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Class 12 Physics Chapterwise PYQs

2026 – 2003 | All CBSE Board Papers

Chapter-wise previous year questions, sorted by marks and year

Chapter 9: Ray Optics and Optical Instruments

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1-Mark Questions (112 questions · Section A · MCQ)

Q1. A concave lens of focal length 10 cm is cut into two identical plano-concave lenses. The focal length of each lens will be:

(A) 20 cm
(B) 30 cm
(C) 40 cm
(D) 5 cm

[2026 • Set 55-1-1]

Q2. A concave lens of focal length 40 cm is coaxially in contact with two convex lenses, each of focal length 20 cm, on each side. The focal length of the combination is:

(A) zero
(B) $\frac{40}{3}$ cm
(C) $-\frac{20}{3}$ cm
(D) $\frac{40}{3}$ cm

[2026 • Set 55-1-2]

Q3. Light from a small object in air falls on a spherical glass surface $(n = 1.5)$ of radius of curvature R. A real image of the object will be formed if the object distance u is related to R as:

(A) $u < \frac{R}{2}$

(B) $\frac{R}{2} < u < R$

(C) $R < u < 2R$

(D) $u > 2R$

[2026 • Set 55-1-3]

Q4. Case Study: In an experiment with convex lens of focal length f, the screen is fixed at a distance D from the object. A student slowly moves the lens away from the object towards the screen and finds that she is able to form sharp image of the object for two positions of the lens. The distance between these two positions of the lens is d. The value of d is:

(A) $\sqrt{D(D-4f)}$

(B) $\sqrt{D(D-2f)}$

(C) $2\sqrt{Df}$

(D) $\sqrt{D(D-f)}$

[2026 • Set 55-2-1]

Q5. Compared to the size of the object, the images formed in the two positions of the lens are respectively:

(A) reduced, enlarged

(B) reduced, reduced

(C) enlarged, enlarged

(D) enlarged, reduced

[2026 • Set 55-2-1]

Q6. If the distance between object and screen is $80{\cdot}00$ cm and the lens forms sharp images at two positions separated by $20{\cdot}00$ cm, the focal length of convex lens is:

(A) $15{\cdot}50$ cm

(B) $18{\cdot}75$ cm

(C) $20{\cdot}50$ cm

(D) $22{\cdot}75$ cm

[2026 • Set 55-2-1]

Q7. Consider a convex lens of focal length 15 cm. For which of the following values of object-screen distance, two positions of the object can be found to obtain sharp image on the screen?

(A) 45 cm

(B) 50 cm
(C) 55 cm
(D) 65 cm

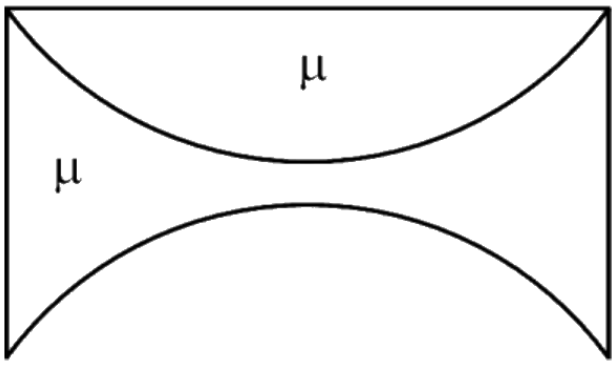
[2026 • Set 55-2-1]

Q8. A thin convex lens of focal length 10 cm and another thin lens of focal length f are placed coaxially in contact. If the power of their combination is 2 D, the value of f is:

(A) -15 cm
(B) -10 cm
(C) -20 cm
(D) -30 cm

[2026 • Set 55-2-1]

Q9. A thin plano-convex lens and a thin equi-concave lens are kept coaxially in contact as shown in the figure. Assuming both the lenses are made of glass of refractive index μ, and R is the radius of curvature of each curved surface, the focal length of the combination is:



(A) $\dfrac{R}{\mu - 1}$
(B) $-\dfrac{R}{\mu - 1}$
(C) $\dfrac{2R}{\mu - 1}$
(D) $-\dfrac{2R}{\mu - 1}$

[2026 • Set 55-3-1]

Q10. A telescope has an objective lens of focal length 144 cm and an eyepiece of focal length $6{\cdot}0$ cm. The magnifying power and the length of the telescope tube will be respectively:

(A) $24,\ 150$ cm
(B) $42,\ 138$ cm
(C) $24,\ 138$ cm
(D) $42,\ 150$ cm

[2026 • Set 55-3-1]

Q11. In which of the following, total internal reflection does not occur?

(A) Twinkling of stars
(B) Brilliance of diamonds
(C) Optical fibre
(D) Reflecting prism

[2026 • Set 55-3-1]

Q12. A plano-convex lens, made of glass $(n = 1{\cdot}5)$ has a curved surface whose radius is 40 cm. The image formed of an object is of the same size as that of the object. The distance of the object from the lens is:

(A) 40 cm
(B) 80 cm
(C) 160 cm
(D) 200 cm

[2026 • Set 55-3-2]

Q13. A ray of monochromatic light travelling in air is incident on a glass slab and is partly reflected and partly refracted. Both the reflected and refracted lights will have:

(A) same wavelength
(B) same frequency
(C) same intensity
(D) same speed

[2026 • Set 55-3-3]

Q14. A ray of yellow light undergoes total internal reflection when it is incident at the interface of two media. This ray is successively replaced by the ray of blue, green and red lights. Which of the following statements is true if the angle of incidence is same in all cases?

(A) Total internal reflection occurs for blue light only.
(B) Total internal reflection occurs for red light only.
(C) Total internal reflection occurs for both green and blue lights.
(D) None of them will undergo total internal reflection.

[2026 • Set 55-3-3]

Q15. Assertion (A): When a convex lens made of glass is immersed in water, its converging power increases. Reason (R): The focal length of a lens depends only on the radii of curvature of its two faces.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.

(D) Both Assertion (A) and Reason (R) are false.

[2026 • Set 55-4-1]

Q16. The images formed by the objective lens and the eyepiece are respectively:

(A) virtual, real
(B) real, virtual
(C) virtual, virtual
(D) real, real

[2026 • Set 55-4-1]

Q17. The magnification produced by the telescope does not depend upon the:

(A) colour of light
(B) focal length of objective lens
(C) focal length of eyepiece
(D) apertures of objective lens and eyepiece

[2026 • Set 55-4-1]

Q18. Which of the following statements is not correct for this telescope?

(A) The focal length of objective lens (f_o) is larger than the focal length of eyepiece (f_e).
(B) Its magnifying power can be increased by increasing the focal length of objective lens (f_o).
(C) The distance between two lenses is more than $(f_o + f_e)$.
(D) The magnifying power can be decreased by increasing the focal length of eyepiece.

[2026 • Set 55-4-1]

Q19. An astronomical telescope has objective lens and eyepiece of focal lengths 80 cm and 4 cm respectively. To view the image in normal adjustment, the lenses must be separated by a distance of:

(A) 84 cm
(B) 76 cm
(C) 20 cm
(D) 320 cm

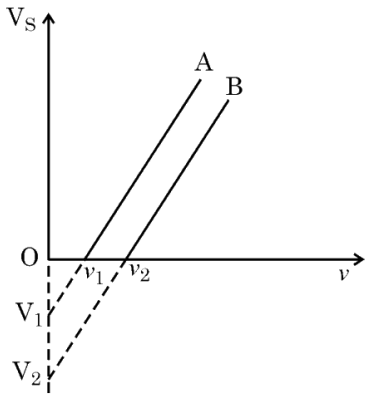
[2026 • Set 55-4-1]

Q20. Consider the telescope described in question (iv) (a). Its magnifying power in normal adjustment will be:

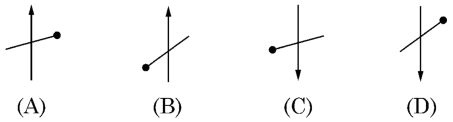
(A) 320
(B) 84
(C) 76
(D) 20

[2026 • Set 55-4-1]

Q21. Case Study (Q30): A thin lens is a transparent optical medium bounded by two surfaces, at least one of which should be spherical. Applying the formula for image formation by a single spherical surface successively at the two surfaces of a lens, one can obtain the 'lens maker formula' and then the 'lens formula'. A lens has two foci, called 'first focal point' and 'second focal point' of the lens, one on each side.



(i) Consider the arrangement shown in figure. A black vertical arrow and a horizontal thick line with a ball are painted on a glass plate. It serves as the object. When the plate is illuminated, its real image is formed on the screen. Which of the following correctly represents the image formed on the screen?



(A) Option A (image as shown)
(B) Option B (image as shown)
(C) Option C (image as shown)
(D) Option D (image as shown)

[2025 • Set 55-1-1]

Q22. (ii) Which of the following statements is incorrect?

(A) For a convex mirror magnification is always negative.
(B) For all virtual images formed by a mirror magnification is positive.
(C) For a concave lens magnification is always positive.
(D) For real and inverted images, magnification is always negative.

[2025 • Set 55-1-1]

Q23. (iii) A convex lens of focal length f is cut into two equal parts perpendicular to the principal axis. The focal length of each part will be:

(A) f
(B) $2f$

(C) $\frac{f}{2}$
(D) $\frac{f}{4}$

[2025 • Set 55-1-1]

Q24. (iii) OR: If an object in case (i) above is 20 cm from the lens and the screen is 50 cm away from the object, the focal length of the lens used is:

(A) 10 cm
(B) 12 cm
(C) 16 cm
(D) 20 cm

[2025 • Set 55-1-1]

Q25. (iv) The distance of an object from first focal point of a biconvex lens is X_1 and distance of the image from second focal point is X_2. The focal length of the lens is:

(A) X_1X_2
(B) $\sqrt{X_1 + X_2}$
(C) $\sqrt{X_1X_2}$
(D) $\frac{\sqrt{X_2}}{X_1}$

[2025 • Set 55-1-1]

Q26. A beaker is filled with water (refractive index $\frac{4}{3}$) upto a height H. A coin is placed at its bottom. The depth of the coin, when viewed along the near normal direction, will be:

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

[2025 • Set 55-1-1]

Q27. The speed of light in two media '1' and '2' are v_1 and $v_2\,(> v_1)$ respectively. For a ray of light to undergo total internal reflection at the interface of these two media, it must be incident from:

(A) medium '1' and at an angle greater than $\sin^{-1}\left(\frac{v_1}{v_2}\right)$
(B) medium '1' and at an angle greater than $\cos^{-1}\left(\frac{v_1}{v_2}\right)$
(C) medium '2' and at an angle greater than $\sin^{-1}\left(\frac{v_1}{v_2}\right)$
(D) medium '2' and at an angle greater than $\cos^{-1}\left(\frac{v_1}{v_2}\right)$

[2025 • Set 55-1-2]

Q28. A point source is placed at the bottom of a tank containing a transparent liquid (refractive index n) to a depth H. The area of the surface of the liquid through which light from the source can emerge out is:

(A) $\frac{\pi H^2}{(n-1)}$

(B) $\frac{\pi H^2}{(n^2-1)}$

(C) $\frac{\pi H^2}{\sqrt{n}}$

(D) $\frac{\pi H^2}{(n^2+1)}$

[2025 • Set 55-1-3]

Q29. A tub is filled with a transparent liquid to a height of 30.0 cm. The apparent depth of a coin lying at the bottom of the tub is found to be 16.0 cm. The speed of light in the liquid will be

(A) 1.6×10^8 m s^{-1}

(B) 2.0×10^8 m s^{-1}

(C) 3.0×10^8 m s^{-1}

(D) 2.5×10^8 m s^{-1}

[2025 • Set 55-2-1]

Q30. The focal length of a concave mirror in air is f. When the mirror is immersed in a liquid of refractive index $\frac{5}{3}$, its focal length will become

(A) $\frac{5}{3}f$

(B) $\frac{3}{5}f$

(C) $\frac{2}{3}f$

(D) f

[2025 • Set 55-2-2]

Q31. The plane face of a planoconvex lens is silvered. The refractive index of material and radius of curvature of the curved surface of the lens are n and R respectively. This lens will behave as a concave mirror of focal length

(A) $\frac{R}{2}$

(B) $\frac{R}{2(n-1)}$

(C) nR

(D) $\frac{R}{2(n-1)}$

[2025 • Set 55-2-3]

Q32. The magnification produced by a spherical mirror is -2.0. The mirror used and the nature of the image formed will be :

(A) Convex and virtual
(B) Concave and real
(C) Concave and virtual
(D) Convex and real

[2025 • Set 55-4-1]

Q33. A compound microscope has an objective and an eyepiece of focal lengths f_o and f_e, respectively. To obtain a large magnification of a small object, the microscope should have:

(A) f_o and f_e small, and $f_e > f_o$
(B) f_o and f_e small, and $f_o > f_e$
(C) f_o and f_e large, and $f_e > f_o$
(D) f_o and f_e large, and $f_o > f_e$

[2025 • Set 55-5-1]

Q34. A glass slab ($\mu = 1.5$) of thickness 6 cm is placed over a paper. The shift in the letters printed on the paper will be:

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

[2025 • Set 55-5-2]

Q35. A beam of light of wavelength 720 nm in air enters water (refractive index $= \frac{4}{3}$). Its wavelength in water will be:

(A) 540 nm
(B) 480 nm
(C) 420 nm
(D) 720 nm

[2025 • Set 55-5-3]

Q36. Assertion (A): In a reflecting telescope, the image does not have chromatic aberration. Reason (R): Chromatic aberration occurs only due to refraction of light through an optical medium. Select the correct answer from the codes given below:

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-6-1]

Q37. Assertion (A): A ray of light is incident normally on the face of a prism. The emergent ray will graze along the opposite face of the prism when the critical angle at glass-air interface is equal to the angle of the prism. Reason (R): The refractive index of a prism depends on angle of the prism. Select the correct answer:

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-7-1]

Q38. Case Study: When light travels from an optically denser medium to an optically rarer medium, at the interface it is partly reflected back into the same medium and partly refracted to the second medium. The angle of incidence corresponding to an angle of refraction 90° is called the critical angle (i_c) for the given pair of media. This angle is related to the refractive index of medium 1 with respect to medium 2. Refraction of light through a prism involves refraction at two plane interfaces. A relation for the refractive index of the material of the prism can be obtained in terms of the refracting angle of the prism and the angle of minimum deviation. For a thin prism, this relation reduces to a simple equation. Laws of refraction are also valid for refraction of light at a spherical interface. When an object is placed in front of a spherical surface separating two media, its image is formed. A relation between object and image distance, in terms of refractive indices of two media and the radius of curvature of the spherical surface can be obtained. Using this relation for two surfaces of a lens, 'lens maker formula' is obtained. (i) A small bulb is placed at the bottom of a tank containing a transparent liquid (refractive index n) to a depth H. The radius of the circular area of the surface of liquid, through which light from the bulb can emerge out, is R. Then $\left(\frac{R}{H}\right)$ is:

(A) $\frac{1}{\sqrt{n^2-1}}$
(B) $\sqrt{n^2-1}$
(C) $\frac{1}{\sqrt{n^2+1}}$
(D) $\sqrt{n^2+1}$

[2025 • Set 55-7-1]

Q39. (ii) (a) A parallel beam of light is incident on a face of a prism with refracting angle 60°. The angle of minimum deviation is found to be 30°. The refractive index of the material

of the prism is close to: OR (b) The angle of minimum deviation for a ray of light incident on a thin prism, made of crown glass ($n = 1.52$) is D_m. If the prism was made of dense flint glass ($n = 1.62$) instead of crown glass, the angle of minimum deviation will:

(A) (a) 1.3 OR (b) decrease by 4%
(B) (a) 1.4 OR (b) increase by 4%
(C) (a) 1.5 OR (b) decrease by 19%
(D) (a) 1.6 OR (b) increase by 19%

[2025 • Set 55-7-1]

Q40. (iii) An object is placed in front of a convex spherical glass surface ($n = 1.5$ and radius of curvature R) at a distance of $4R$ from it. As the object is moved slowly close to the surface, the image formed is:

(A) always real
(B) always virtual
(C) first real and then virtual
(D) first virtual and then real

[2025 • Set 55-7-1]

Q41. (iv) A double-convex lens, made of glass of refractive index 1.5, has focal length 10 cm. The radius of curvature of its each face, is:

(A) 10 cm
(B) 15 cm
(C) 20 cm
(D) 40 cm

[2025 • Set 55-7-1]

Q42. Assertion (A): Plane and convex mirrors cannot produce real images under any circumstance. Reason (R): A virtual image cannot serve as an object to produce a real image.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2024 • Set 55-1-1]

Q43. A double-convex lens, with each face having same radius of curvature R, is made of glass of refractive index n. Its power is:

(A) $\dfrac{2(n-1)}{R}$

(B) $\frac{(2n-1)}{R}$
(C) $\frac{(n-1)}{2R}$
(D) $\frac{(2n-1)}{2R}$

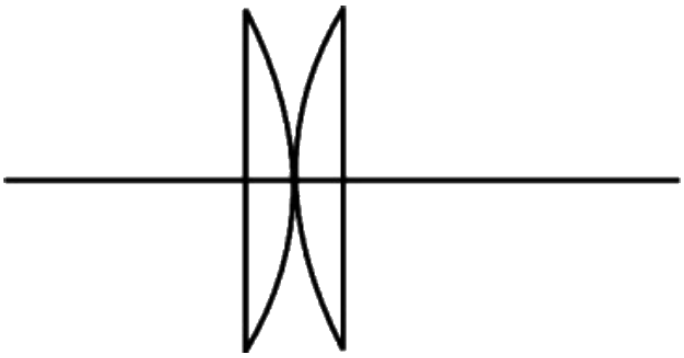
[2024 • Set 55-1-1]

Q44. A double-convex lens of power P, with each face having same radius of curvature, is cut into two equal parts perpendicular to its principal axis. The power of one part of the lens will be:

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

[2024 • Set 55-1-1]

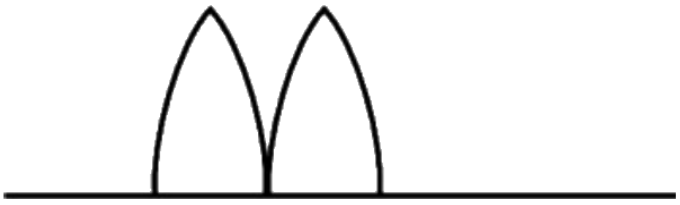
Q45. The above two parts are kept in contact with each other as shown in the figure. The power of the combination will be:



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

[2024 • Set 55-1-1]

Q46. A double-convex lens of power P, with each face having same radius of curvature, is cut along its principal axis. The two parts are arranged as shown in the figure. The power of the combination will be:



(A) Zero
(B) P
(C) $2P$
(D) $\frac{P}{2}$

[2024 • Set 55-1-1]

Q47. Two convex lenses of focal lengths $60\,\text{cm}$ and $20\,\text{cm}$ are held coaxially in contact with each other. The power of the combination is:

(A) $6.6\,\text{D}$
(B) $15\,\text{D}$
(C) $\frac{1}{15}\,\text{D}$
(D) $\frac{1}{30}\,\text{D}$

[2024 • Set 55-1-1]

Q48. The refractive index of the material of a prism is $\sqrt{2}$. If the refracting angle of the prism is 60°, find the: (1) Angle of minimum deviation, and (2) Angle of incidence.

[2024 • Set 55-1-1]

Q49. Assertion (A): The magnifying power of a compound microscope is negative. Reason (R): The final image formed is erect with respect to the object.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2024 • Set 55-2-1]

Q50. When a ray of light propagates from a denser medium to a rarer medium, it bends away from the normal. When the incident angle is increased, the refracted ray deviates more from the normal. For a particular angle of incidence in the denser medium, the refracted ray just grazes the interface of the two surfaces. This angle of incidence is called the critical angle for the pair of media involved. For a ray incident at the critical angle, the angle of reflection is:

(A) 0°
(B) $< 90^\circ$
(C) $> 90^\circ$
(D) 90°

[2024 • Set 55-2-1]

Q51. A ray of light of wavelength 600 nm is incident in water $\left(n = \frac{4}{3}\right)$ on the water-air interface at an angle less than the critical angle. The wavelength associated with the refracted ray is:

(A) $400\ nm$

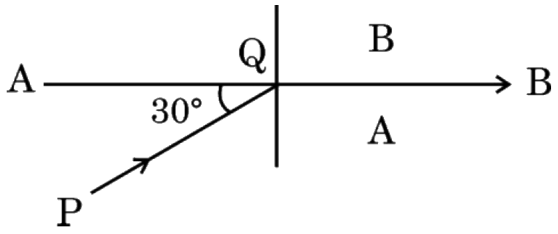
(B) $450\ nm$

(C) $600\ nm$

(D) $800\ nm$

[2024 • Set 55-2-1]

Q52. (a) The interface AB between the two media A and B is shown in the figure. In the denser medium A, the incident ray PQ makes an angle of 30° with the horizontal. The refracted ray is parallel to the interface. The refractive index of medium B w.r.t. medium A is:



OR (b) Two media A and B are separated by a plane boundary. The speed of light in medium A and B is $2 \times 10^8\ ms^{-1}$ and $2.5 \times 10^8\ ms^{-1}$ respectively. The critical angle for a ray of light going from medium A to medium B is:

(A) (a) $\frac{\sqrt{3}}{4}$ (b) $\sin^{-1}\frac{1}{9}$

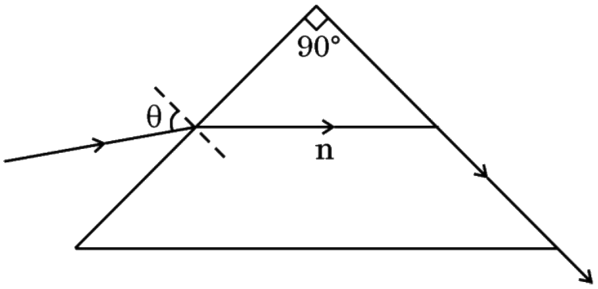
(B) (a) $\frac{\sqrt{5}}{2}$ (b) $\sin^{-1}\frac{4}{5}$

(C) (a) $\frac{4}{3}$ (b) $\sin^{-1}\frac{3}{5}$

(D) (a) $\frac{2}{\sqrt{3}}$ (b) $\sin^{-1}\frac{2}{5}$

[2024 • Set 55-2-1]

Q53. The figure shows the path of a light ray through a triangular prism. In this phenomenon, the angle θ is given by:



(A) $\sin^{-1}\sqrt{n^2 - 1}$

(B) $\sin^{-1}(n^2 - 1)$

(C) $\sin^{-1}\sqrt{\dfrac{1}{n^2-1}}$

(D) $\sin^{-1}\dfrac{1}{(n^2-1)}$

[2024 • Set 55-2-1]

Q54. Assertion (A): A convex lens, when immersed in a liquid, disappears. Reason (R): The refractive indices of material of the lens and the liquid are equal.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

[2024 • Set 55-3-1]

Q55. A thin converging lens of focal length $20\,\text{cm}$ and a thin diverging lens of focal length $15\,\text{cm}$ are placed coaxially in contact. The power of the combination is

(A) $-\dfrac{5}{4}\,\text{D}$

(B) $-\dfrac{5}{3}\,\text{D}$

(C) $\dfrac{4}{3}\,\text{D}$

(D) $\dfrac{3}{5}\,\text{D}$

[2024 • Set 55-4-1]

Q56. The radii of curvature of two surfaces of a convex lens are R and $2R$. If the focal length of this lens is $\left(\frac{5}{3}\right)R$, the refractive index of the material of the lens is

(A) $\dfrac{7}{5}$

(B) $\dfrac{8}{5}$

(C) $\dfrac{19}{15}$

(D) $\dfrac{3}{2}$

[2024 • Set 55-4-1]

Q57. The focal length of an equiconvex lens

(A) increases when the lens is dipped in water.

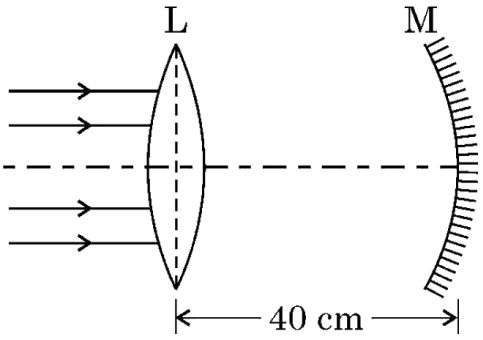
(B) increases when the wavelength of incident light decreases.

(C) increases with decrease in radius of curvature of its surface.

(D) decreases when the lens is cut into two identical parts along its principal axis.

[2024 • Set 55-4-1]

Q58. A thin convex lens L of focal length 10 cm and a concave mirror M of focal length 15 cm are placed coaxially 40 cm apart as shown in figure. A beam of light coming parallel to the principal axis is incident on the lens. The final image will be formed at a distance of



(A) 10 cm, left of lens
(B) 10 cm, right of lens
(C) 20 cm, left of lens
(D) 20 cm, right of lens

[2024 • Set 55-4-1]

Q59. A beam of light coming parallel to the principal axis of a convex lens L_1 of focal length 16 cm is incident on it. Another convex lens L_2 of focal length 12 cm is placed coaxially at a distance 40 cm from L_1. The nature and distance of the final image from L_2 will be
(A) real, 24 cm
(B) virtual, 12 cm
(C) real, 32 cm
(D) virtual, 18 cm

[2024 • Set 55-4-1]

Q60. A prism is an optical medium bounded by three refracting plane surfaces. A ray of light suffers successive refractions on passing through its two surfaces and deviates by a certain angle from its original path. The refractive index of the material of the prism is given by $\mu = \sin\left(\frac{A+\delta_m}{2}\right) \Big/ \sin\frac{A}{2}$. If the angle of incidence on the second surface is greater than an angle called critical angle, the ray will not be refracted from the second surface and is totally internally reflected. The critical angle for glass is θ_1 and that for water is θ_2. The critical angle for glass-water surface would be (given ${}_a\mu_g = 1.5$, ${}_a\mu_w = 1.33$):
(A) less than θ_2
(B) between θ_1 and θ_2
(C) greater than θ_2
(D) less than θ_1

[2024 • Set 55-5-1]

Q61. When a ray of light of wavelength λ and frequency ν is refracted into a denser medium:
(A) λ and ν both increase.

(B) λ increases but ν is unchanged.
(C) λ decreases but ν is unchanged.
(D) λ and ν both decrease.

[2024 • Set 55-5-1]

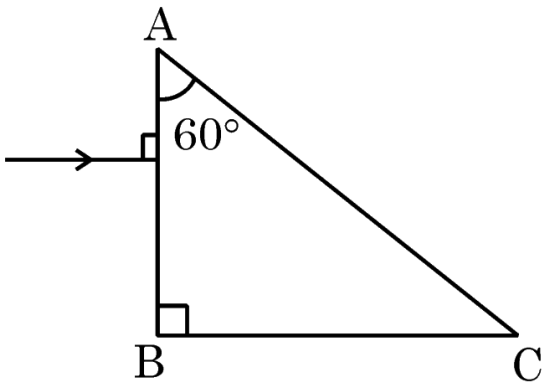
Q62. The critical angle for a ray of light passing from glass to water is minimum for:
(A) red colour
(B) blue colour
(C) yellow colour
(D) violet colour

[2024 • Set 55-5-1]

Q63. Three beams of red, yellow and violet colours are passed through a prism, one by one under the same condition. When the prism is in the position of minimum deviation, the angles of refraction from the second surface are r_R, r_Y and r_V respectively. Then:
(A) $r_V < r_Y < r_R$
(B) $r_Y < r_R < r_V$
(C) $r_R < r_V < r_Y$
(D) $r_R = r_Y = r_V$

[2024 • Set 55-5-1]

Q64. A ray of light is incident normally on a prism ABC of refractive index $\sqrt{2}$, as shown in figure. After it strikes face AC, it will:



(A) go straight undeviated
(B) just graze along the face AC
(C) refract and go out of the prism
(D) undergo total internal reflection

[2024 • Set 55-5-1]

Q65. The focal lengths of the objective and the eyepiece of a compound microscope are 1 cm and 2 cm respectively. If the tube length of the microscope is 10 cm, the magnification

obtained by the microscope for most suitable viewing by relaxed eye is:

(A) 250

(B) 200

(C) 150

(D) 125

[2024 • Set 55-5-1]

Q66. A point object is kept 60 cm in front of a spherical convex surface ($n = 1.5$, radius of curvature 40 cm). The image formed is:

(A) real, at a distance 1.8 m from the surface.

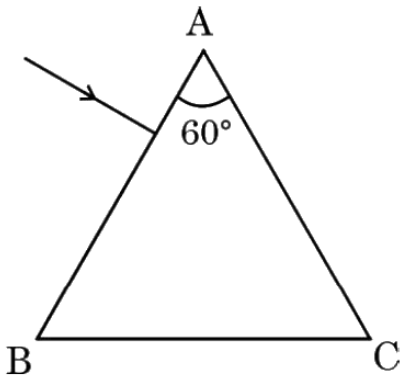
(B) virtual, at a distance 1.8 m from the surface.

(C) real, at a distance 3.6 m from the surface.

(D) virtual, at a distance 3.6 m from the surface.

[2024 • Set 55-5-3]

Q67. Strontium titanate is a rare oxide — a natural mineral found in Siberia. It is used as a substitute for diamond because its refractive index and critical angle are 2.41 and 24.5°, respectively, which are approximately equal to the refractive index and critical angle of diamond. It has all the properties of diamond. Even an expert jeweller is unable to differentiate between diamond and strontium titanate. A ray of light is incident normally on one face of an equilateral triangular prism ABC made of strontium titanate.



Answer the following questions based on the above: Trace the path of the ray showing its passage through the prism.

[2023 • Set 55-1-1]

Q68. For the strontium titanate prism (refractive index 2.41), find the velocity of light through the prism.

[2023 • Set 55-1-1]

Q69. For a concave mirror of focal length 'f', the minimum distance between the object and its real image is:

(A) zero
(B) f
(C) $2f$
(D) $4f$

[2023 • Set 55-1-1]

Q70. The minimum distance between an object and its real image formed by a convex lens of focal length f is:

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

[2023 • Set 55-1-2]

Q71. Which of the following pairs of media has the least value of critical angle?

(A) Glass to air
(B) Glass to water
(C) Diamond to water
(D) Diamond to air

[2023 • Set 55-1-3]

Q72. A ray of monochromatic light propagating in air, is incident on the surface of water. Which of the following will be the same for the reflected and refracted rays?

(A) Energy carried
(B) Speed
(C) Frequency
(D) Wavelength

[2023 • Set 55-2-1]

Q73. A ray of light of wavelength 600 nm propagates from air into a medium. If its wavelength in the medium becomes 400 nm, the refractive index of the medium is

(A) 1.4
(B) 1.5
(C) 1.6
(D) 1.8

[2023 • Set 55-2-2]

Q74. A ray of light travels a distance of 12.0 m in a transparent sheet in 60 ns. The refractive index of the sheet is

(A) 1.33

(B) 1.50
(C) 1.65
(D) 1.75

[2023 • Set 55-2-3]

Q75. Case Study: The lens maker's formula is useful to design lenses of desired focal lengths using surfaces of suitable radii of curvature. The focal length also depends on the refractive index of the material of the lens and the surrounding medium. The refractive index depends on the wavelength of the light used. The power of a lens is related to its focal length.

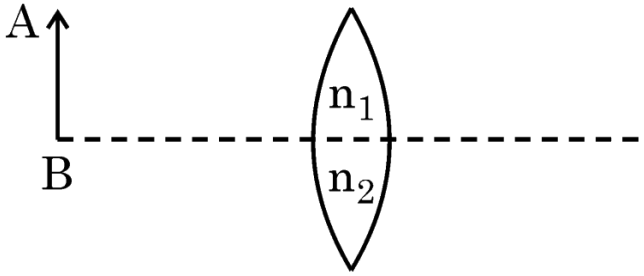
(a) How will the power of a lens be affected with an increase of wavelength of light?

[2023 • Set 55-4-1]

Q76. (b) The radius of curvature of two surfaces of a convex lens is R each. For what value of μ of its material will its focal length become equal to R?

[2023 • Set 55-4-1]

Q77. An object AB is kept in front of a composite convex lens, as shown in figure. Will the lens produce one image? If not, explain.



[2023 • Set 55-5-1]

Q78. A real image of an object formed by a convex lens is observed on a screen. If the screen is removed, will the image still be formed? Explain.

[2023 • Set 55-5-1]

Q79. Two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to this question from the codes (A), (B), (C) and (D) as given below: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A). (C) Assertion (A) is true but Reason (R) is false. (D) Assertion (A) is false and Reason (R) is also false. Assertion (A): The angle of minimum deviation for a prism is lesser for red light than that for blue light. Reason (R): The refractive index of the material of a prism for blue light is greater than

that for red light.

[2021]

Q80. An object approaches a converging lens with a uniform speed of 5 m/s and stops at the focus. How will the image move with respect to the lens? Specify its nature.

[2021]

Q81. In a simple microscope, a convex lens of focal length 5 cm is used. Calculate the magnifying power when the object is placed at the focus of the lens.

[2021]

Q82. A ray of light on passing through an equilateral glass prism, suffers a minimum deviation equal to the angle of the prism. The value of refractive index of the material of the prism is _____.

[2020 • Set 55-1-1]

Q83. Larger aperture of objective lens in an astronomical telescope

(A) increases the resolving power of telescope.
(B) decreases the brightness of the image.
(C) increases the size of the image.
(D) decreases the length of the telescope.

[2020 • Set 55-1-1]

Q84. A biconvex lens of glass having refractive index $1{\cdot}47$ is immersed in a liquid. It becomes invisible and behaves as a plane glass plate. The refractive index of the liquid is

(A) $1{\cdot}47$
(B) $1{\cdot}62$
(C) $1{\cdot}33$
(D) $1{\cdot}51$

[2020 • Set 55-1-1]

Q85. For a glass prism, the angle of minimum deviation will be smallest for the light of

(A) red colour.
(B) blue colour.
(C) yellow colour.
(D) green colour.

[2020 • Set 55-1-1]

Q86. The resolving power of a telescope can be increased by increasing

(A) wavelength of light.
(B) diameter of objective.

(C) length of the tube.
(D) focal length of eyepiece.

[2020 • Set 55-1-2]

Q87. The focal length of the objective of a compound microscope is
(A) greater than the focal length of eyepiece.
(B) lesser than the focal length of eyepiece.
(C) equal to the focal length of eyepiece.
(D) equal to the length of its tube.

[2020 • Set 55-1-3]

Q88. For a higher resolving power of a compound microscope, the wavelength of light used should be _____.

[2020 • Set 55-2-1]

Q89. A compound microscope is used because a realistic simple microscope does not have _____ magnification.

[2020 • Set 55-2-2]

Q90. The resolving power of a compound microscope can be _____ by using a medium (oil) of higher refractive index than air between the object and the objective lens.

[2020 • Set 55-2-3]

Q91. The refractive index of the material of a converging lens is 1.5. If air is replaced by a medium of refractive index 1.6, then the lens will now behave as a _____ lens.

[2020 • Set 55-3-1]

Q92. The value of Brewster's angle for air-glass interface is $\frac{\pi}{3}$; hence the refractive index of glass is _____.

[2020 • Set 55-3-1]

Q93. An astronomical telescope may be a refracting type or a reflecting type. Which of the two produces image of better quality? Justify your answer.

[2020 • Set 55-4-1]

Q94. A biconcave lens of power P vertically splits into two identical plano concave parts. The power of each part will be
(A) $2P$
(B) $P/2$
(C) P
(D) $P/\sqrt{2}$

[2020 • Set 55-5-1]

Q95. State the condition under which a large magnification can be achieved in an astronomical telescope.

OR

How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light?

[2019 • Set 55-3-1]

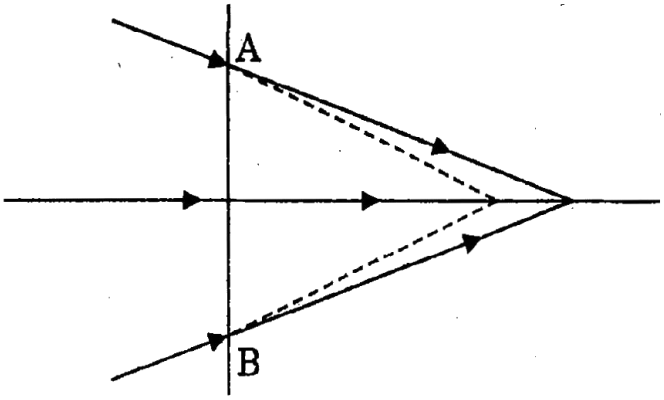
Q96. Does the magnifying power of a microscope depend on the colour of the light used? Justify your answer.

[2017]

Q97. How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced by red light? Give reason.

[2017]

Q98. The line AB in the ray diagram represents a lens. State whether the lens is convex or concave.



[2015]

Q99. A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens?

[2015]

Q100. A convex lens is placed in contact with a plane mirror. A point object at a distance of 20 cm on the axis of this combination has its image coinciding with itself. What is the focal length of the lens ?

[2014]

Q101. A biconcave lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging or a diverging lens ?

Give reason.

[2014]

Q102. Write the relationship between angle of incidence i, angle of prism A and angle of minimum deviation for a triangular prism.

[2013]

Q103. A converging lens is kept coaxially in contact with a diverging lens — both the lenses being of equal focal lengths. What is the focal length of the combination?

[2012]

Q104. For the same value of angle of incidence, the angles of refraction in three media A, B and C are $15°$, $25°$ and $35°$ respectively. In which medium would the velocity of light be minimum?

[2012]

Q105. Under what condition does a biconvex lens of glass having a certain refractive index act as a plane glass sheet when immersed in a liquid?

[2012]

Q106. How does focal length of a lens change when red light incident on it is replaced by violet light? Give reason for your answer.

[2012]

Q107. A glass lens of refractive index 1.45 disappears when immersed in a liquid. What is the value of refractive index of the liquid?

[2010]

Q108. State the conditions for the phenomenon of total internal reflection to occur.

[2010]

Q109. You are given following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope?

Lenses	Power (P)	Aperture (A)
L1	3D	8 cm
L2	6D	1 cm
L3	10D	1 cm

[2009]

Q110. Two thin lenses of power $+6D$ and $-2D$ are in contact. What is the focal length of the

combination?

[2009]

Q111. A glass lens of refractive index 1.5 is placed in a trough of liquid. What must be the refractive index of the liquid in order to make the lens disappear?

[2008]

Q112. An object is held at the principal focus of a concave lens of focal length F. Where is the image formed?

[2008]

2-Mark Questions (98 questions · Section B · VSA)

Q1. A ray of light in air is incident at angle $\angle i$ on a face of an equilateral glass prism and is refracted through the prism. As $\angle i$ is varied, it is observed that the ray undergoes minimum deviation, when $\angle i$ is three-fourth of the angle of the prism. Calculate the speed of light in the prism.

[2026 • Set 55-2-1]

Q2. A 5 cm long pencil is placed along the principal axis of a concave mirror of focal length 20 cm such that its nearest end is at a distance of 25 cm from the mirror. Calculate the length of the image of the pencil.

[2026 • Set 55-2-1]

Q3. A ray of light is incident on the face of a triangular prism of refracting angle 60° and it just suffers total internal reflection at the other face. Find the angle of incidence for the ray if the refractive index of the material of the prism is $\sqrt{2}$.

[2026 • Set 55-2-2]

Q4. A ray of light is incident at an angle $2A$ on one of the faces of a glass prism of refracting angle A. After refraction from this face, the ray strikes the opposite face which is silvered. The reflected ray from this face retraces on its path. Trace the ray diagram and find the relation between the refractive index of material of prism and the angle of prism.

[2026 • Set 55-2-3]

Q5. Draw a labelled ray diagram of an astronomical telescope when final image is formed at infinity. Write the expression for its magnifying power.

[2026 • Set 55-3-2]

Q6. A small bulb is placed at the bottom of a tank, containing a transparent liquid of refractive index $\sqrt{2}$, to a depth of 1 m. Calculate the area of the surface of the liquid through which light from the bulb emerges.

[2026 • Set 55-4-1]

Q7. A concave mirror of radius of curvature 16 cm produces two-times enlarged real image of an object kept in front of it. Find the position of the object.

[2026 • Set 55-4-2]

Q8. A convex lens of refractive index 1·5 has a focal length of 20 cm in air. Find its nature and focal length when it is immersed in a transparent liquid of refractive index 1·25.

[2026 • Set 55-4-3]

Q9. A tank is filled with a liquid to a height of 12.5 m. The apparent depth of a needle lying at the bottom of the tank is measured to be 9.0 m. Calculate the speed of light in the liquid.

[2026 • Set 55-5-1]

Q10. Two thin lenses of focal length f_1 and f_2 are placed in contact with each other coaxially. Prove that the focal length f of the combination is given by $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$.

[2026 • Set 55-5-1]

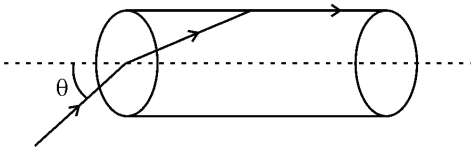
Q11. A point source, in air, is placed at a distance of 6 cm in front of a convex spherical surface ($n = 1.5$ and radius of curvature $= 24$ cm). Find the position and nature of the image formed.

[2026 • Set 55-5-2]

Q12. A ray of light MN is incident normally on the face corresponding with side AB of a prism with an isosceles right-angled triangular base ABC. Trace the path of the ray as it passes through the prism when the refractive index of the prism material is (i) $\sqrt{2}$, and (ii) $\sqrt{3}$.

[2026 • Set 55-5-3]

Q13. A transparent solid cylindrical rod (refractive index $\sqrt{3}$) is kept in air. A ray of light incident on its face travels along the surface of the rod, as shown in figure. Calculate the angle θ.



[2025 • Set 55-1-1]

Q14. A spherical convex surface of radius of curvature R separates glass (refractive index 1.5) from air. Light from a point source placed in air at distance $R/2$ from the surface falls on it. Find the position and nature of the image formed.

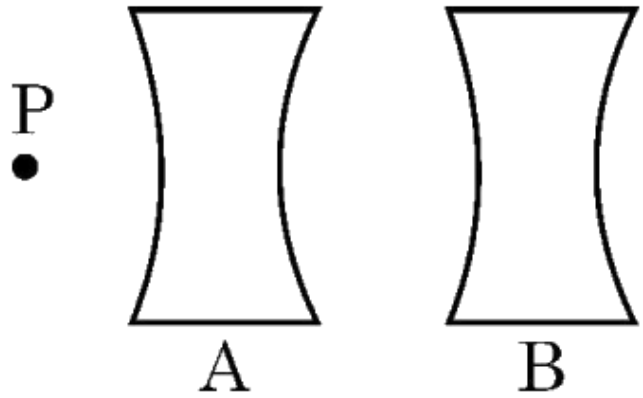
[2025 • Set 55-1-2]

Q15. A double convex lens of glass has both faces of the same radius of curvature 17 cm. Find its focal length if it is immersed in water. The refractive indices of glass and water are 1.5

and 1.33 respectively.

[2025 • Set 55-1-3]

Q16. Two concave lenses A and B, each of focal length 8.0 cm are arranged coaxially 16 cm apart as shown in figure. An object P is placed at a distance of 4.0 cm from A. Find the position and nature of the final image formed.



[2025 • Set 55-2-1]

Q17. Two convex lenses A and B, each of focal length 10.0 cm, are mounted on an optical bench at 50.0 cm and 70.0 cm respectively. An object is mounted at 20.0 cm. Find the nature and position of the final image formed by the combination.

[2025 • Set 55-2-2]

Q18. A light beam converges at a point O. In the path of this beam, a concave lens of focal length 15 cm is placed at a distance of 10 cm before point O. The beam now converges at a point O'. Find the magnitude and the direction of shift OO'.

[2025 • Set 55-2-3]

Q19. An equiconvex lens is made of glass of refractive index 1.55. If the focal length of the lens is 15.0 cm, calculate the radius of curvature of its surfaces.

[2025 • Set 55-4-1]

Q20. Find the focal length of plano-convex lens of refractive index 1.5 and radius of curvature 10 cm when it is immersed in a liquid of refractive index 1.25.

[2025 • Set 55-4-2]

Q21. The two surfaces of a biconvex lens are of radius of curvature 'R' each. Obtain the condition under which its focal length 'f' be equal to 'R'. If one of the two surfaces of this lens is made plane, what will be the new focal length of the lens ?

[2025 • Set 55-4-3]

Q22. (a) A point object is placed in air at a distance $R/3$ in front of a convex surface of radius of curvature R, separating air from a medium of refractive index n (< 4). Find the

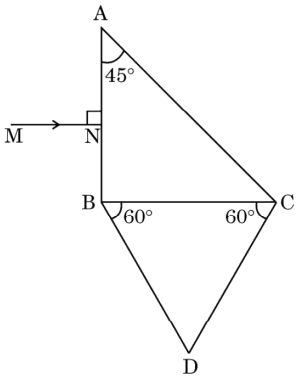
nature and position of the image formed.

OR

(b) In Young's double slit experimental set-up, the intensity of the central maximum is I_0. Calculate the intensity at a point where the path difference between two interfering waves is $\lambda/3$.

[2025 • Set 55-5-1]

Q23. A right angled isosceles glass prism ABC is kept in contact with an equilateral triangular prism DBC as shown in the figure. Both prisms are made of the same glass of refractive index $1{\cdot}6$. Trace the path of the ray MN incident normally on face AB as it passes through the combination.



[2025 • Set 55-6-1]

Q24. A ray of light is incident on face AB of a prism ABC with angle of prism A and emerges out from face AC. The prism is set in the position of minimum deviation with angle of deviation δ. Find (i) the angle of incidence and (ii) the angle of refraction on face AB.

[2025 • Set 55-6-2]

Q25. A tank is filled with a liquid of refractive index $\sqrt{2}$, up to a height of 30 cm. A tiny bulb is glowing at the bottom of the tank. Calculate the diameter of an opaque disc floating symmetrically on the liquid surface that can cut off completely the light from the bulb that comes out of the liquid surface.

[2025 • Set 55-6-3]

Q26. (a) Using the mirror equation and the formula of magnification, deduce that "the virtual image produced by a convex mirror is always diminished in size and is located between the pole and the focus."

OR

(b) A convex lens of focal length 10 cm, a concave lens of focal length 15 cm and a third lens of unknown focal length are placed coaxially in contact. If the focal length of the

combination is $+12$ cm, find the nature and focal length of the third lens, if all lenses are thin. Will the answer change if the lenses were thick?

[2025 • Set 55-7-1]

Q27. Monochromatic light of frequency 5.0×10^{14} Hz passes from air into a medium of refractive index 1.5. Find the wavelength of the light (i) reflected, and (ii) refracted at the interface of the two media.

[2024 • Set 55-1-1]

Q28. A plano-convex lens of focal length 16 cm is made of a material of refractive index 1.4. Calculate the radius of the curved surface of the lens.

[2024 • Set 55-1-1]

Q29. An object is placed 30 cm in front of a concave mirror of radius of curvature 40 cm. Find the (i) position of the image formed and (ii) magnification of the image.

[2024 • Set 55-1-1]

Q30. A ray of light passes through a triangular prism. Show graphically, how the angle of deviation varies with the angle of incidence? Hence define the angle of minimum deviation.

[2024 • Set 55-1-1]

Q31. A ray of light is incident normally on a refracting face of a prism of prism angle A and suffers a deviation of angle δ. Prove that the refractive index n of the material of the prism is given by $n = \dfrac{\sin(A+\delta)}{\sin A}$.

[2024 • Set 55-1-1]

Q32. A convex lens (n = 1.52) has a focal length of 15.0 cm in air. Find its focal length when it is immersed in liquid of refractive index 1.65. What will be the nature of the lens?

[2024 • Set 55-2-1]

Q33. The magnifying power of an astronomical telescope is 24. In normal adjustment, distance between its two lenses is 150 cm. Find the focal length of the objective lens.

[2024 • Set 55-3-1]

Q34. Explain the following:

(a) For a simple microscope, the angular size of the object equals the angular size of the image. Yet it offers magnification.

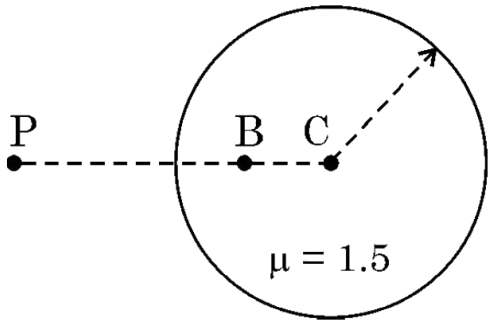
(b) Both plane and convex mirrors produce virtual images of objects. Can they produce real images under some circumstances?

[2024 • Set 55-3-1]

Q35. A ray of light is incident normally on one face of an equilateral glass prism of refractive index μ. When the prism is completely immersed in a transparent medium, it is observed that the emergent ray just grazes the adjacent face. Find the refractive index of the medium.

[2024 • Set 55-4-1]

Q36. An air bubble is trapped at point B ($CB = 20\,\text{cm}$) in a glass sphere of radius $40\,\text{cm}$ and refractive index 1.5 as shown in figure. Find the nature and position of the image of the bubble as seen by an observer at point P.



[2024 • Set 55-4-1]

Q37. In normal adjustment, for a refracting telescope, the distance between objective and eye piece lens is $1.00\,\text{m}$. If the magnifying power of the telescope is 19, find the focal length of the objective and the eyepiece lens.

[2024 • Set 55-4-1]

Q38. A telescope has an objective lens of focal length $150\,\text{cm}$ and an eyepiece of focal length $5\,\text{cm}$. Calculate its magnifying power in normal adjustment and the distance of the image formed by the objective.

[2024 • Set 55-5-1]

Q39. The radius of curvature of a convex mirror is $30\,\text{cm}$. It forms an image of an object which is half the size of the object. Find the separation between the object and the image.

[2024 • Set 55-5-2]

Q40. A thin converging lens of focal length $10\,\text{cm}$ is placed coaxially in contact with a thin diverging lens of focal length $15\,\text{cm}$. How will the combination behave? Justify your answer.

[2024 • Set 55-5-3]

Q41. Why is a reflecting telescope preferred over a refracting telescope? Justify your answer giving two reasons.

[2023 • Set 55-1-1]

Q42. Briefly explain two applications of total internal reflection.

[2023 • Set 55-1-1]

Q43. Define total internal reflection of light. Give two conditions for it.

[2023 • Set 55-1-1]

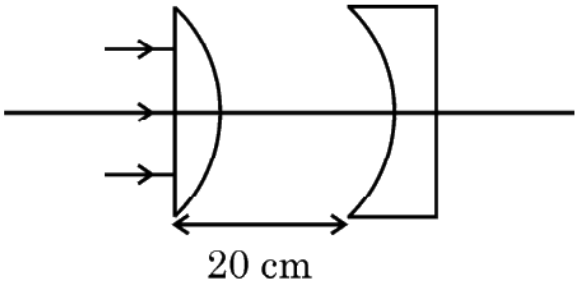
Q44. A double-convex lens of power 4 D is manufactured from a glass of refractive index 1.5. What is the radius of curvature of each face of this lens if both faces have the same radius of curvature?

[2023 • Set 55-1-2]

Q45. The radii of curvature of the faces of a double-convex lens are 20 cm and 30 cm. Its power is $\frac{5}{3}$ D. What is the refractive index of the glass of the lens?

[2023 • Set 55-1-3]

Q46. In the given figure the radius of curvature of curved face in the plano-convex and the plano-concave lens is 15 cm each. The refractive index of the material of the lenses is 1.5. Find the final position of the image formed.



[2023 • Set 55-2-1]

Q47. A point object in air is placed symmetrically at a distance of 60 cm in front of a concave spherical surface of refractive index 1.5. If the radius of curvature of the surface is 20 cm, find the position of the image formed.

[2023 • Set 55-2-2]

Q48. The power of a thin lens is $+5$ D. When it is immersed in a liquid, it behaves like a concave lens of focal length 100 cm. Calculate the refractive index of the liquid. Given refractive index of glass $= 1.5$.

[2023 • Set 55-2-3]

Q49. The refractive indices of two media A and B are 2 and $\sqrt{2}$ respectively. What is the critical angle for their interface?

[2023 • Set 55-3-1]

Q50. (c) The focal length of a concave lens of $\mu = 1.5$ is 20 cm in air. It is completely immersed in water of $\mu = \frac{4}{3}$. Calculate its focal length in water.

OR

(c) An object is placed in front of a lens which forms its erect image of magnification 3. The power of the lens is 5 D. Calculate the distance of the object and the image from the lens.

[2023 • Set 55-4-1]

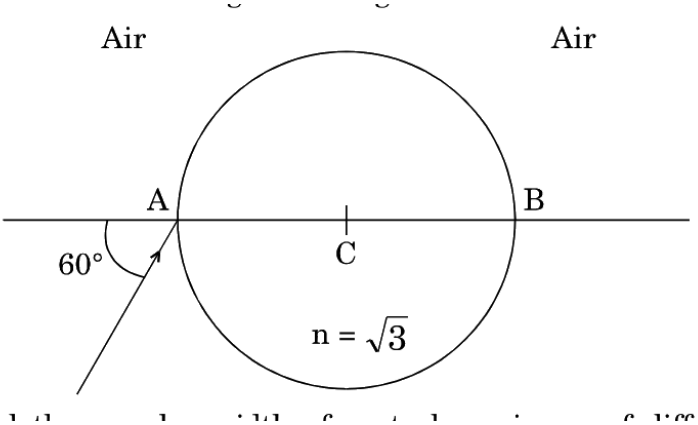
Q51. (iii) A double convex lens is made of glass of refractive index 1.55 with both faces of the same radius of curvature. Find the radius of curvature required if focal length is 20 cm.

OR

(iii) Two convex lenses A and B of focal lengths 15 cm and 10 cm respectively are placed coaxially 'd' distance apart. A point object is kept at a distance of 30 cm in front of lens A. Find the value of 'd' so that the rays emerging from lens B are parallel to its principal axis.

[2023 • Set 55-5-1]

Q52. A ray of light falls on a transparent sphere of $n = \sqrt{3}$ at an angle of incidence $60°$ with the diameter AB of the sphere having centre C. The ray emerges from the sphere parallel to the line AB. Find the angle of emergence.



[2021]

Q53. Using lens maker's formula, derive the thin lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ for a biconvex lens.

[2020 • Set 55-1-1]

Q54. An object is kept 20 cm in front of a concave mirror of radius of curvature 60 cm. Find the nature and position of the image formed.

[2020 • Set 55-2-1]

Q55. The focal length of an equiconcave lens is $\frac{3}{4}$ times of radius of curvature of its surfaces. Find the refractive index of the material of the lens. Under what condition will this lens behave as a converging lens?

[2020 • Set 55-2-2]

Q56. An object is placed in front of a convex mirror of focal length 15 cm. It produces an image that is half the size of the object. Find (a) position of the object, (b) nature of the image, and (c) draw the ray diagram of image formation.

[2020 • Set 55-2-3]

Q57. A converging lens of focal length f_1 is placed coaxially in contact with a diverging lens of focal length f_2 $(f_1 > f_2)$. Determine the power and nature of the combination in terms of f_1 and f_2.

OR

How is the resolving power of a compound microscope affected if (a) wavelength of light used is decreased, and (b) the diameter of its objective lens is increased? Justify your answers.

[2020 • Set 55-3-1]

Q58. Calculate the radius of curvature of an equi-concave lens of refractive index 1.5, when it is kept in a medium of refractive index 1.4, to have a power of -5 D.

[2019 • Set 55-1-1]

Q59. An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $\frac{4\sqrt{2}}{5}$.

[2019 • Set 55-1-1]

Q60. Under which conditions can a rainbow be observed? Distinguish between a primary and a secondary rainbow.

[2019 • Set 55-2-1]

Q61. Explain the following:

(a) Sky appears blue.

(b) The Sun appears reddish at (i) sunset, (ii) sunrise.

[2019 • Set 55-2-1]

Q62. Draw the ray diagram of an astronomical telescope showing image formation in the normal adjustment position. Write the expression for its magnifying power.

OR

Draw a labelled ray diagram to show image formation by a compound microscope and write the expression for its resolving power.

[2019 • Set 55-2-1]

Q63. A beam of light converges at a point P. Draw ray diagrams to show where the beam will converge if (i) a convex lens, and (ii) a concave lens is kept in the path of the beam.

[2019 • Set 55-2-2]

Q64. Under what conditions does the phenomenon of total internal reflection take place? Draw a ray diagram showing how a ray of light deviates by 90° after passing through a right-angled isosceles prism.

[2019 • Set 55-2-2]

Q65. State, with the help of a ray diagram, the working principle of optical fibres. Write one important use of optical fibres.

[2019 • Set 55-2-3]

Q66. For paraxial rays, show that the focal length of a spherical mirror is one-half of its radius of curvature.

[2019 • Set 55-3-1]

Q67. Show that the image formed by a convex mirror of an object is always virtual.

[2019 • Set 55-3-2]

Q68. In the case of a concave mirror of focal length f, when an object is kept between f and $2f$, show that its image is formed beyond $2f$.

[2019 • Set 55-3-3]

Q69. A beam of light converges at a point P. Now a convex lens is placed in the path of the convergent beam at 15 cm from P. At what point does a beam converge if the convex lens has a focal length 10 cm?

OR

An object is kept in front of a concave mirror of focal length 15 cm. The image formed is real and three times the size of the object. Calculate the distance of the object from the mirror.

[2019 • Set 55-4-1]

Q70. Out of the two optical instruments, a microscope and a telescope, which one plays the role in magnifying the objects and in resolving the two objects kept close to each other? Explain, giving example.

[2019 • Set 55-4-3]

Q71. Define the magnifying power of a compound microscope when the final image is formed at infinity. Why must both the objective and the eyepiece of a compound microscope has short focal lengths? Explain.

[2017]

Q72. Why should the objective of a telescope have large focal length and large aperture? Justify your answer.

[2017]

Q73. When are two objects just resolved? Explain. How can the resolving power of a compound microscope be increased? Use relevant formula to support your answer.

[2017]

Q74. Use the mirror equation to show that an object placed between f and $2f$ of a concave mirror forms an image beyond $2f$.

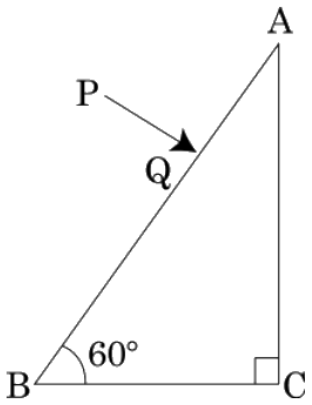
OR

(a) State the condition under which a large magnification can be achieved in an astronomical telescope.

(b) Give two reasons to explain why a reflecting telescope is preferred over a refracting telescope.

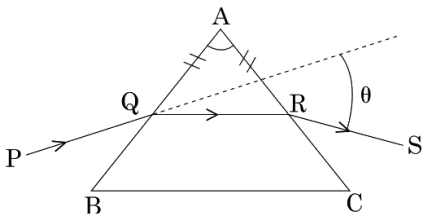
[2017]

Q75. A ray PQ incident normally on the refracting face BA is refracted in the prism BAC made of material of refractive index 1.5. Complete the path of ray through the prism. From which face will the ray emerge? Justify your answer.



[2016]

Q76. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other refracting face AC as RS such that $AQ = AR$. If the angle of prism $A = 60°$ and refractive index of material of prism is $\sqrt{3}$, calculate angle θ.



[2016]

Q77. A ray of light passes through an equilateral glass prism such that the angle of incidence is equal to the angle of emergence and each of these angles is equal to $3/4$ of angle of prism. Find the angle of deviation.

[2015]

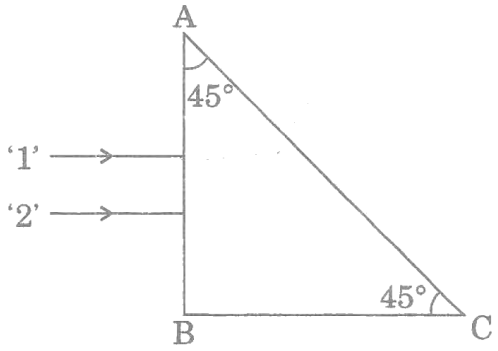
Q78. Calculate the speed of light in a medium whose critical angle is $45°$. Does critical angle for a given pair of media depend on the wavelength of incident light? Give reason.

[2015]

Q79. Use the mirror equation to show that an object placed between f and $2f$ of a concave mirror produces a real image beyond $2f$.

[2015]

Q80. Two monochromatic rays of light are incident normally on the face AB of an isosceles right-angled prism ABC. The refractive indices of the glass prism for the two rays '1' and '2' are respectively 1.38 and 1.52. Trace the path of these rays after entering through the prism.



[2014]

Q81. A convex lens of focal length 25 cm is placed coaxially in contact with a concave lens of focal length 20 cm. Determine the power of the combination. Will the system be converging or diverging in nature?

[2013]

Q82. (a) Write the necessary conditions for the phenomenon of total internal reflection to occur.

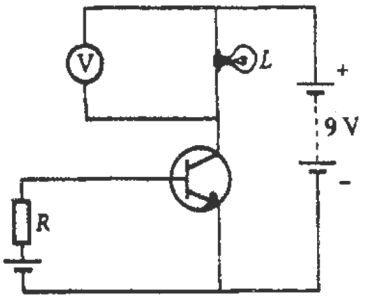
(b) Write the relation between the refractive index and critical angle for a given pair of optical media.

[2013]

Q83. An object AB is kept in front of a concave mirror as shown in the figure.

(i) Complete the ray diagram showing the image formation of the object.

(ii) How will the position and intensity of the image be affected if the lower half of the mirror's reflecting surface is painted black?

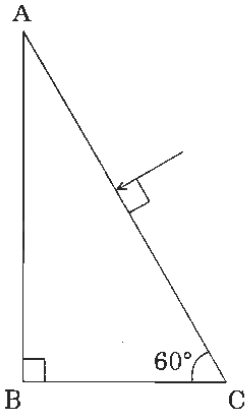


[2012]

Q84. A ray of light, incident on an equilateral glass prism ($\mu_g = \sqrt{3}$) moves parallel to the base line of the prism inside it. Find the angle of incidence for this ray.

[2012]

Q85. Trace the path of a ray of light passing through a glass prism (ABC) as shown in the figure. If the refractive index of glass is $\sqrt{3}$, find out the value of the angle of emergence from the prism.



[2012]

Q86. Two convex lenses of same focal length but of aperture A_1 and A_2 $(A_1 < A_2)$, are used as the objective lenses in two astronomical telescopes having identical eyepieces. What is the ratio of their resolving power? Which telescope will you prefer and why? Give

reason.

[2011 • Set 55-1-1]

Q87. The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. If focal length of the lens is 12 cm, find the refractive index of the material of the lens.

[2010]

Q88. (a) The bluish colour predominates in clear sky.

(b) Violet colour is seen at the bottom of the spectrum when white light is dispersed by a prism. State reasons to explain these observations.

[2010]

Q89. Define refractive index of a transparent medium. A ray of light passes through a triangular prism. Plot a graph showing the variation of the angle of deviation with the angle of incidence.

[2009]

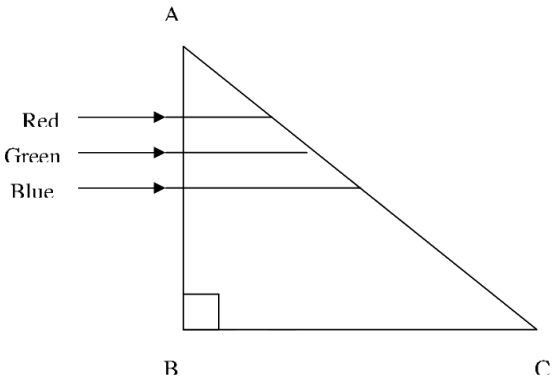
Q90. Draw a ray diagram of a reflecting telescope. State the advantages of this telescope over a refracting telescope.

[2008]

Q91. A ray of light passing through an equilateral triangular glass prism from air undergoes minimum deviation when angle of incidence is $\frac{3}{4}$ of the angle of prism. Calculate the speed of light in the prism.

[2008]

Q92. In the figure given below, light rays of blue, green, red wavelengths are incident on an isosceles right-angled prism. Explain with reason, which ray of light will be transmitted through the face AC. The refractive index of the prism for red, green, blue light are 1.39, 1.424, and 1.476 respectively.



[2008]

Q93. A convex lens of refractive index 1.5 has a focal length of 18 cm in air. Calculate the change in its focal length when it is immersed in water of refractive index 4/3.

[2007]

Q94. Define resolving power of a compound microscope. How does the resolving power of a compound microscope change when

(i) refractive index of the medium between the object and objective lens increases?

(ii) wavelength of the radiation used is increased?

[2007]

Q95. Draw a labelled ray diagram of a reflecting type telescope. Write its any one advantage over refracting type telescope.

[2006]

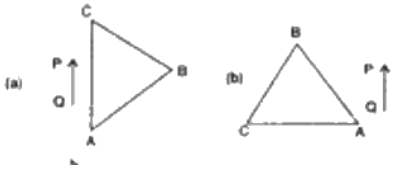
Q96. The image of a candle is formed by a convex lens on a screen. The lower half of the lens is painted black to make it completely opaque. Draw the ray diagram to show the image formation. How will this image be different from the one obtained when the lens is not painted black?

[2005]

Q97. A compound microscope with an objective of 1.0 cm focal length and an eye-piece of 2.0 cm focal length has a tube length of 20 cm. Calculate the magnifying power of the microscope, if the final image is formed at the near point of the eye. Or The magnifying power of an astronomical telescope in the normal adjustment position is 100. The distance between the objective and the eye-piece is 101 cm. Calculate the focal lengths of the objective and of the eye-piece.

[2004]

Q98. An object is placed in front of a right angled prism ABC in two positions (a) and (b) as shown. The prism is made of crown glass with critical angle of $41°$. Trace the path of two rays from P and Q, (i) in (a), normal to the hypotenuse and (ii) in (b), parallel to the hypotenuse.



[2003]

3-Mark Questions (86 questions · Section C · SA)

Q1. (a) Draw the ray diagram to show the image formation by a refracting telescope and

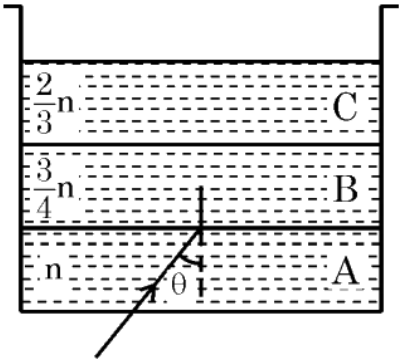
write the expression for angular magnification for the telescope in normal adjustment.

(b) Give two reasons to explain why a reflecting telescope is preferred over a refracting telescope.

[2026 • Set 55-1-1]

Q2. (a) State the two conditions under which total internal reflection occurs.

(b) A transparent container contains layers of three immiscible transparent liquids A, B and C of refractive indices n, $\frac{3}{2}n$ and $\frac{2}{3}n$, respectively. A laser beam is incident at the interface between A and B at an angle θ as shown in figure. Prove that the beam does not enter region C at all for $\sin\theta > \frac{2}{3}$.



[2026 • Set 55-1-1]

Q3. Draw a labelled ray diagram showing the formation of image by a compound microscope when final image is formed at least distance of distinct vision. Derive an expression for its magnifying power for this case.

[2026 • Set 55-1-2]

Q4. (a) Why does one prefer to view the image formed at infinity than that formed at near point in microscope/telescope?

(b) Consider lenses L_1, L_2 and L_3 as specified in the following table. Which of them will you select as objective and eyepiece for constructing best possible (i) telescope (ii) compound microscope? Give reason for your answer.<table border='1' cellpadding='6'><tr><th>Lens</th><th>L_1</th><th>L_2</th><th>L_3</th></tr><tr><td>Power</td><td>3 D</td><td>10 D</td><td>1 D</td></tr><tr><td>Aperture</td><td>1 cm</td><td>8 cm</td><td>1 cm</td></tr></table>

[2026 • Set 55-1-3]

Q5. A ray of light is travelling through a rectangular glass slab (refractive index $\frac{3}{2}$) and is incident on the horizontal glass-air surface at the critical angle for the two media. The slab is then brought in contact with water (refractive index $\frac{4}{3}$) such that a thin horizontal

layer of water is formed on the surface of the slab. Find the angle at which the ray will emerge into air from the water-air surface.

[2026 • Set 55-3-1]

Q6. A ray of light is incident at angle of 45° on one face of a prism with an equilateral triangular base. If it passes symmetrically through the prism, find the:

(a) angle of minimum deviation for the prism, and

(b) refractive index of the material of the prism.

[2026 • Set 55-3-3]

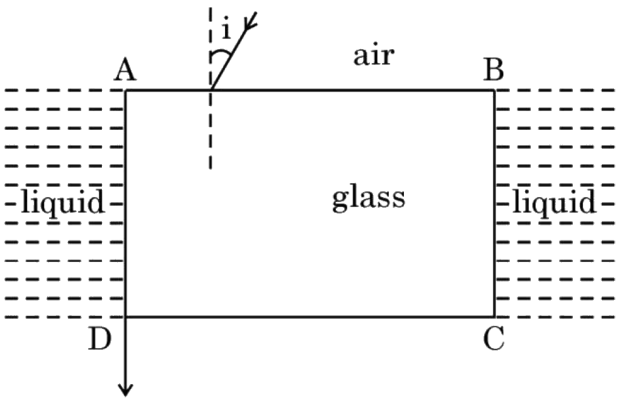
Q7. (a) When a parallel beam of light enters water surface obliquely at some angle, what is the effect on the width of the beam?

(b) With the help of a ray diagram, show that a straw appears bent when it is partly dipped in water and explain it.

(c) Explain the transmission of optical signal through an optical fibre by a diagram.

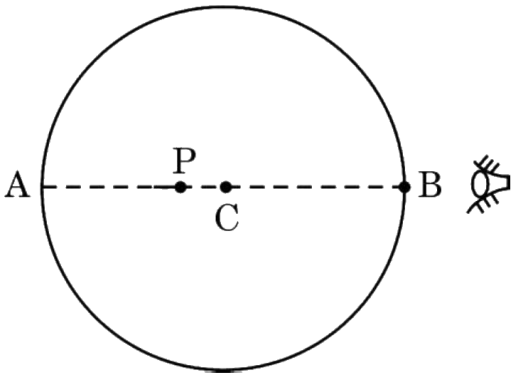
[2025 • Set 55-2-1]

Q8. A rectangular glass slab $ABCD$ (refractive index 1.5) is surrounded by a transparent liquid (refractive index 1.25) as shown in the figure. A ray of light is incident on face AB at an angle i such that it is refracted out grazing the face AD. Find the value of angle i.



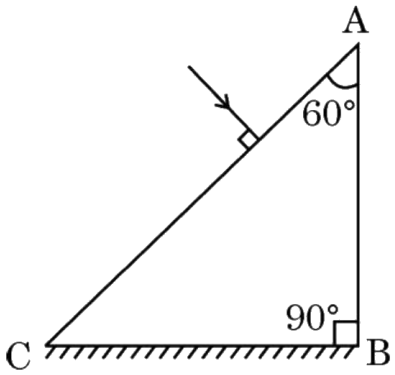
[2025 • Set 55-5-1]

Q9. An air bubble is trapped at point P ($CP = 1.75$ cm) in a spherical glass ball ($n = 1.5$) of radius 7 cm as shown in the figure. Find the nature and position of the image when viewed from side B. Show the image formation by drawing a ray diagram.



[2025 • Set 55-5-2]

Q10. A right-angled prism ABC (refractive index $\sqrt{2}$) is kept on a plane mirror as shown in the figure. A ray of light is incident normally on the face AC.



(a) Trace the path of the ray as it passes through the prism.

(b) Find the angle of deviation produced by the prism.

[2025 • Set 55-5-3]

Q11. Draw a ray diagram showing the image formation when a concave mirror produces a real, inverted and magnified image of an object and hence obtain the mirror formula.

[2025 • Set 55-6-1]

Q12. A ray of light is incident at an angle i on a parallel sided glass slab of thickness 'd' and gets refracted into the slab at angle r. Draw a ray diagram to show its path as it emerges out of the slab. Hence, obtain an expression for the lateral shift of the ray. Under what condition will the shift be minimum?

[2025 • Set 55-6-2]

Q13. (a) A concave mirror has radius of curvature 20 cm. Calculate the distance of an object from the mirror so as to form an image of magnification -2. Also find the location of the image.

(b) If the silver coating around the centre of a concave mirror is removed, will the mirror

still form the image of an object? Justify your answer.

[2025 • Set 55-6-3]

Q14. Define critical angle for a given pair of media and total internal reflection. Obtain the relation between the critical angle and refractive index of the medium.

[2023 • Set 55-2-1]

Q15. A ray of light is incident on a glass prism of refractive index μ and refracting angle A. If it just suffers total internal reflection at the other face, obtain a relation between the angle of incidence, angle of prism and critical angle.

[2023 • Set 55-2-2]

Q16. A ray of light is refracted by a glass prism. Obtain an expression for the refractive index of the glass in terms of the angle of prism A and the angle of minimum deviation δ_m.

[2023 • Set 55-2-3]

Q17. **(i)** Trace the path of a ray of light PQ which is incident at an angle i on one face of a glass prism of angle A. It then emerges out from the other face at an angle e. Use the ray diagram to prove that the angle through which the ray is deviated is given by $\angle\delta = \angle i + \angle e - \angle A$.

(ii) What will be the minimum value of δ if the ray passes symmetrically through the prism?

[2022 • Set 55-1-1]

Q18. A point source in air is kept 24 cm in front of a concave spherical glass surface $(\mu_g = 1.5)$ and radius of curvature 60 cm. Find the nature of the image formed and its distance from the point source.

[2022 • Set 55-1-1]

Q19. Explain with the help of a suitable diagram, the phenomenon on which an optical fibre works. Mention any two uses of optical fibres.

[2022 • Set 55-1-1]

Q20. A thin equiconvex lens of radius of curvature R made of material of refractive index μ_1 is kept coaxially, in contact with an equiconcave lens of the same radius of curvature and refractive index μ_2 $(\mu_2 > \mu_1)$. Find:

(i) the ratio of their powers, and

(ii) the power of the combination and its nature.

[2022 • Set 55-1-1]

Q21. Find the two possible positions of an object kept in front of a lens of $+5.0$ D, so that the

image formed in both cases is four times magnified.

[2022 • Set 55-1-2]

Q22. For a glass prism of refractive index $\sqrt{3}$, the value of angle of minimum deviation δ is equal to the angle of prism A. Find the angle of prism A. How will the angle δ be affected if the prism were immersed in water?

[2022 • Set 55-1-3]

Q23. (i) State the conditions for total internal reflection to take place. (ii) A tank is filled with a transparent liquid to height 'H'. A coin suspended by a thread in the liquid is gradually lowered till it touches the bottom. The apparent depth is determined corresponding to different positions of the coin.

(a) Plot a graph showing variation of the apparent depth with the real depth of the coin.

(b) What is the physical significance of the slope of the graph?

[2022 • Set 55-2-1]

Q24. Draw a labelled ray diagram showing the formation of an image by an astronomical refracting telescope in normal adjustment. Hence, obtain the expression for its magnifying power.

[2022 • Set 55-2-1]

Q25. A converging lens made of glass ($\mu = 1.5$) has its spherical faces of radii of curvature 10 cm and 20 cm. Find its focal length

(a) in air, and

(b) when it is immersed in a liquid of refractive index 1.25.

[2022 • Set 55-2-1]

Q26. (a) Is the speed of light in glass independent of the colour of light? Give reason.

(b) A small bulb is placed at the bottom of a tank containing water to a depth of 70 cm. Find the area of the surface of water through which light from the bulb can emerge out. Given refractive index of water is $\frac{4}{3}$.

[2022 • Set 55-2-2]

Q27. The refractive index of an equilateral triangular prism kept in air is $\sqrt{2}$. Calculate:

(a) the angle of minimum deviation.

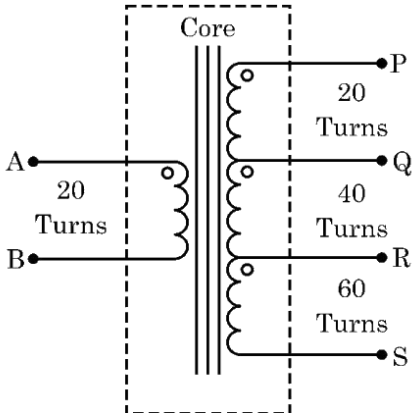
(b) the critical angle for the prism.

[2022 • Set 55-2-2]

Q28. An equiconvex lens forms a two times enlarged real image when an object is kept 16 cm from it. The lens is cut into two identical plano-convex lenses. If the object is again kept 16 cm in front of one of these lenses, then find the nature and position of the image formed.

[2022 • Set 55-2-3]

Q29. A ray is incident on a prism of material of refractive index $\sqrt{2}$ at point M such that it grazes along NC after emerging from the prism, as shown in the figure.



Find:

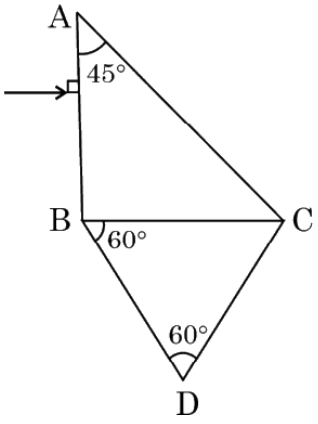
(a) the critical angle for the prism.

(b) the angle of refraction at face AB.

[2022 • Set 55-2-3]

Q30. (a) Write two necessary conditions for total internal reflection.

(b) Two prisms ABC and DBC are arranged as shown in figure.

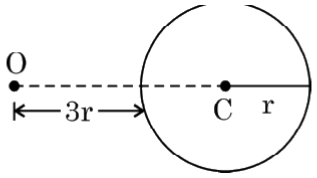


The critical angles for the two prisms with respect to air are $41.1°$ and $45°$ respectively. Trace the path of the ray through the combination.

[2022 • Set 55-3-1]

Q31. (a) An object is placed in front of a converging lens. Obtain the conditions under which the magnification produced by the lens is (i) negative and (ii) positive.

(b) A point object is placed at O in front of a glass sphere as shown in figure.



Show the formation of image by the sphere.

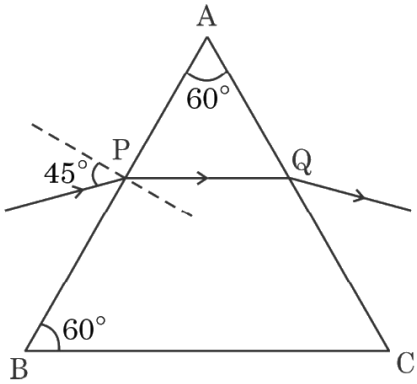
[2022 • Set 55-3-1]

Q32. A ray of light is incident on a prism at an angle of $45°$ and passes symmetrically as shown in the figure. Calculate:

(a) the angle of minimum deviation,

(b) the refractive index of the material of the prism, and

(c) the angle of refraction at the point P.



[2022 • Set 55-4-1]

Q33. (i) Draw a labelled ray diagram showing the formation of the image at infinity by an astronomical telescope.

(ii) A telescope consists of an objective of focal length 150 cm and an eyepiece of focal length 6.0 cm. If the final image is formed at infinity, then calculate: (I) the length of the tube in this adjustment, and (II) the magnification produced.

[2022 • Set 55-4-1]

Q34. (i) Draw a labelled ray diagram showing the formation of the image at least distance of distinct vision by a compound microscope.

(ii) A small object is placed at a distance of 3.0 cm from a magnifier of focal length 4.0 cm. Find: (I) the position of the image formed, and (II) the linear magnification produced.

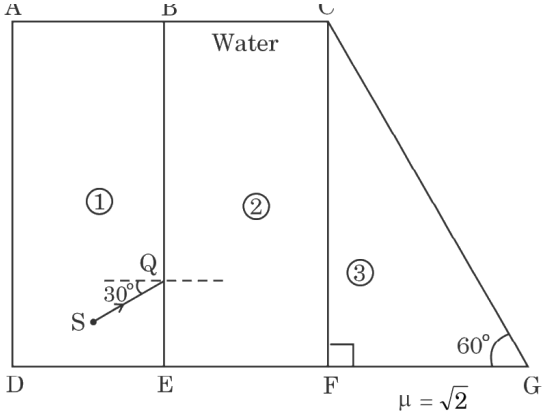
[2022 • Set 55-4-1]

Q35. The figure shows a water column BCFE surrounded by two media (1) and (2) of the same

refractive index $\sqrt{2}$. A ray of light from a point source S is incident on surface BE at an angle of $30°$.

(a) Trace the path of the ray through media (1) and (2) as it emerges out of face CG.

(b) Find the angle of emergence at face CG.



[2022 • Set 55-4-2]

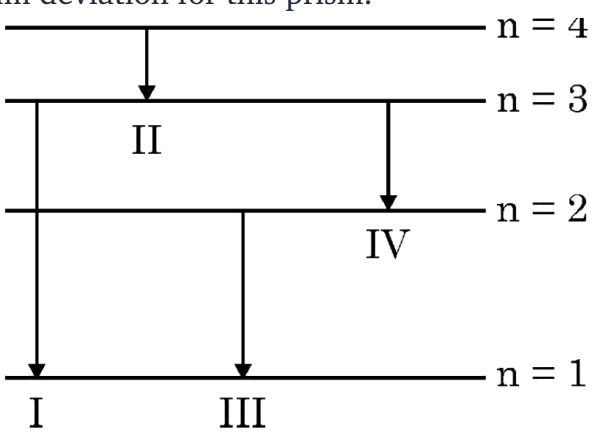
Q36. A diver looking up through water $\left(\mu = \frac{5}{3}\right)$ sees the outside world contained in a circular area on the surface of water. If the diver's eyes are $\sqrt{7}$ m below the surface of water, then calculate the area of the circle.

[2022 • Set 55-4-3]

Q37. A ray of light passes through a prism of refractive index $\sqrt{2}$ as shown in the figure. Find:

(i) The angle of incidence $(\angle r_2)$ at face AC.

(ii) The angle of minimum deviation for this prism.



[2022 • Set 55-5-1]

Q38. With the help of a ray diagram explain the working of a reflecting telescope. Mention two advantages of a reflecting telescope over a refracting telescope.

[2022 • Set 55-5-1]

Q39. **(i)** Define SI unit of power of a lens.

(ii) A plano convex lens is made of glass of refractive index 1.5. The radius of curvature of the convex surface is 25 cm. Calculate the focal length of the lens.

(iii) If an object is placed 50 cm in front of the lens, find the nature and position of the image formed.

[2022 • Set 55-5-1]

Q40. With the help of a ray diagram, show how a compound microscope forms a magnified image of a tiny object, at least distance of distinct vision. Hence derive an expression for the magnification produced by it.

[2022 • Set 55-5-3]

Q41. What is the difference in the construction of an astronomical telescope and a compound microscope? The focal lengths of the objective and eyepiece of a compound microscope are 1.25 cm and 5.0 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 when the final image is formed at the near point.

[2020 • Set 55-2-1]

Q42. **(a)** Using the necessary ray diagram, derive the mirror formula for a concave mirror.

(b) In the magnified image of a measuring scale (with equidistant markings) lying along the principal axis of a concave mirror, the markings are not equidistant. Explain.

[2020 • Set 55-3-1]

Q43. Two objects P and Q when placed at different positions in front of a concave mirror of focal length 20 cm, form real images of equal size. Size of object P is three times size of object Q. If the distance of P is 50 cm from the mirror, find the distance of Q from the mirror.

[2020 • Set 55-4-1]

Q44. An object is placed in front of a concave mirror of focal length 12 cm. There are two possible positions of the object for which the image formed is three times the size of the object.

(a) Draw the ray diagram for each case, and

(b) Find the distance between the two positions of the object.

[2020 • Set 55-4-2]

Q45. A concave mirror forms a real image of an object kept at a distance 9 cm from it. If the object is taken away from the mirror by 6 cm, the image size reduces to $\frac{4}{9}$ th of its

previous size. Find the focal length of the mirror.

[2020 • Set 55-4-3]

Q46. An optical instrument uses a lens of power 100 D for objective lens and 50 D for its eyepiece. When the tube length is kept at 25 cm, the final image is formed at infinity.

(a) Identify the optical instrument.

(b) Calculate the magnification produced by the instrument.

[2020 • Set 55-5-1]

Q47. An optical instrument uses an objective lens of power 100 D and an eyepiece of power 40 D. The final image is formed at infinity when the tube length of the instrument is kept at 20 cm.

(a) Identify the optical instrument.

(b) Calculate the angular magnification produced by the instrument.

[2020 • Set 55-5-3]

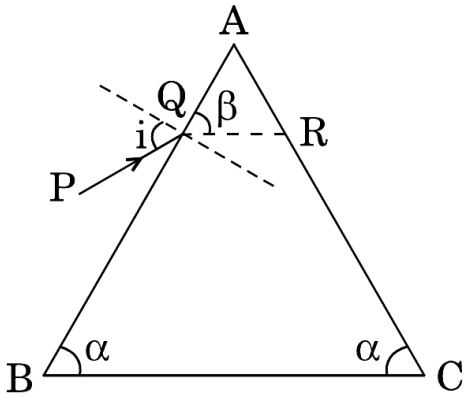
Q48. Draw a labelled ray diagram of an astronomical telescope in the near point adjustment position. A giant refracting telescope at an observatory has an objective lens of focal length 15 m and an eyepiece of focal length 1.0 cm. If this telescope is used to view the Moon, find the diameter of the image of the Moon formed by the objective lens. The diameter of the Moon is 3.48×10^6 m, and the radius of lunar orbit is 3.8×10^8 m.

[2019 • Set 55-1-1]

Q49. A triangular prism of refracting angle $60°$ is made of a transparent material of refractive index $2/\sqrt{3}$. A ray of light is incident normally on the face KL as shown in the figure. Trace the path of the ray as it passes through the prism and calculate the angle of emergence and angle of deviation.

[2019 • Set 55-2-1]

Q50. A ray of light incident on the face AB of an isosceles triangular prism makes an angle of incidence (i) and deviates by angle β as shown in the figure. Show that in the position of minimum deviation $2\beta = \angle\alpha$. Also find out the condition when the refracted ray QR suffers total internal reflection.



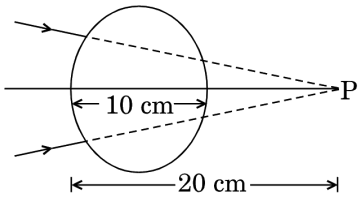
[2019 • Set 55-2-2]

Q51. (a) When a convex lens of focal length 30 cm is in contact with a concave lens of focal length 20 cm, find out if the system is converging or diverging.

(b) Obtain the expression for the angle of incidence of a ray of light which is incident on the face of a prism of refracting angle A so that it suffers total internal reflection at the other face. (Given the refractive index of the glass of the prism is μ.)

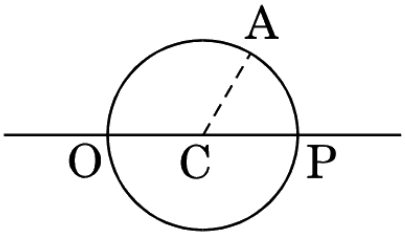
[2019 • Set 55-2-3]

Q52. A converging beam of light travelling in air converges at a point P as shown in the figure. When a glass sphere of refractive index 1.5 is introduced in between the path of the beam, calculate the new position of the image. Also draw the ray diagram for the image formed.



OR

A point 'O' marked on the surface of a glass sphere of diameter 20 cm is viewed through glass from the position directly opposite to the point O. If the refractive index of the glass is 1.5, find the position of the image formed. Also, draw the ray diagram for the formation of the image.



[2019 • Set 55-3-1]

Q53. Draw a ray diagram to show the image formation of a distant object by a refracting

telescope. Write the expression for its angular magnification in terms of the focal lengths of the lenses used. State the important considerations required to achieve large resolution and their consequent limitations.

OR

(a) Plot a graph for angle of deviation as a function of angle of incidence for a triangular prism.

(b) Derive the relation for the refractive index of the prism in terms of the angle of minimum deviation and angle of prism.

[2019 • Set 55-4-1]

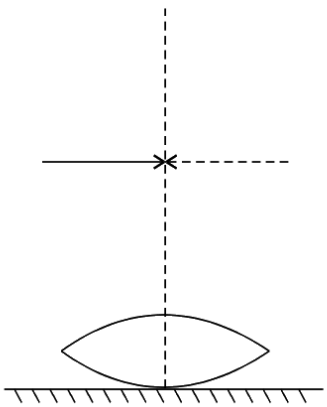
Q54. A screen is placed 90 cm from an object. The image of the object on the screen is formed by a convex lens at two different positions separated by 20 cm. Calculate the focal length of the lens.

OR

A convex lens of focal length 20 cm and a concave lens of focal length 15 cm are kept 30 cm apart with their principal axes coincident. When an object is placed 30 cm in front of the convex lens, calculate the position of the final image formed by the combination. Would this result change if the object were placed 30 cm in front of the concave lens? Give reason.

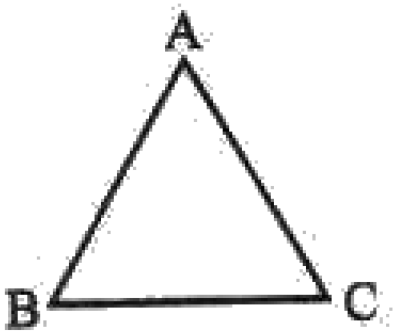
[2019 • Set 55-5-1]

Q55. A symmetric biconvex lens of radius of curvature R and made of glass of refractive index 1.5, is placed on a layer of liquid placed on top of a plane mirror as shown in the figure. An optical needle with its tip on the principal axis of the lens is moved along the axis until its real, inverted image coincides with the needle itself. The distance of the needle from the lens is measured to be x. On removing the liquid layer and repeating the experiment, the distance is found to be y. Obtain the expression for the refractive index of the liquid in terms of x and y.



[2018]

Q56. (i) A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of $30°$. Calculate the speed of light through the prism.



(ii) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.

[2017]

Q57. (a) Monochromatic light of wavelength 589 nm is incident from air on a water surface. If μ for water is 1.33, find the wavelength, frequency and speed of the refracted light.

(b) A double convex lens is made of a glass of refractive index 1.55, with both faces of the same radius of curvature. Find the radius of curvature required, if the focal length is 20 cm.

[2017]

Q58. (a) Draw a ray diagram depicting the formation of the image by an astronomical telescope in normal adjustment.

(b) You are given the following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope? Give reason.

Lenses	Power (D)	Aperture (cm)
L_1	3	8
L_2	6	1
L_3	10	1

[2017]

Q59. (a) Draw a ray diagram showing the formation of image by a reflecting telescope.

(b) Write two advantages of a reflecting telescope over a refracting telescope.

[2017]

Q60. (a) Draw a ray diagram for the formation of image by a compound microscope.

(b) You are given the following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct a compound microscope?

(c) Define resolving power of a microscope and write one factor on which it depends.

[2017]

Q61. (i) What is total internal reflection? Under what conditions does it occur?

(ii) Find a relation between critical angle and refractive index.

(iii) Name one phenomenon which is based on total internal reflection.

[2016]

Q62. (a) Draw a schematic diagram of a reflecting telescope.

(b) State the advantages of reflecting telescope over refracting telescope.

OR

(i) Draw a schematic ray diagram of a compound microscope when image is formed at distance of distinct vision.

(ii) Write the expression for resolving power of a compound microscope. How can the resolving power of a microscope be increased?

[2016]

Q63. (i) A screen is placed at a distance of 100 cm from an object. The image of the object is formed on the screen by a convex lens for two different locations of the lens separated by 20 cm. Calculate the focal length of the lens used.

(ii) A converging lens is kept coaxially in contact with a diverging lens - both the lenses being of equal focal length. What is the focal length of the combination?

[2016]

Q64. (i) For a glass prism ($\mu = \sqrt{3}$) the angle of minimum deviation is equal to the angle of the prism. Calculate the angle of the prism.

(ii) Draw ray diagram when incident ray falls normally on one of the two equal sides of a right angled isosceles prism having refractive index $\mu = \sqrt{3}$.

[2016]

Q65. (i) Name the phenomenon on which the working of an optical fibre is based.

(ii) What are the necessary conditions for this phenomenon to occur?

(iii) Draw a labelled diagram of an optical fibre and show how light propagates through the optical fibre using this phenomenon.

[2016]

Q66. (a) Give two reasons to explain why reflecting telescopes are preferred over refracting type.

(b) Use mirror equation to show that convex mirror always produces a virtual image independent of the location of the object.

[2015]

Q67. (i) A giant refracting telescope has an objective lens of focal length 15 m. If an eye piece of focal length 1.0 cm is used, what is the angular magnification of the telescope?

(ii) If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3.48×10^6 m and the radius of lunar orbit is 3.8×10^8 m.

[2015]

Q68. (a) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.

(b) The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece.

[2014]

Q69. (a) A mobile phone lies along the principal axis of a concave mirror. Show, with the help of a suitable diagram, the formation of its image. Explain why magnification is not uniform.

(b) Suppose the lower half of the concave mirror's reflecting surface is covered with an opaque material. What effect this will have on the image of the object ? Explain.

[2014]

Q70. A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept 15 cm apart. A point object is placed 40 cm in front of the convex lens. Find the position of the image formed by this combination. Draw the ray diagram showing the image formation.

[2014]

Q71. Three rays of light — red (R), green (G) and blue (B) — are incident on the face AB of a right-angled prism ABC. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Trace the path of the rays through the prism. How will the situation change if these rays were incident normally on one of the faces of an equilateral prism?

[2013]

Q72. **(i)** Draw a neat labelled ray diagram of an astronomical telescope in normal adjustment. Explain briefly its working.

(ii) An astronomical telescope uses two lenses of powers $10\,\text{D}$ and $1\,\text{D}$. What is its magnifying power in normal adjustment?

OR

(i) Draw a neat labelled ray diagram of a compound microscope. Explain briefly its working.

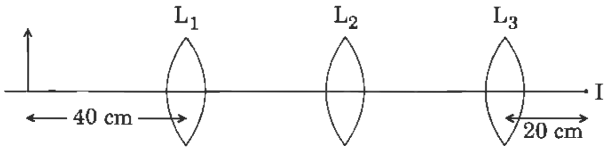
(ii) Why must both the objective and the eye-piece of a compound microscope have short focal lengths?

[2012]

Q73. An illuminated object and a screen are placed $90\,\text{cm}$ apart. Determine the focal length and nature of the lens required to produce a clear image on the screen, twice the size of the object.

[2012]

Q74. You are given three lenses L_1, L_2 and L_3 each of focal length $20\,\text{cm}$. An object is kept at $40\,\text{cm}$ in front of L_1, as shown. The final real image is formed at the focus 'I' of L_3. Find the separations between L_1, L_2 and L_3.



[2012]

Q75. Define power of a lens. Write its units. Deduce the relation $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ for two thin lenses kept in contact coaxially.

[2012]

Q76. A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in (i) a medium of refractive index 1.65, (ii) a medium of refractive index 1.33.

(a) Will it behave as a converging or a diverging lens in the two cases?

(b) How will its focal length change in the two media?

[2011]

Q77. Use the mirror equation to show that

(a) an object placed between f and $2f$ of a concave mirror produces a real image beyond $2f$.

(b) a convex mirror always produces a virtual image independent of the location of the object.

(c) an object placed between the pole and focus of a concave mirror produces a virtual and enlarged image.

[2011]

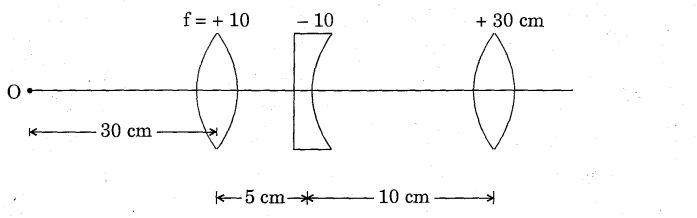
Q78. A compound microscope uses an objective lens of focal length 4 cm and eyepiece lens of focal length 10 cm. An object is placed at 6 cm from the objective lens. Calculate the magnifying power of the compound microscope. Also calculate the length of the microscope.

[2011]

Q79. A giant refracting telescope at an observatory has an objective lens of focal length 15 m. If an eyepiece lens of focal length 1.0 cm is used, find the angular magnification of the telescope. If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3.42×10^6 m and the radius of the lunar orbit is 3.8×10^8 m.

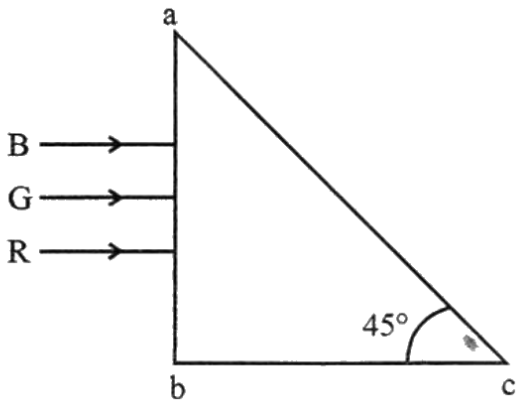
[2011]

Q80. Find the position of the image formed of the object 'O' by the lens combination given in the figure.



[2011 • Set 55-2-1]

Q81. Three light rays red (R), green (G) and blue (B) are incident on a right angled prism abc at face ab. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Out of the three which colour ray will emerge out of face ac? Justify your answer. Trace the path of these rays after passing through face ab.



[2009]

Q82. Draw a plot showing the variation of power of a lens with the wavelength of the incident light. A diverging lens of refractive index 1.5 and of focal length $20\ cm$ in air has the same radii of curvature for both sides. If it is immersed in a liquid of refractive index 1.7, calculate the focal length of the lens in the liquid.

[2008]

Q83. Define the term 'resolving power' of an astronomical telescope. How does it get affected on

(i) increasing the aperture of the objective lens?

(ii) increasing the wavelength of the light used? Justify your answer in each case.

[2007]

Q84. A double convex lens made of a glass of refractive index 1.6 has its both surfaces of equal radii of curvature of 30 cm each. An object of height 5 cm is placed at a distance of 12.5 cm from the lens. Calculate the size of the image formed.

[2007]

Q85. A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in:

(i) medium A of refractive index 1.65

(ii) medium B of refractive index 1.33 Explain, giving reasons, whether it will behave as a converging lens or a diverging lens in each of these two media.

[2006]

Q86. A figure divided into squares, each of size $1\ mm^2$, is being viewed at a distance of 9 cm through a magnifying lens of focal length 10 cm, held close to the eye.

(a) Draw a ray diagram showing the formation of the image.

(b) What is the magnification produced by the lens? How much is the area of each square in the virtual image?

(c) What is the angular magnification of the lens?

[2005]

4-Mark Questions (3 questions · Section D · Case Study)

Q1. An astronomical telescope consists of two converging lenses. One of them of large aperture and large focal length is called objective lens and the other one, of smaller focal length and smaller aperture is called the eyepiece. It is used to see distant objects which are not seen clearly with naked eyes. The image formed by the objective lens acts as an object for the eyepiece and the final image produced by the eyepiece is magnified.

[2026 • Set 55-4-1]

Q2. A lens is a transparent optical medium bounded by two surfaces; at least one of which should be spherical. Considering image formation by a single spherical surface successively at the two surfaces of a lens, lens maker's formula is obtained. It is useful to design lenses of desired focal length using surfaces of suitable radii of curvature. This formula helps us obtain a relation between u, v and f for a lens. Lenses form images of objects and they are used in a number of optical devices, for example microscopes and telescopes.

[2023 • Set 55-5-1]

Q3. Mrs. Rashmi Singh broke her reading glasses. When she went to the shopkeeper to order new spects, he suggested that she should get spectacles with plastic lenses instead of glass lenses. On getting the new spectacles, she found that the new ones were thicker than the earlier ones. She asked this question to the shopkeeper but he could not offer satisfactory explanation for this. At home, Mrs. Singh raised the same question to her daughter Anuja who explained why plastic lenses were thicker.

(a) Write two qualities displayed each by Anuja and her mother.

(b) How do you explain this fact using lens maker's formula?

[2017]

5-Mark Questions (58 questions · Section E · Long Answer)

Q1. (a) Using the relation for refraction at a curved spherical surface, derive the expression for lens maker's formula.

(b) Three lenses L_1, L_2 and L_3, each of focal length 40 cm, are placed coaxially. The distance between L_1 and L_2 and between L_2 and L_3 are 120 cm and 20 cm respectively. An object is kept at a distance of 80 cm to the left of lens L_1. Find the distance of the final image formed from the object.

OR

(a) Draw a ray diagram to show the image formation by a concave mirror when the object

is kept between its focus and the centre of curvature. Using this diagram, derive the mirror formula.

(b) A concave mirror produces a two times magnified virtual image of an object kept 10 cm in front of it. Calculate the focal length of the mirror.

[2026 • Set 55-1-1]

Q2. (a) Draw a labelled ray diagram of a refracting telescope when it forms image of a distant object at infinity. Derive expression for its magnifying power.

[2026 • Set 55-2-1]

Q3. (b) (i) In a telescope the objective has much larger aperture than the eyepiece. Why? (ii) Write two advantages of reflecting telescope over refracting telescope.

[2026 • Set 55-2-1]

Q4. (i) A point object is kept in front of a convex spherical surface of radius of curvature R. Draw the ray diagram to show the formation of image and derive the relation between the object and image distance (u and v) in terms of refractive index n of the medium and R.

[2026 • Set 55-3-1]

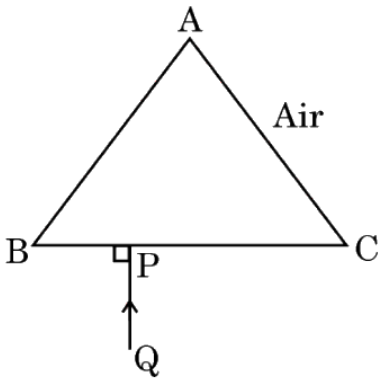
Q5. (ii) A convex lens of focal length of 20 cm is used to form the image of an object placed 30 cm away from the lens. Find the position and nature of the image formed.

[2026 • Set 55-3-1]

Q6. (i) Two thin converging lenses of focal length f_1 and f_2 are placed coaxially in contact. Derive expression for the focal length of the combination.

[2026 • Set 55-3-1]

Q7. (a) (i) Define refractive index of a medium in terms of speed of light. (ii) Derive the relation for the refractive index (μ) of a prism in terms of angle of minimum deviation (δ_m) and angle of prism (A). (iii) A ray of light QP is incident normally on the face BC of a triangular prism ABC of refractive index 1·5 kept in air, as shown in the figure. Trace the path of the ray as it passes through the prism and give relevant explanation.



OR

(b) (i) What is the difference between a ray and a wavefront? (ii) A plane wave is incident on a reflecting surface. Using Huygens principle, show how it is reflected from the surface. Hence, verify the law of reflection. (iii) Depict refraction of a plane wave by a convex lens.

[2026 • Set 55-4-1]

Q8. (b) (i) With the help of a ray diagram, describe the construction and working of a compound microscope. (ii) (I) The real image of an object placed between f and $2f$ from a convex lens can be seen on a screen placed at the image location. If the screen is removed, is the image still there? Explain. (II) Plane and convex mirrors produce virtual images of objects. Can they produce real images under some circumstances? Explain.

[2026 • Set 55-5-1]

Q9. (i) A thin pencil of length $(f/4)$ is placed coinciding with the principal axis of a mirror of focal length f. The image of the pencil is real and enlarged, just touches the pencil. Calculate the magnification produced by the mirror.

(ii) A ray of light is incident on a refracting face AB of a prism ABC at an angle of $45°$. The ray emerges from face AC and the angle of deviation is $15°$. The angle of prism is $30°$. Show that the emergent ray is normal to the face AC from which it emerges out. Find the refraction index of the material of the prism.

[2025 • Set 55-2-1]

Q10. (a) (i) An object is placed 30 cm from a thin convex lens of focal length 10 cm. The lens forms a sharp image on a screen. If a thin concave lens is placed in contact with the convex lens, the sharp image on the screen is formed when the screen is moved by 45 cm from its initial position. Calculate the focal length of the concave lens. (ii) Calculate the angle of minimum deviation of an equilateral prism. The refractive index of the prism is $\sqrt{3}$. Calculate the angle of incidence for this case of minimum deviation also.

OR

(b) (i) A physics teacher wants to demonstrate interference with the help of double slit experiment using a laser beam of 633 nm wavelength. Since the hall is large enough, interference pattern is formed on the wall 5.0 m from the slits. For clear and comfortable view by all the students they want the fringe width 5 mm. (I) Find the slit separation for obtaining the desired interference pattern. (II) How far will the first minimum be from the central maximum ? (ii) A parallel beam of light of wavelength 650 nm passes through a slit of width 0.6 mm. The diffraction pattern is obtained on a screen kept 60 cm away from the slit. Find the distance between first order minima on both sides of the central maximum.

[2025 • Set 55-4-1]

Q11. (a) (i) Draw a ray diagram of a reflecting telescope (Cassegrain) and explain the formation of image. State two important advantages that a reflecting telescope has over a refracting telescope. (ii) In a refracting telescope, the focal length of the objective is 50 times the focal length of the eyepiece. When the final image is formed at infinity, the length of the tube is 102 cm. Find the focal lengths of the two lenses.

OR

(b) (i) Write any two advantages of a compound microscope over a simple microscope. Draw a ray diagram for the image formation at the near point by a compound microscope and explain it. (ii) A thin planoconcave lens with its curved face of radius of curvature R is made of glass of refractive index n_1. It is placed coaxially in contact with a thin equiconvex lens of same radius of curvature of refractive index n_2. Obtain the power of the combination lens.

[2025 • Set 55-5-1]

Q12. (a) (i) Draw a ray diagram to show the image formation by a compound microscope. Obtain the expression for the total magnification of the microscope when the final image is formed at infinity. (ii) In a compound microscope, an object is placed at a distance of $1{\cdot}5$ cm from the objective of focal length $1{\cdot}25$ cm. The eyepiece has a focal length of 5 cm. The final image is formed at infinity. Calculate the distance between the objective and the eyepiece.

OR

(b) (i) Using Huygens' principle, explain the refraction of a plane wavefront, propagating in air, at a plane interface between air and glass. Hence verify Snell's law. (ii) Use mirror formula to deduce that a convex mirror always produces a virtual image of an object kept in front of it.

[2025 • Set 55-6-1]

Q13. (a) (i) Explain with the help of a labelled ray diagram the formation of final image by an astronomical telescope at infinity. Write the expression for its magnifying power. (ii) The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. When the microscope is focussed on a certain object, the distance between the objective and eyepiece is observed to be 14 cm. Calculate the focal lengths of the objective and the eyepiece. (Given that the least distance of distinct vision $= 25$ cm)

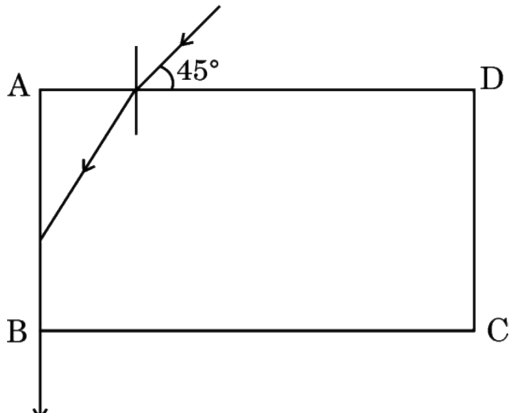
OR

(b) (i) Two coherent light waves, each of intensity I_0 superpose each other and produce interference pattern on a screen. Obtain the expression for the resultant intensity at a point where the phase difference between the waves is ϕ. Write its maximum and minimum possible values. (ii) In a single slit diffraction experiment, the aperture of the slit is 3 mm and the separation between the slit and the screen is 1.5 m. A monochromatic light of wavelength 600 nm is normally incident on the slit. Calculate the distance of (I) first order minimum, and (II) second order maximum, from the centre of the screen.

[2025 • Set 55-7-1]

Q14. (i) Trace the path of a ray of light showing refraction through a triangular prism and hence obtain an expression for angle of deviation (δ) in terms of A, i and e, where symbols have their usual meanings. Draw a graph showing the variation of angle of deviation with the angle of incidence.

(ii) In the figure, a ray of light is incident on a transparent liquid contained in a thin glass box at an angle of $45°$ with its one face. The emergent ray passes along the face AB. Find the refractive index of the liquid.



[2024 • Set 55-3-1]

Q15. (i) Draw a ray diagram for the formation of the image of an object by a convex mirror. Hence, obtain the mirror equation.

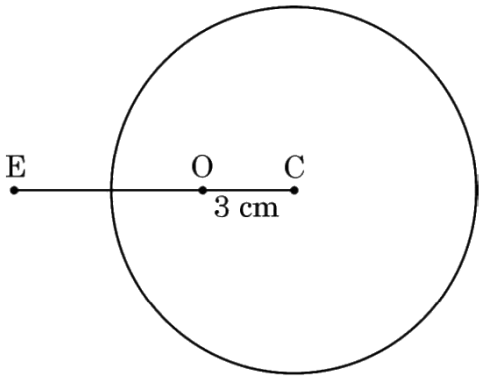
(ii) Why are multi-component lenses used for both the objective and the eyepiece in optical instruments?

(iii) The magnification of a small object produced by a compound microscope is 200. The focal length of the eyepiece is 2 cm and the final image is formed at infinity. Find the magnification produced by the objective.

[2024 • Set 55-4-1]

Q16. (i) A spherical surface of radius of curvature R separates two media of refractive indices n_1 and n_2. A point object is placed in front of the surface at distance u in medium of refractive index n_1 and its image is formed by the surface at distance v, in the medium of refractive index n_2. Derive a relation between u and v.

(ii) A solid glass sphere of radius 6.0 cm has a small air bubble trapped at a distance 3.0 cm from its centre C as shown in the figure. The refractive index of the material of the sphere is 1.5. Find the apparent position of this bubble when seen through the surface of the sphere from an outside point E in air.



[2023 • Set 55-1-1]

Q17. (i) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope.

(ii) The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.

[2023 • Set 55-2-1]

Q18. (a) (i) Draw a ray diagram showing the formation of a real image of an object placed at a distance 'u' in front of a concave mirror of radius of curvature 'R'. Hence, obtain the relation for the image distance 'v' in terms of u and R. (ii) A 1.8 m tall person stands in front of a convex lens of focal length 1 m, at a distance of 5 m. Find the position and height of the image formed.

OR

(b) (i) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (μ) in terms of angle of prism (A) and angle of minimum deviation (δ_m). (ii) The radii of curvature of the two surfaces of a concave lens are 20 cm each. Find the refractive index of the material of the lens if its power is -5.0 D.

[2023 • Set 55-3-1]

Q19. (a) (i) Draw a ray diagram to show how the final image is formed at infinity in an astronomical refracting telescope. Obtain an expression for its magnifying power. (ii) Two thin lenses L_1 and L_2, L_1 being a convex lens of focal length 24 cm and L_2 a concave lens of focal length 18 cm are placed coaxially at a separation of 45 cm. A 1 cm tall object is placed in front of the lens L_1 at a distance of 36 cm. Find the location and height of the image formed by the combination.

OR

(b) (i) Explain the working principle of an optical fibre with the help of a diagram. Mention one use of a light pipe. (ii) A ray of light is incident at an angle of $60°$ on one face of a prism with the prism angle $A = 60°$. The ray passes symmetrically through the prism. Find the angle of minimum deviation (δ_m) and refractive index of the material of the prism. If the prism is immersed in water, how will δ_m be affected? Justify your answer.

[2023 • Set 55-4-1]

Q20. (a) (i) Draw a ray diagram to show the working of a compound microscope. Obtain the expression for the total magnification for the final image to be formed at the near point. (ii) In a compound microscope an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye-piece has a focal length of 5 cm and the final image is formed at the near point, find the magnifying power of the microscope.

OR

(b) (i) Draw a ray diagram for the formation of image of an object by an astronomical telescope, in normal adjustment. Obtain the expression for its magnifying power. (ii) The magnifying power of an astronomical telescope in normal adjustment is 2.9 and the objective and the eyepiece are separated by a distance of 150 cm. Find the focal lengths of the two lenses.

[2023 • Set 55-5-1]

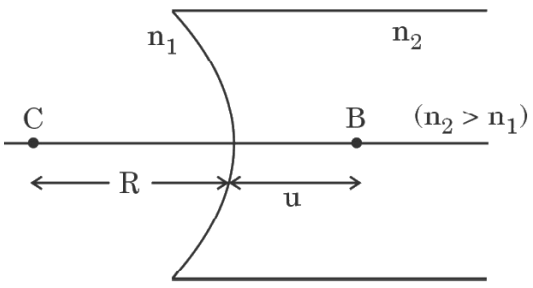
Q21. A compound microscope consists of two converging lenses. One of them, of smaller aperture and smaller focal length is called objective and the other of slightly larger aperture and slightly larger focal length is called eye-piece. Both the lenses are fitted in

a tube with an arrangement to vary the distance between them. A tiny object is placed in front of the objective at a distance slightly greater than its focal length. The objective produces the image of the object which acts as an object for the eye-piece. The eye piece, in turn produces the final magnified image. I. In a compound microscope the images formed by the objective and the eye-piece are respectively (A) virtual, real (B) real, virtual (C) virtual, virtual (D) real, real II. The magnification due to a compound microscope does not depend upon (A) the aperture of the objective and the eye-piece (B) the focal length of the objective and the eye-piece (C) the length of the tube (D) the colour of the light used III. Which of the following is not correct in the context of a compound microscope? (A) Both the lenses are of short focal lengths. (B) The magnifying power increases by decreasing the focal lengths of the two lenses. (C) The distance between the two lenses is more than $(f_o + f_e)$. (D) The microscope can be used as a telescope by interchanging the two lenses. IV. A compound microscope consists of an objective of 10X and an eye-piece of 20X. The magnification due to the microscope would be (A) 2 (B) 10 (C) 30 (D) 200 V. The focal lengths of objective and eye-piece of a compound microscope are 1.2 cm and 3.0 cm respectively. The object is placed at a distance of 1.25 cm from the objective. If the final image is formed at infinity, the magnifying power of the microscope would be (A) 100 (B) 150 (C) 200 (D) 250

[2022 • Set 55-3-1]

Q22. Two transparent media of refractive indices n_1 and n_2 are separated by a spherical transparent surface. The rays of light incident on the surface get refracted into the medium on the other side. The laws of refraction are valid at each point of the spherical surface. A lens is a transparent optical medium bounded by two surfaces, at least one of which should be spherical. The focal length of a lens is determined by the radii of curvature (R_1 and R_2) of its two surfaces and the refractive index (n) of the medium of the lens with respect to the surrounding medium. Depending on R_1 and R_2, a lens behaves as a diverging or a converging lens. The ability of a lens to diverge or converge a beam of light incident on it defines its power.

(a) An object is placed at the point B as shown in the figure. The object distance (u) and the image distance (v) are related as: (i) $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ (ii) $\frac{n_1}{v} - \frac{n_2}{u} = \frac{n_1 - n_2}{R}$ (iii) $\frac{n_2}{u} - \frac{n_1}{v} = \frac{n_2 - n_1}{R}$ (iv) $\frac{n_1}{u} - \frac{n_2}{v} = \frac{n_1 - n_2}{R}$

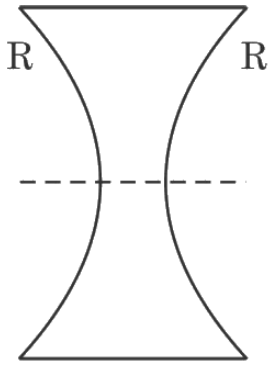


(b) A point object is placed in air at a distance R in front of a convex spherical refracting surface of radius of curvature R. If the medium on the other side of the surface is

glass, then the image is: (i) real and formed in glass. (ii) real and formed in air. (iii) virtual and formed in glass. (iv) virtual and formed in air.

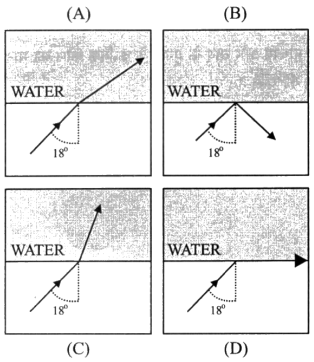
(c) An object is kept at $2F$ in front of an equiconvex lens. The image formed is: (i) real and of the size of the object. (ii) virtual and of the size of the object. (iii) real and enlarged. (iv) virtual and diminished.

(d) A thin converging lens of focal length 10 cm and a thin diverging lens of focal length 20 cm are placed coaxially in contact. The power of the combination is: (i) -5 D (ii) $+5$ D (iii) $+15$ D (iv) -15 D (e) An equiconcave lens of focal length f is cut into two identical parts along the dotted line as shown in the figure. The focal length of each part will be: (i) $\frac{f}{2}$ (ii) $\frac{f}{4}$ (iii) f (iv) $2f$



[2022 • Set 55-4-1]

Q23. A ray of light travels from a denser to a rarer medium. After refraction, it bends away from the normal. When we keep increasing the angle of incidence, the angle of refraction also increases till the refracted ray grazes along the interface of two media. The angle of incidence for which it happens is called critical angle. If the angle of incidence is increased further the ray will not emerge and it will be reflected back in the denser medium. This phenomenon is called total internal reflection of light. (i) A ray of light travels from a medium into water at an angle of incidence of $18°$. The refractive index of the medium is more than that of water and the critical angle for the interface between the two media is $20°$. Which one of the following figures best represents the correct path of the ray of light?



(ii) A point source of light is placed at the bottom of a tank filled with water, of refractive index μ, to a depth d. The area of the surface of water through which light from the source can emerge, is:

(a) $\frac{\pi d^2}{2(\mu^2-1)}$ (b) $\frac{\pi d^2}{(\mu^2-1)}$ (c) $\frac{\pi d^2}{\sqrt{\mu^2-1}}$ (d) $\frac{2\pi d^2}{(\mu^2-1)}$ (iii) For which of the following media, with respect to air, the value of critical angle is maximum?

(a) Crown glass (b) Flint glass (c) Water (d) Diamond (iv) The critical angle for a pair of two media A and B of refractive indices 2.0 and 1.0 respectively is:

(a) $0°$ (b) $30°$ (c) $45°$ (d) $60°$ (v) The critical angle of pair of a medium and air is $30°$. The speed of light in the medium is:

(a) 1×10^8 m s^{-1} (b) 1.5×10^8 m s^{-1} (c) 2.2×10^8 m s^{-1} (d) 2.8×10^8 m s^{-1}

[2022 • Set 55-5-1]

Q24. (i) Draw a ray diagram of an astronomical refracting telescope in normal adjustment. Obtain an expression for its magnifying power. How can we increase the magnifying power of the telescope?

(ii) A beam of light converges at a point P. A lens is placed in the path of the beam at a distance of 25 cm from P. The final image is formed at infinity. Calculate the power of the lens.

[2021]

Q25. (i) A coin is placed inside a denser medium. Why does it appear to be raised? Obtain an expression for the height through which the object appears to be raised in terms of refractive index of the medium and real depth.

(ii) A compound microscope consists of an objective lens of focal length 2 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at the least distance of distinct vision (25 cm)? Calculate the magnifying power of the microscope.

[2021]

Q26. Draw the ray diagram of an astronomical telescope when the final image is formed at infinity. Write the expression for the resolving power of the telescope.

[2020 • Set 55-1-1]

Q27. An object is placed in front of a concave mirror. It is observed that a virtual image is formed. Draw the ray diagram to show the image formation and hence derive the mirror equation $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$.

[2020 • Set 55-1-1]

Q28. An astronomical telescope has an objective lens of focal length 20 m and eyepiece of focal length 1 cm.

(i) Find the angular magnification of the telescope.

(ii) If this telescope is used to view the Moon, find the diameter of the image formed by the objective lens. Given the diameter of the Moon is $3{\cdot}5 \times 10^6$ m and radius of lunar orbit is $3{\cdot}8 \times 10^8$ m.

[2020 • Set 55-1-1]

Q29. An object is placed 30 cm in front of a plano-convex lens with its spherical surface of radius of curvature 20 cm. If the refractive index of the material of the lens is $1{\cdot}5$, find the position and nature of the image formed.

[2020 • Set 55-1-1]

Q30. (a) Derive lens maker's formula for a biconvex lens.

(b) A point object is placed at a distance of 12 cm on the principal axis of a convex lens of focal length 10 cm. A convex mirror is placed coaxially on the other side of the lens at a distance of 10 cm. If the final image coincides with the object, sketch the ray diagram and find the focal length of the convex mirror.

OR

(a) What is a wavefront? How does it propagate? Using Huygens' principle, explain reflection of a plane wavefront from a surface and verify the laws of reflection.

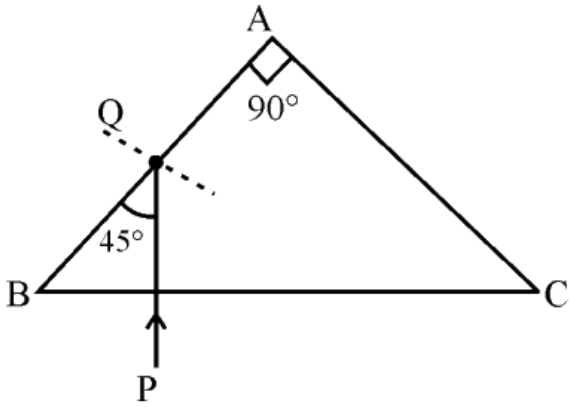
(b) A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is obtained on a screen 1 m away. If the first minimum is formed at a distance of 2.5 mm from the centre of the screen, find the (i) width of the slit, and (ii) distance of first secondary maximum from the centre of the screen.

[2020 • Set 55-2-1]

Q31. (a) Draw the ray diagram showing refraction of ray of light through a glass prism. Derive the expression for the refractive index μ of the material of prism in terms of the angle

of prism A and angle of minimum deviation δ_m.

(b) A ray of light PQ enters an isosceles right angled prism ABC of refractive index 1.5 as shown in figure.



(i) Trace the path of the ray through the prism. (ii) What will be the effect on the path of the ray if the refractive index of the prism is 1.4?

OR

(a) Two thin lenses are placed coaxially in contact. Obtain the expression for the focal length of this combination in terms of the focal lengths of the two lenses.

(b) A converging lens of refractive index 1.5 has a power of 10 D. When it is completely immersed in a liquid, it behaves as a diverging lens of focal length 50 cm. Find the refractive index of the liquid.

[2020 • Set 55-4-1]

Q32. (a) Define the term 'focal length of a mirror'. With the help of a ray diagram, obtain the relation between its focal length and radius of curvature.

(b) Calculate the angle of emergence (e) of the ray of light incident normally on the face AC of a glass prism ABC of refractive index $\sqrt{3}$. How will the angle of emergence change qualitatively, if the ray of light emerges from the prism into a liquid of refractive index 1.3 instead of air ?

OR

(a) Define the term 'resolving power of a telescope'. How will the resolving power be effected with the increase in (i) Wavelength of light used. (ii) Diameter of the objective lens. Justify your answers.

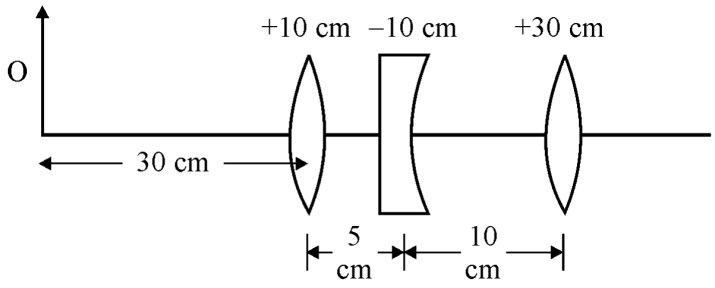
(b) A screen is placed 80 cm from an object. The image of the object on the screen is formed by a convex lens placed between them at two different locations separated by a distance 20 cm. Determine the focal length of the lens.

[2020 • Set 55-5-1]

Q33. Under what conditions is the phenomenon of total internal reflection of light observed? Obtain the relation between the critical angle of incidence and the refractive index of the medium.

[2019 • Set 55-1-1]

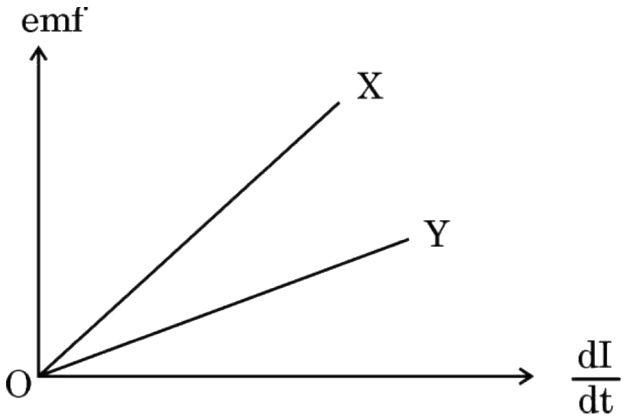
Q34. Three lenses of focal lengths $+10$ cm, -10 cm and $+30$ cm are arranged coaxially as in the figure given below. Find the position of the final image formed by the combination.



[2019 • Set 55-1-1]

Q35. (a) Using the ray diagram for a system of two lenses of focal lengths f_1 and f_2 in contact with each other, show that the two lens system can be regarded as equivalent to a single lens of focal length f, where $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$. Also write the relation for the equivalent power of the lens combination.

(b) Determine the position of the image formed by the lens combination given in the figure.



OR

(a) Explain, using a suitable diagram, how unpolarized light gets linearly polarized by scattering.

(b) Describe briefly the variation of the intensity of transmitted light when a polaroid sheet kept between two crossed polaroids is rotated. Draw the graph depicting the variation of intensity with the angle of rotation. How many maxima and minima would be observed when θ varies from 0 to π?

[2019 • Set 55-4-1]

Q36. (a) Draw a labelled ray diagram of compound microscope, when final image forms at the least distance of distinct vision.

(b) Why is its objective of short focal length and of short aperture, compared to its eyepiece? Explain.

(c) The focal length of the objective is 4 cm while that of eyepiece is 10 cm. The object is placed at a distance of 6 cm from the objective lens. (i) Calculate the magnifying power of the compound microscope, if its final image is formed at the near point. (ii) Also calculate length of the compound microscope.

OR

(a) With the help of a labelled ray diagram, explain the construction and working of a Cassegrain reflecting telescope.

(b) An amateur astronomer wishes to estimate roughly the size of the Sun using his crude telescope consisting of an objective lens of focal length 200 cm and an eyepiece of focal length 10 cm. By adjusting the distance of the eyepiece from the objective, he obtains an image of the Sun on a screen 40 cm behind the eyepiece. The diameter of the Sun's image is measured to be 6.0 cm. Estimate the Sun's size, given that the average Earth-Sun distance is 1.5×10^{11} m.

[2019 • Set 55-5-1]

Q37. (a) Draw a ray diagram to show image formation when the concave mirror produces a real, inverted and magnified image of the object.

(b) Obtain the mirror formula and write the expression for the linear magnification.

(c) Explain two advantages of a reflecting telescope over a refracting telescope.

[2018]

Q38. (a) A point object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 $(n_2 > n_1)$. Draw the ray diagram and deduce the relation between the object distance (u), image distance (v) and the radius of curvature (R) for refraction to take place at the convex spherical surface from rarer to denser medium.

(b) A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index $1 \cdot 6$. If it is immersed in a liquid of refractive index $1 \cdot 3$, find its new focal length.

OR

(a) Draw the ray diagram showing refraction of light through a glass prism and hence obtain the relation between the refractive index μ of the prism, angle of prism and angle of minimum deviation.

(b) Determine the value of the angle of incidence for a ray of light travelling from a medium of refractive index $\mu_1 = \sqrt{2}$ into the medium of refractive index $\mu_2 = 1$, so that it just grazes along the surface of separation.

[2017]

Q39. (a) Draw a ray diagram to show the image formation by a combination of two thin convex lenses in contact. Obtain the expression for the power of this combination in terms of the focal lengths of the lenses.

(b) A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is $\frac{3}{4}$th of the angle of prism. Calculate the speed of light in the prism.

[2017]

Q40. (i) Derive the mathematical relation between refractive indices n_1 and n_2 of two media and radius of curvature R for refraction at a convex spherical surface. Consider the object to be a point since lying on the principal axis in rarer medium of refractive index n_1 and a real image formed in the denser medium of refractive index n_2. Hence, derive lens maker's formula.

(ii) Light from a point source in air falls on a convex spherical glass surface of refractive index 1.5 and radius of curvature 20 cm. The distance of light source from the glass surface is 100 cm. At what position is the image formed?

OR

(a) Draw a labelled ray diagram to obtain the real image formed by an astronomical telescope in normal adjustment position. Define its magnifying power.

(b) You are given three lenses of power 0.5 D, 4 D and 10 D to design a telescope. (i) Which lenses should be used as objective and eyepiece? Justify your answer. (ii) Why is the aperture of the objective preferred to be large?

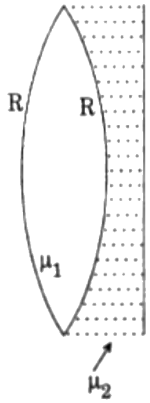
[2016]

Q41. A biconvex lens with its two faces of equal radius of curvature R is made of a transparent medium of refractive index μ_1. It is kept in contact with a medium of refractive index μ_2 as shown in the figure.

(a) Find the equivalent focal length of the combination.

(b) Obtain the condition when this combination acts as a diverging lens.

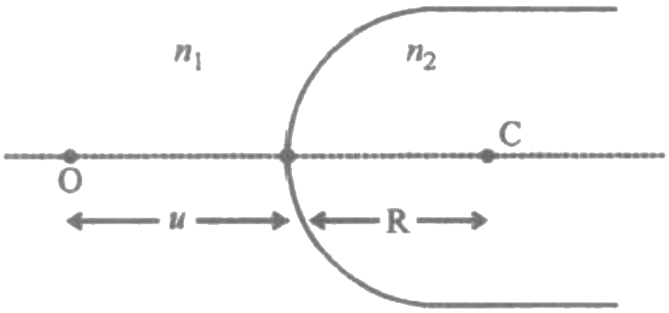
(c) Draw the ray diagram for the case $\mu_2 > (\mu_1 + 1)/2$, when the object is kept far away from the lens. Point out the nature of the image formed by the system.



[2015]

Q42. (a) A point object 'O' is kept in a medium of refractive index n_1 in front of a convex spherical surface of radius of curvature R which separates the second medium of refractive index n_2 from the first one, as shown in the figure. Draw the ray diagram showing the image formation and deduce the relationship between the object distance and the image distance in terms of n_1, n_2 and R.

(b) When the image formed above acts as a virtual object for a concave spherical surface separating the medium n_2 from n_1 ($n_2 > n_1$), draw this ray diagram and write the similar (similar to (a)) relation. Hence obtain the expression for the lens maker's formula.



[2015]

Q43. (a) Draw a ray diagram showing the image formation by a compound microscope. Hence obtain expression for total magnification when the image is formed at infinity.

(b) Distinguish between myopia and hypermetropia. Show diagrammatically how these defects can be corrected.

OR

(a) State Huygen's principle. Using this principle draw a diagram to show how a plane wave front incident at the interface of the two media gets refracted when it propagates from a rarer to a denser medium. Hence verify Snell's law of refraction.

(b) When monochromatic light travels from a rarer to a denser medium, explain the

following, giving reasons: (i) Is the frequency of reflected and refracted light same as the frequency of incident light? (ii) Does the decrease in speed imply a reduction in the energy carried by light wave?

[2013]

Q44. Define magnifying power of a telescope. Write its expression. A small telescope has an objective lens of focal length $150\,\text{cm}$ and an eye piece of focal length $5\,\text{cm}$. If this telescope is used to view a $100\,\text{m}$ high tower $3\,\text{km}$ away, find the height of the final image when it is formed $25\,\text{cm}$ away from the eye piece.

OR

How is the working of a telescope different from that of a microscope? The focal lengths of the objective and eyepiece of a microscope are $1.25\,\text{cm}$ and $5\,\text{cm}$ respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 in normal adjustment.

[2012]

Q45. (a) Draw a ray diagram to show refraction of a ray of monochromatic light passing through a glass prism. Deduce the expression for the refractive index of glass in terms of angle of prism and angle of minimum deviation.

(b) Explain briefly how the phenomenon of total internal reflection is used in fibre optics.

[2011 • Set 55-1-1]

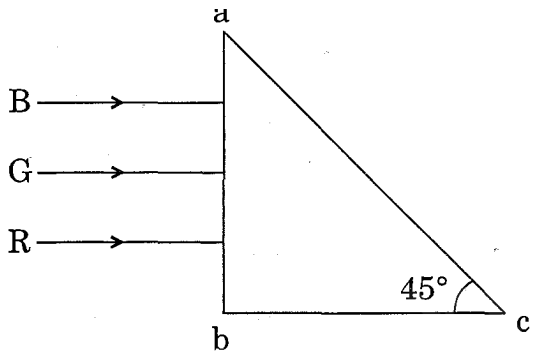
Q46. (a) Obtain lens makers formula using the expression $\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$. Here the ray of light propagating from a rarer medium of refractive index (n_1) to a denser medium of refractive index (n_2) is incident on the convex side of spherical refracting surface of radius of curvature R.

(b) Draw a ray diagram to show the image formation by a concave mirror when the object is kept between its focus and the pole. Using this diagram, derive the magnification formula for the image formed.

[2011 • Set 55-1-1]

Q47. (i) A ray of monochromatic light is incident on one of the faces of an equilateral triangular prism of refracting angle A. Trace the path of ray passing through the prism. Hence derive an expression for the refractive index of the material of the prism in terms of the angle of minimum deviation and its refracting angle.

(ii) Three light rays red (R), green (G) and blue (B) are incident on the right angled prism abc at face ab. The refractive indices of the material of the prism for red, green and blue wavelengths are respectively 1.39, 1.44 and 1.47. Trace the paths of these rays reasoning out the difference in their behaviour.



[2011 • Set 55-2-1]

Q48. Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point. In a compound microscope, an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye piece has a focal length of 5 cm and the final image is formed at the near point, estimate the magnifying power of the microscope.

[2010]

Q49. Trace the rays of light showing the formation of an image due to a point object placed on the axis of a spherical surface separating the two media of refractive indices n_1 and n_2. Establish the relation between the distances of the object, the image and the radius of curvature from the central point of the spherical surface. Hence derive the expression of the lens maker's formula.

[2009]

Q50. Draw the labelled ray diagram for the formation of image by a compound microscope. Derive the expression for the total magnification of a compound microscope. Explain why both the objective and the eyepiece of a compound microscope must have short focal lengths.

[2009]

Q51. (a) (i) Draw a labelled ray diagram to show the formation of image in an astronomical telescope for a distant object. (ii) Write three distinct advantages of a reflecting type telescope over a refracting type telescope.

(b) A convex lens of focal length $10\ cm$ is placed coaxially $5\ cm$ away from a concave lens of focal length $10\ cm$. If an object is placed $30\ cm$ in front of the convex lens, find the position of the final image formed by the combined system.

[2009]

Q52. (a) With the help of a suitable ray diagram, derive the mirror formula for a concave mirror.

(b) The near point of a hypermetropic person is $50\ cm$ from the eye. What is the power

of the lens required to enable the person to read clearly a book held at $25\ cm$ from the eye?

[2009]

Q53. (a) For a ray of light traveling from a denser medium of refractive index n_1 to a rarer medium of refractive index n_2, prove that $\frac{n_2}{n_1} = \sin i_c$, where i_c is the critical angle of incidence for the media.

(b) Explain with the help of a diagram, how the above principle is used for transmission of video signals using optical fibres.

[2008]

Q54. Draw a labeled ray diagram of a compound microscope and write an expression for its magnifying power. The focal lengths of the objective and eye-lens of a compound microscope are $2\ cm$, $6.25\ cm$ respectively. The distance between the lenses is $15\ cm$. (i) How far from the objective lens will the object be kept, so as to obtain the final image at the near point of the eye? (ii) Also calculate its magnifying power.

[2008]

Q55. Draw a labeled ray diagram of an astronomical telescope, in the normal adjustment position and write the expression for its magnifying power. An astronomical telescope uses an objective lens of focal length $15\ cm$ and eye-lens of focal length $1\ cm$. What is the angular magnification of the telescope? If this telescope is used to view Moon, what is the diameter of the image of Moon formed by the objective lens? (Diameter of Moon = $3.5 \times 10^6\ m$ and Radius of lunar orbit = $3.8 \times 10^8\ m$)

[2008]

Q56. With the help of a ray diagram, show the formation of image of a point object by refraction of light at a spherical surface separating two media of refractive indices n_1 and n_2 ($n_2 > n_1$) respectively. Using this diagram, derive the relation:

$$\frac{\{}{n}\_2\}\{v\} - \frac{\{}{n}\_1\}\{u\} = \frac{\{}{n}\_2 - n\_1\}\{R\}$$

Write the sign conventions used. What happens to the focal length of a convex lens when it is immersed in water?

[2004]

Q57. Derive the relation between distance of object, distance of image and radius of curvature of a convex spherical surface, when refraction takes place from a rarer medium of refractive index n_1 to a denser medium of refractive index n_2 and the image produced is real. State assumptions and convention of signs used.

[2003]

Q58. Draw a ray diagram to show the formation of image of an object placed between the optical centre and focus of the convex lens. Write the characteristics of image formed. Using this diagram, derive the relation between object distance, image distance and focal length of the convex lens. Write the assumptions and convention of signs used.

[2003]