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PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

RAY OPTICS AND OPTICAL INSTRUMENTS

Solved Examples

1. An object is kept in front of a spherical mirror and it is found that the image of height double to that of the object is formed by the mirror. If radius of curvature of spherical mirror is 40 cm then what are the possible positions of object in front of the mirror and which type of mirror is this?

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2. Assume that distance between the Earth and the Moon is $4 \times 10^8 m$. Concave mirror of focal length 10 m is used to make the image of the Moon whose diameter is approximately 3,500 km. Calculate the diameter of image of the Moon.

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3. A car has a rear view mirror of radius of curvature 2 m. A motorcycle is approaching the car at $15m/s$. If the car is stationary, how fast is the image of the bike approaching the car when the bike is 40 m away?

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4. In the above example, how is the speed of the image affected if the motor bike comes closer to the car at (a) 30 m from the car (b) 20 m from the car?

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5. 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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6. A 2.5 cm high candle flame is placed at a distance of 2.5 m from a wall. How far from the wall a concave mirror must be placed so that a 7.5 cm high inverted image of the flame is formed on the same wall? Also calculate the focal length of the mirror.

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7. 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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8. An image four times the size of an object is formed when the object is kept in front of a concave mirror of focal length 25 cm. Find the two possible distance of the object from the mirror.

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9. An object is placed at a distance of 10 cm from a concave mirror. When the distance of object from the mirror is decreased to 6 cm, the image gets 2 times magnified than that in first case. Calculate the focal length of the mirror.

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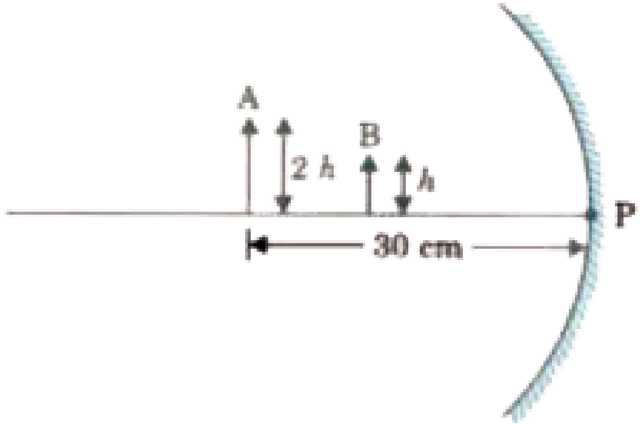
10. In the figure shown below, two objects A and B are placed one after another in front of a concave mirror of focal length 15 cm.



If the objects form image of same size, what should be the distance of object B from the mirror?

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11. Radius of curvature of concave mirror is R and a light ray is incident on it parallel to principal axis at a height h above the principal axis. Calculate distance of the point from pole of mirror where reflected ray intersects with principal axis.

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12. A ray of light of frequency 500 terahertz is passed through a liquid. If the wavelength of light measured inside the liquid is 450 nm, calculate the refractive index of the liquid.

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13. Calculate the frequency and wavelength of a light wave in a medium of refractive index 1.6. Given that the wavelength of light wave in air is $6, 400\text{Å}$.

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14. A ray of light strikes a plane boundary separating two media, medium 1 and medium 2, at an angle of 45°. Calculate the angle of refraction if the ray of light travels from medium 1 to medium 2. Given, refractive indices of medium 1 and 2 are 1.5 and 1.33 respectively.

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15. At the bottom of a trough filled with water a rectangular glass slab is placed. A ray of light is incident on the water surface at an angle of 30° and enters the glass after passing through the water. What is the angle of refraction in glass? Given, refractive index of water is 1.33 and that of glass is 1.5.

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16. 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 index 1.5.Calculate the lateral shift produced.

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17. An object is placed at the bottom of a tank filled with liquid of refractive index 1.6. If the actual depth of the tank is 10 cm, what will be the apparent depth of the object?

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18. An ink dot appeared to be raised by 1 cm when covered with a glass slab of thickness t cm. Calculate the value of t if the velocity of light in air and glass is $3 \times 10^8 m/s$ and $2 \times 10^8 m/s$, respectively.

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19. To determine the refractive index of a liquid experimentally, a mark is made on the beaker and a microscope was focussed on it, giving a reading of 3.42 cm. On pouring liquid till a height 2.68 cm inside the beaker, the reading of refocussed microscope is 3.38 cm. Calculate the refractive index of the liquid.

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20. A vessel has a 3-cm-thick bottom made of glass $(\mu = 1.5)$. The vessel contains water $(\mu = 1.33)$ up to a depth of 6 cm and oil $(\mu = 1.30)$ up to a depth of another 7 cm. Find the apparent depth of vessel when viewed from above.

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

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22. Calculate the critical angle for a liquid in which speed of light is $1.2 \times 10^{8} m/s$ assuming that a ray of light passes from this liquid into air.

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23. A ray of light travelling in air is incident on the surface of glass slab at an angle of 40°. If the ray is deviated through 18°, determine critical angle for the glass-air interface.

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24. When a glass slab is placed in air, its critical angle is 30°. What will be the critical angle when it is immersed in water whose refractive index is 1.33?

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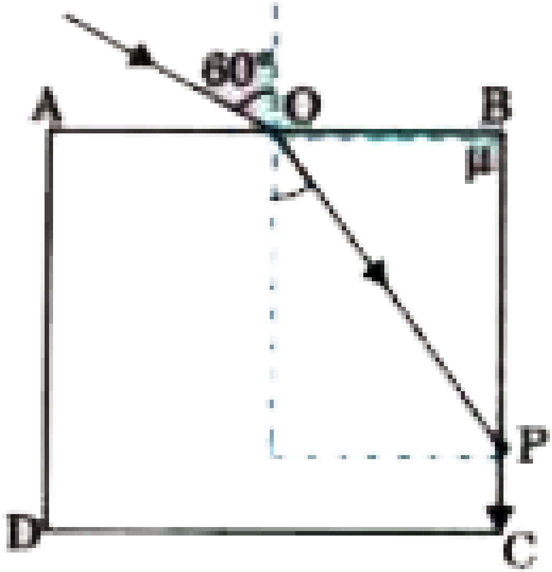
25. Consider the figure given below. A ray of light is incident on one of the horizontal surfaces of glass slab at an angle of 60° and it just grazes along the adjacent vertical sides after refraction. Calculate the critical angle .



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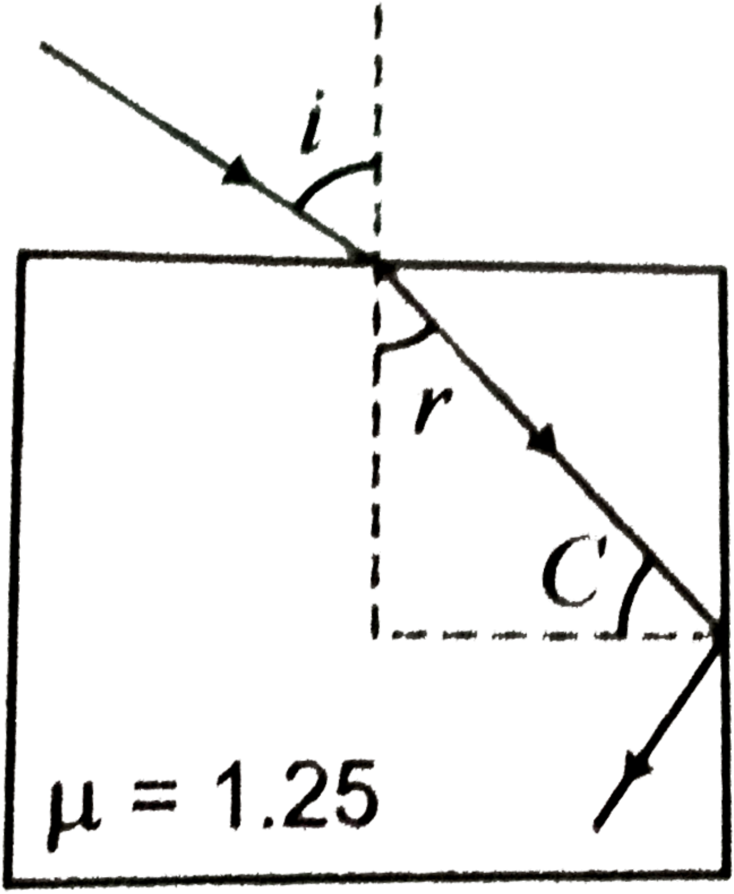
26. In Fig., find the maximum angle i for which light suffers total internal reflection at the vertical surface.



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27. What is the small index of refractive of the material of a right angled prism with equal sides for which a ray of light entering one of the sides normally will be totally reflected ?

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

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29. For a fish under water, the entire outside view is confined within a cone. Draw an appropriate ray diagram for this and calculate the value of semi-vertical angle of the cone. Refractive index of water $= 4/3$

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30. The angle of incidence for a ray of light passing through an equilateral glass prism is equal to its angle of emergence. Also, the angle of emergence is $3/4$ times the angle of prism. Calculate the angle of deviation and refractive index of prism's material.

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31. Determine the speed of light through an equilateral prism for which a ray of light incident on it shows a minimum deviation of 30°.

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32. Minimum angle of deviation of a glass prism is equal to angle of prism. What is angle of prism?

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33. 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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34. A glass prism is made of a material of refractive index 1.5 and has a refracting angle of 60°. It is completely immersed in a liquid of refractive index 1.36. Calculate the angle of minimum deviation of the prism in this situation.

$\left(\sin^{-1} 0.55 = 33.37^\circ\right)$

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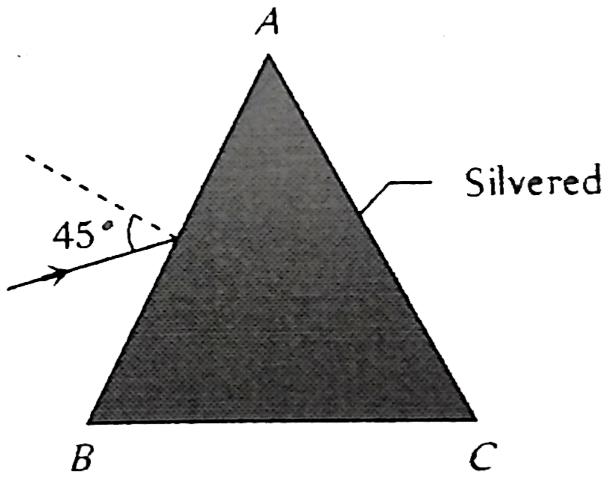
35. A prism ABC of angle 30° has its face AC silvered. A ray of light incident at an angle of 45° at the face AB retraces its path after refraction at face AB and reflection at face AC . The refractive index of the material of the prism is



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36. An equilateral glass prism of refractive index 1.5 is immersed in water. Find the angle of deviation produced when a ray of light is incident at 42° on one face of the prism.

(Refractive index of water = 1.33)

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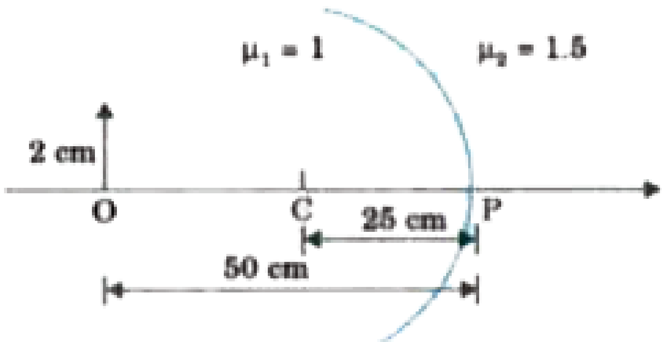
37. Find the location and size of image for the situation shown in figure. Height of the object is 2 cm. Radius of curvature of surface is 25 cm and object is kept at a distance 50 cm from the surface.



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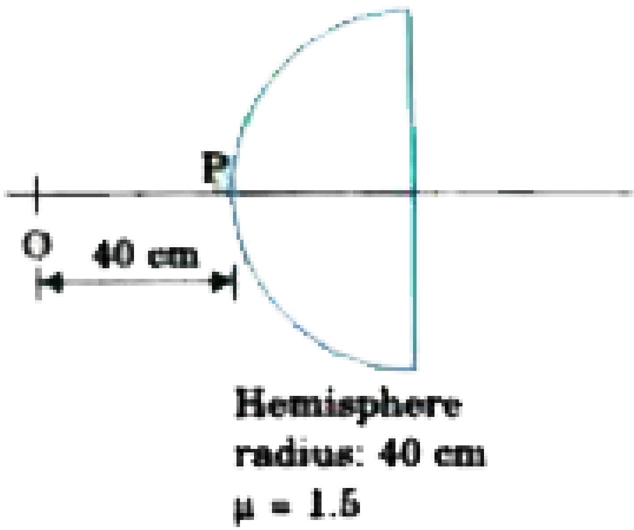
38. In the figure given below a hemisphere made of glass $(\mu = 1.5)$ is shown. Find the location of final image for the object O placed at a distance 40 cm from point P on the hemisphere. Consider outside medium as air.



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39. A point source of light is placed in air, 100 cm away from a convex spherical surface, made of material of refractive index 1.5 and having radius of curvature = 20 cm. If the source emits light, at what position from the convex surface image will be formed?

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40. One end of a cylindrical rod is grounded to a hemispherical surface of radius R = 30 mm. The refractive index of rod is 1.5. Find the position of the image placed on the axis of the rod at 10 cm from the pole.

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41. A glass sphere of diameter 20 cm is constructed with a material of refractive index 1.5. A beam of light strikes the sphere and converges at a point 40 cm behind the pole of a spherical surface. Find the position of the image.

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42. A curved surface of $\mu = 1.5$ forms a virtual image of an object which is placed in air at a distance of 15 cm from the surface. The image is formed at a distance of 60 cm, what is the radius of curvature of the curved surface? Also, calculate the power of curved surface and the two focal lengths of the surface.

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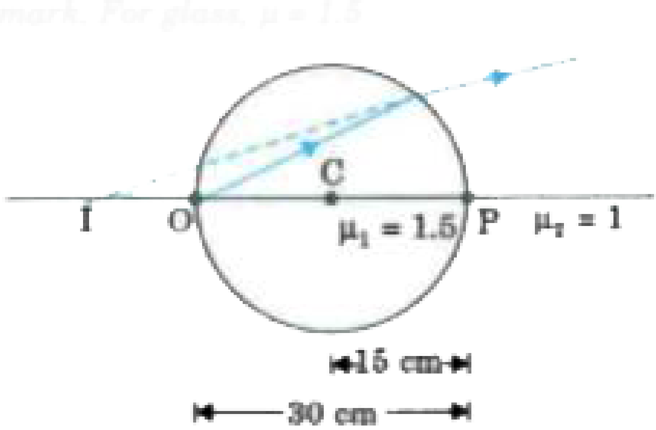
43. A mark placed on the surface of glass sphere is viewed through glass from an oppositely directed position. If the diameter of the sphere is 30 cm, locate the image of the mark.

For glass, $\mu = 1.5$



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44. A small air bubble in a sphere of glass with radius 4 cm appears to be 1 cm from the surface when observed along a diameter. Find the true positino of the air bubble.

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45. There is a convex lens of focal length 20 cm. An object of height 3 cm is placed perpendicular to principal axis of lens at a distance 10 cm from the lens. Find the size of image.

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46. There is one convex lens of focal length 40 cm. Where an object should be placed so that we get image of double the height of the object?

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47. Focal length of the concave lens is 40 cm. An object is kept at a distance 40 cm from the lens. What will be the location and magnification of image formed?

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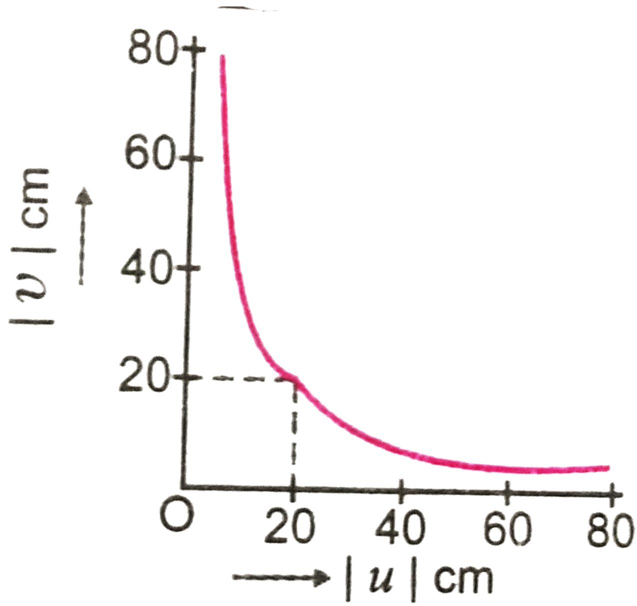
48. The graph in shows the variation of image distance (v) with object distance (u) in case of a lens. Find focal length of the lens. What is the nature of the lens, if image formed is real ?



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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 ?

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50. 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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51. A double convex lens has radii of curvature equal to 10 cm and 15 cm of the two faces. Given the focal length of lens is 12 cm, calculate the refractive index of glass.

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52. A biconcave lens is made of a material of refractive index μ. If the radius of curvature of each face of the lens is $\frac{3}{2}$ times the focal length of lens, calculate value of μ.

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53. Find the radius of curvature of the convex surface of a plano-convex lens, whose focal length is 0.3 m and the refractive index of the material of the lens is 1.5.

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54. A biconvex lens has equal radii of curvature of 20 cm for each face and is made of material of refractive index 1.5. An object of 6 cm height is placed at a distance of 10 cm from the lens. Find the position, nature and size of the image.

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55. A double convex lens of glass $(\mu = 1.5)$ renders parallel rays coming from a distant source at a distance of 5 cm. If the radii of curvature are in the ratio $1:2$, calculate their individual values.

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56. 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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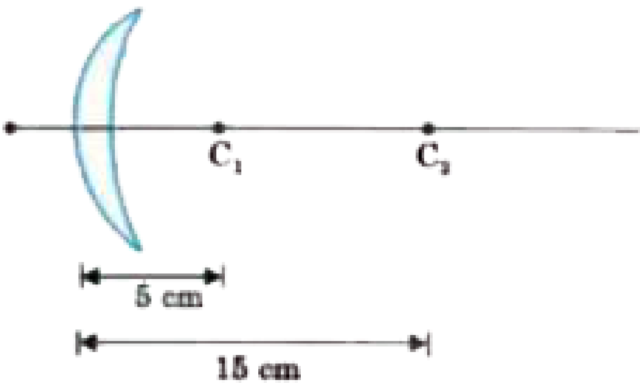
57. A thin lens with centres of curvature C_1 and C_2 is shown in the figure given below. If the refractive index of material of lens is 1.5, calculate the focal length in cm.



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58. Refractiven index of glass is $\frac{3}{2}$ and that of water is $\frac{4}{3}$ w.r.t. air. Calculate the ratio of focal length of a lens made of the glass when placed in water and air.

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59. A convex lens of material of refractive index 1.5 is immersed in a liquid of refractive index (i) 1.3 (ii) 1.6 and (iii) 1.5. What will happen to the focal length and nature of lens in all three cases?

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60. A concave mirror of radius R is kept on a horizontal table. Water (refractive index =mu.) is poured into it up to a height h.

Where should an object be placed so that its image is formed on itself ?

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61. A convex lens is placed at a distance of 40 cm from a screen. A point source is placed at a distance of 60 cm from the screen on the same side of the lens. At this position of point-source, a circular spot of light of diameter equal to the lens is formed. Show the formation of image by a ray diagram. Up to what distance the source be displaced so that its clear image can be formed on the screen?

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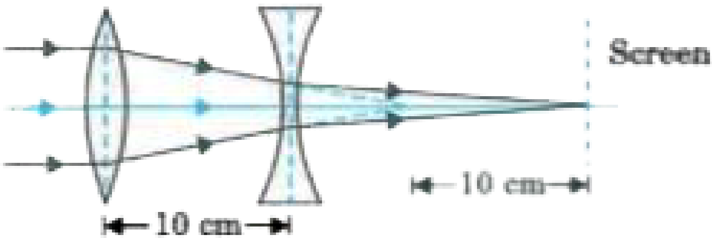
62. An arrangement of a concave and a convex lens is shown below. The focal length of the convex lens is 30 cm. Parallel rays coming from a distant source are focused on the screen after passing through the lenses. Calculate the focal length of the concave lens.



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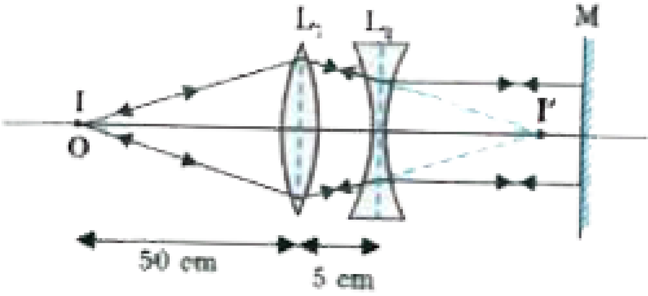
63. In the following ray diagram the positions of an object O, image I and two lenses L_1 and L_2 and a mirror M are given.

The focal length of L_1 is 10 cm. Find the focal length of L_2.



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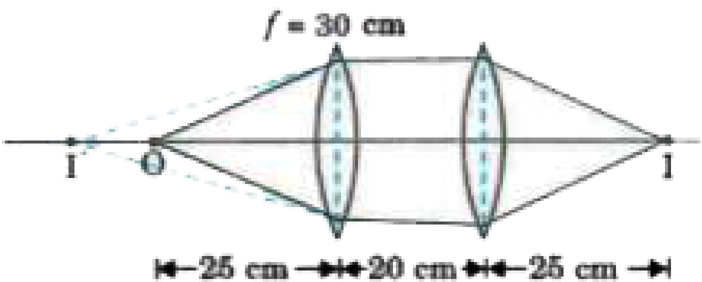
64. From the ray diagram shown below, calculate the focal length of the other convex lens.



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

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66. A double convex lens of radius of curvature of each surface equal to 20 cm is made of glass of refractive index 1.5. Find the ratio of the powers of the lens when placed in air to its power when placed in water. Take refractive index of water = 1.33.

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67. Two thin lenses of power +5 D and -2.5 D are in contact. What is the focal length of the combination ?

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68. An arrangement of two lenses consists of a converging lens of focal length 40 cm placed coaxially in contact with another lens of unknown focal length. The combination behaves like a diverging lens of focal length 40 cm. Find the power and nature of the second lens.

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69. A thin convex lens made of glass of refractive index $3/2$ has a power of 5 D. When it is immersed in a liquid of refractive index μ, it behaves like a divergent lens of focal length 1 m. Calculate the refractive index of the liquid.

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70. Two coaxial thin lenses are placed in contact with each other and a small object is placed at a distance of 20cm from the combination of lenses. The focal length of each lens is 30 cm. What will be the distance between the object and the image when both the lenses are (i) convex (ii) concave

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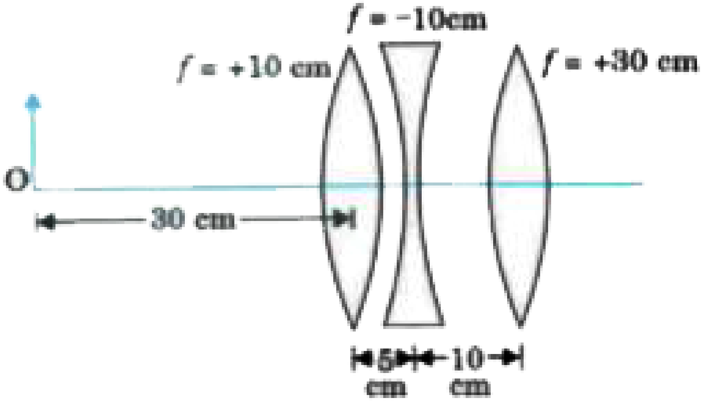
71. Find the position of the image formed by the lens combination given in the following figure :



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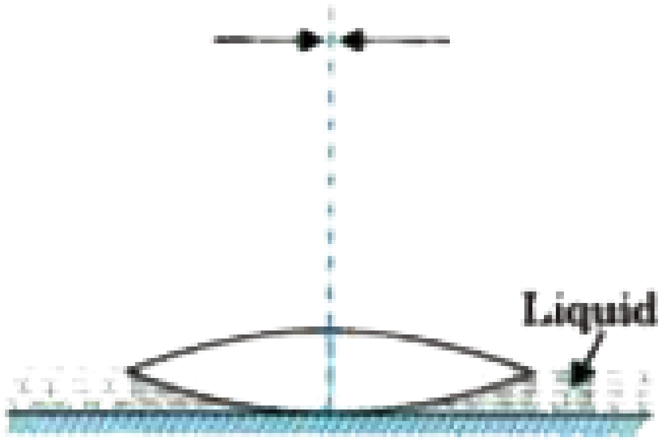
72. An equiconvex lens with radii of curvature of magnitude R each is put over a liquid layer poured on top of a plane mirror. A small needle, with its tip on the principal axis of the lens, is moved along the axis until its inverted real image coincides with the needle itself. The distance of the needle 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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73. A convex lens is placed over a plane mirror. A pin is now positioned so that there is no parallax between the pin and its image formed by this lens-mirror combination. How can this observation be used to find the focal length of the convex lens? Give appropriate reasons in support of your answer.

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74. A convex lens of focal length $20cm$ is placed co-axially with a convex mirror of radius of curvature $20cm$. The two are kept $15cm$ apart from each other. 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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75. A concave lens and a plane mirror re placed coaxially 10 cm apart. A point object is placed at a distance of 40 cm from the concave lens. The final image formed by the combination is located 30 cm behind the mirror. Calculate the focal length of the concave lens.

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76. The far point of a myopic person is 120 cm in front of the eye. Calculate the power of the lens required to enable the person see distant object clearly.

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77. 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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78. Calculate the focal length of a lens used as simple microscope of magnifying power 20. Consider that the final image is formed at the least distance of distinct vision.

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79. A converging lens of focal length 5.0 cm is used as a magnifying glass. The near point of the observer is 25 cm from the eye. If the lens is held close to the eye, find the distance of object from the lens and its angular magnification.

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80. A magnifying glass is a combination of lenses of powers $+20D$ and $-5D$. Calculate the magnifying power of the microscope, if the distance of distinct vision is 25 cm. Also, calculate the size of an object 3 cm high seen through the magnifying glass.

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81. A simple microscope of power 15 D is used to see an object. If the least distance of distinct vision is 25 cm, where should the object be placed so as to produce maximum angular magnification?

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82. A magnifying glass is rated 6X for a normal relaxed eye. For a relaxed farsighted eye whose near point is 50 cm, then what will be its magnifying power?

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83. 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 $5 cm$.

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

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

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

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

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85. 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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86. Two converging lenses of focal lengths 1.5 cm and 6 cm are chosen to design a compound microscope. It is desired to have a magnification of 25. Calculate the required separation between the objective and the eyepiece.

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87. For a compound microscope, the focal length of eyepiece and objective lens is 5 cm and 1 cm, respectively. The length of the tube is 30 cm. If the final image is formed at infinity, calculate the magnifying power of the microscope.

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88. The sum of focal lengths of the two lenses of a refracting telescope is 105 cm. The focal length of one lens is 20 times that of the other. Determine the total magnification of the telescope when the final image is formed at infinity.

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89. A telescope has objective and eyepiece lenses of focal lengths 150 cm and 5 cm, respectively. Calculate the magnifying power of telescope when the final image is formed

(a) at infinity and

(b) at the least distance of clear vision.

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90. A telescope has an objective of focal length 30 cm and an eyepiece of focal length 3 cm. It is used to focus on an object at a distance of 2 m. Calculate the separation between the objective and the eyepiece for seeing with relaxed eye.

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91. The Moon is viewed by the telescope which consists of two lenses of focal lengths $5m$ and $10cm$. Calculate the angle subtended by the eye at the final image. The diameter of the Moon is $3.5 \times 10^3 km$ and its distance from the Earth is approximately $4 \times 10^5 km$.

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92. 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.

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93. A terrestrial telescope has objective and eyepiece lenses of focal length 200 cm and 5 cm, respectively. The erecting lens has a focal length of 4.5 cm. Calculate the separation between the objective and the eyepiece. Also calculate the magnifying power of the telescope.

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94. A Galilean telescope obtains the erect final image by using a diverging lens of focal length 7.5 cm instead of an intermediate erecting lens. If the focal length of the objective is 150 cm, what is the separation between the objective and the eyepiece?

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95. A concave reflector of radius of curvature 110 cm is used by a reflecting type telescope. What will be the focal length of eyepiece required to obtain a magnification of 20?

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96. Focal lengths of a lens for violet, yellow and red colours are f_v, f_y and f_r respectively. Calculate the dispersive power of the material of the lens.

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97. What is the angle of dispersion between red and violet colours produced by a flint glass prism of refracting angle 60°? Refractive indices of the given prism for red and violet colours are 1.622 and 1.663, respectively.

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98. White light is passed through a prism of refracting angle 6°. If the refractive indices for red and blue rays are 1.64 and 1.66 respectively, calculate the angle of dispersion between them.

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99. The angle of minimum deviation for blue, red and yellow colours are $53^\circ, 51^\circ$ and 52°, respectively when passed through a prism of angle $A = 60^\circ$. Calculate its dispersive power.

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100. The refractive indices for violet, yellow and red colours for a flint glass prism are 1.634, 1.623 and 1.616. Calculate the dispersive power of the prism material.

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101. A glass prism deviates the red and blue colour rays through 8° and 10°, respectively. A second prism of equal refracting angle deviates them through 10° and 12° respectively. Calculate the ratio of their dispersive powers.

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102. In a certain spectrum produced by a glass prism of dispersive power 0.0305, it is found that the refractive index for the red ray is 1.645. and that for the violet ray is 1.665. What is the refractive index for the yellow ray?

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Practice Problems 1

1. A concave mirror of focal length 20 cm is placed 40 cm away from a convex mirror of focal length 15 cm . An object is placed between both the mirrors, 15 cm away from the convex mirror. Find the position of image formed by reflection from concave mirror followed by convex mirror. What is nature of the image formed ?

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2. A circular plate of radius 2 cm is kept at a distance of 22 cm in front of a concave mirror. The focal length of mirror is 10 cm. Calculate the perimeter of image formed if plate is kept coaxially to the principal axis.

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3. An iron nail is kept at a distance of 50 cm in front of a convex mirror. The height of the image formed is half of the height of object. Where should we place the pin to get an image of one-fourth the height of object ?

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

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5. 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

19 m and

(d) 9 m. away ?

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6. An object is kept 15 cm away from the mirror. What is the focal length, nature of the mirror, and nature of the image if it is formed at a distance of 5 cm from the mirror in other side of the mirror ?

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7. An object is placed between a wall and a concave mirror of focal length 15 cm. The distance between wall and mirror is 40 cm. Find the position of the object placed such that the image of the object is just formed on the wall.

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8. An object is placed in front of the concave mirror of focal length f. The magnification of the image became twice when the object distance is changed from 20 cm to 11 cm. Calculate the value of f.

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9. A concave mirror of focal length 15 cm is placed on a table. An object is placed in front of the mirror at a distance of 45 cm. Another object of half the size is placed in front of the mirror. At what position should be second object placed so that height of both the images formed are same.

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10. A shaving mirror is used to see the enlarged view of the face while shaving. It is a concave spherical mirror. How far the shaving mirror should be placed to see the face magnified to thrice ? The focal length of the mirror is 10 cm.

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11. A concave mirror has a focal length of 10 cm. Where can we place the object so that the image formed is magnified to twice the size of object ?

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12. A concave mirror has a focal length f. An object of height 1 cm is placed perpendicular to the principal axis in front of the mirror at a distance of 2 f. Calculate the height and nature of the image formed.

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13. A concave mirror has a focal length of 15 cm. A 10 cm long iron scale is placed coaxially to the principal axis such that end away from the mirror is 40 cm away from the pole. What will be length of the image ?

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Practice Problems 2

1. Refractive index of material X with respect to air is 1.5. Refractive index of material Y with respect to air is 1.34. Find the refractive index of material X with respect to material Y.

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2. Calculate speed of light in water of refractive index $4/3$. Given speed of light in air $= 3 \times 10^8 m/s$.

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3. A light ray has a wavelength of $5,000 \text{Å}$ in air. How will its wavelength and frequency change entering in the glass of refractive index 1.5 ?

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4. The inner bottom of a tub filled with water is stained with a mark. The water is filled to a height of 7 cm. Calculate the distance by which the stain appears to be raised. Refractive index of water is 1.33.

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5. Two different transparent media of different refractive indices are placed together as shown in the figure given below. A ray of light enters the medium settled above at an angle of 45°. Calculate the angle of refraction of light in the medium settled below. The refractive indices of upper and lower media are 1.22 and 1.44, respectively.

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6. An observer looks at an object kept at a distance 30 cm in air. If a rectangular glass plate (μ =1.5) is placed between the observer and the object with its thick-ness along the line of observation, the object appears to the observer to be at a distance 25 cm. Find the thickness of glass plate. Position of the glass plate is now shifted (i) from object towards observers (ii) from observer towards the object How does it change the apparent position of the object as seen by the observer?

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7. Find the lateral shift produced in a ray of light incident on a material of refractive index 1.45 at an angle of 30°. The thickness of the material is 5 cm.

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8. A thick rectangular glass slab is kept inside a water trough. A ray of light passing through water is incident on the glass slab at an angle of 45°. Calculate the angle of refraction, if refractive indices of water and glass are 1.33 and 1.45 respectively.

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9. A microscope is focused on a stain on inner bottom of an empty trough. The microscope is leveled and moved 1.4 cm away from the surface. To what height a transparent liquid of refractive index 1.4 should be filled in the trough to focus the stain again.

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Practice Problems 3

1. Calculate the critical angle for a pair of media, water and glass. Given refractive index of glass and water is 1.45 and 1.33 respectively.

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2. The refractive index of glass is 1.5. Calculate the speed of light in glass. The speed of light in air is $3.0 \times 10^{8} ms^{-1}$.

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3. A rectangular box of dimension $15 \times 10 \times 7$ cm is made out from a transparent material, An air bubble is observed from above at a distance of 3 cm when seen from above and at a distance of 0.5 cm when seen from opposite side. What is the refractive index of the material ? Also find the actual distance of the bubble from the upper face.

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4. A glass slab when placed in air has a critical angle of 40°. Calculate the critical angle of the same glass slab if the medium around it is replaced by a liquid of refractive index 1.28.

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5. The ray of light is incident at an angle of 45° on a glass surface. What will be the critical angle of the glass when placed in air if the light ray is deviated by 12° ?

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6. A point light source is attached to the base of an empty trough. A transparent liquid of refractive index 1.35 is filled in the trough to a height of 50 cm. Calculate the total area on the surface of the liquid through which light will emerge.

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7. A salt water lake has refractive index 1.4. A fish when looks towards the surface of water, can only view things outside through a circular area. Calculate the semi-vertical angle of the cone formed within which the circular area lies.

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8. एक मछली पानी के अंदर $\sqrt{7}$ cm की गहराई पर तेर रही है। मछली पानी के बाहर केवल वृताकार भाग से देख सकती है। इस वृताकार भाग की त्रिज्या कितनी होगी । हवा के सापेक्ष पानी का अपवर्तनाक $\frac{4}{3}$ है ।

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9. A prism made of material with refractive index 1.6 has a prism angle of 9°. Calculate the angle of deviation of the prism.

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10. A prism made of refractive index x has prism angle of 50°. A light ray incident at an angle of 45° refracts through the prism and undergoes minimum deviation. Calculate the value of x and angle of minimum deviation.

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11. An equilateral prism is made of material with refractive index 1.73. A light ray incident at an angle i on it refract and moves parallel to the base of the prism. Find the value of i.

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12. प्रकाश की एक किरण वायु से समबाहु त्रिभुजाकार कांच के प्रिज्म से अल्पतम विचलन कोण से गुजरती है, जब आपतित कोण प्रिज्म के कोण का $\frac{3}{4}$ है। प्रिज्म में प्रकाश की चाल की गणना कीजिए।

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13. An equilateral prism of unknown refractive index has a prism angle A. A light ray incident at an angle 0.8 A suffers minimum deviation. What will be the speed of light inside the prism ?

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14. A prism of prism angle 50° has angle of minimum deviation 30°. Determine the velocity of the light inside the prism.

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15. 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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16. A prism has a prism angle 60°. A light ray incident at an angle of 45° deviates by an angle 40°. Calculate the angle between emergent ray and prism surface.

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17. An equilateral prism has a refractive index equal to 1.56 for the light of wavelength 450 nm. Determine the minimum angle of deviation for light of 450 nm.

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18. If a small angled prism, made of glass is immersed in a liquid of refractive index 1 and a ray of light is made incident on it, then

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Practice Problems 4

1. A double convex spherical glass has refractive index 1.5 and both radius of curvature 30 cm. A point object is placed at a distance of 120 cm from the spherical glass. What will be the position of the image formed ?

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2. Light from a point source in air falls on a spherical glass surface. If $\mu = 1.5$, and radius of curvature $= 20cm$, the distance of light source from the glass surface is $100cm$, at what position will the image be formed ? (NCERT Solved Example)

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3. A small LED, emitting light is placed at x distance above a spherical glass of refractive index 1.5 and radius of curvature 30 cm. The image of the LED is formed at a distance of 150 cm away from the surface of sphere along the direction of incident light. Calculate the distance between LED light and the surface of spherical glass.

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4. A spherical shaped fish bowl filled with water of refractive index 1.3 is placed in another large tank filled with another liquid of refractive index 1.4 such that rim of the fish bowl is slightly above the liquid filled in the tank. The diameter of the fish bowl is 20 cm. A parallel light rays from a distant object is incident on the spherical fish bowl. Find the position at which incident light rays will get focused when seen by a small fish at the centre of the bowl.

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5. A fish bowl of diameter 20 cm is filled with a liquid of refractive index 1.4. A letter O is written on the outer surface of the bowl. Determine the position of the image of the word formed when observed through the bowl from the opposite side.

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6. A sunshine recorder globe is a device that provides the information about climate and weather by recording the amount of sunshine for a given location. One such globe of diameter 20 cm and refractive index 1.5 is used for the purpose. A parallel beam of light enters the globe and is refracted by the spherical surface of the globe. Determine the position of the image of the rays formed.

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Practice Problems 5

1. A converging lens has a focal length of 15 cm. Determine the position where an object can be placed so that the image obtained is twice the size of object.

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2. A convex lens with focal length 15 cm forms an image with magnification 3. Determine the position of object and image if image obtained is erect in nature.

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3. An object is kept at a distance of 1 m from the screen. The image formed is twice the size of the object. Calculate the focal length of the lens used. Also determine its nature.

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Practice Problems 6

1. A concave lens with equal radius of curvature both sides has a focal length of 12 cm. The refractive index of the lens is 1.5. How will the focal length of the lens change if it is immersed in the liquid of refractive index 1.8 ?

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2. A magician during a show makes a glass lens with refractive index n = 1.47 disappears in a trough of liquid. What is the refractive index of the liquid ? Could the liquid be water ?

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3. A biconvex lens has a refractive index of 1.5. The parallel beam of light incident on it forms an image at a distance of 12 cm. Calculate the radii of curvature of both the surfaces if the ratio of the radii of curvature is $2:3$.

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Practice Problems 7

1. Focal length of combination of two thin lenses is 1 m. Calculate the power of one lens if the focal length of other lens is 30 cm.

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2. A combination of two lenses with focal length 60 cm diverge the incident rays. Determine the power and nature of one lens if the other lens is convex and has a focal length of 60 cm.

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3. A concave lens with power -7 D is coaxially placed adjacent to a convex lens with power + 12 D. Calculate the focal length of combined lens.

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4. An object is placed at a distance of 20 cm in front of a concave mirror of focal length 10 cm. Determine the position of the image. What is the ratio of the size of the image to the size of the object ?

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5. A convex lens of focal length 10 cm is coaxially placed near a concave lens. The combination forms the image of an object placed, 50 cm away from the convex lens to a point 30 cm away from the concave lens. If the distance between the optical centres of both the lens is 10 cm. calculate the focal length of concave lens.

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6. A concave and convex lens each of focal length 15 cm are kept 5 cm apart. An object is placed in front of the convex lens at a distance of 60 cm. Determine the position of final image.

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7. A convex lens is coaxially placed with a concave lens. A screen is placed at a distance of 100 cm apart from the combination. The focal length of convex lens is 15 cm. Determine the focal length of the concave lens if image of object placed at a distance of 20 cm, from the combination, is projected on the scrcen.

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8. (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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9. A convex lens has a refractive index 1.5 and power 7 diopter. When the lens is immersed in a liquid, it behaves as a concave lens of focal length 120 cm. Calculate the refractive index of the liquid.

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10. A convex lens has a focal length of 15 cm. Determine the focal length and nature of the lens which can be used with the convex lens to obtain a combination with effective power 9 diopter.

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11. 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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12. A convex lens is placed coaxially near a convex mirror of radius of curvature 30 cm. the distance between the lens and the mirror is 40 cm. Calculate the focal length of the lens if the final image of an object placed at 35 cm coincide with the object itself.

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Practice Problems 8

1. What focal length should the reading spectacles have for a person whose near point is $50cm$ where the book is 25 cm infront of him?

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2. A hypermetropic person has a near point at 75 cm. Determine the nature and power of the lens required to rectify the defect.

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3. A child has correction spectacles of power -3 D. Determine the vision defect and also find the far point of the child without spectacles.

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4. A doctor prescribes a person (i) power of -5 D for distant vision correction (ii) power of +2 D for near vision. Determine the focal length of both the parts of corrective lens.

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5. The for 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? In what way does the corrective lens help the above person? Does the lens magnify very distant object? Explain.

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

1. A simple microscope has a combination of two lens of power $+10D$ and $+20D$. Determine the magnifying power of microscope if the image is formed at a distance of 25 cm in front of the eye.

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2. 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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3. The focal lengths of the objective and eyepiece of a compound microscope are 5 cm and 10 cm, respectively. The final image of object placed at a distance of 7 cm from the objective lens is formed at near point. Determine the magnifying power and tube length of the compound microscope.

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

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

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5. Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification the final image is formed at the near point.

In a compound microscope , an object is placed at a distance of 1.5 cm from the objective of focal length 1.25cm. if the eye piece has a focal length of 5 cm and the final image is formed at the near point, estimate the magnifying the power of the microscope.

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6. A man with no vision defects tries to read a manuscript written in small print using a thin convex lens of focal length 10 cm. Determine the range of the distance at which he can read the manuscript through the lens.

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Practice Problems 10

1. 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.

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2. A boy observes a celestial object at a distance of 7×10^3 km from the Earth. The radius of the object is 4×10^3 km. Determine the angle subtended by the image on the eye if focal lengths of objective and eyepiece are 5 m and 10 cm, respectively.

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3. In a refracting type telescope, the distance between objective and eyepiece is 25 cm for normal adjustment. Find the focal lengths of the objective and eyepiece if the magnifying power of the telescope is 10.

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4. An astronomicla telescope has an objective of focal length 20 cm and an eyepiece of focal length 4.0 cm. The telescope is focussed to see an object 10 cmfrom the objective.the fnal imae is formed at infinity.Find the length of the tube and the angular magnification produced by the telescope.

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Practice Problems 11

1. Refractive index of a material for red and violet light is 1.53 and 1.55 respectively. Calculate the ratio of angular dispersion to the mean deviation of the material.

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2. A prism has a prism angle 7°. The refractive index for violet and red light is 1.66 and 1.64, respectively. Calculate the angular dispersion for white light passing through the prism.

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3. Refractive indices of flint glass for blue and red light are 1.668 and 1.648, respectively. Calculate the dispersive power of

the glass.

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4. Find the dispersive power of flint glass. The refractive indices of flint glass for red, yellow and violet light are 1.613, 1.620 and 1.632 respectively.

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Conceptual Questions

1. It is always said now that "Universe is all history". Elaborate.

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2. The windows at airport control towers are slightly sloped inwards towards the bottom of the tower. Explain.

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3. What happens to the frequency, wavelength and speed of a light beam travelling from rarer medium to denser medium ?

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4. A glass slab is made such that the refractive index of the material increases with its depth. The glass slab is kept in air and a light ray is incident on its top face. How will the light ray pass through it ?

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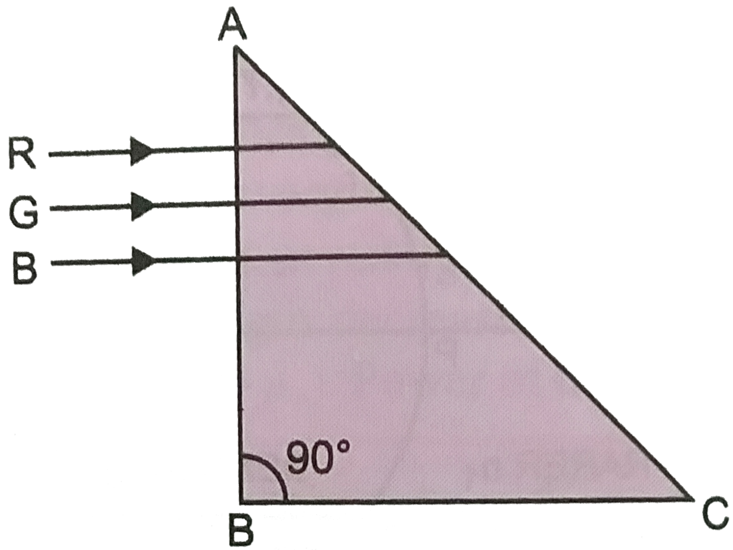
5. In Fig. 6(b).80, light rays of blue, green and red wavelength are incident on an isoscels right angled prism. Explain with reason which ray of light will be transmitted through the face AC. The refractive index of the prism for red, green and blue light are 1.39, 1.424 and 1.476 respectively.



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6. A liquid Z expands on heating and contracts on cooling. It does not stick to wall and appears to be transparent as water. Can we use the liquid to make a liquid thermometer if its refractive index is 1.002 ?

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7. Why sharpened diamonds shine ?

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8. सिल्वर दर्पण प्रतिक्रिया किस युग्म में विभेद के लिए प्रयुक्त होती है-

Watch Video Solution

9. While painting the road signs, tiny clear spheres are used in the paint. Explain.

Watch Video Solution

10. Rainbow is observed when the sun is

Watch Video Solution

11. A ray of light is incident on the surface of water. For what angle, the ray will undergo total internal reflection ?

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12. On a hot sunny day in deserts, illusion of water is seen at some distance. Explain.

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13. Can we ever witness a complete circular rainbow from the surface of the Earth ?

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14. A boy is standing a few metres away from a plane reflecting mirror. The plane mirror has some water marks on its surface. Can he see his image and the water marks simultaneously ?

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15. A spoon partially inserted in beaker filled with water seems bent. Explain.

Watch Video Solution

16. Is it possible that (i) relative refractive index of the medium or (ii) absolute refractive index of the medium is less than unity ?

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17. Three letters are written on the internal base of a glass beaker in three different colours, red, blue and green. Now, the beaker is filled with the water. Which of the following coloured letter will be seen least raised when seen through the water ?

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18. Diamonds do not shine in dark. Explain.

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19. For a real object is it true that image formed is always inverted or always real with (i) concave mirror or (ii) convex mirror ?

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20. State the mirror equation and magnification equation. Can we apply them in case of plane mirrors ?

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21. Why clear streams appear shallow ?

Watch Video Solution

22. Is it possible that the image of real object formed by thin concave lens is (i) inverted, (ii) real, (iii) diminished ?

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23. Can we observe chromatic aberration in the image formed by a plane mirror ?

Watch Video Solution

24. Which type of mirror is used as rear view mirrors in automobiles and why ?

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25. A thin convex lens made of material with refractive index 1.23 is placed in a medium with refractive index 1.56. What will be the nature of the lens now, converging or diverging ?

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26. Eye glasses are either made of converging lens or diverging lens. Both the types of eyeglasses have meniscus design. Explain.

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27. A piece of lens is used to focus the sunlight on a paper and burn it. As the large amount of heat is passing through the piece of glass, will it get heated ?

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28. Which of the following will be a more efficient solar furnace ? (i) concave mirror of parabolic shape of short focal length, (ii) concave mirror of long focal length

Watch Video Solution

29. Why sunglasses have zero power ?

Watch Video Solution

30. Is it possible that a convex lenc can diverge the emergent light rays ?

Watch Video Solution

31. A change in the focal length of the eye lens is brought by.

Watch Video Solution

32. A concave lens is cut vertically into two equal parts. What will be the focal length of each plano-concave lens obtained ?

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

Watch Video Solution

34. How will the focal length of a lens is changed if its aperture is increased to double ?

Watch Video Solution

35. Is there a spectrum observed when white light is passed through a thick rectangular glass slab ?

Watch Video Solution

36. Sky appears blue in colour. Explain.

Watch Video Solution

37. Why do clouds generally look white ?

Watch Video Solution

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

Watch Video Solution

39. The Sun is too large in size than the Moon, still both look apparently of same size (0.5 degrees) in sky. Explain.

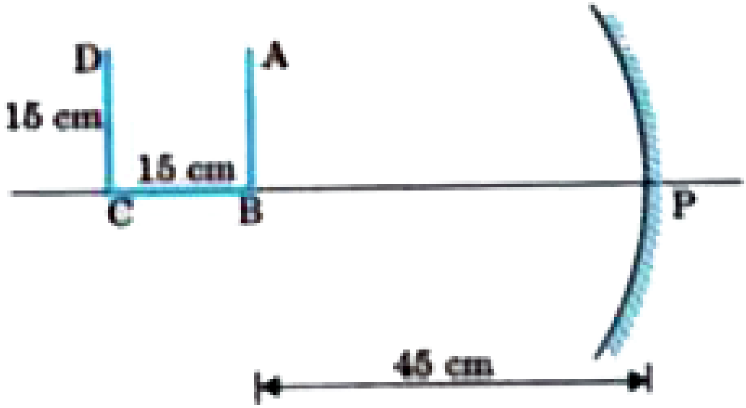
Watch Video Solution

40. Why the aperture of objective lens of the microscope is small and that of telescope is large ?

Watch Video Solution

Tough Tricky Problems

1. There is a concave mirror of radius of curvature 30 cm. A U-shaped wire of shown dimensions is placed in front of concave mirror as shown in given figure. Find the total length of the image formed.



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2. There is a concave mirror of focal length 7.5 cm. Two objects P and Q are placed in front of this concave mirror one by one. Heights of the images of P and Q are found to be same. Height of P is double to that of height of Q and is placed at a distance 15 cm from the mirror. At what distance object Q was placed?

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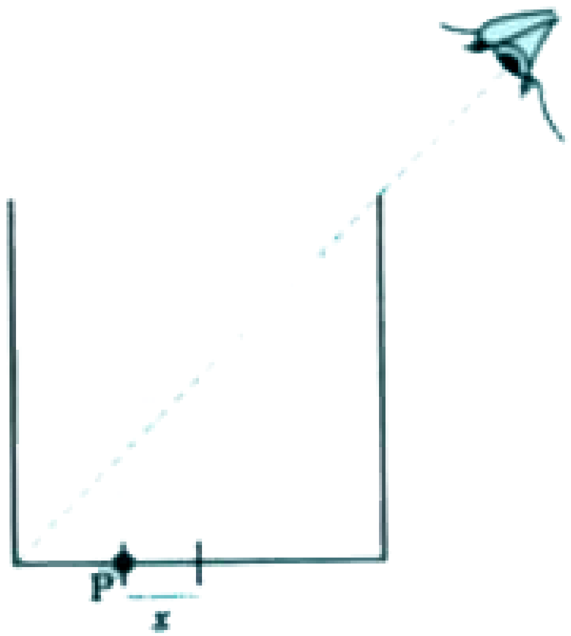
3. There is one cylindrical vessel whose height and diameter are both equal to D. An observer's eye is placed in such a manner that bottom edge of the vessel is just visible to eye.



There is a point P at the bottom of container at a distance x from the centre of container as shown in the figure. Up to what height the liquid of refractive index μ should be poured in the vessel so that point P is visible to the eye?

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4. A hemispherical portion of the surface of a solid glass sphere (mu = 1.5) of radius r is silvered to make the inner side reflecting. An object is placed on the axis of the hemisphere at a distance 3r from the centre of the sphere. The light from the object is refracted at the unsilvered part, then reflected from the silvered part and again refracted at the unsilvered part. Locate the final image formed.

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5. A ray of light passes through a transparent sphere of refractive index μ and radius R. If b is the distance between the incident ray and a parallel diameter of

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6. A cylindrical glass rod of radius 0.1m and refractive index $\sqrt{3}$ lies on horizontal plane mirror. A horizontal ray of light moving perpendicular to the axis of the rod is incident on it. At what height from the mirror should the ray be incident so that it leaves the rod at a height of 0.1m above the plane mirror ? At what distance a second similar rod, parallel to the first, be placed on the mirror, such that the emergent ray from the second rod is in line with the incident ray on the first rod ?

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7. The convex surface of a thin concave-convex lens of glass of refractive index 1.5 has a radius of curvature 20 cm. The concave surface has a radius of curvature 60 cm. The convex side is silvered and placed on a horizontal surface as shown in figure. (a) Where should a pin be placed on the axis so that its image is formed at the same place ? (b) If the concave part is filled with water (mu = 4/3), find the distance through which the pin should be moved so that the image of the pin again coincides with the pin.

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8. A parallel beam of light travelling in water (refractive index $= 4/3)$ is refracted by a spherical air bublle of radius 2mm situated in water. Assuming the light rays to be paraxial,

a. Find the position of image due to refraction at first surface and position of the final image.

b. Draw a ray diagram showing the position of both images.

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9. 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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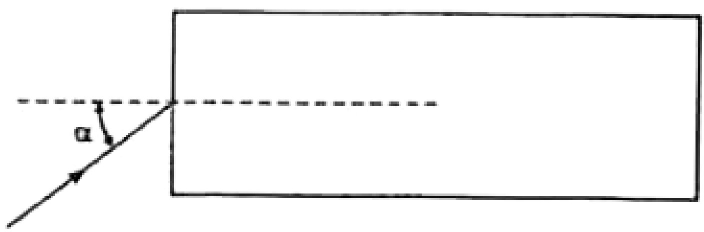
10. n अपवर्तनांक की एक पारदर्शी बेलनाकार छड़ के एक समतल सिरे पर α कोण पर प्रकाश आपतित होता है | n का वह न्यूनतम मान ज्ञात कीजिए जिससे छड़ में प्रवेश करने वाला प्रकाश छड़ के वक्र - पृष्ठ से निर्गत न हो चाहे α का मान कुछ भी क्यों न हो |



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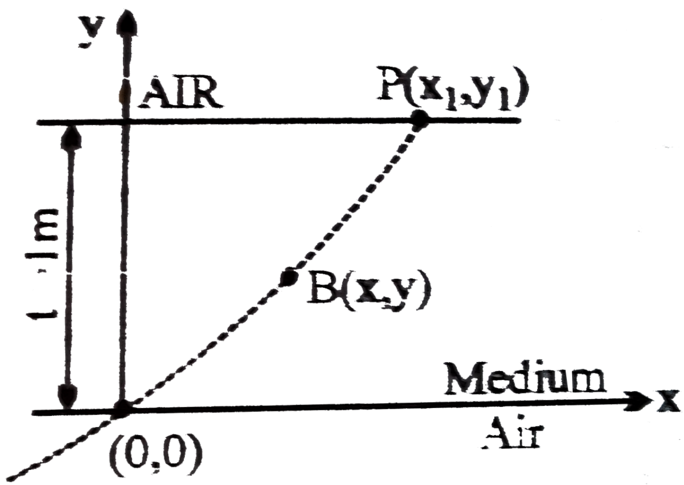
11. A ray of light travelling in air is incident at grazing angle (incident angle=90°) on a long rectangular slab of a transparent medium of thickness $t = 1.0$ (see figure). The point of incidence is the origin $A(O, O)$ .The medium has a variable index of refraction n(y) given by : $n(y) = \left[ky^{3/2} + 1\right]^{1/2}$,where k=$1.0m^{-3/2}$.the refractive index of air is 1.0`



(i) Obtain a relation between the slope of the trajectory of the ray at a point $B(x, y)$in the medium and the incident angle at that point

(ii) obtain an equation for the trajectory $y(x)$of the ray in the medium.

(ii) Determine the coordinates (x_1, y_1) of the point P.where the ray the ray intersects upper surface of the slab -air boundary.

Indicate the path of the ray subsequently.

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12. A small piece of wood is floating on the surface of a 2.5 m deep lake. Where does the shadow form on the bottom when the sun is just setting? Refractive index of water = 4/3

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13. A particle is moving at a constant speed V from a large distance towards a concave mirror of radius R along its principal axis. Find the speed of the image formed by the mirror as a function of the distance x of the particle from the mirror.

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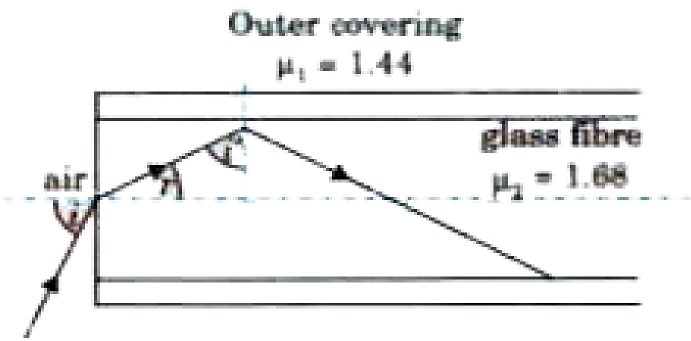
14. Cross section of a light pipe is shown in the following figure :



Inner core is material of refractive index 1.68 and its outer covering is a material of refractive index 1.44. Find the maximum angle at which the ray can be incident with the axis of pipe for which total internal reflection occurs inside the pipe.

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15. A gun of mass M fires a bullet of mass m with a horizontal speed V. The gun is fitted with a concave mirror of focal length f facing towards the receding bullet. Find the speed of separation of the bullet and the image just after the gun was fired.

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16. In case of a concave mirror magnification is found to be $m_1 = -0.5$ for a certain position of object and when object is displaced by 5 cm from this position then magnification is found to be $m_2 = -0.25$. What will be the focal length of the mirror?

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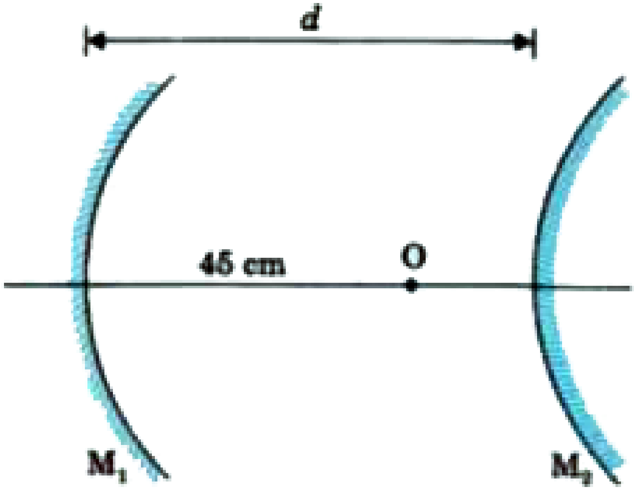
17. In the following figure two mirrors M_1 and M_2 are placed in front of each others.



Both the mirrors have same focal length of 30 cm. Mirror M_1 is concave but mirror M_2 is convex. Distance between the two mirrors is d and their principal axes are coinciding as shown in figure. An object O is placed on principal axis at a distance 45 cm from mirror M_1. It is found that final image is formed on object itself. Calculate the value of d.

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18. A square-shaped planar object of edge length 3 cm is placed at a distance 30 cm from a concave mirror. Focal length of the concave mirror is 12 cm. Find area enclosed by image. Centre of the square lies on principal axis and plane of the square is perpendicular to the principal axis.

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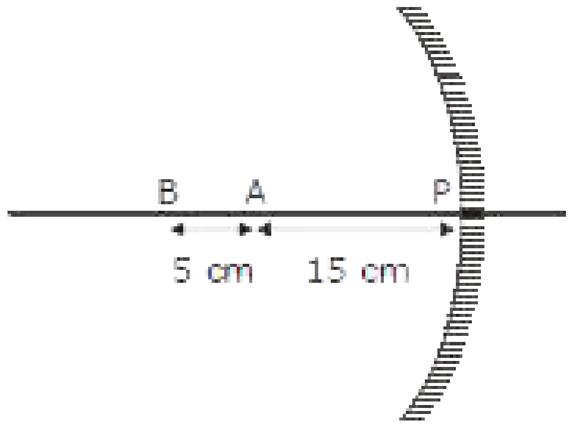
19. A rod AB of length 5 cm is placed in front of a concave mirror of focal length 10 cm as shown in figure. The length of the image of AB formed by the mirror is



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20. There is a plano-convex lens whose radius of curvature for convex surface is 2.5 cm. Thickness of the lens is 9 cm. When object is placed at a certain distance from the convex surface then image is formed on the plane surface of the lens which serves as screen. What should be the magnification in this case? Refractive index is 1.5.

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Ncert File Solved Text Book Exercises

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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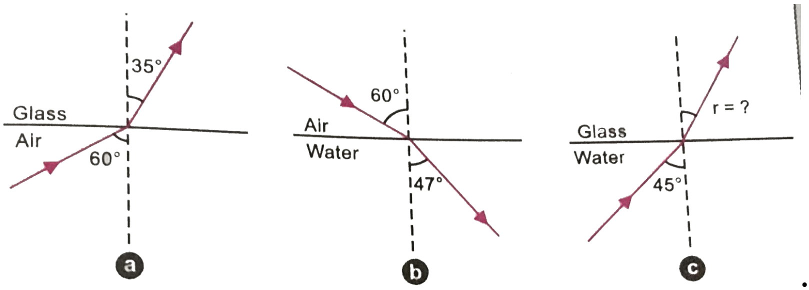
4. Fig. (a) and (b) show refraction of an incident ray in air at 60° with the normal to a glass-air and water-air interface

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 is placed at the bottom of a tank containing water to a depth of 80 cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33. [Consider the bulb to be a point source]

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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. The angle of minimum deviation is measured to be 40°. What is the refractive index of the material of the prism? The refracting angle of the prism is 606°. If the prism is placed in water (refractive idex 1.33), predict the new angle of minimum deviation of a parallel beam of light.

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7. Double convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length of the lens is to be 20 cm?

Watch Video Solution

8. A beam of light converges to a point P. A lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is (a) a convex lens of focal length 20 cm. (b) a concave lens of focal length 16 cm.

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

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11. A compound micrscope consists of an objective of focal length 1.0 cm and an eyepiece of focal length 5.0 cm separated by 12.2 c.a. At wht distance from the objective should a object be placed to focus it prope4y so that the final image is formed at the least distance of clear vision (25cm)? b. calculate the angular magnificationn in this case.

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12. A person with a normal near point $(25 cm)$ using a compound microscope with an objective of focal length $8.0 mm$ and eye piece of focal length $2.5 cm$ can bring an object placed $9.0 cm$ 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 $144 cm$ and an eye-piece of focal length $6.0 cm$. 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) A giant refracting telescope at an observatory has an objective lens of focal length 15 m. If an eyepiece of focal length 1.0 cm is used, what is the angular magnification of the telescope?

(b) If this telescope is used to view the Moon, what is the diameter of the image of the Moon formed by the objective lens? The diameter of the Moon is $3.48 \times 10^6 m$ and the radius of lunar orbit is $3.8 \times 10^6 m$.

Watch Video Solution

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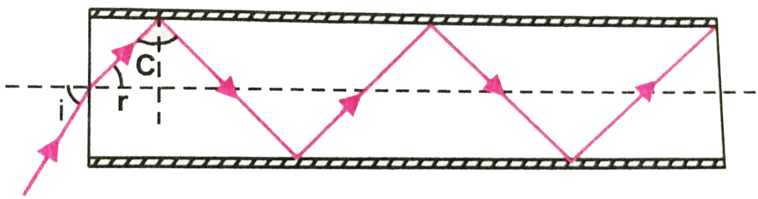
16. A small pin fixed on a table top is viewed from above from a distance of $50cm$. By what distance would the pin appear to be raised, if it be viewed from the same point through a $15cm$. Thick glass slab held parallel to the table? μ of glass is 1.5. Does the answer depend on location of the slab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

Watch Video Solution

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 :

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

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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 90 cm from an object. The image of the object on the screen is formed by a convex lens at two different locations separated by 20 cm. 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 $5cm$.

answer of the following question (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 140 cm and an eyepiece of focal length 5.0 cm. what is the magnifying power of the telescope for viewing distant objects when

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

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

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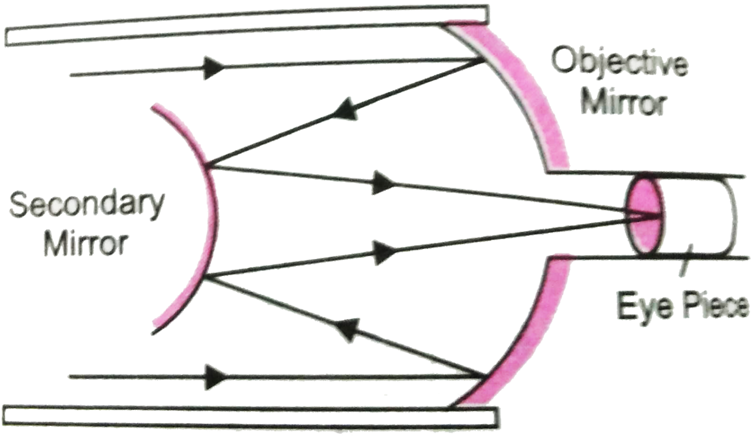
36. A Cassegrainian telescope uses two mirrors as shown in Fig. Such a telescope is built with the mirrors $20mm$ apart. If the radius of curvature of large mirror is $220mm$ and the small mirror is $40mm$, where will the final image of an object at infinity be ?



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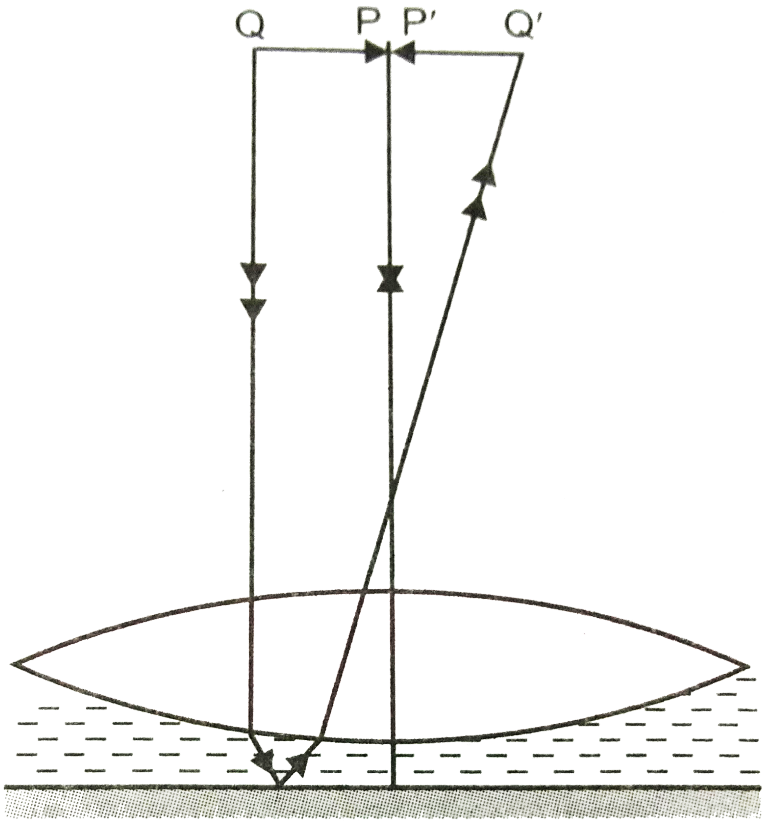
38. Fig. shows an equiconvex lens (of refractive index 1.5) in contact with a liquid layer on top of a plane mirror. A small needle with its tip on the principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of the needle from the lens is measured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



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Ncert Exemplar Problems Obejective Questions Multiple Choice Questions Type I

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 appraches a convergent lens from the left of the lens with a uniform speed $5m/s$ and stops at the focus. The image

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

B. moves away from the lens with a uniform acceleration.

C. moves away from the lens with a pen - 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 following 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 objects that lie on its curved side.

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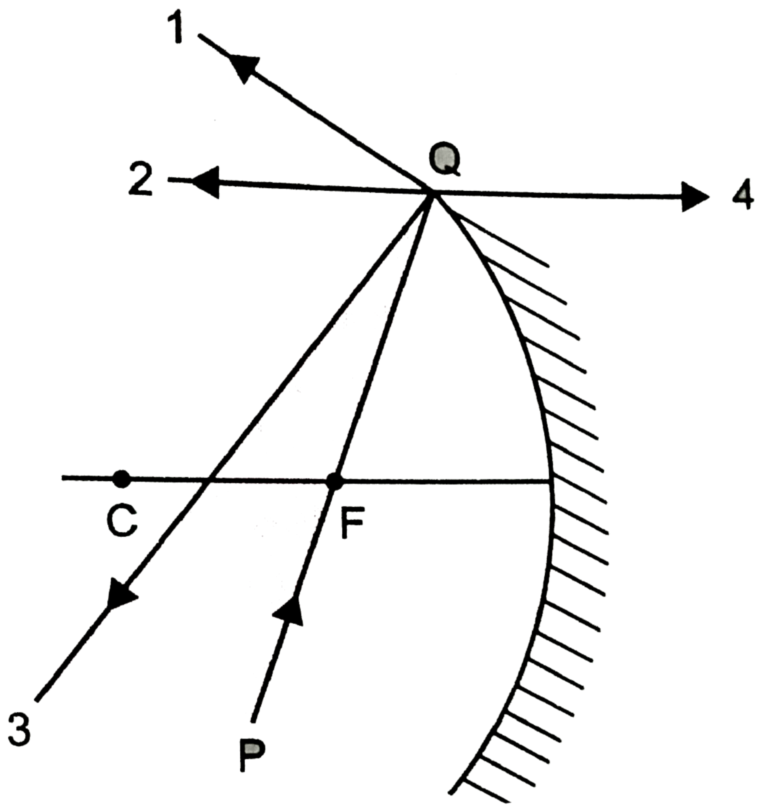
8. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked 1, 2, 3 and 4, Fig. Which of the four rays correctly shows the direction of reflected ray ?



A. 1

B. 2

C. 3

D. 4

Answer: B

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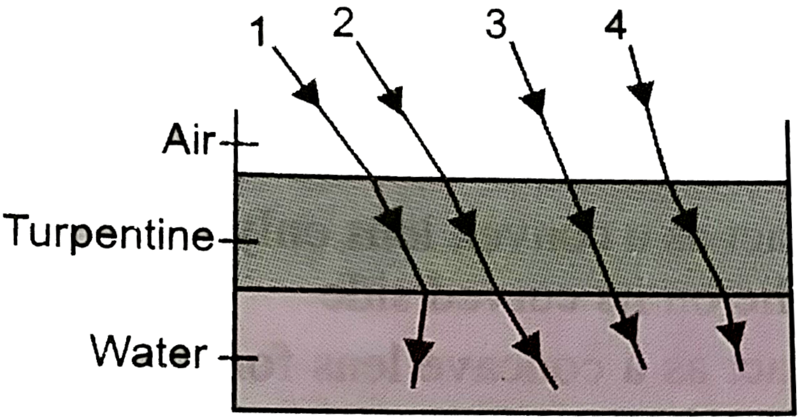
9. The optical density of turpentine is higher than that of water, while its mass density is lower. Fig. shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in Fig., the path shows is correct ?



A. 1

B. 2

C. 3

D. 4

Answer: B

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10. A car is moving with a constant speed of $60 kmh^{-1}$ 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 $5 kmh^{-1}$. 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 $2 s$ 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 $65 \mathrm{~km} \mathrm{~h}^{-1}$

B. In the side mirror the car in the rear would appear to approach with a speed of $5 \mathrm{~km} \mathrm{~h}^{-1}$ 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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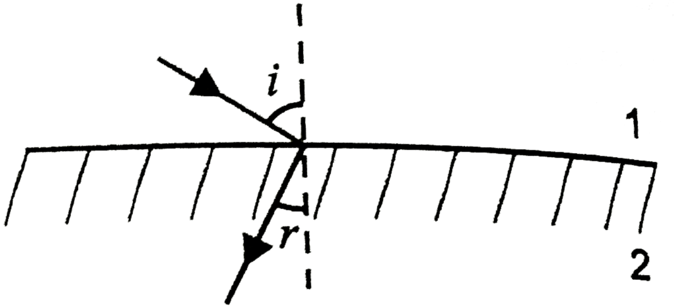
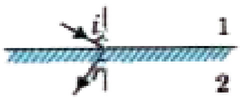
Ncert Exemplar Problems Obejective Questions Multiple Choice Questions Type Ii

1. 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)

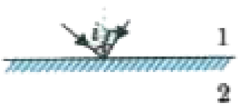


A.

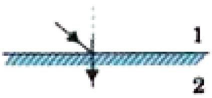


B.

C.



D.



Answer: A

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2. 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 is nearer the surface of the water compared to the points away from the edge.

B. the angle subteded 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 trough acts as a lens and magnifies the object.

Answer: A::B::C

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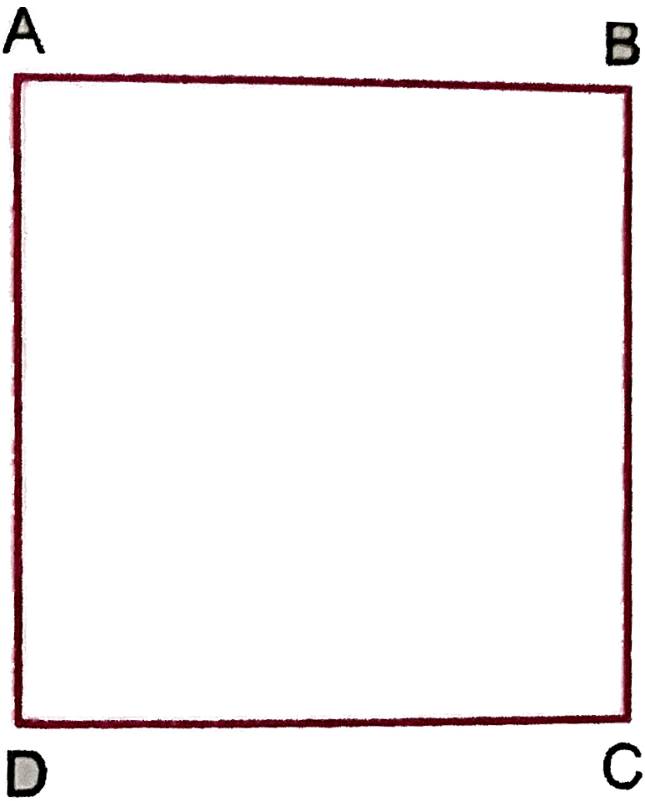
3. A rectangular block of glass $ABCD$ has a refractive index 1.6. A pin is placed midway on the face AB, Fig. When observed from the face AD, the pin shall.



A. appear to be near A.

B. appear to be near D.

C. appear to be at the centre of AD.

D. not be seen at all.

Answer: A::D

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4. 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 interfers 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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5. 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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6. An astronomical refractive telescope has an objective of focal length 20 m and an eyepiece of focal length 2 cm. Then

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

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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Ncert Exemplar Problems Subjective Questions Very Short Answer Type Questions

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

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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 ?

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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 ?

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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.

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

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6. A short object of length L is placed along the principal axis of a concave mirror away 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 $L < \; < |u - f|$.

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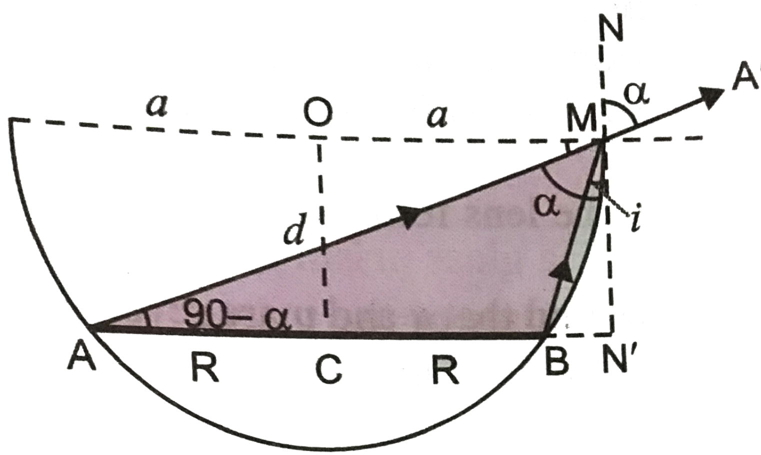
7. A circular disc of radius 'R' is placed co-axially and horizontally inside and opaque hemispherical bowl of radius 'a',

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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8. A thin convex lens of focal length $25 cm$ is cut into two pieces $0.5 cm$ 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.

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9. 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.

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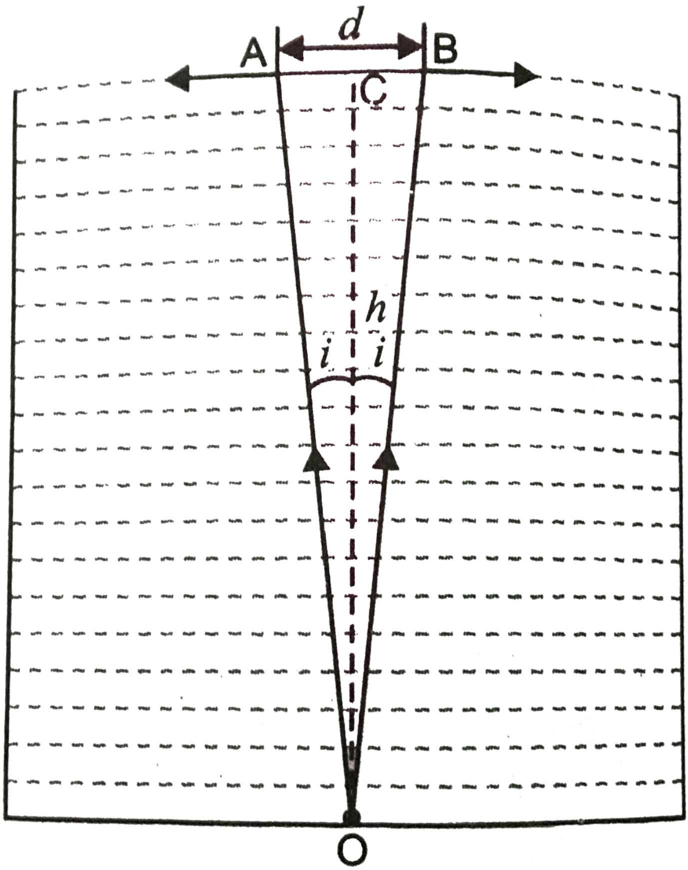
10. A jar of height h is filled wih a transparent liquid of refractive index μ, Fig. At the centre of the jar on the botom surface is a dot. Find the minimum diameter of a disc, such that when placed on the top surface symmetrically about the centre, the dot is invisible.



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11. 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).

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Higher Order Thinking Skills Advanced Level Questions With Answers

1. A light ray inclined at an angle 30° with the horizontal falls on a plane mirror and after reflection light ray becomes vertical. At what angle the plane mirror is inclined with the horizontal?

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2. An object is placed at a distance 48 cm from a convex mirror. A plane mirror is placed in between at a distance 16 cm from convex mirror. It is found that virtual images formed by both the mirrors coincide. What is focal length of convex mirror?

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3. Radius of the Moon is 1.74×10^6 m and its distance from the Earth is 3.82×10^8m. A concave mirror of focal length 20 m is used to form the image of the Moon. What will be the radius of the image of the Moon?

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4. Two concave mirrors of equal focal lengths are placed facing each other with their principal axes coinciding. An object O is to be placed at the mid-point between mirrors. What should be the separation between mirrors so that only one image is formed?

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5. 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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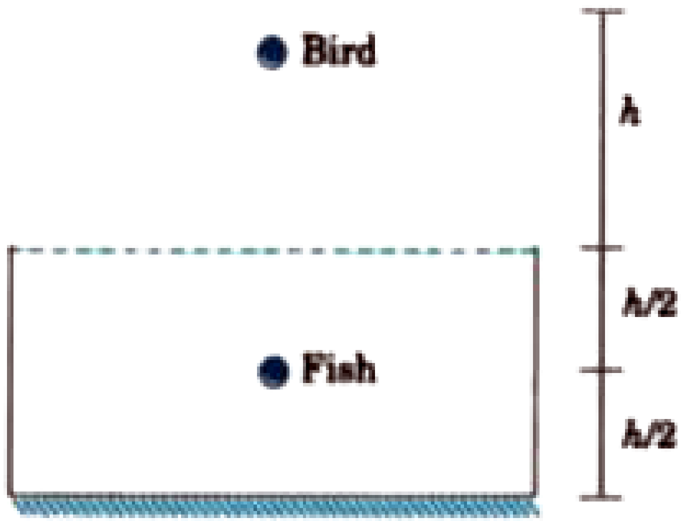
6. A plane mirror is fixed at the bottom of a vessel as shown in the figure. Water of refractive index μ is filled up to a height h in the vessel. There is a fish at a height $h/2$ from bottom of vessel and there is a bird at a height h above the surface of water in the vessel.



(a) Calculate apparent distance of bird as seen by the fish.

(b) Calculate apparent distance of image of bird in mirror as seen by the fish.

(c) Calculate apparent distance of fish as seen by the bird.

(d) Calculate apparent distance of image of fish in the mirror as seen by the bird.

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7. 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 index 1.5.Calculate the lateral shift produced.

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8. There is a cylindrical vessel of radius 10 cm and a cylindrical glass piece of radius 5 cm and height 10 cm is kept inside it. Volume of water $950\pi cm^3$ is poured into it. Bottom of the glass piece is seen with paraxial rays. What will be the apparent depth of bottom of glass cylinder? Index of refraction of glass is $3/2$ and that of water is $4/3$.

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9. A small fish, 0.4m below the surface of a lake, is viewed through a simple converging lens of focal length 3m. The lens in kept at 0.2m above the water surface such that the fish lies on the optical axis of the lens. Find the image of the fish seen by the observer. The refractive index of water is $4/3$.

Watch Video Solution

10. The distance between two point sources of light is $24cm$. Find out where would you place a converging lens of focal

length $9cm$, so that the images of both the sources are formed at the same point.

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11. There is a thin symmetric bi-convex lens with radius of curvature for its surface to be 40 cm. One surface of the lens is silvered to make it reflecting from inner side. What will be the focal length of equivalent concave mirror?

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12. A thin converging lens with focal length $f = 25cm$ projects the image of an object on a screen removed from the lens by a distance $l = \; = 5.0m$. Then the screen was draws closer to the lens by a distance $\Delta l = 18cm$. By what distance should the object be shifted for its image to become sharp again ?

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13. There is a glass $(\mu = 1.5)$ biconvex lens of radius of curvature 5 cm and thickness of the lens is also 5 cm. An object is placed at a distance 20 cm from the front surface of lens. Locate its final image.

View Text Solution

14. If separation between an object and a screen is D, then prove that D must be greater or equal to four times of focal length of convex lens. Also prove that there are two positions of lens for which real image of object can be projected on

screen. If d is separation between these two positions of lens then what will be the focal length of lens in terms of D and d.

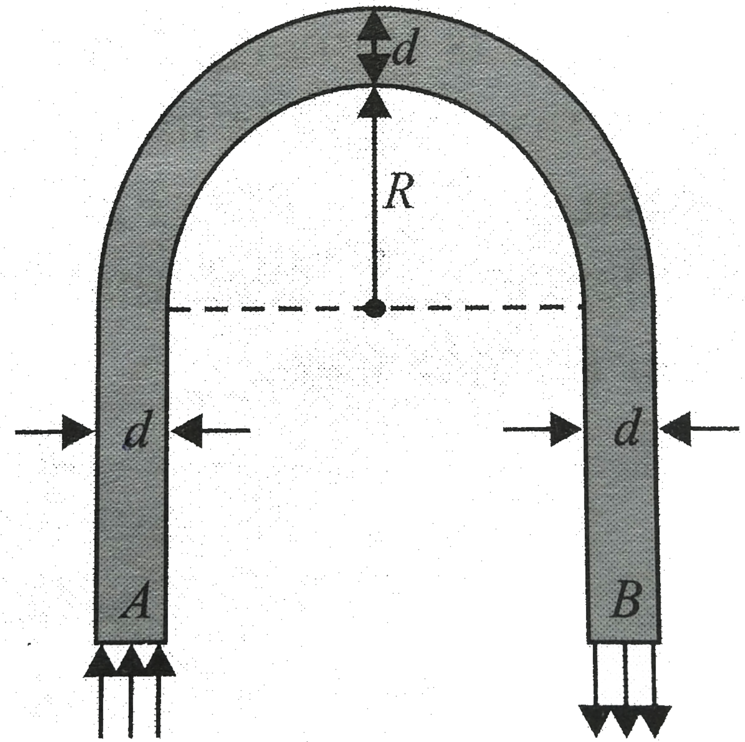
View Text Solution

15. There is a glass sphere of radius 20 cm having refractive index 1.5. A point object is embedded inside it at a distance 6 cm to the left of the centre. Locate the image for observer looking from left. Locate the image for observer looking from right.

Watch Video Solution

16. A glass rod having square cross-section is bent into the shape as shown in the figure. The radius of the inner semi-circle is R and width of the rod is d. Find the minimum value of

d / R so that the light that enters at A will emerge at B. Refractive index of glass is $\mu = 1.5$



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17. Water is filled up to a height of 13 cm in a jar. Apparent depth of a point placed at the bottom is measured by a

microscope and it found to be 10 cm. What is refractive index of water? Now water is replaced by another liquid of refractive index 1.6 up to the same height. By what distance must the microscope be moved in order to focus at the point on the bottom of jar?

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18. A travelling microscope is focussed on to a scratch on the bottom of a beaker. Water of refractive index $\frac{4}{3}$ is poured in it. Then the microscope is to be lifted through 2 cm focus it again. Find the depth of water in the beaker.

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19. The angle of minimum deviation measured with a prism is 30° and the angle of prism is 60°. The refractive index of prism material is

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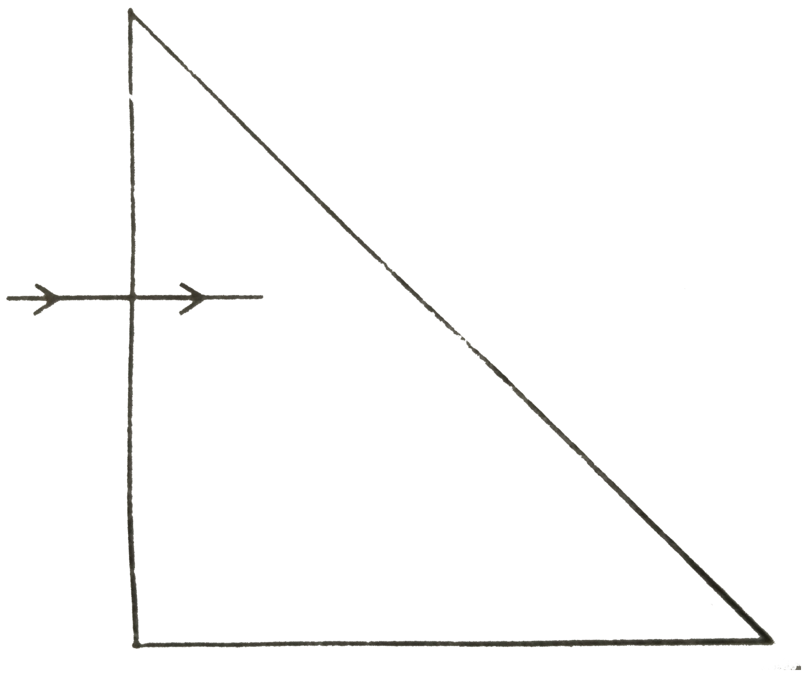
20. 

A ray of ligh is incident normally on one of the faces of right angled isosceles prism as shhown above. It undergoes total internal reflection from hypotenuse. Which on of the following is the minimum refractive index of the material of the prism?

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Revision Exercises Very Short Answer Questions

1. What is the principal axis of a spherical mirror ?

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2. If we turn the mirror by an angle of 20°, the reflected ray will turn through which angle ?

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3. What should be the height of the plane mirror which will enable a person to see his full image ?

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4. What is the position of the object for which the image formed by a concave mirror is virtual, erect and magnified ?

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5. What is the nature and size of the image formed by a convex mirror ?

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6. When a person moves towards a mirror with velocity 3v, by which velocity his image moves relative to himself ?

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7. Why a parabolic mirror is preferred to an ordinary spherical mirror?

Watch Video Solution

8. Which spherical mirror has a real focus ?

Watch Video Solution

9. Which type of mirror is preferred for observing traffic at the back ?

Watch Video Solution

10. What will be the change in focal length of a concave mirror when it is placed in water ?

Watch Video Solution

11. Two plane mirrors are inclined at an angle of θ° What will be the number of images of an object held between these two mirrors ?

Watch Video Solution

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

Watch Video Solution

13. What is the focal length of a plane mirror ?

Watch Video Solution

14. How will the focal length of a concave mirror change if the wavelength of the light falling on the mirror is made twice ?

Watch Video Solution

15. Which mirror is used as a shaving mirror and why ?

Watch Video Solution

16. For which position of the object, magnification of convex lens is -1.(minus one) ?

Watch Video Solution

17. Why danger signals are red ?

Watch Video Solution

18. Write the relation between critical angle and refractive index of a medium.

Watch Video Solution

19. A substance has critical angle of 45° for yellow light. What is its refractive index ?

Watch Video Solution

20. If $\frac{\sin i}{\sin r} = n_{21} > 1.$ Out of medium 1 and medium 2, which is more optically denser ?

Watch Video Solution

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

Watch Video Solution

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

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23. The radii of curvature of both the surfaces of a convex lens are equal. One of the surfaces is made plane by grinding. What is the new focal power of the lens ?

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

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

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26. When red light passing through a convex lens is replaced by light of blue colour, how will the focal length of the lens change ?

Watch Video Solution

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

Watch Video Solution

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

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

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29. Does the critical angle depend on the wavelength of the light ?

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30. Due to which phenomenon, advanced sunrise and delayed sunset occur ?

Watch Video Solution

31. What will be the effect on the power of a glass lens if it is immersed in water ?

Watch Video Solution

32. Define one dioptre.

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33. Find the focal length of a lens having -0.5 D power.

Watch Video Solution

34. What is total internal reflection of light ? What are conditions for total internal reflection ?

Watch Video Solution

35. What are optical fibres ? What is the principle on which optical fibre works ?

Watch Video Solution

36. What is the main requirement in fabricating optical fibres ?

Watch Video Solution

37. What are para-axial rays and marginal rays ?

Watch Video Solution

38. Under what condition will the object and image always be on the same side of the focus of a concave mirror ?

Watch Video Solution

39. An image of an object is formed by using a convex lens. If the orientation of the lens is reversed, will the position of the image change ?

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

Watch Video Solution

41. Two convex lenses of focal length 10 cm each are combined. What will be the focal length of the combined lens ?

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42. Speed of light in glass is $2 \times 10^8 m/s$. Refractive index of glass is.......

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43. What do you mean by angle of prism ?

Watch Video Solution

44. List the factors on which the angle of deviation through a prism depend?

Watch Video Solution

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

Watch Video Solution

46. The sparkle of a diamond can be explained by which phenomenon of light ?

Watch Video Solution

47. What do you mean by pure spectrum ?

Watch Video Solution

48. In the spectrum of white light through the prism, which colour is seen at the top and why ?

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49. An equilateral prism is made of made of material of refractive index $\sqrt{3}$. Angle of minimum deviation through the prism is.

Watch Video Solution

50. Write the relation between angle of prism, angle of incidence and angle of emergence.

Watch Video Solution

51. What is dispersion of light ?

Watch Video Solution

52. On what factors does the dispersive power of a prism depend ?

Watch Video Solution

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

Watch Video Solution

54. What are the steps for the formation of a primary rainbow ?

Watch Video Solution

55. Name the optical phenomenon due to which the sky appears blue.

Watch Video Solution

56. How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced with red light?

Watch Video Solution

57. What is power of accommodation of a human eye ?

Watch Video Solution

58. What do you mean by range of vision ?

Watch Video Solution

59. What is blind spot ?

Watch Video Solution

60. What is yellow spot ?

Watch Video Solution

61. Why does diamond sparkle ?

Watch Video Solution

62. Arrange these colours in an increasing order of wavelength :

red, violet, yellow, green

Watch Video Solution

63. What is the effect of change of medium on the wavelength of light ?

Watch Video Solution

64. A person is not able to see vertical wires clearly in a grid of wires. What is this defect and how it is corrected ?

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65. What are the possible causes of hypermetropia ?

Watch Video Solution

66. What are the possible causes of myopia.

Watch Video Solution

67. Which lens is used for the correction of hypermetropia ? And why ?

Watch Video Solution

68. Which lens is used for the correction of myopia and why ?

Watch Video Solution

69. What are the far point and near point of the human eye with normal vision ?

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70. Which lens is used for the correction of presbyopia ?

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71. What is the difference between microscope and telescope ?

Watch Video Solution

72. What is meant by linear magnification?

Watch Video Solution

73. Write the ray diagram for formation of image in the simple microscope.

Watch Video Solution

74. The magnifying power of a compound microscope is

Watch Video Solution

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

77. Write the formula for magnifying power and length of tube of an astronomical telescope.

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

81. You are given two convex lenses of focal lengths 10 cm and 60 cm. To make a telescope, which of the two lenses will you use as object lens and which one as eye lens ?

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82. What will be the effect on the intensity of the image if the diameter of the objective is doubled in a telescope ?

Watch Video Solution

Revision Exercises Additional Questions

1. Which of the following represents correct mirror formula ?

A. $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

B. $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

C. $f = v + u$

D. $\frac{1}{f} = v + u$

Answer: B

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2. What is the unit of focal length ?

A. None

B. Metre

C. Dioptre

D. Degree

Answer: B

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3. To get three images of a single object, one should have two plane mirrors at an angle of

A. 30°

B. 60°

C. 90°

D. 120°

Answer: C

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4. If the radius of curvature of a convex mirror is 40 cm, then its focal length is

A. -20 cm

B. 20 cm

C. 40 cm

D. -40 cm

Answer: B

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5. The power of a lens of focal length 0.5 m is :

A. $+5D$

B. 2 D

C. $-5D$

D. $+1D$

Answer: B

Watch Video Solution

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

A. 10 cm

B. $-20cm$

C. $-60cm$

D. $-40cm$

Answer: B

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7. Two lenses of power +12 D and -2 D are combined together. What is their equivalent focal length ?

A. 8.33 cm

B. 10 cm

C. 14 cm

D. 12.5 cm

Answer: B

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8. What is the unit of refractive index?

A. Metre

B. Dioptre

C. None

D. Gram

Answer: C

Watch Video Solution

9. Which process takes place in lens ?

A. Reflection

B. Refraction

C. Dispersion

D. Diffraction.

Answer: B

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10. Brilliance of diamond is due to

A. shape

B. cutting

C. reflection

D. total internal reflection.

Answer: D

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11. Mirage is formed due to _____ .

A. Total internal reflection

B. Refraction

C. Reflection

D. Diffraction

Answer: A

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12. The rainbow is formed due to

A. Diffraction

B. Reflection

C. Reflection and diffraction

D. Refraction and total internal reflection

Answer: D

Watch Video Solution

13. For what angle of incidence, the lateral shift produced by a parallel sided glass plate is maximum ?

A. 30°

B. 90°

C. 60°

D. 0°

Answer: B

Watch Video Solution

14. Prism works on the principle of :

A. Reflection

B. Refraction

C. Dispersion

D. Diffraction

Answer: B

Watch Video Solution

15. The final image produced by a simple microscope is :

A. Real and inverted

B. Real and erect

C. Virtual and erect

D. Virtual and inverted

Answer: C

Watch Video Solution

16. Sky appears to be blue in clear atmosphere due to :

A. diffraction

B. dispersion

C. scattering

D. polarization

Answer: C

Watch Video Solution

17. What is the unit of magnification of a microscope ?

A. Centimetre

B. None

C. Metre

D. Dioptre

Answer: B

Watch Video Solution

18. Choose the correct alternative:

A parallel beam of white light falls on one face of a prism. The light emerging from the other face suffers

A. angular deviation, no dispersion

B. dispersion, no angular deviation

C. both dispersion and angular deviation

D. None of these

Answer: C

Watch Video Solution

19. A concave lens always produces .... images.

A. Real

B. virtual

C. magnified

D. None of these

Answer: B

Watch Video Solution

20. A luminous object is separated from a screen by distance d. A convex lends is placed between the object and the screeen such that it forms a distinct image on the screen. The maximum possible focal length of this convex lens is.

A. $D/4$

B. $D/2$

C. D

D. 4D

Answer: A

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21. When light is incident on a medium of refractive index μ from rarer medium at an angle 'i' and is refracted at an angle 'r', then Snell's law gives

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

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

C. $\mu = \sin i \times \sin r$

D. $\frac{1}{\mu} = \frac{\sin i}{\sin r}$

Answer: A

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22. If a very short pulse of white light were to travel through a glass plate, the colour which would emerge out of the glass plate first is

A. green

B. red

C. yellow

D. violet

Answer: B

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Revision Exercises Fill In The Blanks

1. Air bubble in water behaves as

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2. When a ray of light enters from air to glass, frequency of light will....................................

Watch Video Solution

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

Watch Video Solution

4. The power of a plane glass plate is ....

Watch Video Solution

Watch Video Solution

5. In a .... lens the image formed is always virtual and erect.

Watch Video Solution

6. .... mirror is used as a driver's mirror.

Watch Video Solution

7. When the image size is smaller than the object size, then the magnification is .... than 1.

Watch Video Solution

8. The sun is visible a little before the actual sunrise because of which one of the following?

Watch Video Solution

9. In a normal adjustment of a telescope, the final image is formed at ....

Watch Video Solution

10. In a Cassegrainian telescope, ... is a large concave mirror.

Watch Video Solution

Revision Exercises Short Answer Questions

1. The relation between focal length f and radius of curvature R of a spherical mirror is.

Watch Video Solution

2. The correct expression for refraction at single convex spherical surface separating two media of refractiv eindices μ_1 and $\mu_2(\mu_2 > \mu_1)$ and radius of curvature R is (u and v are object, image distane respectively)

Watch Video Solution

3. The graph between $\frac{1}{v}$ and $\frac{1}{u}$ for a concave mirror looks like.

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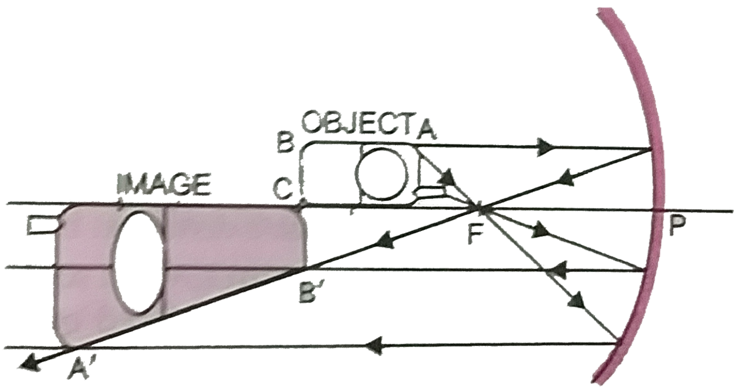
4. A mobile phone lies along the principal axis of a concave mirror as shown in Fig. Show by suitable diagram, the formation of its image. Explain why the magnification is not uniform, and distortion will occur depending on the location of the mobile with respect to the mirror.



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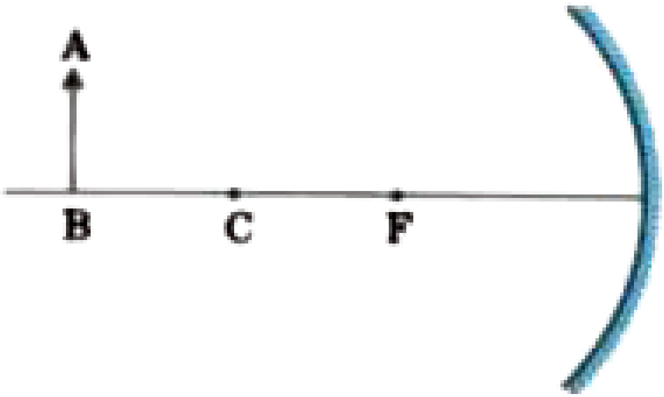
5. An object AB is kept in front of a concave mirror as shown in the figure.

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

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



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6. State the expression for linear magnification of a concave mirror in terms of object distance and image distance.

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

Watch Video Solution

8. 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.

Watch Video Solution

9. Refractive index of glass is 1.5. Find the speed of light in glass and critical angle for glass.

Watch Video Solution

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

Watch Video Solution

11. What is total internal reflection ? What are its conditions ? Establish relationship between critical angle and refractive index.

Watch Video Solution

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

Watch Video Solution

13. What is optical fibre ? On what principle it works ? Give two application of optical fibres.

Watch Video Solution

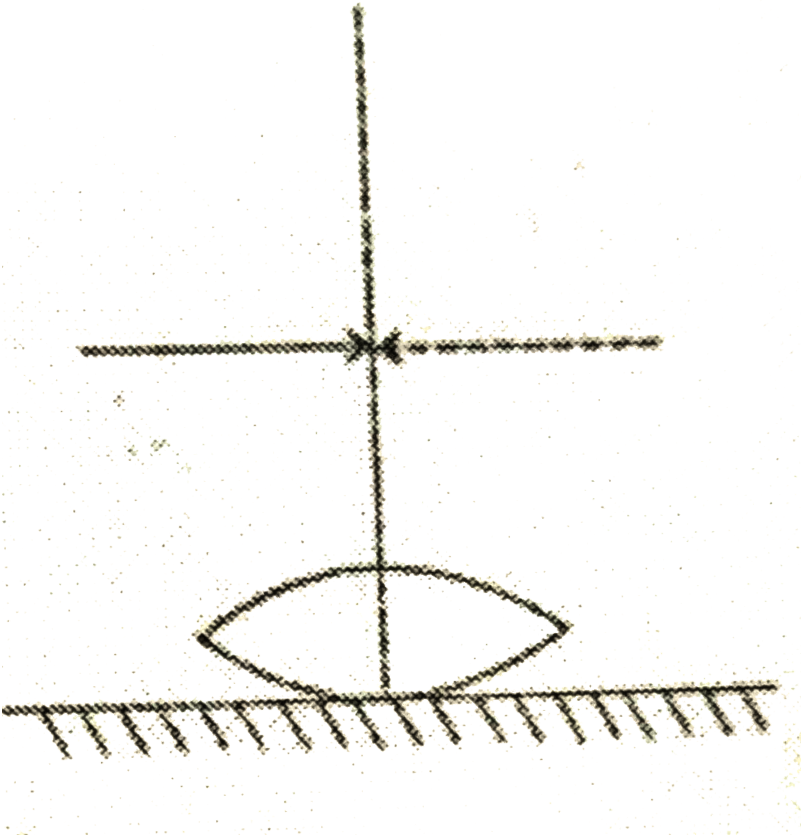
14. Explain the term critical angle for a pair of media. Derive a relation between critical angle and refractive index of a denser medium with respect to a rarer medium.

Watch Video Solution

15. State the conditions under which total internal reflection occurs. One face of a prism with a refracting angle of 30° is coated with silver. A ray incident on another face at an angle of 45° is refracted and reflected from the silver coated face and retraces its path. Find the refractive index of the material of the prism.

Watch Video Solution

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



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

Watch Video Solution

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

Watch Video Solution

19. Draw the schematic diagram of a Cassegrain telescope.

Watch Video Solution

20. Deduce the equivalent focal length of two convex lenses of focal lengths F_1 and F_2 when placed in contact.

Watch Video Solution

21. An equiconvex lens of refractive index μ_1, focal length 'f' and radius of curvature 'R' is immersed in a liquid of refractive index μ_2. For (i) $\mu_2 > \mu_1$, and (ii) $\mu_2 < \mu_1$, draw the ray diagrams in the two cases when a beam of light coming parallel to the principal axis is incident on the lens. Also find the focal length of the lens in terms of the original focal length and the refractive index of the glass of the lens and that of the medium.

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

Watch Video Solution

23. A figure divided into squares, each of size $1.0 mm^2$ is being viewed at a distance of 9.0 cm through a magnifying lens of focal length 10 cm held close to the eye.

(i) The magnification produced by the lens will be

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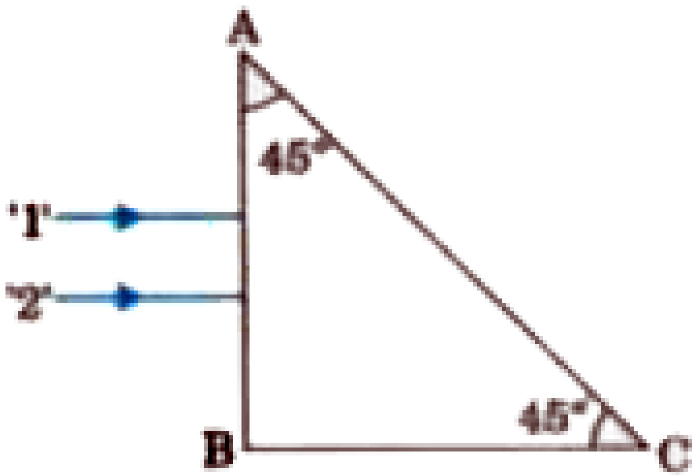
24. Two monochromatic rays of light are incident normally on the face AB of an isosceles right angled prism ABC. The refractive indices of the glass prism for the two rays '1' and '2' are respectively 1.35 and 1.45. Trace the path of these rays after entering through the prism.



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25. Obtain an expression for the combined focal length for two thin convex lenses kept in contact and hence obtain an expression for the combined power of the combination of the lenses.

Watch Video Solution

26. लेंस समीकरण $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ की सहायता से दर्शाइए कि अवतल लेंस से बना प्रतिबिम्ब सदैव आभासी व छोटा होता है |

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27. 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.

Watch Video Solution

28. How does angle of deviation vary with the angle of incidence in case of prism ? What is the angle of minimum deviation?

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29. Sky appears blue in colour. Explain.

Watch Video Solution

30. Why does the sun appear red at sunset ?

Watch Video Solution

31. Why does the Sun visible before the actual sunrise and sunset look reddish from the Earth ?

Watch Video Solution

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

Watch Video Solution

33. Eye is more sensitive to yellow colour but danger signals are made with red colour. Why ?

Watch Video Solution

34. A convex lens of focal length 20 cm and a concave lens of focal length 10 cm are placed 20 cm apart. In between them an object placed at distance x from the convex lens.

What will be the linear magnification produced convex lens and concave lens individually ?

Watch Video Solution

35. What is hypermetropia (far-sightedness) ? What are its causes ? How can it be corrected ?

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

38. What is astigmatism ? How can it be removed ?

Watch Video Solution

39. Draw a ray diagram for the formation of image by a compound microscope.

Watch Video Solution

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

Watch Video Solution

41. Draw a schematic ray diagram of reflecting telescope showing how rays coming from a distant object are received at the eye - piece . Write its two important advantage over a refracting telescope.

Watch Video Solution

42. अपवर्ती दूरदर्शी का नामांकित किरण आरेख खीचिए | इसकी आवर्धन क्षमता को परिभाषित कीजिए तथा इसके लिए व्यंजक लिखिए | परावर्ती दूरदर्शी की तुलना में अपवर्ती दूरदर्शी की दो सीमाएँ लिखिए |

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43. (a) Show using a proper diagram how unpolarised light can be linearly polarised by reflection from a transparent glass surface.

(b) The figure shows a ray of light falling normally on. the face AB of an equilateral glass prism having refractive index 3/2, placed A in water of refractive index 4/3. Will this ray suffer total internal reflection on striking the face AC? Justify your answer.

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Revision Exercises Long Answer Questions

1. Draw a raydiagram showing how a concave mirror can be used to produce a real, inverted and diminished image of an object.

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2. पार्थिव दूरदर्शी का रेखाचित्र खींचकर उसकी आवर्धन क्षमता के लिए सूत्र की व्युत्पत्ति दीजिए।

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3. Use the mirror equation to show that :

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

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

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

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

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

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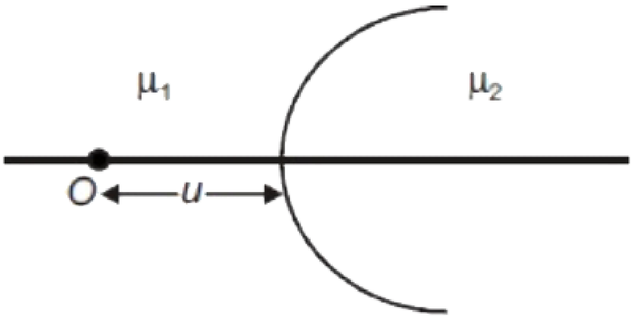
6. The diagram shows a spherical surface which separates two media of refractive indices, μ_1 and μ_2. Respectively. Now, a point object is placed on the principal axis as shown in the figure. Then



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

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

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8. A converging lens has a focal length of 50mm. What is the power of the lens?

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

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10. 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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11. A convex lens of focal length 20 cm is placed in contact with a concave lens of focal length 10 cm. What is the focal length and power of the combination ?

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12. A ray of monochromatic light suffers minimum deviation of 38° while passing through a prism of refracting angle 60° . Refracting index of the prism material is

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13. Explain the phenomenon of refraction through prism. Derive the following relation between refractive index and minimum deviation.

(i) $\angle i + \angle 2 = A + \angle\delta$

(ii) $\mu = \dfrac{\sin(A + \delta_m)/2}{\sin A/2}$

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14. You are given a prism in which the two refracting surfaces are at 90° with each other. Draw ray diagrams using this prism so that (i) the image of an object is rotated by 90° and (ii) the image of the object is rotated by 180°.

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15. Define dispersion of light. Explain its cause.

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16. A convex lens made of a glass of refractive index $3/2$ has a focal length 'f' in air. If it is immersed into water of refractive index $4/3$, then with calculation, predict the new focal length of the lens inside water.

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17. How will you describe the defects of human eye ? How they are caused and how they can be corrected ?

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

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

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

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

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

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Revision Exercises Numerical Problems

1. (a) An object of height 2.5 cm is placed perpendicularly on the principal axis of a concave mirror of focal length f at a distance of $\frac{3}{4}f$. What will be the nature of the image of the object and its height ?

(b) A person uses spectacles of power +2D. What type of defect of vision is it ?

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2. A 6 m tall tree is at a distance of 18 m from a pin hole camera. Where should a screen be placed to obtain a 20 cm tall image of the tree ?

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3. A candle is placed at 4 cm distance from a concave mirror. Radius of curvature of mirror is 10 cm. Find the position and magnification of the image.

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4. Find the areal magnification of a square object which is placed at a distance of 20 cm from a convex mirror of focal length 40 cm.

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5. 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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6. The velocity of light in glass is $2 \times 10^8 m/s$ and in air is $3 \times 10^8 m/s$. If the ray passes through glass to air, calculate the value of critical angle.

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7. The refractive index of glass is 1.5 and that of water is 1.3. If the speed of light in water is $2.25 \times 10^8 m\frac{/}{s}$, what is the speed of light in glass ?

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8. Velocity of light in glass is $2 \times 10^8 m/s$ and that in air is $3 \times 10^8 m/s$. Calculate the apparent shift of an ink dot covered by a 6 cm thick glass plate.

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9. 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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10. 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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11. 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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12. A screen is placed 90 cm from an object. The image of the object on the screen is formed by a convex lens at two different positions separated by 20 cm. Calculate the focal length of the lens.

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

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14. A convex lens of focal length 0.24 m and of refractive index 1.5 is completely immersed in water of refractive index 1.33. Find the change in focal length of the lens.

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15. Find the radius of curvature of the convex surface of a plano-convex lens, whose focal length is 0.3 m and the refractive index of the material of the lens is 1.5.

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16. A lens forms real image of an object 20 cm away from lens. A second lens is kept in contact with this lens, then image shifts 10 cm towards the lens combination. Find the power of another lens.

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17. A beam of light converges to a point P. A lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is (a) a convex lens of focal length 20 cm. (b) a concave lens of focal length 16 cm.

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18. A concave lens is kept in contact with convex lens of focal length 20 cm. The combination works as a convex lens of focal length 50 cm. Find the power of concave lens.

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19. A convex lens of refractive index 1.5 has a focal length of 18 cm in air. Calculate the change in its focal length when it is immersed in water of refractive index $\frac{4}{3}$.

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20. A convex lens of power +5 D is placed in contact with a concave lens of power -4 D. What is the power of combination and nature of lens combination ?

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21. Two identical equiconvex lenses of refractive index $3/2$ and focal length 16 cm are kept in contact. The space between the lenses is filled with water of refractive index $4/3$. What is the focal length of the combination ?

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22. 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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23. A thin prism of 2° angle gives a deviation of 1°. What is the value of refractive index of the material of the prism.

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24. A ray of light passes through an equilateral prism in such a way that the angle of incidence is equal to the angle of emergence and each of these angles is $3/4$th the angle of the prism. Determine the (i) angle of deviation and (ii) the refractive index of the prism.

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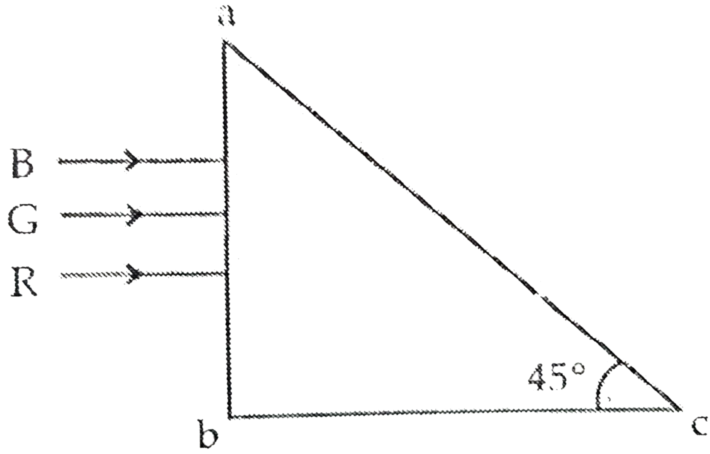
25. Three light rays red (R), green (G) and blue (B) are incident on a right angled prism 'abc' at face 'ab'. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39 , 1.44 and 1.47 respectively. Out of the time three which colour ray will emerge out of face 'ac'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



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

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27. Calculate the speed of light in the prism if a ray of light is passing through an equilateral triangular glass prism from air and undergoes minimum deviation when angle of incidence is $5/4$th of the angle of prism.

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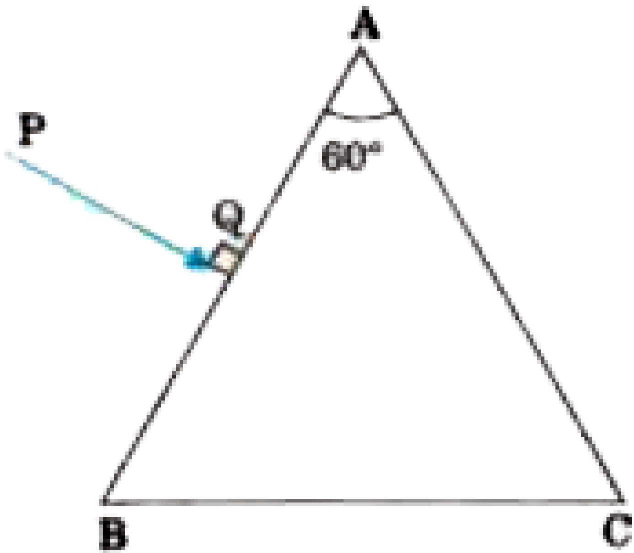
28. A ray PQ is incident normally on the face AB of a triangular prism of refracting angle of 60°, made of a transparent material of refractive index $\frac{2}{\sqrt{3}}$, as shown in the figure. Trace the path of the ray as it passes through the prism. Also calculate the angle of emergence and angle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



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29. Calculate the angle of minimum deviation for an equilateral triangular prism of refractive index $\sqrt{3}$.

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30. What will be the refractive index for yellow colour if the refractive index for red colour is 1.645 and for blue colour is 1.665 ? The spectrum is produced by a glass prism of dispersive power 0.052.

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31. Calculate the dispersive power of flint glass if deviations produced by violet, yellow and red lights are 4.42, 4.36, 4.32 respectively.

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32. The far point of a person having myopia is 200 cm in front of the eye. Find the focal length and power of lens required to enable him see the distant objects clearly.

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33. The near point of a person having hypermetropia is 60 cm in front of the eye. Find the focal length and power of lens required to enable him to see the objects clearly placed at 25 cm from the eye.

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34. Being myopic, the far point for the left eye of a person has shifted to 1.5 metre while being hypermetropic, the near point for his right eye has shifted to 0.50 metre. Find the powers of the lenses used for the corrections.

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35. For a normal relaxed eye, a simple microscope is rated as 3X. What will be the rating of a microscope for a relaxed farsighted eye whose near point is 50 cm.

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36. If a convex lens of focal length 20 cm is held close to the eye of observer and the near point of the observer is 25 cm from the eye, find the distance of the object from the lens.

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Objective Type Questions A Multiple Choice Questions

1. Plane mirror may form a real image at finite distance from it,

A. if converging light rays are incident on the mirror

B. if diverging light rays are incident on the mirror

C. if parallel light rays are incident on the mirror

D. under no circumstances

Answer: A

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2. Total internal reflection may be observed if

A. light ray is travelling from denser medium to rarer medium

B. light ray is travelling from rarer medium to denser medium

C. refractive indices of the two media are widely different

D. refractive indices of the two media are close to each other

Answer: A

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3. When light rays are incident on a thick transparent slab then these rays are partly reflected and partly refracted into the slab. At a certain angle of incidence θ, it is found that reflected and refracted rays are mutually perpendicular. What is refractive index of material ?

A. $\sin\theta$

B. $\cos\theta$

C. $\tan\theta$

D. $\cot\theta$

Answer: C

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4. When we do calculation for image location from spherical mirrors then normally we consider paraxial rays only, because paraxial rays

A. make calculations easier

B. are easier for geometrical analysis

C. contain most of the light intensity that is incident on mirror

D. can form point image for a point source

Answer: D

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5. Consider a situation when light ray is travelling from optically denser medium to rarer medium. Critical angle for this pair of mediums is θ. What is the maximum possible angle of deviation suffered by light ray ?

A. $\pi/2+\theta$

B. $\pi-\theta$

C. $\pi-2\theta$

D. $\pi + \theta$

Answer: C

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6. Image formed by a convex mirror is

A. is always virtual

B. is always real

C. is always virtual if object is real

D. is always real if object is virtual

Answer: C

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7. The image formed by a convex lens

A. is always virtual

B. is always real

C. is always virtual if object is real

D. is always real if object is virtual

Answer: D

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8. A medium of refractive index μ is separated from air using a plane surface. When light ray is incident on this medium at an angle 70° then it is found that refracted and reflected ray suffer equal deviations in opposite directions. What is refractive index of material ?

A. $2\sin 70^\circ$

B. $\sin 70^\circ$

C. $2\sec 70^\circ$

D. $2\cot 70^\circ$

Answer: A

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9. A converging lens forms a real image I on its optic axis. A rectangular galss slab of refractive index μ and thickness t is introduced between the lens and I. I will move

A. towards the lens by $t\left(1 - \frac{1}{\mu}\right)$

B. away from the lens by $t\left(1-\frac{1}{\mu}\right)$

C. towards the lens by $t(\mu-1)$

D. away from the lens by $t(\mu-1)$

Answer: B

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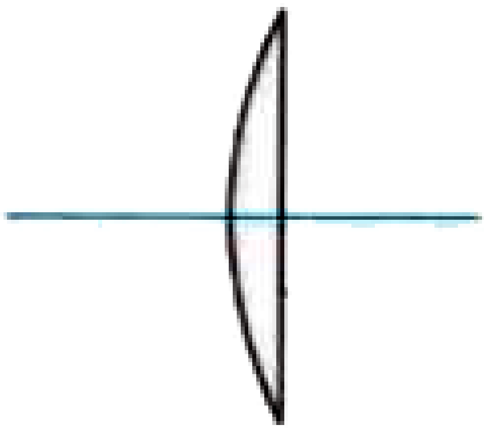
10. Find the focal length of plano-convex lens of material having refractive index of 1.5. Radius of curvature of convex surface is 10 cm.



A. 20 cm

B. 30cm

C. 50 cm

D. 40 cm

Answer: A

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11. A piece of glass is not visible in a colourless transparent liquid. It is possible because

A. both the materials have same density

B. both the materials are colourless

C. both the materials have same refractive index

D. light moves with different speed in the two mediums involved

Answer: C

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12. There is a sphere of radius R and refractive index μ. At what distance from the surface of sphere should an object be placed so that real image is formed at the same distance from the sphere ?

A. $\frac{R}{\mu - 1}$

B. $\frac{R}{\mu}$

C. $\frac{R}{2 - \mu}$

D. $\frac{2R}{\mu - 1}$

Answer: A

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13. Which of the following depend on whether rays are paraxial or not for spherical mirrors ?

A. Pole

B. Principal axis

C. Radius of curvature

D. Focus

Answer: D

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14. Screen is placed at a distance 60 cm from an object. A convex lens of focal length f is placed between object and screen and it is attempted that real image of object is formed on the screen. But real image could not be formed for any position of lens between object and screen.

A. f must be less than 15 cm.

B. f must be greater than 15 cm.

C. f must be less than 10 cm

D. f must be less than 5 cm

Answer: B

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15. An air bubble inside water. The refractive index of water is 4/3 . At what distance from the air bubble should a point object be placed so as to form a real image at the same distance from the bubble:-

A. R

B. 2R

C. 3R

D. air bubble cannot form real image

Answer: D

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16. An object is kept at a distance 20 cm from a convex mirror of focal length 20 cm. The image will form at

A. infinity

B. focus

C. the position of object

D. 10 cm behind the mirror

Answer: D

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17. A point source of light is kept on the surface of a sphere and it is found that parallel light rays emerge from the other side of the sphere. What is refractive index of material of the sphere ?

A. 1.5

B. 2

C. 2.5

D. 3

Answer: B

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18. Two concave lenses are kept in contact and magnitude of equivalent focal length is found to be f_1. Now the space between two lenses is filled with liquid of refractive index slightly more than 1. The magnitude of focal length of combination becomes f_2.

A. $f_1 = f_2$

B. $f_1 > f_2$

C. $f_1 < f_2$

D. $f_2$cannot be defined

Answer: C

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19. Focal length of a double convex lens is 20 cm in air. If this lens is dipped in water of refractive index $4/3$ then what will be the new focal length ? (Take $\mu_{glass} = 1.5$)

A. 60 cm

B. 80 cm

C. 40 cm

D. 20 cm

Answer: B

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20. A thin lens is made of glass of refractive index 1.6. Both the surfaces of lens are convex. When this lens is dipped in water of refractive index $4/3$ then the lens will behave like

A. A rectangular slab of refractive index 1.2 kept in air

B. A prism of refractive index 1.2 kept in air

C. Convergent lens

D. Divergent lens

Answer: C

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21. Two thin concave lenses of focal lengths 10 cm and 30 cm and a thin convex lens of focal length 30 cm are kept in contact. What will be the power of lens combination ?

A. $+10D$

B. $-10D$

C. $-3.33D$

D. $+3.33$

Answer: B

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22. There is a convex lens of focal length 20 cm and a point object is placed at a distance 30 cm to the left of the lens. Radius of the lens is 5 cm. A person has placed eye at the right of lens at a distance 75 cm from the lens and at a height h below the principal axis. What can be the maximum value of h so that person is able to see the image ?

A. 1.25 cm

B. 2.5 cm

C. 3.75 cm

D. 5 cm

Answer: A

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23. A very small object of length a is kept along the axis of a concave mirror of focal length y at a distance x from its pole. Approximate size of the image is

A. $\frac{a^2y^3}{(y-x)^2}$

B. $\frac{a^3y^2}{(y-x)^2}$

C. $\frac{ay^2}{(y-x)^2}$

D. $\frac{a^2y}{(y-x)^2}$

Answer: C

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24. There is symmetric bi-convex lens and it is cut in two pieces by a plane containing principal axis. If power of the original lens is 10 D then what will be the power of each part ?

A. 10 D

B. 5 D

C. 20 D

D. 40 D

Answer: A

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25. There is a symmetric bi-convex lens and it is cut in two equal parts by a plane passing through the centre of lens and perpendicular to its principal axis. If power of original lens is 10 D then what will be the power of each part of the lens ?

A. 10 D

B. 20 D

C. 5 D

D. 2.5 D

Answer: C

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26. There is an equilateral prism of material of refractive index 1.5. Light ray is incident normally on its surface. What will be the angle of deviation of ray ?

A. 15°

B. 30°

C. 45°

D. 60°

Answer: D

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27. An object of height 0.5 m is placed in front of convex mirror. Distance of object from the mirror is equal to the focal length of the mirror. Height of the image of the object is

A. infinite

B. 1 m

C. 0.25 m

D. 0.5 m

Answer: C

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28. A point object is placed in front of a concave mirror. And its image is found to coincide with its own position. Now a glass slab of thickness 15 cm and refractive index 1.5 is placed in between object and the mirror. In order to form image again at the location of object, it is required to move the object

A. towards the mirror by 5 cm

B. away from the mirror by 5 cm

C. towards the mirror by 7.5 cm

D. away from mirror by 7.5 cm

Answer: B

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29. There is a plane mirror at the bottom of tank filled with water having refractive index $4/3$. A point object is placed at a height 10 cm above the bottom. What will be the apparent distance between point object and its image in plane mirror as observed by an observer outside the liquid in air ? Line joining observer and object is normal to the surface of water.

A. 10 cm

B. 15 cm

C. 20 cm

D. 25cm

Answer: B

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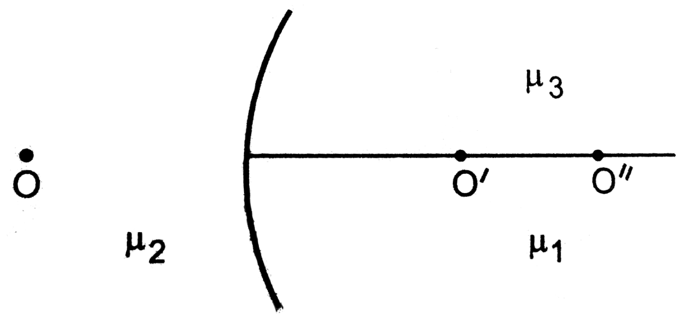
30. Figure shows figure three transparent medi of refractive indices μ_1, μ_2 and μ_3. A point object O is placed in the medium μ_2. If the entire medium on the right of the spherical surface has refractive index μ_1, the image forms at O. If this entire medium has refractive index μ_2 the image form at O''. In the situation shown



A. Between P and Q

B. Between centre of curved surface and P

C. To the right of Q

D. Two images will be formed, one at P and other at Q.

Answer: D

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31. A ray of light is incident normally normallyh on one of the faces of a prism of apex angle 30° and refractive index $\sqrt{2}$. The angle of deviation of the ray is ________________ degrees.

A. 15°

B. 7.5°

C. 0°

D. 30°

Answer: A

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32. There is one bi-concave lens of material having refractive index of 1.3. This lens is now dipped in a transparent liquid of refractive index 1.4. Lens will now behave as :

A. convergent lens

B. divergent lens

C. prism

D. any of the above depending upon the radius of curvature of both the surfaces of lens

Answer: A

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33. There is a thin prism of angle 5° made of material having refractive index 1.6. There is another thin prism made of material of refractive index 1.8. These two prisms are combined in such a manner that they may produce dispersion without mean deviation. What should be the angle of second prism ?

A. 10°

B. 3.75°

C. 4°

D. 6.75°

Answer: B

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34. The rays of different colours fail to converge at a point after going through a converging lens. This defect is called

A. chromatic aberration

B. coma effect

C. distortion

D. spherical aberration

Answer: A

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35. Perceived size of an object by a person depends mainly on

A. aperture of pupil of person

B. size of retina of the person

C. size of image formed on the retina of person

D. distance of object from eye

Answer: C

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36. To increase angular magnification of magnifying glass, we should increase its

A. aperture

B. focal length

C. power

D. thickness

Answer: C

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37. Distance between eye lens and its retina is.x. Maximum possible focal length of eye lens for a normal person

A. must be slightly less than x

B. must be slightly less than 2x

C. must be equal to x

D. must be equal to 2x

Answer: C

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38. Magnification achieved by an astronomical telescope is 6 when final image is formed at infinity. Distance between objective and eyepiece is 49 cm. Calculate focal lengths of objective and eyepiece.

A. 42 cm and 7 cm

B. 54 cm and 9 cm

C. 72 cm and 12 cm

D. 78 cm and 13 cm

Answer: A

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39. When a person is looking at objects kept at different distances then which one of the following factors remains constant ?

A. power of eye lens

B. distance of object from eye lens

C. distance of image from eye lens

D. radius of curvature of eye lens

Answer: C

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40. A person wears glasses with power -2.5 D. Without glasses the person

A. cannot see near objects clearly

B. cannot see objects clearly beyond 25 cm

C. cannot see objects clearly beyond 30 cm

D. cannot see objects clearly beyond 40 cm

Answer: D

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Objective Type Questions B Multiple Choice Questions

1. An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of

A. Large focal length and large diameter

B. Large focal length and small diameter

C. Small focal length and large diameter

D. Small focal length and small diameter

Answer: A

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2. Pick the wrong answer in the context with rainbow.

A. Rainbow is combined effect of dispersion, refraction and reflection of sunlight.

B. When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.

C. The order of colours is reversed in the secondary rainbow.

D. An observer can see a rainbow when his front is towards the sun.

Answer: D

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3. An object is placed at a distance of $40cm$ from a concave mirrorr of focal length $15cm$. If the object is displaced through a distance of $20cm$ towards the mirrorr, the displacement of the image will be

A. 30 cm towards the mirror

B. 30 cm away from the mirror

C. 30 cm away from the mirror

D. 36 cm towards the mirror

Answer: B

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4. In total internal reflection when the angle of incidence is equal to the critical angle for the pair of medium in contact, what will be angle of refraction? In total internal reflection when the angle of incidence is equal to the critical angle for the pair of medium in contact, what will be angle of refraction? In total internal reflection when the angle of incidence is equal to the critical angle for the pair of medium in contact, what will be angle of refraction?

A. 90°

B. 180°

C. 0°

D. equal to angle of incidence

Answer: A

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5. A ray of light travelling in a transparent medium f refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45°. For which of the following value of μ the ray can undergo total internal reflection ?

A. $m\mu = 1.50$

B. $m\mu = 1.25$

C. $m\mu = 1.33$

D. $m\mu = 1.10$

Answer: A

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6. The refractive index of the material of a prism is $\sqrt{2}$ and the angle of the prism is 30°. One of the two refracting surfaces of the prism is made a mirror inwards, by silver coating. A beam of monochromatic light entering the prism from the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is

A. 30°

B. 45°

C. 60°

D. Zero

Answer: B

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7. 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 = 1 cm

B. Virtual, upright, height = 0.5 cm

C. Real, inverted, height = 4 cm

D. Real, inverted, height 1 cm.

Answer: C

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8. A ray is ihncident at an angle of incidence ii on one surface of a prism of small angle A and emerge normally from opposite surface. If the refractive index of the material of prism is μ. the angel of incidance I is nearly equal to

A. $A / 2\mu$

B. μA

C. $\mu A / 2$

D. A / μ

Answer: B

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9. 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. $-2f_1 + f_2$

B. $f_1 + f_2$

C. $-f_1 + f_2$

D. $2f_1 + f_2$

Answer: D

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

A. less than that of glass

B. equal to that of glass

C. less than one

D. greater than that of glass

Answer: B

Watch Video Solution

11. 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. $\dfrac{R}{2(\mu_1 - \mu_2)}$

B. $\dfrac{R}{(\mu_1 - \mu_2)}$

C. $\dfrac{2R}{(\mu_2 - \mu_1)}$

D. $\dfrac{2R}{2(\mu_2 + \mu_1)}$

Answer: B

Watch Video Solution

12. 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. $2.5cm$

B. $1.67m$

C. $1.5cm$

D. $5cm$

Answer: B

Watch Video Solution

13. 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

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

A. $2 \sin A$

B. $2 \cos A$

C. $\frac{1}{2}\cos A$

D. $\tan A$

Answer: B

Watch Video Solution

15. 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

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

A. $180^{\circ}+A$

B. $180^{\circ}-3A$

C. $180^{\circ}-2A$

D. $90^{\circ}-A$

Answer: C

Watch Video Solution

17. 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. $50.0cm$

C. $54.0cm$

D. $37.3cm$

Answer: C

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18. 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. $40^\circ, \sqrt{2}$

C. $30^\circ, \dfrac{1}{\sqrt{2}}$

D. $45^\circ, \dfrac{1}{\sqrt{2}}$

Answer: A

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19. Match the corresponding entries of column 1 with column 2.

[Where m is the magnification produced by the mirror.

Column 1	Column 2
$(A) m = -2$	(a) Convex mirror
$(B) m = -\frac{1}{2}$	(b) Concave
$(C) m = +2$	(c) Real image
$(D) m = +\frac{1}{2}$	(d) Virtual image

A.

$$A \rightarrow a \text{ and } c, B \rightarrow a \text{ and } d, C \rightarrow a \text{ and } b, D \rightarrow c \text{ and } d$$

B.

$$A \rightarrow a \text{ and } d, B \rightarrow b \text{ and } c, C \rightarrow b \text{ and } d, D \rightarrow b \text{ and } c$$

C.

$$A \rightarrow c \text{ and } d, B \rightarrow b \text{ and } d, C \rightarrow b \text{ and } c, D \rightarrow a \text{ and } d$$

D.

$$A \rightarrow b \text{ and } c, B \rightarrow b \text{ and } c, C \rightarrow b \text{ and } d, D \rightarrow a \text{ and } d$$

Answer: D

View Text Solution

20. 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

21. 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

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Objective Type Questions Jee Main Other State Boards For Engineering Entrance

1. A beaker contains water up to a height h_1 and kerosene of height h_2 above water so that the total height of (water + kerosene) is $(h_1 + h_2)$. Refractive index of water is μ_1 and that of kerosene is μ_2 . The apparent shift in the position of the bottom of the beaker when viewed from above is :-

A. $\left(1+\frac{1}{\mu_1}\right)h_1-\left(1+\frac{1}{\mu_2}\right)h_2$

B. $\left(1+\frac{1}{\mu_1}\right)h_1+\left(1-\frac{1}{\mu_2}\right)h_2$

C. $\left(1+\frac{1}{\mu_1}\right)h_2-\left(1+\frac{1}{\mu_2}\right)h_1$

D. $\left(1-\frac{1}{\mu_1}\right)h_2+\left(1-\frac{1}{\mu_2}\right)h_1$

Answer: B

Watch Video Solution

2. A convex lens (of focal length 20 cm) and a concave mirror, having their principal axes along the same lines, are kept 80 cm apart from each other. The concave mirror is to the right of the convex lens. When an object is kept at a distance of 30 cm to the left of the convex lens, its image remains at the same position even if the concave mirror is removed. The maximum distance of the object for which this concave mirror, by itself would produce a virtual image would be :

A. 20 cm

B. 10 cm

C. 30 cm

D. 20 cm

Answer: B

View Text Solution

3. A concave mirror used for face viewing has focal length of $0.4m$. The distance at which you hold the mirror from your face in order to see your image upright with a magnification of 5 is ______ (in m).

A. 0.16 m

B. 1.60 m

C. 0.24 m

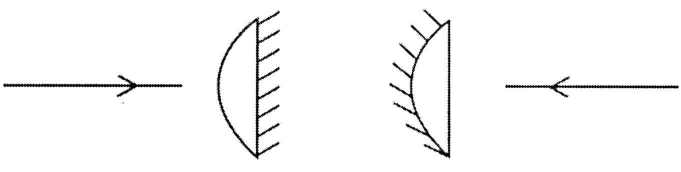
D. 0.32 m

Answer: D

Watch Video Solution

4. A planoconvex len becomes an optical system of 28 cm focal length when its plane surface is silvered illuminated from left to right as shown in Fig-A.

It the same lens is instead silvered on the curved surface and illuminated from other side as in Fig.B, it acts like an optical system of focal length 10 cm. The refractive index of the material of lens is :



A. 1.55

B. 1.5

C. 1.75

D. 1.51

Answer: A

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5. 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

Watch Video Solution

6. Let the x-z plane be the boundary between two transparent media. Medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with $z < 0$ has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\overrightarrow{A} = 6\sqrt{3}\hat{i} + 8\sqrt{3}\hat{j} - 10\hat{k}$ is incident on the plane of separation. The angle of refraction in medium 2 is:

A. 45°

B. 60°

C. 75°

D. 30°

Answer: A

Watch Video Solution

7. 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. 5.6 m

B. 7.2 m

C. 2.4 m

D. 3.2 m

Answer: D

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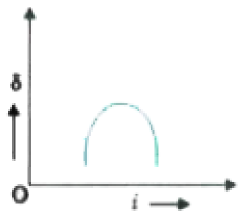
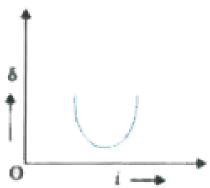
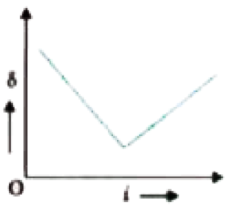
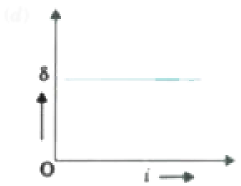
8. The graph between angle of deviation (δ) and angle of incidence (i) for a triangular prism is represented by

A. 

B. 

C. 

D. 

Answer: B

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9. 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. 20 cm

B. 30 cm

C. 10 cm

D. 15 cm.

Answer: D

Watch Video Solution

10. 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_1 and f_2 both become negative

B. $f_1 = f_2 < f$

C. $f_1 > f$ and f_2 becomes negative

D. $f_2 > \; > f$ and f_1 becomes negative

Answer: C

Watch Video Solution

11. A green light is incident from the water to the air - water interface at the critical angle (θ). Select the correct statement.

A. The entire spectrum of visible light will come out of the water at various angles to the normal.

B. The entire spectrum of visible light will come out of the water at an angle of 90° to the normal

C. The spectrum of visible light whose frequency is less than that of green light will come out to the air medium

D. The spectrum of visible light whose frequency is more than that of green light will come out to the air medium.

Answer: D

Watch Video Solution

12. 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. $30\mu m$

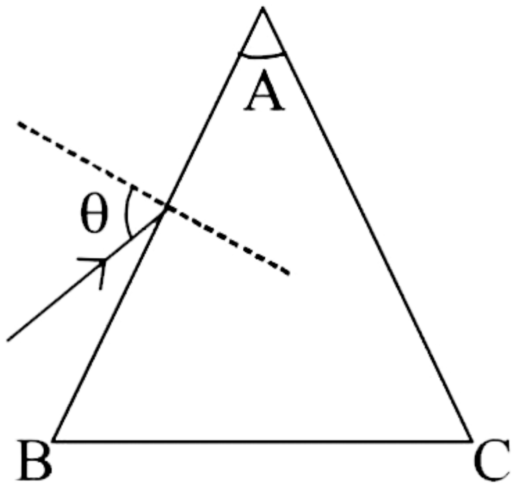
C. $100\mu m$

D. $300\mu m$

Answer: B

Watch Video Solution

13. 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. $\theta < \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{u}\right)\right)\right]$.

Answer: A

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14. You are asked to design a shaving mirror assuming that a person keeps it $10cm$ from his face and views the magnified image of the face at the closest comfortable distance of $25cm$. The radius of curvature of the mirror would then be:

A. 30 cm

B. 24 cm

C. 60 cm

D. 22 cm

Answer: C

Watch Video Solution

15. A telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5 cm. If a 50 m tall tower at a distance of 1 km is observed through this telescope in normal setting, the angle formed by the image of the tower is θ, then θ is close to :

A. 1°

B. 15°

C. 30°

D. 60°

Answer: D

View Text Solution

16. An object is located in a fixed position in front of a screen. Sharp image is obtained on the screen for two positions of a thin lens separated by 10 cm. The size of the images in two situations are in the ratio $3:2$. What is the distance between the screen and the object ?

A. 124.5 cm

B. 144.5 cm

C. 65.0 cm

D. 99.0 cm

Answer: D

View Text Solution

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

A. 200

B. 100

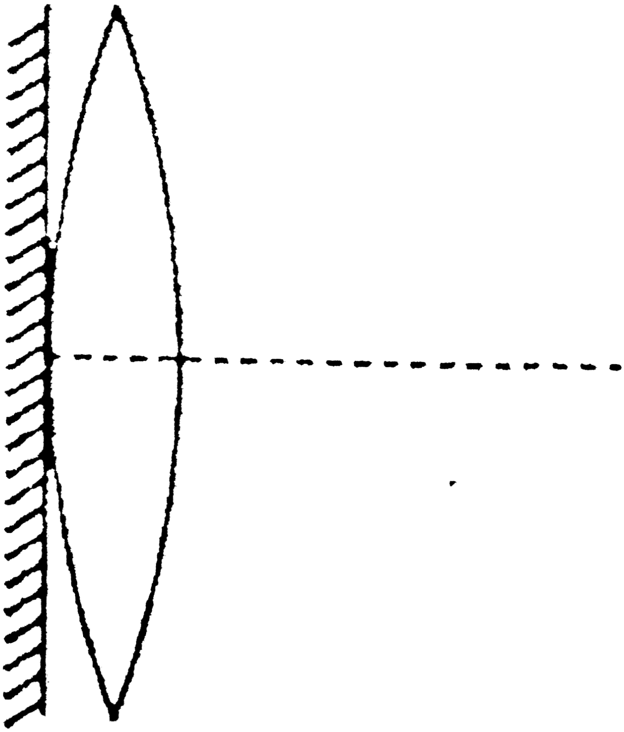
C. 400

D. 150

Answer: A

Watch Video Solution

18. A thin convex lens of focal length 'f' is put on a plane mirror as shown in the figure . When an object is kept at a distance 'a' from the lens - mirror combination , its image is formed at a distance $\frac{a}{3}$ in front of the combination . The value of 'a' is :-



A. f

B. 2f

C. 3f

D. $\frac{3}{2}f$

Answer: B

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19. To find the focal length of a convex mirror , a student records the following data:

Object Pin	Convex Lens	Convex mirror	Image Pin
$22.2cm$	$32.2cm$	$45.8cm$	$71.2cm$

The focal length of the convex lens is f_1 and that of mirror is f_2 . Then taking index correction to be negligibly small , f_1 and f_2 are close to :

A. $f_1 = 12.7cm f_2 = 7.8cm$

B. $f_1 = 7.8cm\,f_2 = 12.7cm$

C. $f_1 = 7.8cm\,f_2 = 25.4cm$

D. $f_1 = 15.6cm\,f_2 = 25.4cm$

Answer: B

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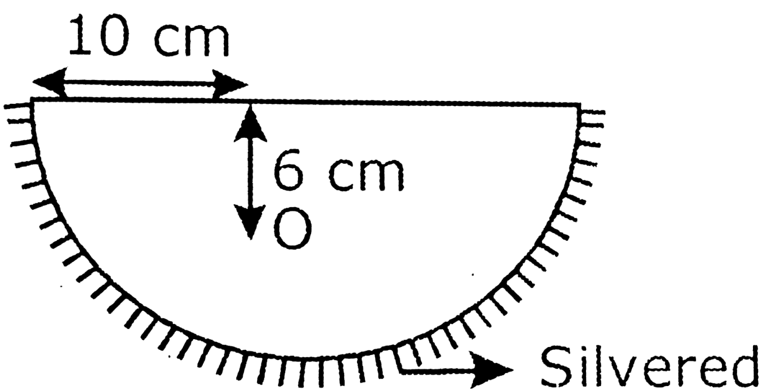

20.

A hemispherical glass body of radius 10 cm and refractive index 1.5 is silvered on its curved surface . A small air bubble is 6 cm below the flat surface inside it along the axis. The position of the image of the air bubble made by the mirror is seen :

A. 14 cm below flat surface

B. 30 cm below flat surface

C. 20 cm below flat surface

D. 16 cm below flat surface

Answer: C

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21. 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

Watch Video Solution

22. An obsever 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: C

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23. To determine refractive index of glass slab using a travelling microscope, minimum num- ber of readings required are :

A. Two

B. Three

C. Four

D. Five

Answer: C

Watch Video Solution

24. Calculate the focal length of a reading glass of a person, if the distance of distinct vision is 75cm.

A. 25.6 cm

B. 37.5 cm

C. 75.2 cm

D. 100.4 cm

Answer: B

Watch Video Solution

25. The focal lengths of the objective and of the eye-piece of a compound microsope are f_0 and f_e respectively. If L is the tube length and D,the least distance of distinct vision, then its angular magnification, when the image is formed at infinity, is

A. $\left(1-\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$

B. $\left(1+\frac{L}{f_e}\right)\left(\frac{D}{f_e}\right)$

C. $\frac{L}{f_0}\left(1-\frac{D}{f_e}\right)$

D. $\frac{L}{f_0}\left(\frac{D}{f_e}\right)$

Answer: D

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26. A particle is oscillating on the X-ais with an amplitude 2 cm about the point $x_0 = 10cm$, with a frequency ω. A concave mirror of focal length 5 cm is placed at the origin (see figure).

Identify the correct statements.

A. (B, C)

B. (A, C, D)

C. (A, D)

D. (B, D)

Answer: B

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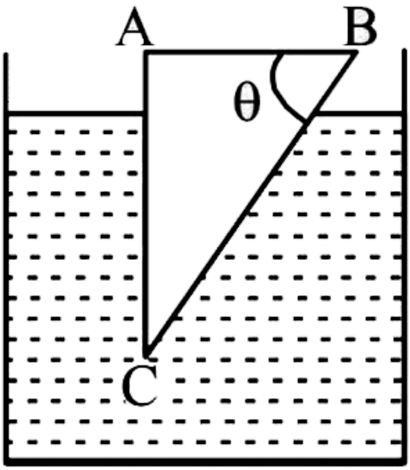
27. A glass prism of refractive index 1.5 is immersed in water (refractive index 4/3). A light beam incident normally on the face AB is totally reflected to reach on the face BC if.



A. $\frac{2}{3} < \sin\theta < \frac{8}{9}$

B. $\sin \leq \frac{2}{3}$

C. $\sin \geq \frac{8}{9}$

D. $\sin \leq \frac{8}{9}$

Answer: C

Watch Video Solution

28. What is the angle of incidence for an equilateral prism of refractive index $\sqrt{3}$ so that the ray si parallel to the base inside the prism?

A. 30°

B. 20°

C. 60°

D. 45°

Answer: C

Watch Video Solution

29. If the speed of light in material A is 1.25 times its speed in material B, then the ratio of the refractive indices of these materials is

A. 1.5

B. 1

C. 0.8

D. 1.25

Answer: C

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

A. 0°

B. 90°

C. 30°

D. 45°

Answer: B

Watch Video Solution

31. In an optical fibre, core and cladding were made with materials of refractive indices 1.5 and 1.414 respectively. To observe total internal reflection, what will be the range of incident angle with the axis of optical fibre?

A. $0^{\circ} - 60^{\circ}$

B. $0^{\circ} - 48^{\circ}$

C. $0^{\circ} - 30^{\circ}$

D. $0^{\circ} - 82^{\circ}$

Answer: C

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32. The focal length of a lens of dispersive power 0.45 which should be placed in contact with a convex lens of focal length 84 cm and dispersive power 0.21 to make the achromatic combination from the two lenses, in cm is

A. 45

B. 90

C. 180

D. -180

Answer: D

Watch Video Solution

33. Which of the following statements are true in the context of a Compound Microscope ?

(a) Each lens produces a virtual and inverted image.

(b) The objective has a very short focal length.

(c) The eyepiece is used as a simple magnifying glass.

(d) The objective and eyepiece are convex and concave lenses respectively.

A. (a), (b) and (d)

B. (b) and (c)

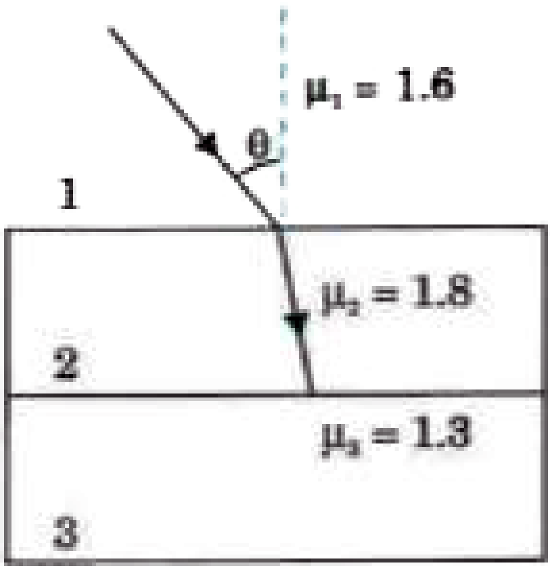
C. (a), (c) and (d)

D. (b) and (d)

Answer: B

View Text Solution

34. A ray of light refracts from medium 1 into a thin layer of medium 2, crosses the layer and is incident at the critical angle on the interface between the medium 2 and 3 as shown in the figure. If the angle of incidence of ray is θ, the values of θ is



A. $\sin^{-1}\left(\frac{8}{9}\right)$

B. $\sin^{-1}\left(\frac{13}{18}\right)$

C. $\sin^{-1}\left(\frac{13}{16}\right)$

D. $\sin^{-1}\left(\frac{8}{13}\right)$

Answer: C

View Text Solution

35. A microscope consists of an objective of focal length 1.9 cm and eyepiece of focal length 5 cm. The two lenses are kept at a distance of 10.5 cm. If the image is to be formed at the least distance of distinct vision, the distance at which the object is to be placed before the objective is (least distance of distinct vision is 25 cm)

A. 6.2 cm

B. 2.7 cm

C. 21.0 cm

D. 4.17 cm

Answer: B

Watch Video Solution

36. A convex lens has its radii of curvature equal. The focal length of the lens is f. If it is divided vertically into two identical plano-convex lenses by cutting it, then the focal length of the plano-convex lens (p = the refractive index of the material of the lens)

A. f

B. $\frac{f}{2}$

C. 2f

D. $(\mu - 1)f$

Answer: C

Watch Video Solution

37. A thin converging lens of focal length f= 25 cm forms the image of an object on a screen placed at a distance of 75 cm from the lens. The screen is moved closer to the lens by a distance of 25 cm. The distance through which the object has to be shifted, so that its image on the screen in sharp again is

A. 37.5 cm

B. 16.25 cm

C. 12.5 cm

D. 13.5 cm

Answer: C

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38. In an experiment a convex lens of focal length 15 cm is placed coaxially on an optical bench in front of a convex mirror at a distance of 5 cm from it. It is found that an object and its image coincide, if the object is placed at a distance of 20 cm from the lens. The focal length of the convex mirror is :

A. 27.5 cm

B. 20.0 cm

C. 25.0 cm

D. 30.5 cm

Answer: A

View Text Solution

39. 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 40 cm from convergent lens

B. Virtual and at a distance of 40 cm from convergent lens

C. Real and at a distance of 40 cm from the divergent lens

D. Real and at a distance of 66 cm from the convergent lens

Answer: A

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40. Let the refractive index of a denser medium with respect to a rarer medium be n_{12} and its critical angle be θ_c. At an angle of incidence A when light is travelling from denser medium to rarer medium, a part of the light is reflected and the rest is refracted and the angle between reflected and refracted rays is 90°, Angle A given by -

A. $\dfrac{1}{\cos^{-1}(\sin\theta_C)}$

B. $\dfrac{1}{\tan^{-1}(\sin\theta_C)}$

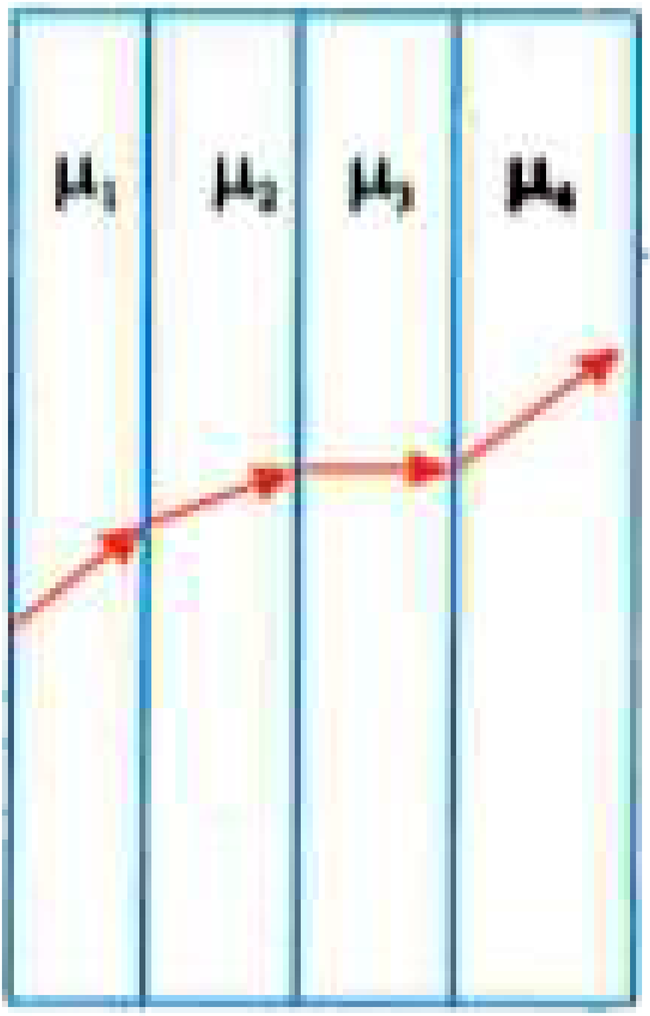
C. $\cos^{-1}\sin\theta_C$

D. $\tan^{-1}\sin\theta_C$

Answer: D

Watch Video Solution

1. A ray of light passes through four transpar ent media with refractive indices μ_1, μ_2, μ_3 and μ_4 as shown in figure. The surfaces of all media are parallel. If the emergent ray is parallel to the incident ray, we must hav



A. $\mu_1 = \mu_2$

B. $\mu_2 = \mu_4$

C. $\mu_3 = \mu_4$

D. $\mu_4 = \mu_1$

Answer: D

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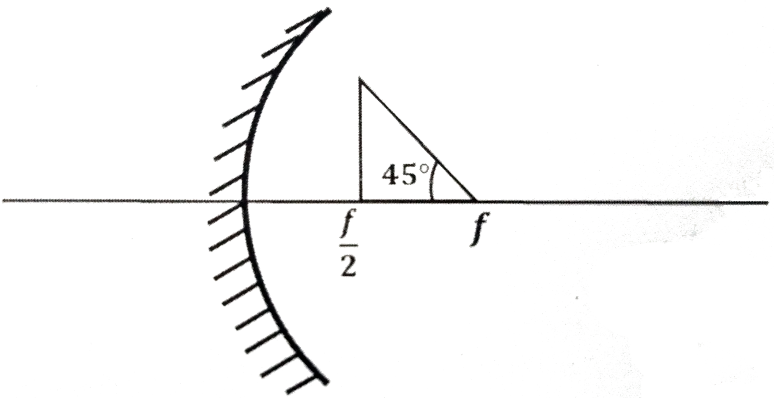
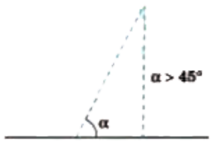
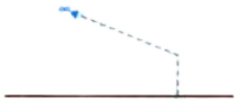
2. A wire is bent in the shape of a right angled triangle and is placed in front of a concave mirror of focal length f,as shown in the figure which of the figures shown in the four options qualitatively represents (s) the shape of the image of the bent wire ? (These figures are not to scale)



A. 

B. 

C. 

D. 

Answer: D

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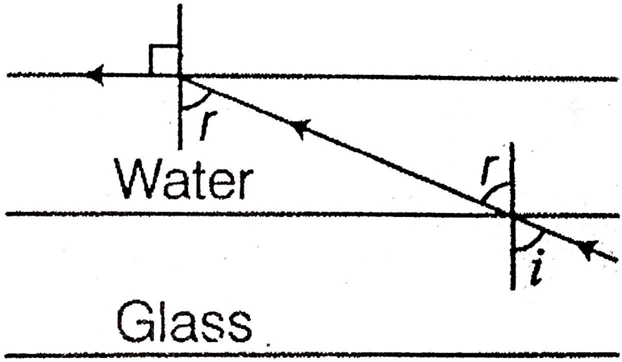
3.



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

A. $(4/3)\sin i$

B. $1/\sin i$

C. $4/3$

D. 1

Answer: B

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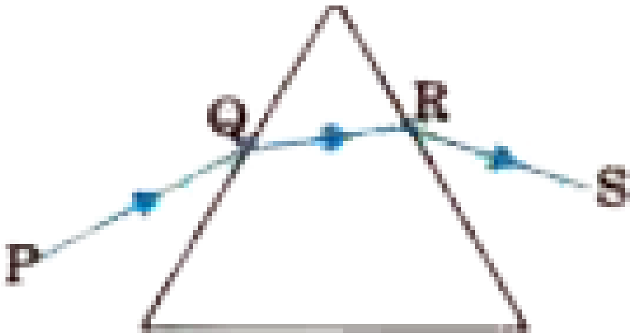
4. A ray of light is incident on an equilateral glass prism placed on a horizontal table. For minimum deviation which of the following is true ?



A. PQ is horizontal

B. QR is horizontal

C. RS is horizontal

D. Either PQ or RS is horizontal.

Answer: B

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

A. 2 cm

B. 4 cm

C. 6 cm

D. 12 cm.

Answer: C

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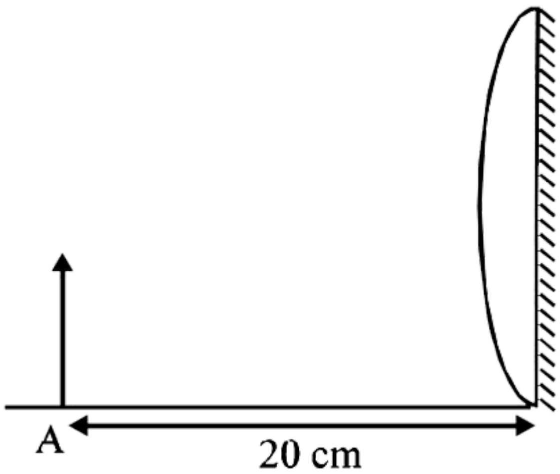
6. Focal length of the plano-convex lens is 15 cm. A small object is placed at A as shown in the figure. The plane surface is silvered. The image will form at `



A. 60 cm left of lens

B. 12 cm left of lens

C. 60 cm right of lens

D. 30 cm left of lens.

Answer: B

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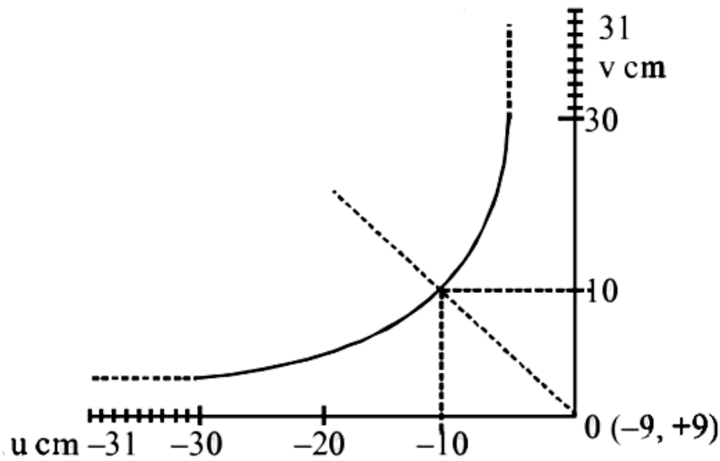
7. The graph shown relationship between object distance and image distance for a equiconvex lens. Then focal length of the lens is `



A. $0.50 \pm 0.05 cm$

B. $0.50 \pm 0.10 cm$

C. $5.00 \pm 0.05 cm$

D. $5.00 \pm 0.10 cm$

Answer: D

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8. A convex lens if in contact with concave lens. The magnitude of the ratio of their focal length is $\frac{2}{3}$. Their equivalent focal length is 30 cm. What are their individual focal lengths?

A. $-75, 50$

B. $-10, 15$

C. $75, 50$

D. $-15, 10$

Answer: D

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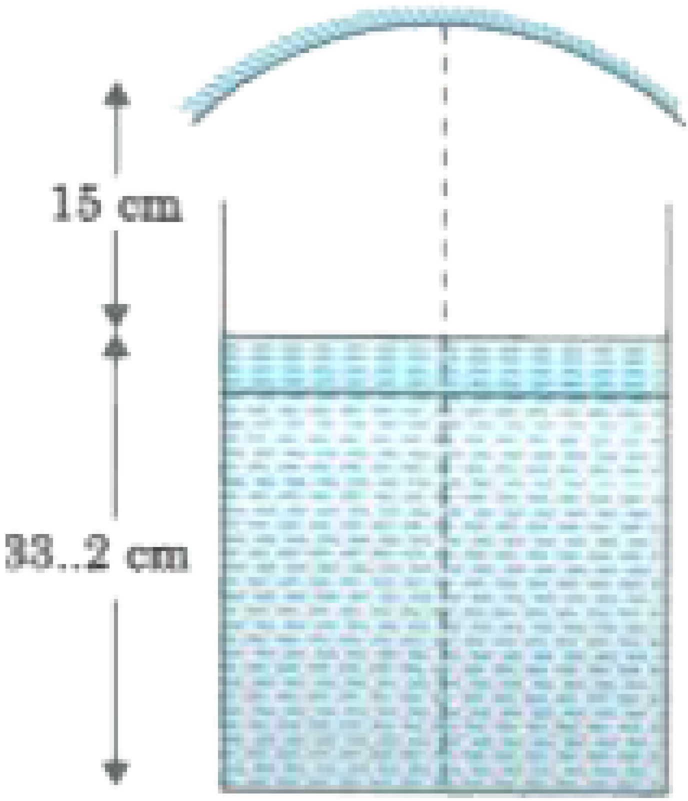
9. A container is filled with water $(\mu = 1.33)$ up to height of $33.2cm$. A concave mirror is placed 15 cm above the water level. Image of an object placed at the bottom is formed at the same place. The focal length of mirror is :

(I.I.T. 2005)



A. 10 cm

B. 15 cm

C. -20 cm

D. 2 cm

Answer: C

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10. A ray of light travelling in water is incident on its surface open to air. The angle of incidence is θ, which is less than the critical angle. Then there will be

A. only a reflected ray and no refracted ray

B. only a refracted ray and no reflected ray

C. a reflected ray and a refracted ray and the angle between them would be less than $(180^\circ - 2\theta)$

D. a reflected ray and a refracted ray and the angle between them would be greater than $(180^\circ - 2\theta)$

Answer: C

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11. In an experiment to determine the focal length (f) of a concave mirror by the $u - v$ method, a student places the object pin A on the principal axis at a distance x from the pole P. The student looks at the pin and its inverted image from a distance keeping his/her eye in line with PA. When the student shifts his/her eye towards left, the image appears to the right of the object pin. Then,

A. $x < f$

B. $f < x < 2f$

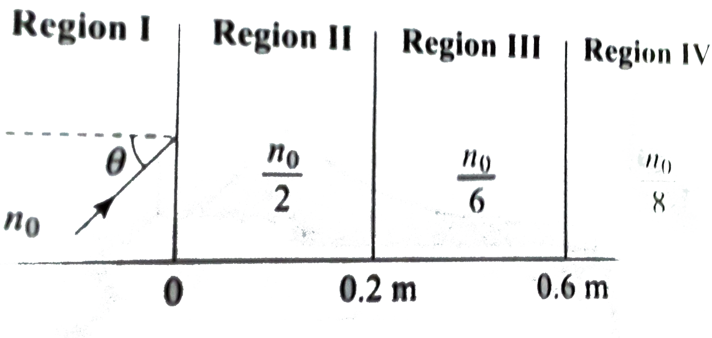
C. x =2f

D. $x > 2f$

Answer: B

Watch Video Solution

12. A light beam is traveling from Region I to region IV (refer figure). The refractive indices in Region I, II, III, and IV are $n_0, n_0/2, n_0/6$ and $n_0/8$, respectively. The angle of incidence θ for which the beam just misses entering Region IV is



A. $\sin^{1}(3/4)$

B. $\sin^{1}(1/8)$

C. $\sin^{1}(1/4)$

D. $\sin^{1}(1/3)$

Answer: B

Watch Video Solution

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

A. Virtual and at a distance of 16 cm from the mirror

B. Real and at a distance of 16 cm from the mirror

C. Virtual and at a distance of 20 cm from the mirror

D. Real and at a distance of 20 cm from the mirror.

Answer: B

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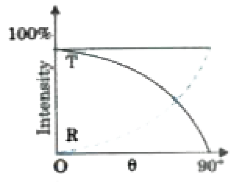
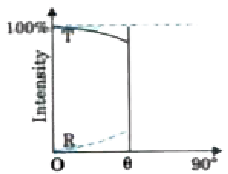
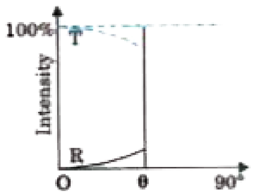
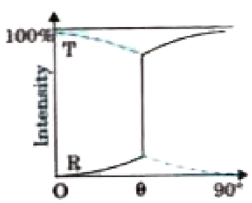
14. A light ray travelling in glass medium is incident of glass- air interface at an angle of incidence θ. The reflected (R) and transmitted (T) intensities, both as function of θ, are plotted The correct sketch is

A. 

B. 

C. 

D. 

Answer: C

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15. A bi-convex lens is formed with two thin plano-convex lenses as shown in the figure. Refractive index n of the first lens is 1.5 and that of the second lens is 1.2. Both the curved surface are of the same radius of curvature R=14 cm. For this bi-convex lens, for an object distance of 40 cm, the image distance will be

`

A. $-280.0cm$

B. $40.0cm$

C. $21.5cm$

D. $13.3cm$

Answer: B

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16. 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 reflectiion, it travels along the direction $\frac{1}{2}\left(\hat{i}-\sqrt{3}\hat{j}\right)$. The angle of incidence is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: A

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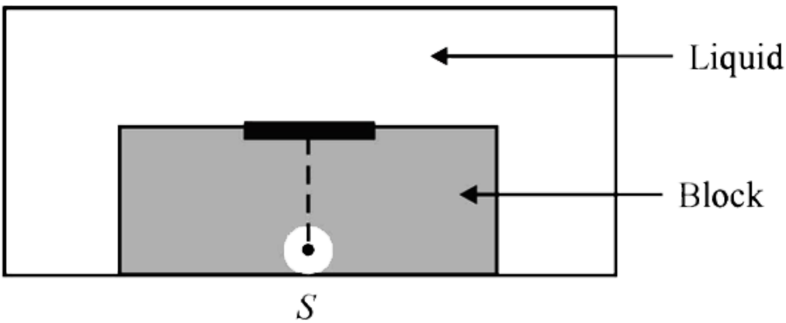
17. A point source S is placed at the bottom of a tranparent block of height 10mm and refractive index 2.72. It is immersed in a lower refractive index liquid as shown in the figure. It is found that the light emerging from the block to the liquid forms a circular bright spot of diameter 11.54 mm on the top of the block. The refractive index of the liquid is `



A. 1.21

B. 1.3

C. 1.36

D. 1.42

Answer: C

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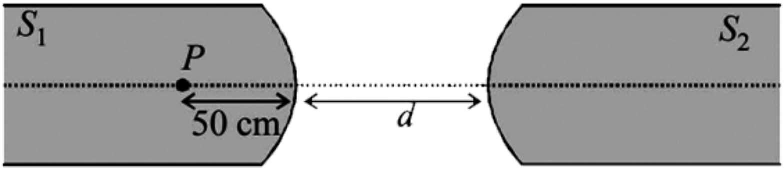
18. Two identical glass rods S_1 and S_2 (refractive index=1.5) have one convex end of radius of curvature 10 cm. They are placed with the curved surfaces at a distance d as shown in the figure, with their axes (shown by the dashed line) aligned. When a point source of light P is placed inside rod S_1 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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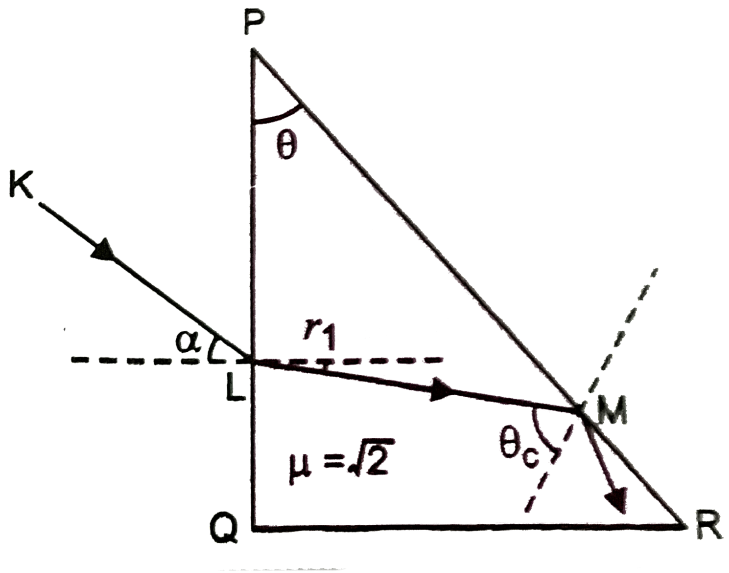
19. A parallel beam of light is incident from air at an angle α on the side of right angled triangular prism of refractive index $\mu = \sqrt{2}$. Light undergoes total internal reflection in the prism at the face PR when α has a minimum value of 45°. The angle θ of the prism is.



A. 15°

B. 22.5°

C. 30°

D. 45°

Answer: A

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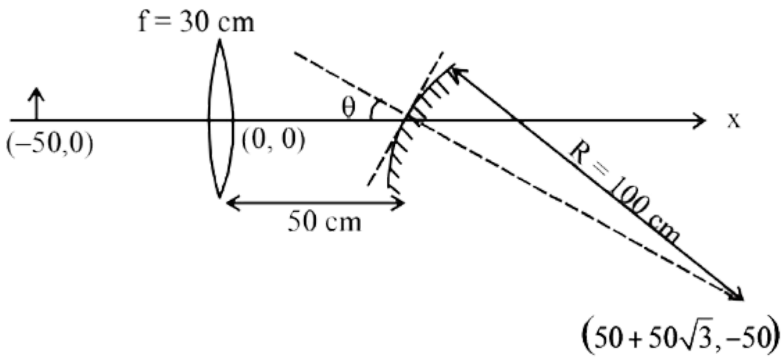
20. A small object is placed 50 cm to the left of a thin convex lens of focal length 30 cm. A convex spherical mirror of radius of curvature 100 cm is placed to the right of the lens at a distance of 50 cm. The mirror is tilted such that the axis of the mirror is at an angle $\theta = 30 degree$ to the axis of the lens, as shown in the figure

If the origin of the coordinate system is taken to be at the centre of the lens, the coordinates (in cm) of the point (x, y)

at which the image is formed are



A. $\left(25,\ 25\sqrt{3}\right)$

B. (0, 0)

C. $\left(125/3,\ 25\sqrt{3}\right)$

D. $\left(50-25/\sqrt{3},\ 25\right)$

Answer: A

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Objective Type Questions C Multiple Choice Questions

1. When we look at some object through our eyes then image formed on the retina is

A. Real

B. Virtual

C. Erect

D. Inverted

Answer: A::D

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2. A ray of light travelling straight bends by a small but fixed angle. It may be due to

A. Reflection

B. Refraction

C. Dispersion

D. Diffraction

Answer: A::B

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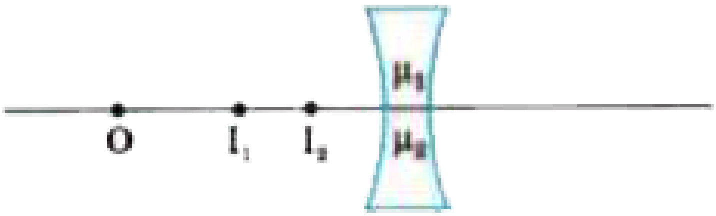
3. Consider three geometrically identical concave lenses A, B and C. A is made of material of refractive index μ_1, B is made of material of refractive index μ_2. Lens C is constructed in such a way that half of the lens above principal axis is made of material of refractive index μ_1, and half of the lens below principal axis is made of material of refractive index μ_2. Image of an object O as shown in figure is formed at I_1 when lens A is used and the image is formed at I_2 when lens B is used at the same location. Now the lens C is placed at the same location.



A. One image will be at I_1

B. One image will be at I_2

C. One image will be formed somewhere between I_1 and I_2

D. One image will be formed between I_2 and the lens

Answer: A::B

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4. In which of the following the final image is erect?

A. Simple microscope

B. Compound microscope

C. Astronomical telescope

D. Galilean telescope

Answer: A::D

Watch Video Solution

5. Distance between a candle and screen is D. A convex lens of focal length 20 cm is brought in between them and it is found that real image of candle can be formed on the screen for some position of lens.

A. D must be less than or equal to 80 cm

B. D must be greater than or equal to 80 cm

C. D may be less than 160 cm

D. D may be greater than 160 cm

Answer: B::C::D

Watch Video Solution

6. Which of the following entities related to spherical mirrors do not depend on whether rays are paraxial or not ?

A. Pole

B. Principal axis

C. Radius of curvature

D. focal length

Answer: A::B::C

Watch Video Solution

7. Which of the following always forms virtual image for real objects ?

A. Concave lens

B. concave mirror

C. Convex mirror

D. convex lens

Answer: A::C

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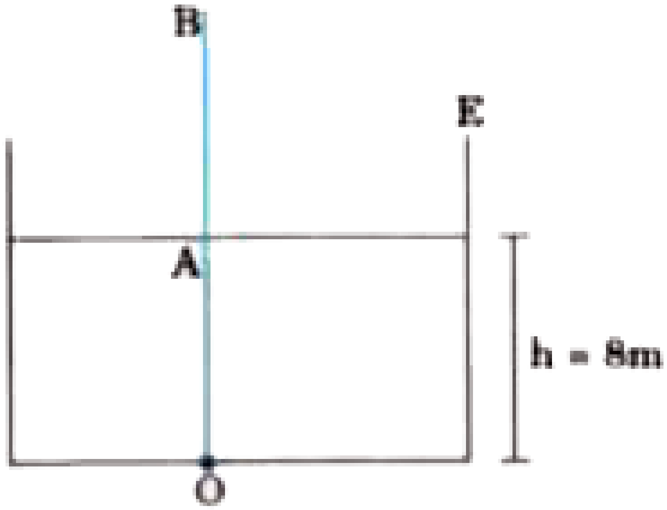
8.



An object O is placed at the bottom of a container in which water is filled up to a height of 8m. Refractive index of water is $4/3$. OAB is a vertical line. Observer is looking at O from point E as shown in figure. For the observer, position of O will appear to be

A. Somewhere on line OAB

B. To the left of line OAB

C. At a depth 6m below water surface

D. At a depth less than 6 m below the water surface

Answer: B::D

View Text Solution

9. The focal length of the objective of a compound microscope is f_0 and its distance from the dyepiefe is L. The object is placed at a distance u from the objective. For proper working of the instrument.,

A. $L > a$

B. $L < a$

C. $L > 2f_0$

D. $f_0 < L < 2f_0$

Answer: A::C

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10. Light ray is travelling from a medium of refractive index μ in to air. Angle of incidence at the interface is 53°. Light ray is found to suffer total internal reflection. Select possible values of μ from the following :

A. 1.2

B. 1.3

C. 1.4

D. 1.6

Answer: B::C::D

View Text Solution

11. Astronomical telescope is used to observe a planet and final image of the planet is found to be formed at infinity. Focal length of objective lens is 20 m and that for the eyepiece is 4 cm.

A. Angular magnification achieved is 500

B. Distance between objective and eyepiece is slightly more than 20 m.

C. Image of the planet is inverted

D. Aperture of objective larger than that of eyepiece

Answer: A::B::C::D

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12. Convex lens of focal length f is used as simple microscope. D is the least distance for distinct vision.

A. Magnification achieved must be equal to $\frac{D}{f}$

B. Magnification achieved may be equal to $\frac{D}{f}$

C. Magnification achieved cannot be less than $1+\frac{D}{f}$

D. Maximum magnification achieved is equal to $1+\frac{D}{f}$.

Answer: B::D

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13. For a light ray passing through a prism

A. angle of deviation increases when angle of incidence is increased

B. angle of deviation decreases when angle of deviation is increased

C. When angle of incidence is increased or decreased from a particular value then in both cases angle of deviation increases.

D. Angle of deviation is approximately proportional to the refracting angle of prism provided prism is very thin.

Answer: C::D

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14. There is a solid transparent sphere with a point object embedded at its centre. Apparent location of the point object will be

A. closer to eye than its actual location

B. farther away from eye than its actual location

C. same as its actual location

D. same for any material

Answer: C::D

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15. There is a thin double convex lens having surfaces of radius of curvature R and 2R. Lens is kept in air and refractive index of the material of the lens is μ. Focal length of the lens

A. will depend on which surface light is incident

B. will not depend on which surface light is incident

C. will be equal to $\frac{2R}{3(\mu - 1)}$

D. will be equal to $\frac{2R}{2(\mu - 1)}$

Answer: B::C

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16. Convergent beam of light is passed through a diverging lens. Light rays after passing lens

A. must be a parallel beam

B. must be a divergent beam

C. may be a divergent beam

D. may be a convergent beam

Answer: C::D

Watch Video Solution

17. A convergent beam is incident on a convex mirror. Reflected light

A. may form a real image

B. may form a virtual image

C. must form a real image

D. must form a virtual image

Answer: A::B

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18. Identical objective lenses are used to make Astronomical telescope and Galilean telescope. Focal length of objective for both is f_o. Focal length of eyepiece for both is also same and equal to f_e. Final image is formed at infinity in both the telescopes.

A. Magnification for both the telescopes will be same.

B. Tube lengths of the telescopes differ by $2f_e$.

C. Length of Astronomical telescope is less than Galilean.

D. Length of Astronomical telescope is more than Galilean.

Answer: A::B::D

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19. Properly cut diamond sparkles because

A. atoms emit light

B. material has high refractive index

C. It reflects all light falling on it

D. Light which enters it suffer multiple total internal reflections

Answer: B::D

Watch Video Solution

20. A convex lens is used to form image of an object on screen. When half of the lens is covered by painting black on it, then

A. Intensity of the image formed will remain same

B. Intensity of the image formed will decrease

C. Half of the image will be formed on the screen

D. Complete image will be formed on the screen

Answer: B::D

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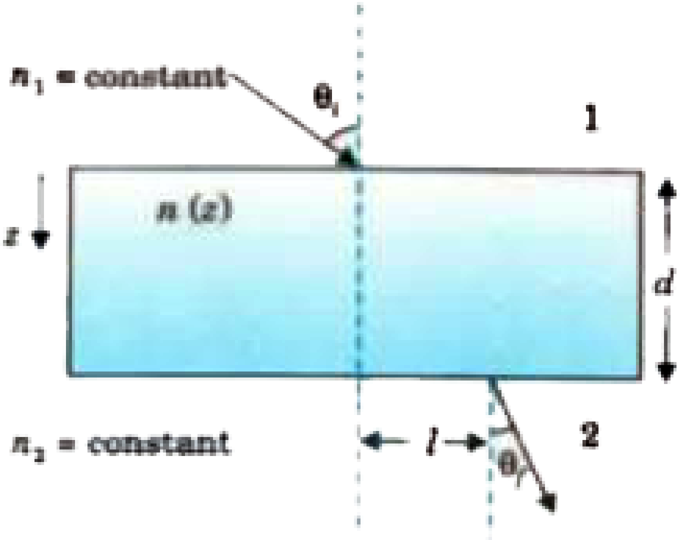
21. A transparent slab of thickness d has a refractive index n(z) that increases with z. Here z is the vertical distance inside the slab, measured from the top. The slab is placed between two media with uniform refractive indices n_1 and $n_2(>n_1)$, as shown in the figure. A ray of light is incident with angle θ_i, from medium 1 and emerges in medium 2 with refraction and θ_f, with a lateral displacement l.



Which of the following statement(s) is (are) true ?

A. l is independent of n_2

B. $n_1 \sin\theta_1 = n_2 \sin\theta_f$

C. l is independent of n(z)

D. $n_1 \sin\theta_1 = (n_2 - n_1)\sin\theta_f$

Answer: A::B

View Text Solution

22. A plano-covex lens is made of a material of refractive index n. When a small object is placed 30cm away in front of the curved surface of the lens, an image of double the size of the object is produced. Due to reflection from the convex surface of the lens, another faint image is observed at a distance of 10 cm away from the lens. Which of the following statement (s) is (are) true?

A. The refractive index of the lens is 2.5

B. The radius of curvature of the convex surface is 45 cm

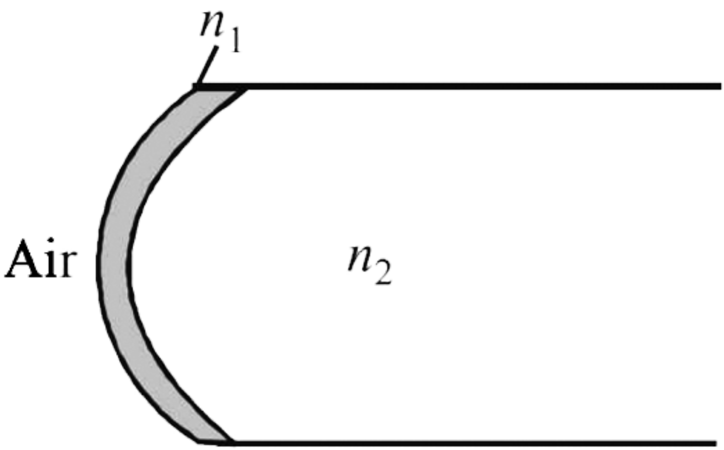
C. The faint image is erect and real

D. The focal length of the lens is 20 cm

Answer: A::D

Watch Video Solution

23. A transparent thin film of uniform thickness and refractive index $n_1 = 1.4$ is coated on the convex spherical surface of radius R at one end of a long solid glass cylinder of refractive index $n_2 = 1.5$, as shown in the figure. Rays of light parallel to the axis of the cylinder traversing through the film from air to glass get focused at distance f_1 from the film, while rays of light traversing from glass to air get focused at distance f_2 from the film, Then `



A. $|f_1| = 3R$

B. $|f_1| = 2.8R$

C. $|f_2| = 2R$

D. $|f_2| = 1.4R$

Answer: A::C

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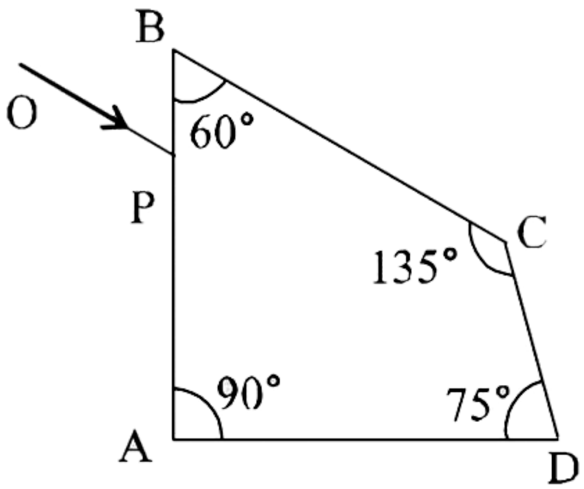
24. A ray OP of monochromatic light is incident on the face AB of prism ABCD mear vertex B at an incident angle of $60 degree$ (see figure). If the refractive index of the material of the prism is $\sqrt{3}$, which of the following is (are) are correct? `



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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25. For an isosceles prism of angle A and refractive index μ, it is found that the angle of minimum deviation $\delta_m = A$. Which of the following options is/ are correct ?

A. At minimum deviation, the incident angle i_1 and the refracting angle r_1 at the first refracting surface are related by $r_1 = \left(\frac{i_1}{2}\right)$

B. For this prism, the refractive index μ and the angle of prism A are related as $A = \frac{1}{2}\cos^{-1}\left(\frac{\mu}{2}\right)$

C. For the angle of incidence i_1 = A, the ray inside the prism is parallel to the base of the prism

D. For this prism, the emergent ray at the second surface will be tangential to the surface when the angle of incidence at the first surface is

$$i_1 = \sin^{-1}\left[\sin A\sqrt{4\cos^2\frac{A}{2} - 1} - \cos A\right]$$

Answer: A::D

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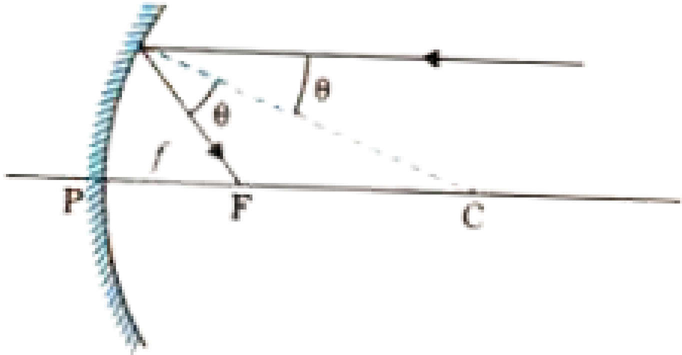
Objective Type Questions D Multiple Choice Questions

1. 

Rays parallel to principal axis, incident on the spherical mirror at different heights from principal axis are focused at different points. And due to this reason we cannot define unique focus. This is known as spherical aberration. Angle of incidence θ shown in figure depends on the height of ray above principal axis. Focal length of spherical mirror can be easily written in terms of angle θ shown in figure as follows :

$$f = R - \frac{R}{2}\sec\theta$$

Here R is radius of curvature of mirror. The light rays which are very close to principal axis are known as paraxial rays and rays far away from principal axis are called marginal rays.

Let f_P and fm represent the focal length corresponding to paraxial rays and marginal rays respectively then

A. Let f_p and fm represent the focal length corresponding to paraxial rays and marginal rays respectively then

B. $f_p = f_m$

C. $f_p > f_m$

D. $f_p < f_m$

Answer:

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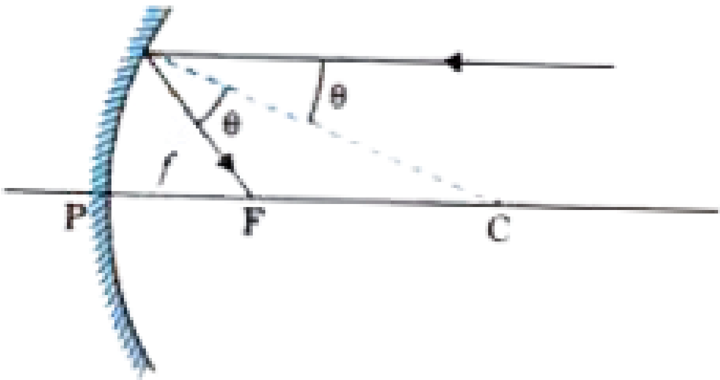
2.



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$$f = R - \frac{R}{2}\sec\theta$$

Here R is radius of curvature of mirror. The light rays which are very close to principal axis are known as paraxial rays and rays far away from principal axis are called marginal rays.

For paraxial rays focal length is approximately

A. For paraxial rays focal length is approximately

B. 2R

C. $R/2$

D. 4R

Answer: D

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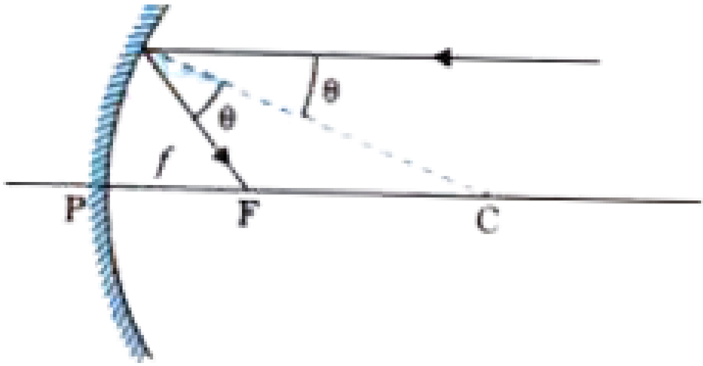
3. 

Rays parallel to principal axis, incident on the spherical mirror at different heights from principal axis are focused at different points. And due to this reason we cannot define unique focus. This is known as spherical aberration. Angle of incidence θ shown in figure depends on the height of ray above principal axis. Focal length of spherical mirror can be easily written in terms of angle θ shown in figure as follows :

$$f = R - \frac{R}{2}\sec\theta$$

Here R is radius of curvature of mirror. The light rays which are very close to principal axis are known as paraxial rays and rays far away from principal axis are called marginal rays.

What will be the focal length for ray which is incident at an angle 60°?

A. What will be the focal length for ray which is incident at an angle 60° ?

B. R

C. 2R

D. $R/2$

Answer:

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4. Focal lengths of objective and eyepiece of a compound microscope are 1 cm and 6cm respectively. Length of tube is fixed to 12.8 cm. Instrument is adjusted to achieve maximum magnification. Least distance of clear vision is 24 cm for the person using instrument.

What should be the distance of object from objective lens?

A. What should be the distance of object from objective lens ?

B. $\frac{7}{8}$

C. $\frac{8}{7}$

D. $\frac{8}{9}$

Answer:

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5. Focal lengths of objective and eyepiece of a compound microscope are 1 cm and 6cm respectively. Length of tube is fixed to 12.8 cm. Instrument is adjusted to achieve maximum magnification. Least distance of clear vision is 24 cm for the person using instrument.

What is maximum magnification achieved by microscope ?

A. What is maximum magnification achieved by microscope ?

B. 35

C. 45

D. 25

Answer:

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Objective Type Questions Assertion Reason Type Questions

1. Assertion : Focal length of a spherical mirror does not depend on the material from which mirror is made but same for the lens depends on the material of lens.

Reason : Law of reflection does not depend on material and surrounding medium but law of refraction depends on refractive index of the materials.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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2. Assertion: Blue light travels slower than red light in vacuum.

Reason : Frequency of blue light is greater than that of red light.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: D

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3. A : A virtual image cannot be produced on screen.

R : The light energy does not meet at the point(s) where virtual image is formed.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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4. Assertion : A reflecting type telescope is preferred over refracting type in astronomy.

Reason : Reflecting type telescope is free from chromatic aberration and parabolic surfaces are used to avoid spherical aberration.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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5. Assertion : A convex lens made of material of refractive index 1.2 behaves as diverging lens when kept in water of refractive index $4/3$.

Reason : A convex lens made of material of refractive index 1.2 behaves as converging lens when placed in air.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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6. Assertion : When two lenses are used to make achromatic lens combination then the materials of the two lenses are always different.

Reason : Dispersive power of the materials of the two lenses must be of opposite sign to become achromatic combination.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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7. Assertion : If two rays start from a point along different paths and then meet again at some point then this point is called real image.

Reason: Convex mirror can never form a real image.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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8. Assertion: Two prisms of different materials can be used to attain a condition of angular dispersion without mean deviation.

Reason: When two prisms of appropriate materials and refracting angles are oppositely directed then mean deviation produced by one can be cancelled by the other due to opposite sense.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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9. Assertion : Concave mirror can produce virtual image of virtual object.

Reason : Convex mirror cannot form image of virtual object.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer: D

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10. Assertion : When object moves in a direction perpendicular to a fixed plane mirror then velocity of image with respect object is double in magnitude to the magnitude of velocity of object.

Reason : Distance of image from the plane mirror is always same as distance of object from the plane mirror.

A. If both assertion and reason are correct and rason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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Objective Type Questions Matching Type Questions

1. Match the quantities given in List-I with the units given in List-II

Match the quantities given in List–I with the units given in List–II

	List–I		List–II
P	First focus of convex lens	1	Light rays converging towards a point on the principal axis become parallel to principal axis after passing lens.
Q	Second focus of convex lens	2	Light rays parallel to principal axis appear to diverge from a point on the principal axis after passing lens.
R	First focus of concave lens	3	Light rays diverging from a point on the principal axis become parallel to principal axis after passing through lens.
S	Second focus of concave lens	4	Light rays parallel to principal axis converge to a point on the principal axis after passing through lens.

A. $\begin{matrix} P & Q & R & S \\ 4 & 3 & 2 & 1 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 3 & 4 & 2 & 1 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 2 & 3 & 1 & 4 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 1 & 2 & 3 & 4 \end{matrix}$

Answer: A

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2. 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.

	List-I	List-II	
P		1	$2r$
Q		2	$r/2$
R		3	$-r$
S		4	r

A. $\begin{matrix} P & Q & R & S \\ 1 & 2 & 3 & 4 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 2 & 4 & 3 & 1 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 4 & 1 & 2 & 3 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 2 & 1 & 3 & 4 \end{matrix}$

Answer: B

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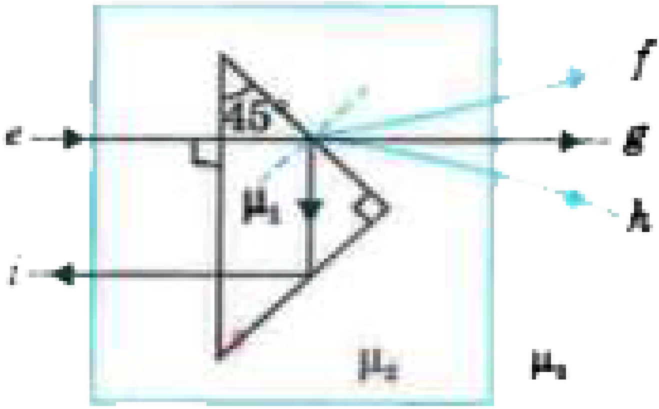
3. A right-angled prism of refractive index μ_1, is placed in a rectangular block of refractive index μ_2, which is surrounded by a medium of refractive index μ_3, as shown in the figure. A ray of light 'e' enters the rectangular block at normal incidence. Depending upon the relationships between μ_1, μ_2 and μ_3, it takes one of the four possible paths $'ef'$, $'eg'$, $'eh'$ or $'ei'$.



Match the paths in List I with conditions of refractive indices in List II and select the correct answer using the codes given below the lists:

	List-I		List-II
P	$e \to f$	1	$\mu_1 > \sqrt{2}\,\mu_2$
Q	$e \to g$	2	$\mu_2 > \mu_1$ and $\mu_2 > \mu_3$
R	$e \to h$	3	$\mu_1 = \mu_2$
S	$e \to i$	4	$\mu_2 < \mu_1 < \sqrt{2}\,\mu_2$ and $\mu_2 > \mu_3$

A. $\begin{array}{cccc} P & Q & R & S \\ 2 & 3 & 1 & 4 \end{array}$

B. $\begin{array}{cccc} P & Q & R & S \\ 1 & 2 & 4 & 3 \end{array}$

C. $\begin{array}{cccc} P & Q & R & S \\ 4 & 1 & 2 & 3 \end{array}$

D. $\begin{matrix} P & Q & R & S \\ 2 & 3 & 4 & 1 \end{matrix}$

Answer: D

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Objective Type Questions Matrix Match Type Questions

1. Match the two columns assuming real objects only.

Column-I		Column-II	
(A)	Convex lens	(p)	Virtual image only
(B)	Concave lens	(q)	Real and virtual image both
(C)	Convex mirror	(r)	Magnification less than one only
(D)	Concave mirror	(s)	Magnification can be less or greater than one.

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Objective Type Questions Integer Type Questions

1. There is a concave mirror of focal length f and an object of length 2.5 cm is placed at a distance 1.5 f from concave mirror. Length of the object is perpendicular to the principal axis. What is the length of image in cm ?

$|0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9|$

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2. When some object is kept at a distances u_1 and u_2 from the concave mirror then size of images are found to be same. If magnitude of focal length can be written as $(u_1 + u_2)/n$, then what will be the value of n ?

$|0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9|$

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3. A layer of oil 3 cm thick is floating on a layer of coloured water 5 cm thick. Refractive index of coloured water is $5/3$ and the apparent depth of the two liquids appears to be $36/7$cm. Find the refractive index of oil.

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4. Magnification of simple microscope is found to be 3 when image is formed at least distance for clear vision. What will be the magnification of simple microscope when final image is formed at infinity ?

$|0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9|$

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5. R is the radius of curvature for both the surfaces of lens shown in figure. Refractive index μ_1, μ_2 and μ_3 are indicated in the figure. Light rays are incident from the side of refractive index μ_1 as shown. If f is focal length of lens then find f/R for $\mu_1 = 1, \mu_2 = 1.5, \mu_3 = 2.$

$|0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9|$

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6. A person wants to use $+20D$ lens as simple microscope. If the person uses $+1.5D$ glasses to have normal vision from 25cm onwards. What maximum magnification can the person achieve if he uses microscope without the glasses ?

$|0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9|$

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7. Sunlight of intensity $1.3 kW m^{-2}$ is incident normally on a thin convex lens of focal length 20 cm. Ignore the energy loss of light due to the lens and assume that the lens aperture size is much smaller than its focal length. The average intensity of light, in kW m^{-2}, at a distance 22 cm from the lens on the other side is ________.

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8. There is a concave mirror of radius of curvature 20cm. A point object is placed at distance 15cm from the mirror. If point object start moving with speed $2 mm / s$ perpendicular to principal axis then at this instant what will be the speed of image in mm / s ?

$$\begin{vmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \end{vmatrix}$$

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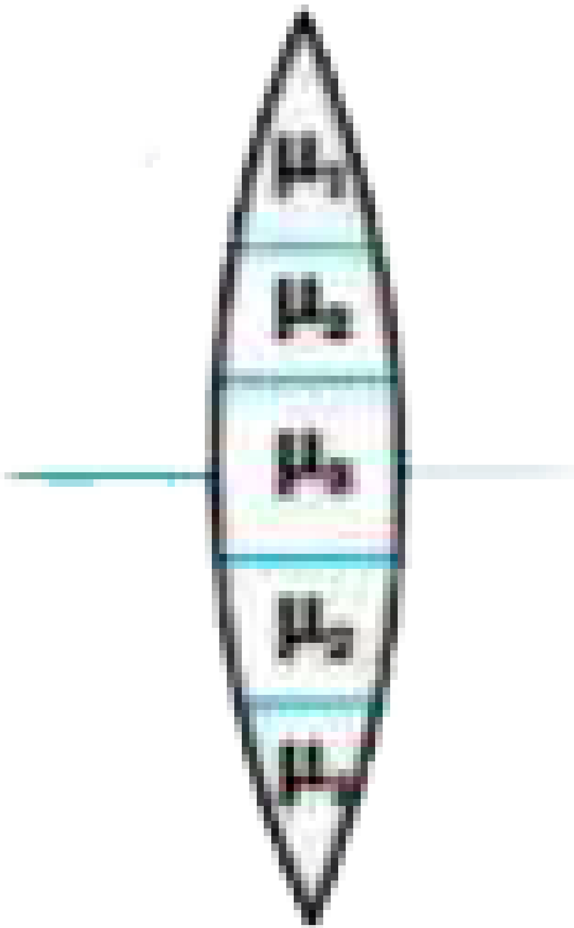
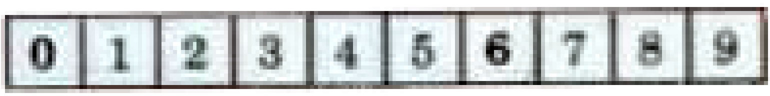
9. A convex lens is made of three different materials which are symmetrically distributed as shown in figure.

If some point object is placed on its principal axis then what will be the number of images formed ?





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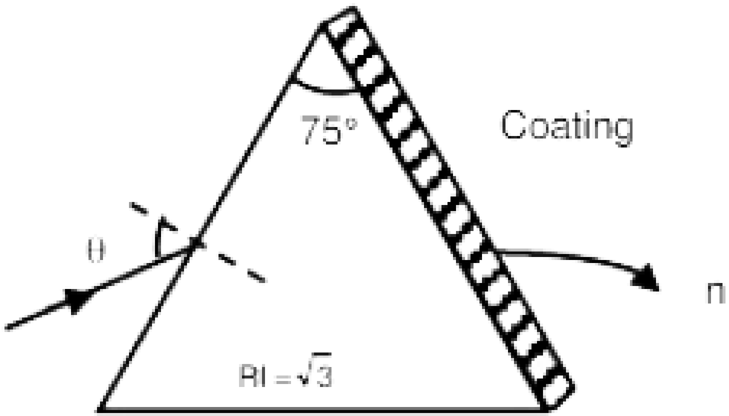
10. A prism is shown in the figure with prism angle 75° and refractive index $\sqrt{3}$. A light ray incidents on a surface at incident angle θ. Other face is coated with a medium of refractive index n. for $\theta \leq 60^\circ$ ray suffers total internal reflection find value of n^2.



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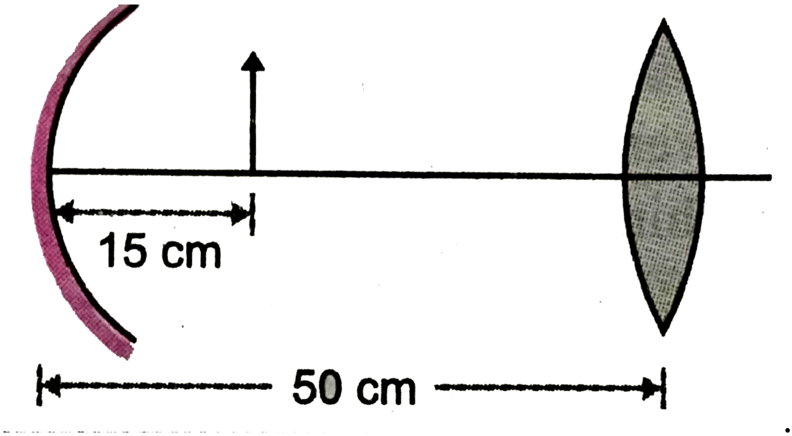
11. Consider a concave mirror and a convex lens (refractive index 1.5) of focal length $10cm$ each separated by a distance of

$50cm$ 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 :



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12. 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.

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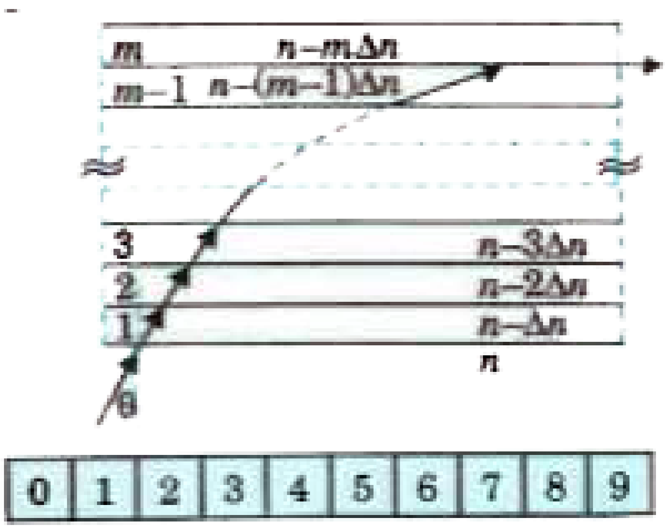
13. A monochromatic light is travelling in a medium of refractive index n = 1.6. It enters a stack of glass layers from the bottom side at an angle $\theta = 30^\circ$. The interfaces of the glass layers are parallel to each other. The refractive indices of different glass layers are monotonically decreasing as $n_m = nm\Delta n$, where n_m is the refractive index of the m^{th} slab and Δn = 0.1 (see the figure). The ray is refracted out parallel to the interface between the $(m-1)^{th}$ and m^{th} slabs from the right side of the stack. What is the value of m ?



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Chapter Practice Test

1. What is the position of the object for which the image formed by a concave mirror is virtual, erect and magnified ?

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2. How will the focal length of a concave mirror change if the wavelength of the light falling on the mirror is made twice ?

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

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

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5. Define inverting prism.

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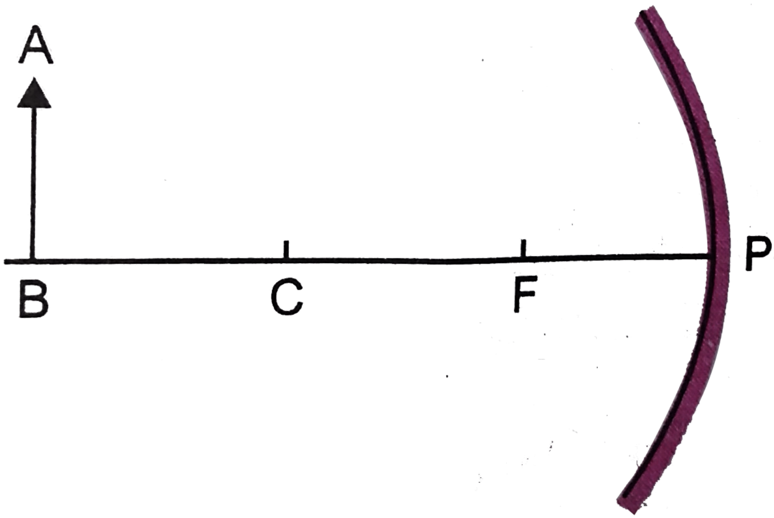
6. An object AB is kept in front of a concave mirror as shown in Fig.



(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 ?

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7. How does angle of deviation vary with the angle of incidence in case of prism ? What is the angle of minimum deviation?

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8. Why does the Sun appear reddish at the time of sunset ?

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9. In an astronomical telescope, the distance between the objective lens and eyepiece is 20 cm. In normal adjustment, the

magnifying power of the telescope is 15. Find the focal length of the objectives lens.

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10. Why the mirrors used in search lights are parabolic, not concave spherical?

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11. Draw a schematic diagram of a single optical fibre structure. Explain briefly how an optical fibre is fabricated. Describe in brief, the mechanism of propagation of light signal through an optical fibre.

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12. What is the difference between the priamry and secondary rainbow? What are the conditions to observe a rainbow?

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13. Explain the phenomenon of refraction through prism. Derive the following relation between refractive index and minimum deviation.

(i) $\angle i + \angle 2 = A + \angle \delta$

(ii) $\mu = \dfrac{\sin(A + \delta_m)/2}{\sin A/2}$

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14. A ray of light passes through an equilateral glass prism in such a manner that the angle of incidence is equal to the angle

of emergence and each of these angles is equal to 3/4 of the angle of the prism. The angle of deviation is

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