PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

RAY OPTICS

Sample problem(b)

1. If refractive indices of glass and water with respect to air are $3/2$ and $4/3$ respectively, what is the refractive index of glass with respect to water ?

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2. The wavelength of sodium light in air is 589 nm. (a) Find its frquency in air. (b) Find its wavelength in water (refactive index = 1.33). (c) find its frequency in water : (d) Find its speed in water.

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3. A small ink dot on a paper is viewed through a glass slab of thickness $10cm$, and refractive index 1.5. By what distance would the dot appear to be raised ?

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4. Calculate the minimum angle of incidence so that a ray travelling from glass $(\mu = 3/2)$ to water $(\mu = 4/3)$ does not emerge out in water.

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5. In the ray diagram shown here, calculate the speed of light in the liquid of unknown refractive index.

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6. What curvature must be given to the bounding concave surface of refracting medium $(\mu = 3/2)$ for a virtual image at $40cm$ of an object in this medium at a distance of $60cm$. The adjoining medium is air $(\mu = 1)$.

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7. A small point objects is placed in air at a distance of $60cm$ from a convex spherical refractive surface of $\mu = 1.5$. If radius of curvature of spherical surface is $25m$, calculate the position of the image and the power of the refracting surface.

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8. The radii of curvature of the surfaces of a double convex lens are $20cm$ and $40cm$ respectively, and its focal length is $20cm$. What is the refractive index of the material of the lens ?

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

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10. A diverging lens of focal length $15cm$ forms an image $10cm$ from the lens. Calculate the distance of the object from the lens, given $\mu = 1.5$. What is the linear magnification of the image ?

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11. Two lenses are placed in contact with each other and the focal length of combination is $80cm$. If the focal length of one is $20cm$, then the power of the other will be

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Sample problem(c)

1. Calculate the deviation produced by a prism of angle 6°, given refractive index of the material of the prism is 1.644.

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2. A ray of light falling at an angle of 50° is refracted through a prism and suffers minimum deviation. The angle of the prism is 60°. Find the angle of minimum deviation and refraction index of the material of the prism.

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3. Calculate the dispersive power for crown glass from the given data

$\mu_v = 1.523$ and $\mu_r = 1.5145$.

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Sample problem(d)

1. A man's shortest distance of distinct vision is $20cm$. What wil be the type and power of the spectacle lens which he would he would require to enable him to read a book at a distance of $60cm$?

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2. A person's far point is at $2m$. Find nature, focal length and power of the lens he must use to see distant objects clearly.

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3. Calculate the maximum magnifying power of a simple microscope consisting of a convex lens of focal length $5cm$. Distance of distinct vision is $25cm$.

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4. An astronomical telescope of magnifying power 7 consists of two thin lenses $40cm$ apart, in normal adjustment. Calculate the focal lengths of the lenses.

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5. In an astronomical telescope, focal length of eye piece is $5cm$ and focal length of objective is $75cm$. The final image is formed at the least distance of distinct vision $(\;=25cm)$ from the eye. What is the magnifying power of the telescope ?

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Solved Example(b)

1. A light of wavelength $6000A$ in air, enters a medium with refractive index 1.5 Inside the medium its frequency is....Hz and its wavelength is ....A

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2. What is the speed of light in glass of refractive index 1.5 ? Given speed of light in water is $2.25 \times 10^8 m/s$ and refractive index of water is 1.3.

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3. A rectangular glass slab rests at the bottom of a trough of water. A ray of light incident on water surface at an angle of 50° passes through water into glass. What is angle of refraction in glass ? Take μ for water $4/3$ and μ for glass $3/2$.

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4. What is the apparent position of an object below a rectangular block of glass $6cm$ thick, if a layer of water $4cm$ thick is on the top of the glass ? Given $\hat{}(a)\mu_g = 3/2 \text{ and } {}^a\mu_w = 4/3$.

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5. A ray of light is incident at an angle of 45° on one face of a rectangular glass slab of thickness $10cm$ and refractive index 1.5. Calculate the lateral shift produced.

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6. Refractive indices of water an glass are $4/3$ and $3/2$ respectively. A ray of light travelling in water is incident on the water glass interface at 30°. Calculate the angle of refraction.

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7. A ray PQ is incident normally on the refracting face of 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 and at what angle ? Justify your answer.

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8. A transparent cube of side $210mm$ contains a small air bubble. Its apparent distance, when viewed from one face of the cube is $100mm$, and when viewed through opposite face is $40mm$. What is the actual distance of the bubble from the second face and what is the refractive index of the material of the cube ?

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9. Refractive indices of water an glass are $4/3 \text{ and } 3/2$ respectively. A ray of light travelling in water is incident on the water glass interface at 30°. Calculate the angle of refraction.

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10. Calculate the speed of light in a medium whose critical angle is 30°.

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11. The critical angle of incidence in a glass slab placed in air is 45°. What will be be the critical angle when the glass slab is immersed in water of refractive index 1.33 ?

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12. Determine the direction in which a fish under water sees the setting sun. Given, for water $\mu = 1.33$.

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13. The refractive index of water is $4/3$. Determine the angle of the cone within which the entire outside view will be confined for a fish under water.

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14. A point source of light S is placed at the bottom of a vessel containing a liquid of refractive index $5/3$. A person is viewing the source from above the surface. There is an opaque disc of radius $1cm$ floating on the surface. The centre of disc lies vertically above the source O. The liquid from the vessel is gradually drained out through a tap. What is the maximum height of the liquid for which the source cannot be seen at all.

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15. Determine the critical angle for a glass interface, if a ray of light, which is incident in air on the surface is deviated through 15°, when its angle of incidence is 40°.

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16. Calculate the critical angle foe total internal reflection of light travelling from

(i) water into air

(ii) glass into water. Given, $.^a\mu_w = 1.33$ and $.^a\mu_g = 1.5$.

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17. One face of a prism of refractive index 1.5 and angle 75° is covered with a liquid of refractive index $\frac{3\sqrt{2}}{4}$. What should be the angle of incidence of light on the clear face of prism for which light is just totally reflected at the liquid covered face ?

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18. Calculate the critical angle for a glass air interface, if a ray of light incident in air on the surface is deviated through 15°, when its angle of incidence is 40°.

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19. A glass dumbbell of length $30cm$ and refractive index 1.5 has ends of radius of curvature $3cm$. A point object is situated at a distance of $12cm$

from one end of dumbbell. Find the position of the image formed due to refraction ai one end only.

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20. A mark placed on the surface of a sphere is viewed through glass from a position directly opposite. If the diameter of the sphere is $10cm$ and refractive index of glass is 1.5, find the position of the image.

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21. Light from a point source in air falls on a convex spherical glass surface $(\mu = 1.5 \text{ and } R = 20cm)$. Calculate position of the image when the light source is at $1m$ from the glass surface.

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22. An empty spherical flask of diameter $15cm$ is placed in water of $\mu = 4/3$. A parallel beam of light strikes the flask. Where does it get focussed, when observed from within the flask ?

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23. Light from a point source in air falls on a convex spherical glass surface $(\mu = 1.5 \text{ and } R = 20cm)$. Calculate position of the image when the light source is at $1m$ from the glass surface.

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24. What curvature must be given to the bounding surface of $\mu = 1.5$ for virtual image of an object in the medium of $\mu = 1at10cm$ to be formed at a distance of $40cm$. Calculate power of the refracting surface and also two principal focal lengths of the surface.

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25. A sunshine recorder globe of $30cm$ diameter is made of glass of $\mu = 1.5$. A ray enters the globe parallel to its axis. Find the position from the centre of the sphere, where the ray crosses the axis.

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26. A biconvex lens has focal length $\frac{2}{3}$ times the radius of curvature of either surface. Calculate refraction index f material of the lens.

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27. Shows a thin lens with centres of curvature C_1 and C_2. If $\mu = 1.5$, what is its focal length ?

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28. A diverging lens of refractive index 1.5 and focal length $15cm$ in air has same radii of curvature for both sides. If it is immersed in a liquid of refractive index 1.7, calculate focal length of the lens in liquid.

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29. A double convex lens made of glass of refractive index 1.56 has both radii of curvature of magnitude $20cm$. If an object is placed at a distance of $10cm$ from this lens, find the position of image formed.

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30. Find the radius of curvature of convex surface of a plano convex lens, whose focal length is $0.3m$ and $\mu = 1.5$.

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31. A magician during a show makes a glass lens $\mu = 1.5$ disappear in a through of liquid. What is the refractive index of the liquid ? Is the liquid water ?

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32. The focal length of an equiconvex lens is equal to radius of curvature of either surface. What is the refractive index of the material of the prism ?

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33. Explain what happens when a convex lens of refractive index 1.2 is immersed in a liquid of refractive index 1.3.

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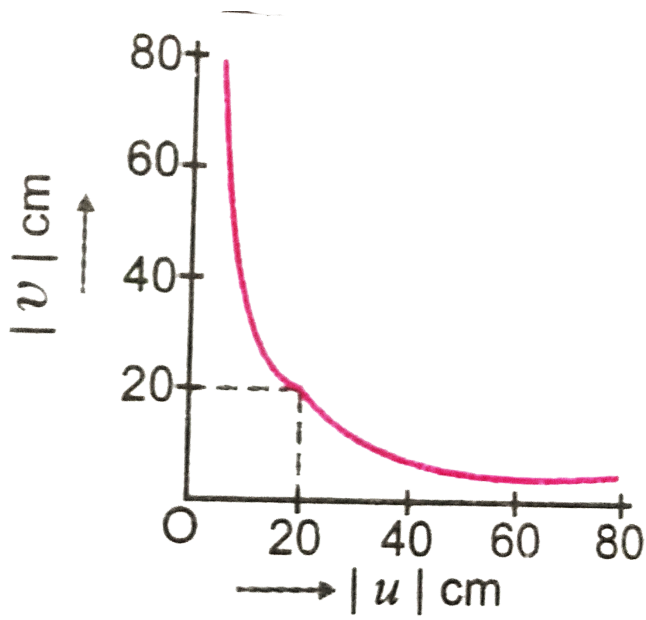
34. The graph in shows the variation of image distance (v) with object distance (u) in case of a lens. Find focal length of the lens. What is the nature of the lens, if image formed is real ?



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35. At what distance should an object be placed from a convex lens of focal langth $15cm$ to obtain an image three times the size of the object ?

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36. The image obtained with a convex lens is erect and its length is 4 times the length of the object. If the focal length of lens is $20cm$, calculate the object and image distances.

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37. An illuminated object and a screen are placed $90cm$ apart. What is the focal length and nature of the lens required to produce a clear image on the screen twice the size of the object ?

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38. A convergent beam of light passes through a diverging lens of focal length $0.2m$ and comes to focus at a distance of $0.3m$ behind the lens. Find the position of the point at which the beam would converge in the absence of the lens.

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39. The image obtained with a convex lens is erect and its length is 4 times the length of the object. If the focal length of lens is $20cm$, calculate the object and image distances.

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40. A converging lens of focal length $50cm$ is placed co-axially in contact with another lens of unknown focal length. If the combination behaves like a diverging lens of focal length $50cm$, find the power and nature of second lens.

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41. Two lens of power $+15D$ and $-5D$ are in contact with each other. What is the focal length of the combination ? What would be the position of image formed by the combination for an object at $30cm$?

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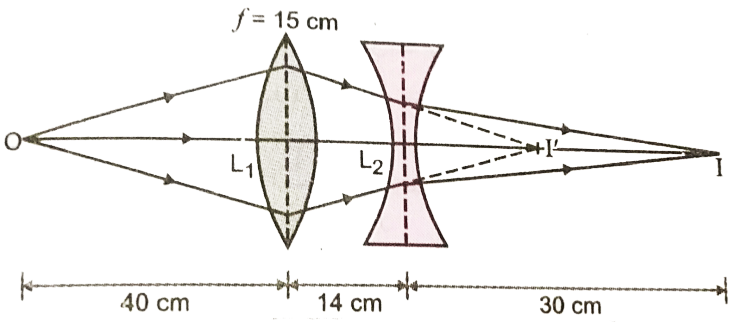
42. Use the following ray diagram, Fig. to calculate focal length of lens L_2.



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43. A convex lens of focal length $10cm$ is placed co-axially $5cm$ away from a concave lens of focal length $10cm$. If an object is placed $30cm$ in front of the convex lens, find the position of final image formed by the combined system.

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44. A concave lens is placed in contact with a convex lens of focal length $25cm$. The combination produces a real image at a distance of $80cm$, when an object is at a distance of $40cm$. What is the focal length of concave lens ?

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45. (i) If $f = +0.5m$, what is the power of the lens ?

(ii) The radii of curvature of the faces of a double convex lens are $9cm$ and $15cm$. Its focal length is $12cm$. What is the refractive index of glass ?

(iii) A convex lens has $20cm$ focal length in air. What is the focal length in water ? (Refractive index of air-water $= 1.33$, refractive index of air-glass $= 1.5$).

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46. A real image of an object is formed at a distance of $20cm$ from a lens. On putting another lens in contact with it, the image is shifted $10cm$ towards the combination, Determine the power of the second lens.

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47. A convex lens of focal length $30cm$ and a concave lens of focal length $60cm$ are placed in combination. If an object is placed $40cm$ away from the combination, find the position of the image.

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48. A double convex lens of $+5D$ is made of glass of refractive index 1.5 with both faces of equal radii of curvature. Find the value of curvature.

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

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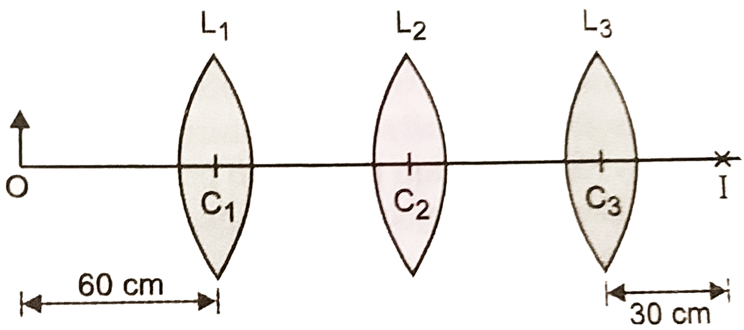
50. Three lenses L_1, L_2, L_3 each of focal length $30cm$ are placed co-axially as shown in (Fig. 11(b).57).

An object is held at $60cm$ from the optic centre of lens L_1. The final real image is formed at the focus of L_3. Calculate separation between

(i) L_1 and L_3

(ii) L_2 and L_3 ?



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51. A convex lens is placed in contact with a plane mirror. An axial point object at a distance of $20cm$ from this combination, has its image coinciding with itself. What is the focal length of the convex lens ?

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52. A convex lens and a convex mirror of radius of curvature $20cm$ are placed co-axially with the convex mirror placed at a distance of $30cm$ from the lens. For a point object at a distance of $25cm$ from the lens, the final image due to this combination coincides with the object itself. What is the focal length of convex lens ?

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53. A convex lens of focal length $20cm$ is placed co-axially with a convex mirrir of radius of curvature $20cm$. The two are kept $15cm$ apart from eachother. A point object is placed $60cm$ in front of the convex lens. Find the position of the image formed by the combination.

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54. A convex lens of focal length $20cm$ and a convex mirror of focal length $10cm$ are placed co-axially $50cm$ apart from each other. An incident beam parallel to its principal axis is incideent on the convex lens. Locate the position of final image formed due to the combination.

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55. An object is placed $15cm$ in front of a convex lens of focal length $10cm$. Find the nature and position of image formed. Where should a concave mirror of radius of curvature $20cm$ be placed so that the final image is formed on the position of the object itself ?

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56. A thin convergent glass lens $(\mu_g = 1.5)$ has a power of $+5.0D$. When this lens is immersed in a liquid of refractive index μ_1, it acts as a divergent lens of focal length $100cm$. The value of μ_1 is

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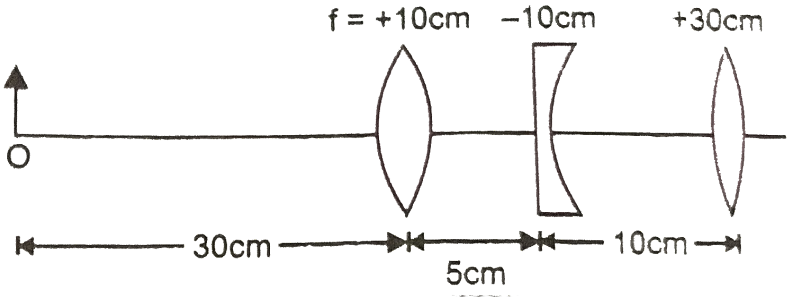
57. Find the position of the image formed by the lens combination given in Fig.



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58. One face of a glass cube of side $0.06m$ from the face opposite to the silvered face. Looking from the object side, the image of the object appears to be $0.11m$ behind the silvered face. Calculate the refractive index of material of glass.

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59. Radius of curvature of an equiconvex lans is $0.2m$. Its refractive index is 1.5 . Calculate its focal length. If two such lenses are kept separated with common principal axis by a distance of $0.2m$, what will be the effective focal length of the combination ?

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60. Using the following data, calculate refractive index of the material of convex lens. Radii of curvature of both the surfacea are $0.2m$.Data recorded in the displacement//shift method to determine focal length of convex lens is shown here.

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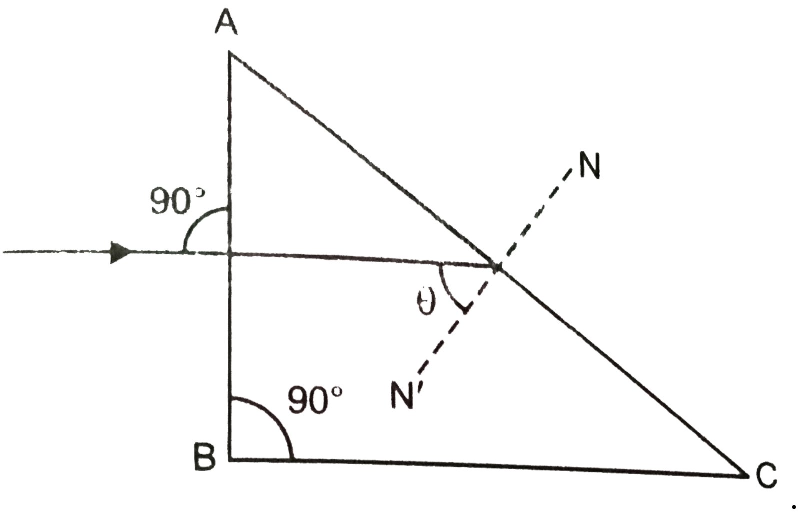
61. A beam of light of wavelength $400nm$ is incident normally on a right angled prism as shown in Fig.

It is observed that light just grazes along the surface AC after falling on it. If refractive index μ of the material of prism varies with wavelength

λ as $\mu = 1.2 + \dfrac{b}{\lambda^2}$

Calculate the value of b and μ of prism material for $\lambda = 500 nm$. Given $\theta = \sin^{-1}(0.625)$.



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Solved Example(c)

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

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2. A ray of light incident on an equilateral triangular glass prism of $\mu = \sqrt{3}$ moves parallel to the base of the prism inside it. What is the angle of incidence for this ray ?

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3. A thin prism of refracting angle 2° deviates an incident ray through an angle of 1°.Find the value of refractive index of material of prism.

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4. The angle of minimum deviation for prism of angle $\pi/3 is \pi/6$. Calculate the velocity of light in the material of the prism if the velocity of light in vacuum is $3 \times 10^8 ms^{-1}$.

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5. A ray of light passes through an equilateral prism (refractive index 1.5) such that angle of incidence is equal to angle of emergence and the latter is equal to $3/4th$ of the angle of prism. Calculate the angle of deviation.

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6. A prism of refractive index 1.53 is placed in water of refractive index 1.33. If the angle of prism is 60°, calculate the angle of minimum deviation in water.

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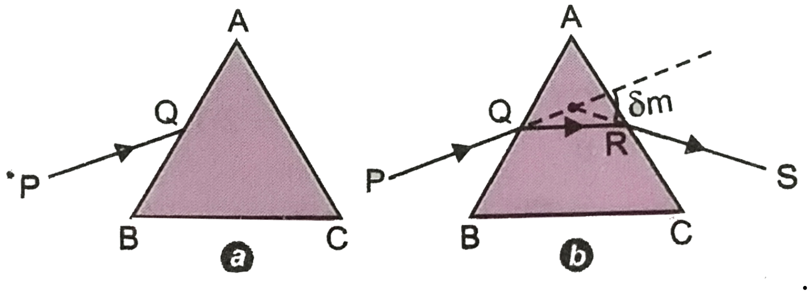
7. A ray PQ incident on face AB of a prism ABC, as shown in Fig., emerges from the face AC such that $AQ = AR$. Draw the ray diagram showing the pasage of the ray through the prism. If the angle of prism is 60° and refractive index of the material of the prism is $\sqrt{3}$, determine the values of angle of incidence and angle of deviation.



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8. A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of $306\,\circ$ .Calculate the speed of light through the prism.

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9. In the above example, find the angle of incidence at face AB, so that emergent ray grazes along the face AC'.

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10. White light its passed through a prism of 5°. If refractive indices for red and blue rays are 1.641 and 1.659 respectively, calculate the angular dispersion of the prism.

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11. Calculate the dispersive power for crown and flint glass prisms from the following data : For crown glass, $m_b = 1.522$, $m_r = 1.514$. For flint glass, $\mu'_b = 1.662$, $\mu'_r = 1.644$.

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12. In a certain spectrum produced by a glass prism of dispersive power 0.031, it was found that $\mu_r = 1.645$ and $\mu_b = 1.665$. What is the refractive index for yellow colour ?

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13. A combination of two prisms, one of flint and other of crown glass produces dispersion without deviation. The angle of flint glass prism is 15°. Calculate the angle of crown glass prism and angular separation of red and violet rays on emergence from the spectroscope. (μ for crown glass $= 1.52$, μ for flint glass $= 1.65$, ω for crown glass $= 0.02$, ω for flint glass $= 0.03$).

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14. A crown glass prism of refracting angle 6° is to be achromatised fro red and blue light using a flint glass prism. Find the angle of flint glass prism and also, the mean deviation from the following data :

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15. A crown glass prism of refracting angle $A = 6^\circ$ is to be achromatised for red and blue light using a flint glass prism. Find the angle of flint glass prism (A') and also, the mean deviation from the following data :

$\mu_b = 1.531 \, \mu_r = 1.520 \, \mu'_b = 1.684 \, \mu'_r = 1.662$

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16. An equilateral glass prism $(\mu - 1.6)$ is immersed in water $(\mu = 1.33)$. Calculate the angle of deviation produced for a ray of light incident at 40° on one face of the prism.

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17. A ray of light is incident at an angle of 60° on the face of a prism having refracting angle 30°. The ray emerging out of the prism makes an angle 30° with the incident ray. Show that the emergent ray is perpendicular to the face through which it emerges and calculate the refractive index of the material of prism.

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18. A 60° prism has a refractive index of 1.5. Calculate (a) the angle of incidence for minimum deviation (b) angle of minimum deviation (c) the angle of emergence of light at maximum deviation (d) angle of maximum deviation.

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19. In a spectrometer experiment, the angle of minimum deviation was found to be 48.6°. What is the percentage accuracy in the measurement of refractive index of the prism ? Given least count of spectrometer $= 0.2^{\circ}$ and angle of prism $= 60^{\circ}$.

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20. A prism is made of glass of unknown refractive index. A parallel beam of light is incident on a face of the prism. By rotating the prism, the minimum angle of deviation is measured to be 40°. What is the refractive index of the prism ? If the prism is placed in water $(\mu = 1.33)$, predict the new angle of minimum deviation of the parallel beam. The refracting angle of prism is 60°.

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21. 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.

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Solved Example(d)

1. A person wears glasses of power $-2.5D$. Is the person short sighted or long sighted ? What is the far point of the person without glasses ?

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2. The near point of a hypermetropic person is $50cm$ from the eye. What is the power of the lens required to enable him to read clearly a book held at $25cm$ from the eye ?

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3. The far point of a myopic person is $150cm$ in front of the eye. Calculate the focal length and power of a lens required to enable him to see distant objects clearly.

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4. A person wears eye glasses with a power of $-5.5D$ for distance viewing. His doctor prescribes a correction of $+1.5D$ for his near vision. What is the focal length of his distance viewing part of the lens and also for near vision section of the lens ?

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5. A hypermetropic person whose near point is at $100cm$ wants to read a book at $25cm$. Find the nature and power of the lens needed.

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6. What focal length should the reading spectacles have for a person whose near point is $50cm$?

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7. A short sighted person can see objects most distinctly of $16cm$. If he wears spectacles at a distance of $1cm$ from the eye, what focal length should he have so as to enable him to see distinctly at a distance of $26cm$?

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8. (a) The far point of a myopic person is $80cm$. In front of the eye. What is the power of the lens required to enable him to see very distant objects clearly ?

(b) In what way does the corrective lens help the person above ? Does the lens magnify very distant objects ? Explain carefully.

(c) The person above prefers to remove his spectacles while reading a book. Explain why ?

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9. (a) The near point of a hypermetropic person is at $75cm$ from the eye. What is the power of the lens required to enable him to read clearly a book held at $25cm$ from the eye ?

(b) In what way does the corrective lens help the person above ? Does the lens magnify objects held near the eye ?

(c) The person above prefers to remove his spectacles while looking at the sky. Explain why ?

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10. (a) A person can see clearly upto $80cm$. He uses spectacles of $-0.80 dioptre$, how far can he see clearly ?

(b) If a person uses spectacles of power $+1.0 dioptre$, what is the nearest distance of distinct vision for him ? Given that near point of the person is $75cm$ from the eye.

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11. A certain person can see clearly objects lying between $20cm$ and $250cm$ from his eye. What spectacles are required to enable him to see distant objects clearly ? When he is wearing these spectacles, what is his least distance of distinct vision ?

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12. A simple microscope is a combination of two leses of powers $+15D$ and $+5D$ in contact. Calculate magnifying power of microscope,

if final image is formed at $25cm$ from the eye.

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13. A child has near point at $10cm$. What is the maximum angular magnification the child can have with a convex lens of focal length $10cm$?

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14. The focal lengths of objective and eye piece of a microscope are $1.25cm$ and $5cm$ respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 in normal adjustment.

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15. A compound microscope with an objective of $1.0cm$ focal length and an eye piece of $2.0cm$ focal length has a tube length of $20cm$. Calculate the magnifying power of microscope is final image is formed at the near point of eye.

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16. A compound microscope uses an objective lens of focal length $4cm$ and eye lens of focal length $10cm$. An object is placed at $6cm$ from the objective lens. Calculate magnifying power of compound microscope if final image is formed at the near point. Also, calculate length of the tube of compound microscope.

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17. A man with normal near point (25 cm) reads a book with small print using a magnifying glass : a thin convex lens of focal length $5cm$.

(a) What are the closest and the farthest distances at which he can read the book when viewing through the magnifying glass ?

(b) What is the maximum and the minimum angular magnifications (magnifying powers) possible using the above simple microscope ?

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18. You are given two converging lenses of focal lengths 1.25 cm and 5cm to design a compaound microscope.if it is desired to have a magnification of 30, find out the separation between the object and the eyepiece.

or

A small telescope has an objective lens of focal length 150 cm and eyepiece of focal length 5 cm. What is the magnifying of the telescope for viewing distant objects on normal adjustment ?

If this telescope is used to view a 100 m tall tower 3 km away, what is the height of the image of the tower formed 3km away, what is the height of the image of the tower formed by the objective lens ?

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19. A person uses $+1.5D$ glasses to have normal vision from $25cm$ onwards. He uses a $20D$ lens as a simple microscope to see an object. Calculate the maximum magnifying power, if he uses the microscope

(a) together with his glasses

(b) without the glasses.

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20. A compound microscope has an objective of focal length 1 cm and an eyepiece of focal length 2.5 cm. An object has to be placed at a distance of 1.2 cm away from the objective for normal adjustment. a.Find the angular magnification. b.Find the length of the microscope tube.

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21. 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 eye piece is observed to be $14cm$. If least distance of distinct vision is $20cm$, calculate the focal length of objective and eye piece.

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22. The focal lengths of the objective and eye piece of a compound microscope are $4cm$ and $6cm$ respectively. If an object is placed at a distance of $6cm$ from the objective, calculate the magnification produced by the microscope. Take distance of distinct vision $= 25cm$.

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23. An astronomical telescope consists of the thin lenses, $36cm$ apart and has a magnifying power 8. Calculate the focal length of lenses. Two stars have an actual separation of one minute of arc. Find the angle of separation as seen through the telescope.

Watch Video Solution

24. A small telescope has an objective lens of focal length $150cm$ and and eye piece of focal length $5cm$. If his telescope is used to view a $100m$ high tower $3km$ away, find the height of the final image when it is formed $25cm$ away from the eye piece.

Watch Video Solution

25. The diameter of the moon is $3.5 \times 10^3 km$ and its distance from the earth is $3.8 \times 10^5 km$. It is viewed by a telescope which $10cm$. Find the angle subtended at the eye by the final image.

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26. An astronomical telescope has a magnifying power of 10. In normal adjustment, distance between the objective and eye piece is $22cm$ calculate focal length of objective lens.

Watch Video Solution

27. A telescope has an objective of focal length $50cm$ and eye piece of focal length $5cm$. The least distance of distinct vision is $25cm$. The telescope is focussed for distinct vision on a scale $200cm$ away from the objective. Calculate

(i) the separation between objective and eye piece

(ii) the magnification produced.

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28. In an astronomical telescope, focal length of objective lens is $75cm$ and that of eye piece is $5cm$. Calculate the magnifying power and the distance between the two lenses, when final image of distant object is seen at a distance of $25cm$ from the eye.

Watch Video Solution

29. A telescope has an objective of focal length $30cm$ and an eye piece of focal length $3.0cm$. It is focussed on a scale distant $2.0m$. For seeing with relaxed aye, calculate the separation between the objective and eye piece.

Watch Video Solution

30. The focal lengths of the objective and eye piece of an astronomical telescope are $25cm$ and $2.5cm$ respectively. The telescope is fucussed on an object $1.5m$ from objective, the final image being formed $25cm$ from eye of the observer. Calculate the length of the telescope.

Watch Video Solution

31. The separation between the eye piece of focal length $0.3m$ and objective of focal length $0.4m$ of a microscope is $0.2m$. The eye piece and objective are to be interchanged such that the angular magnification of the instrument remains the same. What is the new separation between the lenses ?

Watch Video Solution

32. A reflecting type telescope has a large concave spherical mirror of radius of curvature $80cm$ as objective. What is the magnifying power of telescope if eye piece used has a focal length of $1.6cm$?

Watch Video Solution

Conceptual problem(b)

1. Why does a ray of light bend towards normal as it passes from air to glass ?

Watch Video Solution

2. How do the frequency and wavelength of light change when it goes from a rarer to a denser medium ?

Watch Video Solution

3. Can the relative refractive index of a medium w.r.t. another medium be less than unity ?

Watch Video Solution

4. Can the absolute value of refractive index of a medium be less than unity ?

Watch Video Solution

5. When light comes from air to glass, the refracted ray is bent towards the normal. Why ?

Watch Video Solution

6. If a plane glass slab is placed on letters of different colours, then red coloured letter appears to be raised minimum, why ?

Watch Video Solution

7. The critical angle for glass air interface is C and for glass water interface is c'. How are C and C' related ?

Watch Video Solution

8. Why does a diamond shine ?

Watch Video Solution

9. Explain why

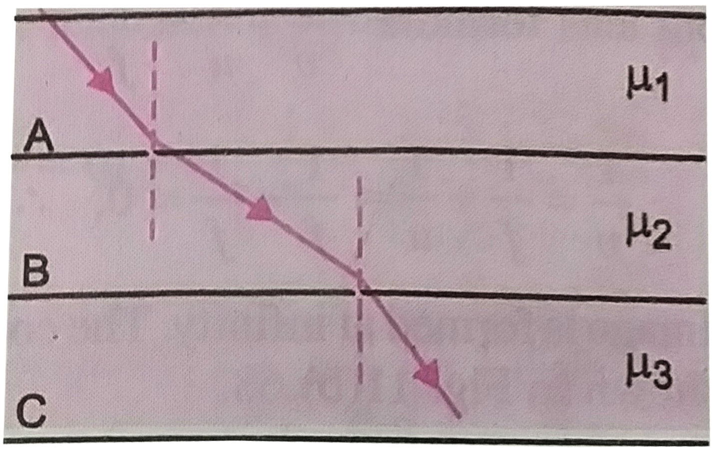
(a) A diamond glitters in a brightly lit room, but not in a dark room.

(b) A crack in a window pane appears silvery.

(c) The bubbles of air rising up in a water tank appear silvery when viewed from top.

Watch Video Solution

10. Path of ray of light passing through three liquids of refractive indices μ_1, μ_2, μ_3 is as shown in Fig. Which liquid has the smallest index of refraction ?



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11. A ray of light after refraction through a concave lens becomes parallel to the principal axis after refraction through the concave lens. Explain with a ray diagram when this can happen.

Watch Video Solution

12. The surfaces of the sun glasses (goggles) are curved, yet their power may be zero. Why ?

Watch Video Solution

13. Calculate the position of the image of an object when placed at

(a) focus of a convex lens.

(b) focus of a convex lens.

Watch Video Solution

14. A concave lens made of a material of refractive index n_1 is kept in a medium of refractive index n_2. A parallel beam of light is incident on the lens. Complete the path of rays of light emerging from the concave lens (i) $n_1 > n_2$ (ii) $n_1 = n_2$ (iii) $n_1 < n_2$.

Watch Video Solution

15. Following data was recorded for values of object distance and the corresponding values of image distance, in the study of real image formation by a convex lens of power $+5D$. One of these observations is incorrect. Identify and give reason :

$(\text{S.No}, 1, 2, 3, 4, 5, 6), (\text{Object distance (cm)}, 25, 30, 35, 45, 50, 55), (\text{Image}$

Watch Video Solution

16. A thin lens focal length f_1 and its aperture has diameter d. It forms an image of intensity I. Now the central part of the aperture up to diameter $\frac{d}{2}$ is blocked by an opaque paper. The focal length and image intensity will change to

Watch Video Solution

17. When does a convex lens behave as a concave lens ?

Watch Video Solution

18. A lens immersed in a transparent liquid becomes invisible. Under what condition does it happen ?

Watch Video Solution

19. A lens is forming the image of an object on its axis. If the lens is placed with its faces reversed, will the position of image change ?

Watch Video Solution

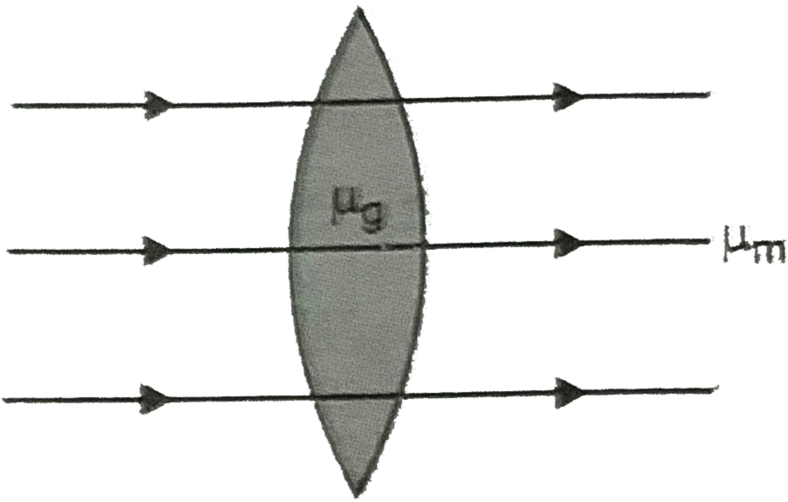
20. What happens to focal length of a convex lens when it is immersed in water ?

Watch Video Solution

21. The radii of curvature of both the surfaces of a lens are equal. How will its focal length and power change if one of the surfaces of the lens is made plane ?

Watch Video Solution

22. A convex lens of refractive index μ_g is held in a reansparent medium of refractive index μ_m If course of rays is as shown in Fig., how are μ_g and μ_m related ?



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Conceptual problem(c)

1. Why is there no dispersion of light refracted through a rectangular glass slab ?

Watch Video Solution

2. A ray of light falls normally on one face of a prism of angle 45°. If critical angle for material of the prism is 45°, trace the course of rays, calculate μ.

Watch Video Solution

3. Does a beam of white light give a spectrum on passing through a hollow prism ?

Watch Video Solution

4. What colour do you observe when white light passes through a blue and yellow filter ?

Watch Video Solution

5. Why does clear sky appear blue ?

Watch Video Solution

6. Why do clouds generally look white ?

Watch Video Solution

7. The sun looks reddish at the time of sunrise and sunset.

Watch Video Solution

8. What is the cause of the blue colour of ocean ?

Watch Video Solution

Conceptual problem(d)

1. Why do some people use bifocal lenses ?

Watch Video Solution

2. A girl is using speces of $f = -50cm$. Name the defect of her vision and calculate power of lens to be used.

Watch Video Solution

3. Why has nature given us two eyes instead of one ?

Watch Video Solution

4. The diameter of the sun is $\approx 10^9 m$, but it appears to be a small disc, why ?

Watch Video Solution

5. The diameter of sun is several hundred times bugger than the moon, still at the time of solar eclips, the entire sun is covered by the moon. How ?

Watch Video Solution

6. What are anastigmatic lenses ?

Watch Video Solution

7. Why should the objective of a microscope be of small aperture ?

View Text Solution

8. A telescope has been adjusted for relaxed eye. How will you change the distance between objective lens and eye if final image is to be seen at the least distance of distinct vision ?

Watch Video Solution

9. How will you distinguish between a compound microscope and a telescope just by looking at them ?

Watch Video Solution

10. By increasing the diameter of the objective of telescope, we can increase its range, why ?

Watch Video Solution

11. How does magnifying power change with change in length of tube for a given telescope ?

Watch Video Solution

12. How does magnifying power change with change in length of tube for a given telescope ?

Watch Video Solution

13. (a) List some advantanges of a reflecting telescope, especially for high resolution astronomy.

(b) A reflecting type telescope has a large mirror for its objective with radius of curvature equal to $80cm$. What is the magnifying power of telescope if eye piece used has a focal length of $1.6cm$?

Watch Video Solution

14. The objective of telescope A has a diameter 3 times that of the objective of telescope B. How much greater amount of light is gathered by A compared to B ? Show that range of A is three times the range of B.

Watch Video Solution

Very Short Answer (b)

1. What is refraction ?

Watch Video Solution

2. State the factors on which refractive index of a medium depend ?

Watch Video Solution

3. For which medium is refractive index maximum ?

Watch Video Solution

4. For which medium is refractive index minimum ?

Watch Video Solution

5. When does Snell's Law of refraction fail ?

Watch Video Solution

6. On what factors lateral shift of a ray on passing through a glass slab depend ?

Watch Video Solution

7. Can total internal reflection occur when light goes from a rarer to a denser medium.

Watch Video Solution

8. Which one has a greater critical angle diamond or glass ?

Watch Video Solution

9. What is the relation between refractive index and critical angle for a given pair of optical media ?

Watch Video Solution

10. Define Snell's law of refraction.

Watch Video Solution

11. Does critical angle depend on colour of light ?

Watch Video Solution

12. What is the cause of refraction of light ?

Watch Video Solution

13. What is critical angle for a material of refractive index $\sqrt{2}$?

Watch Video Solution

14. A beam of light is converging towards a certain point. A parallel sided glass plate is introduced in the path of the converging beam. How will the point of convergence be shifted ?

Watch Video Solution

15. What is the basis of an optical fibre ?

Watch Video Solution

16. Determine refractive index of a substance if critical angle is 45°.

Watch Video Solution

17. What is the ratio of velocities of two light waves travelling in vacuum and having wavelength 4000Å and 8000Å ?

Watch Video Solution

18. What type of lens is a tumbler filled with water ?

Watch Video Solution

19. What type of lens is an air bubble inside water ?

Watch Video Solution

20. a lens of glass is immersed in water. How is power of lens affected ?

Watch Video Solution

21. a convex lens forms a virtual image of an object. What is the position of the object ?

Watch Video Solution

22. An object is placed at the focus of a concave lens. Where will be image ?

Watch Video Solution

23. A glass lens of refractive index 1.45 when immersed in a transparent liquid becomes invisible. Under what condition does it happen ?

Watch Video Solution

24. Two concave lenses each of focal length $30cm$ are placed in contact. What is focal of the compound lens ?

Watch Video Solution

25. Two thin lenses of power $+6D \text{ and } -2D$ are in contact. What is the focal length of the combination ?

Watch Video Solution

26. What is the basis of an optical fibre ?

Watch Video Solution

27. what is the deviation produced in ray passing through optical centre of the lens ?

Watch Video Solution

28. A lens forms a virtual, erect and diminished image whatever be the position of the object. Which type of lens this ?

Watch Video Solution

29. Define one dioptre of power of a lens.

Watch Video Solution

30. What is focal length of a lens of power $2.5D$?

Watch Video Solution

31. What is total magnification of three lenses of magnification $2, 3, 4$ in contact ?

Watch Video Solution

Very Short Answer (c)

1. What is the wavelength region of visible spectrum ?

Watch Video Solution

2. Is there any invisible spectrum ?

Watch Video Solution

3. For which colour, μ of material of a prism is

(i) minimum (ii) maximum ?

Watch Video Solution

4. Which colour deviates (i) most (ii) least on passing through a prism ?

Watch Video Solution

5. Which colour of the light has the longest wavelength?

Watch Video Solution

6. What is meant by dispersion of light ?

Watch Video Solution

7. What are the factors on which angular dispersion of a prism depend ?

Watch Video Solution

8. On what factors does of deviation produced by a prism depend ?

Watch Video Solution

9. What is angle of prism ?

Watch Video Solution

10. What is angle of deviation through a prism ?

Watch Video Solution

11. On what factors does of deviation produced by a prism depend ?

Watch Video Solution

12. What is the relation between angle of prism A, angle of incidence i and angle of minimum deviation δ_m ?

Watch Video Solution

13. refractive indices of glass for blue, red and yellow colours are μ_b, μ_r and μ_y. Write them in decreasing order of values.

Watch Video Solution

14. A glass prism is immersed completely in water. How does angle of minimum deviation change ?

Watch Video Solution

15. When does a ray passing through a prism deviate away from the base of the prism ?

Watch Video Solution

16. In the minimum deviation position of a prism how are angle of incidence and angle of emergence related ?

Watch Video Solution

17. In the specturm of white light through a prism, violet colour is seen at the bottom. Why ?

Watch Video Solution

18. What is the purpose of adding "blue" to clothes ?

Watch Video Solution

19. What is a pure spectrum ?

Watch Video Solution

20. Give the formula that can be used to determine refractive index of material of a prism in terms of minimum deviation position.

Watch Video Solution

21. What is an impure spectrum ?

Watch Video Solution

22. How does the speed of light in glass change

(a) on increasing the wavelength of light ?

(b) on increasing the intensity of light ?

Watch Video Solution

23. How is speed of light in vacuum affected by change in wavelength//intensity of light ?

Watch Video Solution

24. Which one, crown glass or flint glass, has a larger refractive index ?

Watch Video Solution

25. refractive indices of glass for blue, red and yellow colours are $\mu_b, \mu_r \text{ and } \mu_y$. Write them in decreasing order of values.

Watch Video Solution

26. What is the ratio of speed of IR rays and UV rays in vacuum ?

Watch Video Solution

27. Red light is incident on a converging lens of focal length f. State with reason how f will change if red light is replaced by blue light.

Watch Video Solution

Very Short Answer (d)

1. What is blind spot ?

Watch Video Solution

2. What is yellow spot ?

Watch Video Solution

3. What is meant by accommodation of the eye ?

Watch Video Solution

4. What is range of vision ?

Watch Video Solution

5. What is the least distance of distinct vision for a normal eye ? Is it the same as the distance of near point ?

Watch Video Solution

6. A short sighted person may read a book without specs. Comment.

Watch Video Solution

7. A hypermetropic person has problem in driving without specs.

Watch Video Solution

8. A person looking at a mesh of crossed wires is able to see the vertical wires more distincly than the horizontal wires. Why ? How can it be corrected ?

Watch Video Solution

9. What is meant by depth of focus ?

Watch Video Solution

10. What is visual angle ?

Watch Video Solution

11. An astronomical telescope uses lenses of power $10D$ and 1 D`. What is its magnifying power in normal adjustment ?

Watch Video Solution

12. Why is the aperture of objective lens of a telescope taken large ?

Watch Video Solution

13. Why is power of objective lens of a telescope kept as small as possible ?

Watch Video Solution

14. Why does Galilean telescope have a smaller field of view ?

Watch Video Solution

15. In which, microscope or telescope, the difference in the focal lengths of the two lenses is larger ?

Watch Video Solution

16. Why do we prefer a magnifying glass of smaller focal length ?

Watch Video Solution

17. What do you understand by normal adjustment of a telescope ?

Watch Video Solution

18. What is the distance between objective and eye lens of telescope in normal adjustment ?

Watch Video Solution

19. Objective of a compound microscope should have small focal length. Why ?

Watch Video Solution

20. why should objective of a telescope have larger focal length ?

Watch Video Solution

21. Can a terrestrial telescope be used for observing astronomical objects ?

Watch Video Solution

22. What is the main limitation of Galileo's telescope ?

Watch Video Solution

23. What is the eye ring of a telescope or microscope ?

Watch Video Solution

24. Is angular magnification of a telescope equal to ratio of diameters of objective and eye lens ?

Watch Video Solution

25. What is meant by focal plane of a lens ?

Watch Video Solution

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

Watch Video Solution

(NCERT)Very Short Answer

1. Will the focal length of a lens for red light be more, same or less than that for blue light ?

Watch Video Solution

2. The near vision of an average person is $25cm$. To view an object with an angular magnification of 10, what should be the power of the microscope ?

Watch Video Solution

3. An unsymmeterical double convex thin lens forms the image of a point object on its axis. Will the position of the image change if the lens is reversed ?

Watch Video Solution

4. Three immiscible liquids of densities $d_1 > d_2 > d_3$ and refractive indices $\mu_1 > \mu_2 > \mu_3$ are put in a beaker. The height of each liquid column is $\frac{h}{3}$. A dot is made at the bottom of the beaker. For near normal vision, find the apparent depth of the dot.

Watch Video Solution

5. The angle of minimum deviation for a glass prism with $\mu = \sqrt{3}$ equals the refracting angle of the prism. What is the angle of the prism?

Watch Video Solution

Short Answer(b)

1. An ink mark on a sheet of paper is viewed through a glass slab of thickness t and refractive index μ. Through what distance the mark appears to be raised ?

Watch Video Solution

Watch Video Solution

2. A candle flame is held $2metre$ above the water level in a tank $4metre$ deep. If μ of water is $4/3$, where will image of candle flame be seen ?

Watch Video Solution

3. An air bubble in a jar of water shines brightly. Why ?

Watch Video Solution

4. For the same angle of incidence, the angles of refraction in media P, Q and R are $35^\circ, 25^\circ, 15^\circ$ resp. In which medium will the velocity of light be minimum ?

Watch Video Solution

5. Why does the rising sun appear oval shaped ?

Watch Video Solution

6. Where should an object be placed from a convex lens to from an image of the same size ? Can it happen in case of a concave lens ?

Watch Video Solution

7. The focal length of an equiconvex lens placed in air is equal to radius of curvature of either surface. Is it true ?

Watch Video Solution

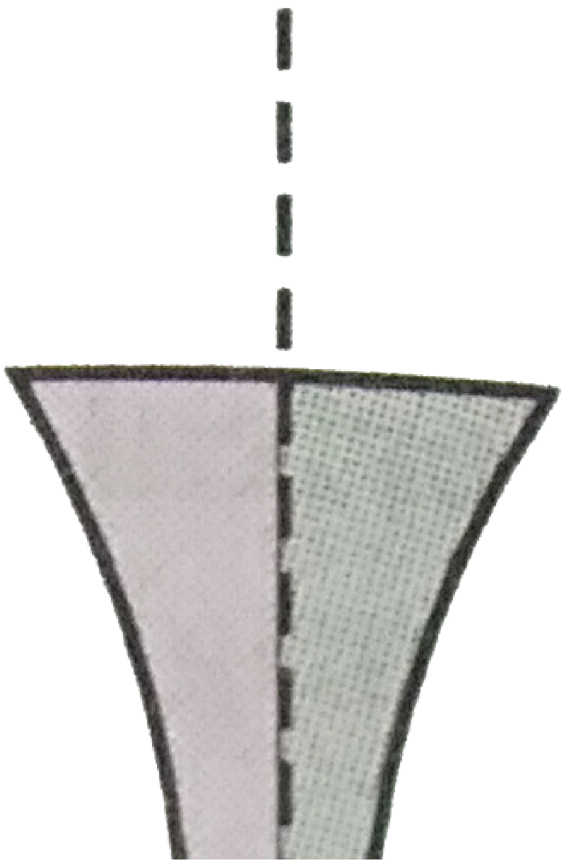
8. Within a glass slab, a double convex air bubble is formed. How would the air bubble behave ?

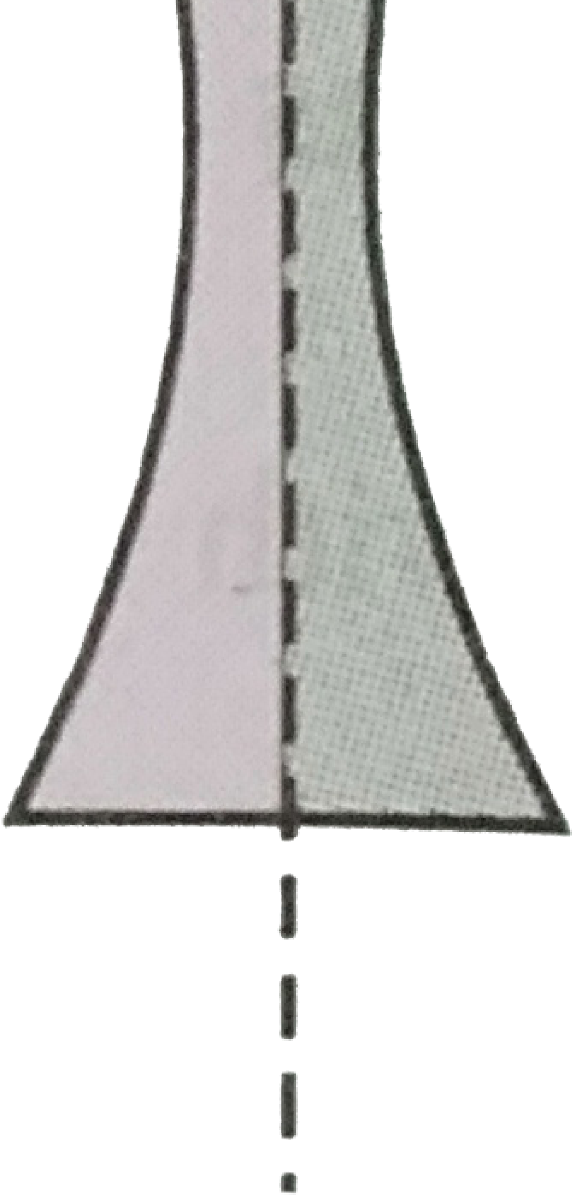
Watch Video Solution

9. Why does a convex lens of glass $\mu = 1.5$ behave as a diverging lens when immersed in carbon disulphide of $\mu = 1.65$?

Watch Video Solution

10. A diverging lens of focal length F is cut into two idential parts, each forming a plano concave lens, What is the focal length of each part ?





Watch Video Solution

11. Draw a plot showing the variation of power of a lens with the wavelength of incident light.

Watch Video Solution

12. A lens whose radii of curvature are different is forming the image of an object placed on its axis. If the lens is reversed, will the position of the image change ?

Watch Video Solution

13. The image of a candle is formed by a convex lens on a screen. If the lower half of the lens is painted black to make it completely opaque, will the full size of image be obtained ?

Watch Video Solution

14. A convex lens forms the image of the sun at a distance of $10cm$. Where will be the image when

(i) another lens of same power but dounle the aperture is used ?

(ii) another lens of same aperture but double the power is used ?

Watch Video Solution

15. An equiconvex lens of focal length $15cm$ is cut into two equal halves in thickness. What is the focal length of each half ?

Watch Video Solution

16. A lens shown in Fig. 6(b).75 is made of two different materials. A point object is placed on the principal axis of the lens. How many images will be obtained ?

Watch Video Solution

17. What is focal length and power of a rectangular glass slab ?

Watch Video Solution

18. How does focal length of a convex lens change if violet light is used instead of red light.

Watch Video Solution

19. Two thin lenses of power $+3D \text{ and } -1D$ are held contact with each other. Focal length of the combination is :

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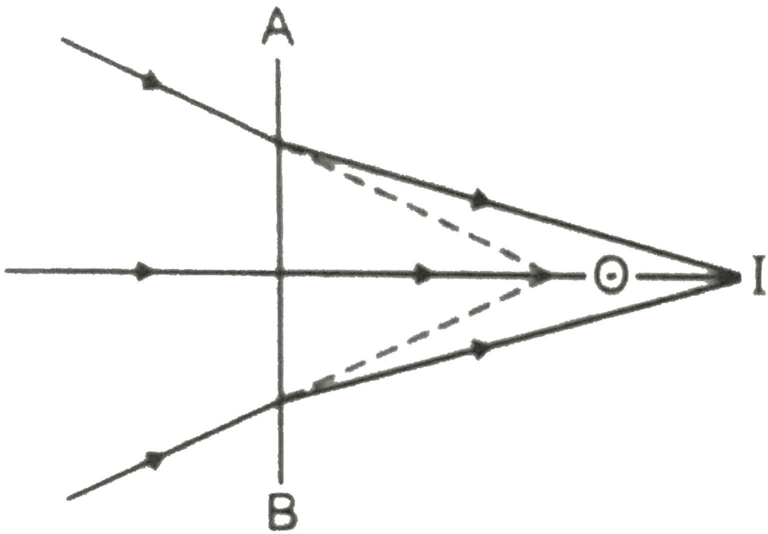
20. In Fig., line AB represents a lens through which course of rays is as shwon. Is this lens convex or concave ?



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21. Explain with reason how the power of a diverging lens changes when

(i) it is kept in a medium of refractive by index greater than that of the lens.

(ii) incident red light is replaced by violet light.

Watch Video Solution

22. A ray of light suffers lateral displacement on passing through a parallel sided glass slab. What is the maximum possible value of lateral displacement ?

Watch Video Solution

23. Prove that $\mu = \frac{1}{\sin C}$' where C is the critical angle.

Watch Video Solution

24. What are optical fibers ? Give three appilications of these fibres.

Watch Video Solution

25. A microscope is focussed on a dot on the bottom of the beaker. Some oil is poured into the beaker to a height of ycm and it found necessary to

raise the microscope through a vertical distance of $x cm$ to bring the dot again into focus. Express refractive index of oil in terms of x and y.

Watch Video Solution

26. What is meant by power of a lens ? What is one dioptre ?

Watch Video Solution

27. How do magnification and focal length change for a combination of thin lenses ?

Watch Video Solution

Short Answer(c)

1. A glass slab is placed over a page in which letters are printed in different colours. Will the image of all the letters lie in the same plane ?

Watch Video Solution

2. In the above question, which letter will appear to be raised maximum ?

Watch Video Solution

3. The intensity of light at a distance r from the axis of a long cylindrical source is inversely proportional to r.

Watch Video Solution

4. What is the essential difference between fluorescence and phosphroescence ?

Watch Video Solution

5. Why does a secondary rainbow have inverted colours ?

Watch Video Solution

6. Why does one prefer a black umbrella to a white one, even in summer ?

Watch Video Solution

7. Why are danger signals red in colour ?

Watch Video Solution

8. What is meant by scattering of light ?

Watch Video Solution

9. (a) What is the essential condition for Rayleigh scattering ?

(b) In Rayleigh scattering, how is intensity of scattered light related to wavelength of light ?

Watch Video Solution

10. What happens when sixe of scatterer is much bigger than the wavelength of light ?

Watch Video Solution

11. (a) Why do spectrum colours recombine on passing through two prisms oriented duly ?

(b) What is the essential condition for observing a rainbow ?

Watch Video Solution

12. In a primary rainbow, what is the order of colours ? And what is true for secondary rainbow ?

Watch Video Solution

13. Why are sodium lamps used for illumination if foggy conditions ?

Watch Video Solution

14. what is a rainbow ? What is the essential condition for observing it ?

Watch Video Solution

15. Why does sky look blue and clouds look white?

Watch Video Solution

16. The sun looks reddish at the time of sunrise and sunset.

Watch Video Solution

17. Violet colour is seen at the bottom of the spectrum, when white light is dispersed by a prism. Explain.

Watch Video Solution

18. What is the cause of dispersion ?

Watch Video Solution

Short Answer(d)

1. Where does a myopic eye focus the parallel rays falling in it ?

Watch Video Solution

2. Give one possible cause of hypermetropia.

Watch Video Solution

3. What is the difference between hypermetropia and presbyopia ?

Watch Video Solution

4. A myopic person prefers to remove his spectacles while reading a book. Why ?

Watch Video Solution

5. Through a simple microscope, an object is seen in red light first and then in violet light. In which case is magnifying power more ?

Watch Video Solution

6. Th diameter of objective of a telescope is doubled. What is its effect on intensity of image seen ?

Watch Video Solution

7. In the above question, how does the magnifying power change ?

Watch Video Solution

8. Can a microscope function as a telescope by inverting it. Can a telescope function as a microscope ?

Watch Video Solution

9. How does the magnifiaction of a magnifying glass differ from its magnifying power ?

Watch Video Solution

10. What is meant by range of a telescope ?

Watch Video Solution

Watch Video Solution

11. By increasing the diameter of the objective of telescope, we can increase its range, why ?

Watch Video Solution

12. Name the factors on which brightness of image in a camera depends and how ?

Watch Video Solution

13. What is the relation between magnifying power and resolving power of a telescope ?

Watch Video Solution

14. Using the data given below, state which two of the given lenses will you prefer to construct a best possible (i) telescope (ii) microscope. Also, indicate which of the selected lenses is to be used as an objective and as an eye piece in each case

Lenses,L_1, L_2, L_3

Power(P), 6 D,3 D, 10 D

Aperture (A), 1 cm, 8 cm, 1 cm.

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15. Four double convex lenses with following specifications are available

Lens, A, B, C, D,

focal length, 100 cm, 100 cm, 0 cm, 5 cm,

aperture, 10 cm, 5 cm,2 cm, 2 cm.

Which of the given four lenses should be selected as objected and eyepiece to construct an astronomical telescope and why ? What will be the magnifying power and length of the tube of the telescope ?

Watch Video Solution

16. From the data of four lenses given in $Q.4$ which one will you select as objective of a compound microscope and which one as eye lens ? How can the magnifying power of such a microscope be increased ?

Watch Video Solution

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

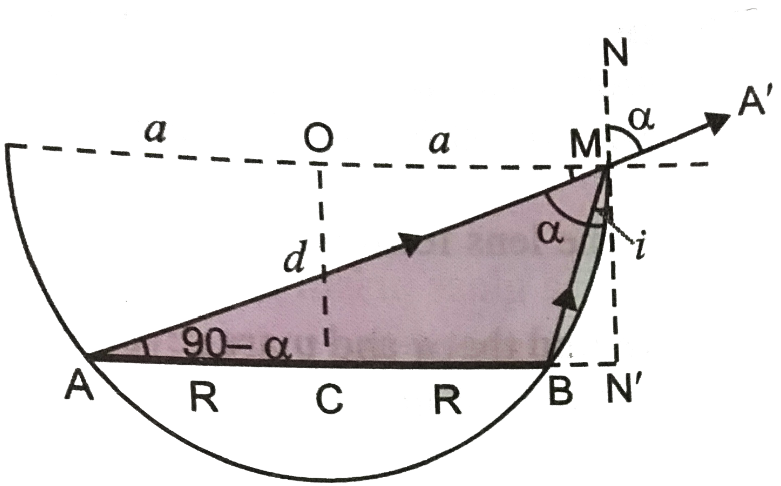
Watch Video Solution

(NCERT)Short Answer

1. A short object of length L is placed along the principal axis of a concave mirror aeay from focus. The object distance is u. If the mirror has a focal length f, what will be the length of the image ? You may take $L < < |v - f|$.

Watch Video Solution

2. A circular disc of radius 'R' is placed co-axially and horizontally inside and opaque hemispherical bowl of radius 'a', Fig. The far edge of the disc is just visible when viewed from the edge of the bowl. The bowl is filled with transparent liquid of refractive index μ and the near edge of the dise becomes just visible. How far below the top of the bowl is the disc placed ?



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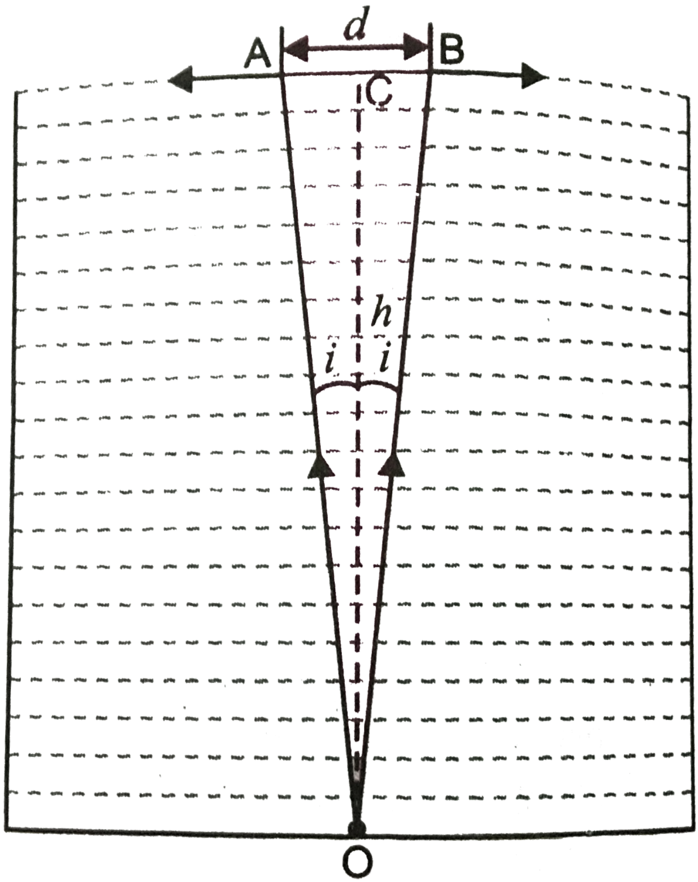
3. A thin convex lens of focal length $25cm$ is cut into two pieces $0.5cm$ above the principal axis. The top part is placed at (0.0) and an object placed at $(-50cm, 0)$. Find the coordinates of the image.

Watch Video Solution

4. In may experimental set-ups the source and screen are fixed at a distance say D and the lens is movable. Show that there are two positions for the lens for which an image is formed on the screen. Find the distance between these points and the ratio of the image sizes for these two points.

Watch Video Solution

5. A jar of height h is filled wih a transparent liquid of refractive index μ, Fig. At the centre of the jar on the botom surface is a dot. Find the minimum diameter of a disc, such that when placed on the top surface symmetrically about the centre, the dot is invisible.



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6. A myopic adult has a far point at $0.1m$. His power of accomodation is 4 diopters.

(i) What power lenses are required to see distant objects ?

(ii) What is his near point without glasses ?

(iii) What is his near point with glasses ? (Take the image distance from the lens of the eye to the retina to be 2 cm).

Watch Video Solution

Long Answer (b)

1. What is meant by refraction of light ? State the laws of refraction. Show that emergent ray from a glass slab is parallel to incident ray.

Watch Video Solution

2. Explain the phenomenon of total internal reflection. What are the conditions for the phenomenon ? Explain the meaning of critical angle.

Watch Video Solution

3. Show by drawing ray diagrams how a totally reflecting glass prism can be used to deviate a ray of light through (i) 90° (ii) 180° and invert it.

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4. Define total internal reflection. State its conditions. How do optical fibres transmit light without absorption.

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5. Describe briefly any three applications of total internal reflection.

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6. Prove that $\frac{-\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$ when refraction occurs from rarer to denser medium at a concave spherical refracting surface.

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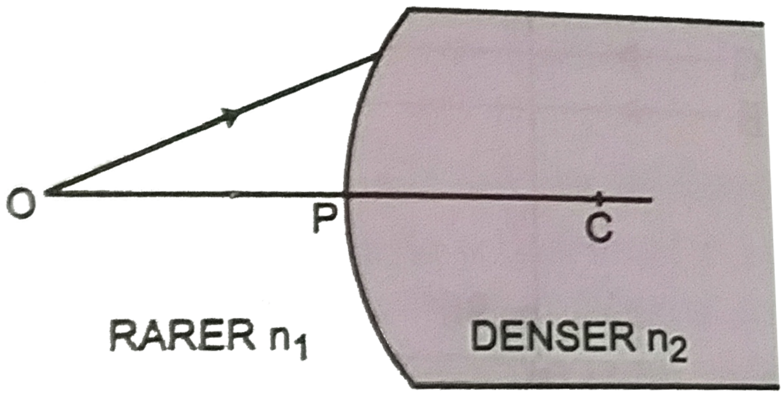
7. A spherical of radius of curvature R, separates a rarer and a denser medium as shown in Fig. Complete the path of the incident ray of light, showing the formation of a real image. Hence derive the relation connecting object distance u, image distance v, radius of curvature R and the refractive indices n_1 and n_2 of the two media. Briefly explain how the focal length of a convex lens changes with increase in wavelength of incident light.



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8. Discuss briefly refraction from rarer to denser medium at a concave spherical refracting surface.

Watch Video Solution

9. Discuss refraction from denser to rerer medium at a convex spherical refracting surface.

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10. Derive lens maker's formula for a thin convex lens.

Watch Video Solution

11. Derive lens maker's formula for a thin convex lens.

Watch Video Solution

12. Draw a ray diagram to show the formation of the image of an object placed between the optical centre and focus of a convex lens. Deduce the relationship between object distance, image disatnce and focal length of lens.

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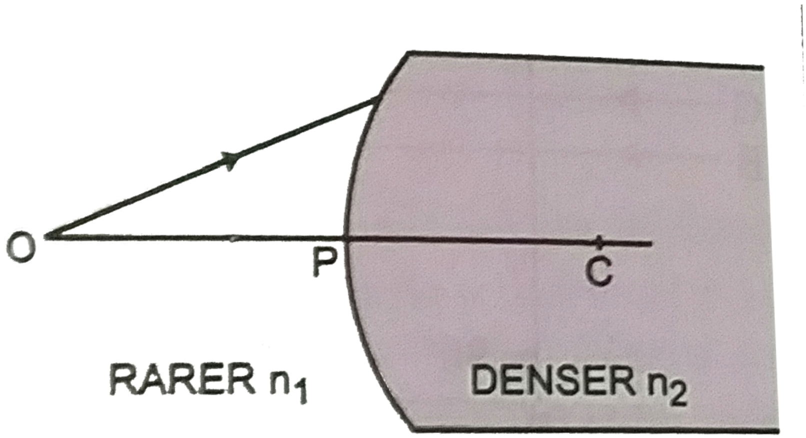
13. Derive lens formula for a concave lens.

Watch Video Solution

14. A spherical of radius of curvature R, separates a rarer and a denser medium as shown in Fig. Complete the path of the incident ray of light, showing the formation of a real image. Hence derive the relation connecting object distance u, image distance v, radius of curvature R and the refractive indices $n_1 \text{ and } n_2$ of the two media. Briefly explain how the focal length of a convex lens changes with increase in wavelength of incident light.



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15. Obtain an expression for focal length of a combination of thin lenses in contact.

Watch Video Solution

Long Answer (c)

1. Discuss the phenomenon of refraction through a prism. Prove that $\delta = (\mu -)A$ where the symbols have their usual meaning.

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2. State and prove prism formula.

Watch Video Solution

3. Explain the refraction of light through a triangular glass prism using a labelled ray diagram. Hence define the angle of diviation.

Watch Video Solution

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

Watch Video Solution

5. Explain the terms angular dispersion and dispersive power. How are the two related ?

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6. Briefly explain the phenomenon of scattering of light giving some examples.

Watch Video Solution

7. What is Raman Effect ? Give some of the salient features of this effect.

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8. What is a rainbow ? What is its two types ? How are they formed ? Discuss briefly.

Watch Video Solution

Long Answer (d)

1. Draw a labelled sketch of the human eye. Explain the functions of each part.

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2. Name common optical defects of eye. How are they removed ?

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3. Explain what is meant by myopia and hypermetropia. How are they caused ? Briefly explain their removal.

Watch Video Solution

4. Describe a simple microscope or a magnifying glass. Derive an expression for its magnifying power.

Watch Video Solution

5. Draw course of rays through a compound microscope. Deduce an expression for its magnifying power. How can the magnifying power be increased ?

Watch Video Solution

6. Describe a reflecting type telescope. What are its advantage over the refracting telescope ?

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(NCERT)Long Answer

1. Show that for a material with refractive index $\mu \geq \sqrt{2}$, light incident at any angle shall be guided along a length perpendicular to the incident face.

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2. The mixture of a pure liquid and a solution in a along vertical column (i.e., horizontal dimensions lt lt vertical dimensions) produces diffusion of solute particles and hence a refractive index gradient along the vertical dimension. A ray of light entering the column at right angles to the vertical is deviated from its original path. Find the deviation in travelling a horizontal distance $d < < h$, the height of the column.

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3. If light passes near a massive object, the gravitational interaction causes a bending of the ray. This can be thought of as happening due to a change in the effective refractive index of the medium given by

$n(r) = 1 + 2GM / rc^2$

where r is the distance of the point consideration from the centre of the mass of the massive body, G is the universal gravitational constant, M the mass of the body and c the speed of light in vacuum. Considering a spherical object, find the deviation of the ray from the original path as it grazes the object.

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4. An infinitely long cylinder of radius R is made of an unusal exotic material with refractive index (-1), Fig. The cylinder is placed between two planes whose normals are along the y direction. The center of the cylinder O lies along the y-axis. A narrow laser beam is directed along the y-direction from the lower plate. The laser source is at a horizontal distance x from the diameter in the y direction. Find the range of x such that light emmited from the lower plane does not reach the upper plane.

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5. (i) Consider a thin lens placed between a source (S) and an observer (O), Fig. Let the thickness of the lens vary as $w(b) = w_0 - \frac{b^2}{\propto}$, where b is the vertical distance from the pole. w_0 is a constant. Using Fermat's principle, i.e., the time of transit for a ray between the source and observer is an exptremum, find the condition that al paraxial rays starting from the source will converge at a point O on the axis. Find the focal length.

(ii) A gravitational lens may be assumed to have a varying width of the form

$$w(b) = k_1 In\left(\frac{k_2}{b}\right) b_{\min} < b < b_{\max} w(b) = k_1 In\left(\frac{k_2}{b_{\min}}\right) b < b_{\min}$$

Show that an observer will see an image of a point object as a ring about the center of the lens with an angular radius $\beta = \sqrt{\frac{(n-1)k_1 \frac{u}{v}}{u+v}}$.

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(NCERT)Exercise With Solution

1. A small candle $2.5cm$ in size is placed $27cm$ in front of a concave mirror of radius of curvature $36cm$. At what distance from the mirror should a screen be placed in order to receive a sharp image ? Describe the nature and size of the image. If the candle is moved closer to the mirror, how would the screen have to be moved ?

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2. A $4.5cm$ needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and the magnification.

Describe what happens as the needle is moved farther from the mirror.

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3. A tank is filled with water to a height of $12.5cm$. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be $9.4cm$. What is the refractive index of water ? If water is replaced by a liquid of refractive index 1.63 upto the same height, by what distance would the microscope have to be moved to focus on the needle again ?

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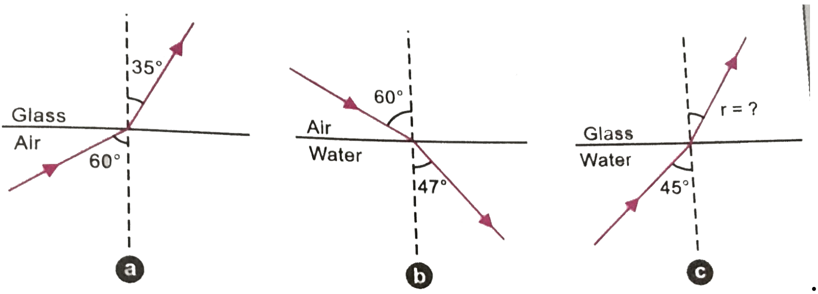
4. Fig. (a) and (b) show refraction of an incident ray in air at 60° with the normal to a glass-air and water-air interface respectively. Predict the angle of refraction of an incident ray in water at 45° with the normal to a water glass interface. Take $.^{a}\mu_{g}=1.32.$



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5. A small bulb (assumed to be a point source) is placed at the bottom of a tank containing water to a depth of $80cm$. Find out the area of the surface of water through which light from the bulb can emerge. Take the value of refractive index of water to be $4/3$.

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6. A prism is made of glass of unknown refractive index. A parallel beam of light is incident on a face of the prism. By rotating the prism, the minimum angle of deviation is measured to be 40°. What is the refractive index of the prism ? If the prism is placed in water $(\mu=1.33)$, predict the

new angle of minimum deviation of the parallel beam. The refracting angle of prism is 60°.

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

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8. A beam of light converges to a point P. A lens is placed in the path of the covergent beam $12cm$ from P. At what point does the beam converge if the lens is

(a) a convex lens of focal length $20cm$

(b) a concave lens of focal length $16cm$?

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9. An object of size $3.0cm$ is placed $14cm$ in front of a concave lens of focal length $21cm$. Describe the image produced by the lens. What happens if the object is moved further from the lens ?

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10. What is the focal length of a convex lens of focal length $30cm$ in contact with a concave lens of focal length $20cm$. Is the system a converging or a diverging lens ? Ignore thickness of the lenses.

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11. A compound microscope has an objective of focal length $2.0cm$ and an eye-piece of focal length $6.25cm$ and distance between the objective and eye-piece is $15cm$. If the final image is formed at the least distance vision $(25cm)$, the distance of the object form the objective is

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12. A person with a normal near point $(25cm)$ using a compound microscope with an objective of focal length $8.0mm$ and eye piece of focal length $2.5cm$ can bring an object placed $9.0cm$ from the objective in sharp focus. What is the separation between the two lenses ? Calculate the magnifying power of the microscope ?

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13. A small telescope has an objective lens of focal length $144cm$ and an eye-piece of focal length $6.0cm$. What is the magnifying power of the telescope ? What is the separation between the objective and the eye-piece ?

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14. A gaint refrecting telescope at an observatory has an objective lens of focal length $15m$. If an eye piece lens of focal length $1cm$ is used, find the angular magnification of the telescope.

If this telescope is used to view the moon, what is the diameter of image of moon formed by objective lens ? The diameter of the moon is $3.42 \times 10^6 m$ and radius of lunar orbit is $3.8 \times 10^8 m$.

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15. Use the mirror equation to deduct that :

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

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

(c) the virtual image produced by a convex mirror is always diminished in size and is located between the focus and the pole.

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

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16. A small pin fixed on a table top is viewed from above from a distance of $50cm$. By what distance would the pin appear to be raised, if it be viewed from the same point through a $15cm$. Thick glass slab held parallel to the table ? μ of glass 1.5 Does the answer depend on location of the slab ?

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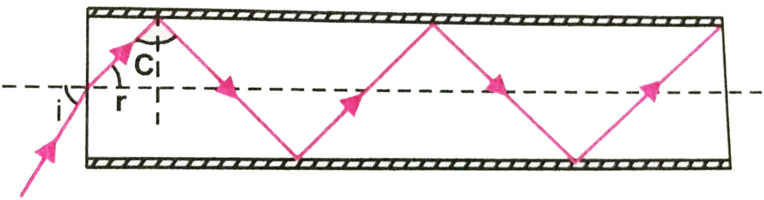
17. (a) Fig. shows a cross-section of a 'light pipe' made of a glass fibre of refractive index 1.68. The outer covering of the pipe is made of a material of refractive index 1.44. What is the axis of the pipe for which total reflection inside the pipe take place as shwon.

(b) What is the answer if there is no outer covering if the pipe ?



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18. Answer the following questions :

(a) You have learnt that plane and convex mirrors produce virtual images of objects. Can they produce real images under some circumstances ? Explain.

(b) A virtual image, we always say, cannot be caught on a screen. Yet when we see a virtual image, we bring it to screen i.e. retine of our eye. Is there a contradiction ?

(c) A diver under water looks obliquely at a fisherman standing on the bank of a lake. Would the fisherman look taller or shorter than what he actually is ?

(d) Does the apparent depth of a tank of water change if viewed obliquely ? If so, does the apparent depth increase or decrease ?

(e) The refractive index of diamond is much greater than that of ordinary glass. Is this fact of some use to a diamond cutter ?

19. The image of a small electric bulb fixed on the wall of a room is to be obtained on the opposite wall $3m$ away by means of a large convex lens. What is the maximum possible focal length of the lens required for the purpose ?

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

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21. a) Determine the effective focal length of the combination of the two lenses in Exercise, if they are placed 8.0cm apart with their principal axes coincident. Does the answer depend on which side of the combination a beam of paralel light is incident? Is the notions of effective focal length of this system useful at all?

b) An object 1.5 cm in size is placed on the side of the convex lens in the arrangement a) above. The distance between the object and the convex lens is 40cm. Determine the magnification produced by the two-lens system, and the size of the image.

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22. At what angle should a ray of light be incident on the face of a prism of refracting angle 60°, so that it just suffers total internal reflection at the other face ? The refractive index of the prism is 1.524.

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23. You are given prism made of crown glass and flint glass with a wide variety of angles. Suggest a combination of prism which will

(i) deviate a pencil of white light without much dispersion.

(ii) disperse and displace a pencil of white light without much deviation.

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24. For a normal eye, the far point is at infinity and the near point of distinct vision is about $25cm$ in front of the eye. The cornea of the provides a converging power of about $40 dioptre$ and the least converging power of eye lens behind the cornea is about $20 dioptre$. From this rough data, estimate the range of accommodation (i.e., the range of converging power of the eye lens) of a normal eye.

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25. Does short sightedness (myopia) or long sightedness (hypermetropia) imply necessarily that the eye has partially lost its ability of accomodation ? If not, what might cause these defects of vision ?

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26. A myopia person has been using spectacles of power -1.0 dioptre for distant vision. During old age, he also needs to use separate reading glasses of power $+2.0$ dioptre. Explain what may have happened.

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27. A person looking at a person wearing a shirt with a pattern comprising vertical and horizontal lines is able to see the vertical lines more distinctly than the horizontal ones. What is this defect due to ? How is much a defect of vision corrected ?

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28. A man with normal near point (25 cm) reads a book with small print using a magnifying glass : a thin convex lens of focal length $5cm$.

(a) What are the closest and the farthest distances at which he can read the book when viewing through the magnifying glass ?

(b) What is the maximum and the minimum angular magnifications (magnifying powers) possible using the above simple microscope ?

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29. A cardsheet divided into squares each of size $1mm^2$ is being viewed at a distance of $9cm$ through a magnifying glass (a conerging lens of focal length $10cm$) held close to the eye.

(a) What is the magnification produced by the lenas ? How much is the area of each square to the virtual image ?

(b) What is the angular magnification (magnifying power) of the lens ?

(c) Is the magnification in (a) equal to the magnifying power in (b) ? Explain

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30. (i) At what distance should the lens be held from the card sheet in order to view the squares distinctly with the maximum possible magnifying power ?

(ii) What is the magnification in this case ?

(iii) Is the magnification equal to magnifying power in this case ? Explain.

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31. What should be the distance between the object and magnifying glass if the virtual image of each square in the figure is to have an area of $6.25mm^2$.Would you be able to see the squares distinctly with your eyes very close to the magnifier ?

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32. a) The anlge subtended at the eye by an object is equal to the angle subtended at the eye by the virtual image produced by a magnifying glass. In what sense then does a magnifying glass provide angular magnifications?

b) in viewing through a magnifying glass, one usually positions one's eyes very close to the lens. Does angular magnification change if the eye is moved back?

c) magnifying power of a simple microscopes is inversely proportional to the focal length of the lens. What then stops us from using a convex lens of smaller and smaller focal length and achieving greater and greater magnifying power?

d) Why must both the objective and the eyepiece of a compound microscope have short focal lengths?

e) When viewing through a compound microscope, our eyes should be positioned not on the eyepiece but a short distance away from it fot best veiwing. Why? How much should be that short distance between the eye and eyepiece?

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33. An angular magnification (magnifying power) of $30X$ is desired using an objective of focal length $1.25cm$ and an eye piece of focal length $5cm$. How will you set up the compound microscope ?

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34. A small telescope has an objective lens of focal length $140cm$ and eye piece of focal length $5.0cm$. What is the magnifying power of telescope for viewing distant objects when

(a) the telescope is in normal adjustment (i.e. when the image is at infinity)

(b) the final image is formed at the least distance of distinct vision $(25cm)$.

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35. (a) For the telescope described what is the separation between the objective lens and eye piece ?

(b) If this telescope is used to view a $100m$ tall tower $3km$ away, what is the height of the image of the tower formed by the objective lens ?

(c) What is the height of the final image of the tower if it is formed at 25 cm` ?

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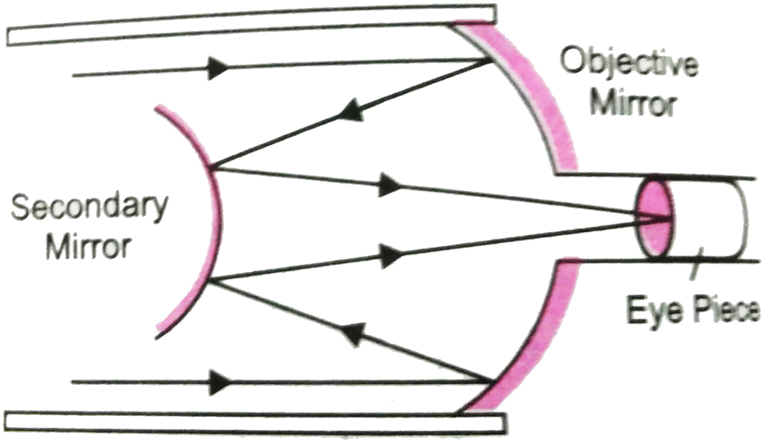
36. A Cassegrainian telescope uses two mirrors as shown in Fig. Such a telescope is built with the mirrors $20mm$ apart. If the radius of curvature of large mirror is $220mm$ and the small mirror is $40mm$, where will the

final image of an object at infinity be ?



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37. Light incident normally on a plane mirror attached to a galvanometer coil retraces backwards a shown in Fig. 6(a). 14. A current in the coil produces a deflection of 3.5° in the mirror. What is the displacement of the reflected spot of light on a screen placed $1.5m$ away ?

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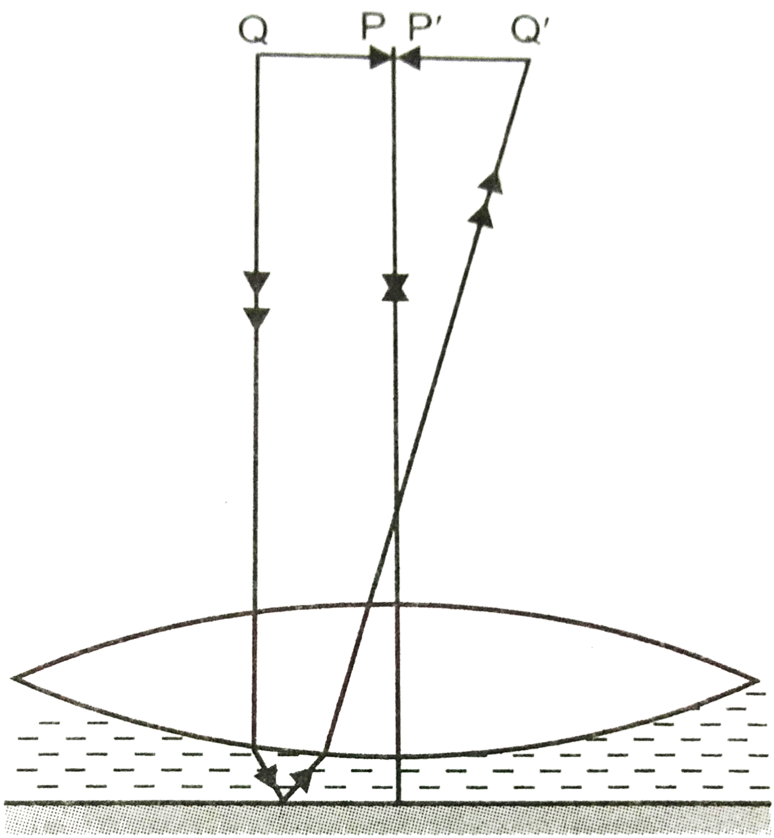
38. Fig. shows an equiconvex lens (of refractive index 1.5) in contact with a liquid layer on top of a plane mirror. A small needle with its tip on the principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of the needle from the lens is measured to be $45.0 cm$. The liquid is removed and the experiment is repeated. The new distance is measured to be $30.0 cm$. What is the refractive index of the liquid ?



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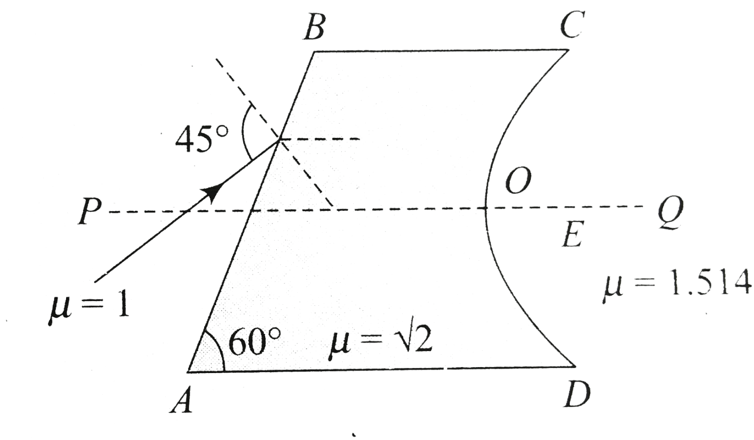
Higher Thinking Order

1. Figure shows an irregular block of material of refractive indec $\sqrt{2}$. A ray of light strikes the face AB as shown. After refraction, it is incident on a spherical surface CD of radius of curvature 0.4 m and enters a medium of refractive index 1.514 to meet PQ at E. Find the distance OE up to two places of decimal.



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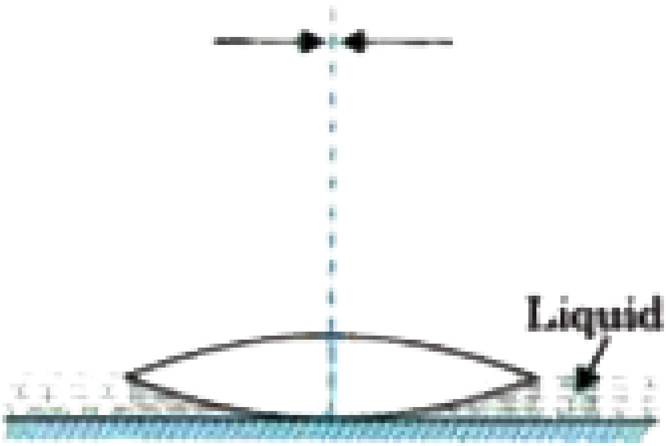
2. An equiconvex lens with radii of curvature of magnitude R each is put over a liquid layer poured on top of a plane mirror. A small needle, with its tip on the principal axis of the lens, is moved along the axis until its inverted real image coincides with the needle itself. The distance of the needle from the lens is measured to be 'a'. On removing the liquid layer and repeating the experiment the distance is found to be 'b'.

Given that the two values of distances measured represent the focal length values in the two cases, obtain a formula for the refractive index of the liquid.



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3. A ray of light incident on the horizontal surface of a glass slab at 70° just grazes the adjacent vertical surface after refraction. Complete the critical angle and refractive index of glass.

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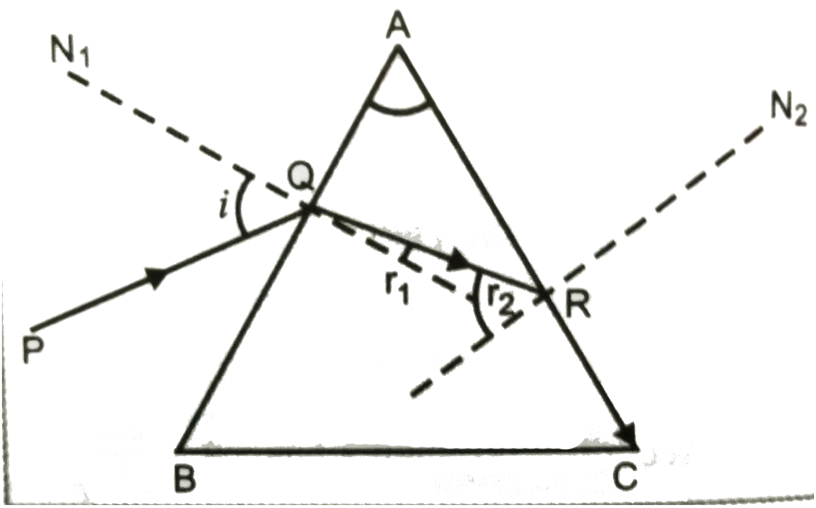
4. A ray of light the face AB of a glass prism of refractive index μ at an angle of incidence i. Find the value of i such that no ray emerges from the face AC of the prism. Given angle of prism is A.



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5. The diameter of a plano convex lens is $6cm$ and thickness at the centre is $3mm$. If the speed of light in the material of the lens is $2 \times 10^8 m/s$, what is the focal length of the lens ?

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Sample Problem(a)

1. A point object is held between two plane mirror held at (i) 24° (ii) 30°. What is the number of images formed in the two cases ?

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2. (a) What is focal length of a convex mirror of radius of curvature $20cm$?

(b) What is radius of curvature of a mirror of focal length $-50cm$?

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3. An object is placed $18cm$ in front of a mirror. If the image is formed at $4cm$ to the right of the mirror, calculate its focal length. Is the mirror convex or concave ? What is the nature of the image ? What is the radius of curvature of the mirror ?

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4. An object is placed at a distance of $6cm$ from a convex mirror of focal length $20cm$. Locate the position and nature of the image.

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5. An erect image $3 \times$ the size of the object is obtained with a concave mirror of radius of curvature $36cm$. What is the position of the object ?

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Solved Example(a)

1. Light of wavelength 5000Å falls on a plane reflecting surface. What are the wavelength and frequency of reflected light ? For what angle of incidence is the reflected ray normal to the incident ray ?

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2. Light incident normally on a plane mirror attached to a galvanometer coil retraces backwards a shown in Fig. 6(a). 14. A current in the coil produces a deflection of 3.5° in the mirror. What is the displacement of the reflected spot of light on a screen placed $1.5m$ away ?

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3. A boy $1.5m$ tall with his eye level at $1.38m$ stands before a mirror fixed on a wall. Indicate by means of a ray diagram how the mirror should be positioned so that he can view himself fully. What should be the minimum length of the mirror ? Does the answer depend on the eye level ?

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4. A square wire of side $3.0cm$ is placed $25cm$ away from a concave mirror of focal length $10cm$. What is the area enclosed by the image of the wire ? The centre of the wire is on the axis of the mirror, with its two sides normal to the axis.

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5. When an object is placed at a distance of $60cm$ from a convex spherical mirror, the magnification produced is $1/2$. Where should the object be placed to get a magnification of $1/3$?

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6. An object is placed (i)$10cm$ (ii) $5cm$ in front of a convex mirror of radius of curvature $15cm$. Find the position, nature and magnification of the image in each case.

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7. Suppose while sitting in a parked car, you notice a jogger approaching towards you in the rear view mirror of $R = 2m$. If the jogger is running at a speed of $5ms^{-1}$, how fast is the image of the jogger moving, when the jogger is

(a) 39 m

(b) 29 m

(c) 19 m and

(d) 9 m. away ?

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8. A $5cm$ long needle is placed $10cm$ from a convex mirror of focul length $40cm$. Find the position, nature and size of image of the needle. What happens to the size of image when needle is moved farhter away from the mirror ?

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9. A concave mirror of focal length $20cm$ is placed $50cm$ from a wall. How far the wall should an object be placed to form a real image on the wall ?

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10. As object is placed exactly midway between a concave mirror of $R = 40cm$ and a convex mirror of $R = 30cm$. The mirrors face eachother and are $50cm$ apart. Determine the nature and position of image formed by successive reflections first at concave mirror and then at convex mirror.

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11. An object is placed at a dustance $36cm$ from a convex mirror. A plane mirror is placed inbetween so that the two virtual images so formed coincide. If the plane mirror is at a distance of $24cm$ from the object, find the radius of curvature of convex mirror.

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

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13. An object of height h is held before a spherical mirror of focal length $|f| = 40cm$. The image of the object produced by the mirror has same orientation as the object and has $height = 0.2h$. Is the image real or virtual ? Is the image on the convex or concave? What is focal length of mirror with proper sign?

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14. a concave mirror of focal length $20cm$ and a convex mirror of focal length $15cm$ are placed $50cm$ apart, such that the two mirrors face eaachother. An object is placed exactly midway between them. Fing the nature and position of image formed by reflection first at concave mirror and then at convex mirror.

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Conceptual Problem(a)

1. Prove that spherical mirror formula is applicable equally to a plane mirror.

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2. The wall of a room is covered with a perfect plane mirror and two movie films are made, one recording the movement of a man and the other of his mirror image. While viewing the film later, can an outside tell which is which ?

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3. An object is placed between two parallel plane mirrors. Why do the distance images get fainter and fainter ?

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4. Why are mirrors used in search lights parabolic and not concave sphrical ?

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5. A man holding a lighted candle in front of a thick glass mirror and viewing it obliquely sees a number of images of the candle. What is the origin of these multiple images ?

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6. If you were driving a car, what type of mirror would you prefer to use for observing traffic at your back ?

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7. Suppose that the lower half of a concave mirror's reflecting surface is covered with an opaque non-reflecting material. What effect will this have on the image of an object placed in front of the mirror ?

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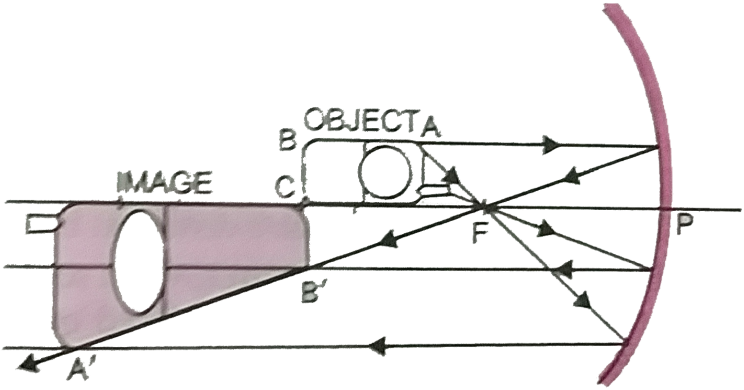
8. A mobile phone lies along the principal axis of a concave mirror as shown in Fig. Show by suitable diagram, the formation of its image. Explain why the magnification is not uniform, and distortion will occur depending on the location of the mobile with respect to the mirror.



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9. A section of a sphere has a radius of curvature of $0.80m$. Both, inside and ouside surfaces have a mirror like polish. What are the focal lengths of the inside and outside surfaces?

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10. Will the reflected rays converge at a point when a parallel beam of light is incident on a concave mirror of large aperture ?

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11. Why are mirrors used in search lights parabolic and not concave sphrical ?

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12. Give three basic differences between real image and virtual image.

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Very Short (a)

1. Define principal axis of a spherical mirror.

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2. A ray incident along normal to the mirror retraces its path. Why ?

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3. What si the number of images of a point object held inbetween two plane mirrors inclined at an angle θ° ?

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4. A mirror is turned through 15°. Through what angle will the reflected ray turn ?

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5. What is the number of images of an object held between two parallel plane mirrors ?

Watch Video Solution

6. Can we obtain the image formed by a convex mirror on a screen ? If not, why ?

Watch Video Solution

7. Which of the mirrors is diverging: concave or convex?

Watch Video Solution

8. Can a convex mirror form a mgnified image ?

Watch Video Solution

9. When does a concave mirror form a virtual image ?

Watch Video Solution

10. What is a mirror formula?

Watch Video Solution

11. what is the relation between $f \text{ and } R$ of a spherical mirror ?

Watch Video Solution

12. Can a virtual image be photographed by a camera ?

Watch Video Solution

13. A person moves with a velocity v towards a plane mirror. With what velocity does his image move towards him ?

Watch Video Solution

14. What is the value of focal length of a plane mirror ?

Watch Video Solution

15. If the wavelength of incident light on a concave mirror is increased, how will the focal length of the mirror change ?

Watch Video Solution

16. To which wavelength of lights is our eye most sensitive ? In which region does this wavelength lie ?

Watch Video Solution

17. Find the minimum height of a mirror where one can see his full image.

Watch Video Solution

18. How many images of himself can a person see in a room whose ceiling and two adjacent walls are mirrors ?

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19. What are the two types of spherical mirrors ?

Watch Video Solution

20. Which spherical mirror has a real focus and which one has a virtual focus ?

Watch Video Solution

21. Which spherical mirror is converging and which one is diverging ?

Watch Video Solution

22. Which spherical mirror forms a virtual, erect and smaller image of an object ?

Watch Video Solution

23. Where should an object be held so that a concave mirror forms a real, inverted and magnified image ?

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Short Answer(a)

1. How will you distinguish between a plane mirror, a convex mirror and a concave mirror without touching them?

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2. Does size of mirror affect the nature of the image ?

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3. A concave mirror of small aperture forms a shrper image. Why ?

Watch Video Solution

4. How can we see a virtual image when it cannot be obtained on a screen ?

Watch Video Solution

5. If a spherical mirror is dipped in water, does its focal length change ? 17. If a thin lens is dipped in water, does its focal length change ?

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6. What is the difference between the virtual images produced by (i) plane mirror (ii) concave mirror and (iii) convex mirror ?

Watch Video Solution

7. Which property of concave mirror is utilized for using them as shaving mirrors ?

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8. A man standing in front of a special mirror finds his image having a small face, big tummy and legs of normal size. What are the shapes of three parts of the mirror?

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9. What is the advantage of using a parabolic concave mirror over ordinary spherical concave mirror ?

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10. A parallel beam of light strikes a (i) plane mirror (ii) a convex mirror and (iii) a concave mirror. What is the deviation produeced in each case in terms of the angle of incidence (i) ?

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11. Use the mirror equation to show that an object placed between $f \text{ and } 2f$ of a concave mirror forms an image beyond $2f$.

Watch Video Solution

12. what is the relation between $f \text{ and } R$ of a spherical mirror ?

Watch Video Solution

13. what is the relation between f and R of a spherical mirror ?

Watch Video Solution

14. Give some practical applications of spherical mirrors.

Watch Video Solution

Long Answer (a)

1. Name two types of spheircal mirrors, Define pole, centre of curvature and angular aperture of the mirror.

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2. Define principal focal length and redius of curvature of a mirror. Establish relation between them for (i), concave mirror and (ii) convex mirror.

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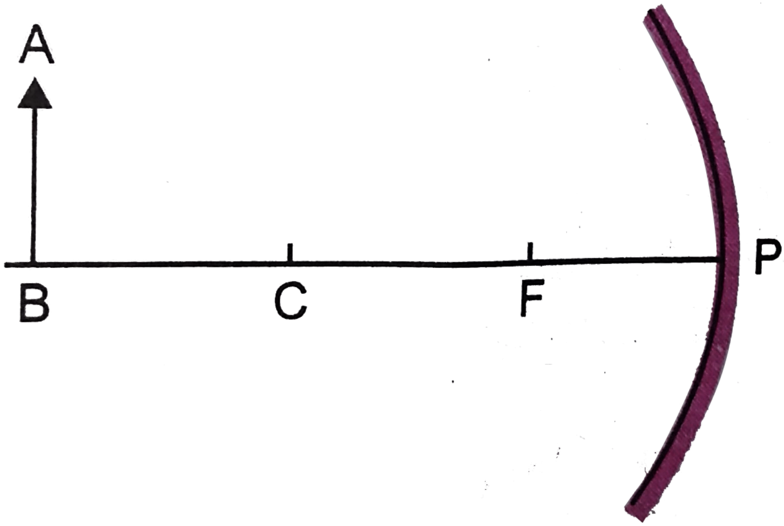
3. What is meant by linear magnification of spherical mirrors ? Deduce the formula for the same.

Watch Video Solution

4. Establish relation between the speeds of object and image formed by a spherical mirror.

Watch Video Solution

5. An object AB is kept in front of a concave mirror as shown in Fig.



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

(ii) How will the position and intensity of the image be affected surface is painted black ?

Watch Video Solution

Problem For Practice(b)

1. A mark is made on the bottom of beaker and a microscope is focussed on it. The microscope is raised through $1.5cm$. To what height water must be poured into the beaker to bring the mark again into focus ? Given that μ for water is $4/3$.

Watch Video Solution

2. Calculate the speed and wavelength of light

(i) in glass

(ii) in air, when light waves of frequency $6 \times 10^{14} Hz$. Travel from air to glass of $\mu = 1.5$.

Watch Video Solution

3. The refractive index of diamond is 2.47 and that of glass is 1.51. How much faster does light travel in glass than in diamond ?

Watch Video Solution

4. A pond of depth $20cm$ is half filled with an oil of $\mu = 1.4$ and the other half is filled with water of refractive index 1.33. Calculate apparent depth of the tank when viewed normally.

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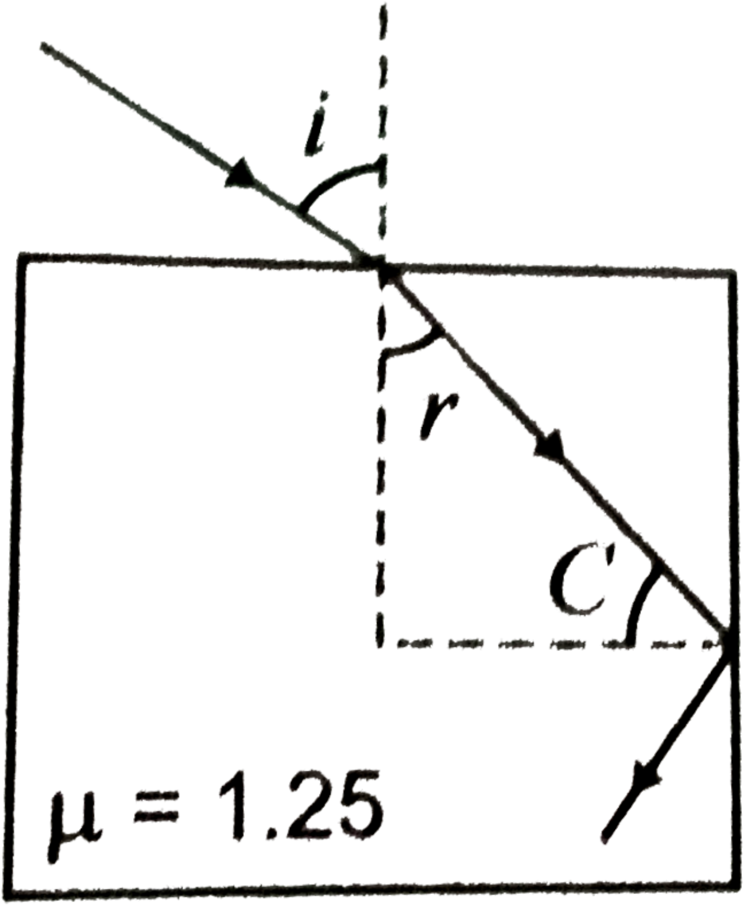
5. A ray of light is incident at an angle of 60° on one face of a rectangular glass slab of thickness $0.1m$, and refractive glass slab of thickness $0.1m$, and refractive index 1.5. Calculate the lateral shift produced.

Watch Video Solution

6. In Fig., find the maximum angle i for which light suffers total internal reflection at the vertical surface.



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7. Calculate the critical angle for glass air surface if a ray of light which is nicident ni air on the glass surface is deviated through 15°, when the angle of incidence is 45°.

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8. A small bulb (assumed to be a point source) is placed at the bottom of a tank containing water to a depth of $80cm$. Find out the area of the surface of water through which light from thr bulb can emerge. Take the value of refractive index of water to be $4/3$.

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9. A refractive indices of glycerine and water are 1.46 and 1.33 respectively. What is the critical angle when the ray passes from gycerine to water ?

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10. A point source of monochromatic light 'S' is kept at the centre of the bottom of a cylinder of radius $15.0 cm$. The cylinder contains water (refractive index 4//3) to a height of $7.0 cm$. Draw the ray diagram and calculate the area of water surface through which the light emerges in air.

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11. When a fish looks up the surface of a perfectly smooth lake, the surface appears dark except inside a circular area directly above it. Calculate the angle that this illuminated region subtends. Given μ of water $= 1.333$.

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12. A right prism is to be made by selecting a proper material and the angles A and B $(B \leq A)$ as shown in figure. It is desired that a ray of light incident normally on AB emerges parallel to the incident direction after two internal reflection.a. What should be the minimum refractive

index μ for this to be possible? b. F or $\mu = \frac{5}{3}$ is it possible to achieve this with the angle A equl to 60 degrees?

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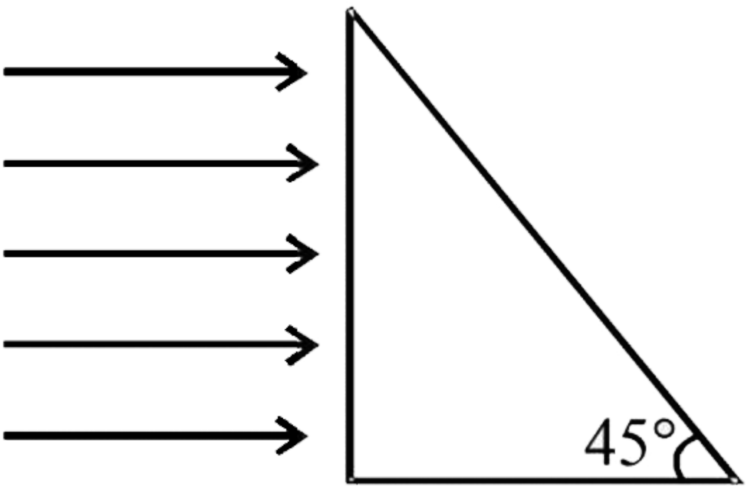
13. A beam of light consisting of red, green and blue colours is incident on a right angled prism, fig. The refractive indices of the material of the prism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The prism will `



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14. Calculate the speed of light in a medium whose critical angle is 45°.

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15. Velocity of light in a liquid is $1.5 \times 10^8 m/s$ and in air, it is $3 \times 10^8 m/s$. If a ray of light passes from this liquid to air, calculate the value of critical angle.

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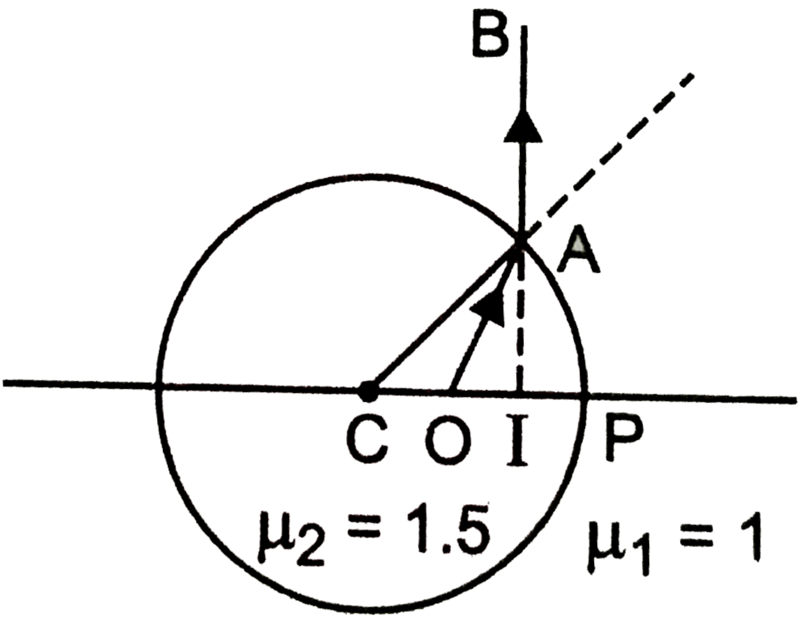
16. A small air bubble in a glass sphere of radius $2cm$ appears to be $1cm$ from the surface when looked at, along a diameter. If the refractive index of glass is 1.5, find the true position of the air bubble.



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17. An object is placed $50 cm$ from the surface of a glass sphere of radius $10 cm$ along the diameter. Where will the final image be formed after refraction at both the surfaces ? μ of glass $= 1.5$.

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18. A spherical surface of radius 30 cm separates two transparent media A and B with refractive indices 1'33 and 1.48 respectively. The medium A is on the convex side of the surface. Where should a point object be placed in medium A so that the paraxial rays become parallel after refraction at the surface ?

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19. An air bubble in a glass sphere $(\mu = 1.5)$ is situated at a distance $3cm$ from a convex surface of diameter $10cm$. At what distance from the surface will the bubble appear ?

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20. A convex refracting surface of radius of curvature $20cm$ separates two media of refractive indices $4/3$ and 1.60. An object is placed in the first medium $(\mu = 4/3)$ at a distance of $200cm$ from the refracting surface. Calculate the position of image formed.

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21. A sphere of glass $(\mu = 1.5)$ is of $20cm$ diameter. A parallel beam enters it from one side. Where will it get focussed on the other side ?

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22. A beam of light strikes a glass sphere of diameter $15cm$ convering towards a point $30cm$ behind the pole of the spherical surface. Find the position of the image, if μ of glass is 1.5.

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23. One end of a horizontal cylindrical glass rod $(\mu = 1.5)$ of radius 5.0 cm is rounded in the shape of a hemisphere. Asnobject 0.5 mm high is placed perpendicular to the axis of the rod at a difference of 20.0 cm from the rounded edge. Locate the image of the object and find its height.

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24. A spherical convex surface separates object and image space of refractive index 1.0 and $\frac{4}{3}$. If radius of curvature of the surface is $10cm$, find its power.

Watch Video Solution

25. The radii of curvatureof double convex lens of glass $(\mu = 1.5)$ are in the ratio of $1:2$. This lens renders the rays parallel coming from an illuminated filament at a distance of $6cm$. Calculate the radii of curvature of its surfaces.

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26. A convex lens of focal legnth $0.2m$ and made of glass $(\mu = 1.50)$ is immersed in water $(\mu = 1.33)$. Find the change in the focal length of the lens.

Watch Video Solution

27. A converging lens has a focal length of $20cm$ in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, what will be its new foacl length ?

Watch Video Solution

28. The radii of curvature of each surface of a convex lens is $20cm$ and the refractive index of the material of the lens is $3/2$ (i) Calculate its focal length (ii) If this is cut along the plane AB. What will be formed ? (iii) What happens if the lens is cut along CD ?

Watch Video Solution

29. A convex lens made up of glass of refractive index 1.5 is dippedin turn

(i) in a medium of refractive index 1.65

(ii) in a medium of refractive index 1.33

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

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

Watch Video Solution

30. A diverging lens of refractive index 1.5 and focal length $15cm$ in air has same radii of curvature for both sides. If it is immersed in a liquid of refractive index 1.7, calculate focal length of the lens in liquid.

Watch Video Solution

31. The radii of curvature of the surfaces of a double convex lens are $20cm$ and $30cm$. What will be its focal length and power in air and water respectively ? Refractive indices for glass and water are $3/2$ and $4/3$ respectively.

Watch Video Solution

32. A convex lens made up of glass of refractive index 1.5 is dippedin turn

(i) in a medium of refractive index 1.65

(ii) in a medium of refractive index 1.33

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

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

Watch Video Solution

33. A biconvex lens is made of glass with $\mu = 1.52$. Each surface has a radius of curvature equal to $30cm$. An object of height $3cm$ is placed $14cm$ from the lens. Find the focal length of the lens and the position and size of image.

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34. A concave lens has same radii of curvature for both sides and is made of material of refractive in index 1.6 It is immersed in a liquid of $\mu = 1.4$ Calculate ratio of focal lengths of lens in air and liquid.

Watch Video Solution

35. A double convex lens of 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.

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36. Convex lens is made of glass of refractive index 1.5 If the radius of curvature of each of the two surfaces is $20 cm$ find the ratio of the powers of the lens, when placed in air to its power, when immersed in a liquid of refractive index 1.25.

Watch Video Solution

37. A glass convex lens has a power of $+10D$. When this lens is totally immersed in a liquid, it acts as a concave lens of focal length $50cm$. Calculate the refractive index of the liquid. Given $.^{a}\mu_{g}=1.5$.

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38. A convex lens of focal length $20cm$ and made of glass $(\mu=1.5)$ is immersed in water of $\mu=1.33$ Calculate change in focal length of the lens.

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39. A thin converging lens made of glass of refractive index 1.5 acts as a concave lens of focal length $50cm$, when immersed in a liquid of refractive index $15/8$. Calculate the focal length of converging lens in air.

Watch Video Solution

40. Find the radius of curvature of convex surface of a plano convex lens, whose focal length is $0.3m$ and $\mu = 1.5.$

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41. A corverging lens has a focal length of $20cm$ in air. It is made of a material of refractive index 1.6. If is immersed in a liquid of refractive index 1.3, what will be its new focal length ?

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42. A diverging lens of refractive index 1.5 and focal length $15cm$ in air has same radii of curvature for both sides. If it is immersed in a liquid of refractive index 1.7, calculate focal length of the lens in liquid.

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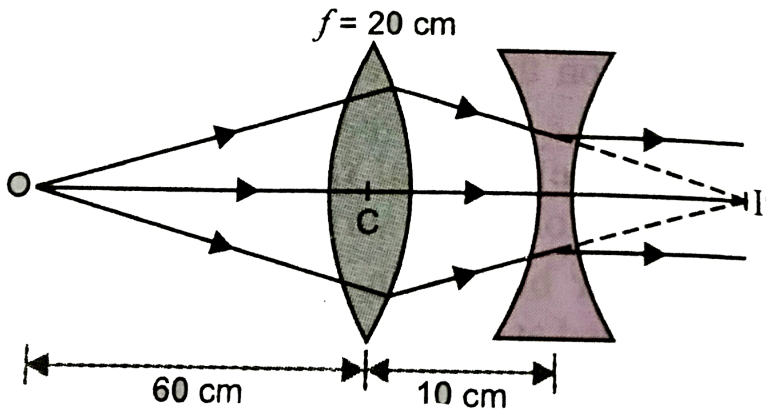
43. From the ray diagram shown in Fig. calculte the focal length of concave lens.



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44. A convex lens is used to throw on a screen $10m$ from the lens, a magnified image of an object. If the magnification is to be 19, find the focal length of the lens.

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45. An object is placed at a distance of $1.5m$ from a screen and a convex lens is interposed between them. The magnification produced is 4. What is the focal length of the lens ?

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46. A screen is placed $80cm$ from an object. The image of the object on the screen is formed by a convex lens at two different locations separated by $10cm$. Calculate the focal length of the lens used.

Watch Video Solution

47. A convergent beam of light passes through a diverging lens of focal length $0.2m$ and comes to focus at a distance of $0.3m$ behind the lens. Find the position of the point at which the beam would converge in the absence of the lens.

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48. The image obtained with a convex lens is erect and its length is 4 times the length of the object. If the focal length of lens is $20cm$, calculate the object and image distances.

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49. An illuminated object and a screen are placed $90cm$ apart. What is the focal length and nature of the lens required to produce a clear image on the screen twice the size of the object ?

Watch Video Solution

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

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

Watch Video Solution

52. A biconvex lens has focal length $\frac{2}{3}$ times the radius of curvature of either surface. Calculate refraction index f material of the lens.

Watch Video Solution

53. An object is placed at a distance of $1.5m$ from a screen and a convex lens is interposed between them. The magnification produced is 4. What is the focal length of the lens ?

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54. Find the focal length and power of a convex lens, which when placed in contact with a concave lens of focal length $25cm$ forms a real image 5 times the size of the object placed $20cm$ from the combination.

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55. Find the focal length and nature of lens which should be placed in contact with a lens of focal length $10cm$ so that the power of the combination becomes 5 dioptre.

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56. Two lenses, one diverging of power 2 diopyre and the other converging of power $6dioptre$ are combined together. Calculate focal length and power of the combination.

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57. Two lenses of power $+10D$ and $-5D$ are placed in contact,

(i) Calculate the focal length of the combination

(ii) where should an object be held from the combination so as to obtain a virtual image of magnification 2 ?

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58. A point object is placed $60cm$ in front of a convex lens of focal length $15cm$. A plane mirror is placed $10cm$ behind the convex lens. Where is the image formed by the system ?

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59. A convex lens of focal length $15cm$, and a concave mirror of radius of curvature $20cm$ are placed co-axially $10cm$ apart. An object is placed in front of convex lens so that there is no parallax between the object and its image formed by the combination. Find the position of the object.

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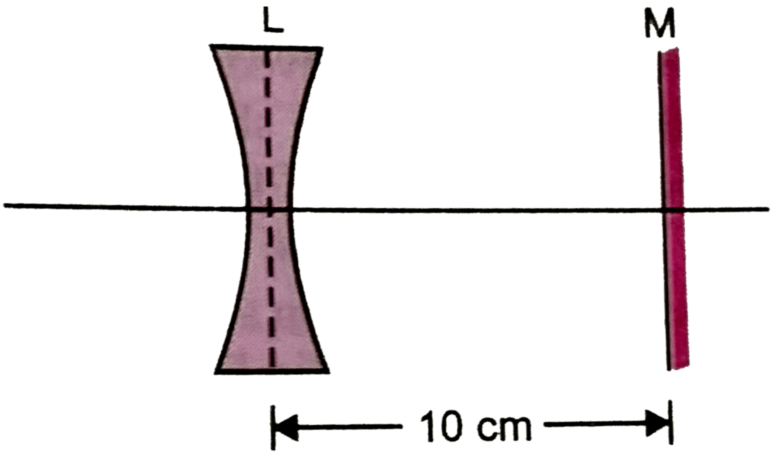
60. Fig. shows a plane mirror M placed at a distance of $10cm$ from a concave lens L. A point object is placed at a distance of $60cm$ from the lens. The image formed due to refraction by the lens and reflection by the mirror is $30cm$ behind th mirror. What is the focal length of this lens ?



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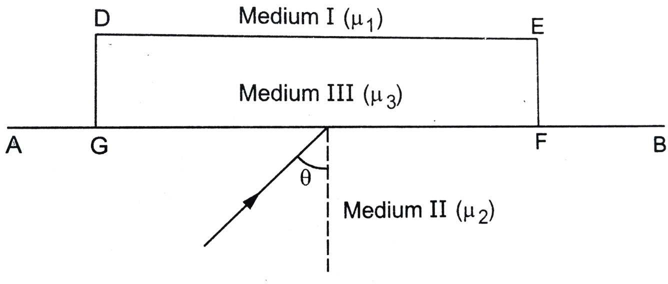
61. Monochramatic light is incident on the pLane interface AB between two media of refractive indices μ_1 and $\mu_2(\mu_2 > \mu_1)$ at an angle of incidence theta as shown in figure. The angle theta is infinitesimally greater thannte critical angle for the two media so thast total internal reflection takes place. Now, if a transparent slab DEFG of uniform thickness and of refractive inde μ_2 is introduced on theinterface (as shown in figure) , show that for any value of μ_2 all light will ultimately be reflected back into medium II.



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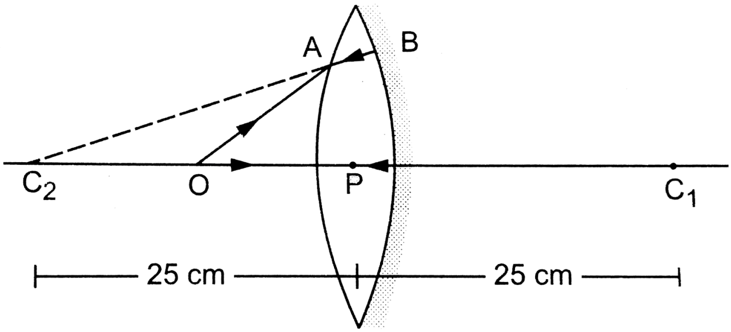
62. The image of a needle placed $45cm$ from a lens is formed on a screen placed $90cm$ on the other side of lens. Find displacement of image if object is moved $5cm$ away from lens.

Watch Video Solution

63. A biconvex thin lens is prepared from glass $(\mu = 1.5)$, the two bounding surfaces having equal radii of 25 cm each. One of the surfaces is silvered from outside to make it reflecting. Whee should an object be placed before this lens so that the image is formed on the object itself?



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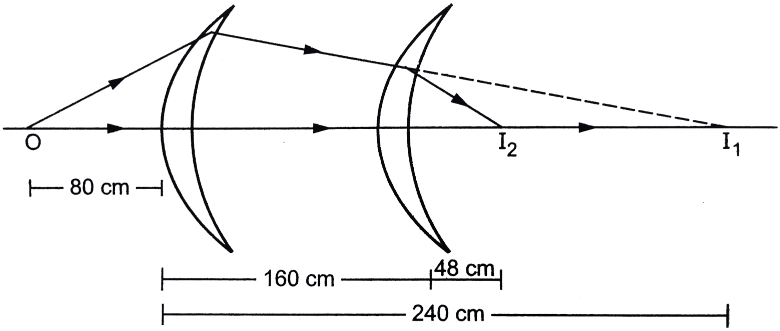
64. A concave convex figure lens made of glas $(\mu = 1.5)$ has surface of radii 20 cm and 60 cm. a. Locate the image ofan object placed 80 cm to the left of the lens along the principal axis. B. A similar lens is placed coaxially at distanc of 160 cm right of it. Locate the position of the image.



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65. A converging beam of light forms a sharp image on a screen. A lens is placed in the path of the beam at $10cm$ from the screen. It is found that the screen has to be moved $8cm$ further away from the lens to obtain a sharp image. Find the focal length and nature of the lens.

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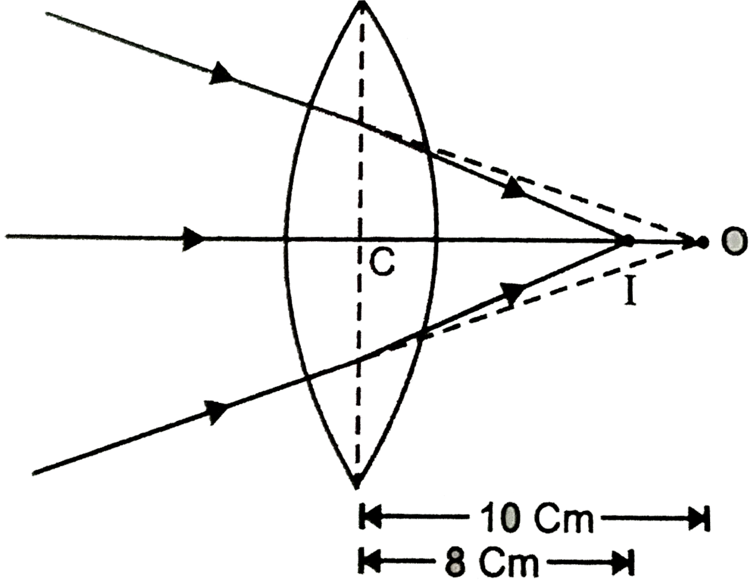
66. Rays of light are falling on a convex lens of focal length $40cm$. As shown in Fig. Determine the position of the image.



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Problem For Practice(c)

1. Calculate the refractive index of the material of an equilateral prism for which angle of minimum deviation is 60°.

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2. A ray of light suffers minimum deviation, while passing through a prism of refractive index 1.5 and refracting angle 60°. Calculate the angle of deviation and angle in incidence.

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3. A ray of light is inclined to one face of a prism at an angle of 50°. The angle of prism is 60° and the ray deviates through an angle which the emergent ray makes with second face of the prism.

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4. A glass prism has a refracting angle of 60°. The angle of minimum deviation is 40°. If velocity of light in vacuum is $3 \times 10^8 m/s$. Calculate the velocity of light in glass. What is the angle of incidence ?

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5. A small angled prism $(\mu - 1.62)$ gives a deviation of 4.8. Calculate the angle of prism.

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6. Show that the angle of deviation produced by a thin prism is reduced to one fourth (w.r.t. air) when it is immersed in water. Given $.^a \mu_g = 3/2$ and $.^a \mu_g = 4/3$.

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7. The refractive index of the material of a prism of 60° angle for yellow light is $\sqrt{2}$. Calculate angle of minimum deviation, angle of incidence and angle of refraction.

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8. A prism of refractive index 1.53 is placed in water of refractive index 1.33. If the angle of prism is 60°, calculate the angle of minimum deviation in water.

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9. A ray of light is inclined to one face of a prism at an angle of 60°. If angle of prism is 60° and the ray deviated through an angle of 42° find the angle which the emergent ray makes with second face of the prism.

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10. A glass prism has a refracting angle of 60°. The angle of minimum deviation is 40°. Find the refractive index. At what angle should the ray be incident so as to suffer minimum deviation ?

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11. The angle of minimum deviation for prism of angle $\pi/3 is \pi/6$. Calculate the velocity of light in the material of the prism if the velocity of light in vacuum is $3 \times 10^8 ms^{-1}$.

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12. A glass prism of angle 72° and refractive index 1.66 is immersed in a liquid of $\mu = 1.33$. Calculate the angle of minimum deviation.

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13. A prism with refracting angle 60° gives angle of minimum deviation, $53^\circ, 51^\circ$ and 52° for blue, yellow and red light respectively. What is the dispersive power of the prism ?

Watch Video Solution

14. The refractive indices of a prism for red, violet and yellow lights are $1.52, 1.62$ and 1.59 resp. What is the dispersive power of the prism ? If mean deviation is 40°. What is angular dispersion produced by the prism ?

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15. Find the angle of flint glass prism which produces the same angular dispersion for c and F wavelengths in 10° crown glass prism.

For crown glass : $\mu_F = 1.5230, \mu_c = 1.5145$

For flint glass : $\mu'_F = 1.6637, \mu'_c = 1.6444.$

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16. The deviations produced for violet, yellow and red lights in case of flint glass prism are $3.32^{\circ}, 3.27^{\circ}$ and 3.22° respectively. Calculate dispersive power of flint glass.

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17. The refractive indices of crown and flint glasses for violet and red light are 1.523, 1.513, 1.773 and 1.743 respectively. Find the dispersive powers of the glasses.

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18. The minimum deviations suffered by red, yellow and violet beams passing passing through an equilateral transparent prism are 38.4°, $38.76 \circ$ and 39.2° respectively. Calculate the dispersive power of the medium.

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19. Determine the angle of flint glass prism, which should be combined with a crown glass prism of 5° so as to give dispersion, but no deviation.

Given for crown glass, $\mu_v = 1.523, \mu_r 1.515$ For flint glass, $\mu_v' = 1.688, \mu_r' = 1.650.$

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20. Calculate angle of dispersion between red and violet colours produced by a flint glass prism of refracting angle $60^\circ. Mu_v = 1.663 \text{ and } \mu_r = 1.622.$

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21. Calculate the angle of a prism of dispersive power 0.021 and refractive index 1.53 to form an achromatic combination with prism of angle 4.2°, and dispersive power 0.045, having refractive index 1.65. Find also the net deviation.

A. $-7.08^\circ, -4.66^\circ$

B. $-11.04^\circ, -3.12^\circ$

C. $-11.04^{\circ}, -6.02^{\circ}$

D. $-6.08^{\circ}, -1.21^{\circ}$

Answer: B

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22. One face of prism of refracting angle 30° and refractive index 1.414 is silvered. At what angle must a ray of light fall on the unsilvered face so that it retraces its path out of the prism ?

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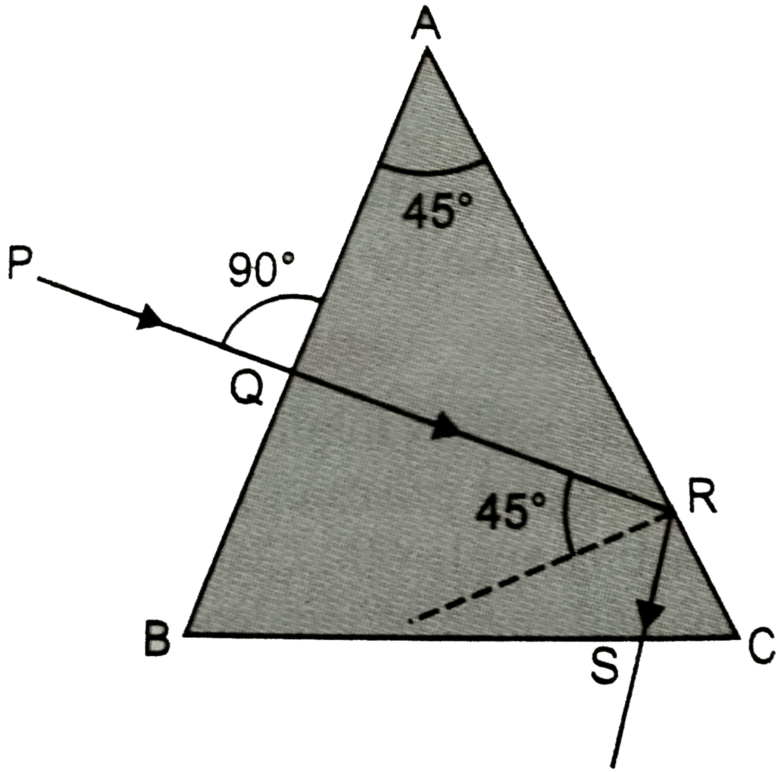
23. As shown in Fig. PQ is a ray incident on prism ABC. Show the corresponding refracted and emergent rays. The critical angle for the material of the prism is 45°. What is refractive index of the material of prism ?



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24. The refractive index of a material M_1 changes by 0.014 and that of another material M_2 changes by 0.024 as the colour of the light is changed from red to violet. Two thin prisms one made of $M_1(A = 5.3^\circ)$ and other made of $M_2(A = 3.7^\circ)$ are combined with their refracting

angles oppositely directed.

(a) Find the angular dispesion produced by the combination.

(b) the prisms are now combined with their refracting angles similarly directed. Find the angular dispersion produced by the combination.

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25. The refractive index of a prism with apex angle A is $\cot A/2$. Prove that the angle of minimum deviation is $\delta_m = (180^\circ - 2A)$.

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26. The refracting angle of a glass prism is 60° and μ of its material is 1.45. Calculate angle of incidence at the first that will just reflect internaly the ray at the second face.

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27. The dispersive powers of crown and flint glasses are $0.03 \text{ and } 0.05$ respectively. The difference in refractive indices for blue and red colour is 0.015 for crown glass and 0.022 for flint glass. Calculate the angles of the two prisms for a deviation of 2° without dispersion.

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Problem For Practice(d)

1. The far point of a myopic person is $150cm$ in front of the eye. Calculate the focal length and power of a lens required to enable him to see distant objects clearly.

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2. A short sighted person is wearing specs of power $-3.5D$. His doctor prescribes a correction of $+2.5D$ for his near vision. What is focal length of his distance viewing part and near vision. What is focal length of his distance viewing part and near vision part ?

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3. A short sighted person cannot see clearly beyond $2m$. Calculate power of the lens required to correct his eye to normal vision.

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4. A myopic person can see things clearly only when they lie between $10cm$ and $100cm$ from his eye. Which lens will enable him to see the moon clearly.

Watch Video Solution

5. A person cannot see the objects distinctly, when placed at a distance less than $100cm$. What is the power of the spectacles that he should use to see clearly, the objects placed at $25cm$?

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6. The distance of distinct vision of a person is $50cm$. He wants to read a book placed at $25cm$. What should be the focal length of the spectacles ?

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7. A person can see the objects lying between $25cm$ and $10m$ from his eye. His vision can be corrected by using lens of power $-0.1D$, Is the statement true or false ?

Watch Video Solution

8. A person has normal for point (infinity) and normal near point (25 cm). He intends to read a book using a magnifying glass of $f = 5cm$. What is the

(i) Closest and

(ii) farthest distance at which he can read the book through the magnifying glass.

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9. An object is to be seen through a simple microscope of power $10D$. Where should an object be placed to produce maximum angular magnification ? Least distance of distinct vision is $25cm$.

Watch Video Solution

10. A simple microscope is rated $5X$ for a normal relaxed eye. What will be its magnifying power for a relaxed far sighted eye whose near point is $40cm$.

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11. The focal lengths of the objective and eye piece of a microscope are $2cm$ and $5cm$ respectively, and the distance between them is $20cm$. Find the distance of the object from the objective when the final image seen by the eye is $25cm$ from the eye piece. What is the magnifying power ?

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12. The focal lengths of the eye piece and objective of a compound microscope are $5cm$ and $1cm$ respectively, and the length of the tube is $20cm$. Calculate magnifying power of microscope when the final image is formed at inifinity. The least distance of distinct cision is $25cm$.

Watch Video Solution

13. A convex lens of focal length $5cm$ is used as a simple microscope. What will be the magnifying power when the image is formed at the least distance of distinct vision ?

Watch Video Solution

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14. A compound microscope has a magnifying power 30. The focal length of its eye-piece is $5cm$. Assuming the final to be at the least distance of distinct vision $(25cm)$, calculate the magnification produced by objective.

Watch Video Solution

15. A compound microscope is made using a lens of focal $10mm$ as objective and another lens of focal length $15mm$ as eye piece. An object is held $1.1cm$ from the objective and final image is obtained at ∞. Calculate distance between objective and eye piece.

Watch Video Solution

16. A compound microscope uses an objective lens of focal length $4cm$ and eye lens of focal length $10cm$. An object is placed at $6cm$ from the objective lens. Calculate magnifying power of compound microscope if final image is formed at the near point. Also, calculate length of the tube of compound microscope.

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17. 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 eye piece is observed to be $14cm$. If least distance of distinct vision is $20cm$, calculate the focal length of objective and eye piece.

Watch Video Solution

18. The magnifying power of an astronomical telescope is 5. When it is set for normal adjustment, the distance between the two lenses is $24cm$. Calculate the focal lengths of eye piece and objective lens.

Watch Video Solution

19. The magnifying power of an astronomical telescope in the normal adjustment position is 100. The distance between the objective and eye piece is $101cm$. Calculate the focal lengths of objective and eye piece.

Watch Video Solution

20. An astronimical telescope is to be designed to hve a magnifying power of 50 in normal adjustment. If the length of the tube is 102 cm, fid the powers of the objective and the eyepiece.

Watch Video Solution

21. A refracting telescope has an objective of focal length $1m$ and an eye piece of focal length $20cm$. The final image of the sun $10cm$ in diameter is formed at a distance of $24cm$ from eye piece. What angle does the sun subtend at the objective ?

Watch Video Solution

22. A gaint refrecting telescope at an observatory has an objective lens of focal length $15m$. If an eye piece lens of focal length $1cm$ is used, find the angular magnification of the telescope.

If this telescope is used to view the moon, what is the diameter of image of moon formed by objective lens ? The diameter of the moon is $3.42 \times 10^6 m$ and radius of lunar orbit is $3.8 \times 10^8 m$.

Watch Video Solution

23. A telescope has an objective of focal length $30cm$ and an eye piece of focal length $3.0cm$. It is focussed on a scale distant $2.0m$. For seeing with relaxed aye, calculate the separation between the objective and eye piece.

Watch Video Solution

24. A telescope consists of two lenses of focal lengths $20cm$ and $5cm$. Obtain its magnifying power when final image is

(i) at infinity

(ii) at $25cm$ from the eye.

Watch Video Solution

25. A telescope consists of two lenses of focal lengths $0.3m$ and $3cm$ respectively. It is fucussed on moon which subtends an angle of 0.5° at the obejctive. Calculate the angle subtended at the eye by the final image in normal adjustment of the telescope.

Watch Video Solution

26. A reflecting type telescope has a concave reflector of radius of curvature $120cm$. Calculate focal length of eye piece to secure a magnification of 20.

Watch Video Solution

27. How would you combine two lenses of focal lengths $25cm$ and $2.5cm$ to make a telescope ? What is the magnifying power of this telescope ?

Watch Video Solution

28. Two boys one 52 inches tall and the other 55 inches tall, are standing at distances 4.0 m and 5.0 m respectivley from an eye. Which boy will taller?

Watch Video Solution

29. The angular magnification of a telescope is 300 What should be the diameter of the objective, if our eyes at the eye ring, are just able to collect all the light refracted from the objective. Take diameter of pupil of eye $= 3mm.$

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30. The image of the moon is focussed by a converging lens of focal length 50 cm on a plane screen. The image is seen by an unaided eye from a distance of 25 cm. Find te angular magnificatioin achievd due to the converging lens.

Watch Video Solution

31. A telescope objective lens has a focal length of $100cm$. When the final image is formed at the least distance of distinct vision, the distance between the lenses is $105cm$. Calculate the focal length of eye piece and magnifying power of telescope.

Watch Video Solution

32. A compound microscope has lenses of focal length $10mm$ and $30mm$. An object placed at $1.2cm$ from the first lens is seen through the second lens at $0.25m$ from the eye lens. Calculate

(i) magnifying power

(ii) distance between the two lenses.

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33. In a compound microscope, the objective and eye piece have focal lengths $0.95cm$ and $5cm$ respectively, and are kept at a distance of $20cm$. The final image is formed at a distance of $25cm$ from the eye piece. Calculate the position of the object and the total magnification.

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34. A reflecting type telescope has a concave reflector of radius of curvature $120cm$. Calculate the focal length of eye piece tom secure a magnification of 15.

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35. The lens of human eye has a diameter of $0.8cm$. How much fainter star can be seen through $508cm$ objective of an astronomical telescope at Mount Polomar in USA ?

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(Test Your Grip)Multiple Choice (b)

1. What is the refractive index of a medium in which light travels with a speed of $2 \times 10^8 m/s$?

A. $3/2$

B. $2/3$

C. 1

D. none of these

Answer: A

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2. Refractive index of glass w.r.t water is $9/8$. What is the speed of light in water ? Given speed pf light in glass is $2 \times 10^8 m/s$.

A. $2 \times 10^8 m/s$

B. $3 \times 10^8 m/s$

C. $2.25 \times 10^8 m/s$

D. none of these

Answer: C

Watch Video Solution

3. A small ink dot on a paper is seen through s glass slab of thickness $4cm$ and refractive index 1.5. The dot appears to be raised by

A. 1 cm

B. 2 cm

C. 3 cm

D. 1.33 cm

Answer: D

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4. For total internal reflection, light must travel

A. from rarer to denser medium

B. from denser to rarer medium

C. in air only

D. in water only

Answer: B

Watch Video Solution

5. Optical fibers are based on the phenomenon of

A. reflection

B. refraction

C. dispersion

D. total internal reflection

Answer: D

Watch Video Solution

6. The relation governing refraction of light from rarer to denser medium at a spherical refracting surface is

A. $-\frac{\mu_1}{u}+\frac{\mu_2}{v}=\frac{\mu_2-\mu_1}{R}$

B. $\frac{\mu_1}{u}+\frac{\mu_2}{v}=\frac{\mu_2-\mu_1}{R}$

C. $\frac{\mu_1}{u}-\frac{\mu_2}{v}=\frac{\mu_2-\mu_1}{R}$

D. none of these

Answer: A

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7. In the above question, the ralation remains the same whether

(A) image is real or virtual

(B) refracting surface is convex or cancave

(C)light is going from rarer to denser medium or from denser to rarer medium

(D) object is close to far off from the refracting surface

Choose the wrong statement

A. A

B. B

C. C

D. D

Answer: C

Watch Video Solution

8. The focal length of a double convex lens is equal to radius of curvature of either surface. The refractive index of its material is

A. 43526

B. 1

C. 43558

D. none of these

Answer: A

Watch Video Solution

9. One dioptre is the power of a lens of facal length

A. 1 cm

B. 1 m

C. $-1cm$

D. $-1m$

Answer: B

Watch Video Solution

10. Two lenses of focal lengths $20cm$ and $-40cm$ are held in contact. The image of an object at infinity will be formed by the combination at

A. oo

B. 20 cm

C. 40 cm

D. 60 cm

Answer: C

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(Test Your Grip)Multiple Choice (c)

1. Which of the following waves have the maximum wavelength?

A. red

B. violet

C. yellow

D. green

Answer: A

Watch Video Solution

2. In vacuum, which colour travels fastest ?

A. red

B. violet

C. yellow

D. all colours have the same velocity.

Answer: D

Watch Video Solution

3. In glass, the velocity of light is minimum for.

A. red

B. violet

C. yellow

D. green

Answer: B

Watch Video Solution

4. The deviation δ of a ray on passing through a prism of small angle A is.

A. $\dfrac{\mu - 1}{A}$

B. $\dfrac{A}{\mu - 1}$

C. $(\mu - 1)A$

D. none of these

Answer: C

Watch Video Solution

5. The relation between angle of incidence i, angle of prism A and angle of minimum deviation for a triangular prism is.

A. $i = A + \delta_m$

B. $i = \dfrac{A + \delta_m}{2}$

C. $\delta_m = i + A$

D. $\delta_m = i - A$

Answer: B

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6. When size of scatterer (x) is very much less than the wavelength (λ) of light, intensity of scattered light (I_s) varies as :

A. $I_s \propto \frac{1}{\lambda}$

B. $I_s \propto \frac{1}{\lambda^2}$

C. $I_s \propto \frac{1}{\lambda^4}$

D. $I_s \propto \frac{1}{\lambda^6}$

Answer: C

Watch Video Solution

7. A thin prism of 6° angle gives a deviation of 3°. The refractive index of the material of the prism is.

A. 1

B. $4/3$

C. $3/2$

D. 2

Answer: C

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8. An equilateral prism is made of made of material of refractive index $\sqrt{3}$.

Angle of minimum deviation through the prism is.

A. 60°

B. 30°

C. 45°

D. 90°

Answer: A

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9. One cannot cannot see through fog, because

A. fog absorbs the light

B. light suffers total reflection at droplets

C. refractive index of fog is infinity

D. light is scattered by droplets.

Answer: D

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10. The angle of minimum deviation for prism of angle $\pi/3is\pi/6$. The refractive index of the material of the prism is.

A. $\sqrt{3}$

B. $\sqrt{2}$

C. $3/2$

D. $2/3$

Answer: B

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(Test Your Grip)Multiple Choice (d)

1. In all optical instruments, we use.

A. ray optics

B. wave optics

C. physical optics

D. none of these

Answer: A

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2. For a normal eye, distance of near point from the eye is.

A. ∞

B. 25 cm

C. 25 m

D. none of these

Answer: B

Watch Video Solution

3. The lens used for correcting myopia is.

A. concave

B. convex

C. plano concave

D. none of these

Answer: A

Watch Video Solution

4. The correct formula for magnifying powerof a simple microscope is.

A. $m = \left(1 + \frac{f}{d}\right)$

B. $m = \left(1 - \frac{d}{f}\right)$

C. $m = \left(1 + \frac{d}{f}\right)$

D. $m = \left(1 - \frac{f}{d}\right)$

Answer: C

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5. In a compound microscope, the distance between objective lens and eye lens is.

A. fixed

B. variable

C. infinite

D. 1 metre

Answer: A

Watch Video Solution

6. For a total magnification of 175 from a compound microscope, the magnification produced by objective is 7. What should be the magnification produced by eye piece ?

A. 7

B. 25

C. 175×7

D. none of these

Answer: B

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7. The final image in a astronomical telescope (w.r.t. object) is.

A. virtual and erect

B. real and erect

C. real and inverted

D. virtual and inverted

Answer: D

Watch Video Solution

8. A telescope uses an objective lens of focal length f_0 and an eye lens of focal length f_e. In normal adjustment, distance between the two lenses is.

A. f_0 / f_e

B. f_e / f_0

C. $(f_0 - f_e)$

D. $(f_0 + f_e)$

Answer: D

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9. What focal length should the reading spectacles have for a person whose near point is $50cm$?

A. 25 cm

B. 50 cm

C. $-50cm$

D. $-25cm$

Answer: B

Watch Video Solution

10. An astronomical telescope has a magnifying power of 10. In normal adjustment, distance between the objective and eye piece is $22cm$. The focal length of objective lens is.

A. 10 cm

B. 22 cm

C. 20 cm

D. 2 cm

Answer: C

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(Test Your Grip)Fill in the blanks (b)

1. Refraction of light is the phenomenon of.......... When it............. .

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2. The basic cause of refraction is............in going............. .

Watch Video Solution

3. The sun is visible to us before actual.............and after.......... . This is because of ....

Watch Video Solution

4. Total internal reflection of light is the phenomenon of...........into........from........... .

Watch Video Solution

5. For total internal reflection, light must travel

Watch Video Solution

6. Total internal reflection will occure only when..................in............medium is..................than............for the pair of media in contact.

Watch Video Solution

7. Mirage is accounted for by.............. .

Watch Video Solution

8. When refraction occurs from denser to..........., then $\frac{\mu_2}{\mu_1}$ = ...

Watch Video Solution

9. For a double convex lens R_1 is............. And R_2 is............... . Therefore, its focal length is............ .

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10. One dioptre is...............of focal length......... .

Watch Video Solution

(Test Your Grip)Fill in the blanks (c)

1. A ray of light undergoes .... on passing through a prism.

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2. The deviation δ of a ray on passing through a prism of small angle A is.

Watch Video Solution

3. For prisms with bigger refracting angles, the deviation is calculated from the relation........... .

Watch Video Solution

4. The deviation through a prism is minimum when........... .

Watch Video Solution

5. In the minimum deviation position, the.......... In the prism is......... to the base of the prism.

Watch Video Solution

6. According to Cauchy's formula, the refractive index μ of a material is related to wavelength λ as.......... .

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7. Wavelength of violet colour is......... wavelength of red colour. Therefore, μ_v ....μ_r. Hence, δ_v .... δ_r.

Watch Video Solution

8. Angular dispersion of a prism is..........of...........and..........colours.

Watch Video Solution

9. Dispersive power of a prism is..........of..........and.......... .

Watch Video Solution

10. When size of scatterer (x) is very much less than the wavelength (λ) of light, intensity of scattered light (I_s) varies as :

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(Test Your Grip)Fill in the blanks (d)

1. A myopia eye can see clearly.........but the.........cannot be seen distinctly.

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2. A hypermetropic eye can see clearly..........but.........cannot be seen distinctly.

Watch Video Solution

3. Presbyopia is also called.......... .

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4. For a normal eye, the least distance of distinct vision is........and far point is............ .

Watch Video Solution

5. Magnifying power of a simple microscope is defined as the.........of angles.........when both are.......... .

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6. In a compound microscope, the objective lens and........are.......... .

Watch Video Solution

7. Focussing in a compound microscope is carried out by changing the........from the......... .

Watch Video Solution

8. In an astronomical telescope, the distance between..........and.......can be varied.

Watch Video Solution

9. In normal adjusment of telescope, final image is....... . And distance between objective lens and eye lens is.......... .

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10. In Cassegrainian telescope, objective lens is.........by............ .

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(Exemplar) Multiple choice

1. A ray of light incident at an angle θ on a refracting face of a prism emerges from the other face normally. If the angle of the prism is 5° and the prism is made of a material of refractive index 1.5, the angle of incidence is.

A. 7.5°

B. 5°

C. 15°

D. 2.5°

Answer: A

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2. A short pulse of white light is incident from air to a glass slab at normal incidence. After travelling through the slab, the first colour to emerge is.

A. blue

B. green

C. violet

D. red

Answer: D

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3. An object approaches a convergent lens from the left of the lens with a uniform speed $5m/s$ and stops at the focus. The image.q

A. moves away from the lens with uniform speed $5m/s$.

B. moves away from the lens with uniform acceleration.

C. moves away from the lens with a non-uniform acceleration.

D. moves towards the lens with a non-uniform acceleration.

Answer: C

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4. A passenger in an aeroplane shall

A. never see a rainbow

B. may see a primary and a secondary rainbow as concentric circles.

C. may see a primary and a secondary rainbow as concentric arcs.

D. shall never see a secondary rainbow.

Answer: B

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5. You are given four sources of light each one providing a light of a single colour-red, blue,green and yellow. Suppose the angle of refraction for a beam of yellow light corresponding to a particular angle of incidence at the interface of two media is 90°. Which of the folowing

statements is correct it the source of yellow light is replaced with that of other lights without changing the angle of incidence ?

A. The beam of red light would undergo total internal reflection.

B. The beam of red light would bend towards normal while it gets refracted through the second medium.

C. The beam of blue light would undergo total internal reflection.

D. The beam of green light would bend away from the normal as it gets refracted through the second medium.

Answer: C

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6. The radius of curvature of the curved surface of a plano-convex lens is $20cm$. If the refractive index of the material of the lens be 1.5, it will

A. act as a convex lens only for the object that lie on its curved side.

B. act as a concave lens for the objects that lie on its curved side.

C. act as a convex lens irrespective of the side on which the object lies.

D. act as a concave lens irrespective of side on which the object lies.

Answer: C

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7. The phenomena involved in the reflected of radiowaves by ionosphere is similar to.

A. reflection of light by a plane mirror.

B. total internal reflection of light in air during a mirage.

C. dispersion of light by water molecules during the formation of a rainbow.

D. scattering of light by the particles of air.

Answer: B

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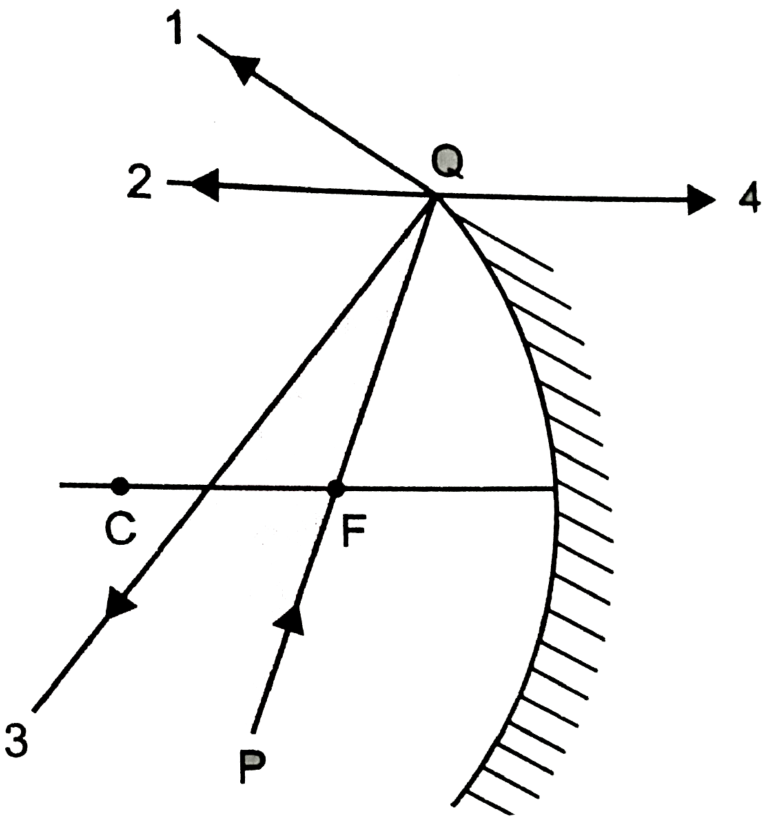
8. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked $1, 2, 3$ and 4, Fig. Which of the four rays correctly shows the direction of reflected ray ?



A. 1

B. 2

C. 3

D. 4

Answer: B

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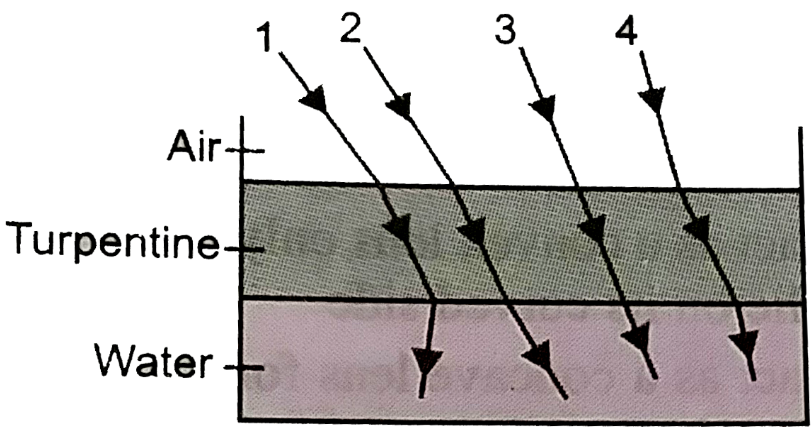
9. The optical density of turpentine is higher than that of water, while its mass density is lower. Fig. shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in Fig., the path shows is correct ?



A. 1

B. 2

C. 3

D. 4

Answer: B

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10. A car is moving with a constant speed of $60 km h^{-1}$ on a straight road. Looking at the rear view mirror, the driver finds that the car following him is at a distance of $100 m$ and is approaching with a speed of $5 km h^{-1}$. In order to keep track of the car in the rear, the driver begins to glane alternatively at the rear and side mirror of his car after every $2s$ till the other car overtakes. If the two cars were maintaining their speeds, which of the following statement (s) is/are correct ?

A. The speed of the car in the rear is $65 km h^{-1}$.

B. In the side mirror, the car in the rear would appear to approach with a speed of $5kmh^{-1}$ to the driver of the leading car.

C. In the rear view mirror, the speed of the approaching car would appear to decrease as the distance between the cars decreases.

D. In the side mirror, the speed of the approaching car would appear to increase as the distance between the cars decreases.

Answer: D

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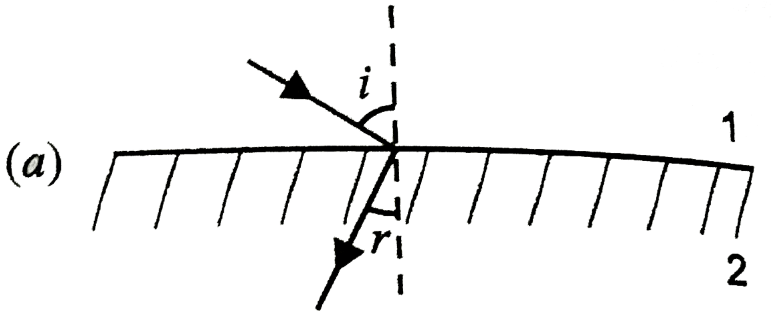
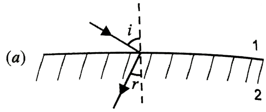
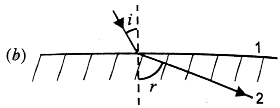
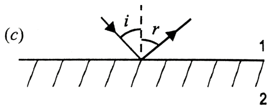
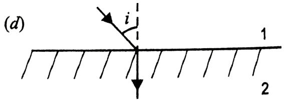
11. There are certain materials developed in laboratories which have a negative refractive index, Fig. A ray incident from air (medium 1) into such a medium (medium 2) shall follow a path given by



A. 

B. 

C. 

D. 

Answer: A

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12. Consider an extended object immersed in water contained in a plane through. When seen from close to the edge of the through, the object looks distorted because.

A. the apparent depth of the points close to the edge are nearer the surface of the water compared to the points away from the edge.

B. the angle subtended by the image of the object at the eye is smaller than the actual angle subtended by the object in air.

C. some of the points of the object far away from the edge may not be visible because of total internal reflection.

D. water in a through acts as a lens and magnifies the object.

Answer: A::B::C

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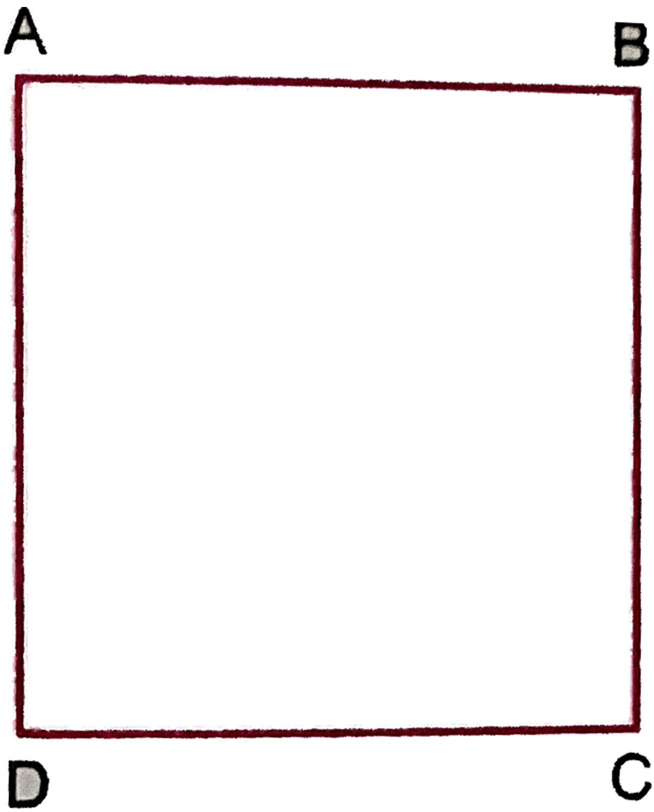
13. A rectangular block of glass $ABCD$ has a refractive index 1.6. A pin is placed midway on the faceAB, Fig. When observed from the face AD, the pin shall.



A. appear to be near A.

B. appear to be near D

C. appear to be at the centre of AD

D. not bee seen at all.

Answer: A::D

Watch Video Solution

14. Between the primary and secondary rainbows, there is a dark band known as Alexander's dark band. This is because

A. light scattered into this region interferes destructively.

B. there is no light scattered into this region.

C. light is absorbed in this region.

D. angle made at the eye by the scattered rays with respect to the incident light of the sun lies between approximately 42° and 50°.

Answer: A::D

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15. A magnifying glass is used, as the object to be viewed can be brought closer to the eye than the normal near point. This results in.

A. a larger angle to be subtended by the object at the eye and hence viewed in greater detail.

B. the formation of a virtual erect image.

C. increase in the field of view.

D. infinite magnification at the near point.

Answer: A::B

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16. An astronomical refractive telescope has an objective of focal length $20m$ and an eyepiece of focal length $2cm$.

A. The length of the telescope tube is $20.02m$.

B. The magnification is 1000.

C. The image formed is inverted.

D. An objective of a larger aperture will increase the brightness and reduce chromatic aberration of the image.

Answer: A::B::C

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(Competition)Multiple choice

1. A source of light lies on the angle bisector of two plane mirrors inclined at angle θ. The value of θ, so that the light reflected from one mirror does not reach the other mirror will be.

A. $\theta \geq 120^\circ$

B. $\theta \geq 90^\circ$

C. $\theta \leq 120^\circ$

D. none of these

Answer: A

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2. A ray of light travelling in the direction $\frac{1}{2}\left(\hat{i}+\sqrt{3}\hat{j}\right)$ is incident on a plane mirror. After reflection, it travels along the direction $\frac{1}{2}\left(\hat{i}-\sqrt{3}\hat{j}\right)$. The anglel of incidence is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: A

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3. The ratio of the speed of an object to the speed of its real image of magnification m in the case of a convex mirror is.

A. $-\frac{1}{m^2}$

B. m^2

C. $-m$

D. $\frac{1}{m}$

Answer: A

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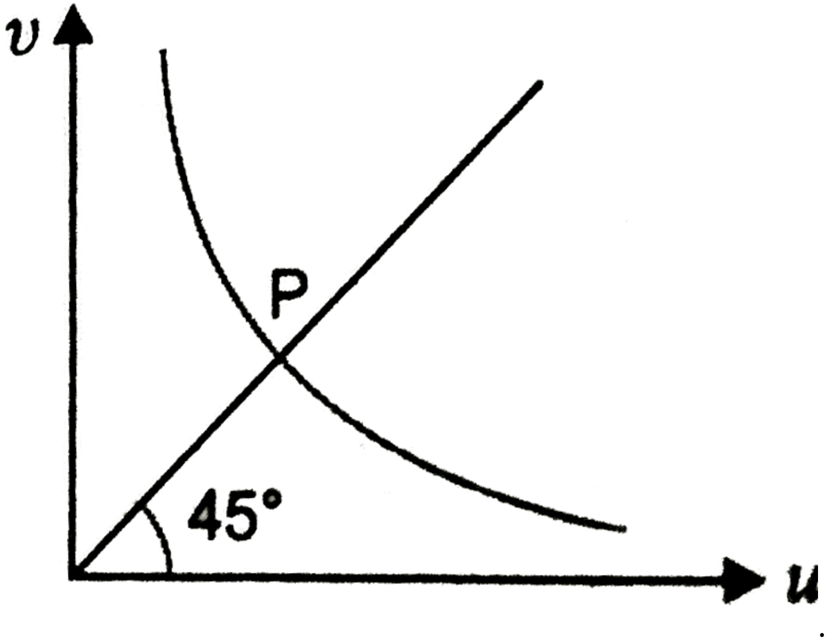
4. The graph in Fig. shows plot of variation of v with change in u for a concave mirror. Points plotted above the point P on the curve are for values of v :



A. smaller than f

B. smaller than $2f$

C. larger than $2f$

D. larger than f but less than $2f$

Answer: C

Watch Video Solution

5. A beam of light from a source L is incident normally on a plane mirrorr fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source L. When the mirrorr is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is given by :

A. $\frac{y}{2x}$

B. $\frac{y}{x}$

C. $\frac{x}{2y}$

D. $\frac{x}{y}$

Answer: A

Watch Video Solution

6. In a concave mirror, an object is placed at a distance d_1 from the focus and the real image is formed aat a distance d_2 from the focus. Then the focal length of the mirror is :

A. $\sqrt{d_1 d_2}$

B. $d_1 d_2$

C. $(d_1 + d_2)/2$

D. $\sqrt{d_1/d_2}$

Answer: A

Watch Video Solution

7. A short linear object of length b lies along the axis of a concave mirror of focal length f at a distanee u from the pole of the mirror. The size of the image is approximately equal to

A. $b\left(\frac{\mu - f}{f}\right)^{1/2}$

B. $b\left(\frac{f}{u - f}\right)^{1/2}$

C. $b\left(\frac{u - f}{f}\right)$

D. $b\left(\frac{f}{u - f}\right)$

Answer: D

Watch Video Solution

8. A car is fitted with a convex side-view mirror of focal length 20 cm. A second car 2.8m behind the first car is overtaking the first car at a relative speed of 15 $\frac{m}{s}$. The speed of the image of the second car as seen in the mrror of the first one is:

A. $-\frac{1}{15}m/s$

B. $10m/s$

C. $15m/s$

D. $\frac{1}{10}m/s$

Answer: A

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9. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that the end closer to the pole is 20 cm away from it. Find the length of the image.

A. 10 cm

B. 15 cm

C. 2.5 cm

D. 5 cm

Answer: D

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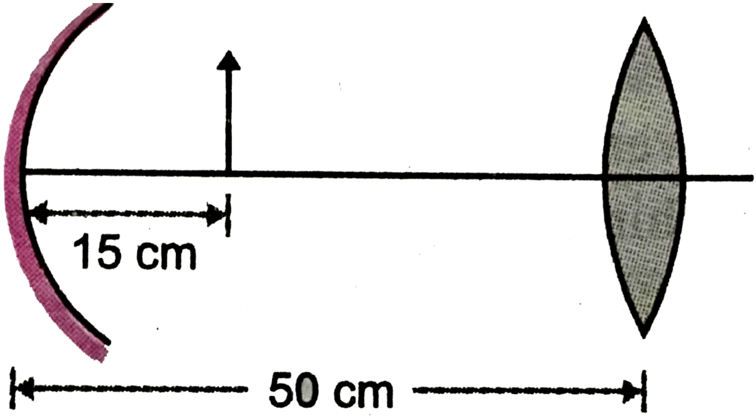
10. Consider a concave mirror and a convex lens (refractive index 1.5) of focal length $10cm$ each separated by a distance of $50cm$ in air (refractive index = 1) as shown in the Fig. An object is placed at a distance of $15cm$ from the mirror. Its erect image formed by this combination has magnification M_1. When this set up is kept in a medium of refractive index $7/6$, the magnification becomes M_2. The magnitude $\left(\frac{M_2}{M_1}\right)$ is :



A. 5

B. 6

C. 7

D. 8

Answer: C

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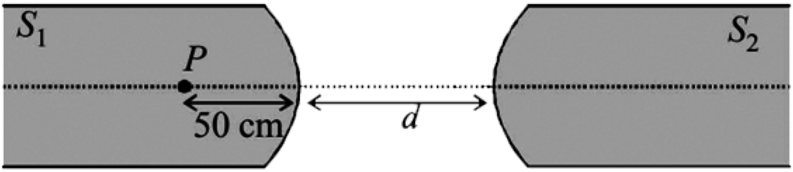
11. Two identical glass rods S_1 and S_2 (refractive index=1.5) have one convex end of radius of curvature 10 cm. They are placed with the curved surfaces at a distance d as shown in the figure, with their axes (shown by the dashed line) aligned. When a point source of light P is placed inside rod S_1 on its axis at a distance of 50 cm from the curved face, the light rays emenating from it are found to be parallel to the axis inside S_2. The distance d is



A. 60 cm

B. 70 cm

C. 80 cm

D. 90 cm

Answer: B

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

A. $-25cm$

B. $-50cm$

C. $50cm$

D. $-20cm$

Answer: B

Watch Video Solution

13. A diverging lens with magnitude of focal length $25cm$ is placed at a distance of $15cm$ from a converging lens of magnitude of focal length

$20cm$. A beam of parallel light falls on the diverging lens. The final image formed is.

A. real and at a distance of $40cm$ from the divergent lens.

B. real and at a distance of $6cm$ from the convergent lens.

C. real and at a distance of $40cm$ from convergent lens.

D. virtual and at a distance of $40cm$ from convergent lens.

Answer: C

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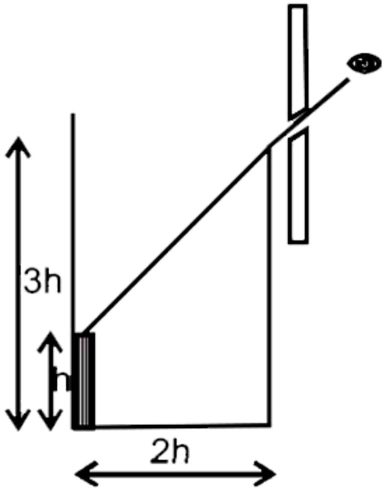
14. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is



A. $\frac{5}{2}$

B. $\sqrt{\frac{5}{2}}$

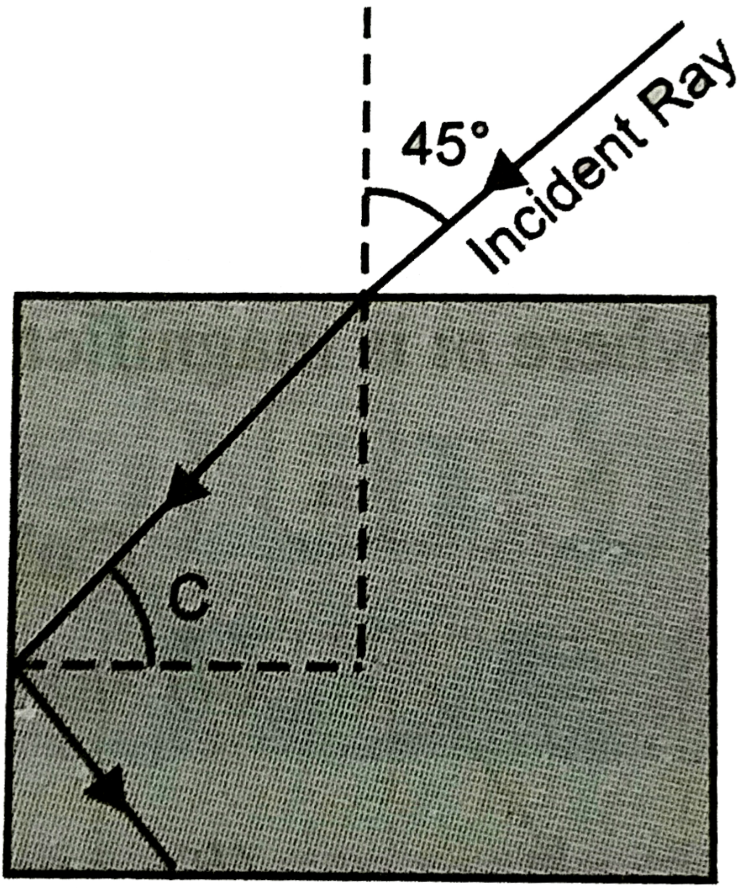
C. $\sqrt{\frac{3}{2}}$

D. $\frac{3}{2}$

Answer: B

Watch Video Solution

15. For a given incident ray as shown in Fig., the condition of total internal reflection of ray will be satisfied if the refractive index of the block will be.



A. $\frac{\sqrt{3}+1}{2}$

B. $\frac{\sqrt{2}+1}{2}$

C. $\sqrt{\frac{3}{2}}$

D. $\sqrt{\frac{7}{6}}$

Answer: C

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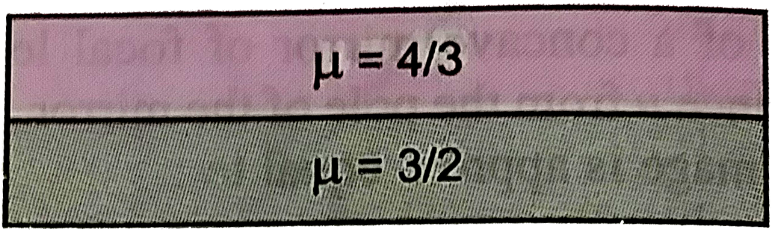
16. Considering normal incidence of ray, the equivalent refractive index of combination of two slabs shown in Fig. is.



A. 1.8

B. 1.43

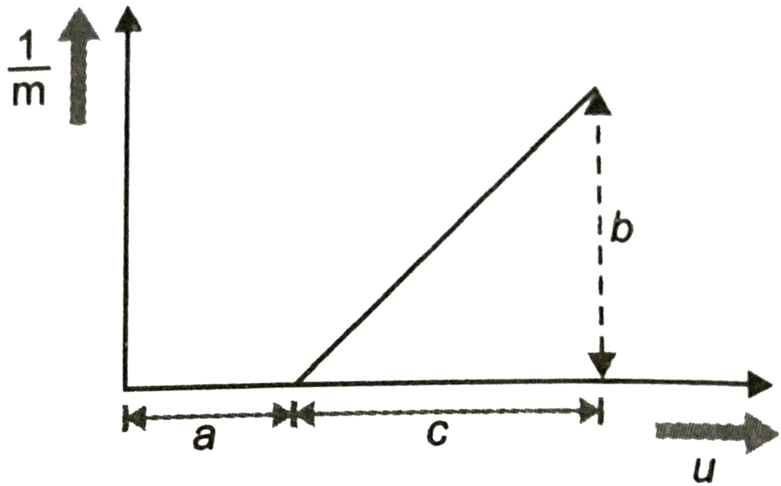
C. 2

D. none of the above

Answer: B

Watch Video Solution

17. The graph in Fig. shows how the inverse of magnification $1/m$ produced by a convex thin lens varies with object distance u. What was the focal length of the lens used ?



A. $\frac{b}{c}$

B. $\frac{b}{ca}$

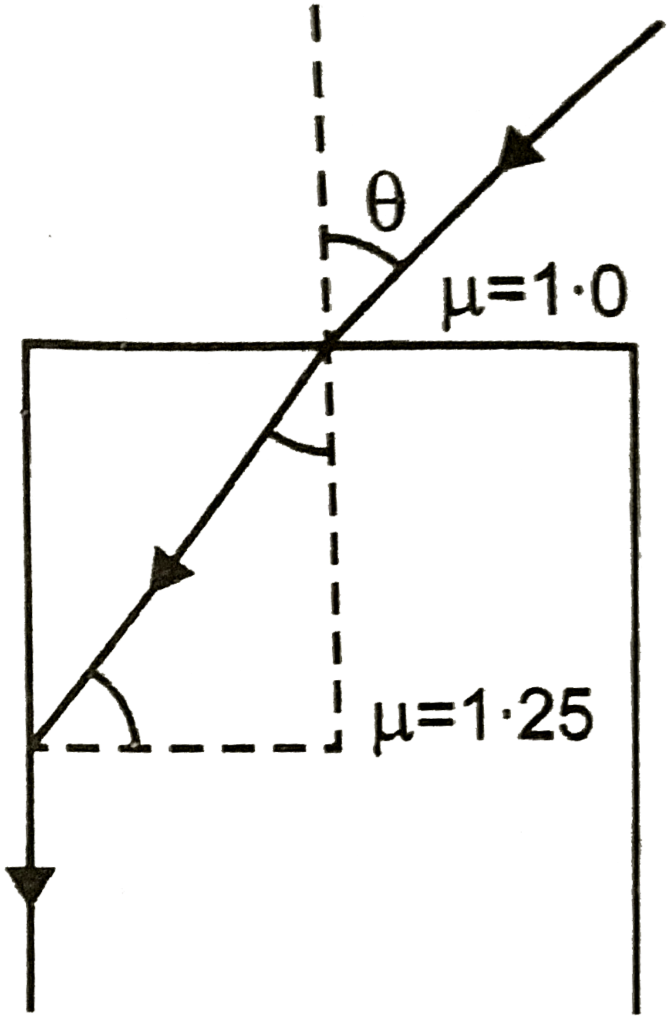
C. $\frac{bc}{a}$

D. $\frac{c}{b}$

Answer: D

Watch Video Solution

18. Consider the ray diagram for the refraction given Fig. The maximum value of angle θ for which the light suffers total internal reflection at the vertical surface, is.



A. $\cos^{-1}\left(\frac{3}{4}\right)$

B. $\sin^{-1}\left(\frac{3}{4}\right)$

C. $\tan^{-1}\left(\frac{4}{3}\right)$

D. $\cot^{-1}\left(\frac{4}{3}\right)$

Answer: B

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19. A luminous object is placed at a distance of $30cm$ from the convex lens of focal length $20cm$. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature $10cm$ be placed in order to have an upright image of the object coincident with it ?

A. 12 cm

B. 30 cm

C. 50 cm

D. 60 cm

Answer: C

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20. Four combinations of two thin lenses are given in List I. The radius of curvature of all curved surfaces is r and the refractive index of all the lenses is 1.5 Match lens combinations in List I with their focal length in List II and select the correct answer using the code given below the lists.

(A) $(p) 2r$

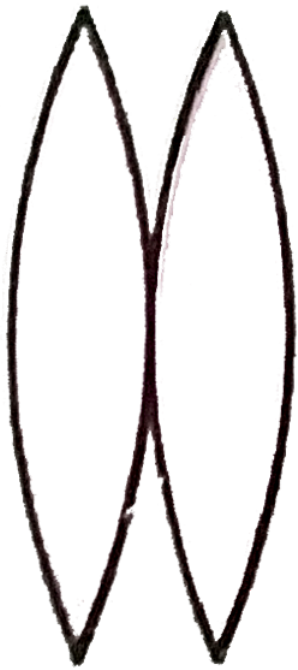
(B) $(q) \frac{r}{2}$

(C) $(r) \ -r$

(D) $(s) r.$

Code :

(A)



(B)

(C)

(D)

A. $A-p, B-q, C-r, D-s$

B. $A - q, B - s, C - r, D - p$

C. $A - s, B - p, C - q, D - r$

D. $A - q, B - p, C - r, D - s$

Answer: B

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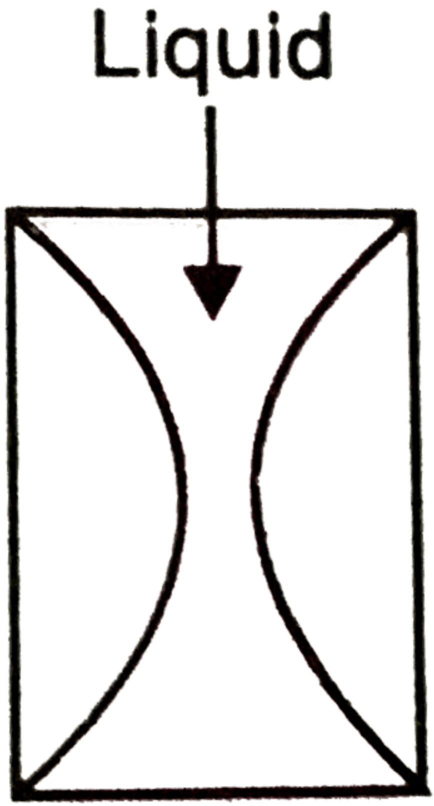
21. The effective focal length of the lens combination shown in Fig. is $-60cm$. The radii of curvature of the curved surfaces of the plano-convex lenses are $12cm$ each and refractive index of the material of the lens is

1.5. The refractive index of the liquid is :



A. 1.33

B. 1.42

C. 1.53

D. 1.6

Answer: D

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22. A ray of light falls on the surface of a spherical glass paper weight making an angle α with the normal and is refracted in the medium at an angle β. The angle of deviation of the emergent ray from the direction of the incident ray is :

A. $(\alpha - \beta)$

B. $2(\alpha - \beta)$

C. $(\alpha - \beta)/2$

D. $(\beta - \alpha)$

Answer: B

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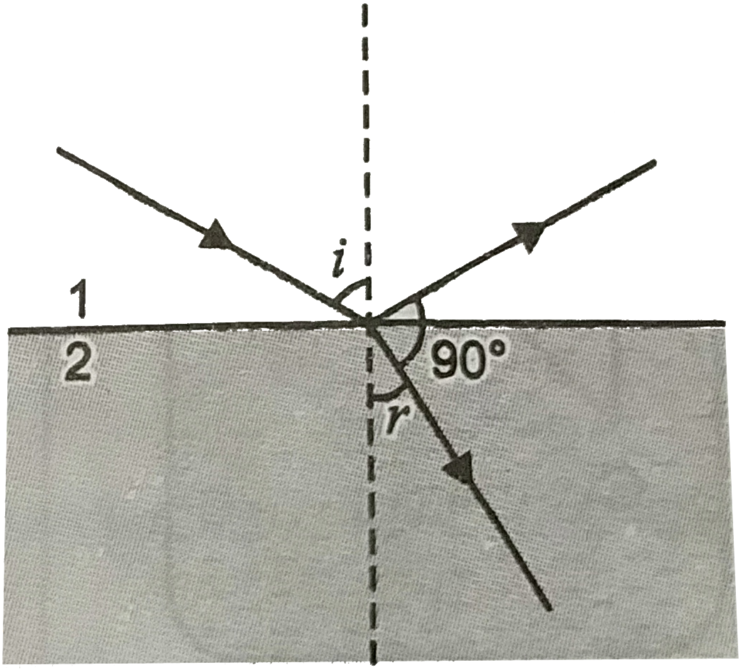
23. Light incident on a surface separating two media is partly reflected and party refracted as shown in Fig. Then :



A. $\sin i = \dfrac{\mu_2}{\left(\mu_1^2 + \mu_2^2\right)^{1/2}}$

B. $\tan i = \dfrac{\mu_1}{\mu_2}$

C. $\sin i = \mu_1 \mu_2$

D. $\sin i = \dfrac{\mu_2}{\mu_1}.$

Answer: A

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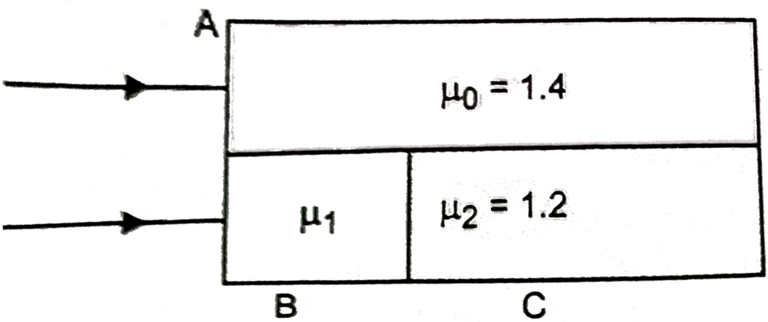
24. A slab of transparent material is made as shown in Fig. Monochromatic parallel beams of light are normally incident on the slab. The thickness of C is twice the thickness of B. If the number of waves in A = number of waves in combination of B and C, then the refractive index of B is :



A. 1.33

B. 1.8

C. 1.6

D. 1.6

Answer: B

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25. The focal length of a thin lens in vacuum is f. If the material of the lens has $\mu = 3/2$, its focal length when immersed in water of refractive index $4/3$ will be.

A. f

B. $4f/3$

C. 2 f

D. 4 f

Answer: D

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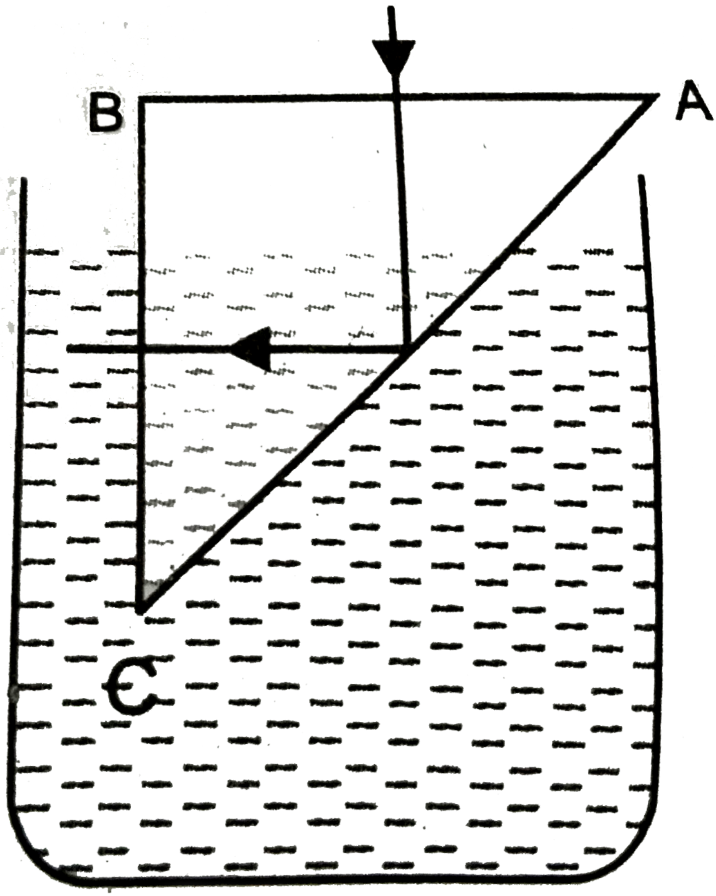
26. A glass prism of refractive index 1.5 is immersed in water (refractive index 4/3). A light beam incident normally on the face AB is totally reflected to reach the face BC, Fig. if :



A. $\sin C = 8/9$

B. $\sin C = 9/8$

C. $\sin C = 2/3$

D. $\sin C = 3/2$

Answer: A

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27. The radius of curvature of curved surface of a thin plano-convex lens is $10cm$ and the refractive index is 1.5. If the plano surface is silvered, then the focal length will be.

A. 15 cm

B. 20 cm

C. 5 cm

D. 10 cm

Answer: D

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28. The refracting angle of a prism is A, the refractive index of the material of the prism is $\cot\left(\frac{A}{2}\right)$. The angle of minimum deviation is :

A. $180^\circ - 2A$

B. $90^\circ - A$

C. $180^\circ + 2A$

D. $180^\circ - 3A$

Answer: A

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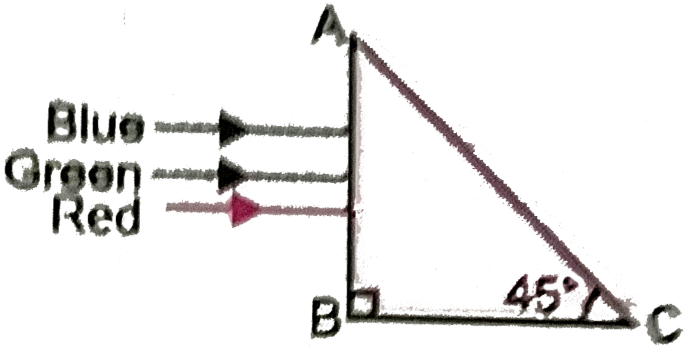
29. A beam of light consisting of red, green and blue colours is incident on right angled prism. The refractive indices of the material of the prism for the above red, green and blue wavelengths are $1.39, 1.44$ and 1.47

respectively. The prism will.



A. Separate the red colour part from green and blue colours.

B. Separate the blue colour part from the red and green colours.

C. Separate all the three colours from one another.

D. Not separate the three colours at all.

Answer: A

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30. A plano convex lens has focal length $f = 20cm$. If its plane surface is silvered, then new focal length will be

A. 20 cm

B. 5 cm

C. 10 cm

D. 25 cm

Answer: C

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

A. $\left(\frac{f}{2}, \frac{f}{2}\right)$

B. (f, f)

C. $(4f, 4f)$

D. $(-2f, 2f)$

Answer: D

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32. The focal length of a thin biconvex lens is $20cm$. When an object is moved from a distance of $25cm$ in front of it to $50cm$, the magni-fication of its image changes from $m_{25} \rightarrow m_{50}$. The ratio $\frac{m_{25}}{m_{50}}$ is.

A. 4

B. 6

C. 1

D. 3

Answer: B

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33. A thin convex lens made from crown glass $\left(\mu = \frac{3}{2}\right)$ has focal length f. When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal lengths f_1 and f_2 respectively . The correct relation between the focal lengths is ,

A. $f_2 > f, f_1$ becomes negative

B. f_1 and f_2 both become negative

C. $f_1 = f_2 < f$

D. $f_1 > f$ and f_2 becomes negative.

Answer: D

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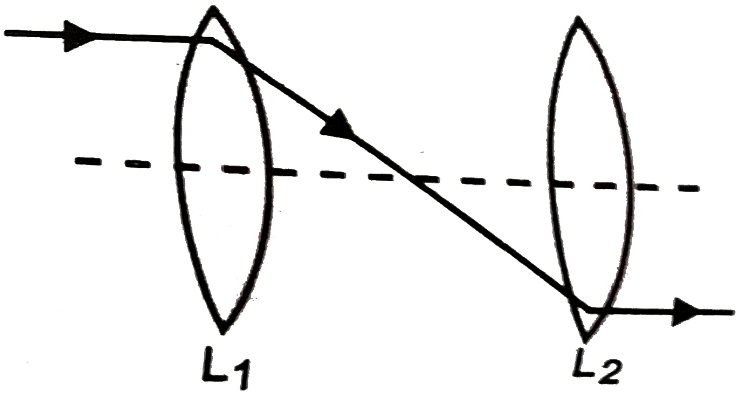
34. In Fig., there are two convex lenses L_1 and L_2 having focal lengths F_1 and F_2 respectively. The distance between L_1 and L_2 will be :



A. F_1

B. F_2

C. $F_1 + f_2$

D. $F_1 - F_2$

Answer: C

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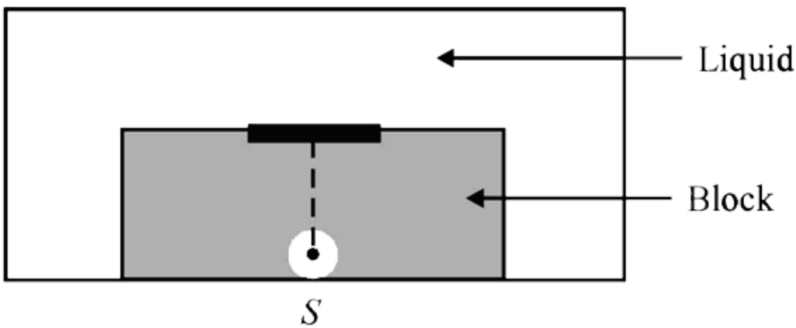
35. A point source S is placed at the bottom of a tranparent block of height 10mm and refractive index 2.72. It is immersed in a lower refractive index liquid as shown in the figure. It is found that the light emerging from the block to the liquid forms a circular bright spot of diameter 11.54 mm on the top of the block. The refractive index of the liquid is `



A. 1.21

B. 1.30

C. 1.36

D. 1.42

Answer: C

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36. A ray of light travelling in a transparant medium falls on a surface separating the medium from air at an angle of incidence of $45 degree$. The ray undergoes total internal reflection. If n is the refractive in index of the medium with respect to air, select the possible value (s) of n from the following:

A. $\mu = 1.33$

B. $\mu = 1.40$

C. $\mu = 1.50$

D. $\mu = 1.25$

Answer: C

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37. A lens haivng focal length and aperture of diameter d forms an image of intensity I. Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively.

A. $f \text{ and } \frac{I}{4}$

B. $\frac{3f}{4} \text{ and } \frac{I}{2}$

C. $f \text{ and } \frac{3I}{4}$

D. $\frac{f}{2} \text{ and } \frac{I}{2}$

Answer: C

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38. The speed of light in media M_1 and M_2 are $1.5 \times 10^8 m/s$ and $2.0 \times 10^8 m/s$ respectively. A ray of light enters from medium M_1 to M_2 at an incidence angle i. If the ray suffers total internal reflection, the value of i is.

A. Equal to $\sin^{-1}\left(\frac{2}{3}\right)$

B. Equal to or less than $\sin^{-1}\left(\frac{3}{5}\right)$

C. Equal to or grater than $\sin^{-1}\left(\frac{3}{4}\right)$

D. Less than $\sin^{-1}\left(\frac{2}{3}\right)$

Answer: C

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

A. $30^\circ, \sqrt{2}$

B. $45^\circ, \sqrt{2}$

C. $30^\circ, \frac{1}{\sqrt{2}}$

D. $45^\circ, \frac{1}{\sqrt{2}}$

Answer: A

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40. In an experiment for determination of refractive index of glass of a prism by $i-\delta$, plot it was found thata ray incident at angle 35°, suffers a deviation of 40° and that it emerges at angle 79°. In that case which of the following is closest to the maximum possible value of the refractive index?

A. 1.5

B. 1.6

C. 1.7

D. 1.8

Answer: A

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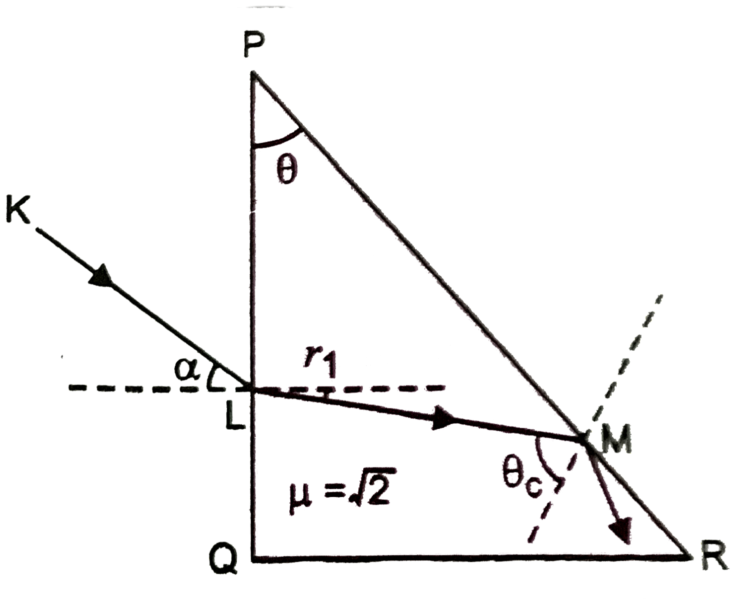
41. A parallel beam of light is incident from air at an angle α on the side of right angled triangular prism of refractive index $\mu = \sqrt{2}$. Light undergoes total internal reflection in the prism at the face PR when α has a minimum value of 45°. The angle θ of the prism is.



A. 15°

B. 22.5°

C. 30°

D. 45°

Answer: A

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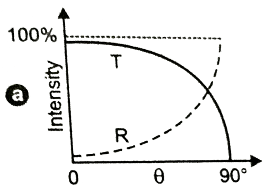
42. A light ray travelling in glass medium is incident of glass- air interface at an angle of incidence θ. The reflected (R) and transmitted (T) intensities, both as function of θ, are plotted The correct sketch is

A. 

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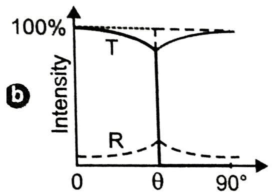
B. 

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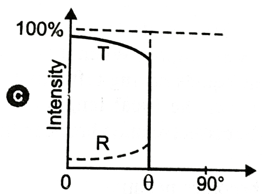
C. 

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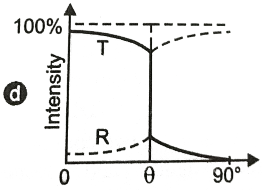
D. 

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Answer: C

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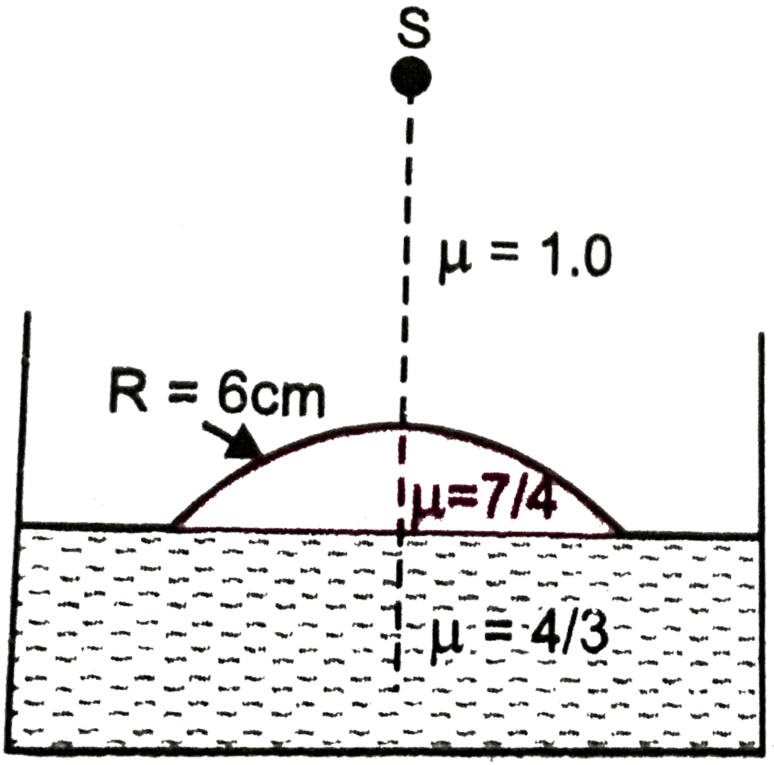
43. Water (with refractive index = 4/3) in a tank is $18cm$ deep. Oil of refraction index $7/4$ lies on water making a convex surface of radius of curvature $R = 6cm$ as shown in Fig. Consider oil to act as a thin lens. An object S is placed $24cm$ above water surface. The location of its image is at $x cm$ above the bottom of the tank. Then x is.



A. 1

B. 2

C. 3

D. 4

Answer: B

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44. A biconvex lens has a radius of curvature of magnitude $20cm$. Which one of the following options describes best the image formed of an object of height $2cm$ place $30cm$ from the lens ?

A. Virtual , upright, height $= 1cm$.

B. Virtual, upright, height $0.5cm$

C. Real, inverted, height $= 4cm$

D. Real, inverted, height $= 1cm$.

Answer: C

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45. A converging beam of rays in incident on a diverging lens. Having passed through the lens the rays intersect at a point $15cm$ from the lens. If the lens is removed, the point where the rays meet, move $5cm$ closer to the mounting that holds the lens. Find the focal length of the lens.

A. $-10cm$

B. 20 cm

C. $-30cm$

D. 5 cm

Answer: C

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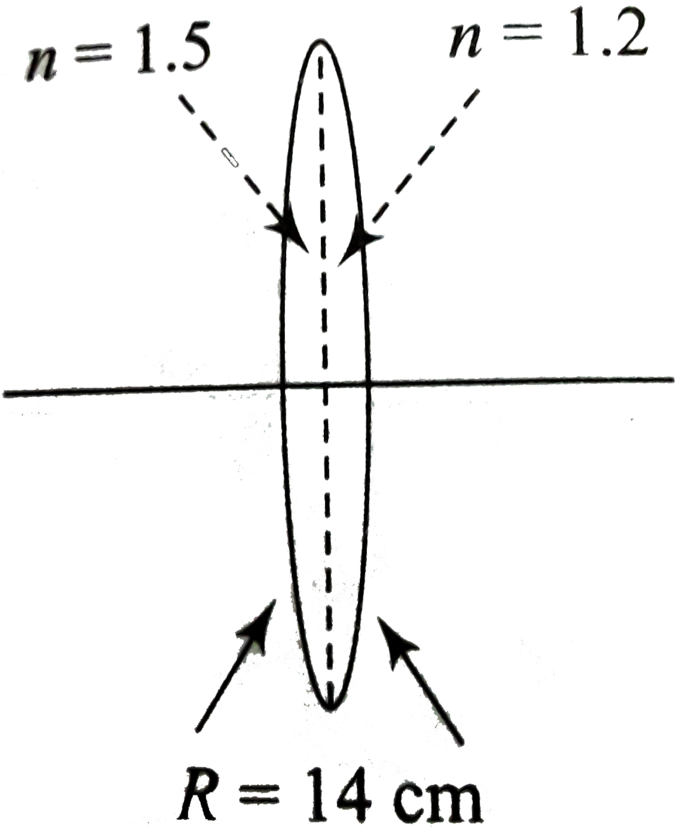
46. A bi-convex lens is formed with two thin plano-convex lenses as shown in the figure. Refractive index n of th efirst lens is 1.5 and that of the second lens if 1.2 Both the curved surfaces are of the same radius of curvature $R = 14cm$. For this bi-convex lens, for an object distance of

40cm, the image distance will be



A. $-280.0cm$

B. $40.0cm$

C. $21.5cm$

D. $13.3cm$

Answer: B

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

A. $7.2m$

B. $2.4m$

C. $3.2m$

D. $5.6m$

Answer: D

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

A. $f_1 + f_2$

B. $-f_1 + f_2$

C. $2f_1 + f_2$

D. $-2f_1 + f_2$

Answer: C

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

A. $\dfrac{2R}{(\mu_2 - \mu_1)}$

B. $\dfrac{R}{2(\mu_2 - \mu_1)}$

C. $\dfrac{R}{2(\mu_1 - \mu_2)}$

D. $\dfrac{R}{(\mu_1 - \mu_2)}$

Answer: D

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50. The diameter of a plano convex lens is $6cm$ and thickness at the centre is $3mm$. If the speed of light in the material of the lens is $2 \times 10^8 m / s$, what is the focal length of the lens ?

A. 15 cm

B. 20 cm

C. 30 cm

D. 10 cm

Answer: C

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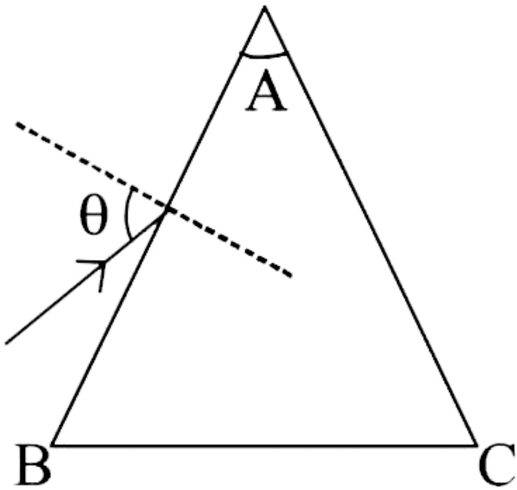
51. Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ, a ray, incident at an angle θ, on the face AB would get transmitted through the face AC of the prism provided:



A. $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

B. $\theta < \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

C. $\theta > \cos^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

D. $\theta < \cos^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

Answer: A

Watch Video Solution

52. A monochromatic beam of light is incident at 60° on one face of an equilateral prism of refractive inder n and emerges from the opposite face making an angle θ with the normal. For $n = \sqrt{3}$, the value of θ is 60° and $\frac{d\theta}{dn} = m$. The value of m is.

A. 1

B. 2

C. 3

D. 4

Answer: A

Watch Video Solution

53. The refracting angle of a prism is A, the refractive index of the material of the prism is $\cot\left(\frac{A}{2}\right)$. The angle of minimum deviation is :

A. $180^{\circ}\; - 2A$

B. $90^{\circ}\; - A$

C. $180^{\circ}\; - 2A$

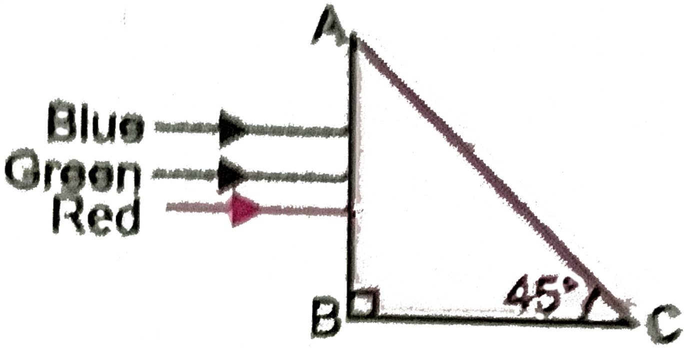
D. $180^{\circ}\; - 3A.$

Answer: A

Watch Video Solution

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

respectively. The prism will.



A. Separate the red colour part from green and blue colours.

B. Separate the blue colour part from the red and green colours.

C. Separate all the three colours from one another.

D. Not separate the three colours at all.

Answer: A

Watch Video Solution

55. Angle of prism is A and its one surface is silvered. Light rays falling at an angle of incidence $2A$ on first surface return back through the same path after suffering reflection at second silvered surface. Refraction index of the material of prism is

A. $2\sin A$

B. $2\cos A$

C. $\frac{1}{2}\cos A$

D. $\tan A$

Answer: B

Watch Video Solution

56. A green light is incident from the water to the air - water interface at the critical angle (θ). Select the correct statement.

A. The spectrum of visible light whose frequency is more than that of green light will come out of the air medium.

B. The entire spectrum of visible light will come out of water at various angle to the normal.

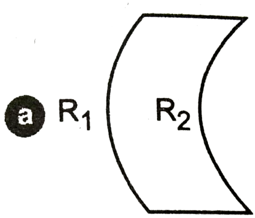
C. The entire spectrum of visible light will come out of water at an angle of 90° to the normal.

D. The spectrum of visible light whose frequency is less than that of green light will come out of the air medium.

Answer: D

Watch Video Solution

57. Which one of the following spherical lenses does not exhibit dispersion? The radii of curvature of the surfaces of the lenses are as given in the diagrams. `

A. 

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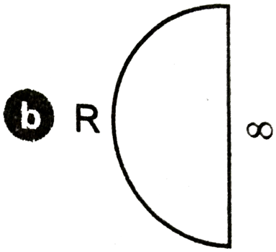
B. 

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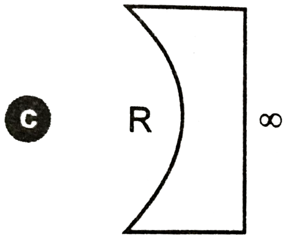
C. 

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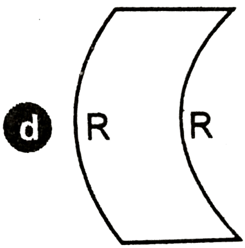
D. 

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Answer: D

Watch Video Solution

58. A thin prism having refracting angle 10° is made of glass of refracting index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be :

A. 4°

B. 6°

C. 8°

D. 10°

Answer: B

Watch Video Solution

59. A thin prism of angle 15° made of glass of refractive index $\mu_1 = 1.5$ is combined with another prism of glass of refractive index $\mu_2 = 1.75$. The combination of the prism produces dispersion without deviation. The angle of the second prism should be

A. 7°

B. 10°

C. 12°

D. 5°

Answer: B

Watch Video Solution

60. A ray of light is incident at small angle I on the surface of prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of the prism is mu, the angle of incidence is nearly equal to

A. μA

B. $\frac{\mu A}{2}$

C. A/μ

D. $A/2\mu$

Answer: A

Watch Video Solution

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

A. lies between $\sqrt{2}$ and 1

B. lies between 2 and $\sqrt{2}$

C. is less than 1

D. is greater than 2

Answer: B

Watch Video Solution

62. Magnification of a compound microscope is 30. Focal length of eye $-$ piece is $5cm$ and the image is formed at a distance of distinct vision of $25cm$. The magnificatio of the objective lens is

A. 6

B. 5

C. 7.5

D. 10

Answer: B

Watch Video Solution

63. The ratio of resolving powers of an optical microscope for two wavelengths $\lambda_1 = 4000\text{Å}$ and $\lambda_2 = 6000\text{Å}$ is

A. $8:27$

B. $9:4$

C. $3:2$

D. $16:81$

Answer: C

Watch Video Solution

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

A. $0.5m$

B. 5 m

C. 50 m

D. 500 m

Answer: C

Watch Video Solution

65. A telescope has an objective lens of $10cm$ diameter and is situated at a distance of one kilometre from two objects. The minimum distance

between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000Å, of the order of

A. 5 mm

B. 5 cm

C. 2.5 m

D. 5 m

Answer: A

Watch Video Solution

66. If the focal length of the objective lens is increased then

A. microscope will increase but that of telescope decrease

B. microscope and telescope, both will increase.

C. microscope and telescope both will decrease

D. microscope will decrease, but that of telescope will increase.

Answer: D

Watch Video Solution

67. A microscope is focused on a mark on a piece of paper and then a slab of glass of thickness $3cm$ and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again ?

A. 2 cm upward

B. 1 cm upward

C. 4.5 upward

D. 1 cm downward

Answer: B

Watch Video Solution

68. A boy is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length $10cm$. The diameter of the sun is $1.39 \times 10^9 m$ and its mean distance from the earth is $1.5 \times 10^{11} m$. What is the diameter of the sun's image on the paper ?

A. $9.2 \times 10^{-4} m$

B. $6.5 \times 10^{-4} m$

C. $6.5 \times 10^{-5} m$

D. $12.4 \times 10^{-4} m$

Answer: A

Watch Video Solution

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

A. 10 cm, 10 cm

B. 15 cm, 5 cm

C. 18 cm, 2 cm

D. 11 cm, 9 cm

Answer: C

Watch Video Solution

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

A. $\frac{L}{I}$

B. $\frac{L}{I}+1$

C. $\frac{L}{I}-1$

D. $\frac{L+I}{L-I}$

Answer: A

Watch Video Solution

71. The near and far points of a person are at $40cm$ and $250cm$ respectively. Find the power of the lens he/she should use while reading at $25cm$. With this lens on the eye, what maximum distance is clearly visible?

A. $2.5D$

B. $5.0D$

C. $1.5D$

D. $3.5D$

Answer: C

Watch Video Solution

72. Assuming human pupil to have a radius of 0.25 cm and a comfortable viewing distance of 25 cm, the minimum separation between two objects than human eye can resolve at 500nm wavelength is :

A. $1\mu m$

B. $30\mu m$

C. $100\mu m$

D. $300\mu m$

Answer: B

Watch Video Solution

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

A. $1.5cm$

B. 5 cm

C. $2.5cm$

D. $1.67cm$

Answer: D

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74. The focal length of the objective and eye piece of a telescope are respectively $100cm$ and $2cm$. The moon subtends and angle of 0.5^2, the angle subtended by the moon's image will be.

A. 10°

B. 25°

C. 75°

D. 100°

Answer: B

Watch Video Solution

75. An astronomical telesope has objective and eyepiece of focal lengths $40cm$ and $4cm$ respectively. To view an object $200cm$ away from the objective, the lenses must be separated by a distance :

A. $46.0cm$

B. 50 cm

C. $54.0cm$

D. 37.3 cm`

Answer: C

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76. An observer looks at a distant tree of height 10m with a telescope of magnifying power of 20. to the observer the tree appears:

A. 10 times taller

B. 10 times nearer

C. 20 times taller

D. 20 times nearer

Answer: D

Watch Video Solution

77. The box of a pin hole camera, of length L, has a hole of radius a . It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say b_(min)) when:

A. $a = \lambda^4 / L$ and $b_{\min} = \dfrac{2\lambda^2}{L}$

B. $a = \sqrt{\lambda L}$ and $b_{\min} = \dfrac{2\lambda^2}{L}$

C. $a = \sqrt{\lambda L}$ and $b_{\min} = \sqrt{4\lambda L}$

D. $a = \dfrac{\lambda^2}{L}$ and $b_{\min} = \sqrt{4\lambda L}$

Answer: C

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78. A ray of light travelling in a transparant medium falls on a surface separating the medium from air at an angle of incidence of $45 degree$. The ray undergoes total internal reflection. If n is the refractive in index of the medium with respect to air, select the possible value (s) of n from the following:

A. 1.3

B. 1.4

C. 1.5

D. 1.6

Answer: C::D

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79. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at a point O, and $PO = OQ$. The distance PO

A. 5 R

B. 3 R

C. 2 R

D. $1.5R$

Answer: A

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80. A diminished image of an object is to be obtained on a screen 1.0 m from it. This can be achieved by appropriately placing

A. a convex lens of suitable focal length

B. a convex lens of of suitable focal length

C. a convex mirror of suitable focal length

D. a concave mirror of suitable focal length

Answer: A::D

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81. A short linear object of length b lies along the axis of a concave mirror of focal length f at a distanee u from the pole of the mirror. The size of the image is approximately equal to

A. $b\left(\frac{u-f}{f}\right)^{1/2}$

B. $b\left(\frac{f}{u-f}\right)^{1/2}$

C. $b\left(\frac{u-f}{f}\right)$

D. $b\left(\frac{f}{u-f}\right)^{2}$

Answer: D

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82. An astronomical telescope has an angular magnification of magnitude 5 for distant object. The separation between the objective and eyepiece is $36cm$ and the final image is formed at infinity. Determine the focal length of objective and eyepiece.

A. $f_0 = 45 \text{ and } f_e = -9cm$

B. $f_0 = 50cm \text{ and } f_e = 10cm$

C. $f_0 = 7.2cm \text{ and } f_e = 5cm$

D. $f_0 = 30cm \text{ and } f_e = 6cm.$

Answer: D

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83. A planet is observed by an astronomical refracting telescope having an objective of ofcal length 16m and an eyepiece of focal length 2 cm. Then,

A. The distance between the objective and eye piece is $16.02m$

B. The angular magnification of the planet is -800

C. The image of the planet is inverted

D. The objective is larger than eye piece

Answer: A::B::C::D

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84. A student performed the experiment of determination of focal length of a concave mirror by $u - v$ method using an optical bench of length 1.5 meter. The focal length of the mirror used is 24 cm. The maximum error in the location of the image can be 0.2 cm. The 5 sets of (u, v) values recorded by the student (in cm) are: $(42, 56), (48, 48), (60, 40), (66, 33), (78, 39)$. The data set (s) that cannot come from experiment and is (are) incorrectly recorded, is (are)

A. (42, 56)

B. (48, 48)

C. (66, 33)

D. (78, 39)

Answer: C::D

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85. A ray of monochromatic light is incident on one refracting face of a prism of angle 75°. It passes through the prism and is incident on the other face at the critical angle. If the refractive index of the material of the prism is $\sqrt{2}$, the angle of incidence on the first face of the prism is

A. The ray gets totally internally reflected at face CD

B. the ray comes out through face AD

C. The angle between the incident ray and the emergent ray is 90°

D. The angle between the incident ray and the emergent ray is 120°.

Answer: A::B::C

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86. The optical length of an astronomical telescope with magnifying power of ten for normal vision is $44cm$. What is the focal length of the objective ?

A. 440 cm

B. 44 cm

C. 40 cm

D. 4 cm

Answer: C

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87. A narrow beam of white light enters slab having parallel faces.

A. The light inside the slab is white,

B. The light inside the slab is split into different colours,

C. The emergent beam is white,

D. The light never splits in different colours.

Answer: B::C

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88. Which of the following (referred to a sphericla mirror) do (does) not depend on whether the rays are paraxial or not?

A. Radius of curvature

B. Focus

C. Pole

D. Principle axis.

Answer: A::B::C

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89. Photograph of the ground are taken form an air-craft ,flying at an altitude of 2000 m by a camera with a lens of focal length $50cm$. The size of the film in the camera is $18 \times 18cm$.What area of the ground can be photography by this camera at any one time.

A. $720m \times 720m$

B. $240m \times 240m$

C. $1080m \times 1080m$

D. $100m \times 100m.$

Answer: C

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(Competition)Comprehension

1. Power (P) of a lens is given by reciprocal of focal length (f) of the lens. i.e. $P = 1/f$. When f is in metre, P is in dioptre. For a convex lens, power is positive and for a concave lens, power is negative. When a number of thin lenses of powers $p_1, p_2, p_3....$ are held in contact with one another, the power of the combination is given by algebraic sum of the powers of all the lenses

i.e., $P = p_1 + p_2 + p_3 + ...$

Answer the following questions :

Focal length of the combined three lenses would be

A. $-26.7cm$

B. 60 cm

C. 80 cm

D. 20 cm

Answer: A

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2. Power (P) of a lens is given by reciprocal of focal length (f) of the lens. i.e. $P = 1/f$. When f is in metre, P is in dioptre. For a convex lens, power is positive and for a concave lens, power is negative. When a number of thin lenses of powers $p_1, p_2, p_3....$ are held in contact with one another, the power of the combination is given by algebraic sum of the powers of all the lenses

i.e., $P = p_1 + p_2 + p_3 + ...$

Answer the following questions :

Focal length of the combined three lenses would be

A. $-3.75D$

B. $0.5D$

C. $-5D$

D. $1.25D$

Answer: A

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3. Power (P) of a lens is given by reciprocal of focal length (f) of the lens. i.e. $P = 1/f$. When f is in metre, P is in dioptre. For a convex lens, power is positive and for a concave lens, power is negative. When a number of thin lenses of powers $p_1, p_2, p_3 \ldots$ are held in contact with one another, the power of the combination is given by algebraic sum of the powers of all the lenses

i.e., $P = p_1 + p_2 + p_3 + \ldots\ldots .$

Answer the following questions :

Power of second lens is

A. $-3.75D$

B. $3.75D$

C. $5.0D$

D. $-5.0D$

Answer: A

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4. Power (P) of a lens is given by reciprocal of focal length (f) of the lens. i.e. $P = 1/f$. When f is in metre, P is in dioptre. For a convex lens, power is positive and for a concave lens, power is negative. When a number of thin lenses of powers $p_1, p_2, p_3....$ are held in contact with one another, the power of the combination is given by algebraic sum of the powers of all the lenses

i.e., $P = p_1 + p_2 + p_3 + ...$

Answer the following questions :

Focal length of the combined three lenses would be

A. 80 cm

B. 60 cm

C. $\pm 20 cm$

D. $-26.7 cm$

Answer: D

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5. An initially parallel cylindrical beam travels in a medium of refractive index $\mu(I) = \mu_0 + \mu_2 I$, where μ_0 and μ_2 are positive constants and I is the intensity of the light beam. The intensity of the beam is decreasing with increasing radius.

30 . At the beam enters the medium, it will

A. converge

B. diverge near the axis and converge near the periphery

C. travel as a cylindrical beam

D. diverge

Answer: A

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6. An initially parallel cylindrical beam travels in a medium of refractive index $\mu(I) = \mu_0 + \mu_2 I$, where μ_0 and μ_2 are positive constants and I is the intensity of the light beam. The intensity of the beam is decreasing with increasing radius.

32. The speed of light in the medium is

A. the same everywhere in the beam.

B. directly proportional to the intensity I.

C. maximum on the axis of the beam

D. minimum on the axis of the beam

Answer: D

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7. An intially parallel cyclindrical beam travels in a medium of refractive index $\mu(I) = \mu_0 + \mu_2 I$, where μ_0 and μ_2 are positive constants and I is intensity of light beam. The intensity of the beam is decreasing with increasing radius.

Answer the following questions :

The initial shape of the wavefront of the beam is

A. concave

B. convex near the axis and concave near the periphery

C. planar

D. convex

Answer: C

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Integer Question

1. A man wants to distinguish between two pillars located at a distance of $11km$. What should be the minimum distance between the pillars ?

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2. A beautiful person with two normal eyes wants to see full width of her face by a plane mirror. The eye and ear to ear distances of her face are $10cm$ and $14cm$ respectively. The minimum width of required mirror is :

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3. In a tank filled with a liquid of refractive index $5/3$, a point source of light is placed $2m$ below the surface of water. To cut off all light coming out of water from the source, what should be the minimum diameter of a disc, which should be placed over the source on the surface of water ?

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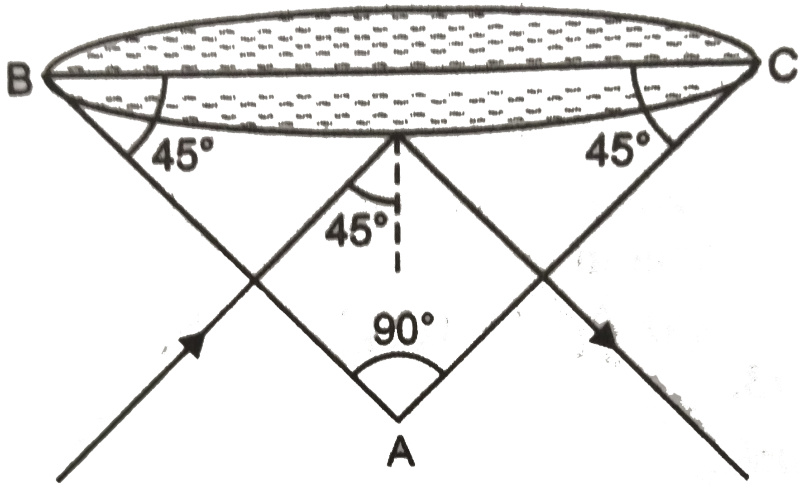
4. A drop of liquid is spread over the hypotenuse of a right angled isosceles prism as shown in Fig. and a ray of light is incident normally on face AB of the prism. If refractive index of liquid is $\sqrt{2}$, then for total internal reflection to occur, refractive index of material prism should be :



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Assertion-Reason Question

1. Assertion : The clouds in the sky generally appear to be whitish.

Reason : Diffraction due to clouds is efficient in equal measures its all wavelengths.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. If Assertion is true but the Reason is false.

D. If both, Assertion and Reason are false.

Answer: (c)

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2. Assertion : In optical fibre, the diameter of the core is kept small.

Reason : The small diameter of the core ensures that the fibre should have inside it an angle greater than critical angle needed for total internal reflection.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. If Assertion is true but the Reason is false.

D. If both, Assertion and Reason are false.

Answer: A

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3. Assertion : A ray of light entering from glass to air suffers change in frequency.

Reason : Velocity of light in glass is more than that ni air.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. If Assertion is true but the Reason is false.

D. If both, Assertion and Reason are false.

Answer: D

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4. Assertion : The frequencies of incident, reflected and refracted beam of monochromatic light are same.

Reason : The incident, reflected and refracted rays are coplanar.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. If Assertion is true but the Reason is false.

D. If both, Assertion and Reason are false.

Answer: B

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5. Statement-1 : A single lens produces a coloured image of an object illuminated by white light.

Statement-2 : The refractive index of material of lens is different for different wavelengths of light.

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: A

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6. Statement-1 : it is impossible to photograph a virtual image.

Statement-2 : The rays which appear diverging from a virtual image fall on the camera and a real image is captured.

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: D

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7. Statement-1 : If a convex lens is kept in water, its convergent power increases.

Statement-2 : Focal length of lens depends on its refractive index w.r.t. surrounding medium.

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: D

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8. Statement-1 : A dentist uses a concave mirror to examine a small cavity.

Statement-2 : A dentist uses a concave mirror so as to form a magnified, virtual image of an object.

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: A

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9. Statement-1 : The refractive index of a prism depends only on the kind of glass of which this is made and the colour of light.

Statement-2 : The refractive index of a prism depens upon refracting angle of prism and angle of minimum deviation.

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: C

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10. Statement-1 : Light travels faster in glass than in air.

Statement-2 : Because air is rarer than glass.

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: D

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11. Statement-1 : When a prism of $\mu = 3/2$ is immersed in water $(\mu = 4/3)$, deviation through the prism becomes $1/4th$ of the deviation, when the prism is in air.

Statement-2 : It follows from $\delta = (\mu - 1)A$

A. Statement - 1 true, Statement - 2 is true. Statement - 2 is correct explanation of statement - 1.

B. Statement - 1 is true, Statement - 2 is true, but Statement - 2 is not a correct explanation of Statement - 1.

C. Statement - 1 is true, Statement - 2 is false.

D. Statement - 1 is false, Statement - 2 is true.

Answer: A

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12. An experment is performed to find the refractive index of glass using a travelling mircroscope. In this experiment distances are measured by

A. a vernier scale provided on the microscope

B. a standard laboratory scale

C. a meter scale provided on the microscope

D. a screw gauge provided on the microscope

Answer: A

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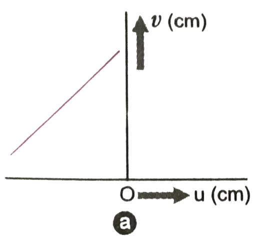
13. A student measures the focal length of a convex lens by putting an object pin at a distance u from the lens and measuring the distance v of the image pin. The graph between u and v plotted by the student should look like

A. 

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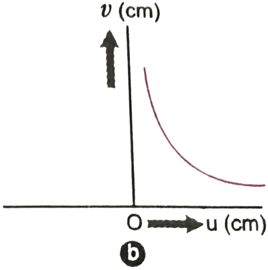
B. 

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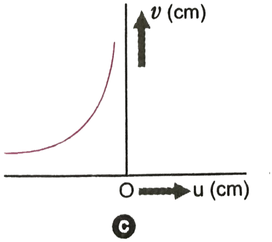
C. 

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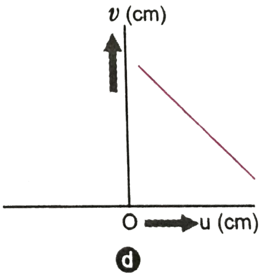
D. 

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Answer: C

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14. We cannot find rough focal length of

A. convex mirror only

B. cncave mirror only

C. both convex and concave mirror

D. none of the above

Answer: A

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15. The lens formula is

A. $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$

B. $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

C. $\frac{1}{f}-\frac{1}{v}=\frac{1}{u}$

D. $\frac{1}{f}-\frac{1}{u}=\frac{1}{v}.$

Answer: B

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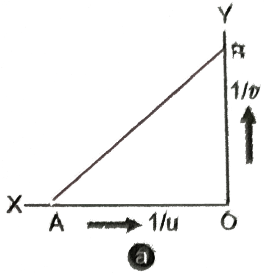
16. The shape of graph between $1/u$ and $1/v$ in case of a convex lens is

Fig.

A. 

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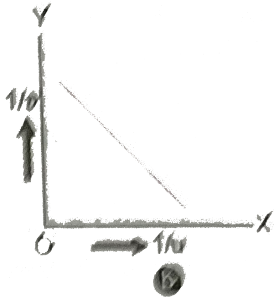
B. 

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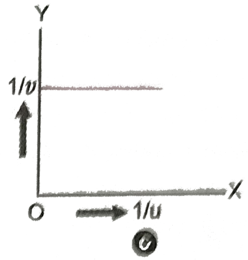
C. 

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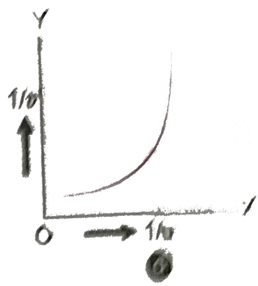
D. 

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Answer: A

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17. An equilaterial prism produces a minimum deviation of 30°. The angle of incidence is.

A. 30°

B. 60°

C. 45°

D. 90°

Answer: C

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(Test Your Grip)Multiple Choice(a)

1. Which is not true for the image formed in a plane mirror ? The image is

A. virtual

B. erect

C. laterally inverted

D. closer to the mirror than the object.

Answer: D

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2. The relation between focal length f and radius of curvature R of a spherical mirror is.

A. f = R

B. f = R/2

C. f = 2 R

D. none of these

Answer: B

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3. The correct mirror equation is.

A. $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$

B. $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

C. $\frac{1}{f}=\frac{1}{u}-\frac{1}{v}$

D. none of these

Answer: A

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4. For any position of an object, image formed in a convex mirror is.

A. virtual

B. erect

C. smaller in size

D. as far behind the mirror as the object is in front

Answer: D

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5. Image of an object in a concave mirror is.

A. always real

B. always virtual

C. always erect

D. real or virtual depending on position of object.

Answer: D

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6. The linear magnification of a concave mirror is.

A. always positive

B. always negative

C. positive or negative depending upon the position of the object.

D. cannot say

Answer: C

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7. When an object is held between pole and focus of a concave mirror, the image formed is.

A. real and inverted

B. real and enlarged

C. virtual and diminished

D. virtual and enlarged

Answer: D

Watch Video Solution

8. The linear magnification of a concave mirror is.

A. always positive

B. always negative

C. sometimes positive and sometimes negative

D. cannot predict

Answer: A

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9. An object is held in front of a concave mirror between f and C. The image formed is.

A. at F

B. at C

C. beyond C

D. none of the above

Answer: C

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(Test Your Grip)Multiple Choice(sec -A)

1. Light of wavelength 6000Å falls on a plane reflecting surface. The reflected wavelength is.

A. 6000Å

B. $< 6000\text{Å}$

C. $> 6000\text{Å}$

D. cannot say

Answer: A

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(Test Your Grip)Fill in the blanks(a)

1. Reflection is the phenomenon of.........without........ .

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2. For a given incident ray, when a plane mirror is turned.......... The reflected ray turns through.......... .

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3. ....of spherical mirror is called.......... Of the mirror.

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4. In case of spherical mirrors, all distances are measured from.......... .

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5. Principal focal length of a spherical mirror is equal to.......... Radius......... of the mirror.

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6. A real image can be...........but a ....cannot be.......... .

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7. Image formed in a convex mirror is always ....whatever be.......... .

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8. Image formed in a concave mirror may be............depending upon.......... .

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9. The linear magnification of a convex mirror is always............because image formed in such a mirror is always.......... .

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10. ....is used as a driver's mirror because it has a........... .

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Problem For Practice(a)

1. Light of wavelength 6000Å falls on a plane reflecting surface. What are the wavelength and frequency of reflected light. If angle between incident ray and reflected ray is 60°, what is the angle of incidence ?

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2. A ray of light is incident at an angle of 60° on a horizontal plane mirror. Through what angle should the mirror br tilted to make the reflected ray horizontal ?

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3. A point object is held between two plane mirrors inclined at 45°. What is the number of images seen ?

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4. A $12m$ tall tree is to be photographed with a pin hole camera. It is situated $15m$ away from the pin hole. How far should the screen be placed from the pin hole to obtain a $12cm$ tall image of the tree ?

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5. A concave mirror of focal length $10cm$ is placed at a distance of $35cm$ from a wall. How far from the wall should an object be placed to get its image on the wall ?

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6. An object is held in front of a concave mirror of focal length $15cm$. The image formed is 3 times the size of the object. Calculate two possible distances of the object from the mirror.

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7. When the distance of an object from a concave mirror is decreased from $15cm$ to 9 cm, the image gets magnified 3 times than that in first case. Calculate focal length of the mirror.

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8. Two objects A and B, when placed one after another in front of a conacve mirror of focal length $10cm$, from images of same size. Size of object A is four times that of B. If object A is placed at a distance of $50cm$ from the mirror, what should be the distance of B from the mirror ?

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9. A dentist concave mirror has a radius of curvature of $30cm$. How far must it be placed from a small cavity in order to get a virtual image magnified 5 times ?

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10. An object of size $10cm$ is placed at a distance of $50cm$ from a concave mirror of focal length $15cm$. Calculate location, size and nature of the image.

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11. An object $2cm$ high is placed at a distance of $16cm$ from a concave mirror, which produces a real image $3cm$ high. What is thr focal length of the mirror ? Find the position of the image ?

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12. An object is placed in front of a concave mirror of focal length 20 cm. The image formed is three times the size of the object. Calculate two possible distances of the object from the mirror?

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13. A concave mirror produces a real image 10 mm tall, of an object 2.5 mm tall placed at 5 cm from the mirror. Calculate focal length of the mirror and the position of the image?

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14. A square object is placed $15cm$ from a convex mirror of radius of curavture $90cm$. Calculate the position of the image and its areal magnification.

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15. The image formed by a convex mirror of focal length $30cm$. is a quarter of the object. What is the distance of the object from the mirror ?

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16. Calculate the distance of an object of height h from a concave mirror of focal length $10cm$ so as to obtain a real image of magnification 2.

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17. When an object is placed at a distance of $60cm$ from a convex spherical mirror, the magnification produced is $1/2$. Where should the object be placed to get a magnification of $1/3$?

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18. An object is placed in front of a concave mirror of radius of curvature $40cm$ at a distance of $10cm$. Find the position, nature and magnification of the image.

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19. A concave mirror of focal length $20cm$ is placed at a distance of $50cm$ from a wall. How far from the wall should an object be placed to form its real image on the wall ?

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20. An object is placed $0.4m$ from a convex mirror and a plane mirror is placed at a distance of $0.3m$ from the object. The images formed in the two mirrors coincide without parallex. What is the focal length of the convex mirror ?

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21. Two plane mirror are inclined to eachother at an angle $\theta = 70^{\circ}$, Fig. A ray SO of light falls at some angle i on the mirror M_1, falls after reflection from it, on the other mirror M_2 from which it gets reflected along a direction parallel to the plane mirror M_1. Find the value of $\angle i$.

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22. A rod $AB = 10cm$ in length is placed along the principal axis of a concave mirror having focal length equal to $10cm$ as shown in Fig. The distance $PB = 20cm$. What is the length of the image of the rod AB ?

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23. Size of an object P is four times that of Q. It is required that the size of the image of P and Q, placed one after the other at certain distances away from a concave mirror of radius of curvature $20cm$ should be equal. To achieve this, if the distance of P from the mirror is $50cm$, what must be the distance of Q ?

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24. An object is placed at a distance of $36cm$ from a convex mirror. A plane mirror is placed inbetween so that the two virtual images so formed coincide. If the plane mirror is at a distance of $24cm$ from the object, find the radius of curvature of convex mirror.

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25. A motor car is fitted with a convex driving mirror of focal length $20cm$. A second motor car is $6m$ away from the driving mirror of the first car. Calculate (i) position of second car as seen in the first car mirror.

(ii) if the second car is overtaking the first car at a relative speed of $15m/s$, how will its image be moving and in what direction ?

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