}{0.024} = -\frac{3}{2}$ and $\frac{1}{f_1} - \frac{1}{f_2} = \frac{1}{90}$

Solving above equations we get $f_1 = 30cm, f_2 = -45cm$

497 **(a)**

Magnifying power of a telescope having objective of focal length (f_0) and image distance (u_e) is

$M = -\dfrac{f_0}{u_e}$

To see with relaxed eye final image should be formed at infinity.

The distance between the objective and eyepiece is so adjusted the image is formed at the focus of the eyepiece.

Substituting $v_e = f_e$, we get

$|M| = \dfrac{f_0}{f_e} = \dfrac{F_1}{F_2}$

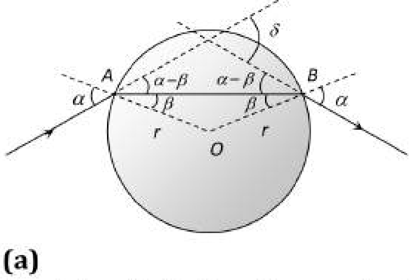
498 **(a)**

Incandescent electric lamp gives continuous emission spectrum. Mercury and sodium vapour lamp give line emission spectrum

499 **(b)**

From the following ray diagram it is clear that

$\delta = (\alpha - \beta) + (\alpha - \beta) = 2(\alpha - \beta)$



501 **(a)**

Resolving limit of eye is one minute (1')

502 **(a)**

$\dfrac{1}{f} = \left(\dfrac{\mu_g}{\mu_m} - 1\right)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$

Here $f = \infty$ So $\frac{1}{f} = 0 \therefore \mu_g = \mu_m$

503 **(b)**

For a compound microscope $f_{objective} < f_{eye\ piece}$

504 **(b)**

$f \propto \frac{1}{\mu - 1}$ and $\mu \propto \frac{1}{\lambda}$

505 **(a)**

Power of lens, P (in dioptre) $= \frac{100}{\text{focal length } f \text{ (in cm)}}$

$\therefore f = \dfrac{100}{10} = 10\ cm$

According to lens maker's formula

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

For biconvex lens $R_1 = +R, R_2 = -R$

$\therefore \dfrac{1}{f} = (\mu - 1)\left(\dfrac{1}{R} + \dfrac{1}{R}\right)$

$\Rightarrow \dfrac{1}{f} = (\mu - 1)\left(\dfrac{2}{R}\right)$

$\dfrac{1}{10} = (\mu - 1)\left(\dfrac{2}{10}\right)$

$\Rightarrow (\mu - 1) = \dfrac{1}{2}$

$\mu = \dfrac{1}{2} + 1 = \dfrac{3}{2}$

507 **(c)**

$m = -\dfrac{f_0}{f_e}$

$m' = \dfrac{m}{2}$

508 **(d)**

Here, $i_1 = 60°, A = 30°, \delta = 30°$

As $i_1 + i_2 = A + \delta$,

$i_2 = 0$

Hence, angle between the ray and the face from which it emerges $= 90° - 0° = 90°$

509 **(d)**

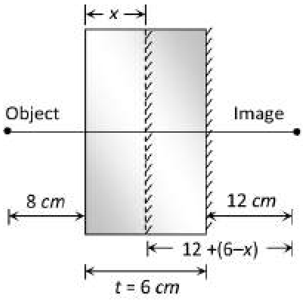
${}_a\mu_g = \dfrac{1}{\sin C}$

$\Rightarrow \sin C = \dfrac{1}{{}_a\mu_g}$

As μ for violet colour is maximum, so sin C is minimum and hence critical angle C is minimum for violet colour.

511 **(c)**

Let x be the apparent position of the silvered surface



According to property of plane mirror

$x + 8 = 12 + 6 - x \Rightarrow x = 5\ cm$

Also $\mu = \frac{t}{x} \Rightarrow \mu = \frac{6}{5} = 1.2$

513 **(a)**

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

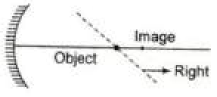
$$= 2\cos\frac{A}{2}$$

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

$$= 2\cos^{-1}\left(\frac{1.5}{2}\right) = 2\cos^{-1}\left(\frac{3}{4}\right)$$

514 **(b)**

Since object and image move in opposite directions, the positioning should be as shown in the figure. Object lies between focus and center of curvature $f < x < 2f$.



515 **(a)**

When the final image is formed at infinity by a telescope, it is called in normal adjustment and then length of the telescope is given by

$L = f_0 + f_e$

Where f_0 is the focal length of objective lens and f_e is the focal length of eye-piece

$\therefore L = f_0 + f_e = 0.3 + 0.05 = 0.35\ m$

516 **(c)**

Total power $P = P_1 + P_2 = 11 - 6 = 5\ D$

Also $\frac{f_l}{f_a} = \frac{({}_a\mu_g - 1)}{({}_l\mu_g - 1)} \Rightarrow \frac{P_a}{P_l} = \frac{({}_a\mu_g - 1)}{({}_l\mu_g - 1)}$

$$\Rightarrow \frac{5}{P_l} = \frac{(1.5-1)}{(1.5/1.6-1)} \Rightarrow P_l = -0.625\ D$$

517 **(c)**

For $m = 1, u = 2f = 40\ cm$

518 **(b)**

Refractive index, $\mu = \frac{1}{\sin C}$

$$\mu = \frac{c}{v}$$

$$\therefore \frac{c}{v} = \frac{1}{\sin C}$$

$$\Rightarrow \frac{3 \times 10^8}{v} = \frac{1}{\sin 30°}$$

$v = 1.5 \times 10^8\ ms^{-1}$

519 **(b)**

Resolving power ∝ Aperture

520 **(d)**

A microscope consists of lens of small focal lengths. A telescope consists of objective lens of large focal length

521 **(c)**

$P = P_1 + P_2 \Rightarrow P = +2 + (-1) = +1D$

$$f = \frac{+100}{P} = \frac{+100}{1} = 100\ cm$$

523 **(a)**

For normally emerge $e = 0$

Therefore $r_2 = 0$ and $r_1 = A$

Snell's law for incident ray's

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

For small angle

$i = \mu A$

524 **(a)**

$$\frac{\omega_1}{\omega_2} = -\frac{f_1}{f_2} \Rightarrow \frac{5}{3} = \frac{-(-15)}{f_2} \Rightarrow f_2 = 9\ cm$$

525 **(b)**

The refractive index of water with respect to air

$$\mu = \frac{C_{air}}{C_{water}} = \frac{v\lambda_{air}}{v\lambda_{water}}, \mu = 1.33$$

$\therefore \lambda$ in water $= \frac{\lambda_{air}}{\mu} \Rightarrow \lambda$ in water $= \frac{589}{1.33} nm$

$\Rightarrow \lambda$ in water $= 443\ nm$

527 **(b)**

Neon street sign emits light of specific wavelength

528 **(c)**

Due to the absorption of certain wavelengths by the elements in outer layers of sun

529 **(a)**

The coverging lens used for magnification is called simple microscope or a magnifier.

When image is formed at D, the least distance of distinct vision, then magnifying power

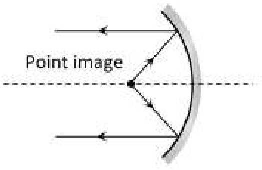
$$M = 1 + \frac{D}{f}$$

Given, $D = 25$ cm, $f = 10$ cm

$$\therefore M = 1 + \frac{25}{10} = 1 + 2.5 = 3.5$$

530 **(b)**

Object should be placed on focus of concave mirror



532 **(d)**

$m=\frac{f}{f-u}$

$\frac{1}{2}=\frac{200}{200-u}$

$200-u = 400$

$u = -200$ cm

$u = -2$ m

533 **(d)**

$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$ and $m=\frac{v}{u}= -\frac{I}{O}$

Using above relation, the length of image

$I=\frac{f^2}{x-f}$

535 **(c)**

$f\propto\frac{1}{\mu-1}$ and $\mu\propto\frac{1}{\lambda}$

536 **(b)**

$\because \angle i>\angle r$, it means light ray is going from rarer medium (A) to denser medium

So $v(A)>v(B)$ and $n(A)<n(B)$

537 **(b)**

When final image formed at normal adjustment, then length of compound microscope,

$L=v_0+u_e =\frac{u_0f_0}{(u_0+f_0)}+\frac{f_eD}{f_e+D}$

$=-\frac{-1.2\times 1}{-1.2+1}+\frac{2.5\times 25}{2.5+25}$

$6 + 2.27 = 8.27 \approx 8.3\ cm$

538 **(b)**

For correcting the near point, required focal length

$f=\frac{50\times 25}{(50-25)}=50cm$

So power $P=\frac{100}{50}=+2D$

For correcting the far point, required focal length

$f=-$ (defected far point) $=-3\ m$

$\therefore P=-\frac{1}{3}D=-0.33\ D$

539 **(a)**

The dispersive power for crown glass $\omega=\frac{n_v-n_r}{n_y-1}$

$=\frac{1.5318-1.5140}{(1.5170-1)}=\frac{0.0178}{0.5170}=0.034$

and for flint glass $\omega'=\frac{1.6852-1.6434}{(1.6499-1)}=0.064$

540 **(a)**

Since $A(\mu_y-1)+A'(\mu_{y'}-1)=0\Rightarrow\frac{A'}{A}=-\frac{(\mu_y-1)}{(\mu_{y'}-1)}$

541 **(b)**

$I\propto\frac{1}{r^2}$

542 **(c)**

$f_o=\frac{1}{1.25}=0.8\ m$ and $f_e=\frac{1}{-20}=-0.05\ m$

$\therefore |L_\infty|=|f_o|-|f_e|=0.8-0.05=0.75m$

$=75\ cm$

and $|m_\infty|=\frac{f_o}{f_e}=\frac{0.8}{0.05}=16$

543 **(d)**

Angular resolution $d\theta=\frac{1.22\lambda}{a}$

$=\frac{1.22\times 5000\times 10^{-10}}{10\times 10^{-2}}=6.1\times 10^{-6}rad$

544 **(a)**

$\mu=1.5$

$\delta_m=A$

We know that

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

$1.5=\frac{\sin\left(\frac{A+A}{2}\right)}{\sin\frac{A}{2}}=\frac{\sin A}{\sin\frac{A}{2}}$

$1.5=\frac{2\sin\frac{A}{2}.\cos\frac{A}{2}}{\sin\frac{A}{2}}$

$1.5=2\cos\frac{A}{2}$

$\cos\frac{A}{2}=\frac{1.5}{2}=0.75$

$cos41.4=0.75$

$\frac{A}{2}=41.4$

$A=82.8$

546 **(c)**

Refraction from lens

$\frac{1}{v_1}=\frac{1}{-20}=\frac{1}{15}$

$\therefore\quad v=60\ cm+ve$ direction

Ie, first image is formed at 60 cm to the right of lens system.

Reflection from mirror After reflection from the mirror, the second image will be formed at a distance of 60 cm to the left of lens system.

Refraction from lens $\frac{1}{v_3}-\frac{1}{60}=\frac{1}{15}+$ ve direction

Or $v_3=12\ cm$

Therefore, the final image is formed at 12 cm to the left of the lens system.

547 **(a)**

$\underset{\text{(Primary)}}{\text{Yellow}} + \underset{\text{(Primary)}}{\text{Blue}} = \underset{\text{(Secondary)}}{\text{Green}}$

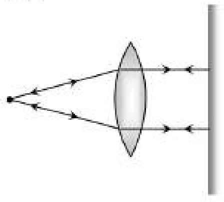
548 **(d)**

$$m_{\max} = 1 + \frac{D}{f} = 1 + \frac{25}{2.5} = 11$$

550 **(d)**

R.P. of microscope $= \frac{2\mu \sin\theta}{\lambda}$

551 **(a)**



When the object is placed at focus the rays are parallel. The mirror placed normal sends them back. Hence image is formed at the object itself as illustrated in figure

552 **(b)**

Let S be the light source. If light falls on the surface at critical angle C, it grazes along the surface as shown.

$$\sin C = \frac{1}{n} = \frac{1}{5}$$

From ΔQSR, we have

$$\tan C = \frac{QR}{QS} = \frac{r}{4}$$

$$\Rightarrow \frac{3}{4} = \frac{r}{4}$$

$$\Rightarrow r = 3$$

Hence, diameter $= 2r = 2 \times 3 = 6$ m

553 **(b)**

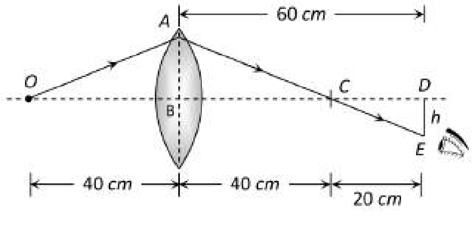
$$h' = \frac{d_1}{\mu_1} + \frac{d_2}{\mu_2} = d\left(\frac{1}{\mu_1} + \frac{1}{\mu_2}\right)$$

554 **(d)**

Colour blindness is a genetic disease and still cannot be cured

555 **(c)**

In the following ray diagram Δ's, ABC and CDE are symmetric



So, $\frac{AB}{AC} = \frac{DE}{CD} \Rightarrow \frac{5}{40} = \frac{h}{20} \Rightarrow h = 2.5\ cm$

557 **(a)**

Since, lens is made of two layers of different refractive indices, for a given wavelength of light it will have two focal lengths or will form two images at two different points as there are μ's as

$$\frac{1}{f} \propto (\mu - 1)$$

559 **(a)**

$L_\infty = v_o + f_e \Rightarrow 14 = v_o + 5 \Rightarrow v_o = 9\ cm$

Magnifying power of microscope for relaxed eye

$$m = \frac{v_o}{u_o} \cdot \frac{D}{f_e} \text{ or } 25 = \frac{9}{u_o} \cdot \frac{25}{5} \text{ or } u_o = \frac{9}{5} = 1.8\ cm$$

560 **(b)**

For normal vision (relaxed eye), the image is formed at infinity. Hence the magnifying power of Gallilean telescope $= \frac{f_o}{f_e} = \frac{200}{2} = 100$

561 **(b)**

In concave mirror, if virtual images are formed, u can have values zero and f

At $u = 0, m = \frac{f}{f-u} = \frac{f}{f} = 1$

At $u = f, m = \frac{f}{f-u} = -\frac{f}{-f-(-f)} = \infty$

562 **(b)**

$$\frac{f_l}{f_a} = \frac{{}_a\mu_g - 1}{{}_l\mu_g - 1} = \frac{(1.5-1) \times 1.7}{(1.5 - 1.7)}$$

$$\Rightarrow f_1 = \frac{0.85}{-0.2} f_a = -4.25\ f_a$$

563 **(d)**

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} - \frac{1}{-15} = \frac{1}{10}$$

Or $\frac{1}{v} = -\frac{1}{15} + \frac{1}{10}$

Or $\frac{1}{v} = \frac{-2+3}{30}$

Or $v = 30$ cm

564 **(c)**

$$m = 1 + \frac{D}{f_e} \Rightarrow 10 = 1 + \frac{25}{f_e} \Rightarrow f_e = \frac{25}{9} \simeq 25\ mm$$

565 **(c)**

Resolving power of the telescope is

$$= \frac{a}{1.22\lambda}$$

Where $a =$ diameter of aperture of objective lens

$\lambda =$ wavelength of light

Therefore, resolving power $\propto a$

As aperture of the objective lens increases, resolving power of telescope increases.

566 **(c)**

$f = -d = -60\ cm$

$\therefore P = \frac{100}{f} = -\frac{100}{60} = -\frac{10}{6} = -1.66\ D$

567 **(c)**

Resultant focal length $= \infty$

$\therefore$ It behaves as a plane slab of glass

568 **(b)**

All colour are reflected

569 **(c)**

Velocity of light water in material is

$v = v\lambda$ ... (i)

Refractive index of material is

$\mu = \frac{c}{v}$ ... (ii)

Where c is speed of light in vacuum or air

or $\mu = \frac{c}{v\lambda}$ ... (iii)

Given, $v = 2 \times 10^{14}$Hz,

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

$c = 3 \times 10^{8}\text{ms}^{-1}$

Hence, from Eq (iii), we get

$$\mu = \frac{3 \times 10^8}{2 \times 10^{14} \times 5000 \times 10^{-10}} = 3.00$$

570 **(c)**

Convexity of lens changes by the pressure applied by ciliary muscles

571 **(a)**

$$t = \frac{\mu x}{c} = \frac{3 \times 4 \times 10^{-3}}{3 \times 10^8} = 4 \times 10^{-11} s$$

573 **(d)**

$$\mu = \frac{1}{\sin C} \Rightarrow C = \sin^{-1}\left(\frac{1}{2}\right) = 30°$$

574 **(a)**

Here, $x = u + v$

As $m = \frac{f}{f+u} = \frac{f-v}{f}$

and image is real, magnification is negative

$$\therefore -m = \frac{f}{f+u}, u = \frac{-(m+1)f}{m}$$

From $-m = \frac{f-v}{f} \Rightarrow v = (m+1)f$

Put in Eq.(i)

$$x = \frac{-(m+1)}{m}f + (m+1)f$$

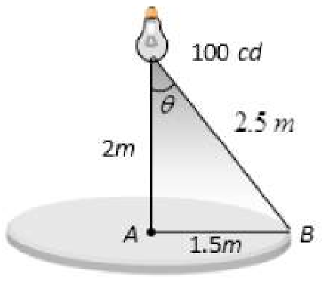
Solving ,we get, $f = \frac{mx}{(m+1)^2}$

575 **(c)**

Since intensity $\propto$ (Aperature)^2, so intensity of image will decrease but no change in the size occurs

576 **(a)**

Case I

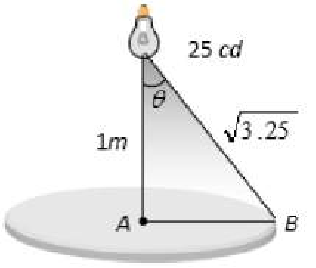


$$I_A = \frac{100}{2^2} = 25\ cd$$

and $I_B = \frac{100}{(2.5)^2}\cos\theta$

$$= \frac{100}{2.5^2} \times \frac{2}{2.5} = \frac{200}{(2.5)^3}$$

Case II



$$I_B' = X\, I_B = \frac{25}{(3.25)^{3/2}}$$

so $\frac{I_B'}{I_B} = \frac{25}{200} \times \frac{(2.5)^3}{(3.25)^{3/2}}$

$\Rightarrow X = 1/3$

577 **(b)**

The image formed by a plane mirror is virtual, erect, laterally inverted, equal in size as that of the object and at a distance equal to the distance of the object in front of the mirror.

578 **(c)**

When incident angle is greater than critical angle, then total internal reflection takes place and will come back in same medium

579 **(d)**

For least distance, the angular magnification of simple microscope is

$$M = 1 + \frac{D}{f}$$

$or\ M = 1 + DP$

And for normal adjustment

$$M = \frac{D}{f}$$

$or\ M = DP$

Hence, if the angular magnification of simple microscope increases then the power of the lens should increase.

580 (d)

$A=30°, \mu=\sqrt{2}$. As we know

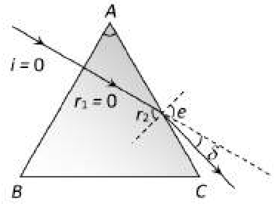
$A=r_1+r_2=0+r_2 \Rightarrow A=r_2$

Applying Snell's law for the surface AC

$$\frac{1}{\mu}=\frac{\sin r_2}{\sin e}=\frac{\sin A}{\sin e}$$

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

$\delta=e-r_2=45°-30°=15°$



582 (d)

$$\frac{c^2}{v^2}=\frac{\mu}{\mu_0}\cdot\frac{\varepsilon}{\varepsilon_0}$$

$$\therefore \frac{\varepsilon}{\varepsilon_0}=\frac{9\times10^{16}}{4\times10^{16}}\times\frac{4\pi\times10^{-7}}{5\times10^{-7}}=5.8\approx 6$$

583 (b)

$5=(\mu-1)A=(1.5-1)A \Rightarrow A=10°$

584 (a)

The focal length of the convex lens

$f=\frac{1}{P}m \Rightarrow f=\frac{1}{5}\times 100\ cm$

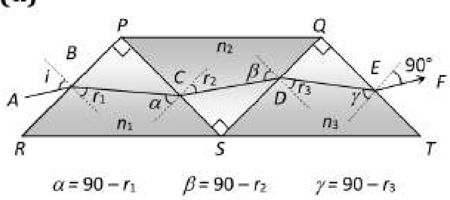
$\Rightarrow f=20\ cm, u=-10\ cm$

$\Rightarrow \frac{1}{f}=\frac{1}{v}-\frac{1}{u} \Rightarrow \frac{1}{20}=\frac{1}{v}-\frac{1}{-20}$

$\therefore v=-20\ cm$

Therefore, the image will be formed at a distance of $20cm$ on the behind the object

585 (d)



At B

$\sin i=n_1\sin r_1 \Rightarrow \sin^2 i=n_1^2\sin^2 r_1$ ...(i)

At C

$n_1\sin(90-r_1)=n_2\sin r_2 \Rightarrow n_2^2\sin^2 r_2=n_1^2\cos^2 r_1$ ...(i)

At D

$n_2\sin(90-r_2)=n_3\sin r_3 \Rightarrow n_2^2\cos^2 r_2=n_3^2\sin^2 r_3$ ...(iii)

At E

$n_3\sin(90-r_3)=(1)\sin(90-i) \Rightarrow \cos^2 i=n_3^2\cos^2 r_3$ ...(iv)

Adding (i), (ii), (iii), and (iv) we get $1+n_2^2=n_1^2+n_3^2$

586 (d)

Use $d=f$; where, $\frac{1}{f}=(\mu-1)\frac{2}{R}=(1.5-1)\times\frac{2}{20}=\frac{1}{20}$

$\Rightarrow f=20$ cm

587 (c)

$$m=\frac{f}{f-u}=\frac{-16}{-16-(-8)}=\frac{-16}{-8}=2$$

588 (b)

$$\frac{1}{f_{air}}=(\mu_g-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad ...(i)$$

and $$\frac{1}{f_{water}}=\left(\frac{\mu_g}{\mu_w}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad ...(ii)$$

Dividing Eq. (i) by Eq. (ii) we get

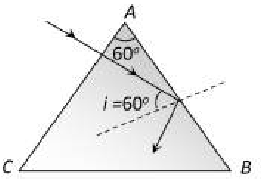
$$\frac{f_{water}}{f_{air}}=\left(\frac{\mu_g-1}{\mu_g/\mu_w-1}\right)=\frac{\left(\frac{3}{2}-1\right)}{\left(\frac{3/2}{4/3}-1\right)}f_{air}$$

$=4f_{air}=4\times10$

$f_{water}=40$ cm

589 (d)

Critical angle for the material of prism $C=\sin^{-1}\left(\frac{1}{\mu}\right)=\sin^{-1}\left(\frac{1}{1.5}\right)=42°$ since angle of incidence at surface $AB(60°)$ is greater than the critical angle $(42°)$, so total internal reflection takes place



591 (a)

For total internal reflection $i>C$

$$\Rightarrow \sin C>\sin C \Rightarrow \sin i>\frac{1}{\mu} \Rightarrow \frac{1}{\sin i}<\mu$$

592 (b)

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

$$\Rightarrow \frac{1}{+10}=(1.5-1)\left(\frac{1}{+7.5}-\frac{1}{R_2}\right) \Rightarrow R_2=-15\ cm$$

593 (a)

The power of the given system is a combination for the positive power of the convex lens, negative power of the plano-concave lens of water and zero power of the plane mirror. Clearly, the power of the system decreases

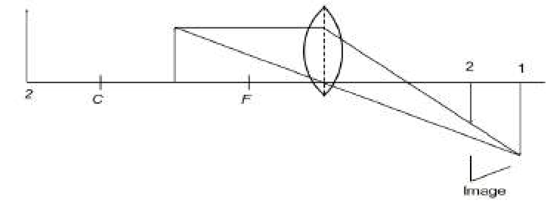
594 (b)

In two images man will see himself using left hand

595 **(c)**

Let as shown, 1 and 2 are positions of objects and images in two different situations.

Object



It is given

$$\left|\frac{v_1}{u_1}\right| = 2\left|\frac{v_2}{u_2}\right|$$

Here, $u_1 = -15\ cm, u_2 = -20\ cm$

$\therefore v_1 = 2v_2 \times \frac{u_1}{u_2} = 2v_2 \times \frac{15}{20} = \frac{3}{2}v_2$

$now, \quad \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\therefore \frac{1}{f} = \frac{1}{v_1} - \frac{1}{u_1}\ and \frac{1}{f} = \frac{1}{v_2} - \frac{1}{u_2}$

$so, \quad \frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{v_2} - \frac{1}{u_2}$

$\Rightarrow \frac{2}{2v_2} + \frac{1}{15} = \frac{1}{v_2} + \frac{1}{20}$

$\Rightarrow v = 20\ cm$

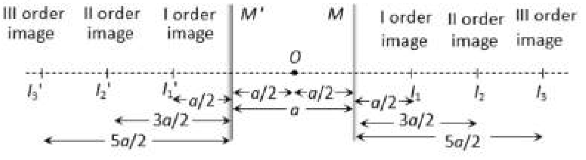
$\therefore \frac{v_1}{u_1} = 2\frac{v_2}{u_2} = 2 \times \frac{20}{20} = 2$

$\Rightarrow v_1 = 2u_1 = 2 \times 15 = 30\ cm$

Therefore, $\frac{1}{f} = \frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{15} + \frac{1}{30} = \frac{3}{30}$

$\therefore f = 10cm = 0.10\ m$

597 **(b)**



From above figure it can be proved that separation between nth order image formed in the two mirrors $= 2na$

598 **(d)**

Luminous flux $= 4\pi\ L = 4 \times 3.14 \times 42 = 528\ Lumen$

Power of lamp $= \frac{\text{Luminous flux}}{\text{Luminous efficiency}} = \frac{528}{2} = 264\ W$

600 **(b)**

Refractive index, $\mu = \frac{1}{\sin C}$,

Where C is the critical angle

Here, $C = 45°$

$\therefore \mu = \frac{1}{\sin 45°}$

$or\ \mu = \sqrt{2}$

$or\ \mu = 1.414$

601 **(b)**

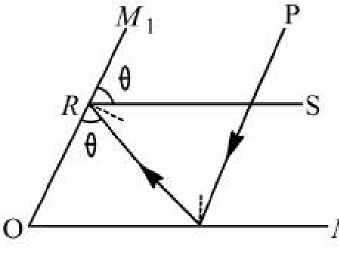
The apparent depth of ink mark

$= \frac{\text{real depth}}{\mu} = \frac{3}{3/2} = 2\ cm$

Thus person views mark at a distance $= 2 + 2 = 4\ cm$

603 **(c)**

Let the angle between the two mirrors beθ, Ray PQ is parallel to mirror M_1 and RS is parallel to M_2.



So, $\angle M_1\ RS = \angle ORQ = \angle\ M_1\ OM_2 = \theta$

Similarly, $\angle M_2QP = \angle OQR = \angle M_2OM_1 = \theta$

$\therefore$ In $\Delta\ ORQ, 3\theta = 180°$

$\theta = 60°$

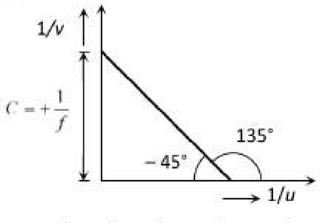
604 **(d)**

This is the defect of hypermetropia

605 **(b)**

$\text{R. P.} \propto \frac{1}{\lambda};\ \lambda_{\text{Blue}} < \lambda_{\text{Red}}$ so $(\text{R. P.})_{\text{Blue}} > (\text{R. P.})_{\text{Red}}$

606 **(a)**



Since $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{v} = -\frac{1}{u} + \frac{1}{f}$

Putting the sign convention property

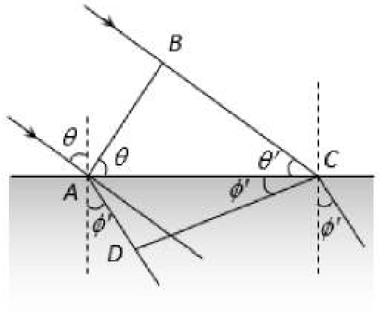
$\frac{1}{(-v)} = \frac{-1}{(-u)} + \frac{1}{(-f)} \Rightarrow \frac{1}{v} = -\frac{1}{u} + \frac{1}{f}$

Comparing this equation with $y = mx + c$

Slope $= m = \tan\theta = -1 \Rightarrow \theta = 135°$ or $-45°$ and intercept $C = +\frac{1}{f}$

607 **(b)**

In the case of refraction if CD is the refracted wave front and v_1 and v_2 are the speed of light in the two media, then in the time the wavelets from B reaches C, the wavelet from A will reach D, such that



$t=\frac{BC}{v_a}=\frac{AD}{v_g} \Rightarrow \frac{BC}{AD}=\frac{v_a}{v_g}$ ... (i)

But in $\Delta ACB, BC=AC\sin\theta$ ...(ii)

While in $\Delta ACD, AD=AC\sin\phi'$ ...(iii)

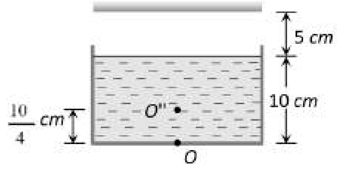
From equations (i), (ii) and (iii) $\frac{v_a}{v_g}=\frac{\sin\theta}{\sin\phi'}$

Also $\mu\propto\frac{1}{v}\Rightarrow\frac{v_a}{v_g}=\frac{\mu_g}{\mu_a}=\frac{\sin\theta}{\sin\phi'}\Rightarrow\mu_g=\frac{\sin\theta}{\sin\phi'}$

608 **(b)**

From figure it is clear object appears to be raised by $\frac{10}{4}cm$ (2.5 cm)

Hence distance between mirror and $O''''''' = 5+7.5=12.5\ cm$



So final image will be formed at 12.5 cm behind the plane mirror

610 **(b)**

$m\propto\frac{1}{f_e}$

611 **(c)**

$\frac{n_g}{n_a}=\frac{c_a}{c_g}$

$\frac{3}{2}=\frac{3\times10^8}{c_g}$

$c_g=2\times10^8$

$\text{Time}=\frac{\text{Distance}}{\text{Speed}}$

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

612 **(c)**

Illuminance produced by the sun $=\frac{L}{(1.5\times10^{11})^2}$

Illuminance produce by the bulb $=\frac{10000}{(0.3)^2}$

According to problem $\frac{L}{(1.5\times10^{11})^2}=\frac{10000}{(0.3)^2}$

$\Rightarrow L=\frac{2.25\times10^{22}\times10^4}{9\times10^{-2}}=25\times10^{26}\ Cd$

613 **(b)**

It is observed if $\angle i=\angle e$ deviation produced is minimum

And $i=\frac{A+\delta_m}{2}$

Here $A=60°$

And $\angle i=\angle e=\frac{3}{4}\angle A$

$\delta_m=2\times\frac{3}{4}\times60°-60°=30°$

614 **(b)**

Fraunhoffer lines observed in solar spectra are absorption lines superposed on a continuous spectrum, This is an example of line absorption spectrum

615 **(d)**

Visible region decreases, so the depth of image will not be seen

616 **(b)**

$f\propto\frac{1}{\mu-1}$ and $\mu\propto\frac{1}{\lambda}$

617 **(d)**

$I\propto A^2\Rightarrow\frac{I_2}{I_1}=\left(\frac{A_2}{A_1}\right)^2=\frac{\pi r^2-\frac{\pi r^2}{4}}{\pi r^2}=\frac{3}{4}$

$\Rightarrow I_2=\frac{3}{4}I_1$ and focal length remains unchanged

618 **(d)**

Length of tube = 10 cm

$f_0+f_e=10\ cm$

Magnification

$m=\frac{f_0}{f_e}=4$

$f_0=4f_e$

Putting in Eq. (I)

$5f_e=10\ cm$

$or\ f_e=2\ cm$

$and\ \ f_0=8\ cm$

$f_0=8cm, f_e=2cm$

Hence, L_4 and L_1 will be used.

619 **(b)**

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

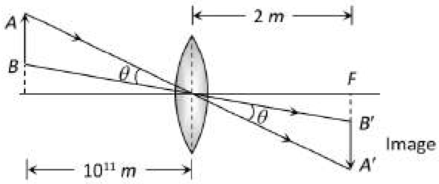
$\cos r=\frac{\mu}{2}$ or $r=\cos^{-1}\left(\frac{\mu}{2}\right)$

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

620 **(c)**

$\theta=\frac{AB}{10^{11}}=\frac{A'B'}{2}\Rightarrow A'B'=\frac{2\times1.4\times10^9}{10^{11}}$

$=2.8\ cm$

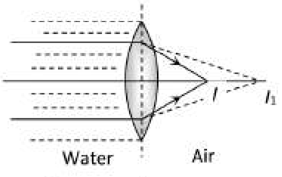


622 **(c)**

Consider the refraction of the first surface, *i.e.*, refraction from rarer medium to denser medium

$$\frac{\mu_2-\mu_1}{R}=\frac{\mu_1}{-u}+\frac{\mu_2}{v_1}\Rightarrow\frac{\left(\frac{3}{2}\right)-\left(\frac{4}{3}\right)}{R}=\frac{\frac{4}{3}}{\infty}+\frac{\frac{3}{2}}{v_1}\Rightarrow v_1=9R$$

Now consider the refraction at the second surface of the lens, *i.e.*, refraction from denser medium to rarer medium



$$\frac{1-\frac{3}{2}}{-R}=-\frac{\frac{3}{2}}{9R}+\frac{1}{v_2}\Rightarrow v_2=\left(\frac{3}{2}\right)R$$

The image will be formed at a distance of $\frac{3}{2}R$. This is equal to the focal length of the lens

623 **(a)**

When two lenses are placed coaxially at a distance d from each other, then equivalent focal length (F) is given by

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1f_2}$$

When the lenses are put together,

$d=0$

Hence, the focal length of the combination will decrease.

624 **(d)**

The image formed by a convex mirror is always virtual

625 **(a)**

Sky appears blue due to scattering. In absence of atmosphere no scattering will occur

626 **(a)**

$r_2 = 0$ ($\because$ No refraction is there at second surface)

$\therefore\ r_1=A=30°$

$$n=\frac{\sin i_1}{\sin r_1}=\frac{\sin i_1}{\sin 30°}=\sqrt{2}\times\frac{1}{2}=\frac{1}{\sqrt{2}}$$

$$\sin i_1=\frac{1}{\sqrt{2}}$$

$i_1=45°$

627 **(a)**

Total deviation $=0$

$\delta_1+\delta_2+\delta_3+\delta_4+\delta_5=(\mu_1-1)A_1-(\mu_2-1)A_2$
$+(\mu_3-1)A_3-(\mu_4-1)A_4+(\mu_5-1)A_5=0$

$\Rightarrow 2\times A_2(1.6-1)=3(1.53-1)9\Rightarrow A_2=11.9°$

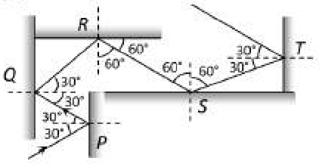
628 **(b)**

$\mu=\frac{c}{v}\Rightarrow\mu=\frac{c}{c/2}=2$ also for total internal reflection

$$i>c\Rightarrow\sin i\geq\sin c\Rightarrow\sin i\geq\frac{1}{\mu}$$

Hence $i\geq\sin^{-1}\left(\frac{1}{\mu}\right)$ or $\mu\geq 30°$

629 **(c)**



630 **(a)**

When final image is formed at infinity, length of the tube $=v_o+f_e$

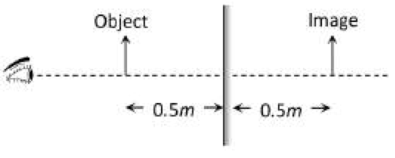
$\Rightarrow 15=v_o+3\Rightarrow v_o=12\ cm$

For objective lens $\frac{1}{f_o}=\frac{1}{v_o}-\frac{1}{u_o}$

$$\Rightarrow\frac{1}{(+2)}=\frac{1}{(+12)}-\frac{1}{u}\Rightarrow u_o=-2.4\ cm$$

631 **(b)**

Distance between object and image $=0.5+0.5=1\ m$



632 **(c)**

$${}_a\mu_g=\frac{1}{\sin\theta}\Rightarrow\mu=\frac{1}{\sin\theta}\quad\text{... (i)}$$

Now from Snell's law $\mu=\frac{\sin i}{\sin r}=\frac{\sin\theta}{\sin r}$

$$\Rightarrow\sin r=\frac{\sin\theta}{\mu}\quad\text{... (ii)}$$

From equation (i) and (ii)

$$\sin r=\frac{1}{\mu^2}\Rightarrow r=\sin^{-1}\left(\frac{1}{\mu^2}\right)$$

633 **(d)**

When total internal reflection just takes place from lateral surface $i=C$, i.e., $60°=C$

$$\Rightarrow\sin 60°=\sin C=\frac{1}{\mu}\Rightarrow\mu=\frac{2}{\sqrt{3}}$$

Time taken by light to traverse some distance in a medium $t=\frac{\mu x}{c}=\frac{\frac{2}{\sqrt{3}}\times 10^3}{3\times 10^8}3.85\ \mu\ s.$

634 **(a)**

$$\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$
For double convex lens, $R_1=R, R_2=-R$
$$\frac{1}{5}=(1.5-1)\left(\frac{1}{R}+\frac{1}{R}\right)$$
$$or\ \frac{1}{5}=0.5\times\frac{2}{R}$$
$or\ R=5\ cm$

635 **(c)**

$L=v_0+u_e$ and $v_0\gg f_0, u_e\simeq f_e$

636 **(a)**

By using formula,
$$\frac{\mu_2}{v}-\frac{\mu_1}{u}=\frac{\mu_2-\mu_1}{R}$$
$$\Rightarrow\frac{1.5}{v}-\frac{1}{(-15)}=\frac{1.5-1}{+30}$$
$$\Rightarrow v=-30\ cm$$

637 **(b)**

This is a modified displacement method problem

Here, $a=1.8$m and $\frac{a+d}{a-d}=\frac{2}{1}$

Solving we get $d=0.6$ m
$$\therefore f=\frac{a^2-d^2}{4a}$$
$=0.4$m

639 **(b)**
$$f=\frac{R}{(\mu-1)}=\frac{60}{(1.6-1)}=100\ cm$$

640 **(d)**
$$\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$
For planoconvex lens

$R_1=\infty, R_2=-R=-1.5\ cm, \mu=1.4$
$$\therefore\frac{1}{f}=(1.4-1)\left(0+\frac{1}{15}\right)$$
$$or\frac{1}{f}=0.4\times\frac{1}{15}$$
Therefore, power of the lens in diopter
$$P=\frac{100}{f}=\frac{40}{15}=2.66\ D$$

641 **(d)**

Resolving power of an optical instrument is inversely proportional to λ *i.e.*, $RP\propto\frac{1}{\lambda}$
$$\therefore\frac{Resolving\ power\ at\ \lambda_1}{Resolving\ power\ at\ \lambda_2}=\frac{\lambda_2}{\lambda_1}=\frac{5000}{4000}=5:4$$

642 **(a)**

Refractive index $\propto\frac{1}{\text{(Temperature)}}$

643 **(c)**

Number of images $=\frac{360°}{\theta}-1$

Where θ is in degrees, $\therefore 5=\frac{360°}{\theta}-1$

or $\theta=\frac{360°}{\theta}=60°$

New angle, $\theta'=\theta-30°=60°-30°=30°$

Number of images $=\frac{360°}{30°}-1=11$

645 **(b)**

According to Cauchy's formula, refractive index (μ) depends on the wavelength on the wavelength of light as
$$\mu=A+\frac{B}{\lambda^2}+\frac{C}{\lambda^4}$$
Where A, B and C are consists

Angle of deviation, $\delta=(\mu-1)A'[A'=$ angle of prism]

$\therefore\lambda_{\text{Violet}}<\lambda_{\text{Green}}<\lambda_{\text{Red}}$

$\mu_{\text{Violet}}>\mu_{\text{Green}}>\mu_{\text{Red}}\Rightarrow\delta_{\text{Violet}}>\delta_{\text{Green}}>\delta_{\text{Red}}$

According to given problem $\theta_1<\theta_2<\theta_3$

646 **(a)**
$$\omega=\frac{\delta_V-\delta_R}{\delta_Y}=\frac{3.72-2.84}{3.28}=0.268$$

647 **(a)**

According to given conditions TIR must take place at both the surfaces AB and AC. Hence only option (a) is correct

648 **(d)**

Using $\delta=i_1+i_2-A\Rightarrow 55=15+i_2-60\Rightarrow$
$i_2=100°$

649 **(b)**

After completely immersed in water this bag will behave as convergence lens.

650 **(a)**

For a prism, as the angle of incidence increases, the angle of deviation first decreases, goes to a minimum value of then increases

652 **(d)**

Apparent height of flame above water surface.
$$h'=\mu h=\frac{4}{3}\times 2=\frac{8}{3}\text{m}$$
Therefore, apparent height of the flame from the eye of fish
$$=d+h'=4+\frac{8}{3}=\frac{20}{3}\text{m}$$

653 **(c)**

$\theta_{net}=\theta+\theta'=0\Rightarrow\omega d+\omega' d'=0$

($\theta=$ Angular dispersion $=\omega.\delta_y$)

654 **(d)**

The atmosphere can be considered to consist of a number of parallel layers of air of different densities and therefore of different refractive indices. The density and the refractive index of layers decrease with altitude.

The rays of light coming from a star to the earth are thus continually refracted from the rarer to the denser layers and so they bend slightly towards the normal at each refraction from one layer to the next. Thus, they follow a curved path and reach the eyes of the observer at O as shown in figure. Hence, the image of the star S is seen as S'. But due to the wind and the convection currents in air the density of layers keep on changing and hence, the position of the stat S' as seen, keeps on changing. These different images of the start give an impression to an observer that the star is twinkling.

655 **(c)**

Real & apparent depth are explained on the basis of refraction only. TIR not involved here

656 **(b)**

$P=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}=0$

$\therefore \frac{1}{f_1}+\frac{1}{f_2}=\frac{d}{f_1 f_2}$

$\frac{1}{20}-\frac{1}{56}=\frac{d}{20(-56)}$

$\frac{56-20}{20\times 56}=\frac{d}{-20\times 56}$

$d=-36$ cm

657 **(b)**

For improving far point, concave lens is required and for this concave lens $u=\infty, v=-30\ cm$

So $\frac{1}{f}=\frac{1}{-30}-\frac{1}{\infty}\Rightarrow f=-30\ cm$

For near point $\frac{1}{-30}=\frac{1}{-15}-\frac{1}{u}$

$\Rightarrow u=-30\ cm$

658 **(b)**

When object is placed between F and pole of a convex lens then a virtual, erect and magnified image will be formed on the same side behind the object.

659 **(b)**

$\frac{1}{60}=\frac{1}{f_1}+\frac{1}{f_2}$ ... (i)

And $\frac{1}{30}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{10}{f_1 f_2}$ ...(ii)

On solving (i) and (ii) $f_1 f_2=-600$ and $f_1+f_2=-10$

Hence $f_1=20\ cm$ and $f_2=-30\ cm$

660 **(c)**

$\mu=\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}=\sqrt{\mu_r K}$

661 **(a)**

$\frac{1}{f}=({}_g\mu_a-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)=\left(\frac{2}{3}-1\right)\left(\frac{2}{10}\right)$

$\Rightarrow f=-15\ cm$, so behaves as concave lens

662 **(b)**

Number of images formed

$=\frac{360°}{\theta}$

$=\frac{360°}{72}=5$

663 **(a)**

When a mirror is rotated by an angle θ, the reflected ray deviates from its original path by angle 2θ

664 **(d)**

$t\propto\frac{f^2}{d^2}$

$\frac{f}{d}$ means that the diameter of aperture is $\frac{f}{2}$

Now, $\frac{1}{100}\propto\frac{f^2}{\left(\frac{f}{2}\right)^2}$

Or $\frac{1}{100}\propto 4$ ...(i)

Again, $t\propto\frac{f^2}{\left(\frac{f}{8}\right)^2}$

Or $t\propto 64$ ...(ii)

Dividing Eq.(ii) by Eq.(i)

$100t=\frac{64}{4}=16$ or $t=\frac{16}{100}s$

666 **(a)**

Since light transmitting area is same, there is no effect on intensity

667 **(b)**

Refractive index, ${}_a\mu_g=1.5$

$\frac{1}{\sin C}=1.5$

$\Rightarrow C=42°$

Critical angle for glass $=42°$

When the angle of incidence in the denser medium is greater than the critical angle, reflection takes place inside the denser medium.

Hence, a ray of light incident at $50°$ in glass medium undergoes total internal reflection.

Deviation $(\delta)=180°-(50°+50°)$

(from the figure)

Or $\delta = 80°$

668 **(a)**

$\mu_w < \mu_g \Rightarrow c_w > c_g$

670 **(b)**

$\frac{I}{O} = \frac{f}{f-u}$; where $u = f + x$ $\therefore \frac{I}{O} = -\frac{f}{x}$

671 **(c)**

In chromatic aberration the image formed by a lens has coloured fringes, because the refractive index for different colours is different and hence the focal length of lens for different colours is different. So, the cause of chromatic aberration is the variation of focal length with colour.

672 **(a)**

Critical angel $\theta_C = \sin^{-1}\left(\frac{1}{\mu}\right)$

Wavelength increases in the sequence of VIBGYOR. According to Cauchy's formula refractive index (μ) decreases as the wavelength increases. Hence, the refractive index will increase in the sequence of ROYGBIV. The critical angle θ_C will thus increase in the same order VIBGYOR. For green light the incidence angle is just equal to the critical angle. For yellow, orange and red the critical angle will be greater than the incidence angel. So these colours will emerge from the glass air interface.

673 **(b)**

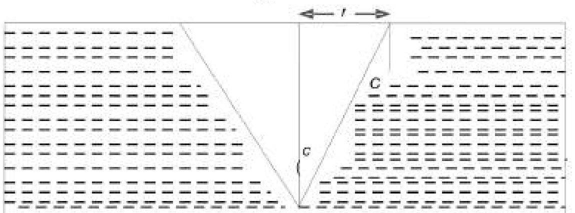
$f = \frac{D^2-x^2}{4D}$ [Focal length by displacement method]

$$\Rightarrow f = \frac{(100)^2 - (40)^2}{4 \times 100} = 21\ cm$$

$$\therefore P = \frac{100}{f} = \frac{100}{21} = 5D$$

674 **(c)**

From figure, $\tan C = \frac{r}{12}$



or $r = 12 \tan C$

$$\text{or } r = \frac{12 \sin C}{\sqrt{1 - \sin^2 C}}$$

$$r = \frac{12 \times \frac{1}{\mu}}{\sqrt{1 - \frac{1}{\mu^2}}} = \frac{12}{\sqrt{\mu^2 - 1}} = \frac{12}{\sqrt{\left(\frac{4}{3}\right)^2 - 1}}$$

$$ie, r = \frac{12 \times 3}{\sqrt{7}}$$

675 **(c)**

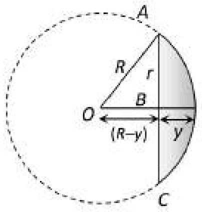
According to lens formula $\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

The lens is plano-convex $i.e.$, $R_1 = R$ and $R_2 = \infty$

Hence $\frac{1}{f} = \frac{\mu-1}{R} \Rightarrow f = \frac{R}{\mu-1}$

Speed of light in medium of lens $v = 2 \times 10^8\ m/s$

$$\Rightarrow \mu = \frac{c}{v} = \frac{3 \times 10^8}{2 \times 10^8} = \frac{3}{2} = 1.5$$



If r is the radius and y is the thickness of lens (at the centre), the radius of curvature R of its curved surface in accordance with the figure is given by

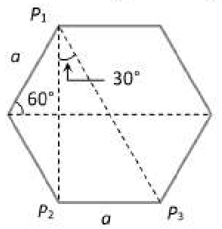
$R^2 = r^2 + (R - y)^2 \Rightarrow r^2 + y^2 - 2Ry = 0$

Neglecting y^2; we get $R = \frac{r^2}{2y} = \frac{(6/2)^2}{2\times0.3} = 15\ cm$

Hence $f = \frac{15}{1.5-1} = 30\ cm$

676 **(a)**

From the geometry of the figure



$P_1P_2 = 2a \sin 60°$

So, $I_{P_2} = \frac{L}{(P_2P_2)^2}$

$$= \frac{L}{(2a \sin 60°)^2} = \frac{L}{3a^2}$$

and $I_{P_3} = \frac{L}{(P_1P_2^2 + a^2)} \cos 30°$

$$= \frac{L}{[(2a \sin 60°)^2 + a^2]} \frac{\sqrt{3}}{2} = \frac{\sqrt{3}L}{8\ a^2}$$

$$\Rightarrow I_{P_3} = \frac{3\sqrt{3}}{8} I_{P_2} = \frac{3\sqrt{3}}{8} I_0$$

677 **(c)**

Image can be formed on the screen if it is real. Real image of reduced size can be formed by a concave mirror or a convex lens

Let $u = 2f + x$, then

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{2f + x} + \frac{1}{v} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{2f + x} = \frac{f + x}{f(2f + x)}$$

$$\Rightarrow v = \frac{f(2f+x)}{f+x}$$

It is given that $u + v = 1.0$ m

$2f + x + \frac{f(2f+x)}{f+x} = (2f+x)\left[1 + \frac{f}{f+x}\right] < 1.0\text{m}$

Or $\frac{(2f+x)^2}{f+x} < 1.0\text{m}$

Or $(2f+x)^2 < (f+x)$

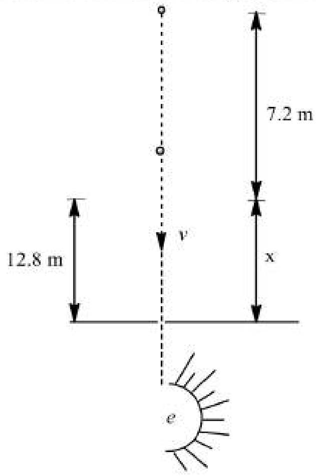
This will be true only when $f < 0.25$ m

678 **(c)**

$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 7}$

$= 12\ \text{ms}^{-1}$

In this case when eye is inside water,



$x_{app.} = \mu x$

$\therefore \frac{dx_{app.}}{dt} = \mu.\frac{dx}{dt}$

Or $v_{app.} = \mu v = \frac{4}{3} \times 12 = 16\ \text{ms}^{-1}$

679 **(b)**

Refractive index $\mu = \frac{\text{Real depth } (d)}{\text{Apparent depth } (x)}$

For 1st liquid, $\sqrt{2} = \frac{d}{x_1}$

$$\Rightarrow x_1 = \frac{d}{\sqrt{2}}$$

Similarly, for 2nd liquid,

$$n = \frac{d}{x_2}$$

$$\Rightarrow \quad x_2 = \frac{d}{n}$$

Total apparent depth $= x_1 + x_2$

$$= \frac{d}{\sqrt{2}} + \frac{d}{n}$$

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

680 **(a)**

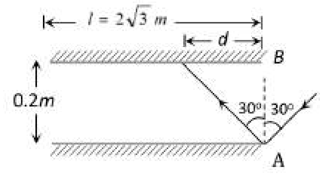
$$\phi_{\text{surface}} = \frac{3000}{6} = 500\ lumen$$

681 **(d)**

Virtual image is seen on the photograph

682 **(b)**

From the following ray diagram



$$d = 0.2 \tan 30° = \frac{0.2}{\sqrt{3}}$$

$$\Rightarrow \frac{l}{d} = \frac{2\sqrt{3}}{0.2/\sqrt{3}} = 30$$

Therefore maximum number of reflections are 30

683 **(c)**

In minimum deviation condition $\angle i = \angle e, \angle r_1 = \angle r_2$

684 **(d)**

$${}_{air}\mu_{\text{water}} = \frac{\text{speed of light in air}}{\text{speed of light in water}} = \frac{c}{v}$$

$$\therefore {}_{air}\mu_{\text{water}} = \frac{v\lambda_{air}}{v\lambda_{\text{water}}}$$

$$\Rightarrow \lambda_{\text{water}} = \frac{\lambda_{air}}{{}_{air}\mu_{\text{water}}} = \frac{4200}{(4/3)} = \frac{3}{4} \times 4200$$

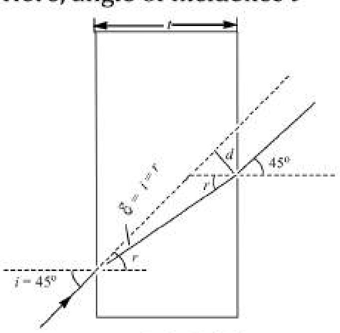
$$= 3150\ \text{Å}$$

685 **(a)**

$F = \frac{f_1 f_2}{f_2 - f_1}$, F will be negative if $f_1 > f_2$

686 **(b)**

Here, angle of incidence $i = 45°$



$$\frac{\text{Lateral shift}(d)}{\text{Thickness of glass slab } (t)} = \frac{1}{\sqrt{3}}$$

Lateral shift $d = \frac{t \sin \delta}{\cos r} = \frac{t \sin(i-r)}{\cos r}$

$$\Rightarrow \frac{d}{t} = \frac{\sin(i-r)}{\cos r}$$

or $\frac{d}{t} = \frac{\sin i \cos r - \cos i \sin r}{\cos r}$

or $\frac{d}{t}=\frac{\sin 45° \cos r-\cos 45° \sin r}{\cos r}=\frac{\cos r-\sin r}{\sqrt{2}\cos r}$

or $\frac{d}{t}=\frac{1}{\sqrt{2}}(1-\tan r)$

or $\frac{1}{\sqrt{3}}=\frac{1}{\sqrt{2}}(1-\tan r)$

or $\tan r=1-\frac{\sqrt{2}}{\sqrt{3}}$

or $r=\tan^{-1}\left(1-\frac{\sqrt{2}}{\sqrt{3}}\right)$

688 **(a)**

Given that, $R=-24$ cm

$f=-12$ cm and $m=1.5$

By the lens formula,

$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{1.5u}+\frac{1}{u}=-\frac{1}{12}$

$\frac{2.5}{1.5u}=-\frac{1}{12}$

Or $u=-20$ cm

689 **(a)**

For a telescope

$\frac{\beta}{\alpha}=\frac{f_0}{f_e}$

$\therefore \frac{\beta}{0.5°}=\frac{0.3}{0.03} \Rightarrow \beta=5°$

691 **(c)**

$m=\frac{v}{u}=5 \Rightarrow v=5\ inch$ [Given $u=1\ inch$]

Using sign convention $u=-1\ inch, v=-5\ inch$

$\therefore \frac{1}{f}=\frac{1}{v}-\frac{1}{u}=\frac{1}{-5}-\frac{1}{-1} \Rightarrow f=1.25\ inch$

692 **(a)**

$I=\frac{L}{r^2} \Rightarrow L=I.r^2=25\times 2^2=100$

Now $\phi=4\pi L=4\times 3.14\times 100=1256\ lumen$

695 **(a)**

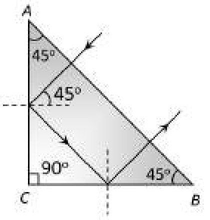
Range of vision for healthy eye is 25 cm (near point) to ∞ (far point). If the person can see clearly only upto a maximum distance of 50 cm he is suffering from myopia (short sightedness). A shortsighted eye can see only nearer objects. This defect can be removed by using a concave lens of suitable focal length $f=50$ cm.

696 **(a)**

Because achromatic combination has same μ for all wavelengths

697 **(a)**

From figure it is clear that TIR takes place at surface AC and BC



$i.e. 45° > C$

$\Rightarrow \sin 45 > \sin C$

$\Rightarrow \frac{1}{\sqrt{2}} > \frac{1}{\mu} \Rightarrow \mu > \sqrt{2}$

Hence $\mu_{\text{least}}=\sqrt{2}$

698 **(b)**

$\frac{1}{f}=(1.65-1)\left(\frac{2}{40}\right)$

Or $\frac{1}{f}=\frac{0.65}{20}$

Or $f=\frac{20}{0.65}$ cm

$=30.77$ cm ≈ 31 cm

699 **(a)**

Refractive index $=\frac{\text{real depth}}{\text{apparent depth}}$

$\therefore \frac{x}{0.04}=\frac{0.21-x}{0.10}$

$\Rightarrow 0.21\times 0.04-x\times 0.04=0.10x$

$\Rightarrow x=\frac{0.21\times 0.04}{0.14}=0.06$ m

700 **(c)**

$y=\sqrt{y_1\times y_2}=\sqrt{16\times 9}=4\times 3=12$ cm

701 **(d)**

In this case $|m|=\frac{f_0}{f_e}=5$ ....(i)

And length of telescope

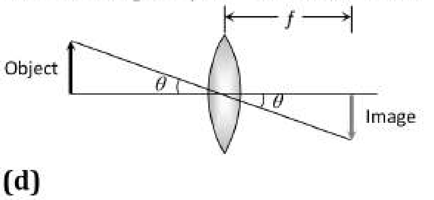
$=f_0+f_e=36$ ....(ii)

Solving eqs (i) and (ii), we get

$f_e=6\ cm, f_0=30\ cm$

702 **(c)**

Size of image $=f\theta=0.5\times(1\times 10^{-3})=0.5\ mm$



703 **(d)**

Amount of scattering of light $I_s \propto \frac{1}{\lambda^4}$

Now here $\lambda_1=440nm, I_s=A$

For $\lambda_2=660\ nm$, let $I_s=A'$

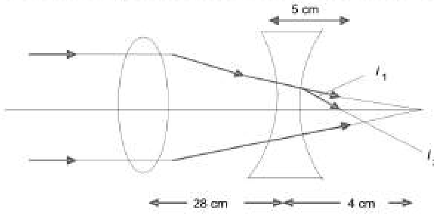
then $\frac{A'}{A}=\left(\frac{440}{660}\right)^4 \Rightarrow A'=\left(\frac{2}{3}\right)^4 A=\frac{A}{5}$

704 **(c)**

$$\frac{f_l}{f_a} = \frac{{}_a\mu_g - 1}{{}_l\mu_g - 1} \Rightarrow f_l = 4R$$

705 **(b)**

Image formed by convex lens at I_1 will act as a virtual object for concave lens. For concave lens



$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$or\ \frac{1}{v} - \frac{1}{4} = \frac{1}{-20}$$

Or $v = 5\text{cm}$

Magnification for concave lens

$$m = \frac{v}{u} = \frac{5}{4} = 1.25$$

As size of the image at I_1 is 2 cm. Therefore, size of image at I_2 will be $2 \times 1.25 = 2.5$ cm.

706 **(c)**

Cylindrical lens are used for removing astigmatism

708 **(d)**

$$\mu = \frac{c}{v} = \frac{3 \times 10^8}{1.5 \times 10^8} = 2$$

709 **(a)**

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

Or $\frac{u}{v} - 1 = \frac{u}{f}$

Or $\frac{u}{v} = \left(\frac{u+f}{f}\right)$

$$m = \frac{v}{u} = \left(\frac{f}{u+f}\right)$$

$$\frac{m_{25}}{m_{50}} = \frac{\left(\frac{20}{-25+20}\right)}{\left(\frac{20}{-50+20}\right)} = 6$$

710 **(c)**

$$v \propto \frac{1}{\mu} \Rightarrow \frac{v_1}{v_2} = \frac{\mu_2}{\mu_1} \Rightarrow \frac{v_g}{v_w} = \frac{\mu_w}{\mu_g} = \frac{4/3}{3/2} = \frac{8}{9}$$

711 **(c)**

$${}_2\mu_1 \times {}_3\mu_2 \times {}_4\mu_3 = \frac{\mu_1}{\mu_2} \times \frac{\mu_2}{\mu_3} = \frac{\mu_3}{\mu_4} = {}_4\mu_1 = \frac{1}{{}_1\mu_4}$$

712 **(c)**

For a lens $f_r - f_v = \omega\, f_y$

$$\Rightarrow \omega = \frac{f_r - f_v}{f_y} = \frac{0.214 - 0.200}{0.205} = \frac{14}{205}$$

713 **(a)**

$$\frac{1}{x^2} = \frac{16}{(100-x)^2}$$

Or $\frac{1}{x} = \frac{4}{100-x}$

Or $5x = 100$ or $x = 20$ cm

714 **(b)**

Because size of the aperture decreases

715 **(d)**

Line and band spectrum are also known as atomic and molecular spectra respectively

716 **(c)**

$$I_\theta = I_o \cos\theta = I_o \cos 60° = \frac{I_o}{2}$$

717 **(b)**

Wave length of the electron wave be $10 \times 10^{-12} m$,

Using $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow E = \frac{h^2}{\lambda^2 \times 2m}$

$$= \frac{(6.63 \times 10^{-34})^2}{(10 \times 10^{-12})^2 \times 2 \times 9.1 \times 10^{-31}} Joule$$

$$= \frac{(6.63 \times 10^{-34})^2}{(10 \times 10^{-12})^2 \times 2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19}}$$

$= 15.1\ KeV$

718 **(a)**

A plano-convex lens behaves as a concave mirror if it's one surface (curved) is silvered. The rays refracted from plane surface are reflected from curved surface and again refract from plane surface. Therefore, in this lens two refractions and one reflection occur.

Let the focal length of silvered lens is F.

$$\frac{1}{F} = \frac{1}{f} + \frac{1}{f} + \frac{1}{f_m} = \frac{2}{f} + \frac{1}{f_m}$$

Where f = focal length of lens before silvering

f_m =focal length of spherical mirror.

$$\therefore \frac{1}{F} = \frac{2}{f} + \frac{2}{R} \quad \ldots..(i)$$

$$(\because R = 2f_m)$$

$$now, \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \ldots.(ii)$$

$here,\ R_1 = \infty, R_2 = 30\ cm$

$$\therefore \frac{1}{f} = (1.5 - 1)\left(\frac{1}{\infty} - \frac{1}{30}\right)$$

$$\Rightarrow \frac{1}{f} = -\frac{0.5}{30} = -\frac{1}{60}$$

$\Rightarrow f = -60\ cm$

Hence from eq (i)

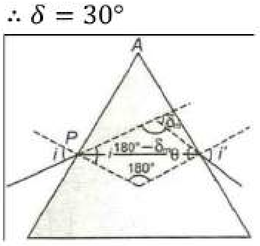
$$\frac{1}{F} = \frac{2}{60} + \frac{2}{30} = \frac{6}{60}$$

$F = 10\ cm$

Again given that,
Size of object = size of image
$\Rightarrow O = I$
$\therefore m = -\frac{v}{u} = \frac{I}{O} \Rightarrow \frac{v}{u} = -1$
$\Rightarrow v = -u$
Thus, from lens formula
$\frac{1}{F} = \frac{1}{v} - \frac{1}{u}$
$\frac{1}{10} = \frac{1}{-u} - \frac{1}{u}$
$\frac{1}{10} = -\frac{2}{u}$
$\therefore u = -20\ cm$
Hence, to get a real image, object must be placed at a distance 20 cm on the left side of lens.

719 **(a)**
The critical angle (θ_C) is given by
$\theta_C = \sin^{-1}\left(\frac{n_2}{n_1}\right)$
Where n_2 is refractive index of less denser medium and n_1 is refractive index of the denser medium.
Also, $\frac{n_2}{n_1} = \frac{v_2}{v_1}$
$\therefore \theta_C = \sin^{-1}\left(\frac{v_2}{v_1}\right)$
Given, $v_2 = 2 \times 10^8\ ms^{-1}$
$v_1 = 2.4 \times 10^8\ ms^{-1}$
$\theta_C = \sin^{-1}\left(\frac{2 \times 10^8}{2.4 \times 10^8}\right)$
$\theta_C = \sin^{-1}\left(\frac{5}{6}\right)$

720 **(b)**
Given, $A = 60°$
$i = i' = \frac{3}{4}, A = 45°$
$\therefore i + i' = A + \delta$
Or $90° = 60° + \delta$
$\therefore \delta = 30°$



Note that $i = i'$ is the condition for minimum deviation
Hence, $\delta = 30° = \delta_{\min}$

721 **(a)**
The refractive index $\mu = \frac{1}{\sin\theta_C}$
$\mu = \frac{1}{\sin 45°} = \sqrt{2} = 1.414$
Because the refractive index for green is 1.44 and blue is 1.47. So, red alone will be transmitted.

722 **(c)**
$P = \frac{1}{f} \Rightarrow f = \frac{1}{0.5} = 2m$

724 **(b)**
According to Rayleigh scattering formula intensity of scattered light, $I \propto \frac{1}{(wavelength\ \lambda)^4}$
or $I \propto (\text{frequency } f)^4 \ \therefore \frac{I_1}{I_2} = \left(\frac{f_1}{f_2}\right)^4$
$\frac{f_1}{f_2} = \left(\frac{I_1}{I_2}\right)^{1/4} = \left(\frac{256}{81}\right)^{1/4} = \frac{4}{3}$

725 **(a)**
$\frac{1}{v} - \frac{1}{-f/2} = \frac{1}{f}$
$\frac{1}{v} = \frac{1}{f} - \frac{2}{f} = -\frac{1}{f}$
or $v = -f$
Again, $m = \frac{v}{u} = \frac{-f}{-f/2} = 2$
Clearly, the image is virtual and double the size

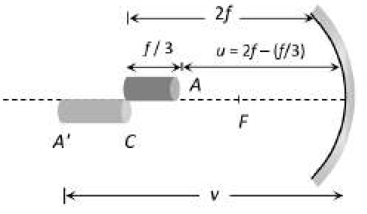
726 **(c)**
Longitudinal chromatic aberration
$= \omega f = 0.08 \times 20 = 1.6cm$

727 **(d)**
Maximum lateral displacement is t.

728 **(d)**
From graph it is clear that $\tan 30° = \frac{\sin r}{\sin i}$
$\Rightarrow \frac{1}{\sqrt{3}} = \frac{\sin r}{\sin i} = \frac{1}{\mu} \Rightarrow \mu = \sqrt{3}$
Also $v = \frac{c}{\mu} = nc \Rightarrow n = \frac{1}{\mu} = \frac{1}{\sqrt{3}} = (3)^{-1/2}$

729 **(d)**
Ray optics is valid when size of the objects is much larger than the order of wavelength of light

730 **(b)**
If end A of rod acts an object for mirror then it's image will be A' and if



$u = 2f - \frac{f}{3} = \frac{5f}{3}$
So by using $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\Rightarrow \frac{1}{-f} = \frac{1}{v} + \frac{1}{\frac{-5f}{3}} \Rightarrow v = -\frac{5}{2}f$

$\therefore$ Length of image $= \frac{5}{2}f - 2f = \frac{f}{2}$

731 **(d)**

Diminished erect image is produced only by a concave lens

732 **(a)**

$$m = \frac{f}{f-u}$$

$$2 = \frac{-0.2}{-0.2-u}$$

Or $2 = \frac{0.2}{0.2+u}$ or $0.4 + 2u = 0.2$

Or $2u = 0.2 - 0.4 = -0.2$

Or $u = -0.1$ m

733 **(a)**

$\delta_m = (\mu - 1)(2r) = (1.5 - 1)2r = 0.5 \times 2r = r$

735 **(c)**

For reading purpose

$u = -25$ cm, $v = -50$ cm, $f = ?$

$\therefore \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{50} + \frac{1}{25} = \frac{1}{50}$

$\text{P} = \frac{100}{f} = +2\text{D}$

For distinct vision,

f' =distance of far point $= -3$m

$P = \frac{1}{f'} = -\frac{1}{3}\text{D} = -0.33$ D

736 **(b)**

As no scattering of light occurs. Space appears black

738 **(c)**

For total internal reflection $\theta > C$

$\Rightarrow \sin\theta > \sin C \Rightarrow \sin\theta > \frac{1}{\mu}$

or $\mu > \frac{1}{\sin\theta} \Rightarrow \mu > \frac{1}{\sin 45°} \Rightarrow \mu > \sqrt{2} \Rightarrow \mu > 1.41$

739 **(a)**

By using $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

where $\mu_1 = \frac{4}{3}, \mu = 1, u = -6cm, v = ?$

On putting values $v = -5.2\ cm$

740 **(c)**

For an achromatic combination $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$

i.e., 1 convex lens and 1 concave lens

741 **(a)**

$$\mu_m = \frac{c}{v} = \frac{n\lambda_a}{n\lambda_m} = \frac{\lambda_a}{\lambda_m}$$

742 **(b)**

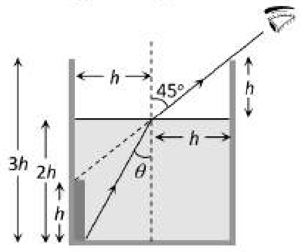
When object is placed, between focus and pole, image formed is erect, virtual and enlarged

743 **(b)**

$$\lambda_{medium} = \frac{\lambda_{vacuum}}{\mu}$$

744 **(b)**

The line of sight of the observer remains constant making an angle of 45° with the normal



$$\sin\theta = \frac{h}{\sqrt{h^2 + (2h)^2}} = \frac{1}{\sqrt{5}}$$

$$\mu = \frac{\sin 45°}{\sin\theta}$$

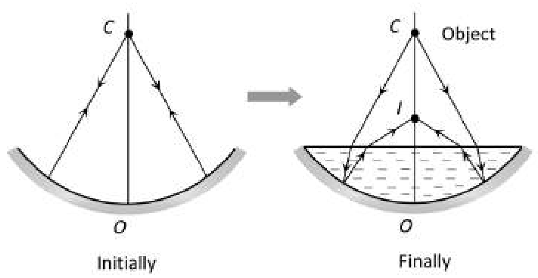
$$= \frac{1/\sqrt{2}}{1/\sqrt{5}} = \sqrt{\left(\frac{5}{2}\right)}$$

745 **(b)**

$\delta_m = (\mu - 1)A$. A = angle of prism

746 **(d)**

From the following figures it is clear that real image (I) will be formed between C and O



747 **(c)**

Magnifying power of a microscope $m \propto \frac{1}{f}$

Since $f_{\text{violet}} < f_{\text{red}}$; $\therefore m_{\text{violet}} > m_{\text{red}}$

748 **(a)**

$f_o - f_e = 9\ cm$ and $f_e = f_o - 9 = 15 - 9 = 6\ cm$

$\Rightarrow m = \frac{f_o}{f_e} = \frac{15}{6} = 2.5$

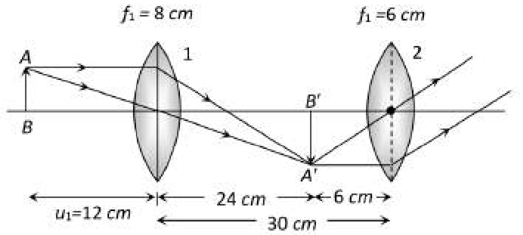
749 **(c)**

Snell's law in vector form is $\hat{\imath} \times \hat{n} = \mu(\hat{r} \times \hat{n})$

750 **(c)**

For lens (1) $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{(-8)} = \frac{1}{v} - \frac{1}{(-12)}$

$\Rightarrow v = 24\ cm$ *i.e.* image $A'B'$ is obtained $6\ cm$ before the lens 2 or at the focus of lens 2. Hence final image formed by lens 2 will be real enlarged and it is obtained at ∞



751 **(a)**

At $u = f, v = \infty$

At $u = 0, v = 0$ (*i.e.* object and image both lies at pole)

Satisfying these two conditions, only option (a) is correct

752 **(c)**

Here, angle of incidence, $i = 60°$

∴ Angle of deviation

$\delta = 180° - (i + r)$

$= 180° - 2i$ (As $i = r$)

$= 180° - 2 \times 60° = 60°$

754 **(d)**

When light travels from rarer to denser medium its wavelength reduces. Wavelength in water

$= \frac{\lambda_a}{\mu_w}$

$= \frac{500}{(4/3)} = 375$ nm $= 376$ nm (Blue colour)

755 **(b)**

Given wavelength does not belong to green therefore all light will be absorbed

756 **(a)**

For convex lens (for real image) $u + v \geq 4f$

For $u = 2f$, v is also equal to $2f$

Hence $u + v = 4f$

757 **(d)**

Deviation = zero

So, $\delta = \delta_1 + \delta_2 = 0$

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

$A_2(1.75 - 1) = -(1.5 - 1)15°$

$A_2 = -\frac{0.5}{0.75} \times 15° \Rightarrow A_2 = -10°$

758 **(d)**

$\delta = (360 - 2\theta) = (360 - 2 \times 60) = 240°$

759 **(c)**

$\frac{1}{-30} + \frac{1}{v} = \frac{1}{30}$

Or $\frac{1}{v} = \frac{2}{30} = \frac{1}{15}$

Or $v = 15$ cm

760 **(a)**

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

$\mu_{water} < \mu$

$\therefore \lambda_{domer} < \lambda_{water}$

ie, wavelength decreases.

761 **(c)**

Let r be the radius of circle through which other objects become visidble. The rays of light must be incident at critical angle C

$\sin C = \frac{1}{\mu} = \frac{r}{\sqrt{r^2 + h^2}}$

$\mu^2 r^2 = r^2 + h^2$

$(\mu^2 - 1)r^2 = h^2$

$r = \frac{h}{\sqrt{\mu^2 - 1}}$

Diameter $2r = \frac{2h}{\sqrt{\mu^2 - 1}}$

762 **(d)**

Here $u = mf$

For divergent lens (concave)

$\therefore v = \frac{mf}{m + 1}$

Now magnification $= \frac{v}{u} = \frac{mf}{m+1} \times \frac{1}{mf} = \frac{1}{m+1}$

763 **(a)**

For largest magnification focal length of eye lens should be least

764 **(d)**

Convex lens, glass slab, prism and glass sphere they all disperse the light

765 **(b)**

In continuous spectrum all wavelength are present

766 **(a)**

$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\Rightarrow -\frac{1}{u^2}\frac{du}{dt} - \frac{1}{v^2}\frac{dv}{dt} = 0$

$\Rightarrow \frac{dv}{dt} = -\frac{v^2}{u^2}\left(\frac{du}{dt}\right)$

But $\frac{v}{u} = \frac{f}{u - f}$

$\therefore \frac{dv}{dt} = -\left(\frac{f}{u - f}\right)^2 \left(\frac{du}{dt}\right)$

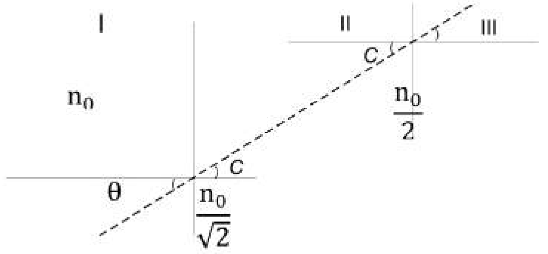
$= \left(\frac{0.2}{-2.8 - 0.2}\right)^2 \times 15 = \frac{1}{15}\text{ms}^{-1}$

767 **(b)**

During minimum deviation the ray inside the prism is parallel to the base of the prism in case of an equilateral prism.

768 **(a)**

The critical angle for region II and III



$\sin C = \frac{\mu_{III}}{\mu_{II}} = \frac{\frac{n_0}{2}}{\frac{n_0}{\sqrt{2}}} = \frac{1}{\sqrt{2}}$

ie. $\angle C = 45°$

The ray, if incident at 45° at the interface of II and III it will be totally internally reflected.

Now, from Snell's lay in region I and II.

$n_0 \sin\theta = \frac{n_0}{\sqrt{2}} \sin C$

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

Or $\sin\theta = \frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}}$

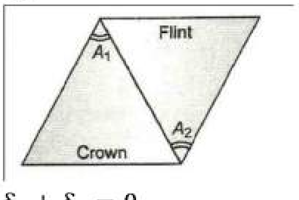
Or $\sin\theta = \frac{1}{2}$

Or $\theta = 30°$

769 **(a)**

(i)When angle of prism is small and angle of incidence is also small, the deviation is given by $\delta = (\mu - 1)A$. Net deviation by the prism is zero.

So,



$\delta_1 + \delta_2 = 0$

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

Here, μ_1 and μ_2 are the refractive indices for crown and flint glass respectively

Hence, $\mu_1 = \frac{1.51+1.49}{2} = 1.5$ and

$\mu_2 = \frac{1.77 + 1.73}{2} = 1.75$

This gives $A_2 = -4°$

Hence, angle of flint glass prism is 4°. Negative sign shows that flint glass prism is inverted with respect to the crown glass prism

(ii)Net dispersion due to the two prism is

$= (\mu_{b_1} - \mu_{r_1})A_1 + (\mu_{b_2} - \mu_{r_2})A_2$

$= (1.51 - 1.49)(6°) + (1.77 - 1.73)(-4°)$

$= -0.04°$

∴ Net dispersion is $-0.04°$

770 **(b)**

Critical angle from region III to region IV

$\sin\theta_C = \frac{n_0/8}{n_0/6} = \frac{3}{4}$

Now applying Snell's law in region I and region III

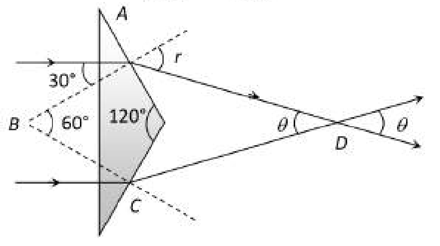
$n_0 \sin\theta = \frac{n_0}{6} \sin\theta_C$

Or $\sin\theta = \frac{1}{6}\sin\theta_C = \frac{1}{6}\left(\frac{3}{4}\right) = \frac{1}{8}$

$\therefore\ \theta = \sin^{-1}\left(\frac{1}{8}\right)$

771 **(d)**

At point $A. \frac{\sin 30°}{\sin r} = \frac{1}{1.44}$



$\Rightarrow r = \sin^{-1}(0.72)$ also $\angle BAD = 180° - \angle r$

In rectangular $ABCD, \angle A + \angle B + \angle C + \angle D =$ 360°

$\Rightarrow (180° - r) + 60° + (180° - r) + \theta = 360°$

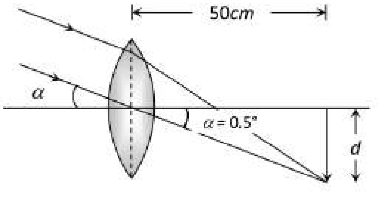
$\Rightarrow \theta = 2[\sin^{-1}(0.72) - 30°]$

772 **(c)**

A bifocal lens consist of both convex and concave lenses with lower part is convex

773 **(b)**

Diameter of image $d = \left(0.5 \times \frac{\pi}{180}\right) \times 500\ mm =$ $4.36\ mm$



774 **(d)**

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$2.5 = \frac{1}{-0.75} - \frac{1}{u}$ or $\frac{1}{u} = -\frac{100}{75} - \frac{25}{10}$

Or $\frac{1}{u} = -\frac{4}{3} - \frac{5}{2}$ or $\frac{1}{u} = \frac{-8-15}{6} = -\frac{23}{6}$

Or $u = -\frac{6}{23}\text{m} = -0.26\text{m}$

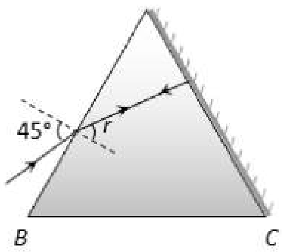
775 **(b)**

$f = \frac{R}{2}$ and $R = \infty$ for plane mirror

776 **(c)**

$A = r + 0 \Rightarrow r = 30°$

$\therefore \mu = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin 30°} = \sqrt{2}$



777 **(b)**

$O = \sqrt{I_1 I_2} = \sqrt{4 \times 16} = 8\ cm$

779 **(a)**

In given images, P, Q and R lenses in contact for P combination of lenses

$$\frac{1}{F_P} = \frac{1}{f} + \frac{1}{f} = \frac{2}{f}$$

$$F_P = \frac{f}{2}$$

Similarly for Q and R combination

$$F_Q = \frac{f}{2}$$

$$F_R = \frac{f}{2}$$

Then $P : Q : R = 1 : 1 : 1$

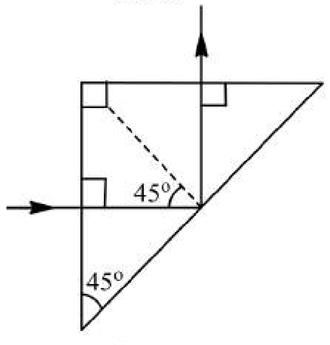
780 **(b)**

For total internal reflection from glass-air interface, critical angle C must be less than angle of incidence.

ie $C < i$

or $C < 45°$ $\quad (\because \angle i = 45°)$

but $n = \frac{1}{\sin C} \Rightarrow C = \sin^{-1}\left(\frac{1}{n}\right)$



$$\therefore \sin^{-1}\left(\frac{1}{n}\right) < 45°$$

$$\Rightarrow \frac{1}{n} < \sin 45°$$

$$\Rightarrow n > \frac{1}{\sin 45°}$$

$$\Rightarrow n > \frac{1}{\left(\frac{1}{\sqrt{2}}\right)}$$

$$\Rightarrow n > \sqrt{2}$$

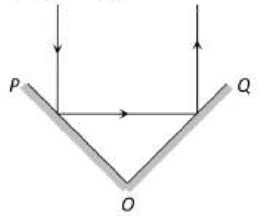
781 **(b)**

Incident ray and finally reflected ray are parallel to each other means $\delta = 180°$

From $\delta = 360 - 2\theta$

$\Rightarrow 180 = 360 - 2\theta$

$\Rightarrow \theta = 90°$



782 **(d)**

$$f = \frac{R}{2(\mu - 1)}, f' = \frac{R}{(\mu - 1)} \Rightarrow f' = 2f$$

783 **(c)**

$f \propto \frac{1}{\mu - 1}$ and $\mu \propto \frac{1}{\lambda}$

784 **(b)**

Since $m = \frac{f_o}{f_e}$

Also $m = \frac{\text{Angle subtended by the image}}{\text{Angle subtended by the object}}$

$$\therefore \frac{f_o}{f_e} = \frac{\alpha}{\beta} \Rightarrow \alpha = \frac{f_o \times \beta}{f_e} = \frac{60 \times 2}{5} = 24°$$

785 **(b)**

$$5 \times 10^{-4} = \frac{I \cos 60°}{200 \times 200}$$

Or $I = 5 \times 10^{-4} \times 4 \times 10^4 \times 2 = 40$ cd

786 **(d)**

If final image is formed at least distance of distinct vision, magnification

$$= 1 + \frac{D}{f}$$

Or magnification

$$= 1 + \left(\frac{25}{5}\right) = 6$$

787 **(b)**

Power of lens is reciprocal of its focal length.

Power of combined lens is

$P = P_1 + P_2$

$= -15 + 5 = -10\ D$

$\therefore f = \frac{1}{P} = \frac{100}{-10} cm$

$f = -10\ cm$

788 **(c)**

As $u \to f, v \to \infty; u \to \infty, v \to f$

789 **(c)**

The walls will act as two mirrors inclined to each other at 90° and so will form $\left(\frac{360}{90} - 1\right) = 4 - 1$, *i.e.*, 3 images of the person. Now these images with person will act as objects for the ceiling mirror and so ceiling mirror will form 4 images further. Therefore total number of images formed $= 3 + 3 + 1 = 7$

Note : He can see, 6 images of himself

790 **(b)**

Final image formed by astronomical telescope is inverted not erect

791 **(a)**

$m_L = 4$

$m_A = (m_1)^2$ so that $A' = A_0 \times 16 = 1600\ cm^2$

792 **(d)**

Velocity and wavelength change but frequency remains same

793 **(b)**

According to Rayleigh's law of scattering, intensity scattered is inversely proportional to the forth power of wavelength. So red is least scattered and sun appears Red

794 **(b)**

Angular description,

$\delta_b - \delta_r = (\mu_b - \mu_r)A$

$= (1.659 - 1.641)5°$

$= 0.09°$

795 **(a)**

$(1) M = -\frac{f_0}{f_e}\left(1 + \frac{f_e}{D}\right)$

$M = -\frac{200}{5}\left(1 + \frac{5}{25}\right)$

$M = -40\left(1 + \frac{1}{5}\right) = -40 \times \frac{6}{5} = -48$

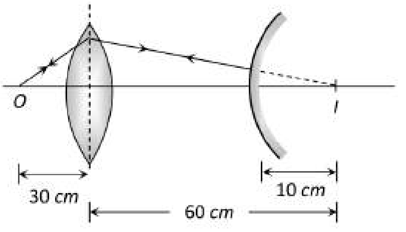
$(2)\ M = \frac{f_o}{f_e} = -\frac{200}{5} = -40$

796 **(c)**

For lens $u = 30\ cm, f = 20\ cm$, hence by using

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{+20} = \frac{1}{v} - \frac{1}{-30} \Rightarrow v = 60\ cm$

The final image will coincide the object, if light ray falls normally on convex mirror as shown. From figure it is seen clear that separation between lens and mirror is $60 - 10 = 50\ cm$



797 **(a)**

Optical fibres are used to send signals from one place to another

798 **(a)**

When light enters water from vacuum, then wavelength of light

$\lambda' = \frac{\lambda}{\mu}$

For water, $\mu > 1$

So,

$\lambda' < \lambda$

Hence, wavelength of light decreases, when light enter to water from vacuum.

799 **(b)**

$\mu = \frac{c}{v}$

$\therefore \frac{\mu}{\mu'} = \frac{v'}{v}$

$\frac{1.5}{1.8} = \frac{v'}{2 \times 10^8}$

$v' = \frac{3 \times 10^8}{1.8} = 1.67 \times 10^8 \text{ms}^{-1}$

800 **(c)**

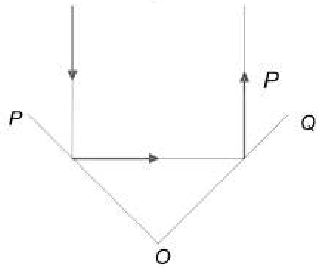
The dispersion produced by a spherical surface depends on it's radius of curvature. Hence, a lens will not exhibit dispersion only if it's two surfaces have equal radii, with one being convex and the other concave

801 **(b)**

Here, angular deviation

$\delta = 2\pi - 2\theta$

$= 2\pi - 2 \times \frac{\pi}{2} = \pi$



Hence, final emergent ray is parallel to incident ray.

802 **(a)**

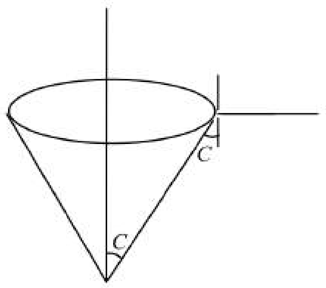
When the screen is equally illuminated,

$E_1 = E_2$

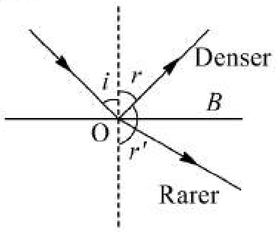
Or $\frac{I_1}{r_1^2} = \frac{I_2}{r_2^2}$ or $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2} = \frac{30 \times 30}{50 \times 50} = \frac{9}{25}$

803 **(c)**

$C = \sin^{-1}\left(\frac{1}{\mu}\right) = \sin^{-1}\left(\frac{3}{4}\right)$



806 **(b)**



$\sin C = \dfrac{1}{\mu} = \dfrac{1}{\sin r'/\sin i} = \dfrac{\sin i}{\sin r'}$

As is clear as shown in figure

$\angle CBD = 90°$

$\therefore 90° - r + 90° - r' = 90°$

Or $r' = 90° - r$

$\therefore \sin C = \dfrac{\sin i}{\sin(90° - r)} = \dfrac{\sin i}{\cos r}$

$= \dfrac{\sin i}{\cos i} = \tan i \; (\because i = r)$

$C = \sin^{-1}(\tan i) = \sin^{-1}(\tan r)$

807 **(a)**

Only one converging point is found by this lens. Therefore only one image is formed

808 **(d)**

The rainbow is formed due to the dispersion of white light from the sun and due to one or two total internal reflections from the water droplets behaving like prisms. The rainbow is not seen after every rain necessarily.

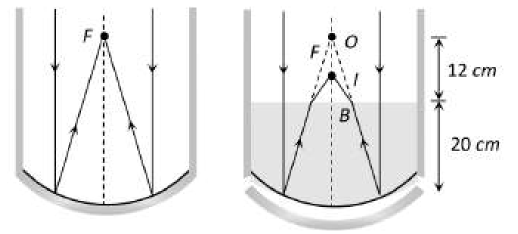
809 **(b)**

Sun is at infinity, *i.e.*, $u = \infty$ so from mirror formula we have $\frac{1}{f} = \frac{1}{-32} + \frac{1}{(-\infty)} \Rightarrow f = -32\ cm$

When water is filled in the tank upto a height of 20 *cm*, the image formed by the mirror will act as virtual object for water surface. Which will form it's image at *I* such that $\frac{\text{Actual height}}{\text{Apparent height}} =$

$\frac{\mu_\omega}{\mu_a}$, i.e., $\frac{BO}{BI} = \frac{4/3}{1}$

$\Rightarrow BI = BO \times \dfrac{3}{4} = 12 \times \dfrac{3}{4} = 9\ cm$



810 **(d)**

Focal length of eye lens = $-2\ m$

So, power of lens $= \frac{1}{f} = \frac{1}{-2}$

= -0.5 D (short-sighted)

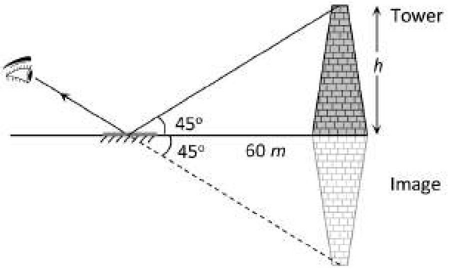
811 **(c)**

Minimum angular separation $\Delta\theta = \frac{1}{R.P.} = \frac{1.22\,\lambda}{d}$

$= \dfrac{1.22 \times 5000 \times 10^{-10}}{2} = 0.3 \times 10^{-6} rad$

814 **(b)**

$\tan 45° = \dfrac{h}{60} \Rightarrow h = 60\ m$



817 **(a)**

Magnification $m = \frac{v}{u}$

$-4 = \dfrac{v}{u}$

Or $v = -4u$

Now, $v - u = 10$

Or $-5u = 10$

Or $u = -2$ m

$v = 8$ m

Again, $\dfrac{1}{f} = \dfrac{1}{v} - \dfrac{1}{u}$

Or $\dfrac{1}{f} = \dfrac{1}{8} - \dfrac{1}{-2}$

Or $\dfrac{1}{f} = \dfrac{1}{8} + \dfrac{1}{2}$

$= \dfrac{1+4}{8} = \dfrac{5}{8}$

Or $f = \dfrac{8}{5}$ m $= 1.6$ m

818 **(c)**

$m = \pm 3$, using $m = \frac{f}{f+u}$

For virtual image $3 = \frac{f}{f-8}$ ...(i)

For real image $-3 = \frac{f}{f-16}$ ...(ii)

Solving (i) and (ii) we get $f = 12\ cm$

819 **(a)**

When monochromatic light pass through a prism, the red colour suffers minimum deviation.

820 **(b)**

$\mu \propto \frac{1}{\lambda}, \lambda_r > \lambda_v$

821 **(b)**

$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ or $\frac{1}{v}=-\frac{1}{u}+\frac{1}{f}$

Now, compare with $y = mx + c$

Therefore graph is a straight line having negative slope

822 **(a)**

Dispersion take place because the refractive index of medium for different colours is different, for example, red light bends less than violet, refractive index of the material of the prism for red light is less than that for violet light. Equivalently, we can say that red light travels faster than violet light in a glass prism

823 **(a)**

Lens maker's formula

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

Where, $R_2 = \infty, R_1 = 0.3\ m$

$\therefore \frac{1}{f}=\left(\frac{5}{3}-1\right)\left(\frac{1}{0.3}-\frac{1}{\infty}\right)$

$\Rightarrow \frac{1}{f}=\frac{2}{3}\times\frac{1}{0.3}$

$or\ f = 0.45\ m$

824 **(b)**

Magnifying power of astronomical telescope

$m = -\frac{f_o}{f_e}\left(1+\frac{f_e}{D}\right) = -\frac{200}{5}\left(1+\frac{5}{25}\right) = -48$

825 **(b)**

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

Also, by Cauchy's formula

$\mu = A+\frac{B}{\lambda^2}+\frac{C}{\lambda^4}+\cdots.$

$\lambda_{blue} < \lambda_{red}$

$\mu_{blue} > \mu_{red}$

Hence, $f_{red} > f_{blue}$

826 **(a)**

Sunlight consists of all the wavelength with some black lines

827 **(b)**

ω depend only on nature of material

828 **(d)**

Image will be real

We know that

$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

$\Rightarrow \frac{v}{f}=1-\frac{v}{u}$ ($\because u$ is negative)

$v = f(m+1)$

829 **(a)**

Apparent shift $= t\left(1-\frac{1}{\mu}\right)$

$8 = 40\left(1-\frac{1}{\mu}\right)$ or $\frac{1}{5}=1-\frac{1}{\mu}$

Or $\frac{1}{\mu}=\frac{4}{5}$ or $\mu=\frac{5}{4}$

830 **(a)**

$f = -\frac{0.6}{2} = -0.3\ \text{m} = -30\ \text{cm}$

$\frac{1}{v}+\frac{1}{-10}=\frac{1}{-30}$

$\frac{1}{v}=\frac{1}{10}-\frac{1}{30}=\frac{3-1}{30}$

Or $v = \frac{30}{2}\text{cm} = 15\ \text{cm}$

$m = -\frac{v}{u} = -\frac{15}{-10} = 1.5$

Object lies between principal focus and pole. So, the image is virtual and erect

831 **(c)**

At minimum distance, incidence is normal.

Therefore, $E = \frac{I}{r^2}=\frac{250}{6^2}=6.94$ lux

832 **(b)**

If object in a denser medium is seen from a rarer medium then image of object will appear at a leaser distance. The distance between object and its image, called as normal shift is given by

$x = t\left[1-\frac{1}{\mu}\right]$

Here, $t = 6$ cm, $\mu = 1.5$

$\therefore \quad x = 6\left[1-\frac{1}{1.5}\right]$

$= 6\left[\frac{0.5}{1.5}\right] = 2$ cm

833 **(d)**

$\mu = \frac{9}{8}$

$\sin C = \frac{1}{{}_w\mu_g} = \frac{8}{9}$

$C = \sin^{-1}\left(\frac{8}{9}\right)$

$\theta > \sin^{-1}\frac{8}{9}$

834 **(a)**

Power of combination $P = P_1 + P_2$

$= +20 - 10 = +10\text{D}$

$F = \frac{1}{P} = \frac{1}{10}\text{m} = 10 \text{ cm}$

For image at infinity

$M = \frac{D}{F} = \frac{25}{10} = 2.5$

835 **(a)**

The black lines in solar spectrum are called Fraunhoffer lines

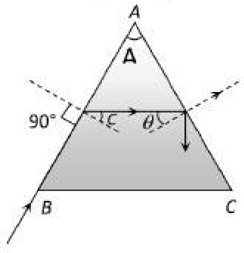
836 **(b)**

Time of exposure $\propto (f.\text{number})^2 \Rightarrow \frac{t_2}{t_1} = \left(\frac{5.6}{2.8}\right)^2 = 4$

$t_2 = 4t_1 = 4 \times \frac{1}{200} = \frac{1}{50} sec = 0.02\ sec$

837 **(c)**

From ray diagram



$A = C + \theta$ for TIR at AC

$\theta > C$ so $A > 2C$

839 **(a)**

$|m| \propto \frac{1}{f_o f_e}$

840 **(b)**

$I_{\text{edge}} = \frac{L \cos\theta}{(h^2 + r^2)} = \frac{Lh}{(h^2 + r^2)^{3/2}}$

For maximum intensity $\frac{dI}{dh} = 0$

Applying this condition have get $h = \frac{r}{\sqrt{2}}$

841 **(b)**

We know that

$\mu = \frac{\text{velocity of light in vacuum}}{\text{velocity of light in water}}$

$\frac{4}{3} = \frac{3 \times 10^{10}}{\text{velocity in light in water}}$

$\Rightarrow$ velocity of light in water $= 2.25 \times 10^{10} \text{cms}^{-1}$

Time taken $= \frac{500 \times 100}{2.25 \times 10^{10}} = 2.22 \times 10^{-6}$ s

Equivalent optical path = μ × diatance travelled in water

$= \frac{4}{3} \times 500 = 666.64$ m

842 **(c)**

Refractive index of refracted medium w.r.t. incident medium

$= \frac{\text{Speed in incident medium}}{\text{Speed in refracted medium}}$

843 **(a)**

$\because \mu = a + \frac{b}{\lambda^2}$ [Cauchy's equation]

and dispersion $D = -\frac{d\mu}{d\lambda} \Rightarrow D = -(-2\lambda^{-3})b = \frac{2b}{\lambda^3}$

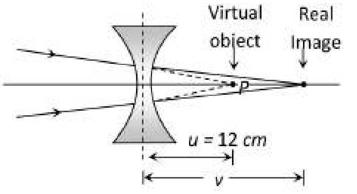
$\Rightarrow D \propto \frac{1}{\lambda^3} \Rightarrow \frac{D'}{D}\left(\frac{\lambda}{\lambda'}\right)^3 = \left(\frac{\lambda}{2\lambda}\right)^3 = \frac{1}{8} \Rightarrow D' = \frac{D}{8}$

844 **(d)**

By using lens formula

$\frac{1}{-16} = \frac{1}{v} - \frac{1}{(-12)} \Rightarrow \frac{1}{v} = \frac{1}{12} - \frac{1}{16} = \frac{4-3}{48} \Rightarrow v$

$= 48\ cm$



845 **(a)**

Focal length in air is given by

$\frac{1}{f_{a\text{a}}} = ({}_a\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

The focal length of lens immersed in water is given by

$\frac{1}{f_1} = ({}_l n_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

When, R_1, R_2 are radii of curvatures of the two surfaces of lens and ${}_l n_g$ is refractive index of glass with respect to liquid.

Also, ${}_l\mu_g = \frac{{}_a n_g}{{}_{\text{a}\,a} n_l}$

Given, ${}_{\text{a}\,a} n_g = 1.5, f_{a\text{a}} = 12$ cm, ${}_{\text{a}\,a} n_l = \frac{4}{3}$

$\therefore \frac{f_l}{f_{a\text{a}}} = \frac{({}_{\text{a}\,a} n_g - 1)}{({}_l n_g - 1)}$

$\frac{f_1}{12} = \frac{(1.5 - 1)}{\left(\frac{1.5}{4/3} - 1\right)} = \frac{0.5 \times 4}{0.5}$

$\Rightarrow f_1 = 4 \times 12 = 48$ cm

846 **(b)**

From Rayleigh scattering concept

$I \propto \frac{1}{\lambda^4} or \frac{I_1}{I_2} = \left(\frac{\lambda_2}{\lambda_1}\right)^4$

$or \quad \left(\frac{\lambda_2}{\lambda_1}\right)^4 = \frac{1}{4}$

$or \quad \frac{\lambda_2}{\lambda_1} = \left(\frac{1}{2}\right)^{1/2}$

$or \quad \frac{\lambda_1}{\lambda_2} = \frac{\sqrt{2}}{1}$

847 **(a)**

$\frac{D}{F}$ or $\frac{25}{F}$

848 **(a)**

Focal length of lens

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

For equi-convex lens,

$R_1 = +R, R_2 = -R$

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

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

$f = \frac{R}{2(\mu - 1)}$

$f < R, so, 2(\mu - 1) < 1$

$(\mu - 1) < \frac{1}{2}$

$(\mu - 1) < 0.5$

$\mu < 1.5$

Focal length of convex lens is positive. So, μ cannot be negative, hence should be greater than zero but less than 1.5

849 **(c)**

Critical angle $= \sin^{-1}\left(\frac{1}{\mu}\right)$

$\therefore \theta = \sin^{-1}\left(\frac{1}{\mu_{\lambda_1}}\right)$ and $\theta' = \sin^{-1}\left(\frac{1}{\mu_{\lambda_2}}\right)$

Since $\mu_{\lambda_2} > \mu_{\lambda_1}$, hence $\theta' < \theta$

850 **(d)**

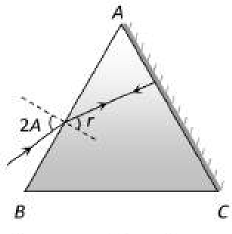
$I_1 D_1^2 t_1 = I_2 D_2^2 t_2$ [D is diameter of aperature]

Here D is constant and $I = \frac{L}{r^2}$

So $\frac{L_1}{r_1^2} \times t_1 = \frac{L_2}{r_2^2} \times t_2 \Rightarrow \frac{60}{(2)^2} \times 10 = \frac{120}{(4)^2} \times t \Rightarrow$

$20\ s = t$

851 **(b)**



$A = r + 0$ and $\mu = \frac{\sin i}{\sin r}$

$\Rightarrow \mu = \frac{\sin 2A}{\sin A}$

$= \frac{2 \sin A \cos A}{\sin A} = 2 \cos A$

852 **(b)**

$f_o > f_e$ for telescope

853 **(a)**

Subtract the given time from $\begin{matrix} \text{hr.} & \text{min.} \\ 11 & : 60 \end{matrix}$

855 **(c)**

The image of an object in white light formed by a lens is usually coloured and blurred. This defect of image is called chromatic aberration and arises due to the fact that focal length of a lens is different for different colours. In case of two thin lenses in contact, the combination will be free from chromatic aberration. The lens combination which satisfies this condition is called achromatic lenses.

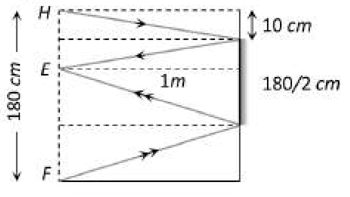
856 **(d)**

When a ray of light moves from one medium to other, its velocity changes. This change depends on refractive index of the medium. Light travels from denser to rarer medium, *ie*., from medium of higher refractive index to lower refractive index. So, in second (rarer) medium, its velocity increases.

857 **(b)**

According to the following ray diagram length of mirror

$= \frac{1}{2}(10 + 170) = 90cm$



858 **(a)**

$d = f_1 - f_2 = 7.5 - 7.3 = 0.2\ cm$

859 **(b)**

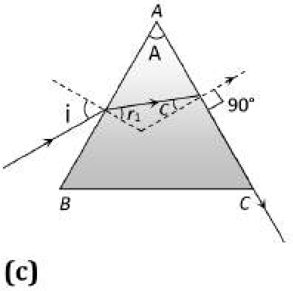
From figure

$A = r_1 + c = r_1 + \sin^{-1}\left(\frac{1}{\mu}\right)$

$\Rightarrow r_1 = 75 - \sin^{-1}\left(\frac{1}{\mu}\right)$

From Snell's law At B

$\mu = \frac{\sin i}{\sin r_1} \Rightarrow \sqrt{2} = \frac{\sin i}{\sin 30°} \Rightarrow i = 45°$



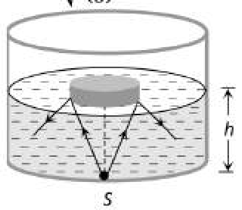
860 **(c)**

Suppose the maximum height of the liquid is h for which the source is not visible

Hence radius of the disc

$r = \frac{h}{\sqrt{\mu^2 - 1}}$

$$1 = \frac{h}{\sqrt{\left(\frac{5}{3}\right)^2 - 1}} \Rightarrow h = 1.33\ cm$$



861 **(a)**

$$\frac{\omega_1}{\omega_2} = -\frac{f_1}{f_2} = -\frac{2}{3}$$

862 **(a)**

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{1.5}{+OQ} - \frac{1}{(-OP)} = \frac{(1.5-1)}{+R}$$

On putting $OQ = OP, OP = 5R$

863 **(a)**

The atoms in the chromosphere absorb certain wavelengths of light coming from the photosphere. This gives rise to absorption lines

864 **(b)**

For passing the ray from prism,

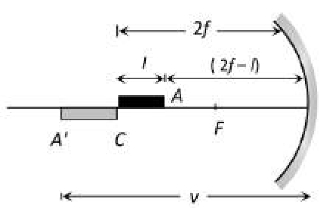
$$\mu < cosec \frac{A}{2}$$

$$\mu < cosec \left(\frac{90°}{2}\right)$$

$$\mu < \sqrt{2}$$

$$\mu_{max} = \sqrt{2}$$

865 **(b)**



End A of the rod acts as an object for mirror and A' will be its image so $u = 2f - l = 20 - 5 = 15\ cm$

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

Now $m = \frac{\text{Length of image}}{\text{Length of object}} = \frac{(30-20)}{5} = 2$

866 **(c)**

Glass lens will disappear if $\mu_L = \mu_g$. Therefore, when a glass lens of refractive index 1.47 is immersed in glycerin whose refractive index is 1.473 (at 20°C), the glass lens look like disappeared

868 **(c)**

In both A and B, the refracted ray is parallel to the base of prism

870 **(a)**

Focal length of the mirror remains unchanged

871 **(d)**

Resolving power of telescope $= \frac{d}{1.22\,\lambda}$

872 **(d)**

$$L = v_o + u_e = \frac{u_o f_o}{(u_o - f_o)} + \frac{f_e D}{f_e + D}$$

$$\Rightarrow L = \frac{2 \times 1.5}{(2-1.5)} + \frac{6.25 \times 25}{(6.25+25)} = 11\ cm$$

873 **(c)**

It lamp is placed at the focus of concave mirror then we get parallel beam of light.

874 **(d)**

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

μ decreases, P decreases and f increases

875 **(c)**

In case of a telescope if object and final image are at infinity then $m = \frac{f_o}{f_e}$

876 **(a)**

When two lenses of different powers are combined, the power of combination is sum of individual powers

$\therefore P = P_1 + P_2$

$P = 3D + (-5D) = -2D$

Also power $= \frac{1}{f}$ *diopire*

$$\therefore f = \frac{100}{P} = -\frac{100}{2} m = -50\ m$$

From lens formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Putting $f = -50\ cm, u = -50\ cm$

$$-\frac{1}{50} = \frac{1}{v} - \left(-\frac{1}{50}\right)$$

$$\Rightarrow v = -25\ cm$$

Hence, image is formed at same side as object.

877 **(c)**

If nothing is said then it is considered that final image is formed at infinite and $m_\infty = \frac{(L_\infty - f_o - f_e).D}{f_o f_e} \simeq \frac{LD}{f_o f_e}$

$$\Rightarrow 400 = \frac{20 \times 25}{0.5 \times f_e} \Rightarrow f_e = 2.5\ cm$$

878 **(b)**

In telescope $f_o \gg f_e$ as compared to miscroscope

880 **(b)**

Light is travelling from glass to air. *ie*, form denser medium to rarer medium, so it will bend away from the normal, so $\theta_2 > \theta_1$.

881 **(d)**

When object is kept at centre of curvature. It's real image is also formed at centre of curvature

882 **(b)**

Huygen eyepiece satisfies the conditions for elimination of the chromatic aberration as well as spherical aberration.

883 **(d)**

Clearly, $2f = 20$ cm or $f = 10$ cm

Now, $u = -15$ cm, $v = ?$

$F = 10$ cm

$$\frac{1}{v} - \frac{1}{-15} = \frac{1}{10}$$

Or $\frac{1}{v} + \frac{1}{15} = \frac{1}{10}$ or $\frac{1}{v} = \frac{1}{10} - \frac{1}{15}$

Or $\frac{1}{v} = \frac{3-2}{30} = \frac{1}{30}$ or $v = 30$ cm

The charge in image distance is $(30 - 20)$cm *ie*, 10 cm

884 **(d)**

$P = P_1 + P_2$

$= \frac{100}{f_1} + \frac{100}{f_2}$, both f_1 and f_2 are in cm.

$= \frac{100}{50} - \frac{100}{40}$

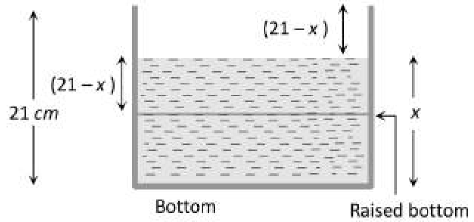
$=2-2.5=-0.5$ D

885 **(c)**

To see the container half-filled from top, water should be filled up to height x so that bottom of the container should appear to be raised upto height $(21 - x)$

As shown in figure apparent depth $h' = (21 - x)$

Real depth $h = x$

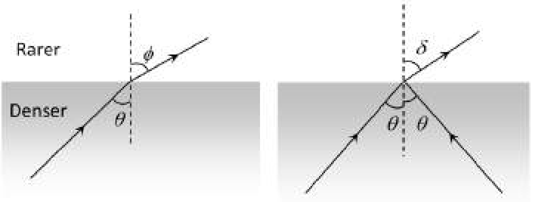


$$\therefore \mu = \frac{h}{h'} \Rightarrow \frac{4}{3} = \frac{x}{21 - x} \Rightarrow x = 12\ cm$$

886 **(c)**

When the ray passes into the rarer medium, the deviation is $\delta = \phi - \theta$. This can have a maximum value of $\left(\frac{\pi}{2} - C\right)$ for $\theta = C$ and $\phi = \frac{\pi}{2}$

When total internal reflection occurs, the deviation is $\delta = \pi - 2\theta$, the minimum value of θ being C. The maximum value of $\delta = \pi - 2C$



887 **(b)**

Here, $A = 60°, \mu = \sqrt{2}$

Now,

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

Substituting given values in Eq. (i) , we get

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

Or $\sin\left(30° + \frac{\delta_m}{2}\right) = \sqrt{2}\ \sin 30°$

Or $\sin\left(30° + \frac{\delta_m}{2}\right) = \sqrt{2} \times \frac{1}{2} = \frac{1}{\sqrt{2}}$

Or $\sin\left(30° + \frac{\delta_m}{2}\right) = 45°$

Or $\left(30° + \frac{\delta_m}{2}\right) = \sin 45°$

Or $\delta_m = 30°$

$\therefore$ Angle of incidnece $i = \frac{A + \delta_m}{2}$

$= \frac{60° + 30°}{2} = 30°$

888 **(b)**

$$m = \frac{v_o}{u_o}\left(1 + \frac{D}{f_e}\right) = m_o\left(1 + \frac{D}{f_e}\right)$$

$$\Rightarrow 30 = m_o\left(1 + \frac{25}{5}\right) = m_o \times 6 \Rightarrow m_o = 5$$

889 **(a)**

Here $d = 1\ m, \lambda = 4538$ Å

$= 4.538 \times 10^{-7} m$

Resolving limit $\theta = \frac{1.22\lambda}{d}$

$= \frac{1.22 \times 4.538 \times 10^{-7}}{1}$

$= 5.54 \times 10^{-7}$ rad

891 **(a)**

So, velocity of light in glass

$$V_g = \frac{V_m}{\mu}$$

$$V_m - V_g = V_m - \frac{V_m}{\mu}$$

$$\therefore 6.25 \times 10^7 = V_m\left(1 - \frac{1}{\frac{4}{3}}\right)$$

$V_m = 6.25 \times 10^7 \times 4$

$= 2.5 \times 10^8 ms^{-1}$

892 **(c)**

In fog, visible light is scattered more according to Rayleigh scattering, but scattering of infrared radiations is less due to high wavelengths, hence in fog, photographs of the objects taken with infrared radiations are clearer.

893 **(d)**

$$f = \frac{R}{2(\mu - 1)} \Rightarrow P = \frac{2(\mu - 1)}{0.2} = \frac{2(1.5 - 1)}{0.2}$$
$$= +5D$$

894 **(b)**

$$\mu = \frac{c}{v} = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin 30°}$$
$$\Rightarrow v = \frac{3 \times 10^8}{\sqrt{2}} = 2.12 \times 10^8\ m/s$$

895 **(b)**

Power of the system decreases due to separation between the lenses. So, the focal length increases

896 **(b)**

Resolving limit (minimum separation) $\propto \lambda$

$$\Rightarrow \frac{P_A}{P_B} = \frac{2000}{3000} \Rightarrow P_A < P_B$$

897 **(d)**

Size of object

$h = \sqrt{h_1 h_2}$

898 **(b)**

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

$$\mu = \frac{\sin\left(\frac{60°+30°}{2}\right)}{\sin\left(\frac{60°}{2}\right)} = \frac{\sin 45°}{\sin 30°} = \sqrt{2}$$

Also $\mu = \frac{1}{\sin C} \Rightarrow C = \sin^{-1}\left(\frac{1}{\mu}\right) \Rightarrow C = 45°$

899 **(b)**

For real image $v = 0$

$\therefore$ From $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

900 **(b)**

As a convex lens alone can form a real images as well as a virtual images, therefore, the lens in the present question is a convex lens. Let f be the focal length of the lens and m be the magnification produced

In the first case, when image is real,

$u = -16$ cm, $v = (m \times 16)$cm

As $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\therefore \frac{1}{16m} + \frac{1}{16} = \frac{1}{f}$ or $1 + \frac{1}{m} = \frac{16}{f}$ ...(i)

In the second case, when image is virtual

$u = -6$ cm, $v = (-6$ m$)$cm

From $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{-6m} + \frac{1}{6} = \frac{1}{f}$ or $1 - \frac{1}{m} = \frac{6}{f'}$ ...(ii)

Add Eq.(i) and Eq.(ii) we have

$2 = \frac{22}{f}$ or $f = \frac{22}{2} = 11$ cm

901 **(c)**

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} =$ constant, so (c) is correct graph.

902 **(c)**

In plane mirror, size of the image is independent of the angle of incidence

903 **(b)**

Apparent depth of bottom

$$= \frac{H/4}{\mu_1} + \frac{H/4}{\mu_2} + \frac{H/4}{\mu_3} + \frac{H/4}{\mu_4}$$
$$= \frac{H}{4}\left(\frac{1}{\mu_1} + \frac{1}{\mu_2} + \frac{1}{\mu_3} + \frac{1}{\mu_4}\right)$$

904 **(b)**

As is clear from figure, $A = 30°, i_1 = 60°$

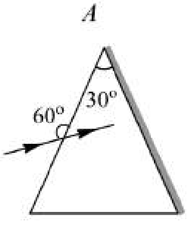
As the ray retraces its path on reflection at the silvered face, therefore,

$i_2 = 0, r_2 = 0$

As $r_1 + r_2 = A$

$\therefore r_1 + 0 = 30°$

Or $r_1 = 30°$



$$\mu = \frac{\sin i_1}{\sin r_1} = \frac{\sin 60°}{\sin 30°} = \frac{\sqrt{3}/2}{1/2} = \sqrt{3}$$

905 **(c)**

$$\text{Time} = \frac{\text{distance}}{\text{speed}} = \frac{t}{c/n} = \frac{nt}{c}$$

906 **(a)**

For total internal reflection at AC face

$$\sin i \geq \frac{\mu_w}{u_g}$$
$$\sin\theta \geq \frac{4}{3 \times 1.5}$$
$$\sin\theta \geq \frac{8}{9}$$

907 **(d)**

Suppose water is poured up to the height h,

So $h\left(1 - \frac{1}{\mu}\right) = 1 \Rightarrow h = 4\ cm$

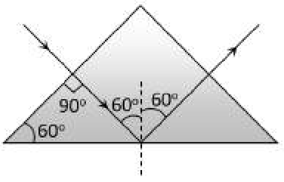
909 **(b)**

In each case two plane-convex lens are placed close to each other, and $\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}$

911 **(c)**

Ray from setting sun will be refracted at angle equal to critical angle

912 **(b)**



913 **(b)**

For TIR at PQ; $\theta > C$

From geometry of figure $\theta = 60°, i.e., 60° < C$

$\Rightarrow \sin 60 > \sin C$

$$\Rightarrow \frac{\sqrt{3}}{2} > \frac{\mu_{Liquid}}{\mu_{Prism}} \Rightarrow \mu_{Liquid} < \frac{\sqrt{3}}{2} \times \mu_{Prism}$$

$$\Rightarrow \mu_{Liquid} < \frac{\sqrt{3}}{2} \times 1.5 \Rightarrow \mu_{Liquid} < 1.3$$

915 **(c)**

From law of reflection, $\angle i = \angle r$ ... (i)

And $\frac{\sin r'}{\sin i} = \frac{\mu_d}{\mu_r}$ ... (ii)

From the figure,

$r + r' + 90° = 180°$

$\Rightarrow r + r' = 90°$

Or $i + r' = 90°$

$r' = (90° - i)$ ... (iii)

From Eq. (ii), $\frac{\sin(90° - i)}{\sin i} = \frac{\mu_d}{\mu_r}$

Or $\frac{\cos i}{\sin i} = \frac{\mu_d}{\mu_r} \Rightarrow \cot i = \frac{\mu_d}{\mu_r}$

But $\frac{\mu_d}{\mu_r} = \sin C$ (where C is critical angle)

$\therefore \cot i = \sin C \Rightarrow C = \sin^{-1}(\cot\ i)$

916 **(a)**

When final image is formed at ∞,

$$M = \frac{v_0}{u_0}\left(\frac{D}{f_e}\right) = \frac{v_o}{f_o}\left(\frac{D}{f_e}\right)$$

Now, $v_o = 16 - f_e = 16 - 2.5 = 13.5$ cm

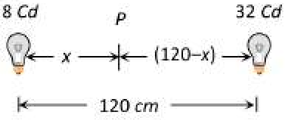
$$M = \frac{13.5}{-0.4} \times \frac{25}{2.5} = -337.5$$

917 **(d)**

$$\frac{f_l}{f_a} = \frac{({}_a\mu_g - 1)}{({}_l\mu_g - 1)}$$

$$\Rightarrow \frac{f_w}{f_a} = \frac{(1.5-1)}{\left(\frac{1.5}{1.33}-1\right)} \Rightarrow f_w = 32\ cm$$

919 **(c)**



$$I = \frac{L}{r^2} \Rightarrow \frac{L_1}{r_1^2} = \frac{L_2}{r_2^2}$$

or $\frac{8}{x^2} = \frac{32}{(120-x)^2}$

Solving it we get $x = 40\ cm$

920 **(b)**

$P_1 + P_2 = 9$

$P = P_1 + P_2 - dP_1P_2$

$$\frac{27}{9} = 9 - \frac{20}{100} \times P_1P_2$$

The above equation is correct for $P_1 = 3$ and $P_2 = 6$

921 **(c)**

When light waves are incident on the interface between air and glass, then for the first ray there is no phase change on reflection from such an interface. The second ray is reflected at an interface between an optically less dense medium (air) through which the ray travels and a dense medium (glass). There is a 180° phase change on reflection from such an interface.

922 **(d)**

In general, the simple microscope is used with image at D, hence

$$m = 1 + \frac{D}{f} = 1 + \frac{25}{5} = 6$$

923 **(d)**

$$\phi = \frac{3}{1.5 \times 10^{-3}} \times 0.685 = 1.37 \times 10^3 lumen$$

924 **(b)**

$$\frac{I_{\text{centre}}}{I_{\text{edge}}} = \frac{(r^2+h^2)^{3/2}}{h^3} = \frac{\left(1+\frac{1}{4}\right)^{3/2}}{1^3} = \left(\frac{5}{4}\right)^{3/2}$$

925 **(b)**

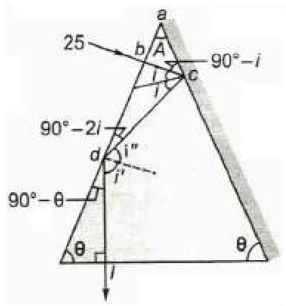
$$\alpha = \frac{3.5 \times 10^3}{3.8 \times 10^5}\text{rad} = \frac{3.5}{3.8 \times 100} \times \frac{180°}{\pi}$$

$$= \frac{3.5 \times 180 \times 7°}{38 \times 100 \times 22}$$

Also, $M = \frac{f_o}{f_e} = \frac{400}{10} = 40$

$$\beta = \frac{40 \times 35 \times 180 \times 7°}{35 \times 100 \times 22} = 21.1° \approx 21°$$

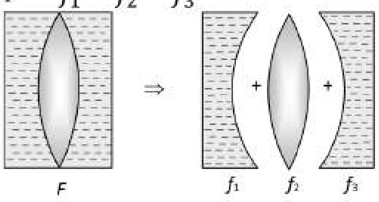
926 **(b)**



Form $\Delta\, abc, A + 90° + (90° - i) = 180°$
Or $i = A$
Now, complementary angle at point $d, \theta = 2i$
$\therefore \theta = 2A$
Only option (b) satisfies this

927 **(d)**

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$



$$\frac{1}{f_1} = (1.6-1)\left(\frac{1}{\infty} - \frac{1}{20}\right) = -\frac{0.6}{20} = -\frac{3}{100} \quad \text{... (i)}$$
$$\frac{1}{f_2} = (1.5-1)\left(\frac{1}{20} - \frac{1}{-20}\right) = \frac{1}{20} \quad \text{... (ii)}$$
$$\frac{1}{f_3} = (1.6-1)\left(\frac{1}{-20} - \frac{1}{\infty}\right) = -\frac{3}{100} \quad \text{... (iii)}$$
$$\Rightarrow \frac{1}{F} = -\frac{3}{100} + \frac{1}{20} - \frac{3}{100} \Rightarrow F = -100\ cm$$

928 **(d)**

Length of the telescope when final image is formed at least distance of distinct vision is

$$L = f_o + u_e = f_o + \frac{f_e D}{f_e + D} = 50 + \frac{5 \times 25}{5 + 25}$$
$$= \frac{325}{6} cm$$

929 **(d)**

Resolving power $\propto$ aperture

930 **(d)**

Convex mirror always forms, virtual, erect and smaller image

931 **(b)**

In any medium other than air or vacuum, the velocities of different colours are different. Therefore, both red and green colours are refracted at different angles of refraction. Hence, after emerging from glass slab through opposite parallel face, they appear at two different points and move in the two different parallel directions.

932 **(a)**

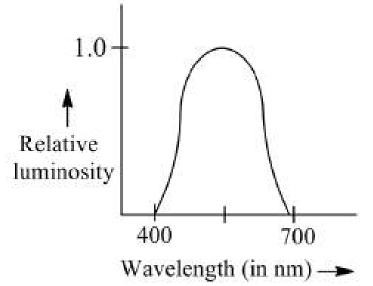
Colour of light is determined by its frequency and as frequency does not change, colour will also not change and will remain green

933 **(a)**

Virtual image formed is larger in size in case of concave mirror

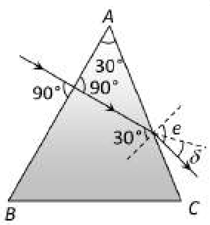
934 **(c)**

The variation of relative luminosity with wavelength is shown here



935 **(a)**

For surface $AC = \frac{1}{\mu} = \frac{\sin 30°}{\sin e} \Rightarrow \sin e = \mu \sin 30°$



$\Rightarrow \sin e = 1.5 \times \frac{1}{2} = 0.75$
$\Rightarrow e = \sin^{-1}(0.75) = 48°36'$
From figure $\delta = e - 30°$
$= 48°\, 36' - 30° = 18°36'$

936 **(b)**

When an object is placed in front of convex mirror, then for all positions of object, convex mirror forms erect and diminished image of that object. So, it is obvious that man seeing his image shorter than his height uses convex mirror.

937 **(b)**

Clearly, the given mirror is a convex mirror

$m = \frac{f}{f-u}$

$\frac{1}{3} = \frac{18}{18-u}$

Or $3 \times 18 = 18 - u$
Or $u = -2 \times 18$ cm or $u = -36$ cm

938 **(c)**

$\delta_{Prism} = (\mu - 1)A = (1.5-1)4° = 2°$
$\therefore \delta_{Total} = \delta_{Prism} + \delta_{Mirror}$
$= (\mu - 1)A + (180 - 20) = 2° + (180 - 2 \times 2)$
$= 178°$

939 **(c)**

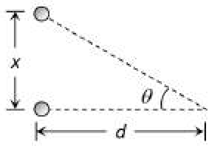
$$P = \frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

Hence, $\frac{P_2}{P_1} = \left(\frac{\mu_2 - 1}{\mu_1 - 1}\right)$

ie, $\frac{P_2}{1} = \frac{1.6 - 1}{1.5 - 1}$

Hence, $P_2 = 1.2$

940 **(c)**



$$\theta = \frac{x}{d} = \frac{1.22\,\lambda}{a}$$

$$\Rightarrow x = \frac{1.22\,\lambda d}{a}$$

$$= \frac{1.22 \times 5000 \times 10^{-10} \times 10^3}{10 \times 10^{-2}} = 6.1\,mm$$

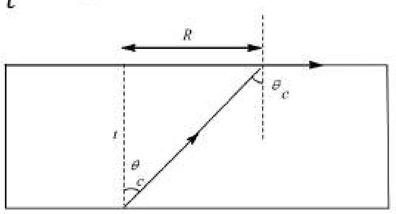
i.e., order will be 5 mm

941 **(d)**

The two lenses of an achromatic doublet should have, sum of the product of their powers and dispersive power equal to zero

942 **(a)**

$\frac{R}{t}\tan\theta_C$



Or $R = t(\tan\theta_C)$

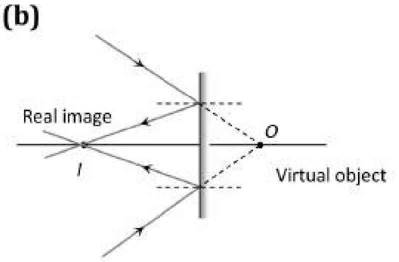
But, $\sin\theta_C = \frac{1}{\mu} = \frac{3}{5}$

$\therefore \tan\theta_C = \frac{3}{4}$

$R = \frac{3}{4}t = \frac{3}{4}(8\text{ cm}) = 6\text{ cm}$

Hence, the answer is 6.

943 **(b)**



944 **(c)**

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}} \Rightarrow \sqrt{3} = \frac{\sin\left(\frac{60^\circ+\delta_m}{2}\right)}{\sin\frac{60^\circ}{2}}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \sin\left(30^\circ + \frac{\delta_m}{2}\right) \Rightarrow \delta_m = 60^\circ$$

945 **(a)**

$$n_1 = \frac{c}{v_1} = \frac{v\lambda}{v\lambda_1} = \frac{\lambda}{\lambda_1}$$

$$n_2 = \frac{c}{v_2} = \frac{v\lambda}{v\lambda_2} = \frac{\lambda}{\lambda_2}$$

Now, $\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1}$

Or $\lambda_2 = \left(\frac{n_1}{n_2}\right)\lambda_1$

947 **(c)**

$$\sqrt{3} = \frac{\sin\left(\frac{60^\circ-\delta_m}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)}$$

$$\frac{\sqrt{3}}{2} = \sin\left(\frac{60^\circ + \delta_m}{2}\right)$$

$$\sin 60^\circ = \sin\left(\frac{60^\circ + \delta_m}{2}\right)$$

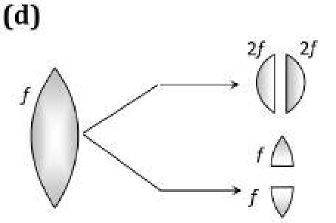
Or $\frac{60^\circ+\delta_m}{2} = 60^\circ$

Or $\delta_m = 60^\circ; i = \frac{A+\delta_m}{2} = \frac{60^\circ+60^\circ}{2} = 60^\circ$

948 **(a)**

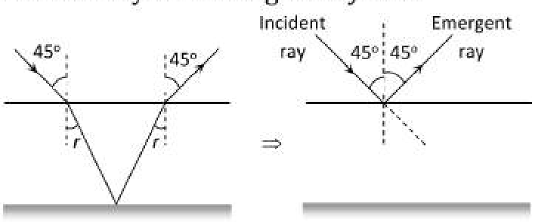
$P = P_1 + P_2 = 2D - 4D = -2D$

949 **(d)**



950 **(a)**

From the figure it is clear that the angle between incident ray and emergent ray is 90°



951 **(c)**

The focal length

$$\frac{1}{f_1} = (\mu - 1)\frac{1}{-R}$$

$$\frac{1}{f_1} = (1.5 - 1)\frac{1}{-25}$$

$$\frac{1}{f_1} = -50\text{ cm}$$

The focal length

$$\frac{1}{f_2} = (1.5 - 1) \times \frac{1}{-20}$$

$$\frac{1}{f_2} = 0.5 \times \frac{1}{-20}\text{ m}$$

$\frac{1}{f_2} = -40$ cm

The focal length of bi-convex

$\frac{1}{f_3} = ({}_1n_2 - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

$\frac{1}{f_3} = \left(\frac{4}{3} - 1\right)\left(\frac{1}{20} + \frac{1}{25}\right)$

$\frac{1}{f_3} = \frac{1}{3} \times \left(\frac{5+4}{100}\right)$

$\frac{1}{f_3} = \frac{1}{3} \times \frac{9}{100}$

$\frac{1}{f_3} = \frac{3}{100}$

$\frac{1}{F} = \frac{-200}{3}$

$F = -66.3$ cm

952 **(b)**

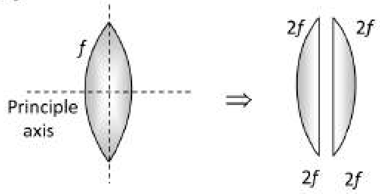
Absolute refractive index is defined as the ratio of speed of light in free space to that in a given medium

$ie, \mu = \frac{c}{v}$

For a given light, denser is the medium, lesser will be the speed of light and so greater will be the refractive index, eg, as $v_{\text{glass}} > v_{\text{water}}, \mu_g < \mu_w$.

As speed of light in vacuum is always greater than speed in a transparent medium, so the refractive index in a transparent medium is greater than one.

953 **(a)**



Ratio of focal length of new plano convex lenses is 1:1

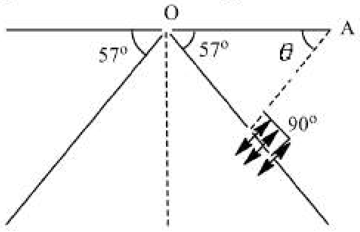
954 **(c)**

Since the image is formed at the point of object $i.e.$, object is kept on the radius of curvature

$\therefore$ C. F. = F. P. $= 60\ cm = f$

955 **(d)**

While vibrating, the resultant polarized light in a plane makes an angle θ with reflecting surfaces.



Taking triangle OAB, we have

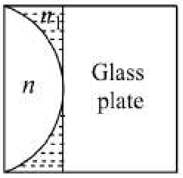
$\theta + 57° = 90°$

$\Rightarrow \theta = 90° - 57° = 33°$

957 **(c)**

According to lens maker's formula

The focal length of plano convex lens is



$\frac{1}{f} = (n-1)\left(\frac{1}{\infty} - \frac{1}{-R}\right)$

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

or $R = \frac{f}{2}$ ...(i)

The focal length of liquid lens is

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

$\frac{1}{f_1} = \frac{(n_l - 1)}{R}$

$\frac{1}{f_1} = \frac{2(n_l - 1)}{f}$ [Using (i)]

Effective focal length of the combination is

$\frac{1}{2f} = \frac{1}{f} + \frac{1}{f_1}$

$\frac{1}{2f} = \frac{1}{f} - \frac{2(n_l - 1)}{f} \Rightarrow 2(n_l - 1) = 1 - \frac{1}{2} = \frac{1}{2}$

$\Rightarrow n_l - 1 = \frac{1}{4} \Rightarrow n_l = \frac{5}{4} = 1.25$

958 **(a)**

$\mu = \frac{1}{\sin C} = \frac{1}{\sin 60°} = \frac{2}{\sqrt{3}}$

960 **(d)**

$u = -10\ cm, v = 20\ cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{20} - \left(-\frac{1}{10}\right) = \frac{3}{20} \Rightarrow f = \frac{20}{3} cm$

Now $P = \frac{100}{f} = \frac{100}{20/3} = +15\ D$

961 **(a)**

$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin(A/2)} = \frac{\sin 45°}{\sin 30°} = \sqrt{2}$

962 **(d)**

Given, $f_{aa} = 0.15$ m, $\mu_g = \frac{3}{2}$ and $\mu_{w} = \frac{4}{3}$

According to Lens maker's formula

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

$\frac{1}{f_{aa}} = \left(\frac{\mu_g}{\mu_{aa}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$= \left(\frac{(3/2)}{1} - 1\right) C$ where $C = \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Or $\frac{1}{f_{aa}} = \frac{C}{2}$ ... (i)

Also, $\frac{1}{f_{w_w}} = \left(\frac{\mu_g}{\mu_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$= \left(\frac{(3/2)}{(4/3)} - 1\right) C$

Or $\frac{1}{f_{w_w}} = \frac{C}{8}$ (ii)

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

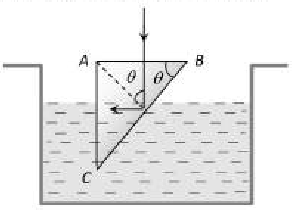
$\frac{f_{w_w}}{f_{aa}} = \frac{C}{2} \times \frac{8}{C} = 4$

Or $f_{ww} = 4 f_{aa} = 4 \times 0.15 = 0.6$ m

963 **(b)**

For total internal reflection from surface BC

$\theta \geq C \Rightarrow \sin\theta \geq \sin C$



$\Rightarrow \sin\theta \geq \left(\frac{1}{{}_l\mu_g}\right)$

$\Rightarrow \sin\theta \geq \left(\frac{\mu_{\text{Liquid}}}{\mu_{\text{Prism}}}\right)$

$\sin\theta \geq \left(\frac{1.32}{1.56}\right) \Rightarrow \sin\theta \geq \frac{11}{13}$

964 **(a)**

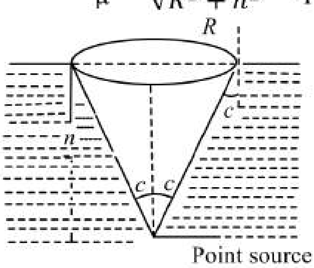
When light ray goes from denser to rarer medium ($i.e.$, more μ to less μ) it deviates away from the normal while if light ray goes from rarer to denser medium ($i.e.$ less μ more μ) it bend towards the normal.

This property is satisfied by the ray diagram (i) only

965 **(a)**

$\frac{\sin 90°}{\sin C} = \mu$

$\sin C = \frac{1}{\mu} \Rightarrow \frac{R}{\sqrt{R^2 + h^2}} = \frac{3}{4}$



Squaring, $16R^2 = 9R^2 + 9h^2$

$7R^2 = 9h^2 \Rightarrow R = \frac{3}{\sqrt{7}} h$

966 **(d)**

$f = \frac{R}{2(\mu - 1)} \Rightarrow 10 = \frac{R}{2(1.6 - 1)} \Rightarrow R = 12\ cm$

967 **(a)**

A concave lens always from virtual image for real objects

968 **(a)**

Power of the combination $P = P_1 + P_2 = 12 - 2 = 10\ D$

$\therefore$ Focal length of the combination

$F = \frac{100}{P} = \frac{100}{10} = 10\ cm$

969 **(d)**

For achromatic combination $\omega_C = -\omega_F$

$[(\mu_v - \mu_r)A]_C = -[(\mu_v - \mu_r)A]_F$

$\Rightarrow [\mu_r A]_C + [\mu_r A]_F = [\mu_v A]_C + [\mu_c A]_F$

$= 1.5 \times 19 + 6 \times 1.66 = 38.5$

Resultant $\delta = [(\mu_r - 1)A]_C + [(\mu_r - 1)A]_F$

$= [\mu_r A]_C + [\mu_r A]_F - (A_C + A_F)$

$= 38.5 - (19 + 6) = 13.5°$

970 **(c)**

Here, $i = 45°$

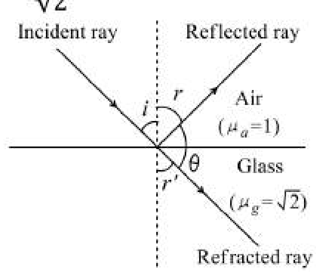
Applying Snell's law at air-glass surface, we get

$\mu_a \sin i = \mu_g \sin r''$

$1 \sin i = \sqrt{2} \sin r''$

$\sin r'' = \frac{1}{\sqrt{2}} \sin i$

$= \frac{1}{\sqrt{2}} \sin 45°$



$\sin r'' = \frac{1}{2}$

$r'' = \sin^{-1}\left(\frac{1}{2}\right) = 30°$

From figure, $r + \theta + r'' = 180°$

$i + \theta + 30° = 180°$ $[\because i = r]$

$i + \theta + 30° = 180° \Rightarrow \theta = 180° - 75° = 105°$

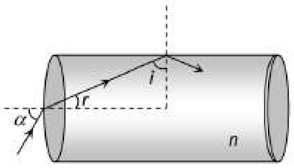
Hence, the angle between reflected and refracted rays is $105°$

972 **(b)**

Size is $\frac{1}{5}$. It can't be plane and concave mirror, because both conditions are not satisfied in plane or concave mirror. Convex mirror can meet all the requirements

973 **(a)**

From the following figure



$r + i = 90° \Rightarrow i = 90° - r$

For ray not to emerge from curved surface $i > C$

$\Rightarrow \sin i > \sin C \Rightarrow \sin(90° - r) > \sin C \Rightarrow \cos r > \sin C$

$\Rightarrow \sqrt{1 - \sin^2 r} > \frac{1}{n} \quad \left[\because \sin C = \frac{1}{n}\right]$

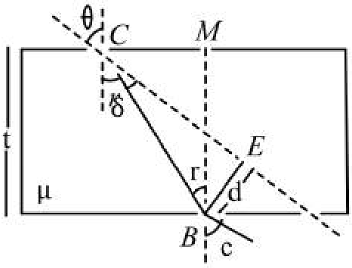
$\Rightarrow 1 - \frac{\sin^2 \alpha}{n^2} > \frac{1}{n^2} \Rightarrow 1 > \frac{1}{n^2}(1 + \sin^2 \alpha)$

$\Rightarrow n^2 > 1 + \sin^2 \alpha \Rightarrow n > \sqrt{2}$ [$\sin i \to 1$]

$\Rightarrow$ Least value $= \sqrt{2}$

975 **(b)**

In ΔBCE



$\sin(\theta - r) = \frac{CE}{BC}$

$CE = BC \sin(\theta - r)$

or $d = BC \sin(\theta - r)$ ... (i)

In ΔBMC

$\cos r = \frac{BM}{BC}$

or $BC = \frac{BM}{\cos r} = \frac{t}{\cos r}$ ... (ii)

From Eqs (i) and (iii) we get

$d = \frac{t}{\cos r}\sin(\theta - r)$

$d = \frac{t}{\cos r}(\sin\theta \cos r - \cos\theta \sin r)$

$d = t(\sin\theta - \cos\theta \tan r)$

If n is the refractive index of material of slab (glass) w.r.t. air, then

$n = \frac{\sin\theta}{\sin r}$

For small angle

$n = \frac{\theta}{r}$

$r = \frac{\theta}{n}$

And $d = t(\theta - 1 . r)[\because \sin\theta = \theta \cos\theta = 1$ if θ is small]

$d = t\left(\theta - \frac{\theta}{n}\right) = t\theta\left(1 - \frac{1}{n}\right)$

$\therefore d = \frac{t\theta(n-1)}{n}$

976 **(a)**

In minimum deviation condition $r = \frac{A}{2} = \frac{60}{2} = 30°$

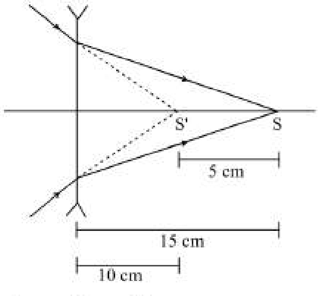
977 **(a)**

$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}} = \frac{\sin\left(\frac{60°+60°}{2}\right)}{\sin\left(\frac{60°}{2}\right)} = \sqrt{3}$

978 **(a)**

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$u = 10, v = 15, f = ?$



$\frac{1}{15} - \frac{1}{10} = \frac{1}{f}$

$\Rightarrow f = -30\ cm$

980 **(a)**

When plane mirror rotates through an angle θ, the reflected ray rotates through an angle 2θ. So spot on the screen will make $2n$ revolutions per second

981 **(d)**

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} \Rightarrow \frac{1}{80} = \frac{1}{20} + \frac{1}{f_2} \Rightarrow f_2 = -\frac{80}{3} cm$

$\therefore$ Power of second lens

$P_2 = \frac{100}{f_2} = \frac{100}{-80/3} = -3.75\ D$

982 **(d)**

According to Kirchhoff's law, a substance in unexcited state will absorb these wavelength which it emits in de-excitation

983 **(d)**

The image formation by a convex lens is as follows

Image formed is diminished, when objects lies between $2F$ and infinity.

Magnification

$(M) = \frac{image\ size}{object\ size}$

$= \frac{1}{2} = \frac{v}{u}$ ....(i)

From lens formula

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ ....(ii)

Where, f is focal length, v the image distance and u the object distance.

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

$\frac{1}{f} = \frac{1}{u} + \frac{2}{u}$

As $u = 90\ cm$

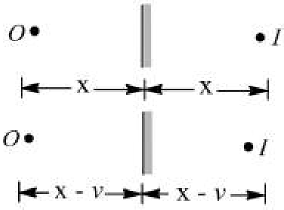
$\frac{1}{30} = \frac{3}{u}$

$\Longrightarrow u = 90\ cm$

984 **(a)**

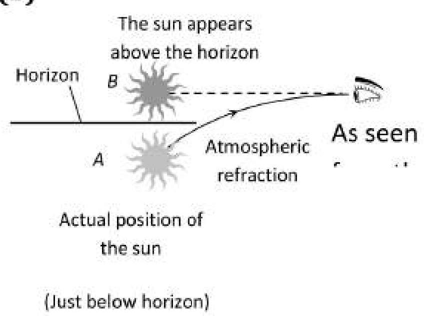
$|m| = \frac{f_o}{f_e} = 20$ and $L = f_o + f_e = 105 \Rightarrow f_o = 100\ cm$

985 **(c)**



As is clear from figure, the new distance is $2x - 2v$. The distance of image from object is reduced by an amount $2v$ is one second

986 **(b)**



987 **(a)**

$f = \frac{R}{2}$

988 **(c)**

The parallel rays coverage at a distance equal to focal length of lens so $f = L$

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

$= (1.5 - 1)\left(\frac{1}{20} + \frac{1}{20}\right)$

$= \frac{0.5 \times 2}{20} = \frac{1}{20}$

So $f = 20\ cm$ therefore, $L = 20\ cm$

989 **(c)**

$\frac{\sin r}{\sin i} = \tan 30° = \frac{1}{\sqrt{3}}$

Or $\frac{\sin i}{\sin r} = \sqrt{3}$ or $\mu = \sqrt{3}$

So, speed of light in Y is $\sqrt{3}$ times less

990 **(c)**

μ_w and μ_g are refractive indices for rarer (water) and denser (glass) media, then

$\frac{\sin C}{\sin 90°} = \frac{\mu_w}{\mu_g}$

$\Rightarrow \sin C = \frac{4/3}{3/2} = \frac{8}{9}$

$\Rightarrow C = \sin^{-1}\left(\frac{8}{9}\right)$

991 **(a)**

Since prism P is placed in position of minimum deviation, therefore refracted rays becomes parallel to the base of the prism, again by adding two prism R and Q of same material as shown in figure, the deviation produced by Q and R equal and opposite in sense, therefore final deviation is same as due to prism P.

992 **(c)**

Angle of incidence = 2(Angle of refraction), $i = 2r$ [Given]

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

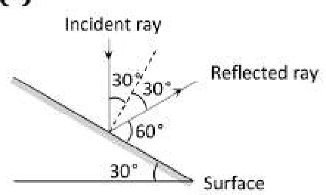
$= \frac{2 \sin r \cos r}{\sin r}$ $[\because \sin 2\theta = 2 \sin\theta \cos\theta]$

$= 2 \cos r$

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

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

993 **(c)**



994 **(c)**

Given, $n = 1.5, h_0 = 3$

$n = \frac{h_0}{h_1}$

$1.5 = \frac{3}{h_1}$

$h_i = \frac{3}{1.5} = 2\ cm$

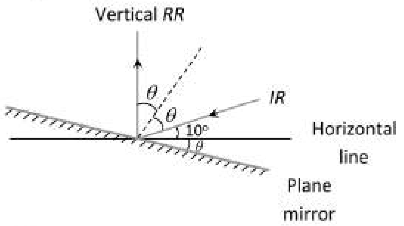
Hence, 3-2 = 1 cm upwards.

995 **(a)**

From figure

$\theta + \theta + 10 = 90$

$\Rightarrow \theta = 40°$



996 **(b)**

In short sightedness, the focal length of eye lens decreases, so image is formed before retina

997 **(c)**

When a slab of thickness t is introduced between P and the mirror, the appearent position of P shifts towards the mirror by $\left(t - \frac{t}{\mu}\right)$. Hence, the mirror must be moved in the same direction through the same distance

998 **(a)**

According to Snell's law

Refractive index, $\mu = \frac{\sin i}{\sin r}$

Given $i = 2r$

$\therefore \ \mu = \frac{\sin 2r}{\sin \ r}$

Or $\mu = \frac{2 \sin r \cos r}{\sin r}$

Or $\cos^{-1} \frac{\mu}{2} = r$

$\Rightarrow i = 2 \cos^{-1} \left[\frac{\mu}{2}\right]$

999 **(a)**

Lens formula is given by

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ ... (i)

Where f is focal length of lens, v is image distance and u is object distance.

Given $f = 10$ cm (as lens is converging)

$u = -8$ cm (as object is placed on left side of the lens)

Substituting these values in Eq. (i) , we get

$\frac{1}{10} = \frac{1}{v} - \frac{1}{-8}$

$\Rightarrow \frac{1}{v} = \frac{1}{10} - \frac{1}{8}$

$\Rightarrow \frac{1}{v} = \frac{8 - 10}{80}$

$\therefore v = \frac{80}{-2} = -40$ cm

Hence, magnification produced by the lens

$m = \frac{v}{u} = \frac{-40}{-8} = 5$

1000 **(a)**

For lens, mirror combination, combined focal length is given by

$\frac{1}{F} = \frac{2}{f} + \frac{1}{f_m}$

Here, $f_m = \infty$

$\therefore \frac{1}{F} = \frac{2}{f}$

Or $F = \frac{f}{2} = \frac{20}{2} = 10$cm

1001 **(b)**

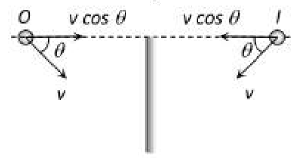
Deviation is greater for lower wavelengths

1002 **(a)**

Solids and liquids given continuous and line spectra. Only gases are known to given band spectra

1003 **(c)**

From figure it is clear that relative velocity between object and it's image $= 2v \cos \theta$



1005 **(c)**

Given, ${}_a\mu_g = {}_a\mu_e$

The focal length of convex lens in liquid f is given by

$\frac{1}{f} = \left(\frac{{}_a\mu_g}{{}_a \, {}_a\mu_{ee}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

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

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

Or $f = \infty$

Its focal length will become infinite.

1007 **(b)**

For achromatic combination, $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$

$\Rightarrow \omega_1 f_2 + \omega_2 f_1 = 0$

1008 **(a)**

$\angle i = \angle r = 0°$

1009 **(d)**

After refraction through a medium, red rays deviate less. Also, since air is rarer than water, so the rays bend towards the normal. So, the correct dispersion pattern is (b).

1010 **(b)**

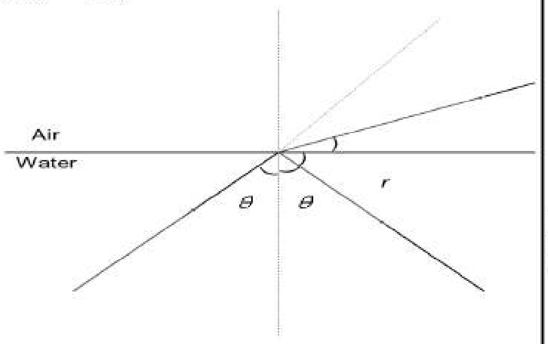
Refractive index of liquid C is same as that of glass piece. So it will not be visible in liquid C

101 **(a)**

1 $\delta \propto (\mu - 1)$

101 **(c)**

2 Since $\theta < \theta_C$, both reflection and refraction will take place. From the figure we can see that angle between reflected and refracted rays $\alpha$is less than $180° - 2\theta$.



101 **(d)**

3 For total internal reflection

$\mu = \frac{1}{\sin C}$

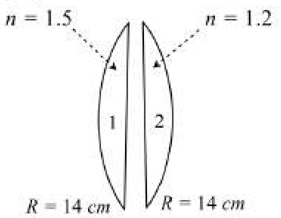
$\mu = \frac{1}{\sin(90° - \theta)}$

$\mu = \frac{1}{\cos\theta} \Rightarrow \cos\theta = \frac{1}{\mu}$

$\theta = \cos^{-1}\left(\frac{1}{\mu}\right)$

101 **(b)**

4



$\frac{1}{f_1}(\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

$\frac{1}{f_1} = (1.5 - 1)\left[\frac{1}{14} - \frac{1}{\infty}\right]$

$\frac{1}{f_1} = \frac{0.5}{14}$

$\frac{1}{f_2} = (1.2 - 1)\left[\frac{1}{\infty} - \frac{1}{-14}\right]$

$\frac{1}{f_2} = \frac{0.2}{14}$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{0.5}{14} + \frac{0.2}{14}$

$\Rightarrow \frac{1}{f} = \frac{0.7}{14}$

$\frac{1}{v} = \frac{7}{140} - \frac{1}{40} = \frac{1}{20} - \frac{1}{40}$

$\Rightarrow \frac{1}{v} = \frac{2-1}{40}$

$\Rightarrow v = 40\ cm$

101 **(b)**

6 When light passes from one medium to another, its frequency remains unchanged but it velocity (and hence, wavelength) changes.

${}_a\mu_g = \frac{\text{wavelength in air } (\lambda_a)}{\text{wavelength in glass } (\lambda_g)}$

$\Rightarrow 1.6 = \frac{5890}{\lambda_g}$

$\Rightarrow \lambda_g = \frac{5890}{1.6} = 3681\ \text{Å}$

101 **(d)**

7 After silvering the plane surface, plano convex lens behave as a concave mirror of focal length

$\frac{1}{F} = \frac{2}{f_{lens}}$

but $F = 0.2\ m$

$\therefore f_{lens} = 2F = 2 \times 0.2 = 0.4\ m$

Now, from lens maker's formula

$\frac{1}{f_{lens}} = (\mu - 1)(\frac{1}{R_1} - \frac{1}{R_2})$

$\therefore \frac{1}{0.4} = (1.5 - 1)(\frac{1}{R_1} - \frac{1}{\infty})$

$\Rightarrow R_1 = 0.5 \times 0.4 = 0.2\ m$

101 **(d)**

8 Angle of incidence = angle of emergence

Ie, $i = i'$

Also, $i = \frac{3}{4} \times$ angle of equilateral prism $= \frac{3}{4} \times 60° = 45°$

Thus, angle of deviation

$= i + i - A$

$= (45° + 45° - 60°) = 30°$

102 **(c)**

0 Let distance between lenses be x. As per the given condition, combination behaves as a plane glass plate, having focal length ∞

So by using $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 f_2}$

$\Rightarrow \frac{1}{\infty} = \frac{1}{+30} + \frac{1}{-10} - \frac{x}{(+30)(-10)} \Rightarrow x = 20\ cm$

102 **(b)**

1 Only the light-gathering power is reduced

102 **(c)**

2 Covering a portion of lens does not effect position and size of image

102 **(a)**

3

Magnification of objective lens $m = \frac{I}{O} = \frac{v_0}{u_0} = \frac{f_0}{u_0}$

$\Rightarrow \frac{I}{50} = \frac{200 \times 10^{-2}}{2 \times 10^3} \Rightarrow I = 5 \times 10^{-2} m = 5\ cm$

102 **(d)**

4 Apparent distance of fish from lens $u = 0.2 + \frac{h}{\mu}$

$= 0.2 + \frac{0.4}{4/3} = 0.5m$

From $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{(+3)} = \frac{1}{v} - \frac{1}{(-0.5)} v = -0.6\ m$

The image of the fish is still where the fish is 0.4 m below the water surface

102 **(b)**

5 The point on the right side of the lens at will rays converge will behave as virtual object of the lens.

$\therefore\ u = +12\ cm, f = 20\ cm$

From the relation

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\therefore\ \frac{1}{20} = \frac{1}{v} - \frac{1}{12}$

$\Rightarrow \frac{1}{v} = \frac{1}{20} + \frac{1}{12}$

$= \frac{3+5}{60} = \frac{8}{60}$

$\therefore\ u = \frac{60}{8} = 7.5\ cm$

So, image will be formed on same side of the virtual object at a distance of 7.5 cm from the lens.

102 **(a)**

6 Let A be the angle of prism, and δ the angle of minimum deviation, then refractive index of the medium of prism is given by

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

Given, $\delta = A, \mu = 1.5$

$\therefore 1.5 = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

Also $\sin 2\theta = 2 \sin\theta \cos\theta$

$\therefore 1.5 = \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}}$

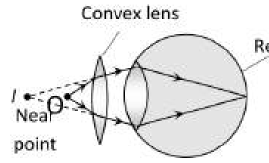
$\Rightarrow \cos\frac{A}{2} = \frac{1.5}{2} = 0.75$

$\Rightarrow \frac{A}{2} = 41° - 24' - 36''$

$\Rightarrow A = 82° - 48' - 72''$

102 **(d)**

8 Hypermetropia is removed by convex lens



102 **(b)**

9 Velocity of light is maximum in vacuum

103 **(a)**

0 Let distance $= u$. Now $\frac{v}{u} = 16$ and $v = u + 120$

$\therefore \frac{120 + u}{u} = 16 \Rightarrow 15u = 120 \Rightarrow u = 8\ cm$

103 **(a)**

1 $\mu = A + \frac{B}{\lambda^2}$

103 **(c)**

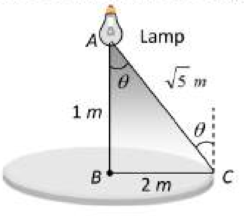
2 Objective of compound microscope is a convex lens. Convex lens forms real and enlarged image when an object is placed between its focus and lens.

103 **(d)**

4 The illuminance at B

$I_B = \frac{L}{1^2}$ ... (i)

And illuminance at point C



$I_C = \frac{L\cos\theta}{(\sqrt{5})^2} = \frac{L}{(\sqrt{5})^2} \times \frac{1}{\sqrt{5}}$

$\Rightarrow I_C = \frac{L}{5\sqrt{5}}$ ... (iii)

From equation (i) and (ii) $I_B = 5\sqrt{5}\, I_0$

103 **(c)**

5 $\frac{1}{50^2} = \frac{16}{d^2}$

Or $d^2 = (50)^2 \times 16$

Or $d = 50 \times 4\text{cm} = 200\text{cm} = 2\text{m}$

103 **(b)**

6 $m = \frac{f}{f-u} \Rightarrow -3 = \frac{f}{f-(-20)} \Rightarrow f = -15\ cm$

103 **(a)**

7 $m = \frac{f}{f-u}$

$-2 = \frac{-20}{-20-u}$

$-2 = \frac{20}{20+u}$

Or $20 + u = -10$

Or $u = -30$ cm

103 **(a)**

8 In myopia, eye ball may be elongated so, light rays focussed before the retina

103 **(a)**

9 $m = \frac{f}{f+u} = -2 = \frac{\frac{1}{3}}{\frac{1}{3}+u}$

$-\frac{2}{3} - 2u = \frac{1}{3}$

Or $-2u = \frac{1}{3} + \frac{2}{3} = 1$

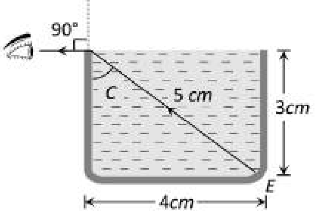
Or $u = -\frac{1}{2}\text{m} = -0.5$ m

104 **(c)**

0 From colour triangle

104 **(a)**

1 Light ray is going from liquid (Denser) to air (Rarer) and angle of refraction is 90°, so angle of incidence must be equal to critical angle



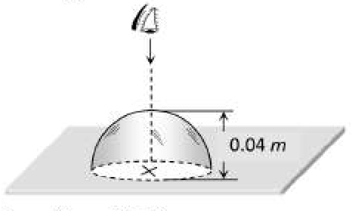
From figure

$\sin C = \frac{4}{5}$

Also $\mu = \frac{1}{\sin C} = \frac{5}{4} = 1.2$

104 **(b)**

2 **Case (i)** When flat face is in contact with paper



$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$ where

$\mu_1 = R.I.$ of medium in which light rays are going $= 1$

$\mu_1 = R.I.$ of medium from which light rays are coming $= 1.6$

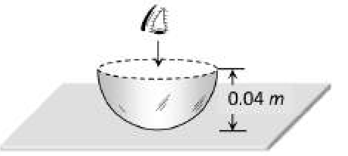
$u =$ distance of object from curved surface $= -0.04\ m$

$R = -0.04\ m$

$\therefore \frac{1}{v} - \frac{1.6}{(-0.04)} = \frac{1-1.6}{(-0.04)} \Rightarrow v = -0.04\ m$

i.e., the image will be formed at the same position of cross

Case (ii) When curved face is in contact with paper



$\mu = \frac{\text{Real depth } (h)}{\text{Apparent depth } (h')}$

$\Rightarrow 1.6 = \frac{0.04}{h'}$

$\Rightarrow h' = 0.025\ m$

104 **(a)**

3 $5 = (1.5 - 1)\left(\frac{2}{R}\right)$ ...(i)

$-1 = \left(\frac{1.5}{n} - 1\right)\left(\frac{1}{R}\right)$ ...(ii)

Dividing Eq.(i) by Eq.(ii), we get

$-5 = \frac{0.5n}{1.5-n}$

Or $-7.5 + 5n = 0.5n$ or $-7.5 = -4.5n$

Or $n = \frac{75}{45} = \frac{5}{3}$

104 **(c)**

4 $\mu \propto \frac{1}{v} \Rightarrow \frac{\mu_l}{\mu_g} = \frac{v_g}{v_l} \Rightarrow \frac{\mu_l}{1.5} = \frac{2 \times 10^8}{2.5 \times 10^8} \Rightarrow \mu_l = 1.2$

104 **(b)**

6 $I \propto \frac{1}{r^2}$ so,

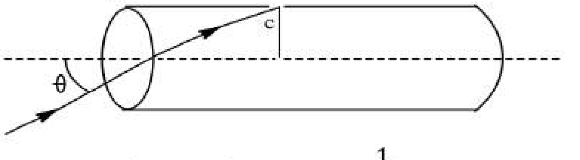
$\frac{\text{Illuminance on slide}}{\text{Illuminance on screen}}$

$= \frac{(\text{Length of image on screen})^2}{(\text{Length of object on slide})^2}$

$= \left(\frac{3.5\ m}{35\ mm}\right)^2 = 10^4 : 1$

104 **(d)**

7 $\sin C = \frac{\sqrt{3}}{2}$ ... (i)



$\sin r = \sin(90° - C) = \cos C = \frac{1}{2}$

$\frac{\sin \theta}{\sin r} = \frac{\mu_2}{\mu_1}$

$\sin \theta = \frac{2}{\sqrt{3}} \times \frac{1}{2}$

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

104 **(b)**

8 Far point of the eye = focal length of the lens

$= \frac{100}{P} = \frac{100}{0.66} = 151\ cm$

104 **(a)**

9 Apparent depth is given by

$$d_{apparent} = \frac{d_1}{\mu_1} + \frac{d_2}{\mu_2}$$

$$= \frac{6}{4/3} + \frac{6}{1.5} = 4.5 + 4$$

$$= 8.5 \text{ cm}$$

1050 **(a)**

The central ray goes undeviated. So, $\mu_2 = \mu_1$

Also, $\mu_3 < \mu_2$

1051 **(b)**

The far and near point for normal eye are usually taken to be infinite and 25 cm respectively, ie, a normal eye can see very distant objects clearly but near objects only if they are at a distance greater than 25 cm from the eye. The ability of eye to see objects from infinite distance to 25 cm from it is called power of accommodation.

RAY OPTICS AND OPTICAL INSTRUMENTS

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: The focal length of the mirror is f and distance of the object from the focus is u, the magnification of the mirror is f/u

Statement 2: Magnification $= \frac{\text{Size of image}}{\text{Size of object}}$

2

Statement 1: The illuminance of an image produced by a convex lens is greater in the middle and lens towards the edges

Statement 2: The middle part of image is formed by undeflected rays while outer part by inclined rays

3

Statement 1: A red object appears dark in the yellow light

Statement 2: A red colour is scattered less

4

Statement 1: The focal length of the refractive of the telescope is larger than that of eye piece

Statement 2: The resolving power of telescope increases when the aperture of objective is small

5

Statement 1: The focal length of lens does not change when red light is replaced by blue light

Statement 2: The focal length of lens does not depends on colour of light used

6

Statement 1: Within a glass slab, a double convex air bubble is formed. This air bubble behaves like a converging lens

Statement 2: Refractive index of air is more than the refractive index of glass

7

Statement 1: The cloud in sky generally appear to be whitish

Statement 2: Diffraction due to cloud is efficient in equal measure at all wavelengths

8

Statement 1: The reflective index of diamond is $\sqrt{6}$ and that liquid is $\sqrt{3}$. If the light travels from diamond to the liquid, it will initially reflected when the angle of incidence is 30°

Statement 2: $\mu = \frac{1}{\sin C}$ where μ is the refrective index of diamond with respect to liquid

9

Statement 1: The polar caps of earth are cold in comparison to equatorial plane

Statement 2: The radiation absorbed by polar caps is less than the radiation absorbed by equatorial plane

10

Statement 1: For the sensitivity of a camera, its aperture should be reduced

Statement 2: Smaller the aperture , image focusing is also sharp

11

Statement 1: In optical fibre, the diameter of the core is kept small

Statement 2: This smaller diameter of the core ensures that the fibre should have incident angle more than the critical angle required for total internal reflection

12

Statement 1: The resolving power of a telescope is more if the diameter of the objective lens is more

Statement 2: Objective lens of large diameter collects more light

13

Statement 1: A concave mirror and convex lens both have the same focal length in air. When they are submerged in water, they will still have the same focal length

Statement 2: The refractive index of water is greater than the refractive index of air

14

Statement 1: The formula connecting u, v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.

Statement 2: Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces.

15

Statement 1: A short sighted person cannot see objects clearly when placed beyond 30 cm. He should use a concave lens of power 2 D

Statement 2: Concave lens should form image of an object at infinity placed at a distance of 50 cm

16

Statement 1: Diamond glitters brilliantly

Statement 2: Diamond does not absorb sunlight

17

Statement 1: Glass is transparent but its powder seems opaque. When water is poured over it, it becomes transparent.

Statement 2: Light gets refracted through water.

18

Statement 1: The stars twinkle while the planets do not

Statement 2: The stars are much bigger in size than the planets

19

Statement 1: In a movie, ordinarily 24 frames are projected per second from one end to the other of the complete film

Statement 2: The image formed on retina of eye is sustained upto 1/10 second after the removal of stimulus

20

Statement 1: If objective and eye lenses of a microscope are interchanged then it can work as telescope

Statement 2: The objective of telescope has small focal length

21

Statement 1: The images formed by total internal reflections are much brighter than those formed by mirror or lenses

Statement 2: There is no loss of intensity in total internal reflection

22

Statement 1: Just before setting, the sun may appear to be elliptical. This happens due to refraction

Statement 2: Refraction of light ray through the atmosphere may cause different magnification in mutually perpendicular directions

23

Statement 1: Dispersion of light occurs because velocity of light in a material depends upon its colour

Statement 2: The dispersive power depends only upon the material of the prism, not upon the refracting angle of the prism

24

Statement 1: The resolving power of an electron microscope is higher than that of an optical microscope

Statement 2: The wavelength of electron is more than the wavelength of visible light

25

Statement 1: The refractive index of a prism depends only on the kind of glass of which it is made of and the colour of light

Statement 2: The refractive index of a prism depends upon the refracting angle of the prism and the angle of minimum deviation

26

Statement 1: The setting sun appears to be red

Statement 2: Scattering of light is directly proportional to the wavelength

27

Statement 1: By increasing the diameter of the objective of telescope, we can increase its range

Statement 2: The range of a telescope tells us how far away a star of some standard brightness can be spotted by telescope

28

Statement 1: Propagation of light through an optical fibre is due to total internal reflection taking place at the core-clad interface.

Statement 2: Refractive index of the material of the core of the optical fibre is greater than that of air.

29

Statement 1: It is impossible to photograph a virtual image

Statement 2: The rays which appear diverging from a virtual image fall on the camera and a real image is captured

30

Statement 1: Angle of deviation depends on the angle of prism.

Statement 2: For thin prism $\delta = (\mu\text{-}1)A$ Where δ= angle of deviation μ =refractive index A = angle of prism

31

Statement 1: Convergent lens property of converging remain same in all mediums

Statement 2: Property of lens whether the ray is diverging or converging depends on the surrounding medium

32

Statement 1: Owls can move freely during night

Statement 2: They have large number of rods on their retina

33

Statement 1: Using Huygen's eye-piece measurements cab be taken but are not correct.

Statement 2: The cross wires, scale and final image are not magnified proportionately because the image of the object is magnified be two lenses, whereas the cross wire scale is magnified by one lens only. Identify the correct one of the following

34

Statement 1: A double convex lens ($\mu = 1.5$) has focal length 10 cm. When the lens is immersed in water ($\mu = 4/3$) its focal length becomes 40 cm

Statement 2: $\frac{1}{f} = \frac{\mu_1 - \mu_m}{\mu_m}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

35

Statement 1: The fluorescent tube is considered better than an electric bulb

Statement 2: Efficiency of fluorescent tube is more than the efficiency of electric bulb

36

Statement 1: Different colours travel with different speed in vacuum

Statement 2: Wavelength of light depends on refractive index of medium

37

Statement 1: An empty test tube dipped into water in a beaker appears silver, when viewed from a suitable direction

Statement 2: Due to refraction of light, the substance in water appears silvery

38

Statement 1: A short sighted person cannot see objects clearly when placed beyond 50 cm. He should use a concave lens of power 2 D.

Statement 2: Concave lens should form image of an object at infinity placed at a distance of 50 cm.

39

Statement 1: We cannot produce a real image by plane or convex mirrors under any circumstances

Statement 2: The focal length of a convex mirror is always taken as positive

40

Statement 1: All the materials always have the same colour, whether viewed by reflected light or through transmitted light

Statement 2: The colour of material does not depend on nature of light

41

Statement 1: By roughening the surface of a glass sheet its transparency can be reduced

Statement 2: Glass sheet with rough surface absorbs more light

42

Statement 1: The speed of light in a rarer medium is greater than that in a denser medium

Statement 2: One light year equals to $9.5 \times 10^{12} km$

43

Statement 1: Critical angle of light passing from glass to air is minimum for violet colour

Statement 2: The wavelength of violet light is greater than the light of other colours

44

Statement 1: The air bubble shines in water

Statement 2: Air bubble in water shines due to refraction of light

45

Statement 1: The colour of the green flower seen through red glass appears to be dark

Statement 2: Red glass transmits only red light

46

Statement 1: If the angles of the base of the prism are equal, then in the position of minimum deviation, the refracted ray will pass parallel to the base of prism

Statement 2: In the case of minimum deviation, the angle of incidence is equal to the angle of emergence

47

Statement 1: The mirrors used in search lights are parabolic and not concave spherical.

Statement 2: In a concave spherical mirror the image formed is always virtual.

48

Statement 1: Blue colour of sky appears due to scattering of blue colour

Statement 2: Blue colour has shortest wave length in visible spectrum

49

Statement 1: The frequencies of incident, reflected and refracted beam of monochromatic light incident from one medium to another are same

Statement 2: The incident, reflected and refracted rays are coplanar

50

Statement 1: There is no dispersion of light refracted through a rectangular glass slab

Statement 2: Dispersion of light is the phenomenon of splitting of a beam of white light into its constituent colours

51

Statement 1: If a plane glass slab is placed on the letters of different colours all the letters appear to be raised up to the same height

Statement 2: Different colours have different wavelengths

RAY OPTICS AND OPTICAL INSTRUMENTS

: ANSWER KEY :

1)	a	2)	a	3)	b	4)	d	29)	d	30)	A	31)	d	32)	c
5)	d	6)	d	7)	c	8)	a	33)	c	34)	a	35)	a	36)	d
9)	c	10)	c	11)	a	12)	a	37)	c	38)	b	39)	d	40)	d
13)	d	14)	c	15)	a	16)	b	41)	c	42)	b	43)	c	44)	c
17)	a	18)	b	19)	c	20)	d	45)	a	46)	a	47)	c	48)	a
21)	a	22)	a	23)	b	24)	c	49)	b	50)	b	51)	d		
25)	c	26)	c	27)	b	28)	b								

RAY OPTICS AND OPTICAL INSTRUMENTS

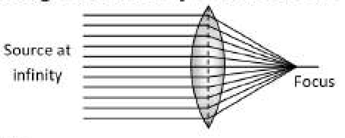
: HINTS AND SOLUTIONS :

1 **(a)**

Magnification produced by mirror $m = \frac{I}{O} = \frac{f}{f-u} = \frac{f}{x}$ x is distance from focus

2 **(a)**

Image formed by convex lens



4 **(d)**

The magnifying power of telescope in relaxed state is $m = \frac{f_0}{f_e}$

So, for high magnification, the focal length of objective length should be larger than of eye-piece

Resolving power of a telescope $= \frac{d}{1.22\,\lambda}$

For high resolving power. Diameter (d) of objective should be higher

5 **(d)**

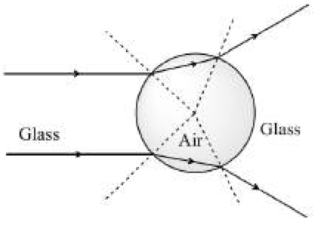
Focal length of the lens depends upon it's refractive index as $\frac{1}{f} \propto (\mu - 1)$

Since $\mu_b > \mu_r$ so $f_b < f_r$

Therefore, the focal length of a lens decreases when red light is replaced by blue light

6 **(d)**

The air bubble would behave as a diverging lens, because refractive index of air is less than refractive index of glass. However, the geometrical shape of the air bubble shall resemble a double convex lens



7 **(c)**

The clouds consist of dust particles and water droplets. Their size is very large as compared to the wavelength of the incident light from the sun. So there is very little scattering of light. Hence the light which we receive through the clouds has all the colours of light. As a result of this, we receive almost white light. Therefore, the cloud are generally white

8 **(a)**

Reflection index of diamond w.r.t. liquid ${}_l\mu_d = \frac{1}{\sin C}$

$\therefore \frac{\sqrt{6}}{\sqrt{3}} = \frac{1}{\sin C}$

Or $\sin C = \frac{1}{\sqrt{2}} = \sin 45°$

$\therefore C = 45°$

9 **(c)**

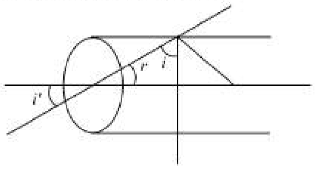
Polar caps receives almost the same amount of radiation as the equatorial plane. For the polar caps angle between sun rays and normal (to polar caps) tends to 90°. As per Lambert's cosine law, $E \propto \cos\theta$, therefore E is zero. For the equatorial plane, $\theta = 0°$, therefore E is maximum. Hence polar caps of earth are so cold. (where E is radiation received)

10 **(c)**

Very large apertures gives blurred images because of aberrations. By reducing the aperture the clear image is obtained and thus the sensitivity of camera increases. Also the focussing of object at different distance is achieved by slightly altering the separation of the lens from the film

11 **(a)**

For smaller diameter incident angle at $A(i'')$ will be greater than critical angle to cause total internal reflection



12 **(a)**

Resolving power $= \frac{a}{1.22\lambda}$

13 **(d)**

If a mirror is placed in a medium other than air its focal length does not change as $f = R/2$, but for the lens

$$\frac{1}{f_a} = ({}_a n^g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

and $\frac{1}{f_w} = ({}_w n^g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

As ${}_w n^g < {}_a n^g$, hence focal length of lens in water increases. The refractive index of water is 4/3 and that of air is 1. Hence, $\mu_w > \mu_a$

14 **(c)**

Laws reflection can be applied to any type of surface.

15 **(a)**

We know that power of lens is a reciprocal of its focal length, hence

$$P = \frac{1}{f} = \frac{1}{\frac{50}{100}} = 2\text{D}$$

Since, lens is concave hence, its power will be 2D. If the objective is placed at infinity then

$u = \infty, v = ?, f = 50$ cm

From the formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{v} - \frac{1}{\infty} = \frac{1}{-50}$$

$v = -50$ cm

Thus, concave lens will form an image of the object at infinity at a distance of 50 cm

16 **(b)**

Diamond glitters brilliantly because light enters in diamond suffers total internal reflection. All the light entering in it comes out of diamond after number of reflections and so light is absorbed by it

18 **(b)**

The stars twinkle while the planets do not. It is due to variation in density of atmospheric layer. As the stars are very far and giving light continuously to us. So, the light coming from stars is found to change their intensity continuously. Hence they are seen twinkling. Also stars are much bigger in size than planets but it has nothing to deal with twinkling phenomenon

19 **(c)**

After the removal of stimulus the image formed on retina is sustained up to 1/6 second

20 **(d)**

We cannot interchange the objective and eye lens of a microscope to make a telescope. The reason is that the focal length of lenses in microscope are very small, of the order of *mm* or a few *cm* and the difference $(f_o - f_e)$ is very small, while the telescope objective have a very large focal length as compared to eye lens of microscope

21 **(a)**

In total internal reflection, 100% of incident light is reflected back into the same medium, and there is no loss of intensity, while in reflection from mirrors and refraction from lenses, there is always some loss of intensity. Therefore images formed by total internal reflection are much brighter than those formed by mirrors or lenses

22 **(a)**

When the sun is close to setting, refraction will effect the top part of the sun differently from the bottom half. The top half will radiate its image truly, while the bottom portion will send an apparent image. Since the bottom portion of sun is being seen through thicker, more dense atmosphere. The bottom image is being bent intensely and gives the impression of being squashed or "flattened" or elliptical shape

23 **(b)**

The velocity of light in a material medium depends upon it's colour (wavelength). If a ray of white light incident on a prism, then on emerging, the different colours are deviated through different angles

Also dispersive power $\omega = \frac{(\mu_V - \mu_R)}{(\mu_Y - 1)}$

$i.e.$, ω depends upon only μ

24 **(c)**

The wavelength of wave associated with electron (de Broglie waves) is less than that of visible light. We know that resolving power is inversely proportional to wavelength of wave used in microscope. Therefore the resolving power of an electron microscope is higher than that of an optical microscope

26 **(c)**

The sun and its surroundings appears red during sunset or sunrise because of scattering of light. The amount of scattered light is inversely proportional to the fourth power of wavelength of light, $i.e.$, $I \propto \frac{1}{\lambda^4}$

27 **(b)**

The light gathering power (or brightness) of a telescope $\propto (diameter)^2$. So by increasing the objective diameter even far off stars may produce images of optimum brightness

30 **(A)**

The relation between angle of deviation δ for a thin prism, an angle of prism and refractive index of material of prism is given by $\delta = (\mu\text{-}1)A$

31 **(d)**

In air or water, a convex lens made of glass behaves as a convergent lens but when it is placed in carbon disulfide, it behaves as a divergent lens. Therefore, when a convergent lens is placed inside a transparent medium of refractive index greater than that of material of lens, it behave as a divergent lens.

It simply concludes that property of a lens whether the ray is diverging or converging depends on the surrounding medium

32 **(c)**

Owls can move freely during night, because they have large number of cones on their retina which help them to see in night

33 **(c)**

Using Huygen's eye-piece, measurements can be taken but not accurately due to the reason given.

34 **(a)**

Focal length of lens immersed in water is four times the focal length of lens in air. It means $f_\omega = 4f_a = 4 \times 10 = 40\ cm$

35 **(a)**

The efficiency of fluorescent tube is about 50 $lumen/watt$, whereas efficiency of electric bulb is about 12 $lumen/watt$. Thus for same amount of electric energy consumed, the tube gives nearly 4 times more light than the filament bulb

36 **(d)**

The velocity of light of different colours (all wavelengths) is same in vacuum and $\mu \propto \frac{1}{\lambda}$

37 **(c)**

The ray of light incident on the water air interface suffers total internal reflections, in that case the angle of incidence is greater than the critical angle. Therefore, if the tube is viewed from suitable direction (so that the angle of incidence is greater than the critical angle), the rays of light incident on the tube undergoes total internal reflection. As a result, the test tube appears as highly polished $i.e.$ silvery

38 **(b)**

We know that power of lens is a reciprocal of its focal length, hence $P = \frac{1}{f} = \frac{1}{\frac{50}{100}} = 2\text{D}$

Since, lens is concave hence, its power will be 2D. If the object is placed at infinity then

$\mu = \infty, v = ?, f = 50$ cm

From the formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

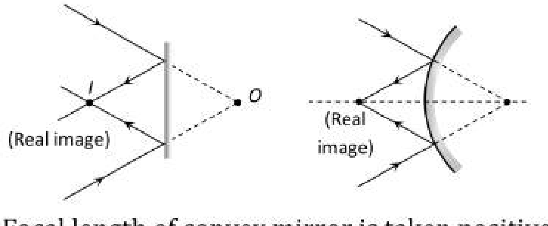
$$\frac{1}{v} - \frac{1}{\infty} = \frac{1}{-50}$$

$$v = -50 \text{ cm}$$

Thus, concave lens will form an image of the object at infinity at a distance of 50 cm.

39 **(d)**

We can produce a real image by plane or convex mirror



Focal length of convex mirror is taken positive

40 **(d)**

It is not necessary for a material to have same colour in reflected and transmitted light. A material may reflect one colour strongly and transmit some other colour. For example, some lubricating oils reflect green colour and transmit red. Therefore, in reflected light, they will appear green and in transmitted light, they will appear red

41 **(c)**

When glass surface is made rough, then light incident on it is scattered in different directions. Due to which its transparency decreases

There is no effect of roughness on absorption of light

43 **(c)**

$\mu \propto \frac{1}{\lambda} \propto \frac{1}{C}$. λ_V is least so C_V is also least. Also the greatest wavelength is for red colour

44 **(c)**

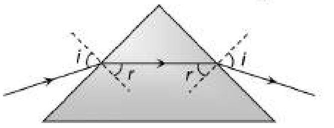
Shining of air bubble in water is on account of total internal reflection

45 **(a)**

Red glass transmits only red light and absorbs all the colours of which light. Thus, when green flower is seen through red glass it absorbs the green colour, so it appears to be dark

46 **(a)**

In case of minimum deviation of a prism $\angle i = \angle e$



so $\angle r_1 = \angle r_2$

48 **(a)**

I (scattering of light) $\propto \frac{1}{\lambda^4}$, blue light has small wavelength and order of wavelength of blue light is nearly equal to size of scattered particle of sky and blue scattered most not violet even violet has smallest wavelength in visible spectrum

50 **(b)**

After refraction at two parallel faces of a glass slab, a ray of light emerges in a direction parallel to the direction of incidence of white light on the slab. As rays of all colours emerge in the same direction (of incidence of white light), hence there is no dispersion, but only lateral displacement

51 **(d)**

Apparent shift for different coloured latter is

$d = h\left(1 - \frac{1}{\mu}\right) \Rightarrow \lambda_R > \lambda_V$ so $\mu_R < \mu_V$

Hence $d_R < d_V$ *i.e.* red coloured letter raised least

RAY OPTICS AND OPTICAL INSTRUMENTS

Matrix-Match Type

This section contain(s) 0 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II**.

1. Match List I with List II and select the correct answer using the codes given below the lists

Column-I	Column- II
(A) An object is placed at focus before a convex mirror	(p) Magnification is $-\infty$
(B) An object is placed at centre of curvature before a concave mirror	(q) Magnification is 0.5
(C) An object is placed at focus before a concave mirror	(r) Magnification is +1
(D) An object is placed at centre of curvature before a convex mirror	(s) Magnification is −1
	(t) Magnification is 0.33

CODES :

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

2. Match the List *I* with the List *II* from the combinations shown

Column-I	Column- II
(A) Presbyopia	(p) Sphero-cylindrical lens
(B) Hypermetropia	(q) Convex lens of proper power may be used close do the eye
(C) Astigmatism	(r) Concave lens of suitable focal length
(D) Myopia	(s) Bifocal lens of suitable focal length

CODES :

	A	**B**	**C**	**D**

a)	a	c	b	d
b)	b	d	c	a
c)	d	b	a	c
d)	d	a	c	b

3. Two transparent media of refractive indices μ_1 and μ_3 have a solid lens shaped transparent material of refractive index μ_2 between them as shown in figures in Column-II. A ray traversing these media is also shown in the figures. In column-I different relationships between μ_1, μ_2 and μ_3 are given. Match them to the ray diagrams shown in Column-II

Column-I

(A) $\mu_1 < \mu_2$

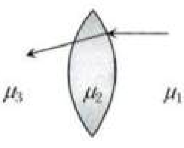
(B) $\mu_1 > \mu_2$

(C) $\mu_2 = \mu_3$

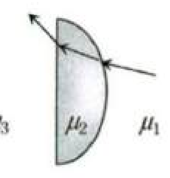
(D) $\mu_2 > \mu_3$

Column- II

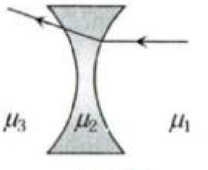
(p)



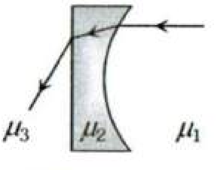
(q)



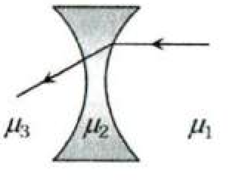
(r)



(s)



(t)



CODES :

	A	**B**	**C**	**D**
a)	P,r	q,s,t	p,r,t	q,s
b)	q,s,t	p,r	q,s	p,r,t
c)	p,r,t	q,s	p,r	q,s,t
d)	q,s	p,r,t	q,s,t	p,r

4. A simple telescope used to view distant objects has eyepiece and objective lenses of focal lengths f_e and f_0 respectively. Then

Column-I **Column- II**

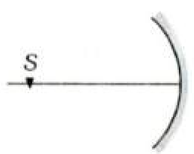
(A)	Intensity of light received by lens	(p)	Radius of aperture
(B)	Angular magnification	(q)	Dispersion of lens
(C)	Length of telescope	(r)	Focal length of objective lens and eyepiece lens
(D)	Sharpness of image	(s)	Spherical aberration

CODES :

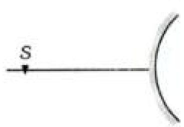
	A	B	C	D
a)	P,q,r	p,b	r	r
b)	r	p,q,r	r	p,b
c)	p,b	r	r	p,q,r
d)	r	p,b	p,q,r	r

5. An optical component and an object *S* placed along its optic axis are given in Column I. The distance between the object and the component can be varied. The properties of images are given in Column II. Match all the properties of images from Column II with the appropriate components given in Column I

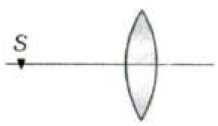
Column-I | **Column- II**

(A)


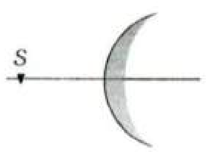
(p) Real image

(B)


(q) Virtual image

(C)


(r) Magnified image

(D)


(s) Image at infinity

CODES :

	A	B	C	D
a)	P,q,r	p	q	r,s
b)	p,q,r,s	q	p,q,r,s	p,q,r,s
c)	r,s	p,q	q	p,q,r,s
d)	p,q	p,q,r,s	r,s	q

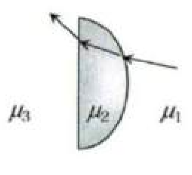
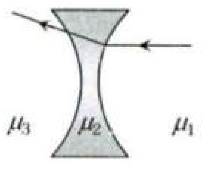
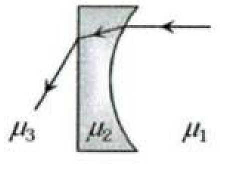
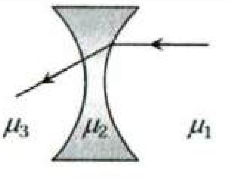
RAY OPTICS AND OPTICAL INSTRUMENTS

: ANSWER KEY :

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

: HINTS AND SOLUTIONS :

3 **(a)**

(p)		$\mu_2 = \mu_3$ As there is no deviation. As the light bends towards normal in denser medium $\mu_2 > \mu_1$ p → A and C
(q)		As light bends away from normal $\mu_2 < \mu_1$ and $\mu_3 < \mu_2$ q → B and D
(r)		$\mu_2 = \mu_3$ (As no deviation) $\mu_2 > \mu_1$ (As light bends – towards normal) r → C and A
(s)		$\mu_2 < \mu_1$ $\mu_3 < \mu_2$ As light bends away from normal s → B and D
(t)		$\mu_2 = \mu_3$ As no deviation of light $\mu_2 < \mu_1$ As light bends away from normal t → C and B