PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

GEOMETRICAL OPTICS

Illustration

1. Show that for a light ray incident at an angle i on getting reflected the angle of deviation is $\delta = \pi - 2i$ or $\pi + 2i$.

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2. For a fixed incident light ray, if the mirror be rotated through and angle θ (about an axis which lies in the plane of mirror and perpendicular to the plane of incidence), show that the reflected ray turns through an angle 2θ in same sense.

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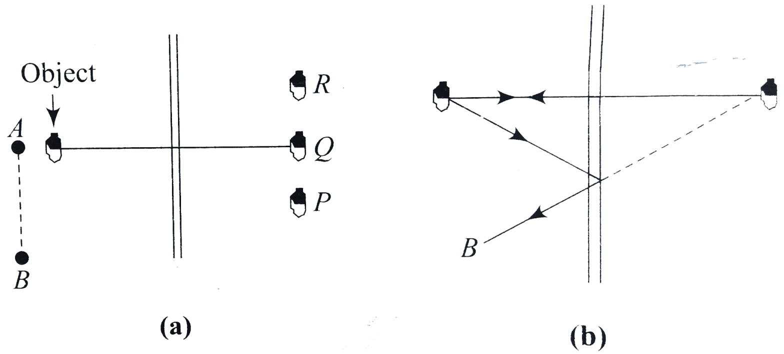
3. Figure. (a)shows an object placed in front of a plane mirror. P,Q and R are the three positions where the image of object may be seen, Observer A is able to see the image at position Q. Where does the observer B see the image of the object?



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4. A light ray is incident on a plane mirror at an angle of 30° with horizontal. At what angle with horizontal must a plane mirror be placed in its path so that it becomes vertically upwards after reflection?

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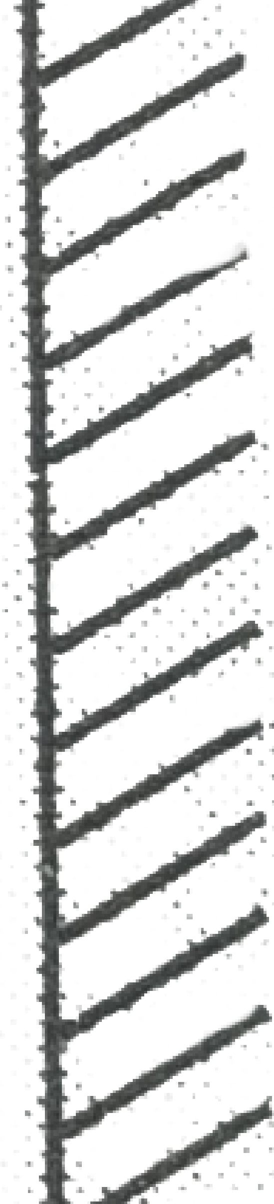
5. Figure. Shows a point object A and a plane mirror MN. Find the position of the image of object A, in mirror MN, by drawing ray diagram. Indicate the region in which the observer's eye must be present in order to view the image. (This region is called field of view.)



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6. A point source of light S, placed at a

distance L in front of the centre of a mirror of width d,

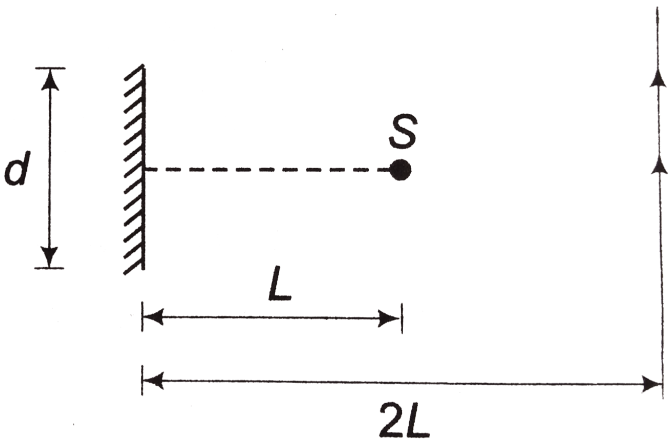
hangs vertically on a wall. A man walks in front of the

mirror along a line parallel to th mirror at a distane

2L form it as shown.The greatest distance over which

he can see the image of the light source in the mirror is

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



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7. Show that the minimum size of a plane mirror required to see the full image of an observer is half the size of that observer.

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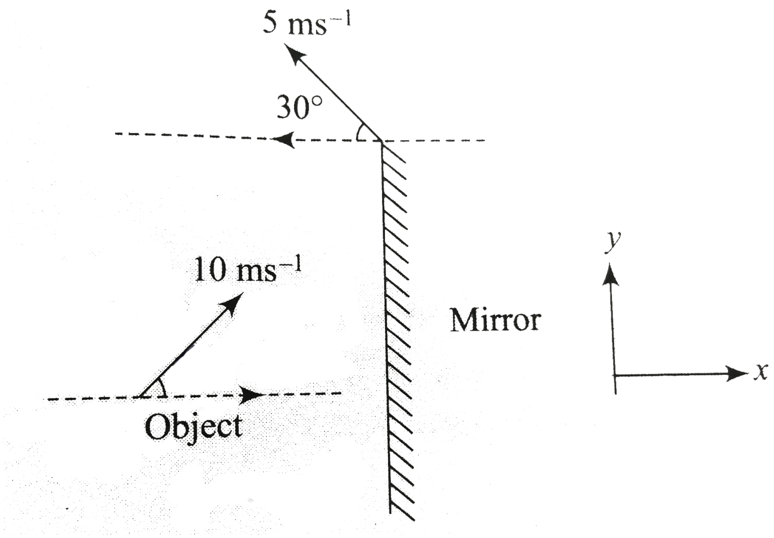
8. Figure shows a plane mirror and an object that are moving towards each other. Find the velocity of image.



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9. Consider two perpendicular mirrors M_1 and M_2 and a point object O. Taking origin at the point of intersection of the mirrros and the coordinates of object as (x,y), find the position and number of images.

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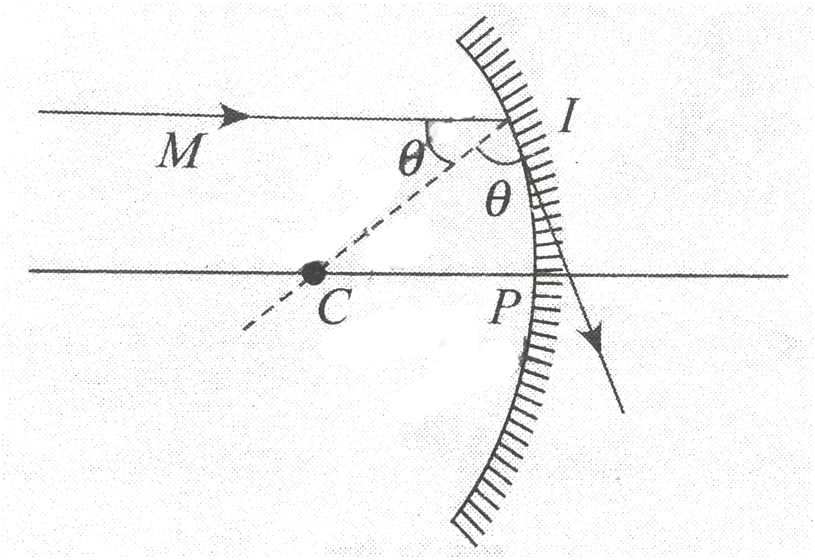
10. Find the angle of incidence of the ray shown in Fig. for which it passes through the pole, given that $MI \mid \mid CP$.



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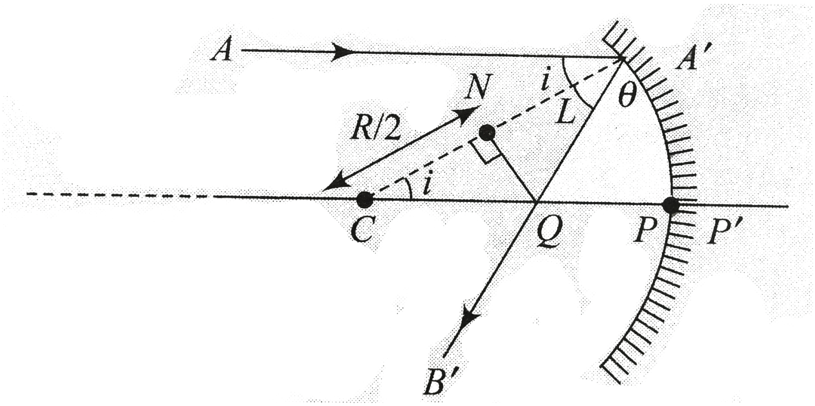
11. Find the distance CQ if incident light ray parallel to principal axis is incident at an angle i. Also, find the distance CQ if $i \to 0$.



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12. Can a convex mirror form a real image! Explain.

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13. An extended object is placed perpendicular to the principal axis of a concave mirror of radius of curvature 20cm at a distance of 15 cm from the pole. Find the lateral magnification produced.

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14. A peson looks into a spherical mirror. The size of image of his face is twice the actual size of his face. If the face is at a distance of 20cm, then find the radius of curvature of the mirror.

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15. An image of a candle on a screen is found to be double its size. When the candle is shifted by a distance of 5cm, then the image becomes triple its size. Find the nature and radius of curvature of the mirror.

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16. A point object is placed 60 cm from the pole of a concave mirror of focal length 10 cm on the principal axis.

Find:

a. the position of image.

b. If the object is shifted 1 mm towards the mirror along principal axis, find the shift in image. Explain the result.

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17. The distance between a real object and its image in a convex mirror of focal length 12cm is 32cm. Find the size of image if the object size if 1cm.

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18. A plane mirror is placed at a distance of 50 cm from a concave mirror of focal length 16 cm. Where should a short object be placed between the mirrors and facing both the mirrors so that its virtual image in the plane mirror coincides with the real image in concave mirror? What is the ratio of the sizes of the two images?

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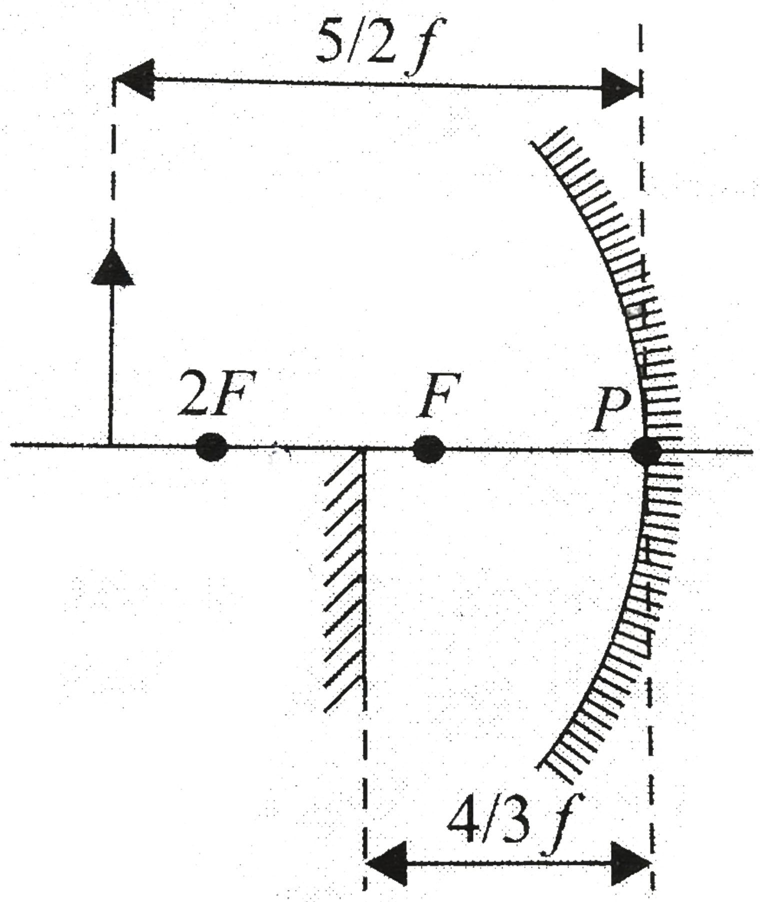
19. Shown in Fig. is a vertically erect object placed on the optic axis at a distance $(5/2)f$ from a concave mirror of focal length f. If a plane mirror is placed perpendicular to the optic axis at a distanc $(4/3)f$ from the pole, facing concave mirror, find the position and nature of the final image formed.



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20. Two concave mirrors are places 40cm apart and are facing each other. A point object lies between them at a distance of 12cm from the mirror of focal length 10cm. The other mirror has a focal length of 15cm. Find the location of final image formed after two reflections - first at the mirror nearer to the object and second at the other mirror.

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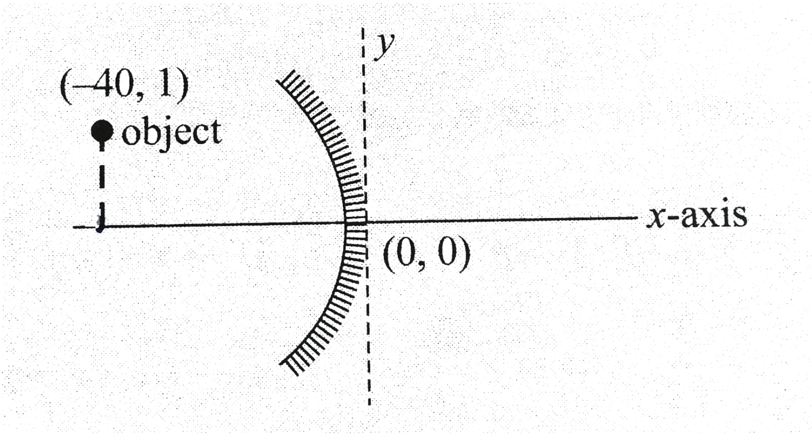
21. Figure shows a shperical concave mirror of focal length f=5cm with its pole at (0,0) and principal axis along x-axis. There is a point object at (-40cm, 1cm), find the postion of image.



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22. A thin rod of length $f/3$ is placed along the optical axis of a concave mirror of focal length f such that its image whichis real and elongated just touches the rod. Calculate the magnification.

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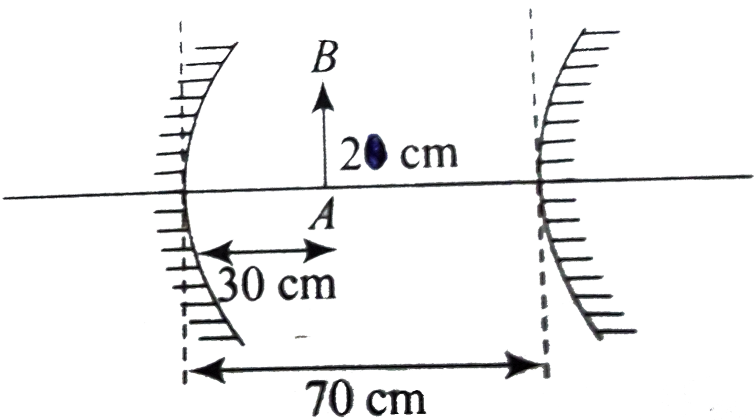
23. A concave mirror and a convex mirror of focal lengths 10cm and 15cm are places at a distance of 70cm. An object AB of height 2cm is places at a distance of 30cm from the concave mirror. First ray is incident on the concave mirror then on the convex mirror. Find size, position, and nature of the image.



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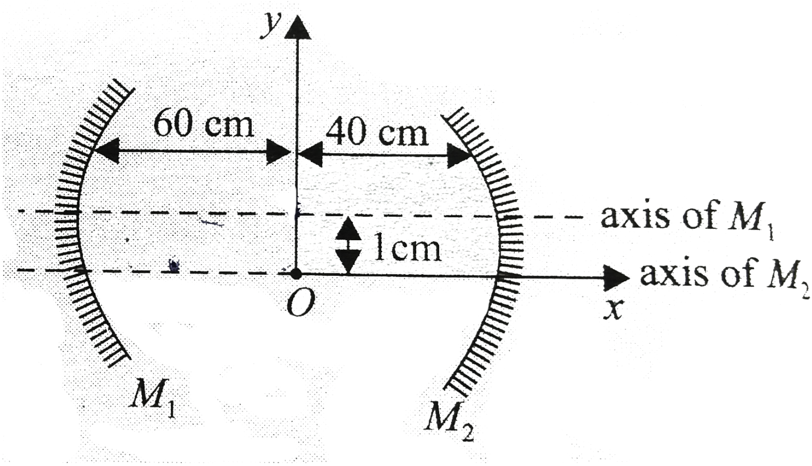
24. Two concave mirrors each of radius of curvature 40cm are placed such that their principla axes are parallel to each other and at a distance of 1cm to each other. Both the mirrors are at a distance of 100cm to each other. Consider first reflection at M_1 and then at M_2 , find the coordinates of teh image thus formed. Take location of object as the origin



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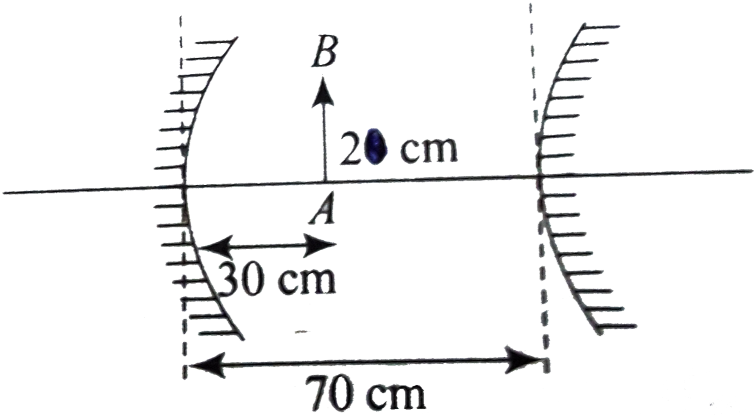
25. A mirror of radius of curvature 20cm and an object which is placed at a distance of 15cm are both moving with velocities $1ms^{-1}$ and $10ms^{-1}$ as shown in Fig. Fing the velocity of image at this situation.



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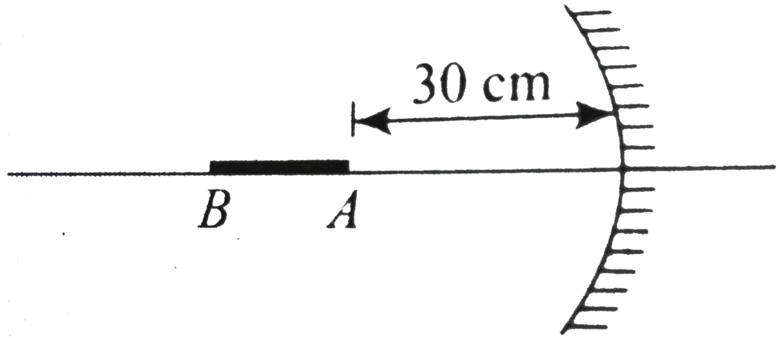
26. Object AB is placed on the axis of a concave mirror of focal length 10cm. End A of the object is at 30cm from the mirror. Find the length of the image

a. if length of object is 5cm.

b. if length of object is 1 mm.



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27. Determing the refractive index of glass with repext to water. Given that $\mu_g = 3/2, \mu_w = 4/3.$

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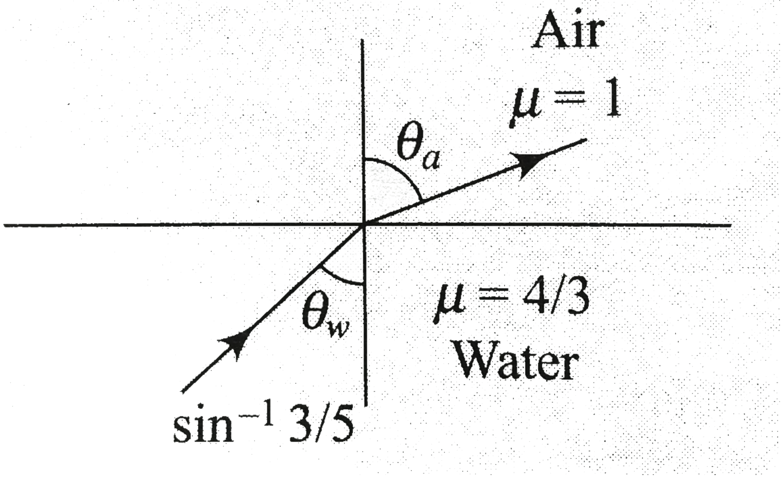
28. Find the angle θ_a made by the light ray when it gets refracted from water to air, as shown in Fig .



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29. Find the speed of light in medium 'a' if speed of light in medium 'b' is $c/3$, where c =speed of light in vacuum and light refracts from medium 'a' to medium 'b' making 45° and 60°, respectively, with the normal.

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30. At what angle of incidence should a light beam strike a glass slab of refractive index $\sqrt{3}$, such that the reflected and the refracted rays are perpendicular to each other ?

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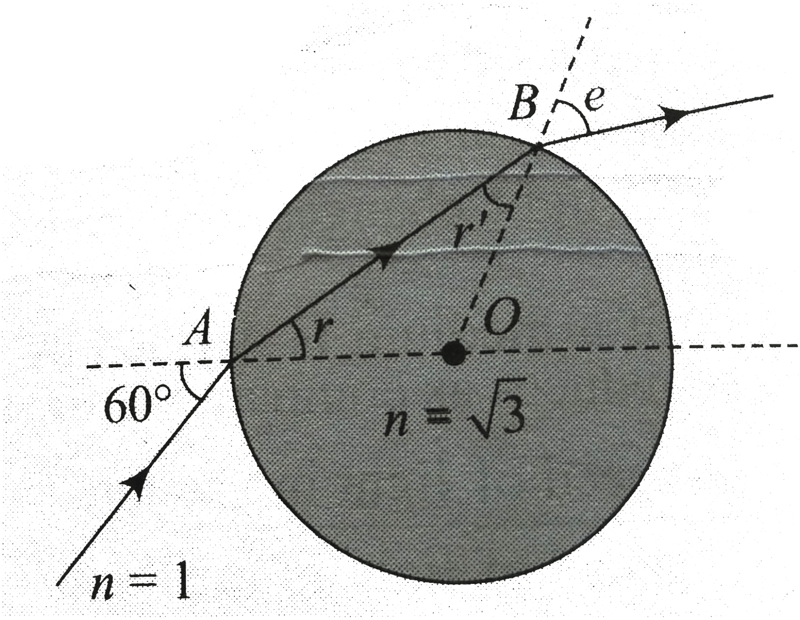
31. A light ray is incident on a glass sphere of reflective index $\mu=\sqrt{3}$ at an angle of incidence 60° as shown in Fig. Find the angles r, r' e and the total deviation after two refractions.



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32. A cylindrical vessel, whose diameter and height both are equal to 30 cm, is placed on a horizontal surface and a small particle P is placed in it at a distance of 5.0 cm from the centre. An eye is placed at a position such that the edge of the bottom is just visible (see figure 18-E8). The particle P is in the plane of drawing. Up to what minimum height should water be poured in the vessel to make the particle P visible ?

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33. 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:

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34. Find the maximum angle of refraction when a light ray is refracted from glass $(\mu = 1.50)$ to air.

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35. Find the angle of refraction in a medium $(\mu = 2)$ if light is incident in vacuum, making an angle equal to twice the critical angle.

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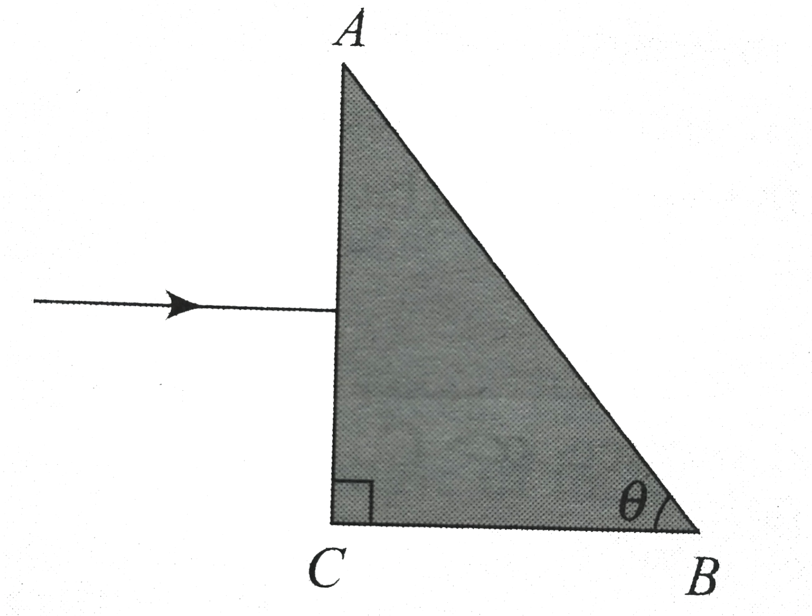
36. What should be the value of angle θ so that light entering normally through the surface AC of a prism $(n = 3/2)$ does not cross the second refracting surface AB?



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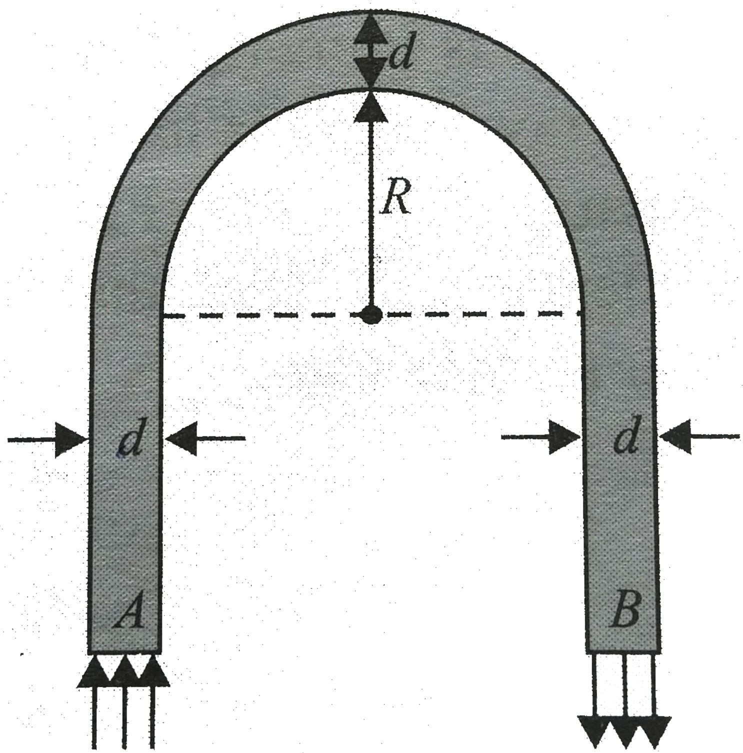
37. A glass rod having square cross-section is bent into the shape as shown in the figure. The radius of the inner semi-circle is R and width of the rod is d. Find the minimum value of d / R so that the light that enters at A will emerge at B. Refractive index of glass is $\mu = 1.5$



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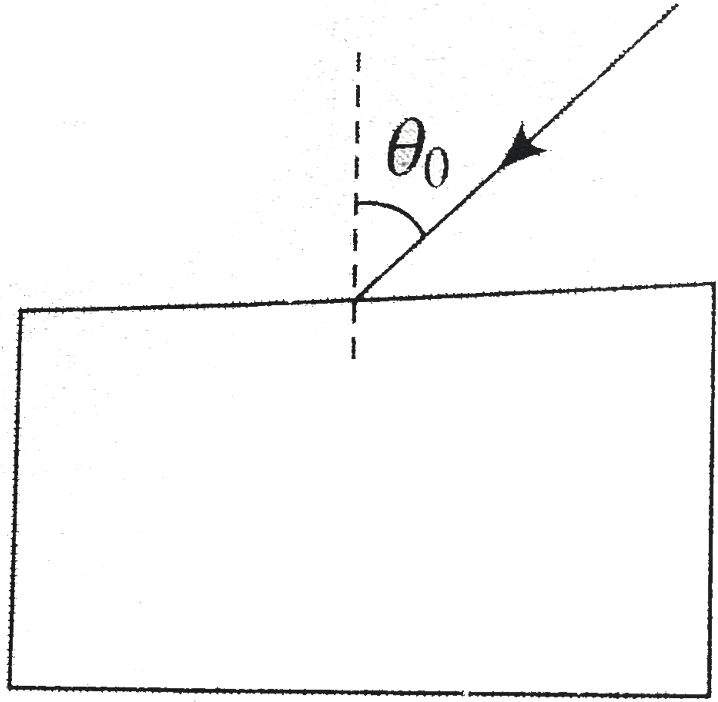
38. A slab of refractive index μ is placed in air and light is incident at maximum angle θ_0 from vertical. Find minimum value of μ for which total internal reflection takes place at the vertical surface.



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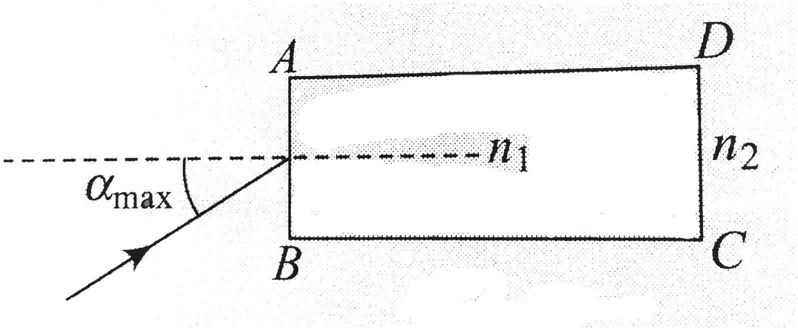
39. A rectangular slab ABCD, of refractive index n_1 , is immersed in water of refractive index $n_2 (n_1 < n_2)$. A ray of light is incident at the surface AB of the slab as shown in Fig. Find the maximum value of angle of incidence $\alpha_{\max}$, such that the ray comes out only from the other surface CD.



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40. A point source of light is placed at a distance h below the surface of a large and deep lake. Show that the fraction f of light that escape directly from water surface is independent of h and is given by

$$f = \frac{\left[1 - \sqrt{1 - 1/\mu^2}\right]}{2}$$

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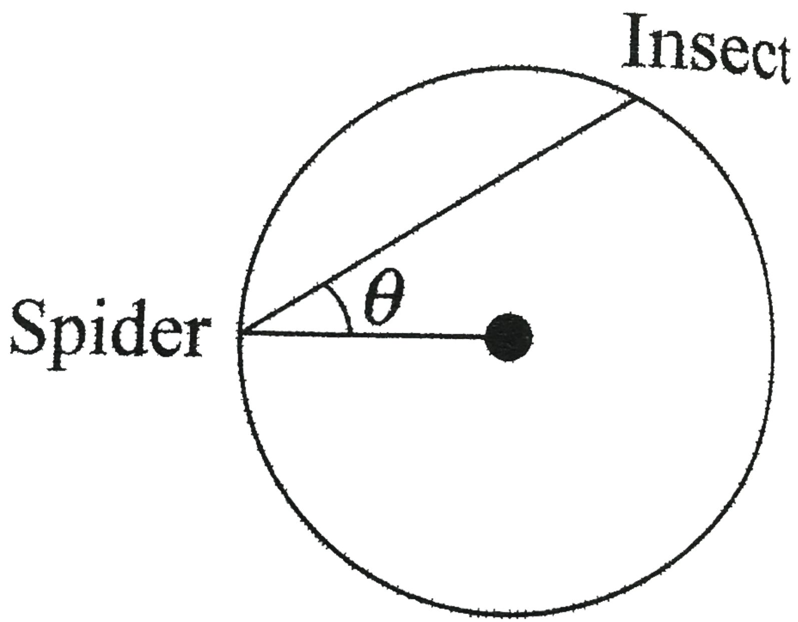
41. A spider is on the surface of a glass sphere with a refractive inndex of 1.5 . An insect crawls on the other side of the sphere as shown in

Fig. For what maximum value of θ will the spider be able to still see the insect. Assume the spiders eye is in air.



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42. Monochromatic light is incident on plane interference AB between two media of refractive indices μ_1 and $\mu_2(\mu_2 > \mu_1)$ at angle of incidence θ as shown in the figure.

The angle θ is infinitesimally greater than the critical angle for the two media so that total internal reflection takes places. Now if a transparent slab DEFG of uniform thickness and of refractive index μ_3 is introduced on the interface (as shown in the figure), show that for any value of μ_3 all light will ultimately be reflected back again into medium II. Consider separately the cases.

(a) $\mu_3 < \mu_1$, (b) $\mu_3 > \mu_1$

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43. An object lies 100 cm inside water $(\mu = 4/3)$. It is viewed from air nearly normally. Find the apparent depth of the object.

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44. See Fig. and answer the following question.

a. Find apparent height of the bird.

b. Find apparent depth of the fish.

c. At what distance will the bird appear to the fish ?

d. At what distance will the fish appear to the bird?

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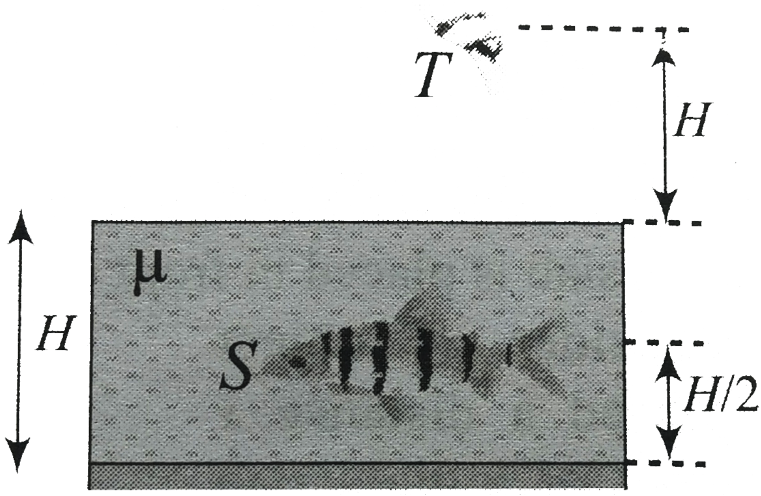
45. Consider the situation in Fig. The bottom of the pot is a reflecting plane mirror, S is a small fish, and T is a human eye. Refractive index of water is μ.

a. At what distance(s) from itself will the fish see the image(s) of the eye?

b. At what distance(s) from itself will the eye see the image(s) of the fish?



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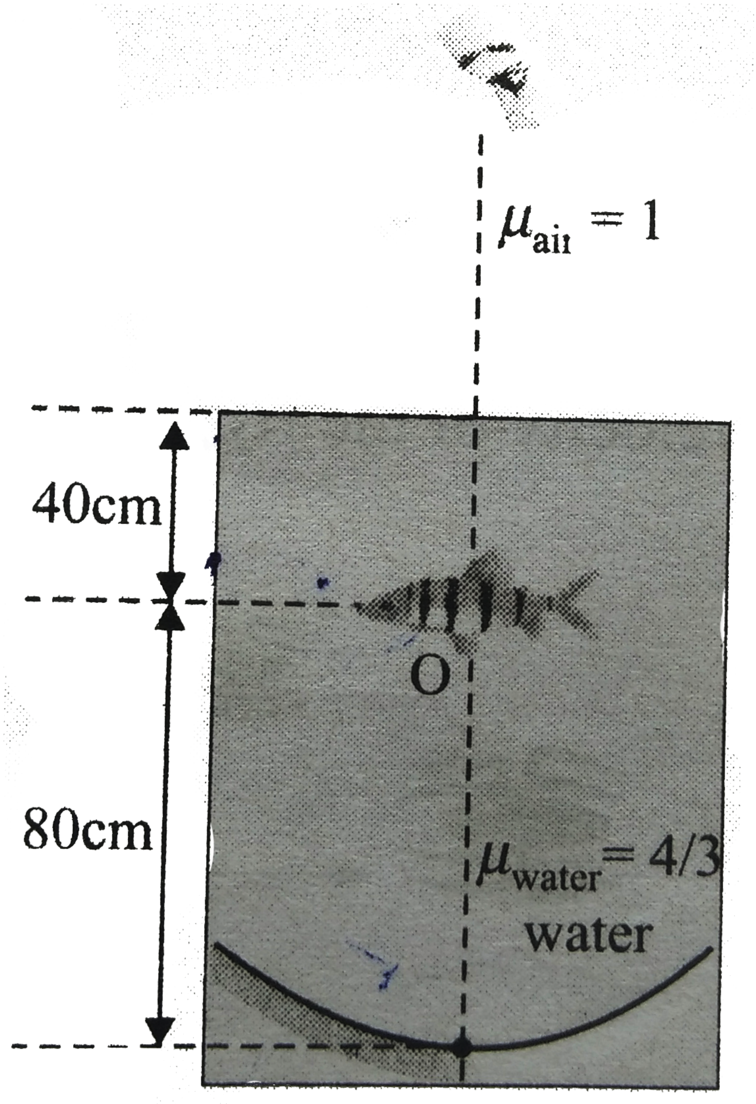
46. Consider the situation skteched. A fish lies 40 cm under the surface of water $(\mu_{water} = 4/3)$, 80 cm above a concave spherical mirro whose radius of curvature is 120cm. An observer looking down from above in the air $(\mu_{air} = 1)$ sees two images of fish. Find distance (in meters) between these two images.



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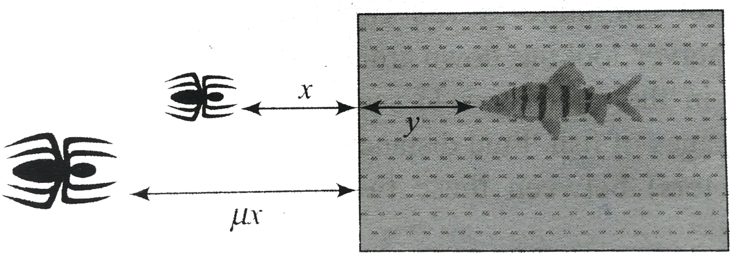
47. A fish in an aquarium approaches the left wall at a rate of $3ms^{-1}$ observes a fly approaching it at $8ms^{-1}$. If the refractive index of water is $(4/3)$, find the actual velocity of the fly.



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48. Find the lateral shift of a light ray while it passws through a parallel glass slab of thickness 10 cm places in air. The angle of incidence in air is 60° and the angle of refraction in glass is 45°.

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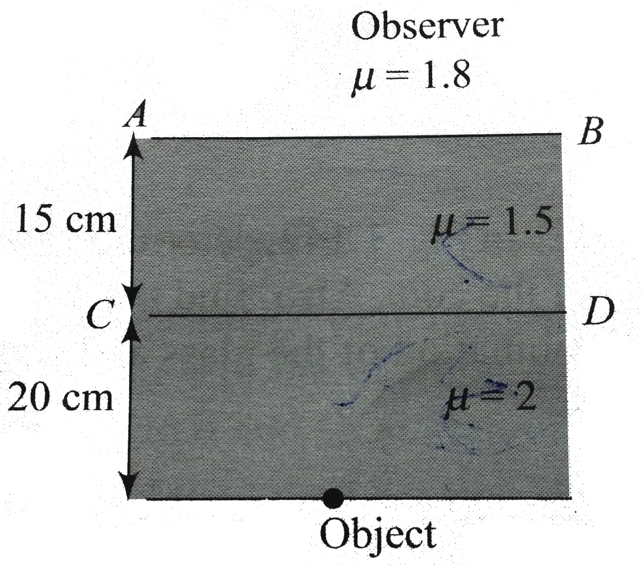
49. In Fig. , find the apparent depth of the object seen below surface AB.



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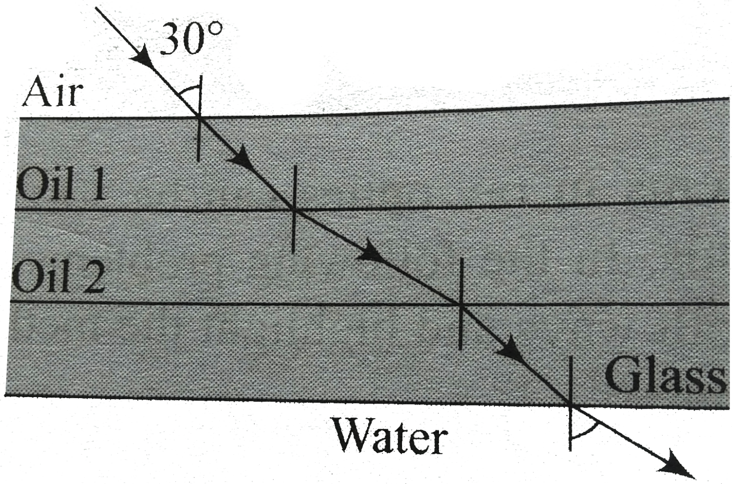
50. Light is incident from air on an oil layer at an incident angle of 30°. After moving through the oil 1, oil 2, and glass it enters water. If the refraction index of glass and water are 1.5 and 1.3, respectively. Find the angle which the ray makes with the normal in water.



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51. 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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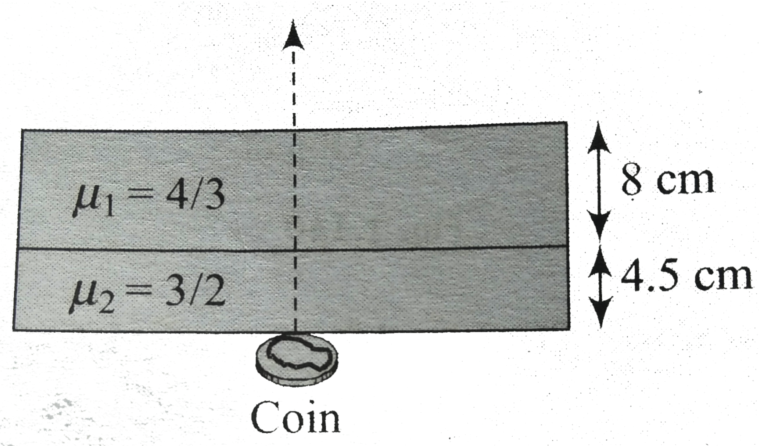
52. In Fig., determine the apparent shift in the position of the coin. Also, find the effective refractive index of the combinatino of the glass and water slab.



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53. A small object is placed 20 cm in front of a block of glass 10 cm thick and its farther side silvered. The image is formed 22 cm behind the silvered face. Find the refractive index of glass.

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54. A $20cm$ thick glass slab of refractive index 1.5 is kept in front of a plane mirror. Find the position of the image (relative to mirror) as seen by an observer through the glass slab when a point object is kept in air at a distance of $40cm$ from the mirror.

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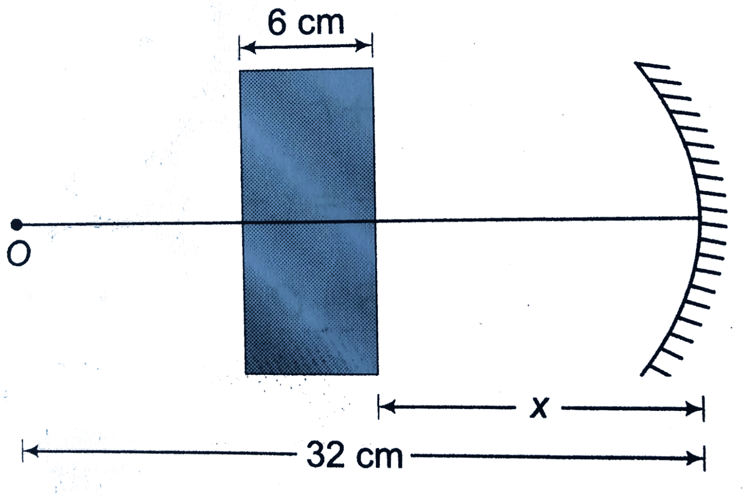
55. A point object O is placed in front of a concave mirror of focal length $10cm$. A glass slab of refractive index $\mu = \frac{3}{2}$ and thickness $6cm$ is

inserted between object and mirror. Find the position of final image when the

distance x shown in figure is



(a) $5cm$, (b) $20cm$

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56. A vessel having perfectly reflecting plane botton is filled with water $(\mu = 4/3)$ to depth d. A point source of light is placed at a height h above the surface of water. Find the distance of final image from water surface.

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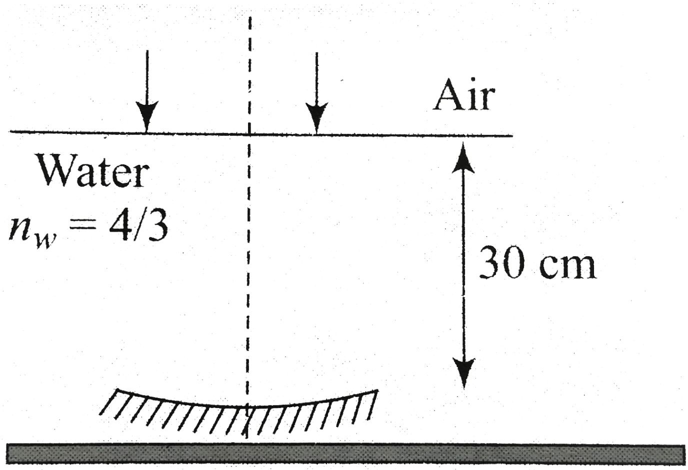
57. A concave mirror of focal length $20 cm$ is placed inside water with its shining surface upwards and principla axis vertical as shown in Fig. Rays are incident parallel to the principa, axis of concave mirror. Find the position of final image.



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58. A ray of light is incident on a glass slab at grazing incidence. The refractive index of the material of the slab is given by $\mu = \sqrt{(1+y)}$. If the thickness of the slab is $d = 2m$, determing the equation of the trajectory of the ray inside the slab and the coordinates of the point where the ray exits from the slab. Take the origin to be at the point of entry of the ray.

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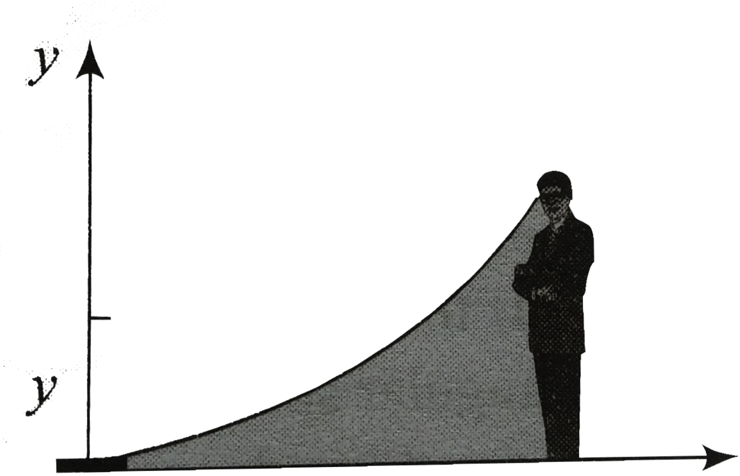
59. Due to a vertical temperature gradient in the atmosphere, the index of refraction varies. Suppose index of refraction varies as $n = n_0 \sqrt{1 + ay}$, where n_0 is the index of refraction at the surface and $a = 2.0 \times 10^{-6} m^{-1}$. A person of height $h = 2.0m$ stands on a level surface. Beyond what distance will he not see the runway?



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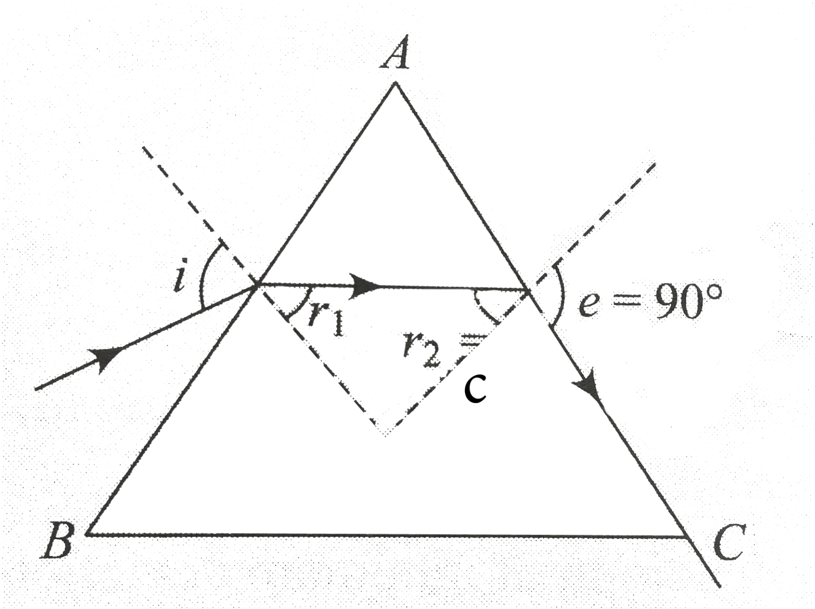
60. What should be the minimum value of refractive index of a prism, refracting angle A, so that there is no emergent ray irrespective of the angle of incidence?



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61. An isosceles prism has one of the refracting surfaces silvered. A ray of light is incident normally on the refracting face AB. After two reflections, the ray emerges from the base of the prism perpendicular to it. Find the angle of the prism.

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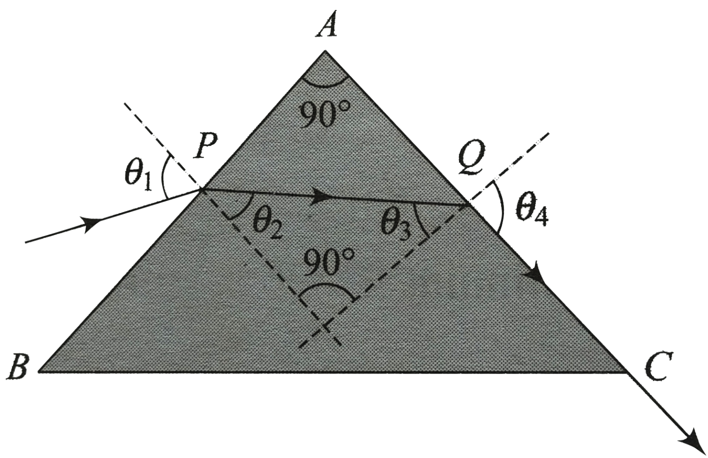
62. Figure.. Shows a triangular prism of refracting angle 90° . A ray of light incident at face AB at an angle θ_1, refracts at point Q with an angle of refraction 90°.

a. What is the regractive index of the prism in terms of θ_1?

b. What is the maximum value that the refractive inde can have?

c. What happens to the light at Q if the incident angle at Q is (i) increased slightly, and (ii) decrease slightly?



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63. A prism has refracting angle equal to $\pi/2$. It is given that γ is the angle of minimum deviation and β is the deviation of the ray entering at grazing incidence. Prove that $\sin\gamma = \sin^2\beta$.

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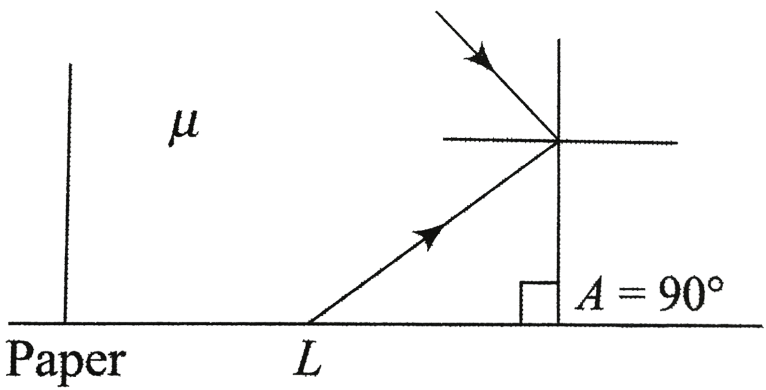
64. A rectangulat block of refractive index μ is placed on a printed page lying on a horizontal surface as shown in Fig. , Find the minimum value of μ so that the letter L on the page is not visible from any of the vertical sides.



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65. The cross section of a glass prism has the form of an isosceles triangle. One of th erefracting faces is silvered. A ray of light falling normally on the other refracting face, being reflected twice, emerges through the base of the prism perpendicular to it. Find the angles of the prism.

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66. For a prism, $A = 60^\circ, n = \sqrt{7/3}$. Find the minimum possible angle of incidence, so that the light ray is refracted from the second surface. Also, find $\delta_{\max}$.

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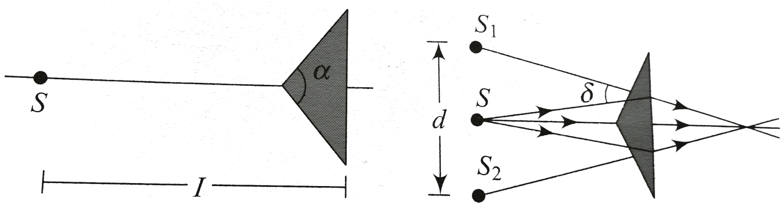
67. A thin biprism (see Fig..) of obtuse angle $\alpha = 178^\circ$ is places at a distance $l = 20cm$ from a slit. How many images are formed and what is the separation between them? Refrative index of the material $\mu = 1.6$.



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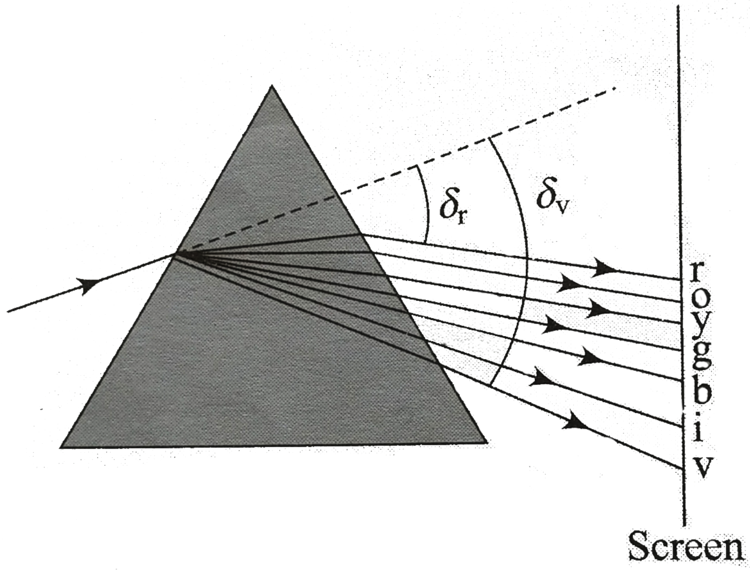
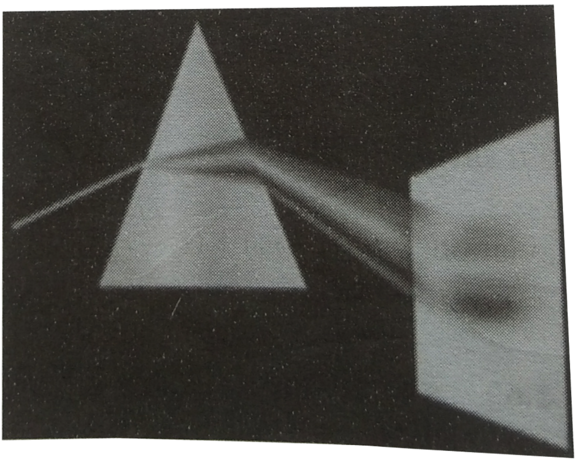
68. A thin prism of angle $A = 6^\circ$ produces a deviation $d = 3^\circ$. Find the refractive index of the material of prism.





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69. Calcualte the dispersive power for crown glass from the given data

$\mu_v = 1.523$ and $\mu_R = 1.5145$

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70. Find the dispersion produced by a thin prism of 18° having refractive index for red ligh $= 1.56$ and for violet light $= 1.68.$

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71. Two thin prisms are combined to form an achromatic combination. For prism I, $A = 4^\circ$, $\mu_R = 1.35$, $\mu_Y = 1.40$, $\mu_v = 1.42$ For prism II, $\mu'_R = 1.7$, $\mu'_Y = 1.8$ and $\mu'_V = 1.9$. Find the prism angle of prism II and the net mean deviation.

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72. A crown glass prism of angle 5° is to be combined with a flint prism in such a way that the mean ray passes undeviated. Find (a) the angle of the flint glass prism needed and (b) the angular dispersion produced by the combinatino when white light goes through it. Refractive indices for red, yellow, and violet light are 1.541, 1.517 and 1.523, repectively, for crown flass and 1.613, 1.620 and 1.632 for flint glass.

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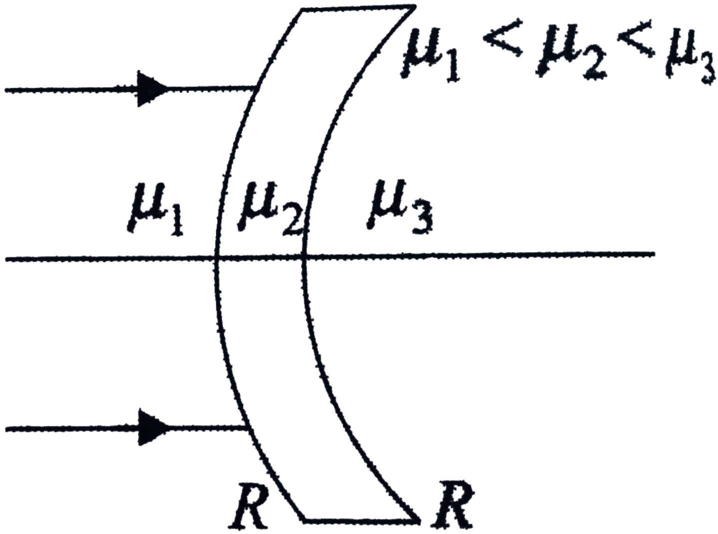
73. Find the focal length of the lens shown in Fig . The radii of curvature of both the surfaces are equal to R.



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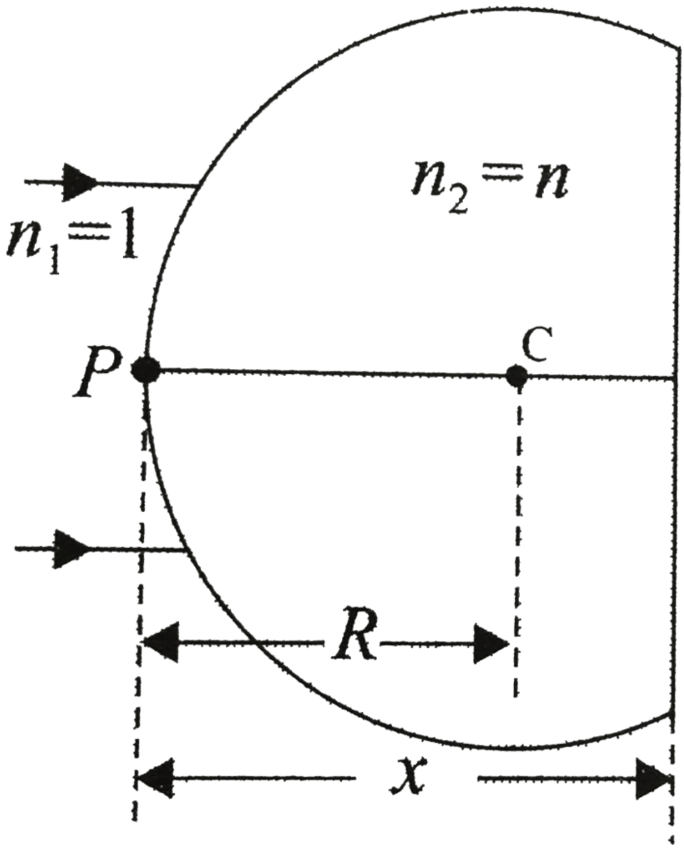
74. Shown in the Fig. is a shperical surface of radius of curvature R and R.I. $(= n) 1.5$. Find the distance of the silvering of the plane surface so as to form an image at the pole due to a very far object.



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75. A ring of radius 1cm is placed 1m in front of a spherical glass ball of radius 25cm with refractive index 1.50. Determing the positiion of the final image of the ring and its magnification.

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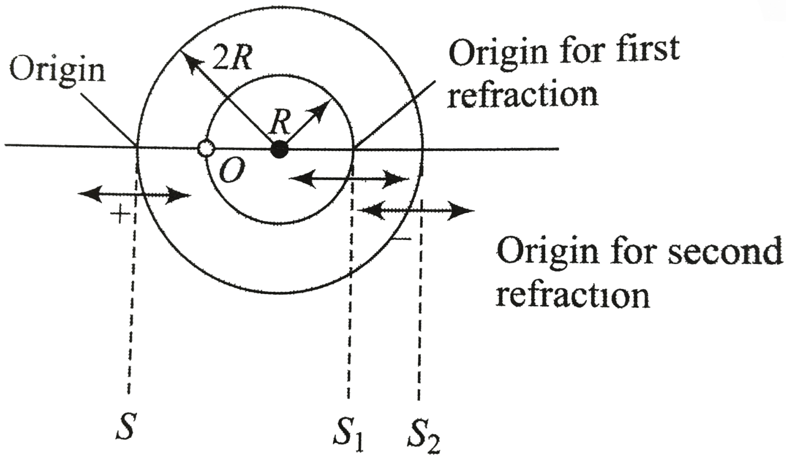
76. A glass shere of radius 2R, refractive index n has a spherical cavity of radius R, concentric with it. A black spot on the inner surface of the hollow sphere is viewed from the left as well as right. Obtain the shift in position of the object.



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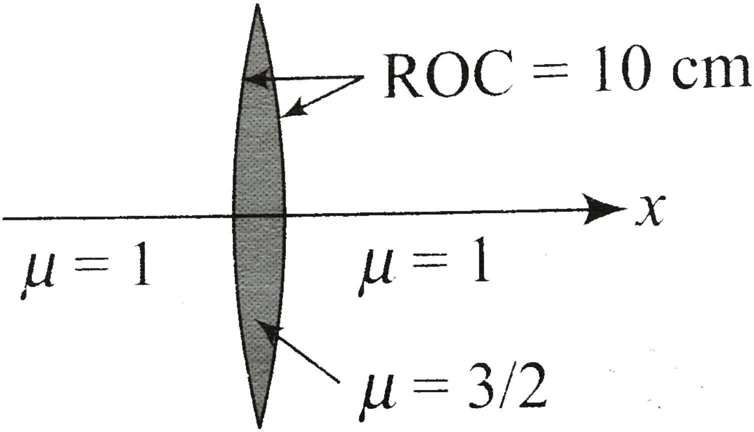
77. Find the focal length of the lens shown in the Fig..



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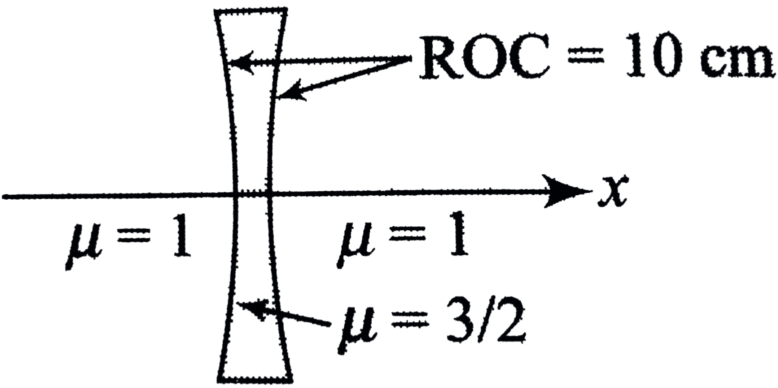
78. Find the focal length of the lens shown in Fig.



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79. A point object is places on the principal axis of a thin lens with parallel curved boundaries, i.e., having same radii of curvature. Discuss about the position of the image formed.

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80. Focal length of a thin lens in air is 10cm. Now, medium on one side of the lens is replaced by a medium of refractive inidex $\mu = 2$. The radius of curvature of the surface of lens, in contact with the medium, is 20cm. Find the new focal length.

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81. A glass or glycerin convex lens of refractive index $3/2$ has got a focal length equal to 50 cm. Find the focal length of the lens, if it is immersed in ethyl alcohol of refractive index 1.36.

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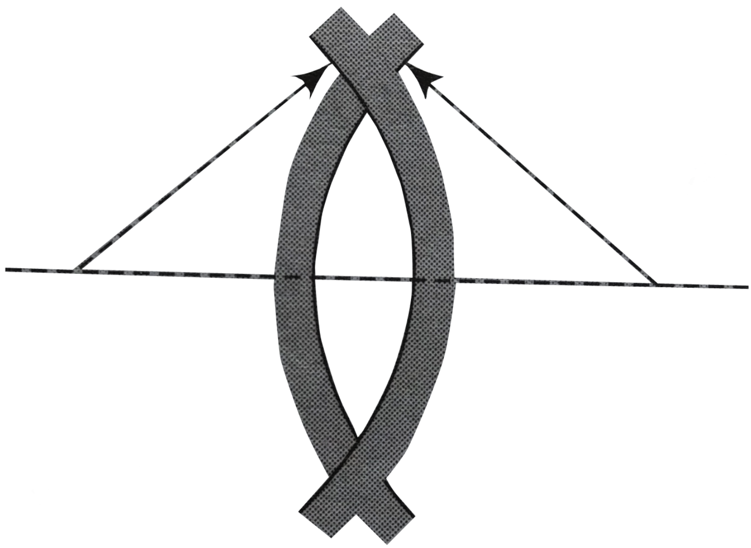
82. There are two spherical surfaces of radii $R_1 = 30cm$ and $R_2 = 60cm$. In how many ways these surfaces may be arranged to get different lenses. If all the lenses are made of glass $(\mu = 1.5)$, find the focal length of each lens.



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83. A thin lens made of a material of refractive index μ_0 has a focal length f_0 in air. Find the focal length of this lens if it is immersed in a liquid of refractive index μ.

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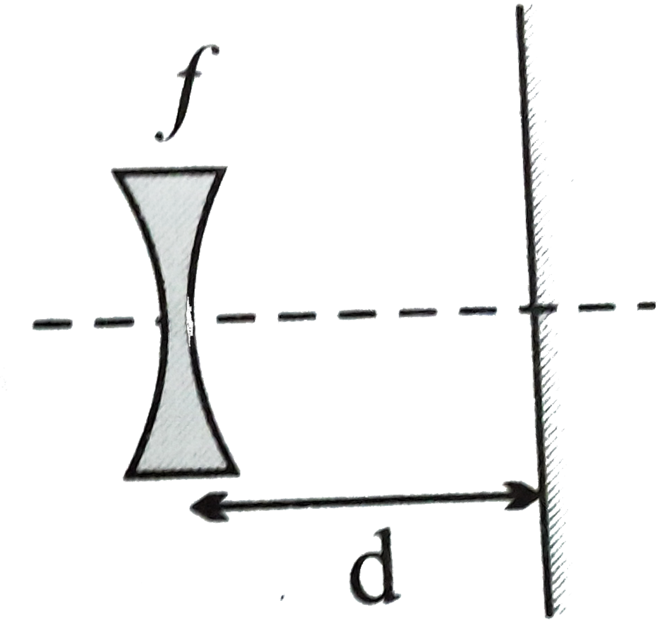
84. A diverging lens of focal length 10cm is placed 10cm away in front of a plane mirror as shwon in figure. Light from a very far away source falls on the lens. An observer is situated some where in between lens and mirror, and observer is looking towards mirror. The observer will see the image behind teh mirror at a distance.



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85. An object is placed at a distance of 15 cm from a convex lens of focal length 10 cm. On the other side of the lens, a convex mirror is placed at its focus such that the image formed by the combination coincides with the object itself. The focal length of the convex mirror is

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86. A point source of light is placed 60 cm away from screen. Intensity detected at point P is I . Now a diverging lens of focal length 20cm is placed 20cm away from S between S and P. The lens transmits 75% of light incident on it. Find the new value intensity at P.

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87. A point source of light S is placed on the axis of a lens of focal length 20cm at a distance 25cm from lense. A screen is placed normal to the axis of lens at a distance x from it (treat all rays as paraxial). Identify the true or false statements.

a. As x is increased from zero , intensity continuously decreases.

b. As x is increased from zero, intensity first increases then decreases.

c. Intensity at center of screen for $x=90cm$ and $x=110cm$ is same.

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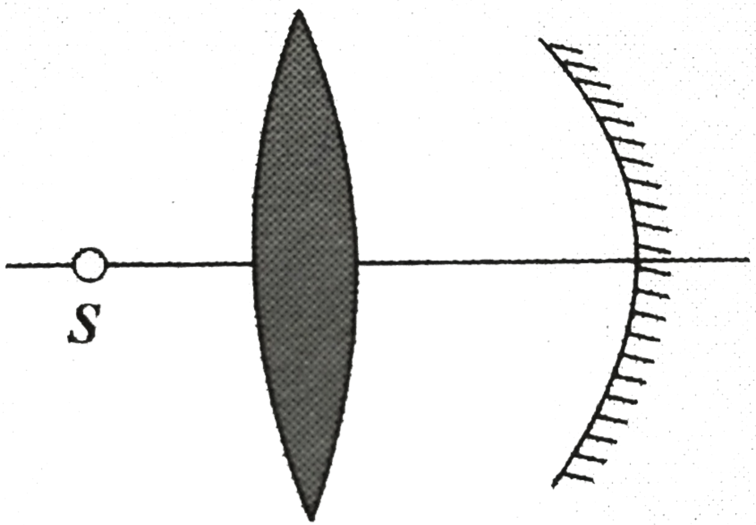
88. A converging lens and a converging mirror are placed with their principal axis coinciding. Their separation equals 40cm. A point source S is placed on the principal axis at a distance of 12 cm from the lens as shown in Fig. It is found that the final beam comes out parallel to the principal axis. Focal length of the lens equals 15 cm. Find the focal length of the mirror.



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89. A thin bi-convex lens made up of glass of refractive index $3/2$ is placed is front of a plane mirror. The space between the lens and the mirror is filled with water of refractive index $4/3$. The radii of curvatures of the lens are $R_1 = 15cm$ and $R_2 = 25cm$. A point object is placed at distance x from the surface whose curvature is R_1. The distance x is greater than the separation between the lens and the mirror. Find the value of x so that image must coincide with the object.

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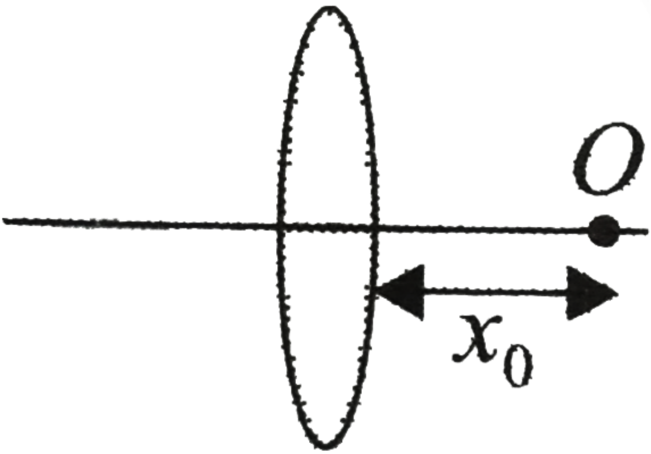
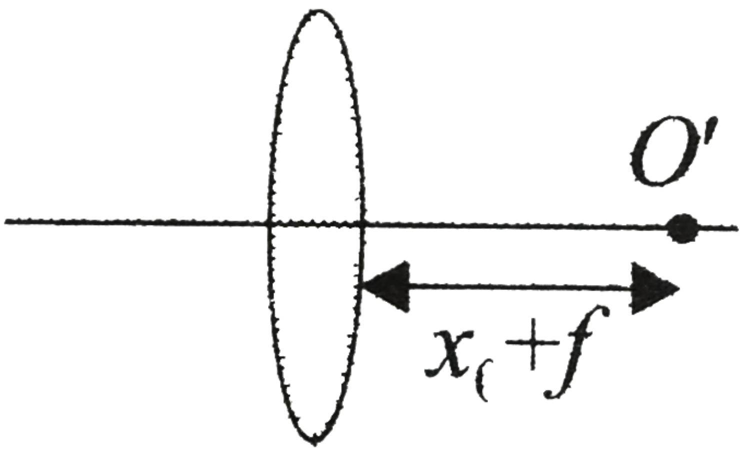
90. A convex lens is held directly above a con lying on a table and forms an image of it. After the lens has been moved vertically a distance equal to its focal length, it forms another image of the coin equal in size with the previous image. If the diameter of the coin is 16 mm, what is the diameter in milimeters of the image?



(a)



(b)

91. A lens has a power of ± 5 diopeters in air. What will be its power if completely immersed in water? $\left(\cdot_{a}\mu_{w}=4/3 \text{ and } {}_{a}\mu_{g}=3/2\right)$

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92. (a) A screen is kept at a distance of 1m from the object. A converging lens between the object and the screen, when placed at any of the two positions which are 60cm apart, forms a sharp image of the object on the screen. Find the focal length of the lens.

(b) In the two positions of the lens, lateral size of the image is 4cm and 9cm. Find the size of the object.

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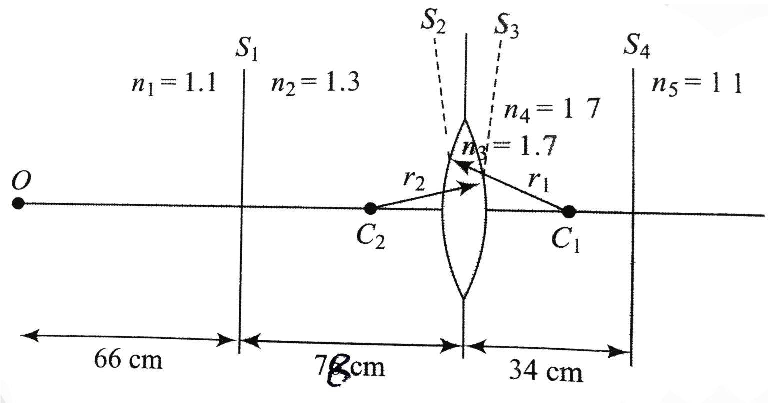
93. A biconvex lens separates two media of refractive indices 1.3 and 1.7. the refractive index of the lens is 1.5 and the radii of curvature of the two sides of the lens are $r_1 = 10cm$ and $r_2 = 60cm$.

The medium of refractive index 1.3 extends to 78 cm from the lens and that of refractive index 1.7 extends of 34 cm from the lens. A luminous object O is at a distance of 144 cm from the lens. Find the position of the final image from the lens.



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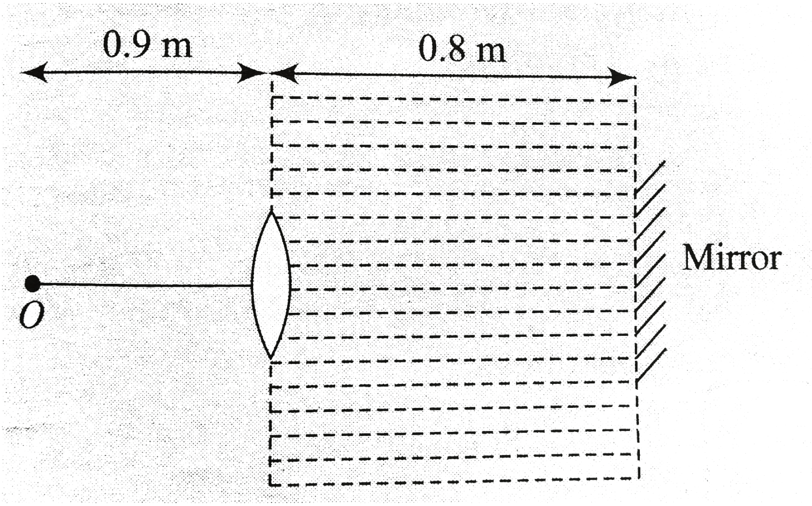
94. A thin equiconvex lens made of glass of refractive index $3/2$ and of focal length $0.3m$ in air is sealed into an opening at one end of a tank filled with water $\left(\mu = \frac{3}{2}\right)$. On the opposite side of the lens, a mirror is placed inside the tank on the tank wall perpendicular to the lens axis as shown in Figure. The separation between the lens and mirror is

$0.8m$. A small object is placed outside the tank in front of the lens at a distance oa $0.9m$ from the lens along its axis. Find the position (relative to lens) of the image of the object formed by the system.



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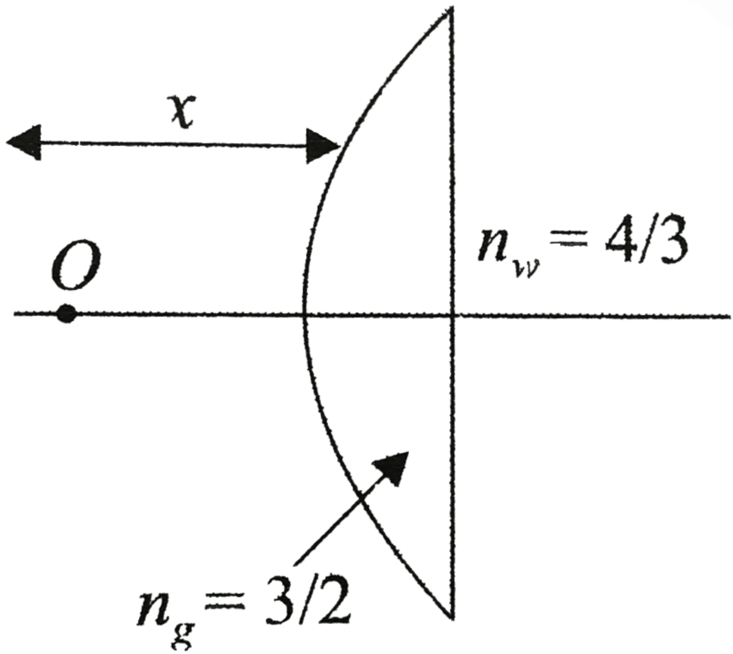
95. Object O is kept in air in fron of a thin plano convex lens of radius of curvature 10cm. It's refractive index is $3/2$ and the medium toward right of plane surface is water of refractive indec $4/3$. What should be the distance x of the object so that the rays become parrallel finall?



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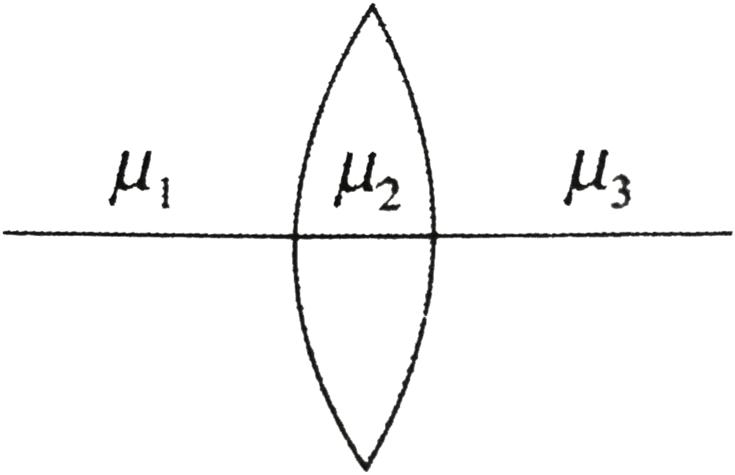
96. The diagram shows an equiconvex lens. What should be the condition on the refractive indices so that the lens becomes diverging?



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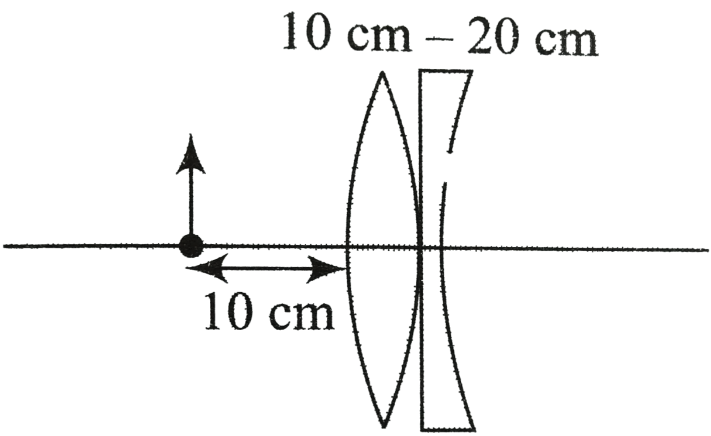
97. Find the lateral magnification produced by the combination of lenses shown in Figure.



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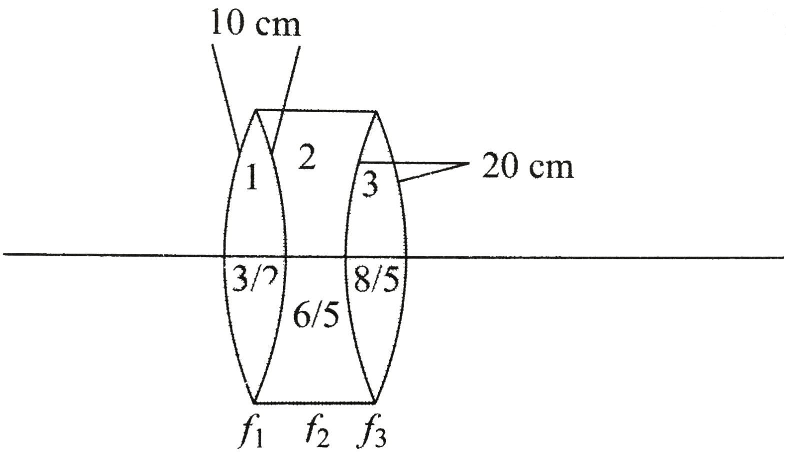
98. Find the focal length of equivalent system shown in Figure.



99. Two convex lenses f focal length 20 cm each are placed coaxially with a separation of 60 cm between them. find the image of a distance object formed by the combination by a. using thin les formula separately for the two lenses and b. using the equivalent lens. Note that although the combination forms a real image of as distance

object on the other side, it is equivalent to as diverging lens as far as the locatiion of the final image is concerned.

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100. Consider a coaxial system of two thin convex lenses of focal length f each separated by a distance d. Draw ray diagrams for image formation corresponding to an object at infinity placed on the principal axis in the following cases: (a) $d < f$,(b)$d = f$, (c) $f < d < 2f$, (d) $d = 2f$, and (e) $d > 2f$. Indicate the nature of the combination (concave, convex or plane) in each case.

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101. An object is placed at a distance of 10cm to the left on the axis of convex lens A of focal length 20cm. A second convex lens of focal length 10cm is placed coaxially to the right of the lens A at a distance of 5cm from A. Find the position of the final image and its magnification. Trace the path of the rays.

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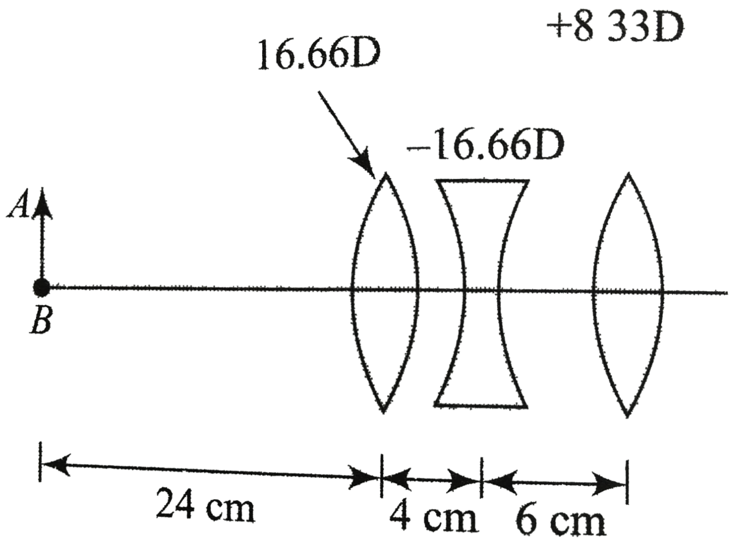
102. In Figure. , the length of object AB is 9cm. Find the nature and position of the final image and also its length. Assum that each lens is a thin lens.



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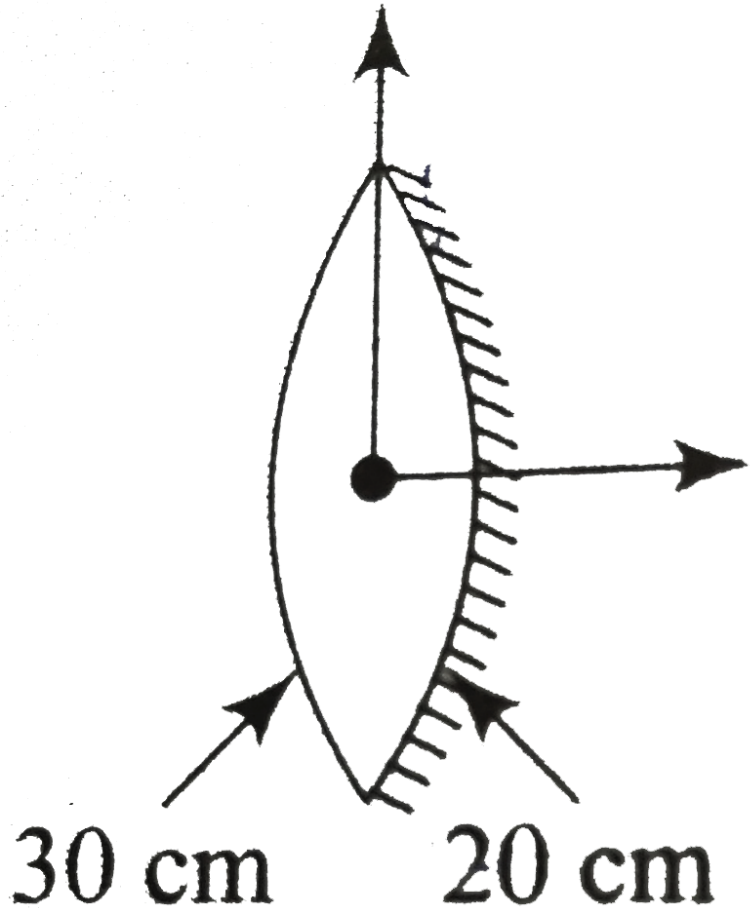
103. A biconvex lens is made of glass with refractive index 1.5 and has radii of curvature 20 cm and 30 cm. If the 20 cm surface is silvered, what is the effective focal length of the mirror formed?



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104. The redius of curvature of the convex face of a plano-convex lens is 12cm and its refractive index is 1.5.

a. Find the focal length of this lens. The plane surface of the lens is now silvered.

b. At what distance form the lans will parallel rays incident on the convex face converge?

c. Sketch the ray diagram to locate the image, when a point object is places on the axis 20cm from the lens.

d. Calculate the image distance when the object is placed as in (c).

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105. An object in placed 30cm in front of a concave lens that is made of a glass of refractive index 1.5 and has equal radii of curvature of its two surfaces, each 30 cm. The surface of the lens farther away from the object is silvered. Find the nature and position of the final image.

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106. One face of an equiconvex lens of focal length 60cm made of glass $(\mu = 1.5)$ is silvered. Does it behave like a convex mirror or concave mirror? Determine its focal length.

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107. A glass slab of thickness 3cm and refractive index 1.5 is placed in front of a concave mirror of focal length 20cm. Where should a point object be placed if it is to image on to itself?

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108. A convex lens of focal length 20cm is placed 10cm in front of a convex mirror or radius of curvature 15cm. Where should a point object be placed in front of the lens so that it images on to itself?

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109. A glass slab of thickness 2cm and refractive index 2 is placed in contact with a biconvex lens of focal length 20cm. The refractive index of the material of the lens 1.5 . The far side of the lens is silvered. Where should an object be placed in front of the slab so that it images on to itself?

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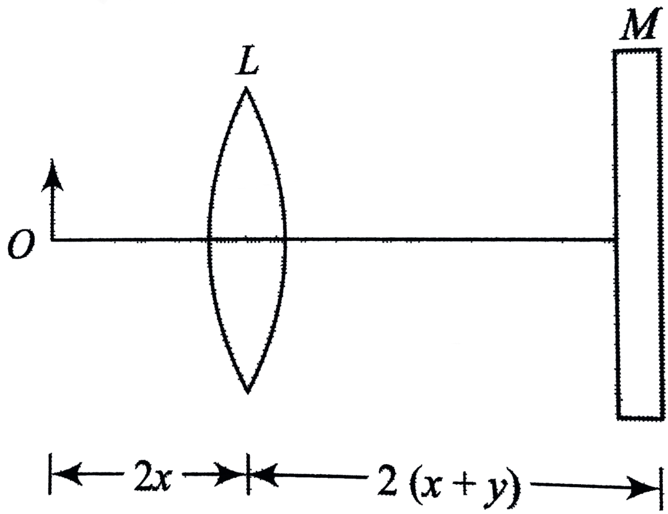
110. L is a lens such that a parallel beam of light I ncident on it, after refraction, converges to a point at a distance x from it and M is a mirror such that a parallel lbeam of light incident on it, after reflection, converges to a point at a distance y from it. Now the lens L and mirror M are placed at a distan $2(x+y)$ from each other. An object of size 2 cm is kept infront of lens at a distance 2x from it. Find the nature, position , and size of the image that willl be seen by an observer looking toward the mirror through the lens.



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111. An object of height 2cm is kept 2m in front of a convex lens of focal length 1m. A plane mirror is placed at 3m from the lens on its other side. Find the nature, position, and magnification of the final image that will be seen by an observer looking toward the mirror through the lens.

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Solved Examples

1. A telescope has a objective of focal length 50 cm and an eye-piece of focal length 5 cm. The least distance of distinct vision is 25 cm. The telescope is focussed for distinct vision on a scale of 200 cm away. The separation between the objective and the eye-piece is

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

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3. (a) A short linear object of length b lies along the axis of a concave mirror of focal length f at a distance u from the pole. What is the size of the image? (b) If the object begins to move with speed V_0 , what will be the speed of its image?

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4. A parallel bean of light travelling in water (refractive index = 4/3) is refracted by a spherical bubble of radius 2 mm situation in water. Assuming the light rays to be paraxial. i. find the position of the image due to refraction at the first surface and the position of the final image, and ii. draw a ray diagram showing the positions of the images.

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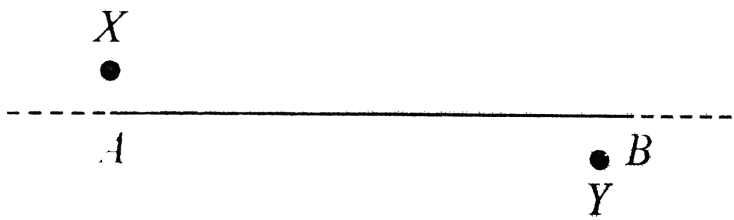
5. An image Y is formed of a point object x by a lens whose optic axis is AB as shown in Figure. Draw a ray diagram to locate the lens and its focus. If the image Y of object X is formed by a concave mirror (having the same optic axis AB) instead of lens, draw another ray diagram to locate the mirror and its focus. Write down the steps of construction of the ray diagrams.



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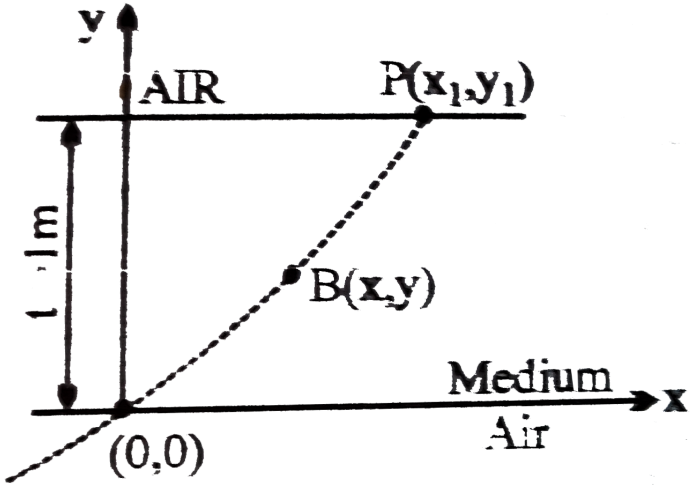
6. A ray of light travelling in air is incident at grazing angle (incident angle=90°) on a long rectangular slab of a transparent medium of thickness $t = 1.0$ (see figure). The point of incidence is the origin $A(O, O)$ .The medium has a variable index of refraction n(y) given by : $n(y) = \left[ky^{3/2} + 1\right]^{1/2}$,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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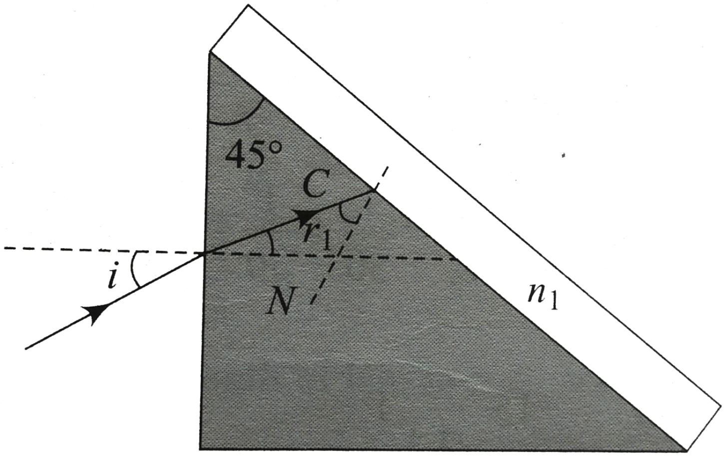
7. A right angles prism $(45^\circ, 90^\circ, 45^\circ)$ of refractive index n has a plate of refractive index $(n_1 < n)$ cemented to its diagonal face. The assembley is in air. A ray is incident on AB.

a. Calculate the angle of incidence at AB for which the ray strikes the diagonal face at the critical angle.

b. Assuming $n = 1.351$, calculate the angle of incidence at AB for which the refracted rey passes through the diagonal face undeviated.



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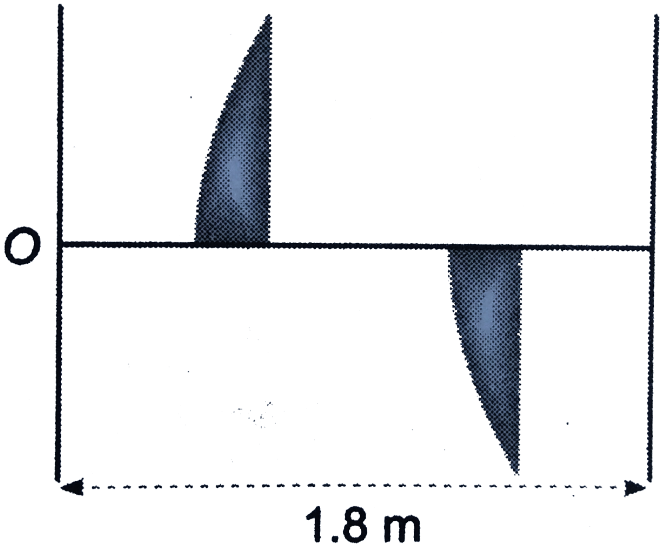
8. A thin plano-convex lens of focal length f is split into two halves. One of the halves is shifted along the optical axis as shown in figure. The sepration between object and image planes is $1.8m$. The magnification of the image formed by one of the half lens is 2. Find the focal length of the lens and separation between the two halves.

Draw the ray diagram for image formation.



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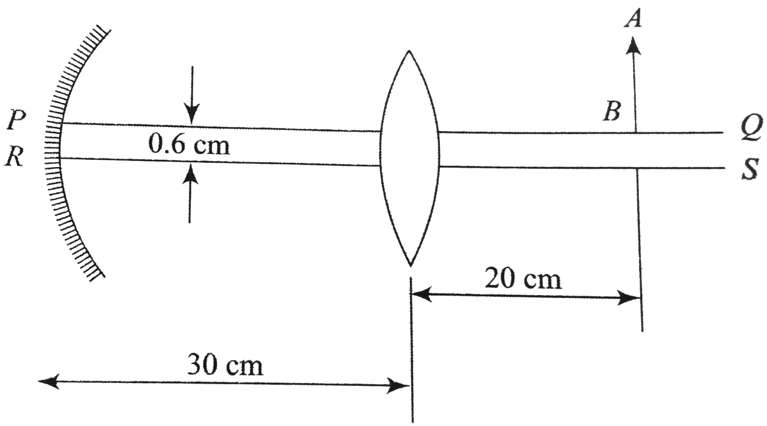
9. A convex lens of focal length 15cm and a concave mirror of focal length 30cm are kept with their optic axes PQ and RS paralledl but separated in vertical direction by 0.6 cm as shown in Figure. The distance between the lens and mirror is 30cm. An upright object Ab of height 1.2 cm is placed on the optics axis PQ of the lens at a distance of 20 cm from the lens. If $A'B'$ is the image after refraction from the lens and reflection from the mirror, find the distance of $A'B'$ from the pole of the mirror and obtain its magnification. Also, locate positions of A' and B' with respect to the optic axis RS.



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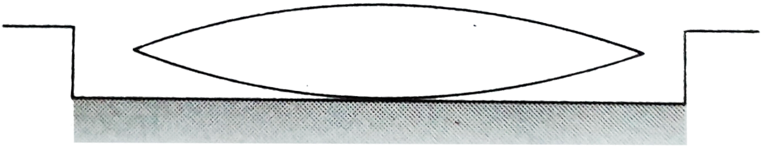
10. A thin equiconvex lens of refractive index $3/2$ is placed on a horizontal plane mirror as shown in figure. The space between the lens and the mirror is filled with a liquid of refractive index $4/3$. It is found that when a point object is placed 15 cm above the lens on its priincipal axis, the object coincides with its own image.



Q. If another liquid is filled instead of water, the object and the image coincide at a distance 25 cm from the lens.

Calculate the refractive index of the liquid.

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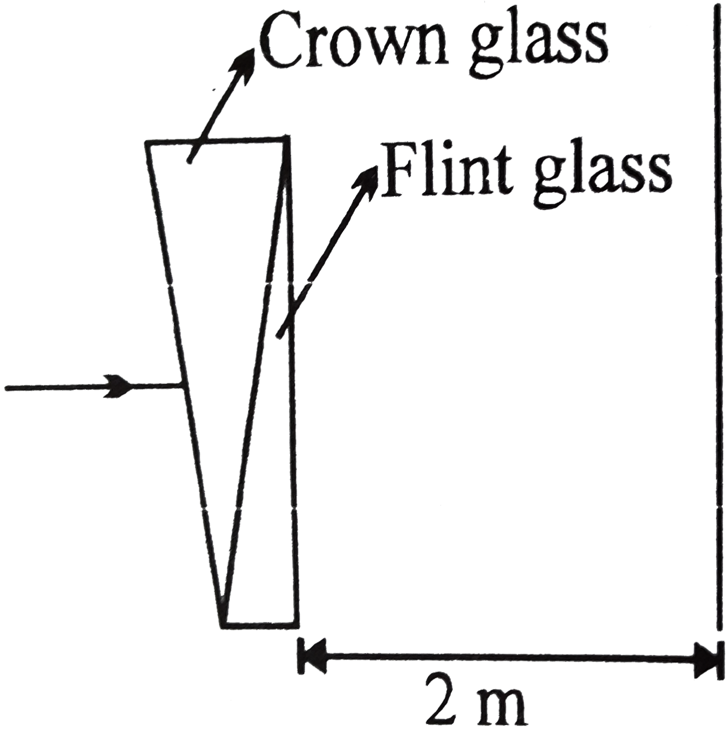
11. The refractive indices of the crown glass for violet and red lights are $1.51$and 1.49respectively and those of the flint glass are1.77and1.73 respectively A prism of angle 6° is made of crown glass .A beam of white light is incident at a small angle on this prism.The other thin flint glass prism is combined white the crown glass prism such that te net mean deviation is1.5° anticlockwise.

(i)Determine the angle of the flint glass prism.



(ii)A screen is placed normal to the emerging beam at a distance of$2m$ from the prism combination.find the distance between red and violet spot on the screen Which is the topmost colour on screen.

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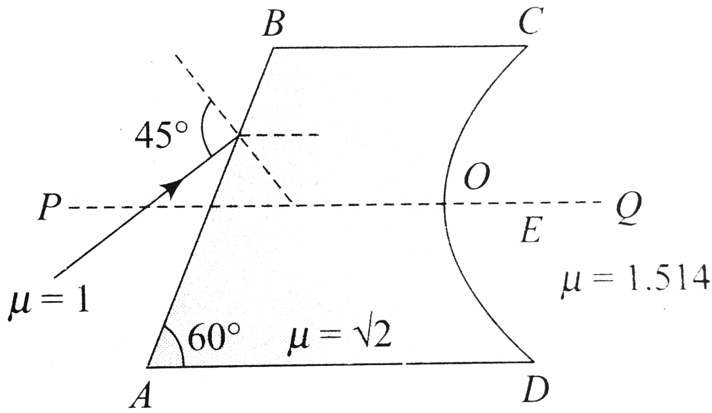
12. Figure shows an irregular block of material of refractive indec $\sqrt{2}$. A ray of light strikes the face AB as shown. After refraction, it is incident on a spherical surface CD of radius of curvature 0.4 m and enters a medium of refractive index 1.514 to meet PQ at E. Find the distance OE up to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



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13. An object is approaching a convex lens of focal length 0.3m with a speed of $0.01ms^{-1}$. Find the magnitudes of the ratio of change of position and lateral magnification of image when the object is at a distance of 0.4m from the lens

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14. AB and CD are surfaces ot two slabs as shown in Figure . The medium between the slabs has refractive indes 2. Refractive indes of the slab above Ab is $\sqrt{2}$ and below CD is $\sqrt{3}$. Find the minimum angle of incidence at Q, so that the ray is totally reflected by both the slabs.

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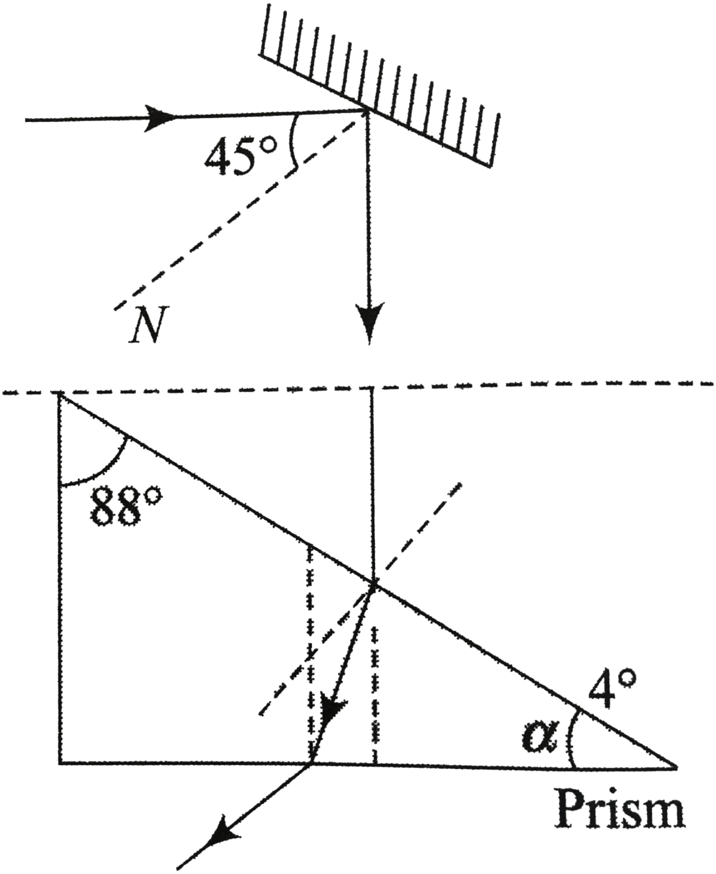
15. A ray of light strikes a plane mirror at an angle of incidence 45° as shown in Figure . After reflection,l the ray passes through a prism of refractive indes 1.5 whos apex angle is 4°. Through what angle must the mirror be rotated it total deviation of the ray be 90° ?



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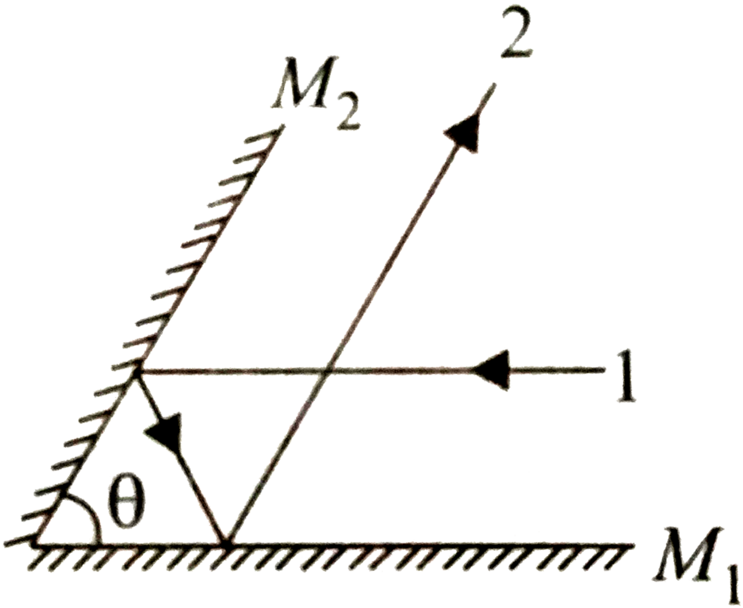
Exercise1.1

1. Two plane mirrors, M_1 and M_2 are inclined at angle θ as shown in the figure. A ray of light 1, which is parallel to M_1 strikes M_2 and after two reflections, the rays is 2 becomes parallel to M_2, The angle θ is



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2. Can we project the image formed by a plane mirror on to a screen? Give reasons.

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3. Real object means that the object is actually present at the point where the incident ray originates. $(True / False)$

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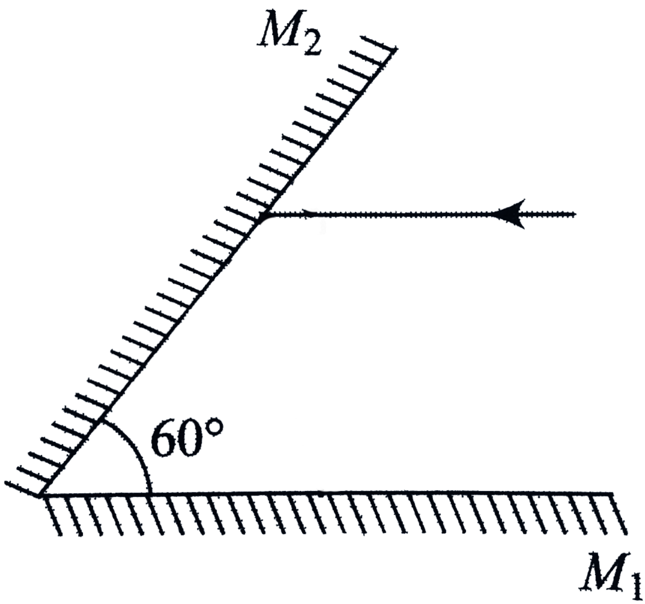
4. Two plane mirrors are inclined at an angle of 60° as shown in Figure. A ray of light parallel to M_1 strikes M_2. At what angle will the ray finally emerge?



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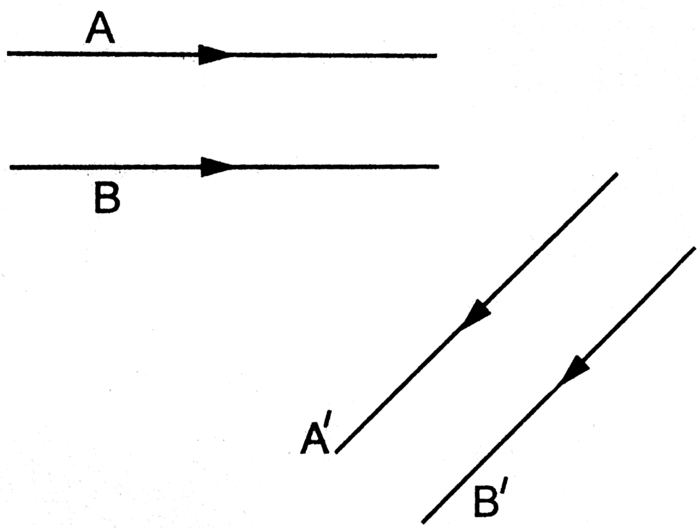
5. Figure shows two rays A and B beig reflected by a mirror and going as A' and B'. The mirror



A. is plane

B. is convex

C. is concave

D. may be any spherical 1 mirror

Answer: a

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6. Two plane mirrors are placed parallel to each other. The distance between the mirrors is 10cm. An object is placed between the mirrors at a distance of 4cm from one of them, say M_1. What is the distance between the first time formed at M_1 and the second image formed at M_2 ?

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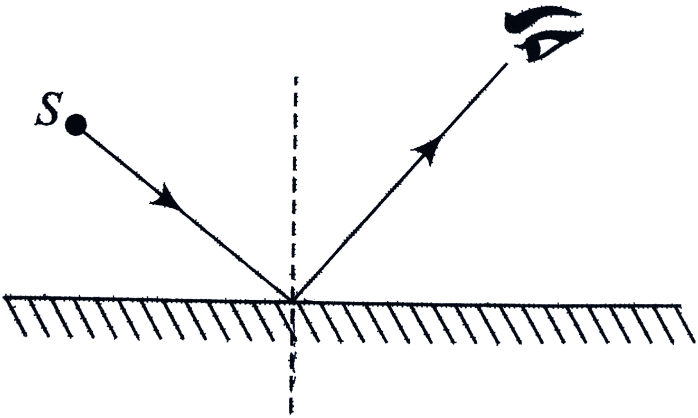
7. A ray of light travels from a light source S to an observer after reflection from a plane mirror. If the source rotates in the clockwise direction by 10°, by what angle and is what direction must the mirror be rotated so that the light ray still strikes the observer?



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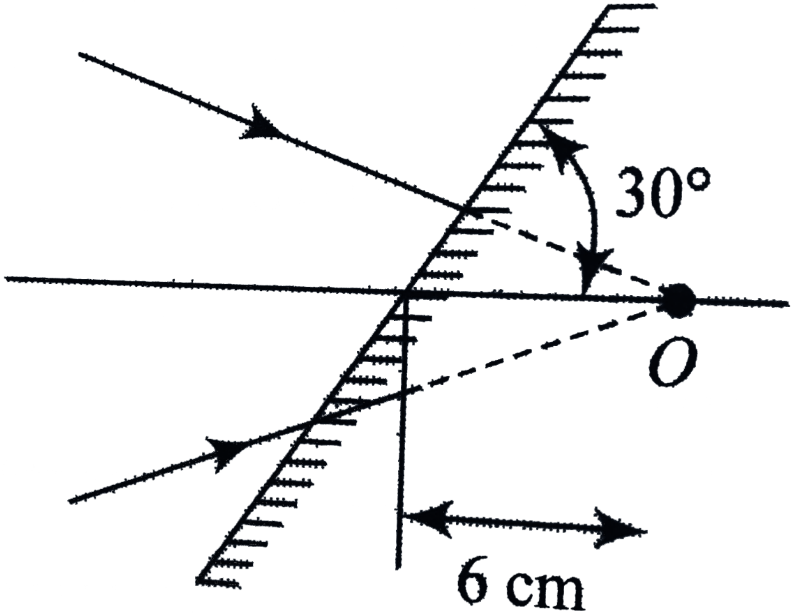
8. Determine image location for the object in Figure.



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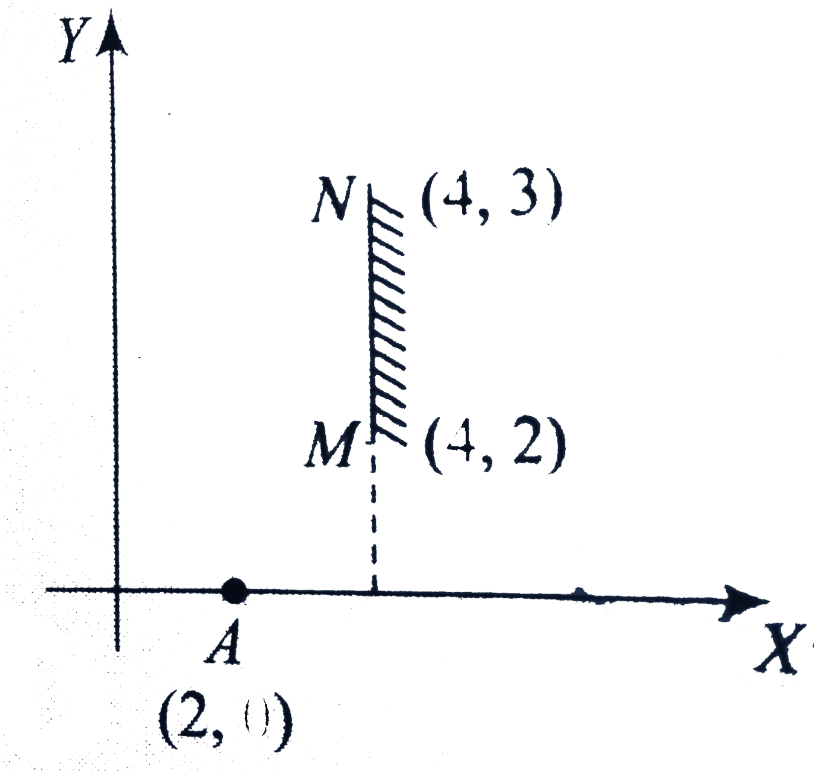
9. Find the region on Y-axis in which reflected rays are present. Object ia at $A(2, 0)$ and MN is a plane mirror, as shown in Figure.



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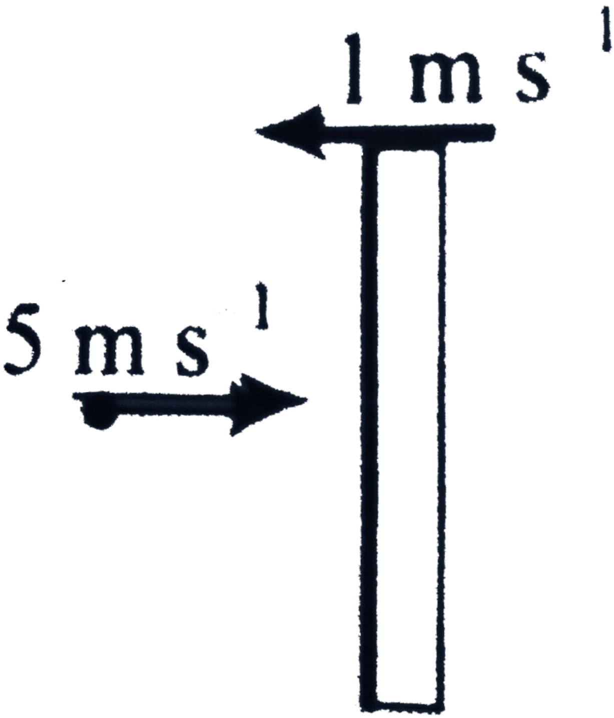
10. An object moves with $5ms^{-1}$ toward right while the mirror moves with $1ms^{-1}$ toward the left as shown in Figure. Find the velocity of image.



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11. There is a point object and a plane mirror. If the mirror is moved by 10cm away from the object, find the distance which the image will move.

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12. A man is standing at distance x from a plane mirror in front of him. He wants to see the entire wall in mirror which is at distance. y behind the man. Find the minimum size of the mirror required.

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13. Find the velocity of the image when the object and mirror both are moving towards each other with velocities 2 and $3ms^{-1}$. How are they moving?

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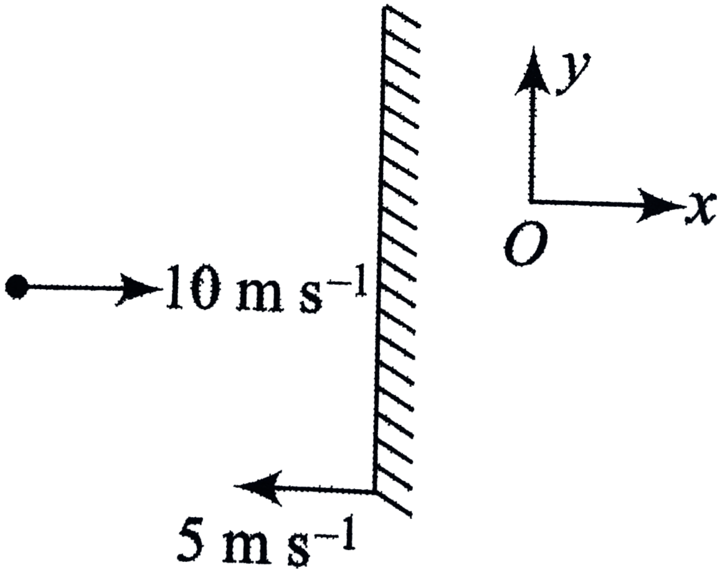
14. In Figure. , a plane mirror is moving with a uniform speed of $5ms^{-1}$ along negative x-direction and observer O is moving with a velocity of $10ms^{-1}$. What is the velocity of image of a particle P, moving with a velocity as shown in the figure, as observed by observer O? Also find its direction.



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Exercise1.2

1. State the following statements as TRUE or FALSE.

a. A convex mirror cannot from a real image for a real object.

b. The image formed by a convex mirror is always diminished and erect.

c. Virtual image formed by a concave mirror is always enlarged.

d. Only in the case of a concave mirror, it may happen that the object and its image move in same direction.

e. In the case of a concave mirror, the image always move faster than the object.

f. If an object is placed in front of a diverging mirror at a distance equal to its focal length, then the height of image formed is half of the height of object.

g. For two positions of an object , a concave mirror can form englarged image.

h. Concave mirror is used as a rear view mirror in motor vehicles.

i. If some portion of the mirror ois covered, then complete image will be formed but of reduced brightness.

j. A plane mirror always forms an erect iamge of same size as that of the object.

k. The image formed by a plane mirror has left-right reversal.

l. A virtual object means a converging beam.

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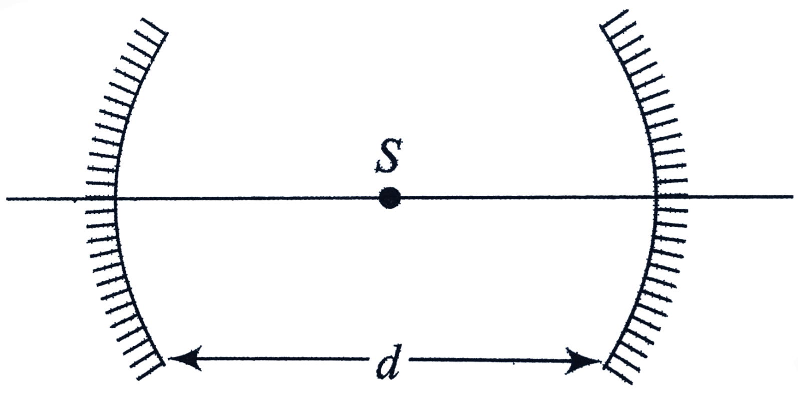
2. a. An object 1 cm high is placed at 10cm in front of a concave mirror of focal length 15 cm. Find the position, height, and nature of the image.

b. A point source S is placed midway between two converging mirrors having equal focal length f as shown in Figure. Find the value of d for which only one image is formed.



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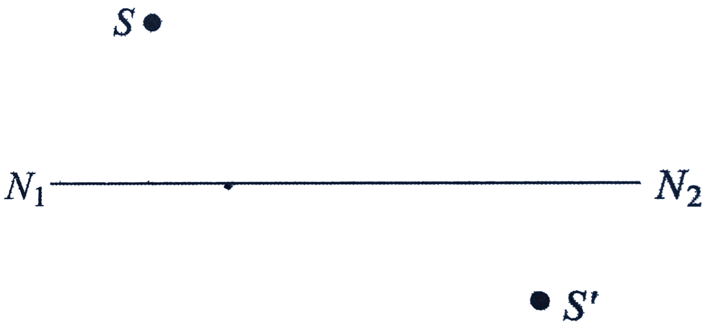
3. Point S' is the image of a point source of light S in a spherical mirror whose optical axise is $N_1 N_2$ (shown in Figure). Find by construction the position of the center of the mirror and its focus.



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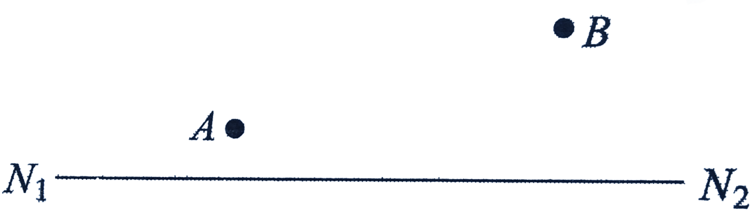
4. The position of optical axis N_1N_2 of a spherical mirror, the source and the image are known (as shown in Figure). Find by construction the positions of the center of the mirror, its focus, and the pole for the cases

a. A-source, B-image,

B-source, A-image.



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5. An object is placed midway between a concave mirror of focal length f and a convex mirror of focal length f. The distance between the two mirrors is 6f. Trace the ray that is first incident on the concave mirror and then the convex mirror.

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6. A particle moves in a circular path of radius 5 cm in a plane perpendicular to the principla axis of a xonvex mirror with radius of curvature 20cm. The object is 15cm in front of the mirror. Calculate the radius of the circular path of the image.

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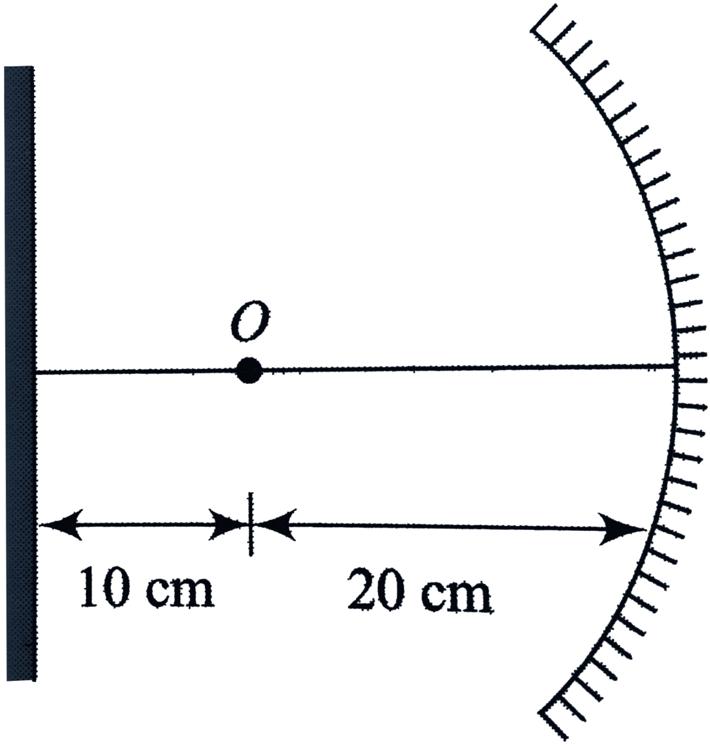
7. An object is placed between a plane mirror and a concave mirror of focal length 15 cm as shown in Figure . Find the position of the images after two reflections.



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8. A body of length 6 cm is placed 10cm from a concave mirror of focal length 20cm. Find the position, size, and nature of the image.

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9. An object is placed 15cm from a mirror and an image is captured on the screen with magnification 2. Calculate the focal length of the mirror and determing if it is concave or convex.

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10. An object is places 15 cm from a mirror and an erect image of size 5cm is seen. Determing the focal length and the nature of the mirror. Assume the object size is 15 cm.

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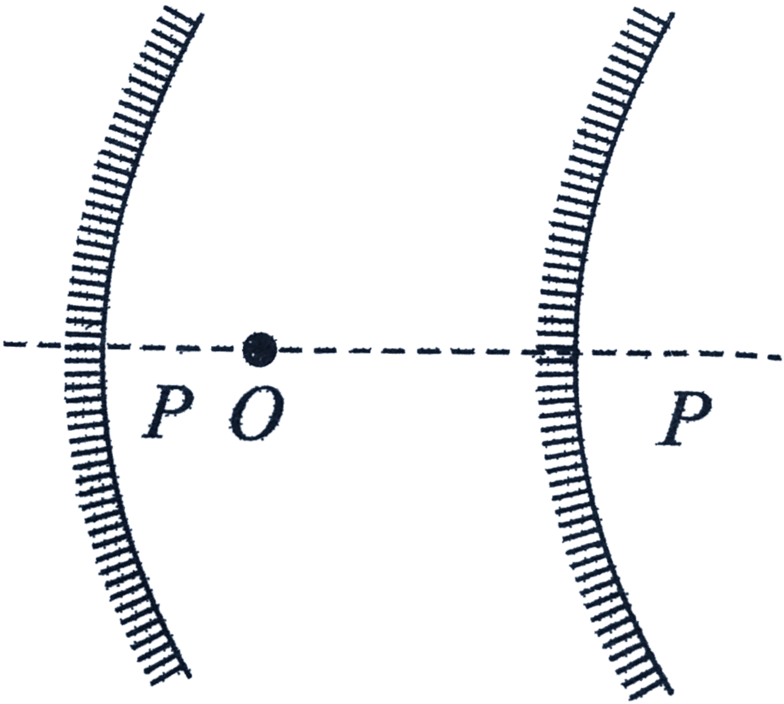
11. A concave mirror of focal length 10cm is placed in front of a convex mirror of focal length 20 cm. The distance between the two mirrors is 20cm. A point object is placed 5cm from the concave mirror. Discuss the formation of image.



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12. A beam of light converges to a point on a screen S. A mirror is placed in front of the screen at a distance of 10cm form the screen. It is found that the beam now converges at a point 20cm in front of the mirror. Find the focal length of the mirror.

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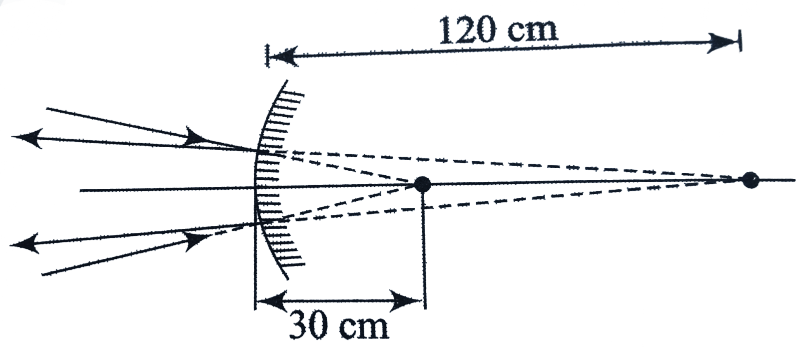
13. Converging rays are incident ono a convex spherical mirror so that their extensions intersect 30cm behind the mirror on the optical axis. The reflected rays form a diverging beam so that their extensions intersect the optical axis 1.2 m from the mirror. Determine the focal length of the mirror.



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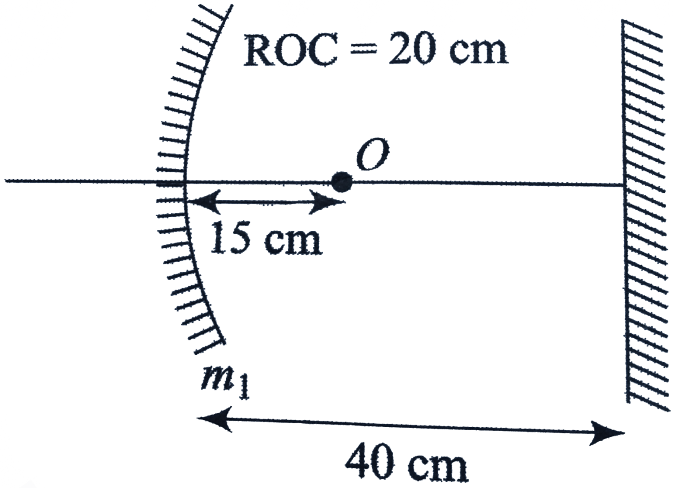
14. Find the position of the final image after three successive reflections taking the first reflection on m_1 .



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15. A concave mirror gives a real image magnifies 4 times. When the object is moved 3 cm the magnification of the real image is 3 times. Find the focal length of mirror.

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16. The image of a real object in a convex mirror is 4cm from the mirror. If the mirror has a radius of curvature of 24cm, Find the position of object and magnification

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17. When an object is placed at a distance of 25 cm from a mirror, the magnification is m_1. The object is moved 15cm farther away with respect to the earlier position, and the magnification becomes m_2. If $m_1 / m_2 = 4$, then calculate the focal length of the mirror.

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18. A short linear object is placed at a distance u along the axis of a spherical mirror of focal length f.

a. Obtain an expression for the longitudinal magnification.

b. Also, obtain an expression for th eration of the velocity of image (v) to the velocity of the object (u).

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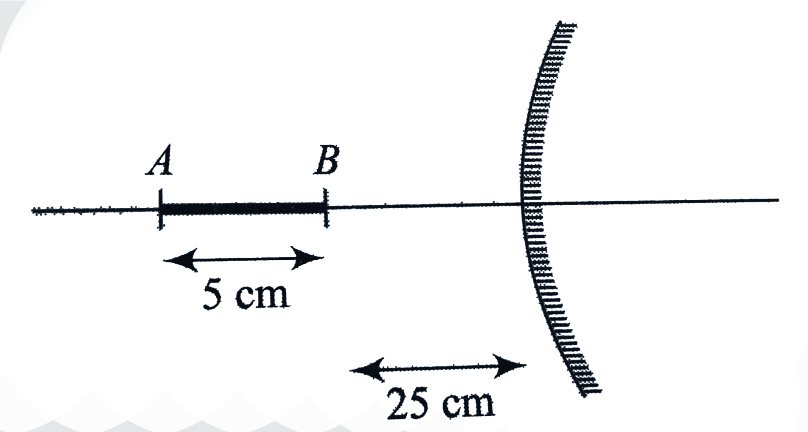
19. A convex mirror of focal length 10cm is shown in Figure . A linear object $AB = 5cm$ is placed along the optical axis. Point B is at distance $25cm$ from the pole of mirror. Calculate the size of the image of AB.



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20. A concave mirror forms a real image three times larger than the object on a screen. The object and screen are moved until the image becomes twice the size of the object. If the shift of the object is 6cm, find the shift of screen.

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Exercise1.3

1. Identify the True or False statements.

a. A glass slab cannot deviate the light.

b. A glass slab can produce lateral displacement.

c. The shift produced by a slab depends ono the converging and diverging nature of beam.

d. Apparent shift in case of a slab always occurs in the direction of light ray travelling.

e. The shift produced by a slab can never exceed its thickness.

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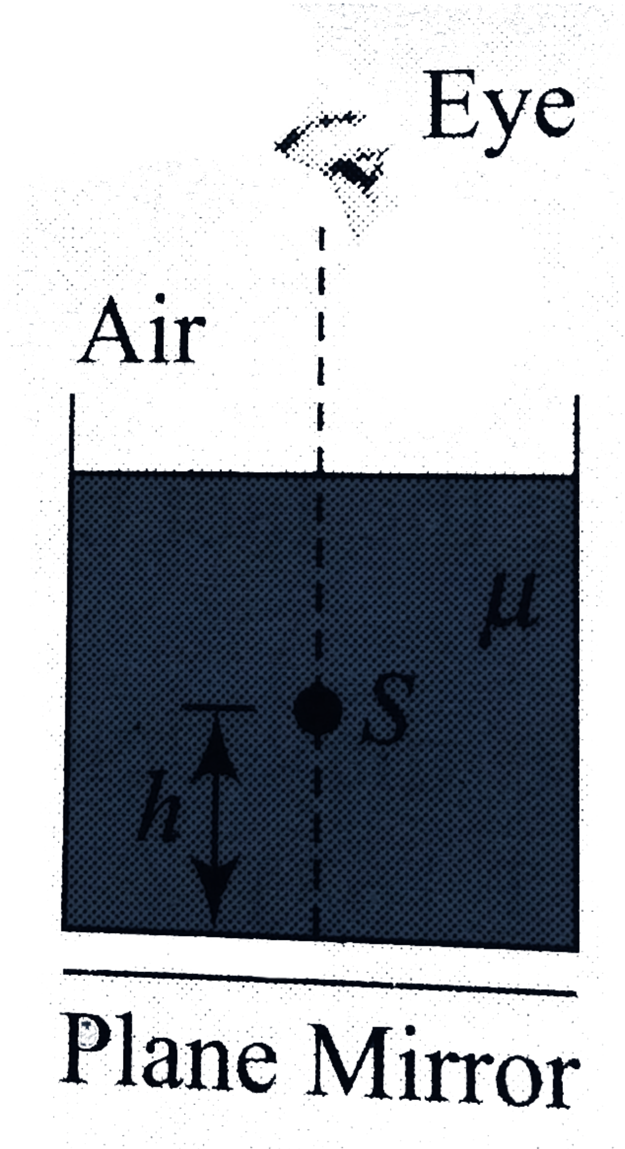
2. In figure, a point source S is placed at a height h above the plane mirror in a medium of refractive index μ.

a. Find the number of images seen for normal view.

b. Find the distance between the images.



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3. A beam of width t incident at 45° on an air-water boundary. The width of the beam in water is _______

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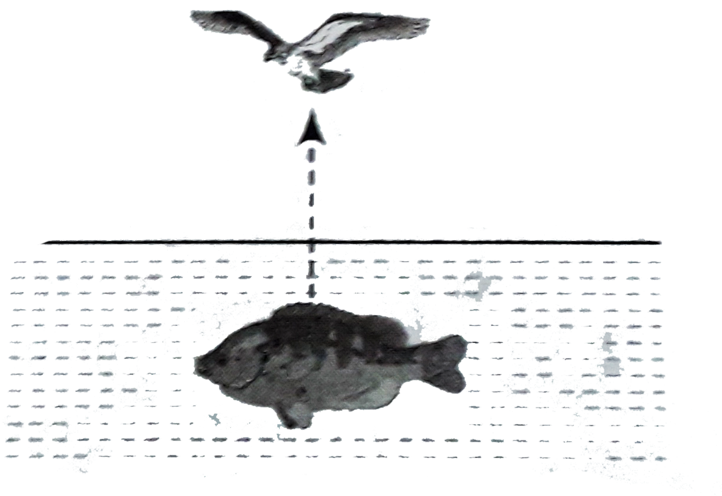
4. A fish is vertically below a flying bird moving vertically down toward water surface. The bird will appear to the fish to be



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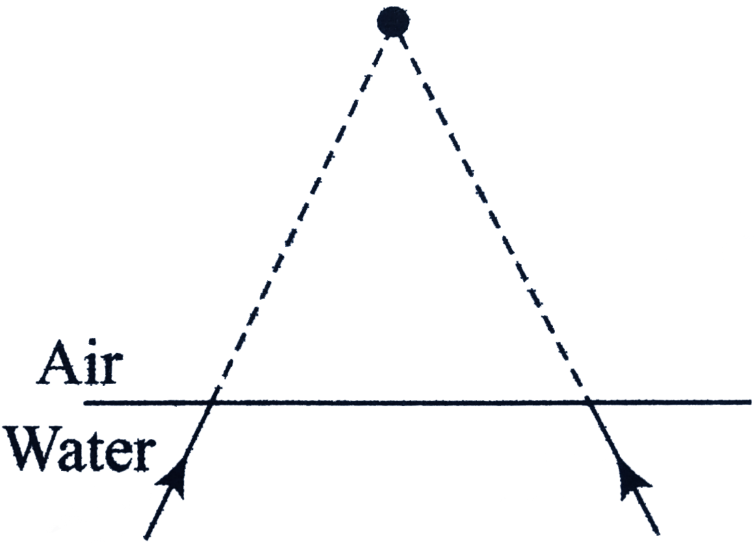
5. A converging set of ray, traveling from water to air, is incident on a plane interface. In the absence of the interface, the rays would have converged to a point O, 60 cm above the interface. However, dur to refraction the rays will bend. At what distance above the interface will the rays actually converge?



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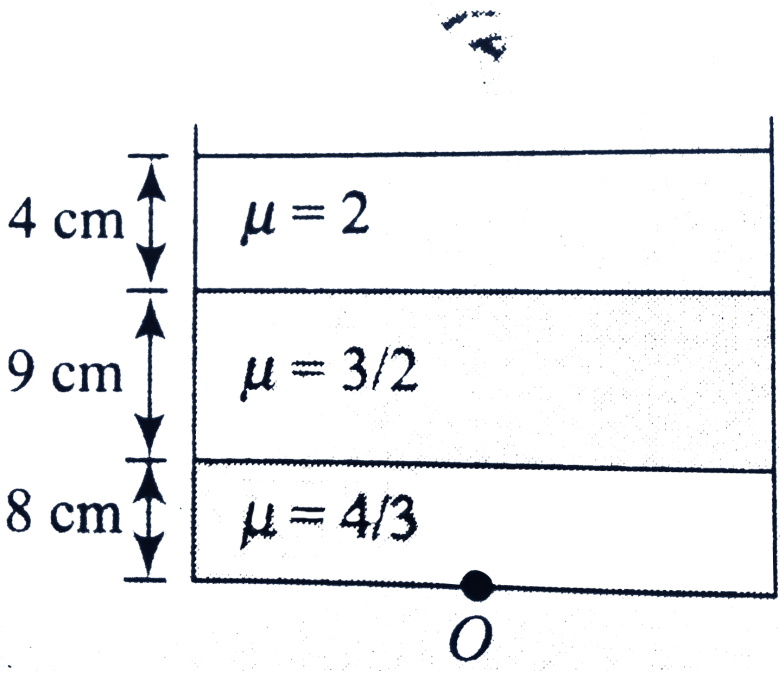
6. A tank contains three layers of immiscible liquids. The first layer is of water with refractive index $4/3$ and thickness 8cm. The second layer is of oil with refractive index $3/2$ and thickness 9cm while the third layer is of glycerine with refractive index 2 and thickness 4cm. Find the apparent depth of the bottom of the container.



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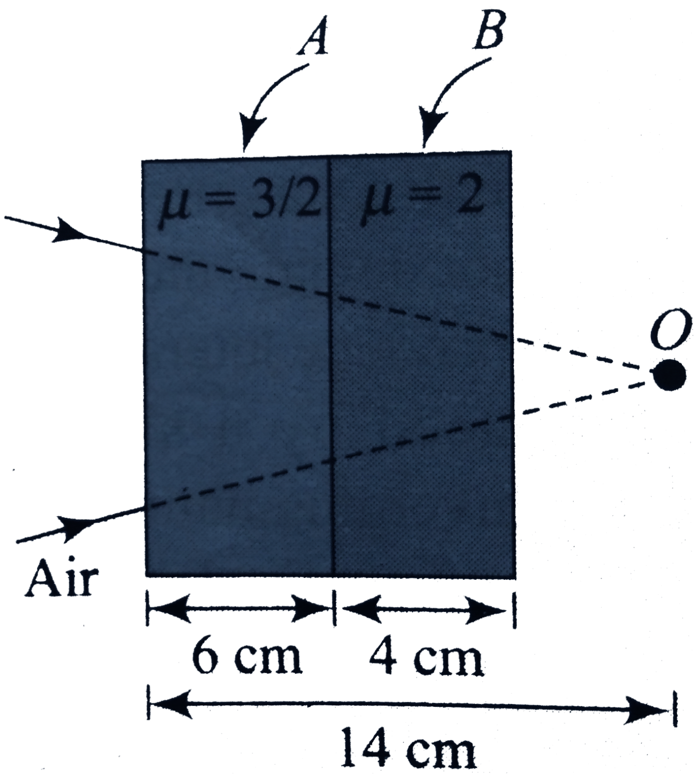
7. A convergent beam is incident on two slabs placed in contact as shownin figure. Where will the rays finally converge?



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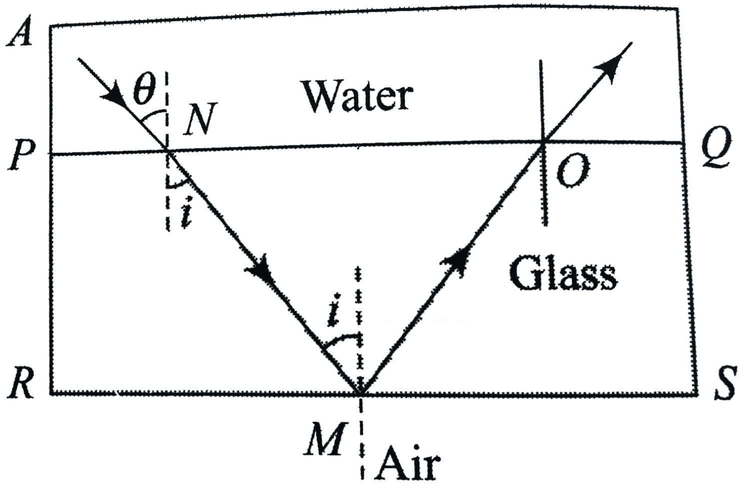
8. A slab of water is on the top of a glass slab of refractive index 2. At what angle to the normal must a ray be incident on the top sureface of th eglass slab so that it is reflected from the bottom surface as shown in figure ?



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9. A ray of light ravels from a liquid of refractive index μ to air. If the incident beam is rotating at a rate ω , what is the angular sped of the refracted beam at the instant the angle of incidence is 30° ? (Given $\mu=\sqrt{2}, \omega=1 / \sqrt{6} rads^{-1}$).

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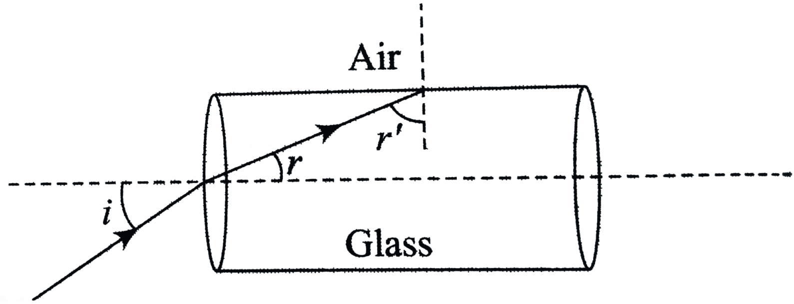
10. What should be the value of refractive index n of a glass rod placed in air, so that the light entering through the flat surface of the rod does not cross the curved surface of the rod?



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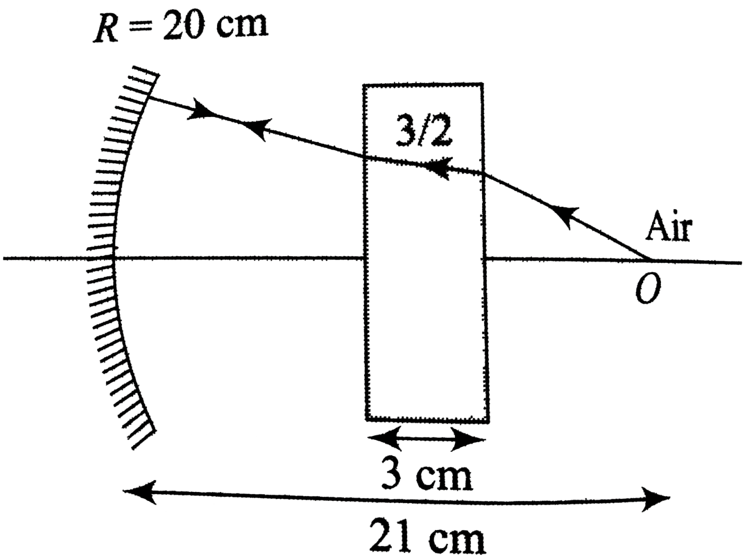
11. An object is placed on the principle axis of a concave mirror of focal length 10cm at a distance of 21cm from it. A glass slab is placed between the mirror and the object as shown in figure.

Find the distance of final image formed by the mirror.



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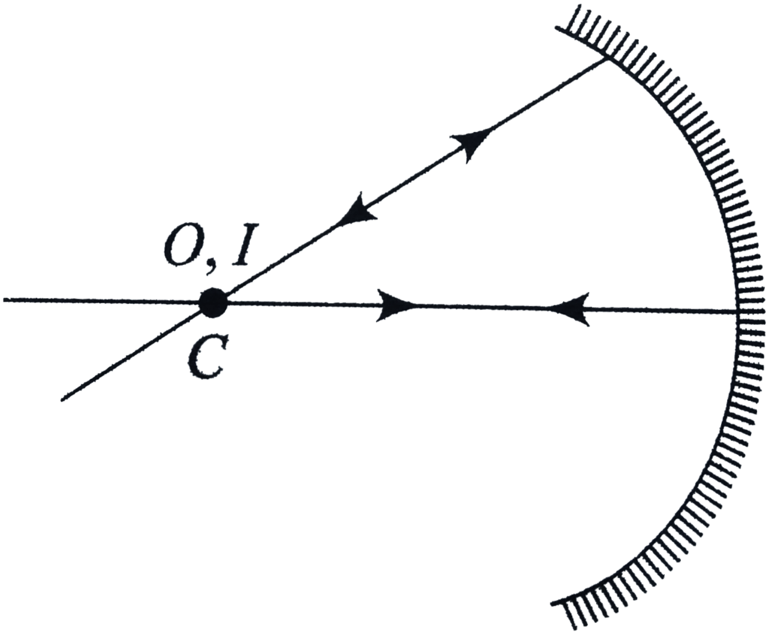
12. The image of an object kept at a distance of 30 cm in front of a concave mirror is found to coincide with itself. If a glass slab $(\mu = 1.5)$ of thickness 3 cm is introduced between the mirror and the object, then

a. Identify, in which direction the mirror should be displaced so that the final image may again coincide with the object itself.

b. Find the magnitude of displacement.



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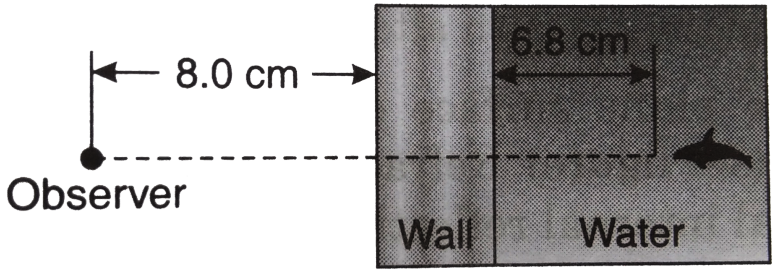
13. In figure, a fish watcher watches a fish through a $3.0cm$ thick glass wall of a fish tank. The watcher is in level with the fish, the index of refraction of the glass is $8/5$ and that of the water is $4/3$.



To the fish, how far away does the watcher appear to be?

To the watcher, how far away does the fish appear to be?

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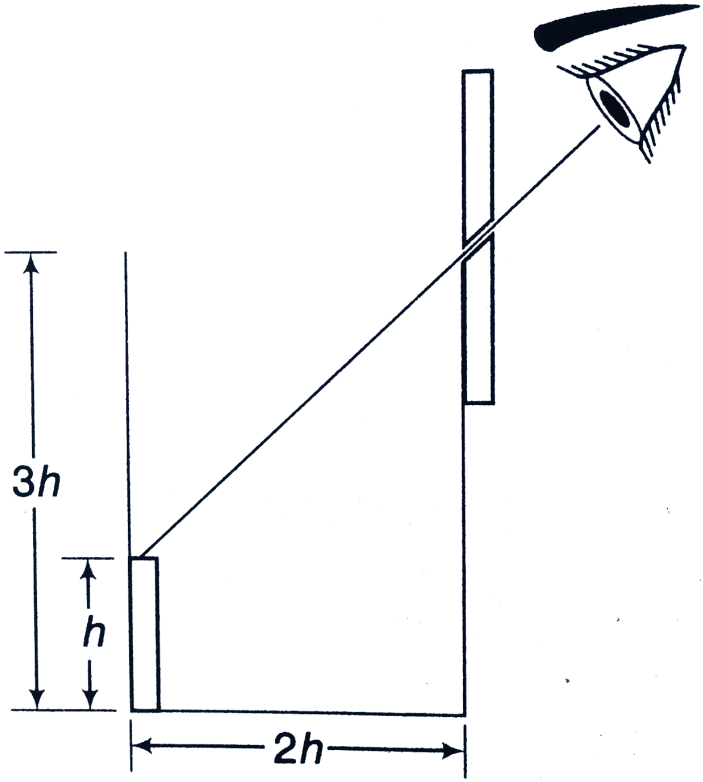
14. An observer can see through a pin-hole the top end of a thin rod of height h,placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then, the refractive index of the liquid is



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

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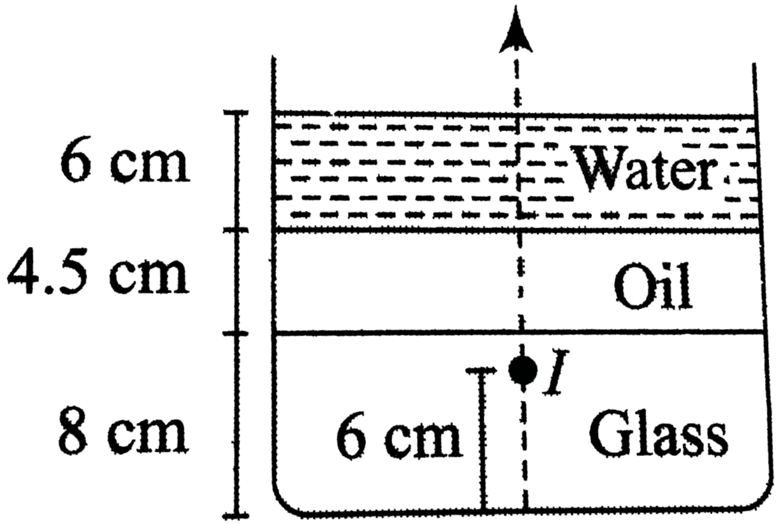
15. A vesserl contains a slab of glass 8cm thick and of refractive index 1.6 . Over the slab, the vessel is filled by oil of refractive index μ upto height 4.5 cm and then by another liquid, i.e., water of refractive index $4/3$ and height 6cm as shown in Figure. An observer looking down from above observer that a mark at the bottom of glass slab appears to be raised up to a position 6cm from bottom of the slab. Find refractive index of oil (μ) .



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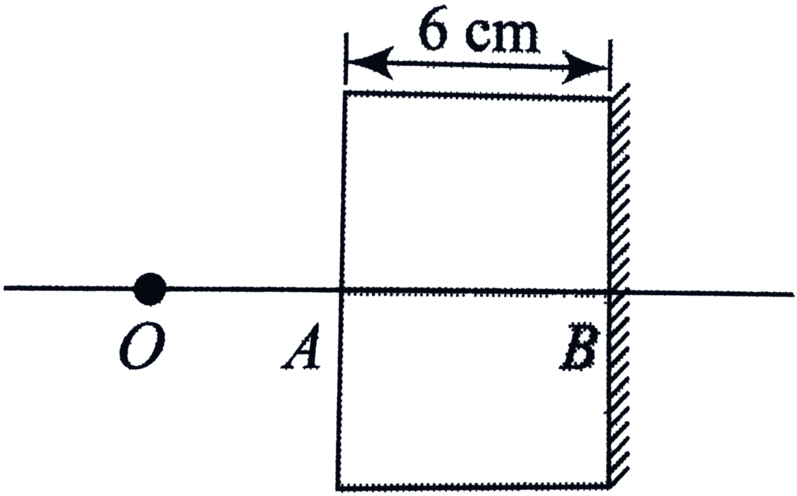
16. An object O is placed at 8cm in front of a glass slab, whose one face is silvered as shown in Figure. The thickness of the slab is 6cm. If the image formed 10 cm behind the silvered face, find the refractive index

of glass.



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17. x-y plane separates two media, $z \geq 0$ contains a medium of refractive index 1 and $z \leq 0$ contains a medium of refractive index 2. A ray of light is incident from first medium along a vector $\hat{i} + \hat{j} - \hat{k}$. Find the unit vector along the refracted ray.

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18. The n transparent slabs of refractive index1.5 each having thickness 1cm, 2 cm,...to n cm are arranged one over another. A point object is seen through this combineation with near perpendicular light. If the shift of object by the combination is 1 cm, then find the value of n.

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19. A concave mirror with its optic axis vertical and mirror facinig upward is placed at the bottom of the water tank. The radius of curvature of the mirror is 40 cm and refractive index for water $\mu = 4/3$. The tank is 20 cm deep and if a bird is flying over the tank at a height of 60 cm above the surface of water, find the position of image of the bird.

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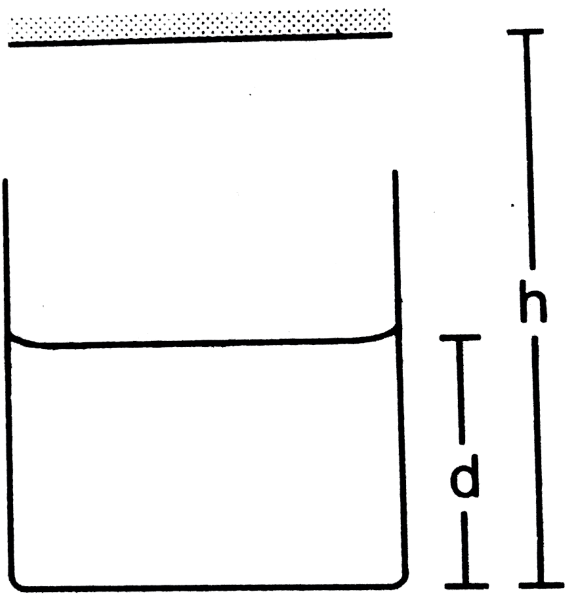
20. Consider the situation shown in figure. A plane mirror is fixed at a height h above the bottom of a beaker containing water (refractive index μ) up of a bottom formed by the mirror.Find the position of the image of bottom formed by the mirror.



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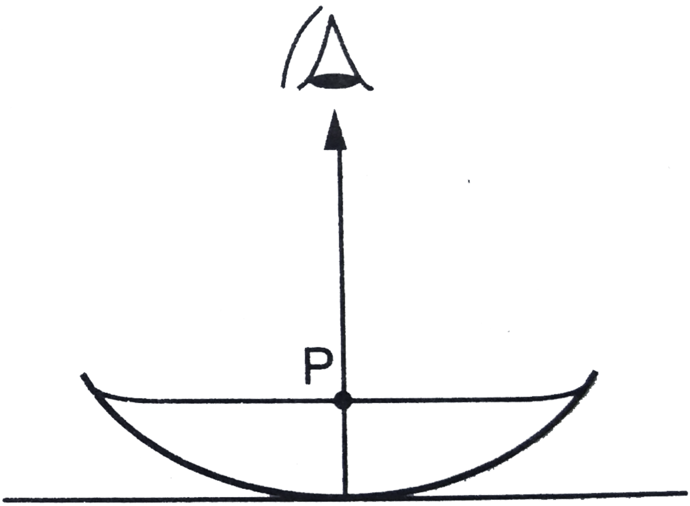
21. A concave mirror of radius 40 cm lies on a horizontal table and water is filled in it upto a height of 5.00 cm. A small dust particle floats on the water surface at a point P vertically above the point of contact of the mirror with the table. Locate the image of the dust particle as seen from a point directly above it. the refractive index of water is 1.33.



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22. 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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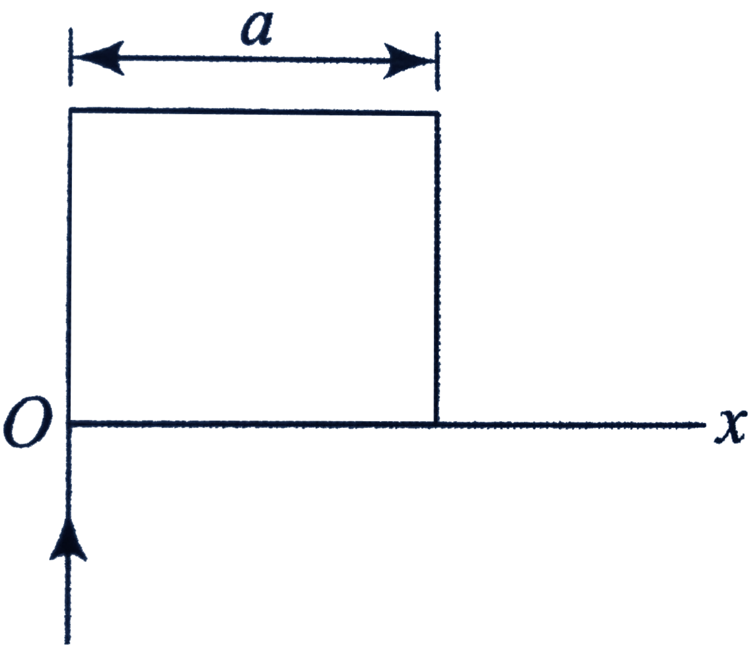
23. The refractive index of an anisotropic medium varies as $\mu = \mu_0\sqrt{(x+1)}$, where $0 \le x \le a$. A ray of light is incident at the origin just along y-axis (shown in figure). Find the equation of ray in the medium .



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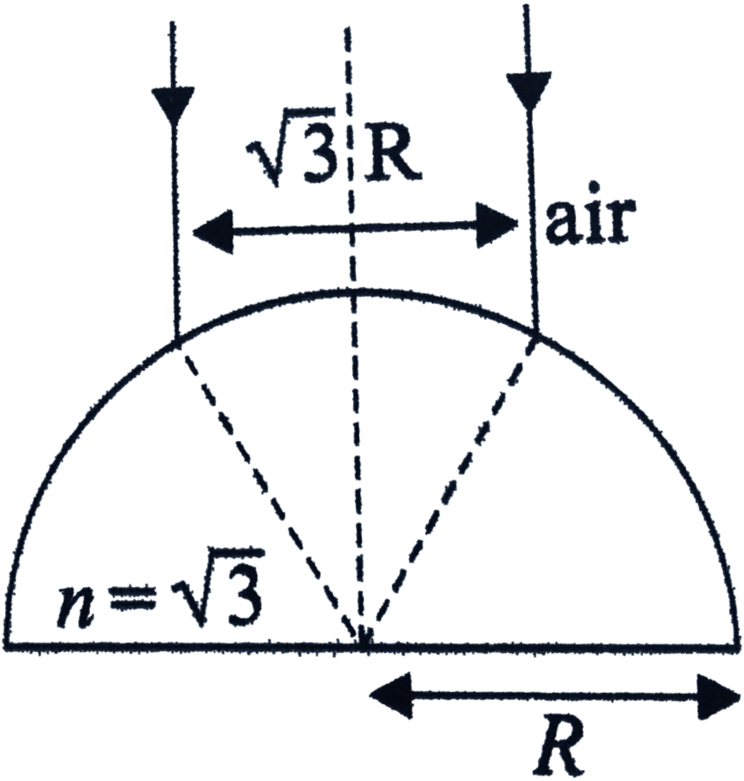
24. A light beam of diameter $\sqrt{3R}$ is incident symmetrically on a glass hemispher of radius R and of refractive index $n = \sqrt{3}$. Find radius of the beam at the base of hemispher.



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25. A ray of light travelling in air is inciden at angle of inciden 30° on one surface of slab in which refractive index varies with y. The light travels along the curve $y = 4x^2$ (y and x are in meter) in the slab. Find out the refractive index of the slab at $y = 1/2m$ in the slab.

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Exercise1.4

1. The refractive indices of flint glass for red and violet lights are 1.613 and 1.632, respectively. Find the angular dispersion produced by a thin prism of flint glass having refracting angle 5°.

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2. Refractive index of glass for red and violet colors are 1.50 and 1.60, respectively. Find:

a. The refractive index for yellow color, approximately

b. Dispersive power of the medium.

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3. An equilateral prism is made of glass of refractive index 1.5. Calculate the angles of minimum and maximum deviation. Given:

$A = 60^\circ, \mu = 1.5, \sin 48.6^\circ = \frac{3}{4}, \sin 41.8^\circ = \frac{3}{2}, \sin 27.9^\circ = \frac{3}{2} \sin 18.2$

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4. A prism is made of glass of refractive index 1.5. If the angle of minimum deviation is equal to the refracting angle of the prism, calculate the angle of the prism.

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5. A horizontal ray of light passes through a prism of $\mu = 1.5$ whose apex angle is 4° and then strikes a vertical mirror M as shown. For the ray to become horizontal, either just after reflection from the mirror or finally, the mirror must be rotated through an angle of

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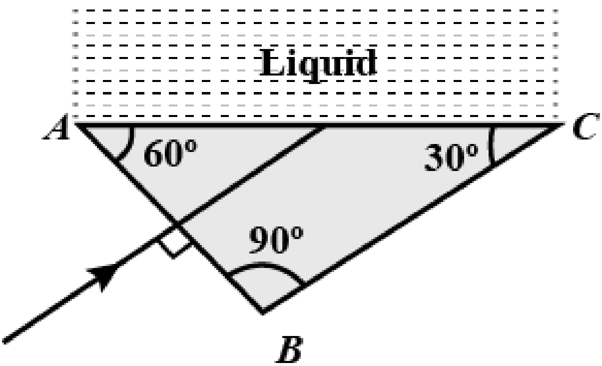
6. Light is incident normally on face AB of a prism as shown in Figure. A liquid of refractive index μ is placed on face AC of the prism. The prism is made of glass of refractive indes $3/2$. Find the limits of μ for which total internal reflection takes place on the face AC.

(A)$\mu > \dfrac{\sqrt{3}}{2}$ (B)$\dfrac{3\sqrt{3}}{4} > \mu$ (C)$\mu > \sqrt{3}$ (D)$\mu < \dfrac{\sqrt{3}}{2}$



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7. A ray of light passing through a prism having refractive index $\sqrt{2}$ suffers minimum deviation. It is found that the angle of incidence is double the angle of refraction within the prism. What is the angle of prism?

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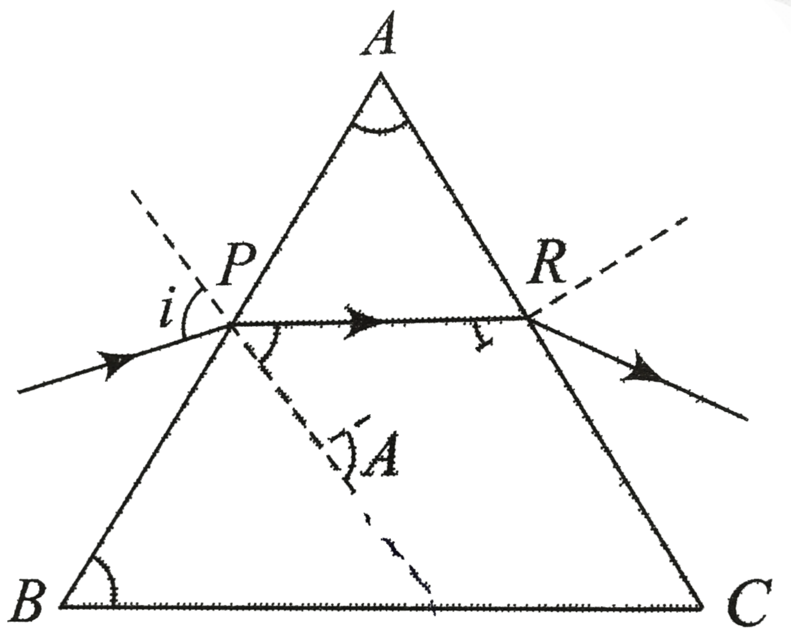
8. A ray of light undergoes a deviation of 30° when incident on an equilateral prism of refractive index $\sqrt{2}$.

What is the angle subtended by the ray inside the prism with the base of the prism?



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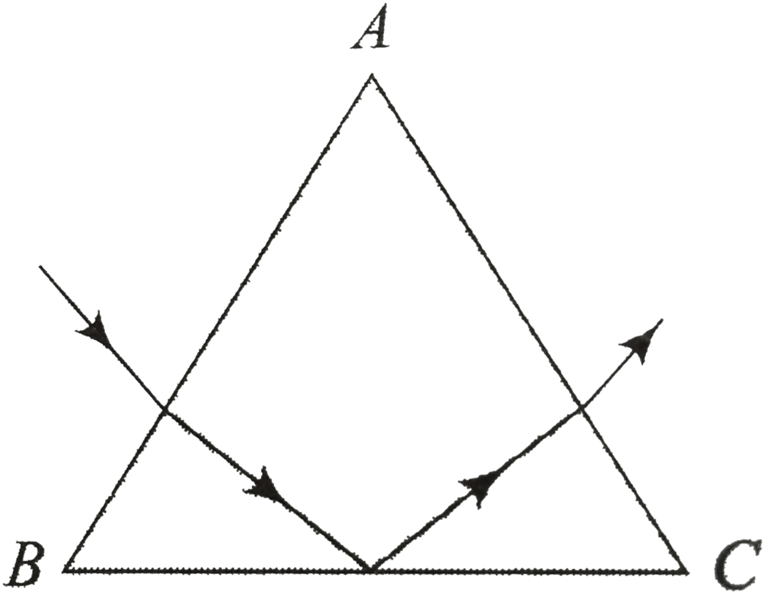
9. The path of a ray of light passing through an equilateral glass prism ABC is shown in figure. The ray of light is incident on face BC at the critical angle for just total internal reflection. The total internal reflection. The total angle of deviation after the refraction at face AC is

108°. Calculate the refractive index of the glass.



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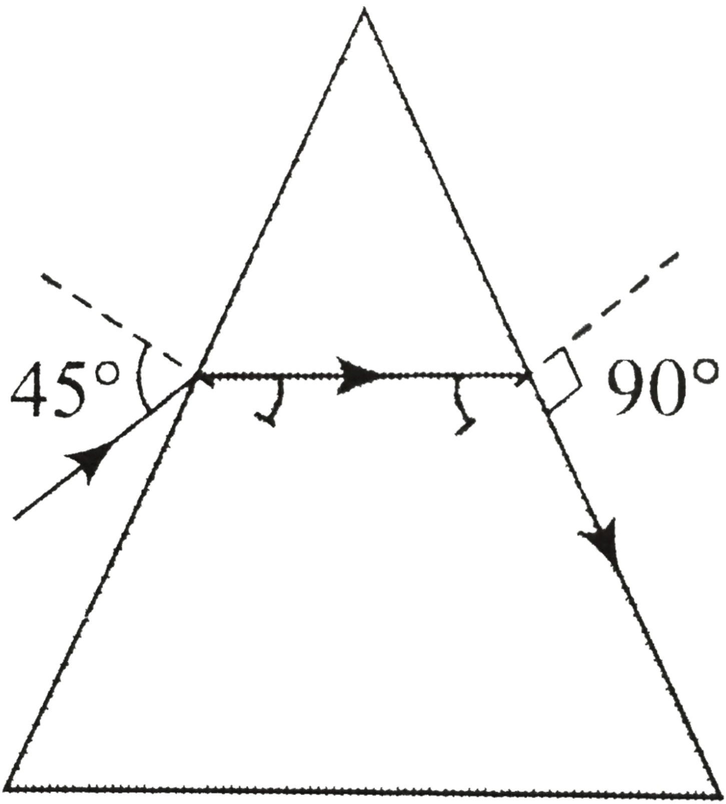
10. In an isosceles prism of angle 45°, it is found that when the angle of incidence is same as the prism angle, the emergen ray grazes the emergent surface.

Find the refractive index of the material of the prism. For what angle of incidenc, the angle of deviation will be minimum?



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11. Refracting angle o f a prism $A = 60^\circ$ and its refractive index is $n = 3/2$. What is angle of incidence i to get minimum deviation. Also,

find the minimum deviation. Assume the surrounding medium to be air $(n = 1)$.

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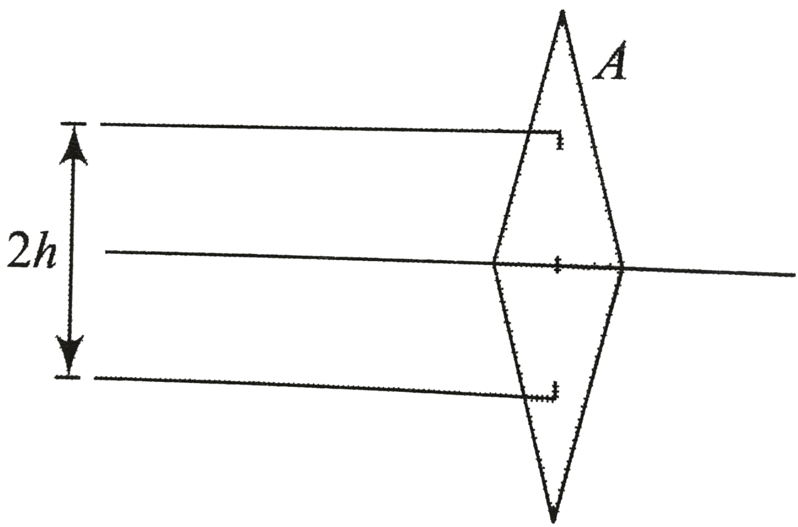
12. Two identical thin isosceles prisms of refracting angle A and refractive index μ are placed with their bases touching each other and this system can collectively act as a crude converging lens. A parallel beam of light is incident on this system as shown in Figure. Find the focal length of this so called converging lens.



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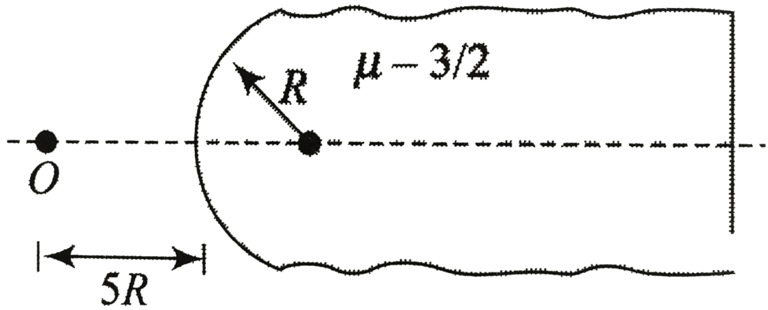
Exercise1.5

1. Identify the statements are True of False.

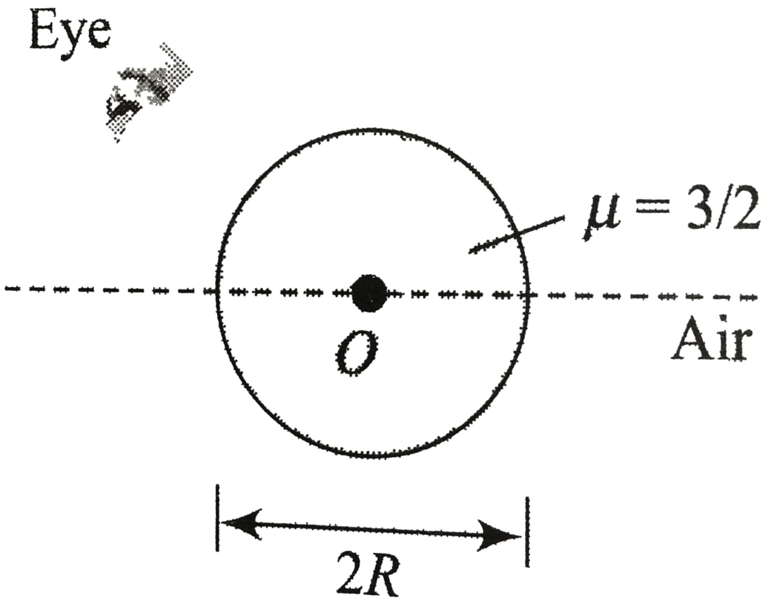
a. The equation $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_{12} - \mu_1}{R}$ is applicabel to a plane surface for $R = \infty$.

h. In the above equation, μ_1 is medium in which the object is placed and μ_2 is the medium in which the image is formed.

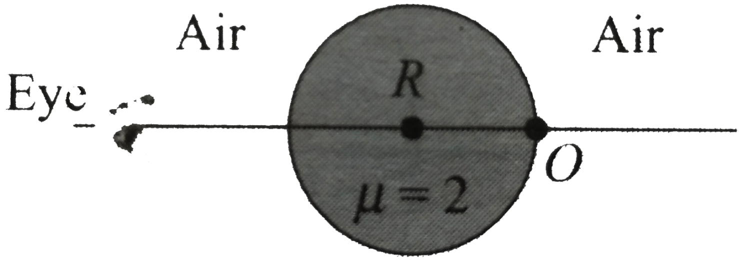
c. In the figure shown, the real image of object O is formed at a distance $5R$ in the medium.



d. In figure, the image of an object O place on the center face of the sphere is formed at infinity,.



e. In fig , the image of an object O placed on the opposite face of the sphere is foremd at infinity.



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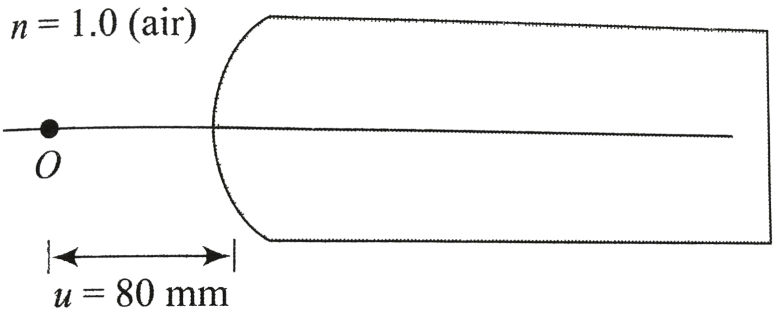
2. One end of a cylindrical glass rod shown in figure, is ground to a hemispherical surface of radius $R = 20mm$.



a. Find the image distance of a point object on the axis of the rod, 80mm to the left of the vertex. The rod is in air.

b. Let the same rod be immersed in water of refractive index $4/3$, the other quantities having the same values as before. Find the image distance.

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3. A lens(n=1.5) is 5cm thick and the radii of curvature of its object is placed at a distance of 12cm from the surface whose radius of curvature is 10cm. How far beyond the other surface is the image formed?

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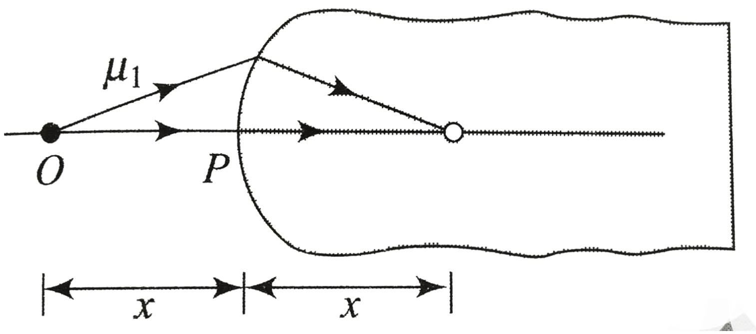
4. A spherical surface of radius R ssparates two media of refractive indices μ_1 and μ_1 as shown in figure., Where should an object be placed in medium 1 so that a real image is formed in medium 2 at the same distance?



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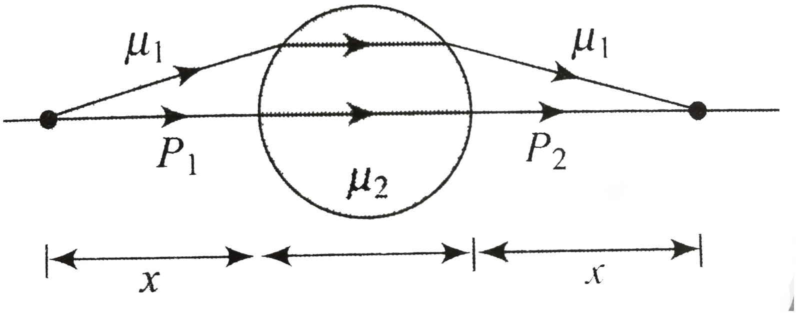
5. A sphere of radius R made of material of refractive index μ_2 is placed in a medium of refractive index μ_1. Where would an object be placed so that a real image is formed at equidistant fromk the sphere? ltbgt



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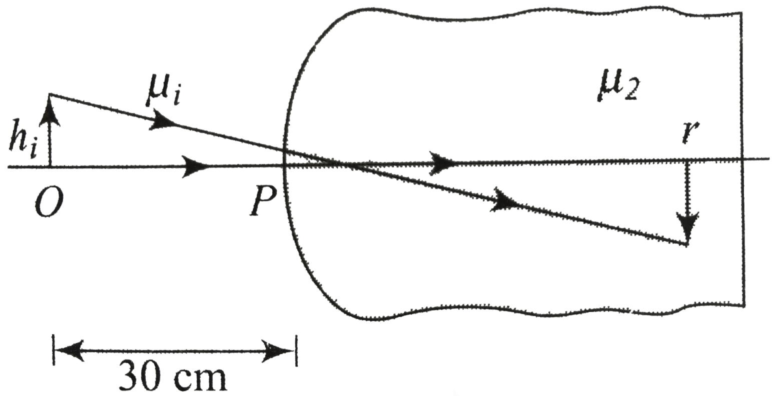
6. A small object of height 0.5 cm is placed in front of a convex surface of glass $(\mu - 1.5)$ of radius of curvature 10cm. Find the height of the image formed in glass.



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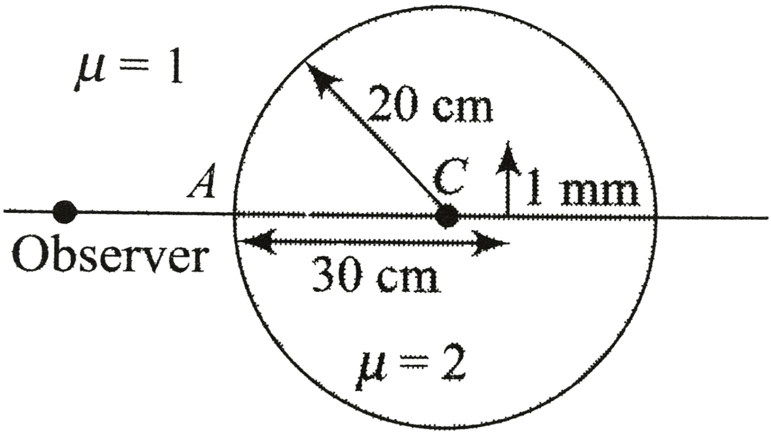
7. An object of height 1mm is placed inside a sphere of refractive index $\mu = 2$ and radius of curvature 20 cm as shown in the figure. Find the position, size, and nature of image, for the situation shown in Figure. Draw ray diagram.



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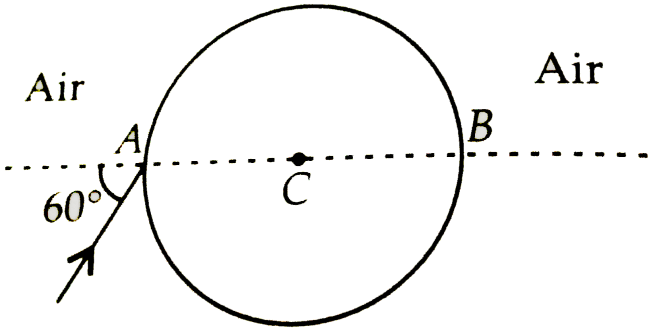
8. A ray of light on a transparent sphere with centre C as shown in the figure. The ray emerges from sphere parallel to line AB. The refractive index of sphere is



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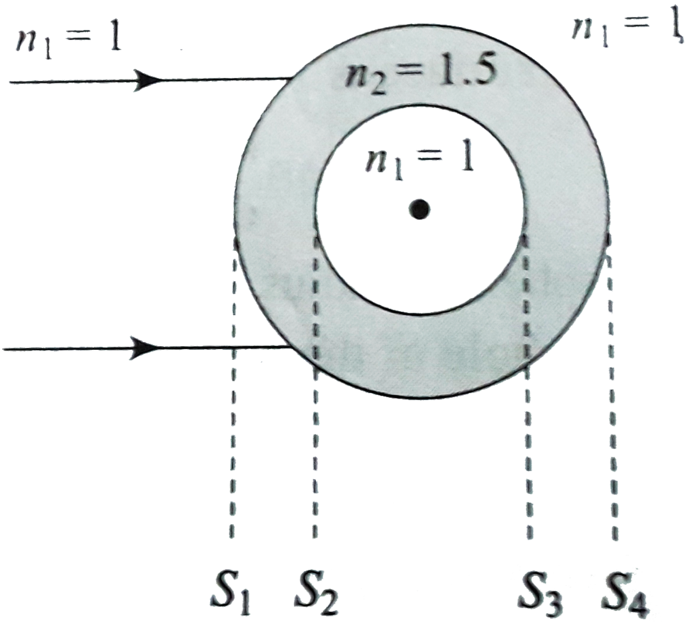
9. A glass sphere, refractive index 1.5 and radius 10cm, has a spherical cavity of radius 5cm concentric with it. A narrow beam of parallel light is directed into the sphere. Find the final image and its nature.



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

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11. There is small air bubble inside a glass sphere $(\mu = 1.5)$ of radius 10 cm. The bubble is 4.0 cm below the surface and is viewed normally from the outside figure. Find the apparent depth of the bubble

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12. Figure shows a transparent hemisphere of radius 3.0 cm made of a material of refractive index 2.0. (a) A narrow beam of parallel rays is incident on the hemisphere as shown in the figure. Are the rays totally reflected at the plane surface ? (b) Find the image formed by the refraction at the first surface. (c) Find the image formed by the reflection or by the refraction at the plane surface. (d) Trace qualitatively the final rays as they come out of the hemisphere.

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13. A small object is embedded in a glass sphere (mu =1.5) of radius 5.0 cm at a distance 1.5 cm left to the centre. Locate the image of the object as seen by an observer standing (a) to the left of the sphere and (b) to the right of the sphere.

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14. A paperweight in the form of a hemisphere of radius 3.0 cm is used to hold down a printed page. An observer looks at the page vertically through the paperweight. At what height above the page will the printed letters near the centre appear to the observer ?

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15. Find the image shift if the paperweight is inverted at its place so that the spherical surface touches the paper

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

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17. A point object is above the principal axis in the concave side of a spherical interface separating medium 1 from medium 2. I f the object is in medium 1 and $\mu_1 > \mu_2$, determine the position of the image by ray tracing.

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18. A solid hemispherical bowl of radius R, made of glass, is placed on a flat horizontal surface with its curved surface on the ground. A small object is placed under the hemisphere at the center of the curved surface. If an observer sees the object directly above the plane surface, Where will the object appear to be ?

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19. 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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20. A horizontal ray of light is incident on a solid glass sphere of radius R and refractive index μ . What is net deviation of the beam when it emerged from the other side of the sphere?

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21. A converging bundle of rays travel from water (refractive index $4/3$) to glass (refractive index 1.5) through a convex interface of radius 16cm. In the absence of the interface, The rays would have converged to a point 32 cm from the pole of the interface. Where will the rays actually meet after refraction?

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22. A parallel incident beam falls on a solid glass sphere at normal incidenc. Prove that the distance of the fianll image after two refractions is at a distance $(2-\mu)/2(\mu-1)a$ from the outer edge of the sphere. Refractive index of the sphere is μ and radius of the sphere is a.

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Exercise1.6

1. Choose the following statement a True of False.

a. The real image formed by a lens is always inverted.

b. The image formed by a lens is always inverted.

c. The image formed by a concave lens is always erect and diminished.

d. An air bubble inside water acts like a concave lens.

e. The distance between a real object and its real image formed by a single lens cannot be more than 4f.

f. I an object is moved at a constant speed toward a convex lens from infinity to focus, then its image moves slower in the beginning and faster later on, away from the lens.

g. The focal length of a glass $(\mu = 1.5)$ lens is 10 cm in air. When it is completely immersed in water its focal length will become 40cm.

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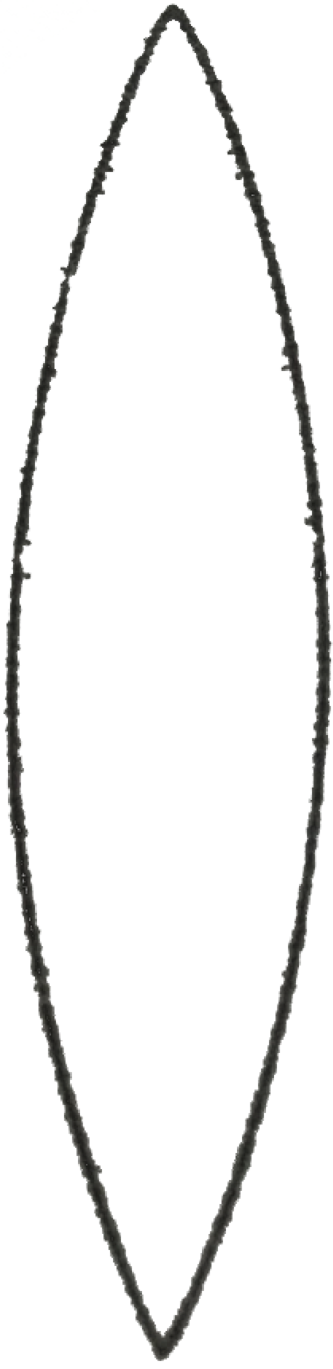
2. The layered lens shown in Figure. , is made of kinds of glasses. How many and what kind of images will be produced by this lens with a point source placed on the optical axis? Neglect the reflection of light at the boundaries between layers.



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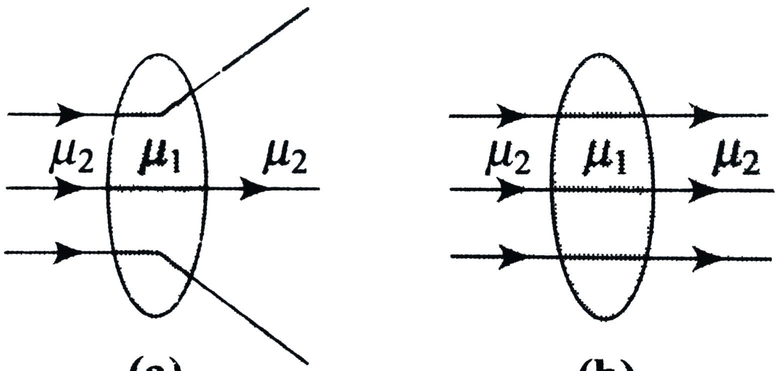
3. What is the relation between the refractive indices μ, μ_1 and μ_2 if the behaviour of light rays is shown in Figure.



(a) (b)

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4. Can a single lens ever form a real and erect image?

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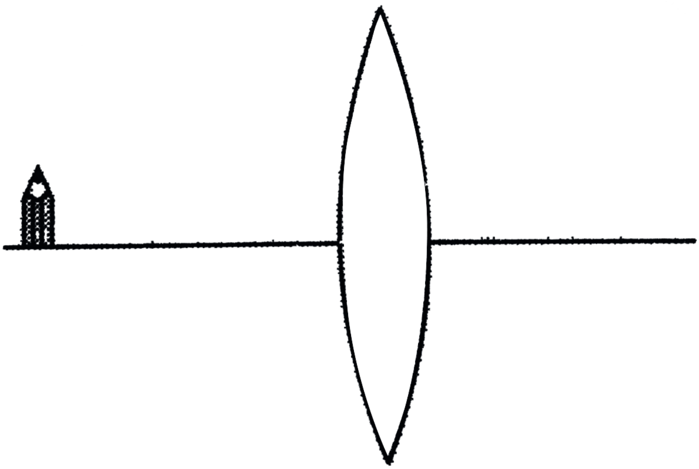
5. A pencil of height 1cm is placed 30cm from an equiconvex lens, refractive index $n = 3/2$, radius of curvature for both the surfaces, $R_1 = R_2 = R = 10cm$

Find the location of the image and descrive characteristics.



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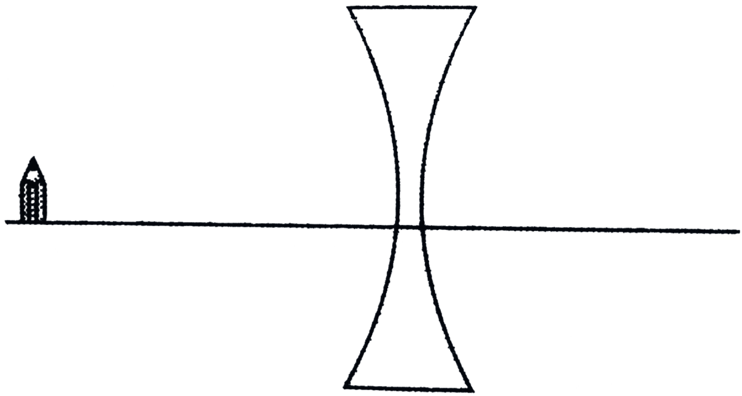
6. If in the previous example, we use a diverging lens with a focal length $10.0cm$ to form an image of the pencile kept 15 cm in front of the lens, locate and characterize the image.



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7. Solve the problem similar to the previous on if A and A' are interchanged.

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8. A biconvex lens has radii of curvature 20 cm and 40cm. The refractive index of the material of the lens is 1.5. An object is placed 40cm in front of the lens. Calculate the psition of the image.

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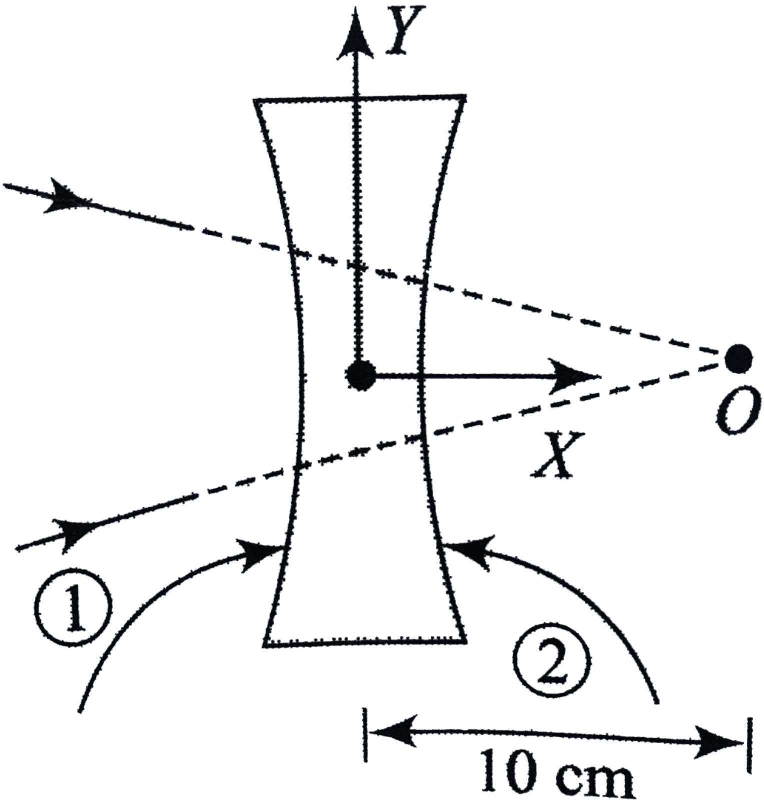
9. A converging bundle of rays is intercepted by a biconcave lens. The radii of curvature of both surfaces are 20cm and the refractive index of the material of the lens is 1.5. If the rays originially converged to a point 10cm in front of the lens, where will they now converge after passing through the lens?



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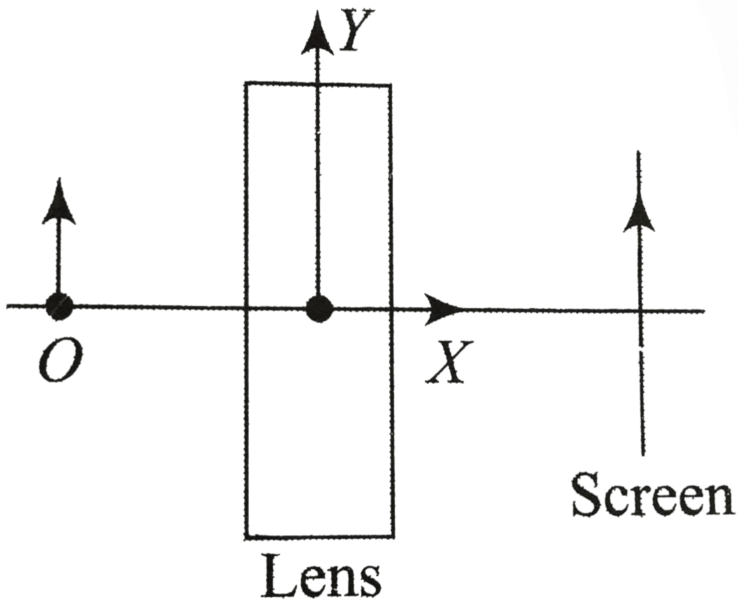
10. A candle is placed 15cm in front of a lens. If the image of the candle captured on a screen is magnified two time, calculate the focal length and nature of the lens.



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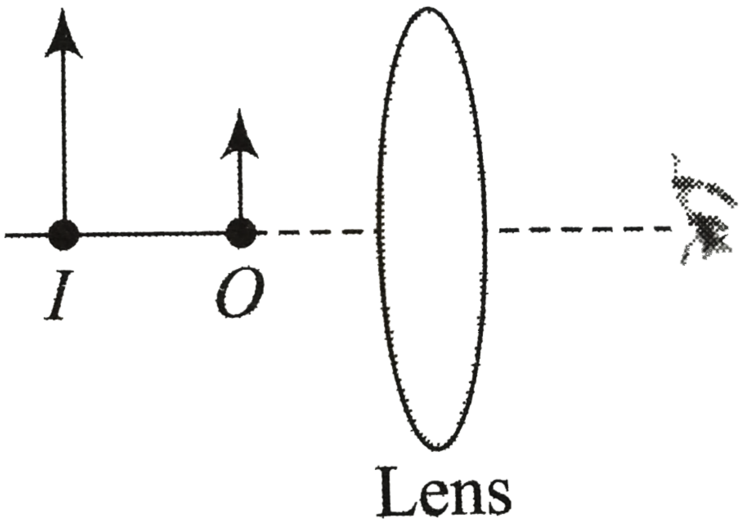
11. A man wishes to view an object through a convex lens of focal length 10cm. The final image is to be eret and magnified 2 times. How far from the object must he hold the lens?



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12. An object is placed 12cm in front of a lens to form an image on a screen. The size of the image is twice that of the object. What is the distance between the object and the image?

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13. An object is placed in front of a concave lens. A virtual image of the object is formed on the same side of the lens as the object but is closer to the lens. Will rays form this image refract once again at the lens to form a second image?

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14. A biconvex lens of focal length 20cm, made of glass or refractive index 1.5, has water $(\mu = 1.33)$ on one side and air on the other. An object is placed 15 cm form the lens on the side with water. Where is the image formed?

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15. A point source is placed on the axis of a symmetrical convex lens of focal length 20 cm at a distance of 40cm. If the lens is raised by 1cm, by how much will the image be lifted relative to the previous axis?

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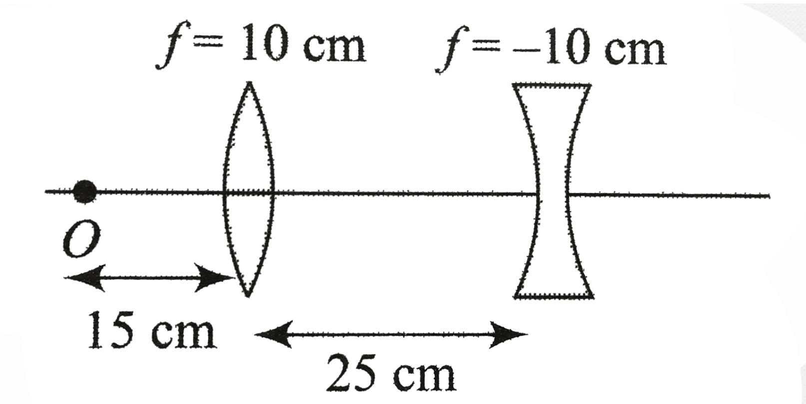
Exercise1.7

1. In Figure. , find the position of final image formed.



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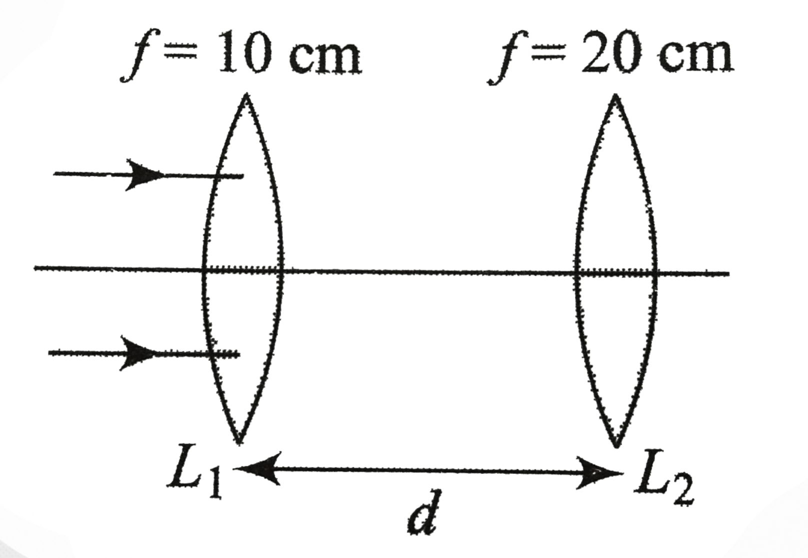
2. Figure, shown two converging lenses. Incident rays are parallel to the principal axis. What should be the value of d so that final rays are also parallel?

Here, the diameter of ray beam become wider.



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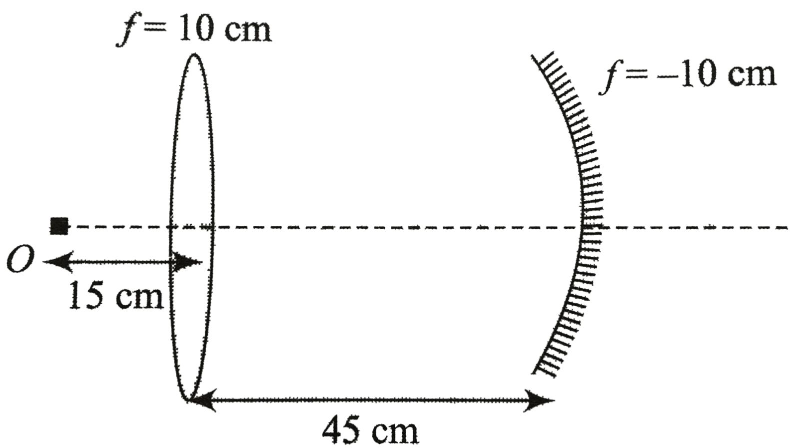
3. In Figure., find the position of final image formed.



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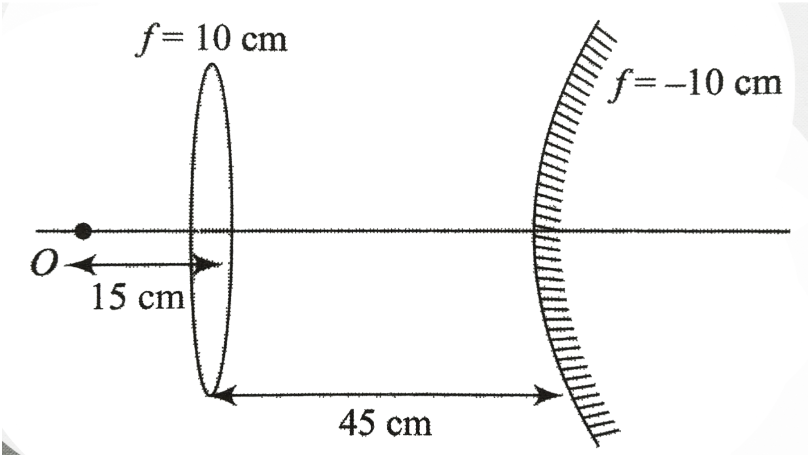
4. In Fig. what should be the value of d so that image is formed on the object itself .



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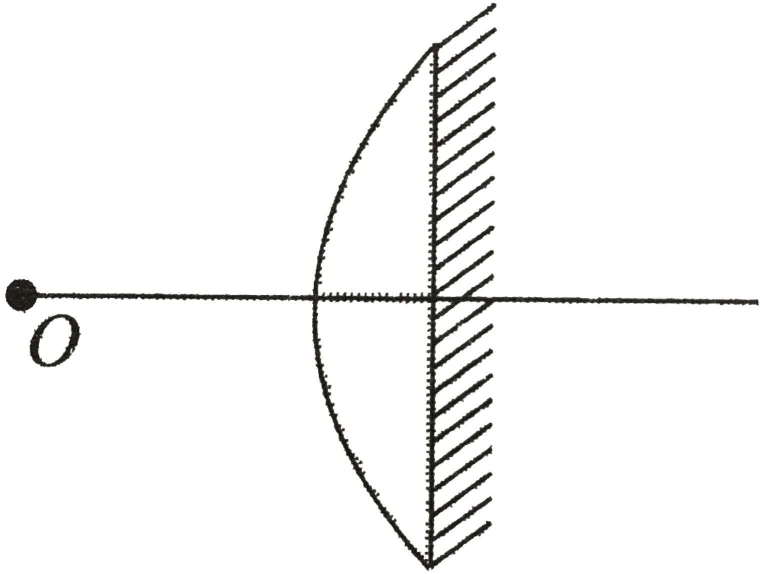
5. In Fig,, if the image of object O has to coincide with itself, then where must the object be placed at a distance from the lens?



$R = 30$ cm

$\mu = 1.5$

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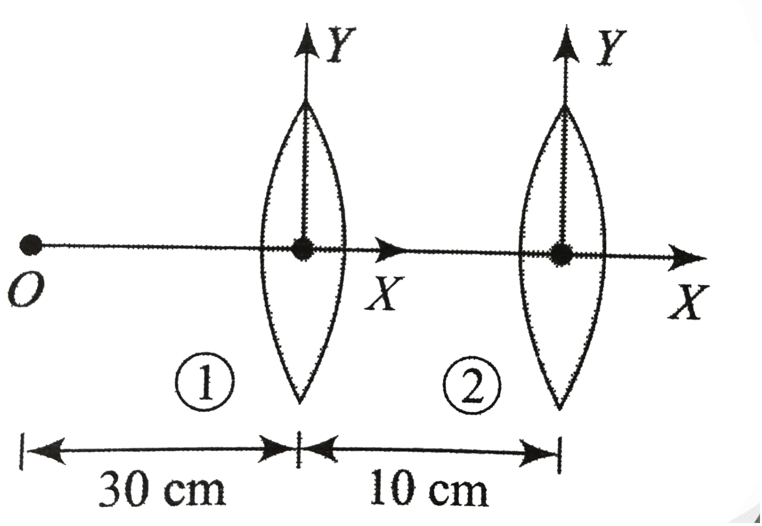
6. A convex lens of focal length 20cm is placed 10cm away from a second convex lens of focal length 25 cm. What wil be the location of

the image of an object at 30 cm in front of the first lens?



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7. When an object is placed at the proper distance ot the left of a converging lens, the image is focused in a screen 30 cm to the right of lens. A dieverging lens is now placed 15 cm to the right of the converging lens and it is found that the screen must be moved $19.2cm$ farther to the right to obtain a sharp image. Find the focal length of the diverging lens.

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8. A telephoto combination consists of convex lens of focal length 30cm and a concave lens of focal length 15cm, the separation between two lens is 27.5cm. Where should be the photographic plate placed in order to photograph an object 10m in front of the first lens?

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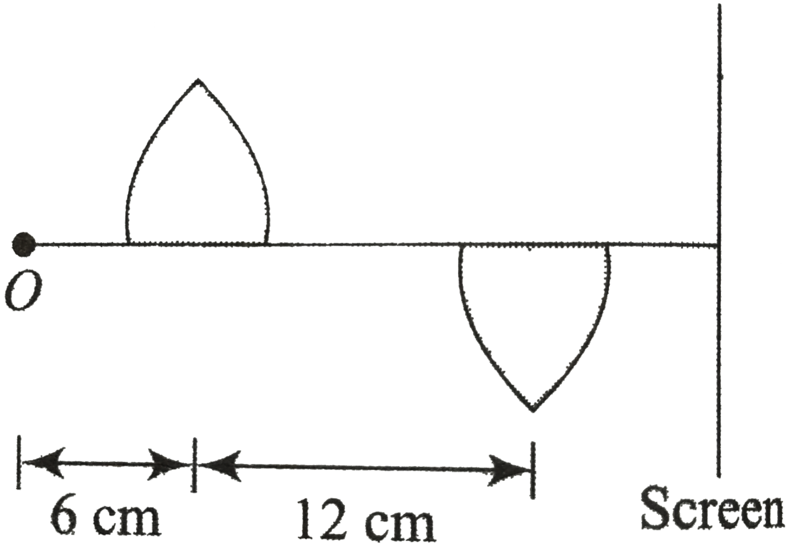
9. A convex lens is cut in half along its principal axis and the two halves are separated by a distance of 12cm. An object is placed 6cm in front of the lens as shown in Figure., Two sharp images are formed on the screen placed 80cm from the object. What is the focal length of the lens?



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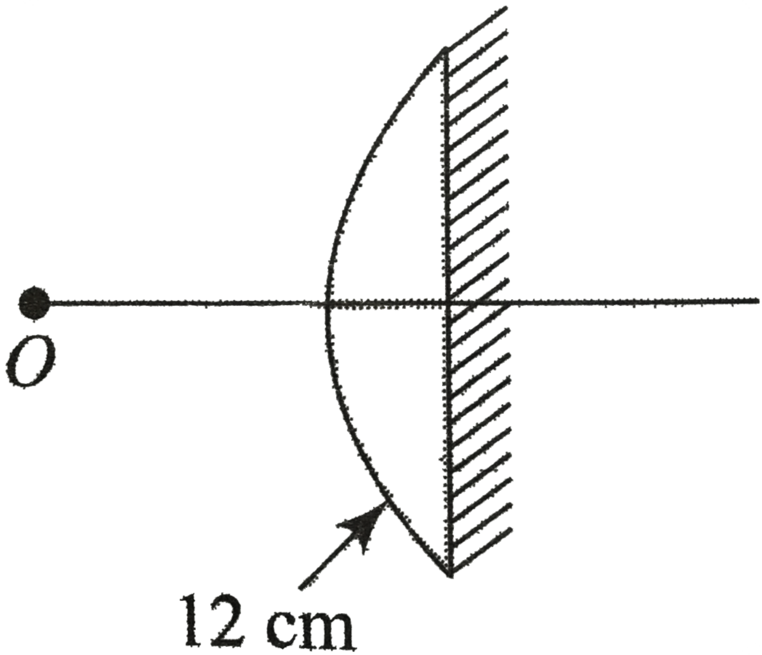
10. A plano-convex lens is silvered on its plane side. The radius of curvature of the other face is 12cm and the refractive index of the material of the lens is 1.5. An object is placed 24 cm in front of the silvered lens. Where will the image be formed?



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11. A convex lens of focal length 10cm is placed 30 cm in front of a second convex lens also of th esame focal length. A plane mirror is placed after the two lenses. Where should a point object be placed in front of the first lens so that it imagees on to itself?

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12. A concave mirror of focal length 30 cm is placed on the flat horizontal surface with its concave side up. Water with refractive index 1.33 is poured into the lens. Where should an object be placed if its image is to be captured on a screen with a magnification of 2?

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13. The convex side of a thin concavo-convex lens of glass of refractive index 1.5 has a radius of curvature of 20cm. The concave surface has a radius of curvature of 60cm. What is the focal length of the lens? The convex side is silvered and placed on a horizontal surface. What is the effective focal length of the silvered lens? The concave part is filled with water with refractive index 1.33. What is the effective focal length of the combined glass and water lens? If the convex side is silvered what is the new effective focal length of the silvered compound lens?

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14. The source is placed 30 cm from a convex lens which has a focal length of 20cm. The source is initially located on the axis of the lens. The lens is then cut into two halves in a plane along the principal axis. The two halves are separated by a distance of 4mm. What will be the locations of the image of the source?

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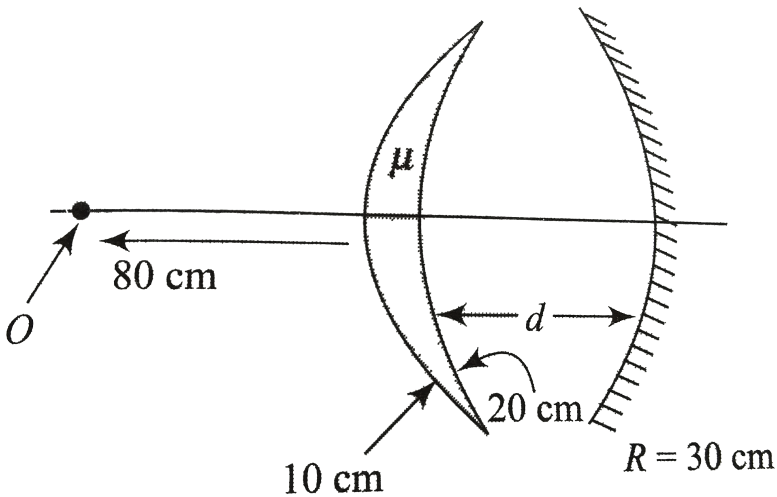
15. If final image after two refractions through the lens and one reflection from the mirror forms at the same point O. Refrative index of the material of the lens $\mu = 3/2$. Then find d.



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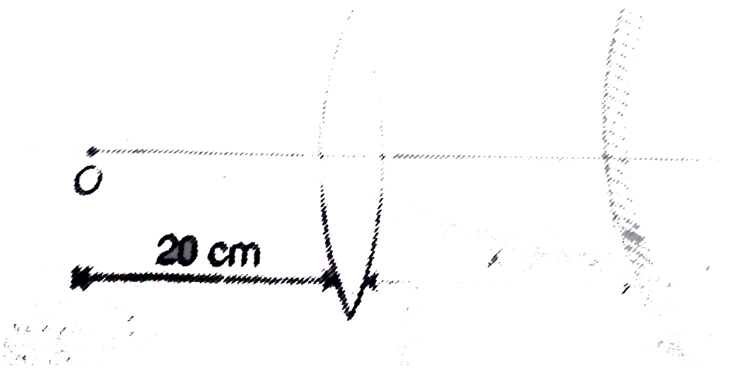
16. A point object O is placed at a distance of 20 cm from a convex lens of focal length 10 cm as shown in figure. At what distance x from the lens should a concave mirror of focal length 60 cm, placed so that final image coincides with the object ?



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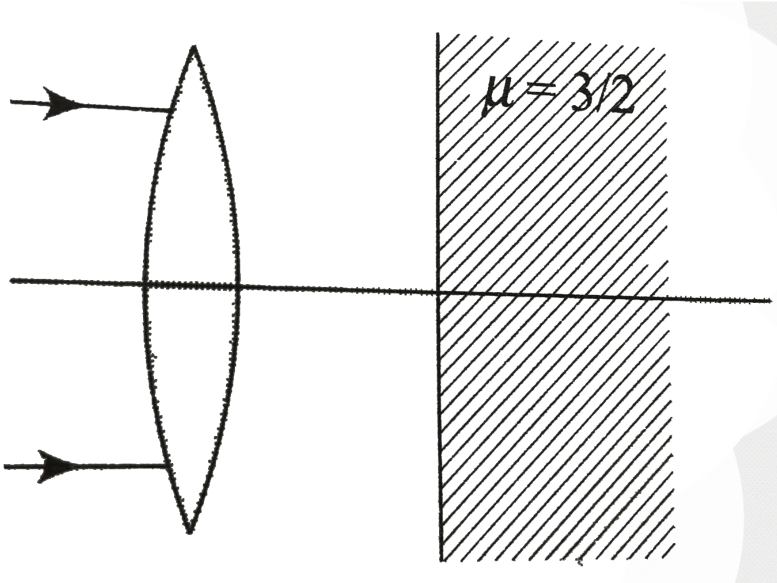
17. The focal length of a thin convex-lens is 30cm. At a distance of 10 cm from the lens there is a plane refracting surface fo refractive inidex

$3/2$ Where will parallel rays incident on lens converge?



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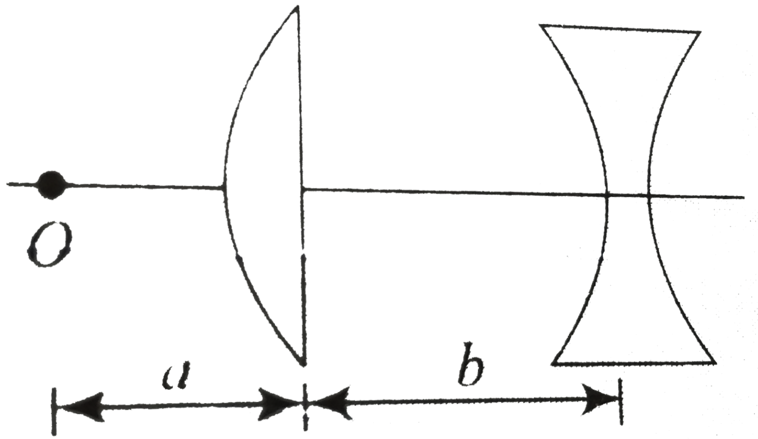
18. A plano-convex glass lens $\left(\mu_g = 3/2\right)$ of radius of curvature $R = 10cm$ is placed at a distance of b from a concave lens of focal length 20cm. What should be the distance a of point object O from the

plano-convex lens so that position of final image is independent of b?



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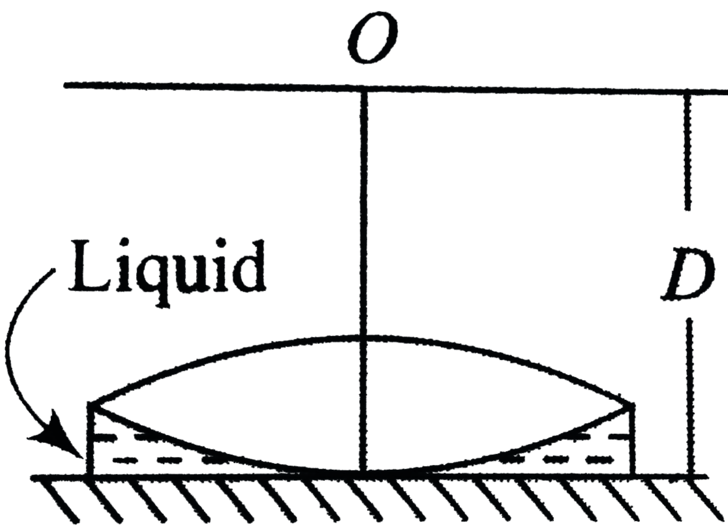
19. On a horizontal plane mirror, a thin equiconvex lens of glass is placed and when the space between the lens and mirror is filled with a liquid, an object held at a distance D which is 30cm vertically above the lens is found to coincide with its own image as shown in Figure. If equiconvex lens of glass has refractive index $\mu = 1.5$ and radius of

curvature $R = 20cm$ then find refractive index of the liquid.



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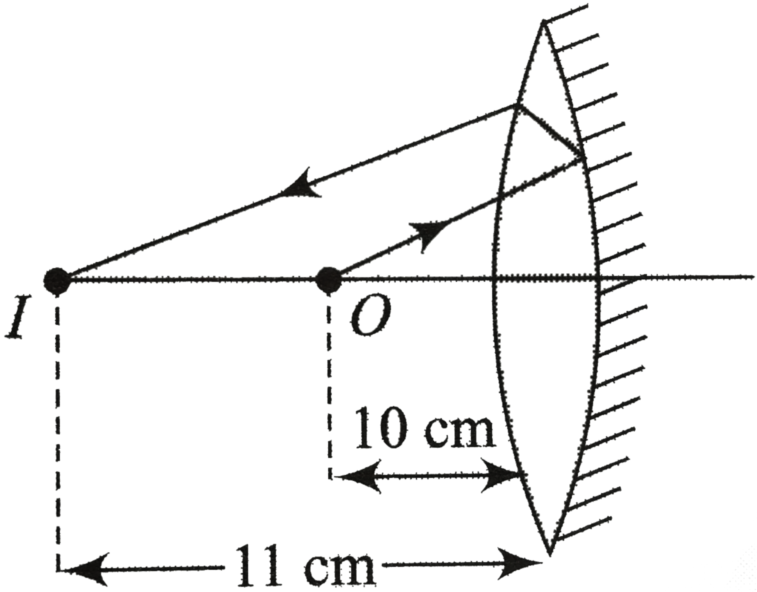
20. A pin is placed 10cm in front of a convex lens of focal length 20cm, made of a material having refractive index 1.5 . The surface of lens farther away from the pin is silvered and has a radius of curvature 22cm. Determine the position of the final image. Is the image real or virtual?



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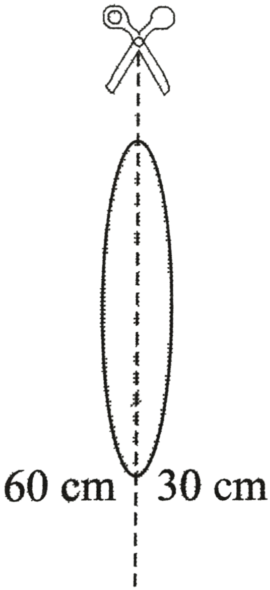
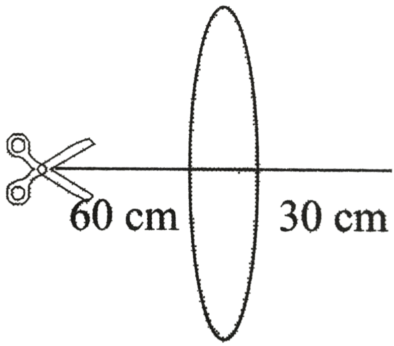
21. A convex lens of glass $(\mu = 1.5)$ is formed by combining two surfaces of radii $R_1 = 60cm$ and $R_2 = 30cm$. It is cut into two parts in two different ways as shown in Figure .



(a)



(b)

Find:

a. the focal length of the lens.

b. in figure (a), the focal length of left portion and that of the right portion.

c. in figure (b), the focal length of the upper part and that of the lower part.

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Subjective

1. A ray of light is falling on a glass sphere of $\mu = \sqrt{3}$ such that the incident ray and the emergent ray, when produced, intersect at a point on the surface of the sphere. Find the value of angle of incidence.

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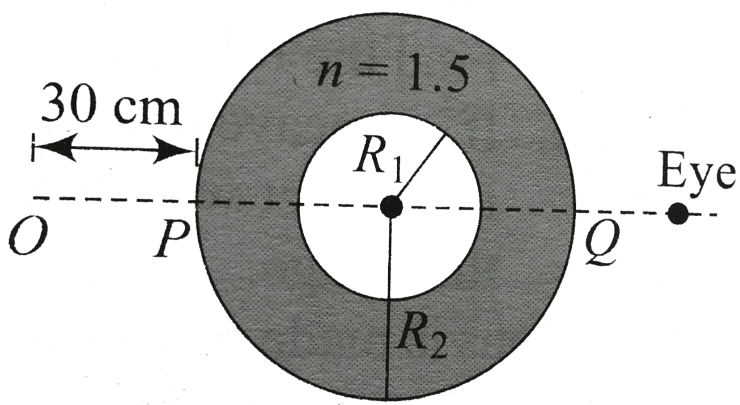
2. There is a spherical glass shell of refractive index 1.5, inner radius 10 cm and outer radius 20 cm. Inside th espherical cavity, there is air. A point object is placed at a point O at a distance of 30cm from the outer spherical surface. Find the final position of th eimage as seen eye.



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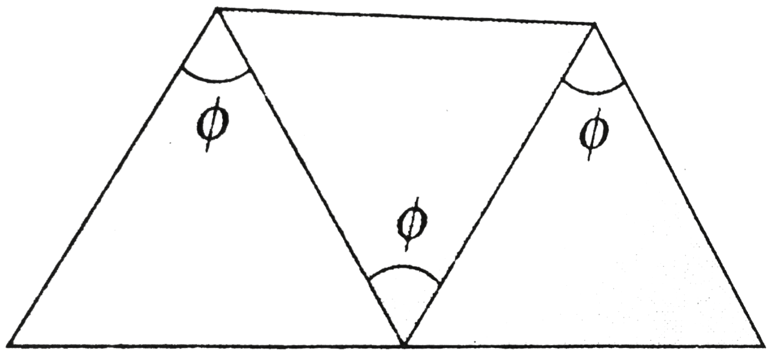
3. A direct-vision prism is made out of three prisms, each with a refracting angle of $\phi = 60^\circ$, attached to each other as shown in Figure. Light of a certain wavelength is incident on the first prism. The angle of incidence is 30° and the ray leaves the third prism parallel to the direction of incidence. The refractive index of the glass of the first and third prisms, is 1.5. Find the refractive index of the material of the middle prism. $(\sqrt{6} = 2.45)$



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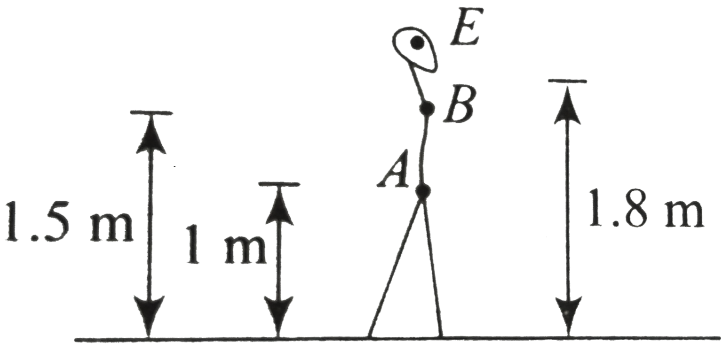
4. A person wants to see AB part of his image. His eye level is at 1.8m above the ground. If he uses minimum size of mirror required for this, find the height of the lowest point of mirror above the ground.



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5. The internal surface of the walls of a sphere is specular. The radius of the sphere is $R = 36cm$. A point source S is placed at a distance $R/2$ from the cneter of the sphere and sends light to the remote part of the sphere. Where will the image of the source be after two successive reflections from the remote and then nearest wall of the sphere? How will the position of the image change if the source sends light to the nearest wall first?Consider paraxial rays.

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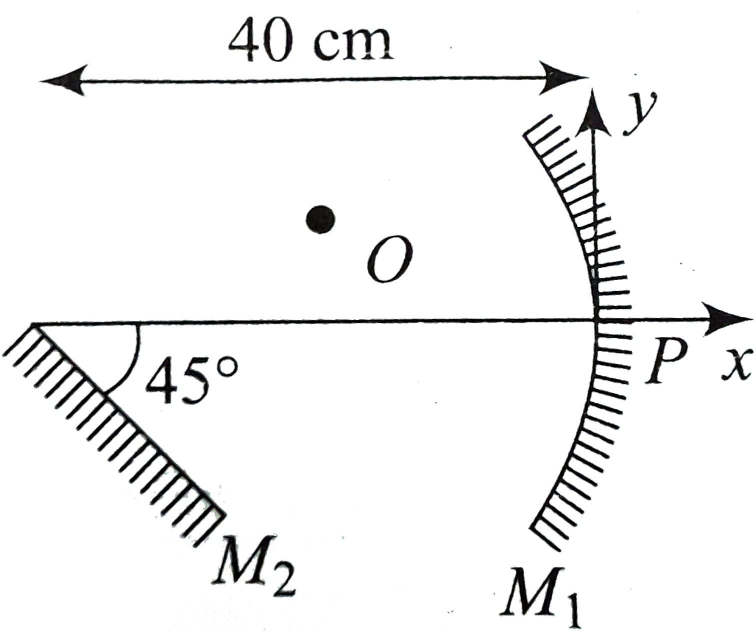
6. As shown in Figure,. And object O is at the position (-10,2) with respect to the origin P. The concave mirror M_1 has radius of curvature 30cm. A plane mirror M_2 is kept at a distance of 40cm in front of the concave mirror. Considering first refletion on the concave mirror M_1 and second on the plane mirror M_2. Find the coordinates of the second image w.r.t. the origin P.



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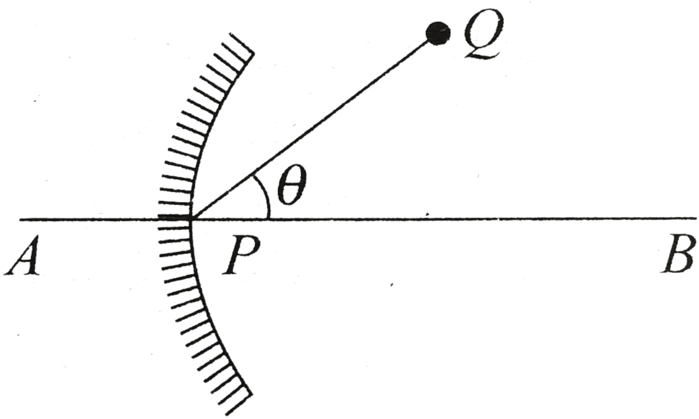
7. In figure, AB is the principal axis of the concave mirror. A point object moves on th eline PQ which makes small angle θ with the principal axis. Show that image also moves in straight line making same angle θ with principle axis .



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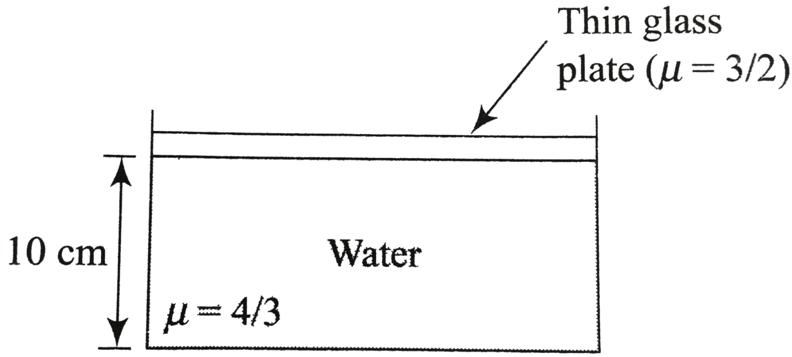
8. If an observer sees the bottom of the vessel shown in Figure., at 8cm, find the refractive index of the medium in which the observer is present.



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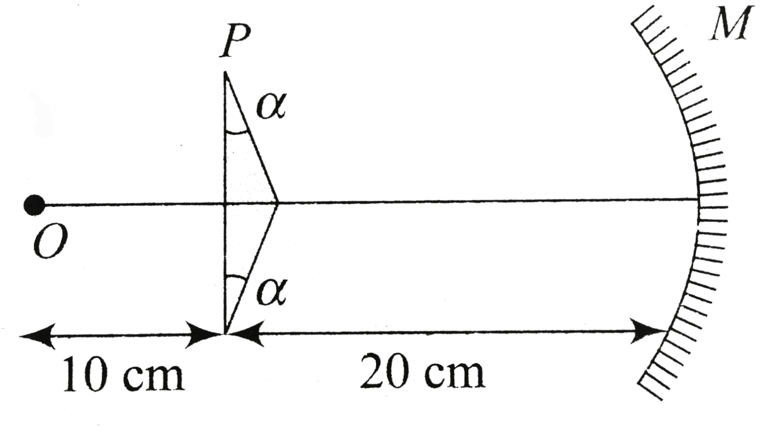
9. O is a point object kept on the principal axis of a concave mirror M of radius of curvature 20cm. P is a prism of angle 1.8° . Light falling on the prism (at small angle of incidence) gets refracted through the prism and then falls on the mirror. Refractive index of the prism is $3/2$. Find the distance between the images formed by the concave mirror due to this light.



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10. In Figure ., L is a converging lens of focal length 10cm and M Iis a concave mirror of radius of curvature 20cm. A point object O is placed in front of the lens at a distance of 15cm. Ab and CD are optical axes of the lens and mirror, respectively. Find the distance of the final image formed by this system from the optical center of the lens. The distance between CD and AB is 1cm.

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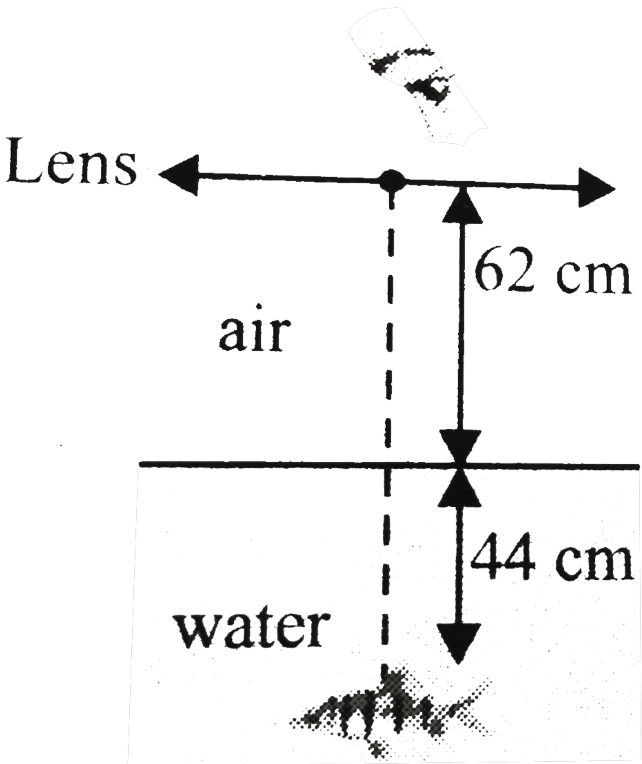
11. A stationary observer O looking at a fish F in water $(\mu_w = 4/3)$ through a converging lens of focal length $90.0cm$. The lens is allowed to fall frelly from a height $62.0cm$ with its axis vertical. The fish and the observer are on the principal axis of the lens. The fish moves up with constant velocity $100cm/s$. Initially it was at depth of $44.0cm$. Find the velocity (in cm//s) with which the fish appears to move with respect to lens to the observer at $t = 0.2s$. (take $g = 10m/s^2$)



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12. The back wall of an aqaurium is a mirror that is 30 cm away from the fron wall. The sides to the tank are negligibly thin. A fish is swimming midway between the front and back walls.

a. An image of the fish appears behind the mirror. How far dows this image appear to be from the front wall of the aquarium?

b. Would the refractive index of the liquid have to be larger or smaller in order for the image of the fish to appear in front of the mirror, rather than behind it? Find the limiting value of this refractive index. Initially, water is there in aquarium having refractive index $4/3$

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13. An object is placed 20cm to the left of a converging lens having focal length 16cm. A second, identical lens is placed to the right of the first lens, such that the image formed by the combination is of the same size and orientation as the object is. Find the separation between the lenses.

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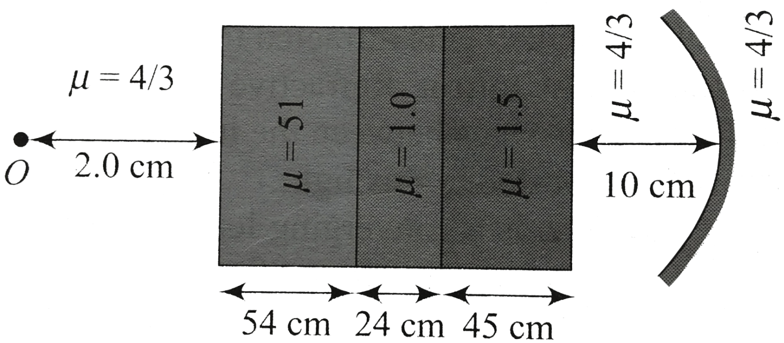
14. A composite slab consisting of different media is placed in front of a concave mirror of radius of curvature 150 cm as shown in figure., The whole arrangement is immersed in water. Locate the final image of point object O.



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15. A parallel beam of light falls on the surface of a convex lens whose radius of curvature of both sides of 20cm. The refractive index of the material of the lens varies as $\mu = 1.5 + 0.5r$, where r is the distance of the point on the aperture from the optical centre in cm. Find the length of the region on the axis of the lens where the light will appear. The radius of aperture of the lens is 1cm.

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16. A thin biconvex lens of refractive index $3/2$ and radius of curvature 50cm is placed on a reflecting convex surface of radius of curvature 100cm. A point object is placed on the principal axis of the system such that its final image coincides with itself. Now, few drops of a transparent liquid is placed between the mirror and lens such that final image of the object is at infinity. Find refractive index of the liquid used. Also, find the position of the object.

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17. A convex lens of focal length f_1 is placed in front of a luminous point object. The separation between the object and the lens is $3f_1$. A glass slab of thikness t is placed between the object and the lens. A real image of the object is formed at the shortest possible distance from the object.

a. Find the refractive index of the slab.

b. If a concave lens of very large focal length f_2 is placed in contact with the convex lens, find the shifting of the image.

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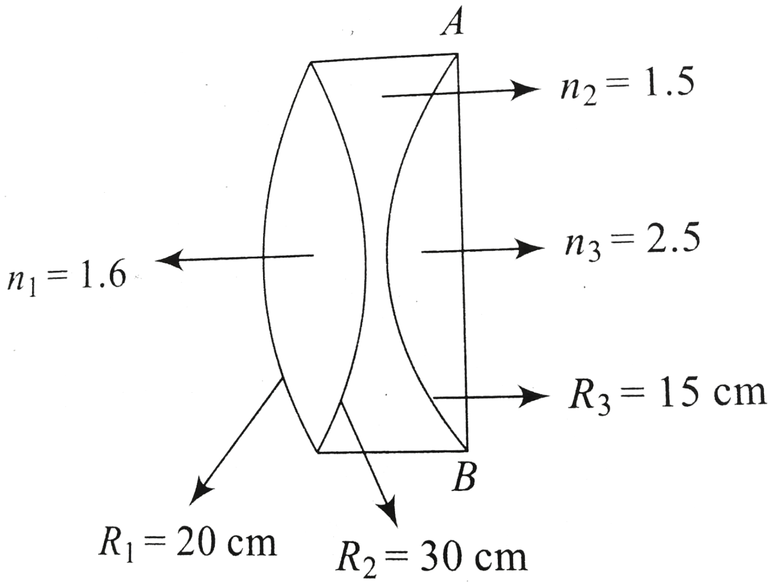
18. A lens is made of three thin different mediums. Radius of curvature and refractive index of each medium is shown iin Figure., Surface AB is straight. An object is placed at some distance from the lens by which a real image is formed on the screen placed at a distance of 10cm from the lens. Find the distance of the object from the lens.



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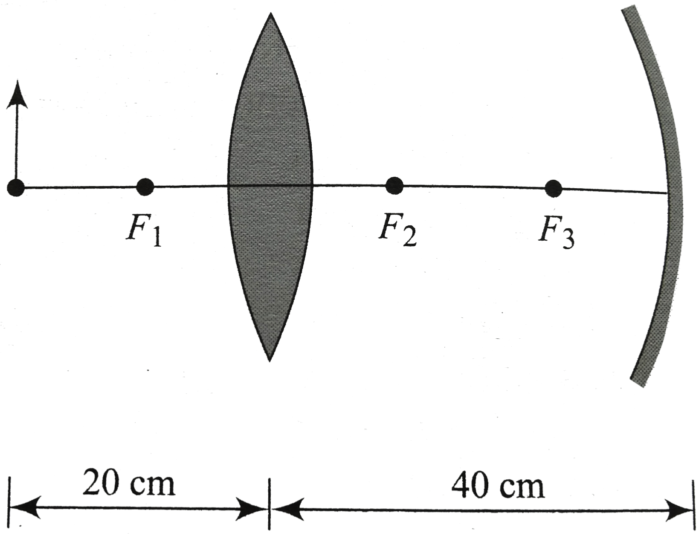
19. An equiconvex lens, $f_1 = 10cm$, is placed 40 cm in front of a concave mirror, $f_2 = 7.50cm$ as shown in Figure ., An object 2 cm high is placed 20cm to the left of the lens . Find the position of the final image is formed when leftward travelling rays once again pass through the lens. Find overall magnification.



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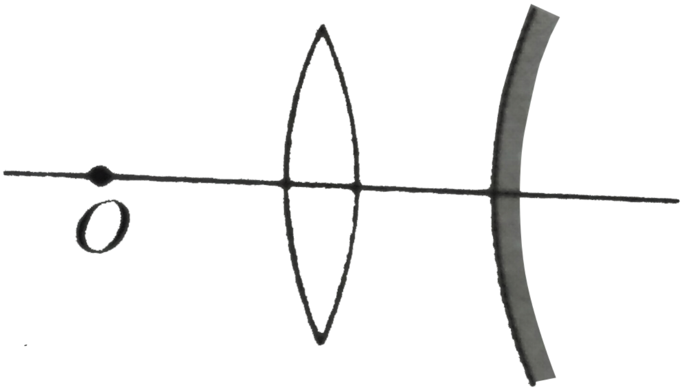
20. A biconvex lens, $f_1 = 20cm$, is placed 5cm in front of a convex mirror, $f_2 = 15cm$. An object of length 2 cm is placed at a distance 10cm from the lens.

Find the loaction and nature of the final image after the leftward travelling rays once again pass through the lens. Find overall magnification.



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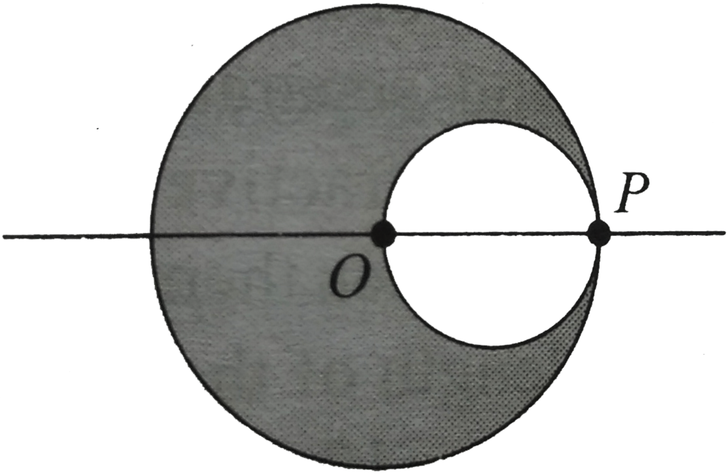
21. A transparent sphere of radius R ahs a cavity of radius $R/2$ as shown in figure,. Find the refractive index of the sphere if a parallel beam of light falling on left sureface focuses at point P.



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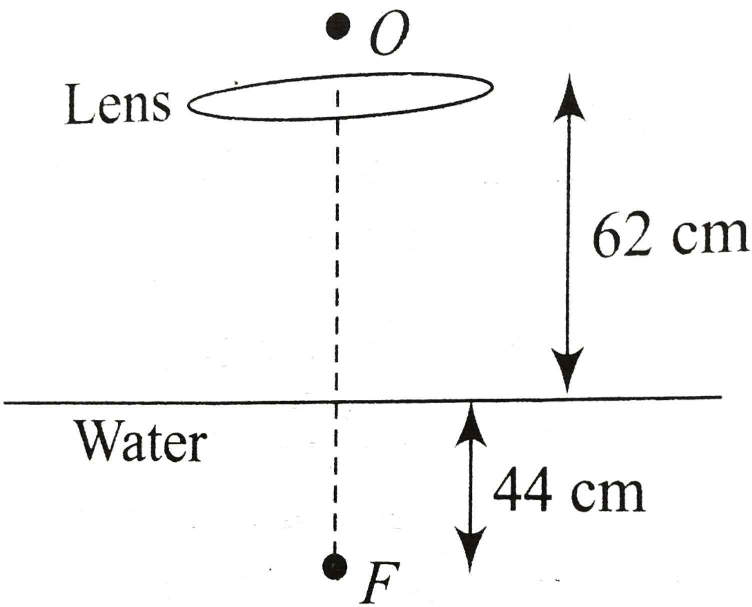
22. A stationary observer O looking at a fish (in water of $\mu = 4/3$) through a converging lens of focal length $90.0 cm$. the lens is allowed to falll freely from a height of $62.0 cm$ with its axis vertical. The fish and the observer are on the principal axis of the lens. The fish moves up with constant velocity $100 cms^{-1}$. Initially, it was at a depth of $44.00 cm$. Finally the velocity with which the fish appears to move to the observer at $t = 0.2$ sec.



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23. The bottom of glass beaker is made of a thin equiconvex lens having bottom side silver polished as shown in figure,. Now the water is filled in the baker upto a height of $h = 4m$. The image of point object floating at middle point of beaker at the surface of water coincides with it. Find out the value of radius of curvature of lens.

$(\cdot_a \mu_g = 3/2, \cdot_a \mu_w = 4/3)$

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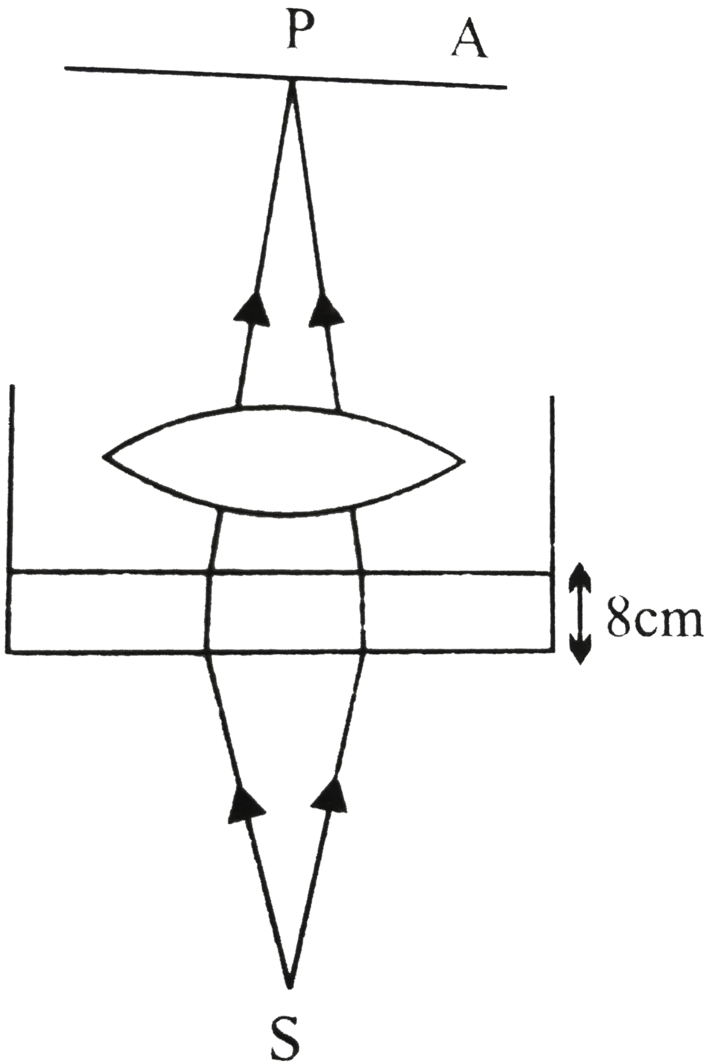
24. A thin convex lens of refractive index $\mu = 1.5$ is placed between a point source of Light S and a screen A, shown in figure,. Light rays from the source S are brought to focus on the screen A, forming a point image P. The distance SP is equal to 50cm. Water $(\mu = 4/3)$ is now poured into a vessel interposed between the object and the lens, and it is observed that when the water level is 8cm the screen has to be moved up by a distance of 6cm in order to get a sharp image. Find the focal length of the lens.



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25. A thin equi-convex glass lens (refractive index = 1.5) is being placed on the top of a vessel of height h = 20 cm as shown in the figure. A luminous point source is being placed at the bottom of the vessel on the principle axis of the lens. When air is on both sides of the lens, the image of luminous point source is found at a distance 20 cm from the lens outside the vessel. When the air inside the vessel is being replaced by a source is fomed at a distance 30 cm from the lens outside the vessel. The value of μ is

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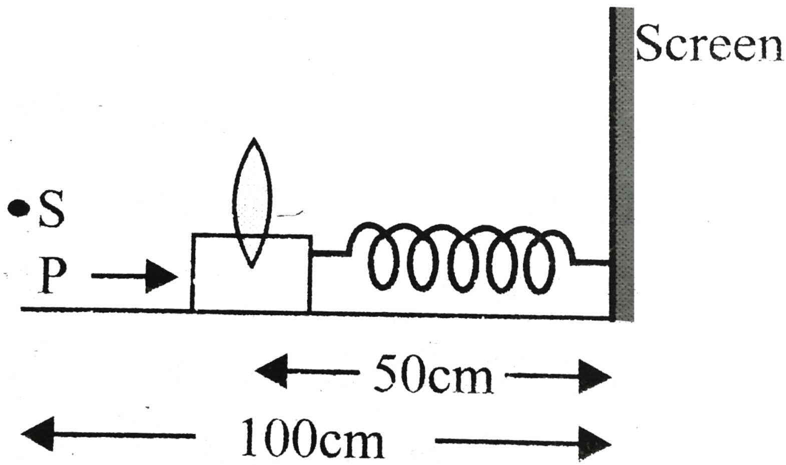
26. A point object is located at a distance of 100cm from a screen. A lens of focal length 23 cm mounted on a movable frictionless stad is kept between the source and the screen. The stand is attached to a spring of natureal length 50cm and spring constant $800N/m$ as shown in Figure . Mass of the stand with lens is 2 kg. How much impulse P should be imparted to the stand so that a real image of the object is formed on the screen after a fixed time gap? Also find this time gap. (Neglect width width of the stand)



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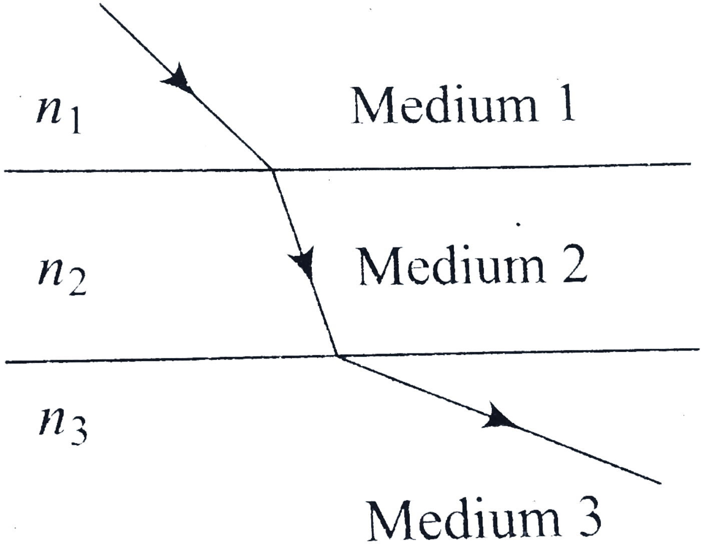
Single Correct

1. A beam of light passes from medium 1 to medium 2 to medium 3 as shown figure. What may be concluded about the three indices of refraction, n_1, n_2, and n_3 ?



A. $n_3 > n_1 > n_2$

B. $n_1 > n_3 > n_2$

C. $n_2 > n_3 > n_1$

D. $n_2 > n_1 > n_3$

Answer: d.

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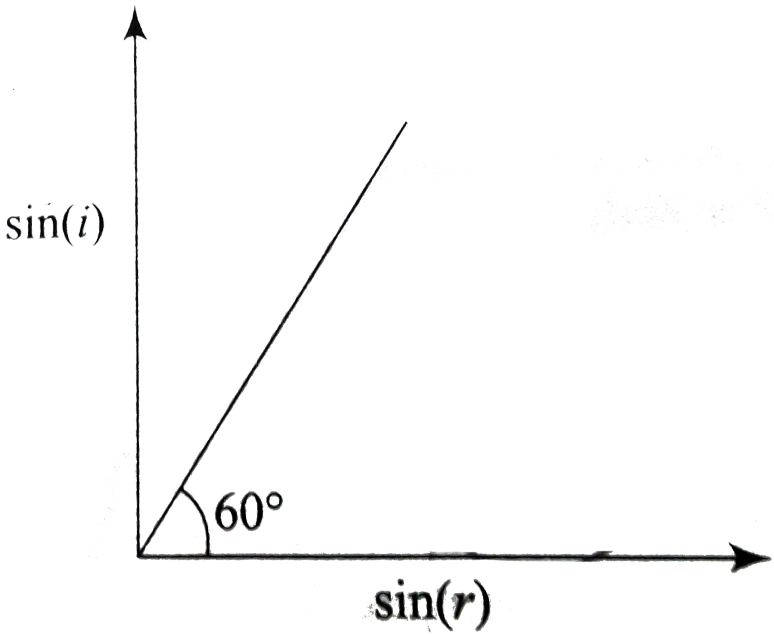
2. A ray of light is incident on a medium with angle of incidence I and refracted into a second medium with angle of refraction r. The graph of $\sin(i) vs \sin(R)$ is as shown in figure. Then the velocity of light in the first medium in n times the velocity of light in the second medium. What shoul be th evalue of n?



A. $\sqrt{3}$

B. $1/\sqrt{3}$

C. $\sqrt{3}/2$

D. $2/\sqrt{3}$

Answer: a.

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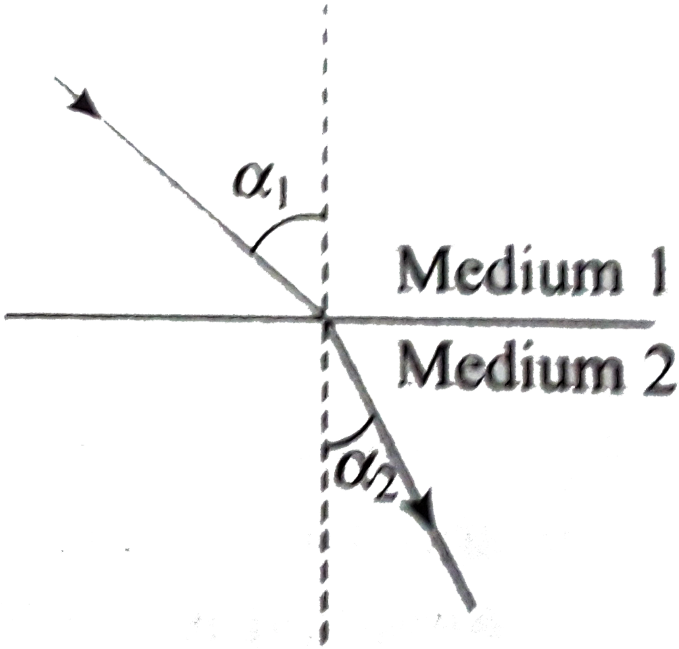
3. A beam of light propagates through a medium 1 and falls onto another medium 2, at an angle α_1 as shown in figure. After that, it propagates in medium 2 at an angle α_2 as shown. The light's wavelength in medium 1 is λ_1. What is the wavelength of light in medium



A. $\dfrac{\sin\alpha_1}{\sin\alpha_2}\lambda_1$

B. $\dfrac{\sin\alpha_2}{\sin\alpha_1}\lambda_1$

C. $\dfrac{\cos\alpha_1}{\cos\alpha_2}\lambda_1$

D. $\dfrac{\cos\alpha_2}{\cos\alpha_1}\lambda_1$

Answer: b.

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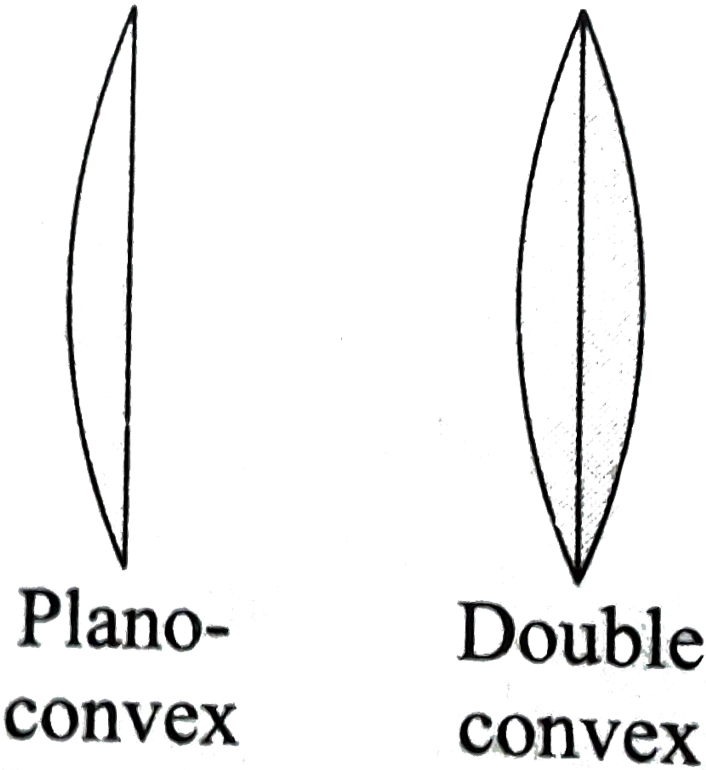
4. You are given two identical plano-convex lenses. When you palce an object 20cm to the left of a single plano-convex lens, the image appears 40cm to the right of the lens. You then arrange the two plano-convex lenses back to back to form a double convex lens. If the object is 20cm to th eleft of this new lens, what is the approximate location of the image?



A. 10cm to the right of the lens

B. 20cm to the right of the lens

C. 80cm to the right of the lens

D. 80 cm to the left of the lens

Answer: a.

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5. Light from a denser medium 1 passes to a rarer medium 2. When the angle of incidence is θ the partially reflected and refracted rays are mutually perpendicular. The critical angle will be

A. $\sin^{-1}(\cot\theta)$

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

C. $\sin^{-1}(\cos\theta)$

D. $\sin^{-1}(\sec\theta)$

Answer: b.

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6. Light is incident on a glass block as shown in figure. If θ_1 is increased slightly, what happens to θ_2

A. θ_2 also increases slightly

B. θ_2 is unchanged

C. θ_2 decreases slightly

D. θ_2 changed abruptly, since the ray experiences total internal reflection

Answer: c.

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7. A thin equi-convex $\left(\mu = \frac{3}{2}\right)$ lens of focal length 10 cm is cut and separated. A material of $\mu = \frac{5}{2}$ is introduced between between them. The flat portion of one of the part is silvered as shown in figure. The focal length of new combination is

A. $-10cm$

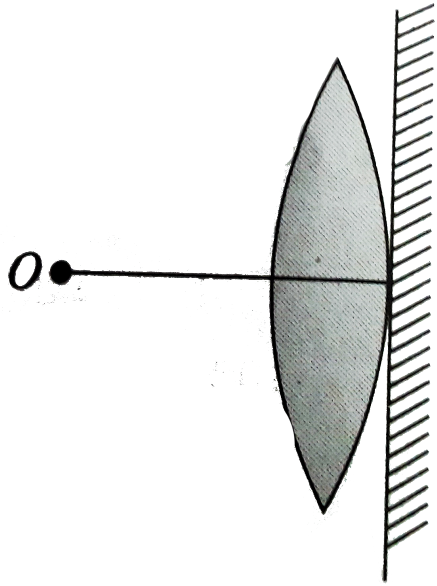
B. $-10/4cm$

C. $-10/3cm$

D. None of these

Answer: c.

8. Behind a thin converging lens having both the surfaces of the same radius 10cm, a plane mirror has been placed. The image of an object at a distance of 40 cm from the lens is formed at the same position. What is the refractive index of the lens?



A. 1.5

B. $5/3$

C. $9/8$

D. None of these

Answer: c.

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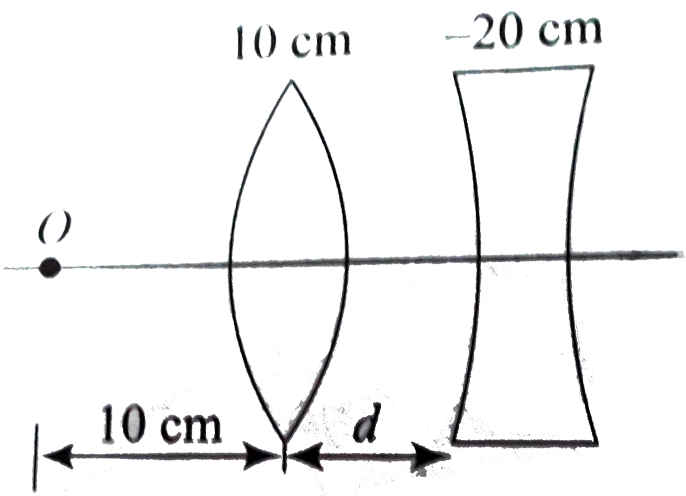
9. What should be the value of distance d so that final image is formed on the object itself. (Focal length of the lenses are written on the lenses.)



A. 10cm

B. 20cm

C. 5cm

D. None of these

Answer: a.

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10. A ray of light passes from glass, having a refractive index of 1.6, to air. The angle of incidence for which the angle of refraction is twice the angle of incidence is

A. $\sin^{-1}\left(\frac{4}{5}\right)$

B. $\sin^{-1}\left(\frac{3}{5}\right)$

C. $\sin^{-1}\left(\frac{5}{8}\right)$

D. $\sin^{-1}\left(\frac{2}{5}\right)$

Answer: b.

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

A. is greater than zero but less than 1.5

B. is greater than 1.5 but less then 2.0

C. is greater than 1.0 but less than 1.5

D. None of these

Answer: c.

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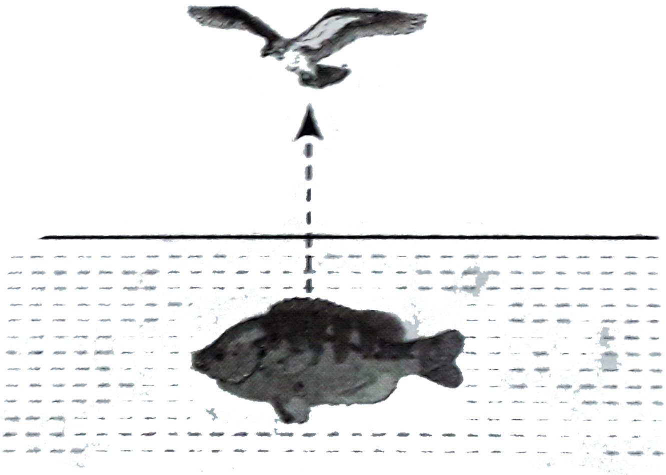
12. A fish is vertically below a flying bird moving vertically down toward water surface. The bird will appear to the fish to be



A. moving faster than its speed and also from thereal distance

B. moving faster than its real speed and nearer than its real distance

C. moving slower than its real speed and also nearer than its real distance

D. moving slower than its real speed and away from the real distance

Answer: a.

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13. 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. 45°

C. 60°

D. Either 30° or 60°

Answer: c.

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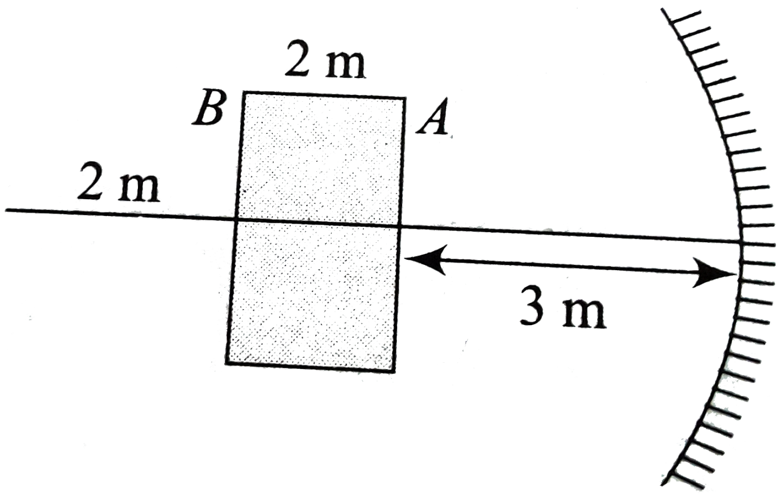
14. A cube of side 2m is placed in front of a concave mirror of focal l ength 1m with its face A at a distance of 3m and face B at a distance of 5m form the mirror. The distance between the images of faces A and B

and heights of images of A and B are , repectively,



A. $1m, 0.5m, 0.25m$

B. $0.5m, 1m, 0.25m$

C. $0.5m, 0.25m, 1m$

D. $0.25, 1m, 0.5m$

Answer: d.

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15. A plano-convex lens when silvered ono the plane side behaves like a concave mirror of focal length 60 cm. However, when silvered on the convex side, it behaves like a concave mirror of focal length 20cm. Then, the refractive index of the lens is

A. 3.0

B. 1.5

C. 1.0

D. 2.0

Answer: b.

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16. Two thin lenses are placed 5cm apart along the same axis and illuminted with a beam of light parallel to that axis. The first lens in the path of the beam is a converging lens of focal length 10cm whereas the second is a diverging lens of focal length 5cm. If the second lens if now moved toward the first, the emergent light

A. remains parallel

B. remains convergent

C. remains divergent

D. changes form parallel to divergent

Answer: d.

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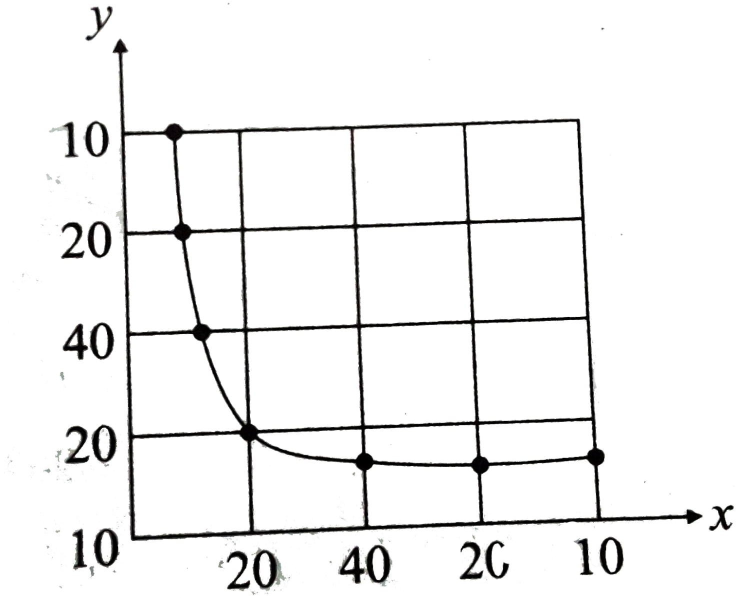
17. A lens forms a real image of an object. The distance from the object to the lens is x cm and that from the lens to the image is y cm. The graph shows the variation of y with x.

It can be deduced that the lens is



A. converging and of focal length 10cm

B. converging and of focal length 20cm

C. converging and of focal length 40cm

D. diverging and of focal length 20cm

Answer: a.

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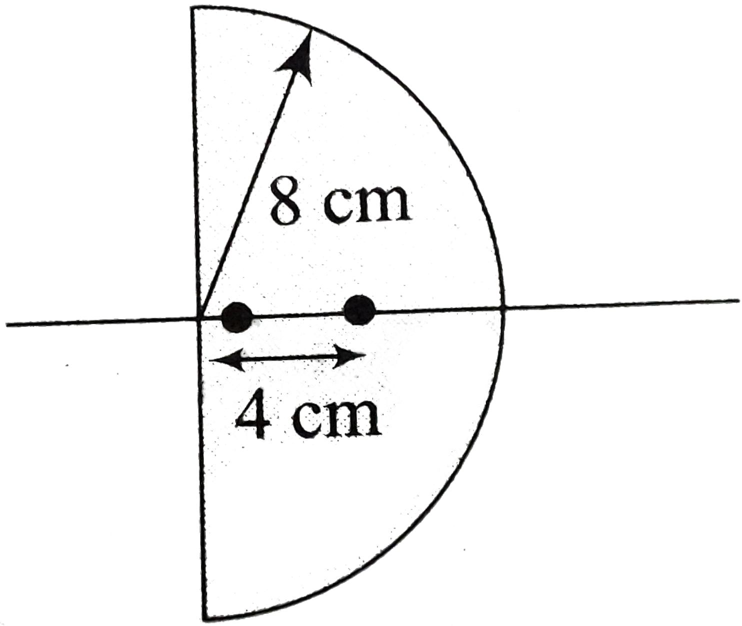
18. A plastic hemisphere has a radius of curvature of 8cm and an index of refraction of 1.6. On the axis halfway between the plane surface and the spherical one (4cm from each) is a small object O.

The distance between the two images when viewed along the axis from the two sides of the hemisphere is approximately.



A. 1.0cm

B. 1.5cm

C. 3.75cm

D. 2.5cm

Answer: d.

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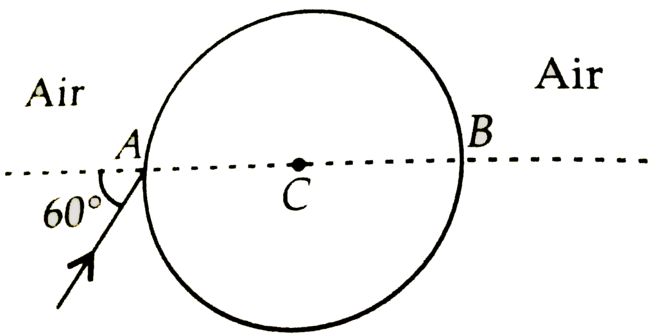
19. A ray of light on a transparent sphere with centre C as shown in the figure. The ray emerges from sphere parallel to line AB. The refractive index of sphere is



A. $\sqrt{2}$

B. $\sqrt{3}$

C. $3/2$

D. $1/2$

Answer: b.

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20. A circular beam of light of diameter $d = 2cm$ falls on a plane refractive of glass. The angle of incidence is 60° and refractive index of glass is $\mu = 3/2$. The diameter of the refracted beam is

A. 4.00cm

B. 3.0cm

C. 3.26cm

D. 2.52cm

Answer: c.

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21. Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be $(\mu_g = 3/2, \mu_w = 4/3)$

A. less than θ_2

B. between θ_1 and θ_2

C. greater than θ_2

D. less than θ_1

Answer: c.

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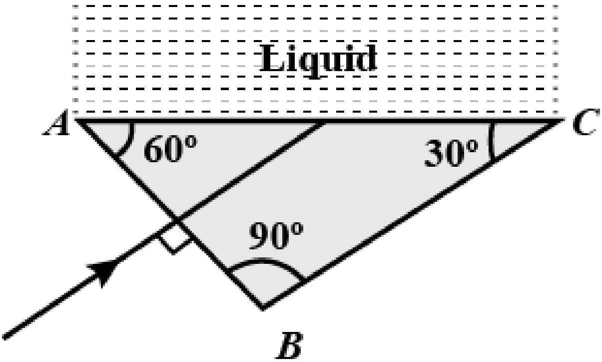
22. Light is incident normally on face AB of a prism as shown in Figure. A liquid of refractive index μ is placed on face AC of the prism. The prism is made of glass of refractive indes $3/2$. Find the limits of μ for which total internal reflection takes place on the face AC.

(A)$\mu > \frac{\sqrt{3}}{2}$ (B)$\frac{3\sqrt{3}}{4} > \mu$ (C)$\mu > \sqrt{3}$ (D)$\mu < \frac{\sqrt{3}}{2}$



A. $\mu > \frac{3}{4}$

B. $\mu < \frac{3\sqrt{3}}{4}$

C. $\mu > \sqrt{3}$

D. $\mu < \frac{\sqrt{3}}{2}$

Answer: c.

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23. A ray of light is incident on a glass sphere of refractive index 3/2. What should be the angle of incidence so that the ray which enters the sphere does not come out of the sphere ?

A. $\tan^{-1}(2/3)$

B. 60°

C. 90°

D. 30°

Answer: c.

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24. Two identical glass $(\mu_g = 3/2)$ equiconvex lenses

A. f

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

C. $\frac{4f}{3}$

D. $\frac{3f}{4}$

Answer: d.

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25. An object is kept at a distance of $16cm$ from a thin lens and the image formed is real. If the object is kept at a distance of $6cm$ from the lens, the image formed is virtual. If the sizes of the images formed are equal, the focal length of the lens will be

A. 15cm

B. 17cm

C. 21cm

D. 11cm

Answer: d.

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26. Point object O is placed on the principal axis of a convex lens of focal length 20cm at a distance of 40 cm to the left of it. The diameter of the lens is 10cm to the right of the lens at a distance h below the principal axis, then the maximum value of h to see the image will be

A. 0

B. 5cm

C. 2.5cm

D. 10cm

Answer: c.

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27. Light of wavelength 500nm traveling with a speed of $2.0 \times 10^8 ms^{-1}$ in a certain medium enters another medium of refractive index $5/4$ times that of the first medium. What are the wavelength and speed in the second medium?

A. Wavelength (nm) speed$\left(ms^{-1}\right)$ 400 1.6×10^8

B. Wavelength (nm) speed$\left(ms^{-1}\right)$ 400 2.5×10^8

C. Wavelength (nm) speed$\left(ms^{-1}\right)$ 500 2.5×10^8

D. Wavelength (nm) speed$\left(ms^{-1}\right)$ 625 1.6×10^8

Answer: a.

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

A. air and placed in air

B. air and immersed in L_1

C. L_1 and immersed in L_2

D. L_2 and immersed in L_1

Answer: d.

Watch Video Solution

29. The velocity of light in a medium is half its velocity in air. If a ray of light emerges from such a medium into air, the angle of incidenc, at which it will be totally internally reflected, is

A. 15°

B. 30°

C. 45°

D. 60°

Answer: B

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30. A convex lens of focal length 20cm and a concave lens of focal length f are mounted coaxially 5cm apart. Parallel beam of light incident on the convex lens emerges from the concave lens as a parallel beam. Then, f in cm is

A. 35

B. 25

C. 20

D. 15

Answer: d.

Watch Video Solution

31. An equiconvex lens is made from glass of refractive index 1.5. If the radius of each surface is changed from 5cm to 6cm, then the power

A. remains unchanged

B. increases by 3.33D

C. decreases by 3.33D

D. decreases by 5.5D

Answer: c.

Watch Video Solution

32. An object is put at a distance of 5cm from the first focus of a convex lens of focal length 10cm. If a real image is formed, its distance from the lens will be

A. 15cm

B. 20cm

C. 25cm

D. 30cm

Answer: d.

Watch Video Solution

33. A luminous object is placed 20 cm from surface of a convex mirror and a plane mirror is set so that virtual images formed in two mirrors coincide. If plane mirror is at a distance of 12cm from object. Then focal length of convex

A. 20cm

B. 15cm

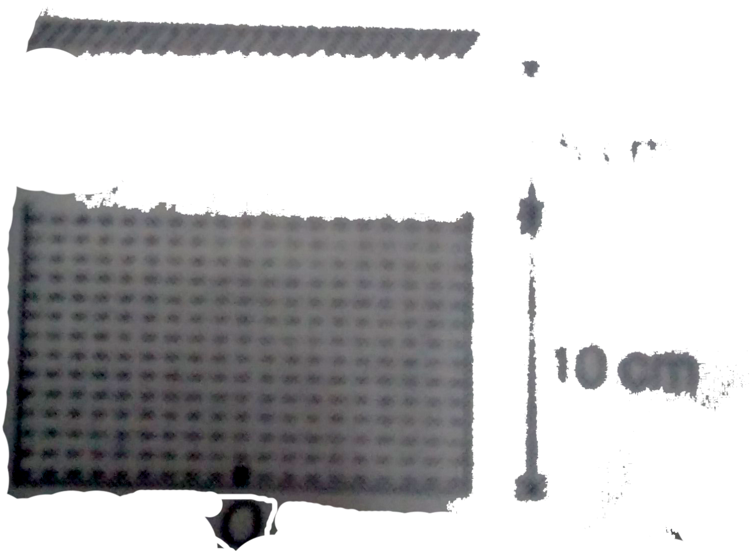
C. 10cm

D. 5cm

Answer: d.

Watch Video Solution

34. Consider the situation shown in figure. Water $\left(\mu_w = \frac{4}{3}\right)$ is filled in a breaker upto a height of 10 cm. A plane mirror is fixed at a height of 5 cm from the surface of water. Distance of image from the mirror after reflection from it if an object O at the bottom of the beaker is



A. 15cm

B. 12.5cm

C. 7.5cm

D. 10cm

Answer: b.

Watch Video Solution

35. Refraction takes place at a convex spherical boundary separating air-glass medium. For the image to be real, the object distance $(\mu_g = 3/2)$

Note Object lying in the glass.

A. greater than three times the radius of curvature of the refracting surface

B. greater than two times the radius of curvature of the refracting surface

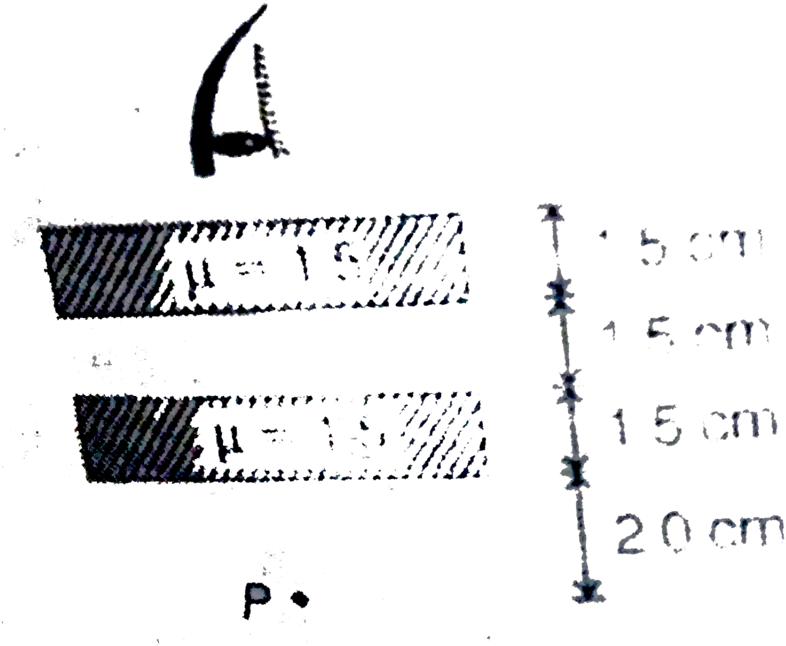
C. greater than the radius of curvature of the refracting surface

D. independent of the radius of curvature of the refracting surface

Answer: a.

Watch Video Solution

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



A. 2.0cm above P

B. 1.5 cm above P

C. 2.0cm below P

D. 1cm above P

Answer: d.

Watch Video Solution

37. The refractive index of a prism is 2. this prism can have a maximum refracting angle of

A. 90°

B. 60°

C. 45°

D. 30°

Answer: b.

Watch Video Solution

38. One of the refracting surfaces of a prism of angle of 30° is silvered. A ray of light incident at an angle of 60° retraces its path. The refractive index of the material of prism is

A. $\sqrt{2}$

B. $\sqrt{3}$

C. $3/2$

D. 2

Answer: b.

Watch Video Solution

39. Angle of minimum deviation is equal to the angle prism A of an equilateral glass prism. The angle incidence at which minimum deviation will be obtained is

A. 60°

B. 30°

C. 45°

D. $\sin^{-1}(2/3)$

Answer: a.

Watch Video Solution

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

A. $\dfrac{R}{\mu_1 - \mu_2}$

B. $\dfrac{2R}{\mu_2 - \mu_1}$

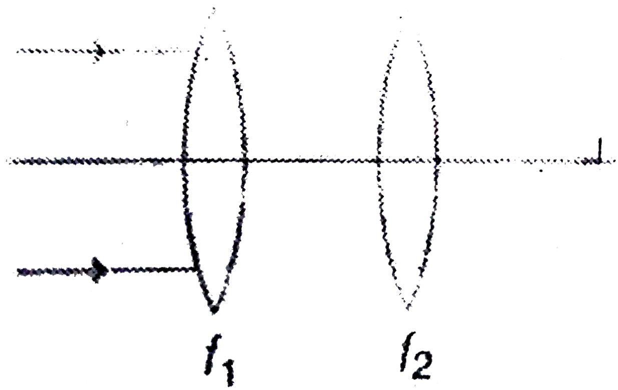
C. $\dfrac{R}{2(\mu_1 - \mu_2)}$

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

Answer: a.

Watch Video Solution

41. Parallel beam of light is incident on ths syetem of two convex lenses of focal lengths $f_1 = 20cm$ and $f_2 = 10cm$. What should be the distance between the two lenses so that rays after refraction from both the lenses pass undeviated



A. 60cm

B. 30cm

C. 90cm

D. 40cm

Answer: b.

Watch Video Solution

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

A. 10cm

B. 5cm

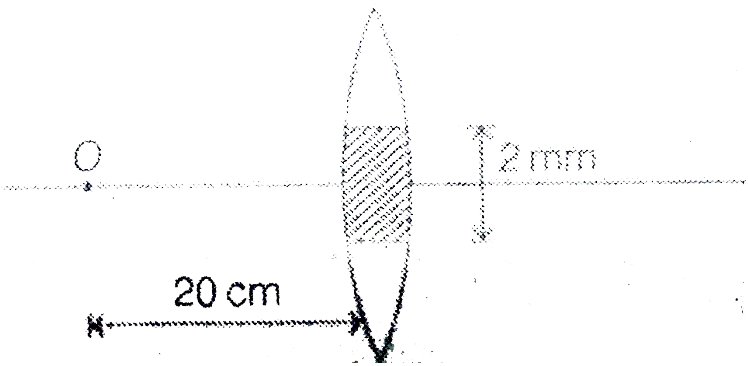
C. 20cm

D. 15cm

Answer: d.

Watch Video Solution

43. A convex lens of focal length 10 cm is painted black at the middle portion as shown in figure. An object placed at a distance of 20 cm from the lens. Then



A. only one image will be formed by the lens

B. the distance between the two images formed by such a lens is 6mm

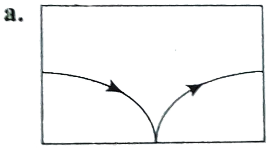
C. the distance between the images is 4mm

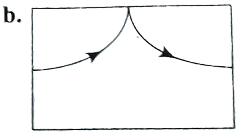
D. the distance between the images is 2mm

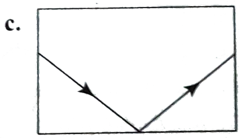
Answer: a.

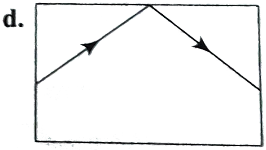
Watch Video Solution

44. A cubic container is filled with a liquid whose refractive index increases linearly from top to bottom. Which of the following represents the path of a ray of light inside the liquid ?

A. 

B. 

C. 

D. 

Answer: a.

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45. A lens forms a virtual, diminished image of an object placed at 2m from it. The size of image is half of the object. Which one of the following statements is correct regarding the nature and focal length of the lens?

A. Concave, $|f| = 1m$

B. Convex, $|f| = 1m$

C. Concave, $|f| = 2m$

D. Convex, $|f| = 2m$

Answer: c.

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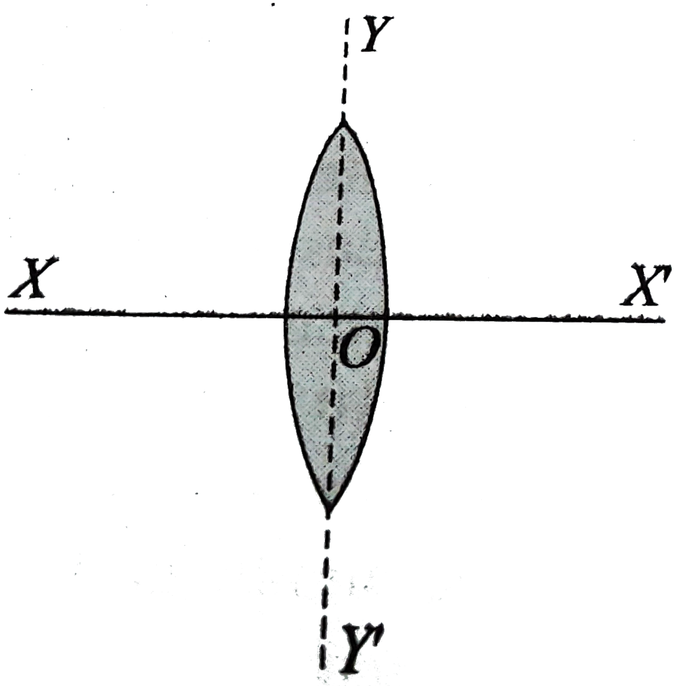
46. Two convex lenses placed in contact form the image of a distant object at P. If the lens B is moved to the right, the image will



A. move to the left

B. move to the right

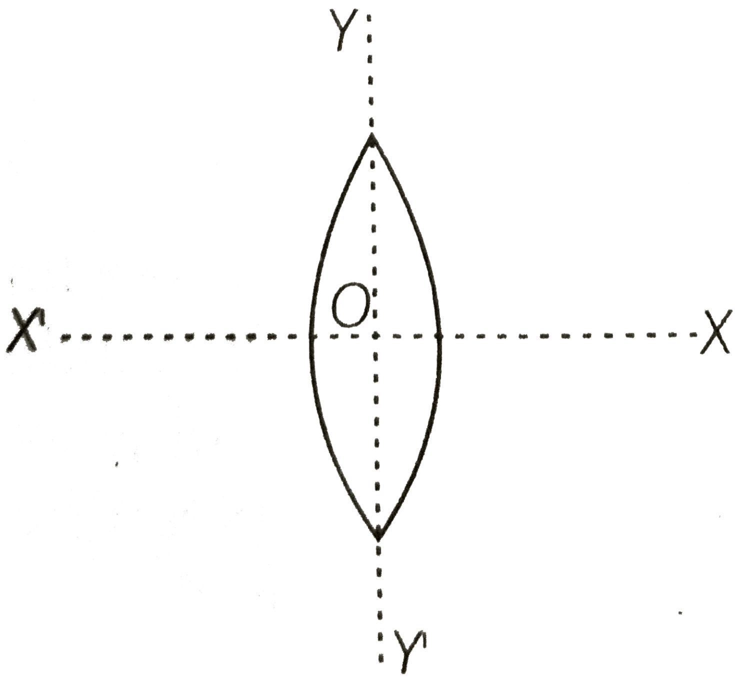
C. remain at P

D. move either to the left or right, depending upon focal lengths of the lenses.

Answer: b.

Watch Video Solution

47. An equiconvex lens in cut into two halves along (i) XOX' f,f',f'' be the focal lengths of the complete lens, of each half in case (i) and of each half in case (ii) respectively.



Choose the correct statement from the following

A. $f' = f, f^{''} = 2f$

B. $f' = 2f, f^{''} = f$

C. $f' = f, f^{''} = f$

D. $f' = 2f, f^{''} = 2f$

Answer: a.

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48. A spherical mirror forms an image of magnification3. The object distance, if focal length of mirror is 24cm, may be

A. 32cm, 24cm

B. 32cm, 16cm

C. 32cm only

D. 16cm only

Answer: b.

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49. The critical angle of light from medium A to medium B is θ. The speed of light in medium A is v. the speed of light in medium B is

A. v cosθ

B. $v / \cos \theta$

C. vsinθ

D. $v / \sin \theta$

Answer: d.

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

A. 2.5cm

B. 0.2cm

C. 16.7cm

D. 37.5cm

Answer: d.

Watch Video Solution

51. a convex lens of power $+6$ dioptre is placed in contact with a concave lens of power -4 dioptre. What will be the nature and focal length of this combination?

A. Concave, 25cm

B. Convex, 50cm

C. Concave, 20cm

D. Convex, 100cm

Answer: b.

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52. A convex lens of focal length 1.0 m and a concave lens of focal length 0.25 m are 0.75 m apart. A parallel beam of light is incident in the convex lens. The beam emerging after refraction from both lenses is

A. parallell to the principal axis

B. convergent

C. divergent

D. none of the above

Answer: a.

Watch Video Solution

53. A convex lens A of focal length 20cm and a concave lens G of focal length 5cm are kept along the same axis with the distance d between them. If a parallel beam of light falling on A leaves B as a parallel beam, then distance d in cm will be

A. 25

B. 15

C. 30

D. 50

Answer: b.

Watch Video Solution

54. A convex lens forms an image of an object placed 20cm away from it at a distance of 20cm on the other side of the lens. If the object is moves 5cm toward the lens, the image will be

A. 5cm toward the lens

B. 5cm away from the lens

C. 10cm toward the lens

D. 10cm away from the lens

Answer: d.

Watch Video Solution

55. With a concave mirrorr, an object is placed at a distance x_1 from the principal focus, on the principal axis. The image is formed at a distance x_2 from the principal focus. The focal length of the mirrorr is

A. $x_1 x_2$

B. $(x_1 + x_2)/2$

C. $\sqrt{x_1/x_2}$

D. $\sqrt{x_1 x_2}$

Answer: d.

Watch Video Solution

56. A concave mirror is placed on a horizontal table with its axis directed vertically upward. Let O be the pole of the mirror C its center of curvature and F is the focus. A point object is placed at C. It has a real image, also located at C. If the mirror is now filled with water, the image will be

A. real and will remain at C

B. real and located at a point between C and ∞

C. virtual and located at a point between C and O

D. real and located at a point between C and O

Answer: d.

Watch Video Solution

57. A plane mirror is made of glass slab $(\mu_g = 1.5)$ 2.5 cm thick and silvered on back. A point object is placed 5 cm in front of the unsilvered face of the mirror. What will be the position of final image ?

A. 9cm

B. 11cm

C. 12cm

D. 13cm

Answer: d.

Watch Video Solution

58. A point source of light S, placed at a

distance L in front of the centre of a mirror of width d,

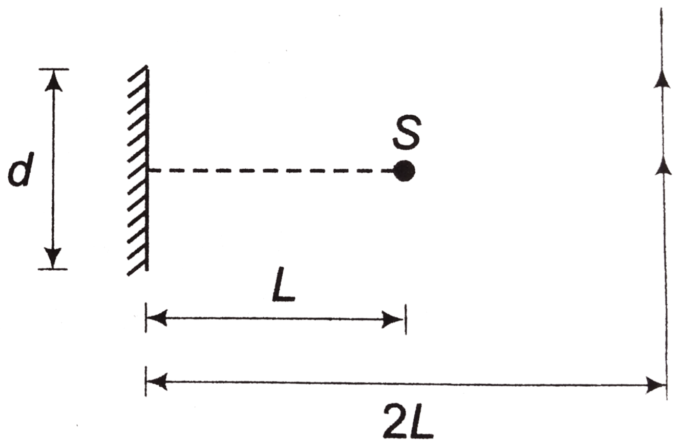
hangs vertically on a wall. A man walks in front of the

mirror along a line parallel to th mirror at a distane

2L form it as shown.The greatest distance over which

he can see the image of the light source in the mirror is

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



A. $d/2$

B. d

C. 2d

D. 3d

Answer: a.

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59. An object is object at a distance of 25cm from the pole of a convex mirror and a plane mirror is set at a distance 5 cm from convex mirror so that the virtual images formed by the two mirrors do not have any parallax. The focal length of the convex mirror is

A. 37.5cm

B. $-7.5cm$

C. $-37.5cm$

D. $+7.5cm$

Answer: a.

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60. When an object is kept at a distance of 30 cm from a concave mirror, the image is formed at a distance of 10 cm from the mirror. If the object is moved with a speed of $9cms^{-1}$, the speed (in cms^{-1}) with which image moves at that instant is ________ .

A. $0.1ms^{-1}$

B. $1ms^{-1}$

C. $3ms^{-1}$

D. $9ms^{-1}$

Answer: b.

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

A. $8/13m$ in fron of the mirror

B. $8/13m$ behind the mirror

C. $4/9$ m in front of the mirror

D. $4/9m$ behind the mirror

Answer: d.

Watch Video Solution

62. In the above question, the magnification is

A. $4/9$

B. $-4/9$

C. $9/4$

D. $8/13$

Answer: a.

Watch Video Solution

63. A convex and a concave mirror of radii 10 cm are placed facing each other and 15 cm apart. An object is placed exactly between them. If the reflection first takes place in concave and then in convex mirror the position of the final image will be

A. on the pole of the convex mirror

B. on the pole of the concave mirror

C. at a distance of 10cm from the convex mirror

D. at a distance of 5cm from the concave mirror

Answer: a.

Watch Video Solution

64. A piece of wire bent into an L shape with upright and horizontal portion of equal lengths 10 cm each is placed with the horizontal portion along the axis of the concave mirror towards pole of mirror whose radius of curvature is 10 cm. If the bend is 20 cm from the pole of the mirror, then the ratio of the lengths of the images of the upright and horizontal portion of the wire is

A. $1:2$

B. $3:1$

C. $1:3$

D. $2:1$

Answer: b.

Watch Video Solution

65. The image of an object placed on the principal axis of a concave mirror of focal length 12 cm is formed at a point which is 10cm more distance form the mirror than the object. The magnification of the image is

A. $8/3$

B. 2.5

C. 2

D. -1.5

Answer: d.

Watch Video Solution

66. A clear transparent glass sphere $(\mu = 1.5)$ of radius R is immersed in a liquid of refractive index 1.25. A parallel beam of light incident on it will converge to a point. The distance of this point from the center will be

A. $-3R$

B. $+3R$

C. $-R$

D. $+R$

Answer: b.

Watch Video Solution

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

A. $\tan^{-1}(\sin i)$

B. $\sin^{-1}(\sin r)$

C. $\sin^{-1}(\tan i)$

D. $\sin^{-1}(\tan r)$

Answer: c.

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68. A ray of light travelling in glass $(\mu_g = 3/2)$ is incident on a horizontal glass-air surface at the critical angle θ_C. If a thin layer of water $(\mu_w = 4/3)$ is now poured on the glass-air surface. At what angle will the ray of light emerges into water at glass-water surface?

A. 60°

B. 45°

C. 90°

D. 180°

Answer: c.

Watch Video Solution

69. A ray of light enters a rectangular glass slab of refractive index $\sqrt{3}$ at an angle of incidence 60°. It travels a distance of 5cm inside the slab and emerges out of the slab. The perpendicular distance between the incident and the emergent rays is

A. $5\sqrt{3}cm$

B. $\frac{5}{2}cm$

C. $5\sqrt{3/2}cm$

D. 5cm

Answer: b.

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70. A ray of monochromatic light is incident on the refracting face of a prism (angle $75^\circ 0$. It passes through the prism and is incident on the other face at the critical angle. If the refractive index of the prism is $\sqrt{2}$, then the angle of incidence on the first of the prism is

A. 15°

B. 30°

C. 45°

D. 60°

Answer: c.

Watch Video Solution

71. An object is placed at a distance of 15 cm from a convex lens of focal length 10 cm. On the other side of the lens, a convex mirror is placed at its focus such that the image formed by the combination coincides with the object itself. The focal length of the convex mirror is

A. 20cm

B. 10cm

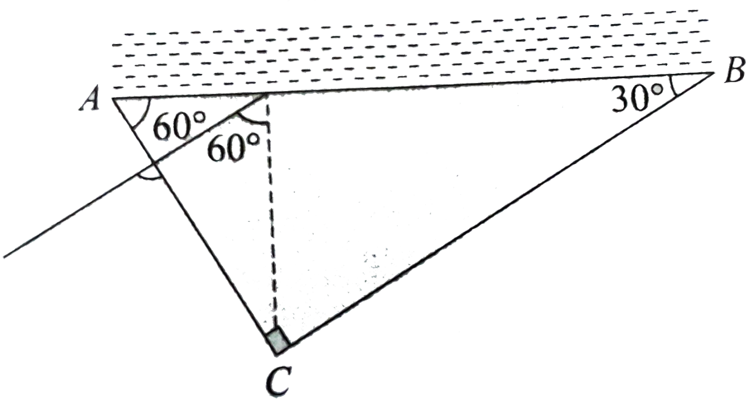
C. 15cm

D. 30cm

Answer: b.

Watch Video Solution

72. ACB is right-angled prism with other angles as 60° and 30° . Refractive index of the prism is 1.5. AB has thin layer of liquid on it as shown. Light falls normally on the face Ac. For total internal reflection, maximum refractive index of the liquid is



A. 1.4

B. 1.3

C. 1.2

D. 1.6

Answer: b.

Watch Video Solution

73. The lateral magnification of the lens with an object located at two different position u_1 and u_2 are m_1 and m_2 , respectively. Then the focal length of the lens is

A. $f = \sqrt{m_1 m_2}(\mu_2 - \mu_1)$

B. $f = \sqrt{m_1 m_2}(u_2 - u_1)$

C. $\dfrac{(u_2 - u_1)}{\sqrt{m_1 m_2}}$

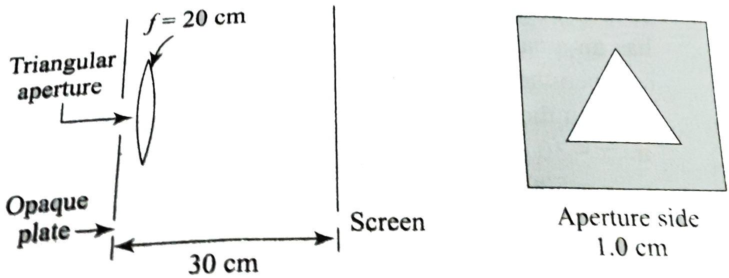
D. $\dfrac{(u_2 - u_1)}{(m_2)^{-1} - (m_1)^{-1}}$

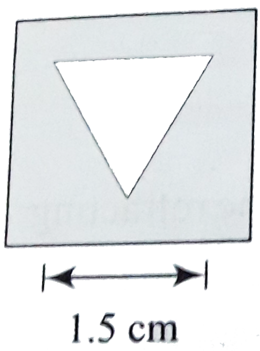
Answer: d.

Watch Video Solution

74. A parallel beam of light falls axially on a thin converging lens of focal length 20cm. The emergent light falls on a screen placed 30cm beyond the lens. An opaque plate with a triangular aperture, side 1 cm, is in contact with the lens

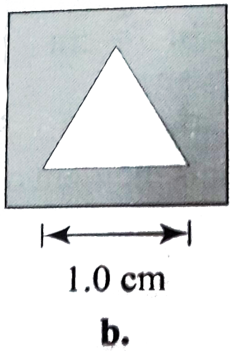
Which one of the following diagrams best shows to appearance of the patch of light seen on the screen?



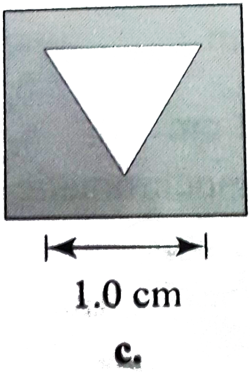


a.

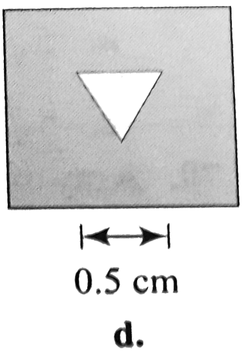
A.



B.



C.



D.

Answer: d.

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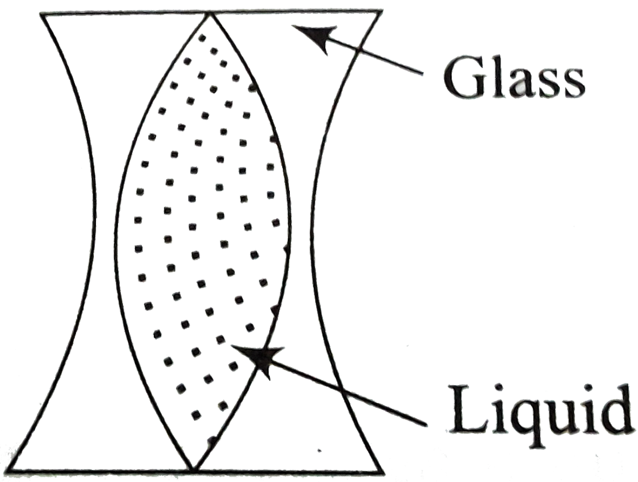
75. A liquid of refractive index 1.6 is contained in the cavity of a glass specimen of refractive index 1.5 as shown in figure. If each of the curve surface has a radius of curvature of 0.20m, the arrangement obehaves as a



A. converging lens of focal length 0.25m

B. diverging lens of focal length 0.25m

C. diverging lens of focal length 0.17m

D. converging lens of focal length 0.72m

Answer: b.

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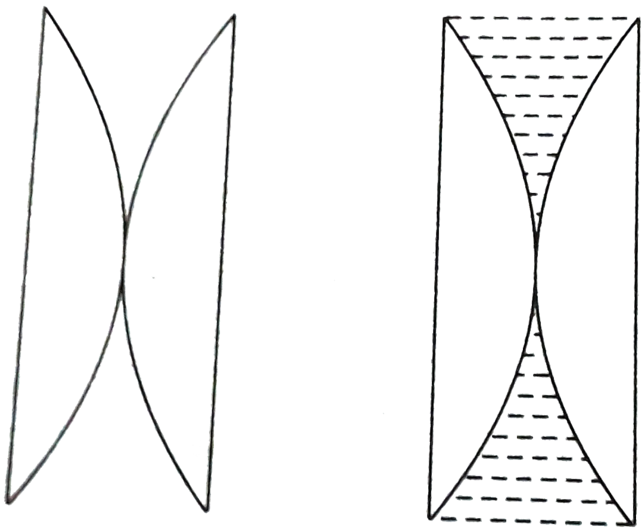
76. Figure(a) shows two plano-convex lenses in contact as shown. The combination has focal length 24cm. Figure (b) shows the same with a liquid introduced between them. If refractive index of glass of the lenses is 1.50 and that of the liquid is 1.60, the focal length of system in figure (b) will be



(a) (b)

A. $-120cm$

B. 120cm

C. $-24cm$

D. $24cm$

Answer: a.

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77. In a slide show programme, the image on the screen has an area 900times that of the slide. If the distance between the slide and the screen is x times the distance between the slide and the projector lens, then

A. $x = 30$

B. $x = 31$

C. $x = 500$

D. $x = 1/30$

Answer: b.

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78. A prism having refractive index 1.414 and refracting angle 30° has one of the refracting surfaces silvered. A beam of light incident on the other refracting surface will retrace its path, if the angle of incidence is

A. 0

B. $\pi/6$

C. $\pi/4$

D. $\pi/3$

Answer: c.

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79. In a lake, a fish rising vertically to the surface of water uniformly at the rate of 3 m/s, observes a bird diving vertically towards the water at the rate of 9 m/s. The actual velocity of the dive of the bird is (given, refractive index of water =4/3)

A. $4.5ms^{-1}$

B. $5.4ms^{-1}$

C. $3.0 ms^{-1}$

D. $3.4 ms^{-1}$

Answer: A

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80. A concave lens with unequal radii of curvature made of glass $(\mu_g = 1.5)$ has a focal length of 40cm. If it is immersed in a liquid of refractive index $\mu_1 = 2$, then

A. it behaves like a convex lens of 80cm focal length

B. it behaves like a convex lens of 20cm focal length

C. its focal length becomes 60cm

D. nothing can be said

Answer: a.

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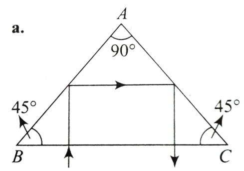
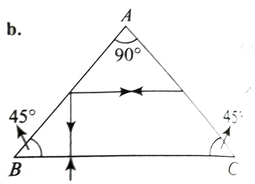
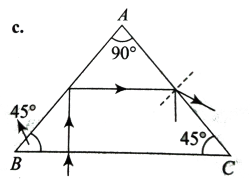
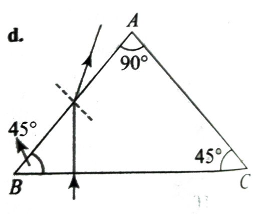
81. The refractive index of material of a prism of angles $45^\circ, -45^\circ$, and -90° is 1.5. The path of the ray of light incident normally on the hypotenuse side shown in

A. 

B. 

C. 

D. 

Answer: a.

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82. An object is placed 1m in front of the curved surface of a plano-convex lens whose plane surface is silvered. A real image is formed in front of the lens at a distance of 120cm. Then, the focal length of the lens is

A. 100cm

B. 120cm

C. 109.1cm

D. 110.0cm

Answer: c.

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83. The apparent thickness of a thick plano-convex lens is measured once with the plane face upward and then with the convex face upward. The value will be

A. more in the firest case

B. same in the two cases

C. more in the second case

D. any of the above depending on the value of its actual thickness

Answer: c.

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84. An object is placed in front of a convex mirror at a distance of 50cm. A plane mirror is introduced covering the lower half of the convex mirror. If the distance between the object and the plane mirror is 30cm, it is found that there is no parallax between the images formed by the two mirrors. What is the radius of curvature of the convex mirror?

A. 25cm

B. 7cm

C. 18cm

D. 27cm

Answer: a.

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85. A concave mirror of focal length 10cm and a convex mirror of focal length 15cm are placed facing each other 40cm apart. A point object is placed between the mirrors, on their common axis and 15cm from the concave mirror. Find the position and nature of the image produced by successive reflections, first at the concave mirror and then at the convex mirror.

A. 12cm behind convex mirror, real

B. 9cm behind convex mirror, real

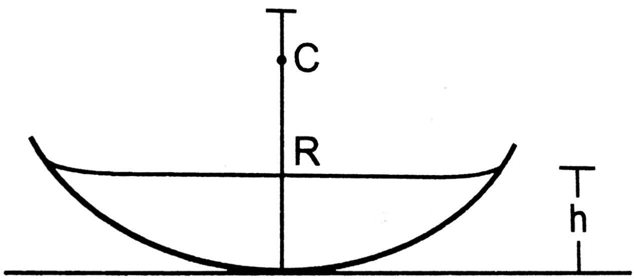
C. 6cm behind convex mirror, virtual

D. 3cm behind convex mirror, virtual

Answer: c.

Watch Video Solution

86. A U-shaped wire is placed before a concave having radius of curvature 20 cm as shown (18-E1). Find the total length of the image.



A. 2cm

B. 10cm

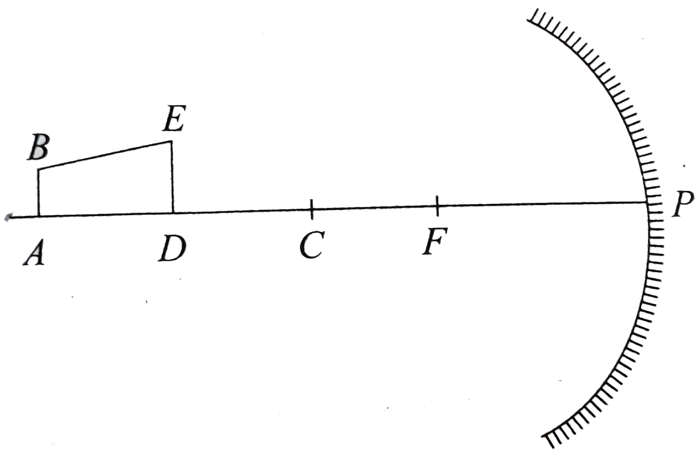
C. 8cm

D. 14cm

Answer: b.

Watch Video Solution

87. An object ABED is placed in front of a concave mirror beyond the center of curvature C as shown in figure., State the shape of the image.



A. $|m_{AB}| < 1$ and $|m_{ED}| < 1$

B. $|m_{AB}| > 1 \text{ and } |m_{ED}| < 1$

C. $|m_{AB}| < 1 \text{ and } |m_{ED}| > 1$

D. $|m_{AB}| > 1 \text{ and } |m_{ED}| > 1$

Answer: a.

Watch Video Solution

88. 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.

A. $\left(1 + \frac{m_2}{m_1}\right)v_0$

B. $2\left(1 - \frac{m_2}{m_1}\right)v_0$

C. $2\left(1 + \frac{2m_2}{m_1}\right)v_0$

D. $2\left(1 + \frac{m_2}{m_1}\right)v_0$

Answer: D

Watch Video Solution

89. 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.

A. 6cm from S_1

B. 15 cm from S_1

C. 10 cm from S_1

D. 12 cm from S_1

Answer: a.

Watch Video Solution

90. Two thin symmetrical lenses of different nature and of different material have equal radii of curvature $R = 15cm$. The lenses are put close together and immersed in water $\left(\mu_w = \frac{4}{3}\right)$. The focal length of the system in water is 30 cm. The difference between refractive indices of the two lenses is

A. $1/2$

B. $1/4$

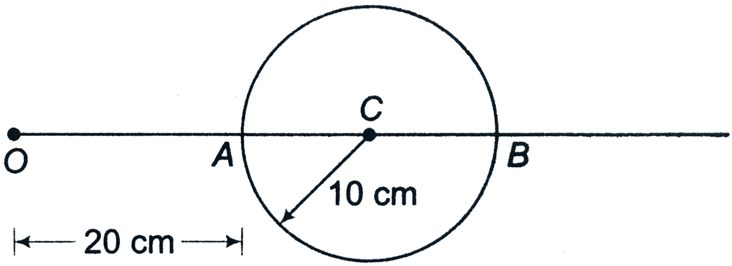
C. $1/3$

D. $3/4$

Answer: c.

Watch Video Solution

91. A glass sphere of radius $R = 10cm$ is kept inside water. A ponit object O is placed at $20cm$ from A as shown in figure. Find the position and nature of the image when seen from other side of the sphere. Also draw the ray diagram. Given, $\mu_g = 3/2$ and $\mu_w = 4/3$



A. 200cm, virtual

B. 100cm, real

C. 100cm, virtual

D. 300cm , virtual

Answer: c.

Watch Video Solution

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

A. 3.4D

B. 2.5D

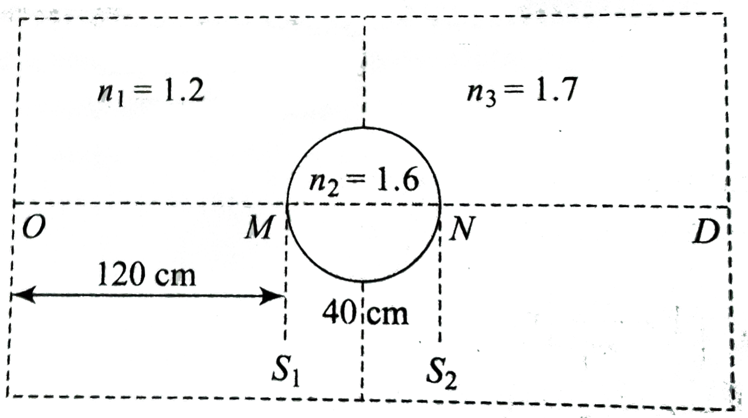
C. 25D

D. 1.5D

Answer: b.

Watch Video Solution

93. A tranparent sphere of radius 20cm and refractive index 1.6 is fixed in a hole of the partition separating the two media: A(refractive index $n_1 = 1.2)$ and B (refractive index $n_3 = 1.7)$. A luminous point object is placed 120cm from the surface of the sphere iin medium A. it is viewed from D in medium B in a direction normal to the sphere. Find the position of the image formed by the rays, from point N.



A. 304cm, left side of N

B. 175 cm, right side of N

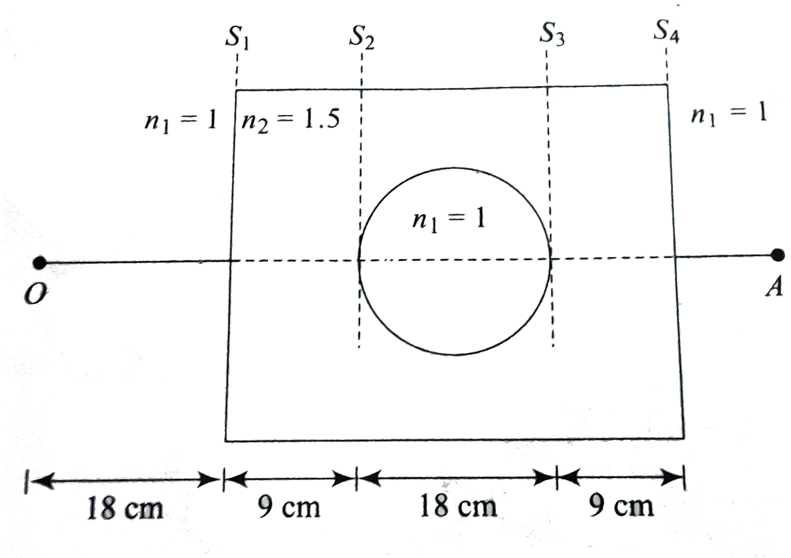
C. 204 cm, right side of N

D. 220cm, left side of N

Answer: C

Watch Video Solution

94. A cubical block of glass, refractive index 1.5, has a spherical cavity of radius $r = 9cm$ inside it as shown in figure . A luminous point object O is at a distance of 18cm from the cube. What is the apparent position of O as seen from A?



A. 17cm, left of S_4

B. 25cm, right of S_4

C. 13cm, left of S_4

D. 10cm, right of S_4

Answer: a.

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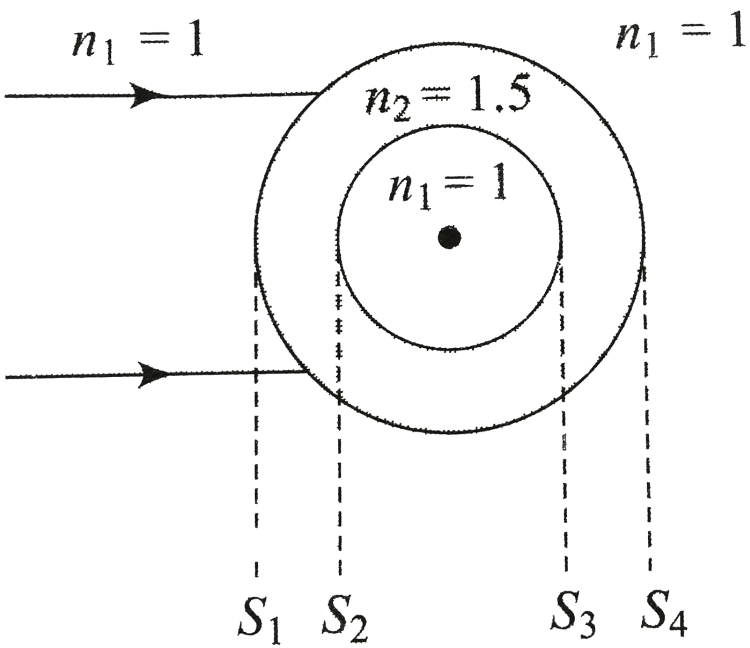
95. A glass sphere, refractive index 1.5 and radius 10 cm, has a spherical cavity of radius 5 cm concentric with it. A narrow beam of parallel light is direccted into the sphere. Locate the final image.



A. 25cm left of S_4, virtual

B. 25 cm right of S_4 , real

C. 15 cm left of S_4, virtual

D. 20cm right of S_4, virtual

Answer: a.

Watch Video Solution

96. A luminous object and a screen are at a fixed distance D apart. A converging lens of focal length f is placed between the object and screen. A real image of the object in formed on the screen for two lens positins if they are separated by a distance d equal to

A. $\sqrt{D(D+4F)}$

B. $\sqrt{D(D-4F)}$

C. $\sqrt{2D(D-4F)}$

D. $\sqrt{D^2+4F}$

Answer: b.

Watch Video Solution

97. For the same statement as above, the ration of the two image sizes for these two positions of the lens is

A. $\left[\frac{D-d}{D+d}\right]^2$

B. $\left[\frac{D+d}{D-d}\right]^2$

C. $\left[\frac{D-2d}{D+2d}\right]^2$

D. $\left[\frac{D+2d}{D-2d}\right]^2$

Answer: B

Watch Video Solution

98. For statement of question 118, if the heights of the two images are h_1 and h_2 , respectively,then the height of the object (h) is

A. $h_1 + h_2$

B. $h_1 h_2$

C. $\sqrt{h_1 h_2}$

D. h_1 / h_2

Answer: c.

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99. The focal length of the lens used in question 118 is

A. $\dfrac{D^2 + d^2}{2D}$

B. $\dfrac{D^2 - d^2}{4D}$

C. $\dfrac{D^2 - d^2}{2D}$

D. $\dfrac{D^2+d^2}{d}$

Answer: b.

Watch Video Solution

100. In question 118, if m_1 and m_2 are the magnifications for two positions of the lens, then

A. $f=\dfrac{d}{m_1+m_2}$

B. $f=\dfrac{2d}{m_1+m_2}$

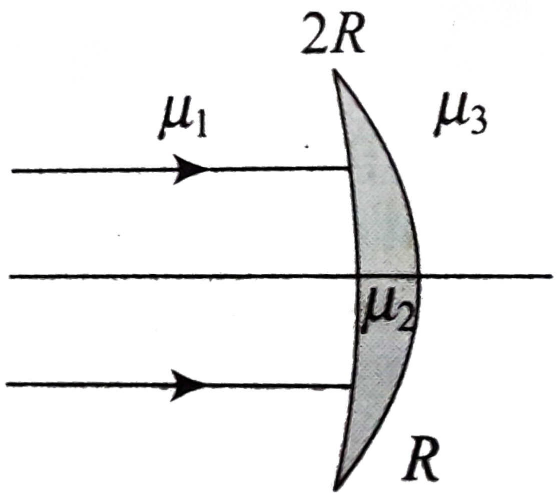
C. $f=\dfrac{3d}{m_1-m_2}$

D. $f=\dfrac{d}{m_1-m_2}$

Answer: d.

Watch Video Solution

101. Figure, shows a concavo-convex lens μ_2. What is the condition on the refractive indiecs so the at the lens is diverging?



A. $2\mu_3 < \mu_1 + \mu_2$

B. $2\mu_3 > \mu_1 + \mu_2$

C. $\mu_3 > 2(\mu_1 - \mu_2)$

D. None of these

Answer: b.

Watch Video Solution

102. The image produced by a concave mirror is one-quarter the size of object. If the object is moved 5cm closer to the mirror, the image will only be half the size of the object. The focal length of mirror is

A. $f = 5.0cm$

B. $f = 2.5cm$

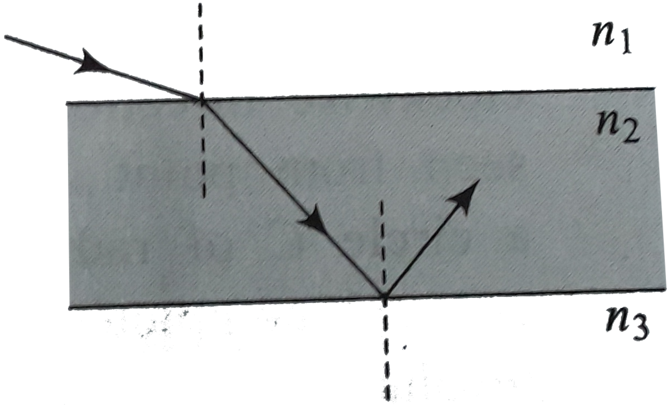
C. $f = 7.5cm$

D. $f = 10cm$

Answer: b.

Watch Video Solution

103. Light traveling trhought three transparent substances follows the path shown in figure. Arrange the indices of refraction in order from smallest to largest. Not the total internal reflection does occur on the bottom surface of medium 2.



A. $n_1 < n_2 < n_3$

B. $n_2 < n_1 < n_3$

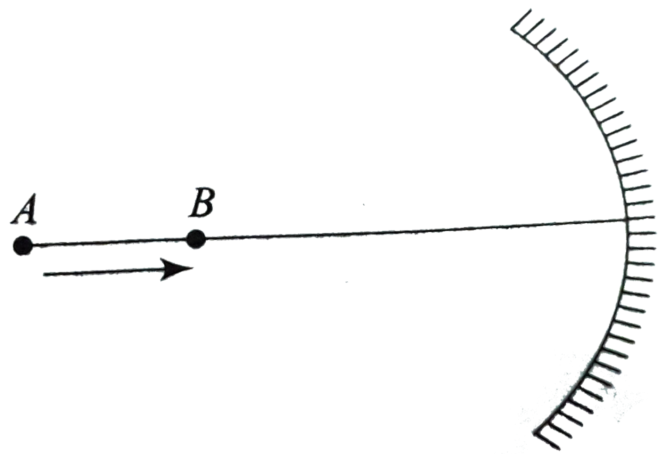
C. $n_1 < n_3 < n_2$

D. $n_3 < n_1 < n_2$

Answer: D

Watch Video Solution

104. A linear object AB is placed along the axis of a concave mirror. This object is moving towards the mirror with speed U. The speed of the image of the point A is 4U and the speed of the image of B is alSO 4U btu in opposite direction. If the center of the line AB is at a distance L from the mirror then find out the length of the object.



A. $3L/2$

B. $5L/3$

C. L

D. None of these

Answer: c.

Watch Video Solution

105. A mango tree is at the bank of a river and one of the branch of tree extends over the river. A tortoise lives in the river. A mango falls just ono the tortoise. The acceleration of the mango falling from tree as it appears to the tortoise is (refractive index of water is $4/3$ and the tortoise is stationary)

A. g

B. $3g/4$

C. $4g/3$

D. none of these

Answer: c.

Watch Video Solution

106. In the figure ABC is the cross-section of a right angled prism and BCDE is the cross-section of a glass slab. The value of theta so that light incident normally on the face AB does not cross the face BC is $\left(Given\sin^{-1}3/5=37^{\circ}\right)$

A. $\theta \leq 37^{\circ}$

B. $\theta < 37^{\circ}$

C. $\theta \leq 53^{\circ}$

D. $\theta < 53^{\circ}$

Answer: b.

Watch Video Solution

107. A bird is flying up at an angle $\sin^{-1}(3/5)$ with the horizontal. A fish in a pond looks at that bird when it is vertically above the fish. The angle at which the bird appears to fly (to the fish) is $[\mu_w = 4/3]$

A. $\sin^{-1}(3/5)$

B. $\sin^{-1}(4/5)$

C. 45°

D. $\sin^{-1}(9/16)$

Answer: c.

Watch Video Solution

108. A point object 'O' is at the center of curvature of a concave mirror. The mirror starts to move at a speed u, in a direction perpendicular to the principal axis. Then, the initial velocity of the image is

A. 2u, in the direction opposite to theat of mirror's velocity

B. 2u, in the direction same as that of mirror's velocity

C. zero

D. u, in the direction same as that of mirror's velocity

Answer: b.

Watch Video Solution

109. Refractive index of a prism is $\sqrt{7/3}$ and the angle of prism is 60°. The minimum angle of incidence of a ray that will be transmitted through the prism is

A. 30°

B. 45°

C. 15°

D. 50°

Answer: a.

Watch Video Solution

110. For a prism kept in air, it is found that for an angle of incidence 60° , the angle of refraction 'A', angle of deviation δ, and angle of emergence 'e' become equal. The minimum angle of incidence of a ray that will be transmitted through the prism is

A. 1.73

B. 1.15

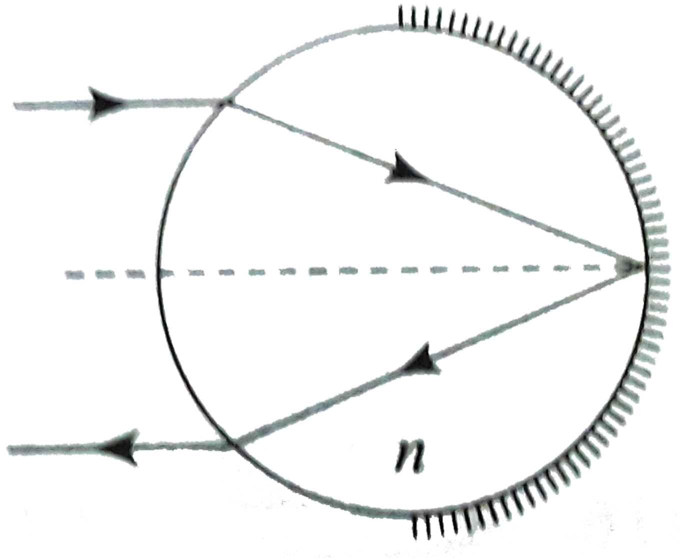
C. 1.5

D. 1.33

Answer: a.

Watch Video Solution

111. A transparent cylinder has its right half polished so as to act as a mirror. A paraxial light ray inciden from left, that is parallel to the principal to the incident ray as shown. The refractive index n of the material of the cylinder is



A. 1.2

B. 1.5

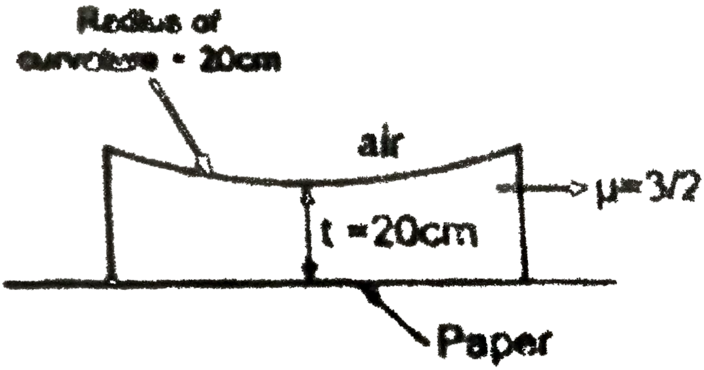
C. 1.8

D. 2.0

Answer: d.

Watch Video Solution

112. In the given figure a plano-concave lens is placed on a paper on which a flower is drawn. How far above its actual position does the flower appear to be ?



A. 10cm

B. 15cm

C. 50cm

D. None of these

Answer: a.

Watch Video Solution

113. The distance between an object and the screen is 100cm. A lens produces an image on the screen when the lens is placed at either of the positions 40cm apart. The power of the lens is nearly

A. 3 diopter

B. 5 diopter

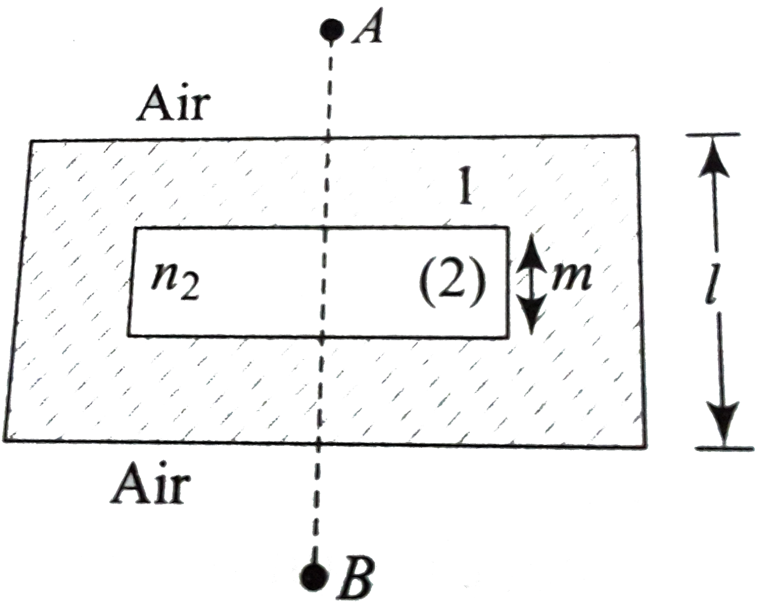
C. 2 diopter

D. 9 diopter

Answer: b.

Watch Video Solution

114. In a thick glass slab of thicknes l, and refractive index n_1, a cuboidal cavity of thickness 'm' is carved as shown in figure, and is filled with a liquid of $R.\ I.\ n_2(n_1 > n_2)$. The ratio l/m, so that shift produced by this slab is zero when an observer A observes an object B with paraxial rays is



A. $\dfrac{n_1 - n_2}{n_2 - n_1}$

B. $\dfrac{n_1 - n_2}{n_2(n_1 - 1)}$

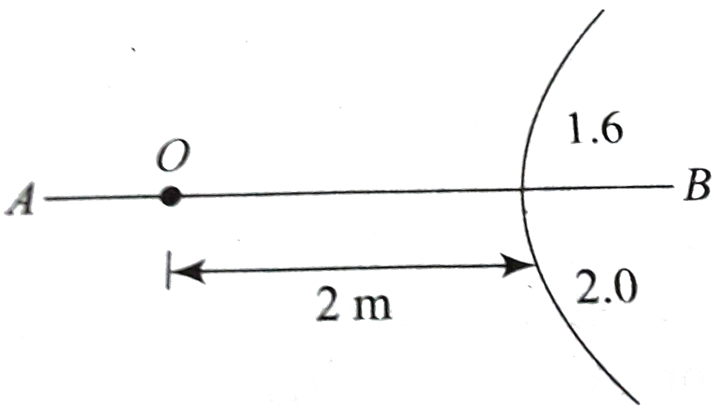
C. $\dfrac{n_1 - n_2}{n_1 - 1}$

D. $\dfrac{n_1 - n_2}{n_1(n_{2-1})}$

Answer: b.

Watch Video Solution

115. In Figure, a point object O is placed in air. A spherical boundary separates two media. Ab is the principall axis. The refractive index above AB is 1.6 and below AB is 2.0. The separation between the images formed due to refraction at a the spherical surface is (assume the radius of curvature (R) to be 1 unit)



A. 12m

B. 20m

C. 14m

D. 10m

Answer: a.

116. A square ABCD of side 1mm is kept at distance 15 cm infront of the concave mirror as shown in the figure. The focal length of the mirror is 10 cm. The length of the perimeter of its image will be approximately

A. 8mm

B. 2mm

C. 12mm

D. 6mm

Answer: c.

117. A point object is kept in front of a plane mirror. The plane mirror is doing SHM of amplitude 2cm. The plane mirror moves along the x-axis which is normal to the mirror. The amplitude of the mirror is such that the object is always in front of the mirror. The amplitude of SHM of the image is

A. 0

B. 2cm

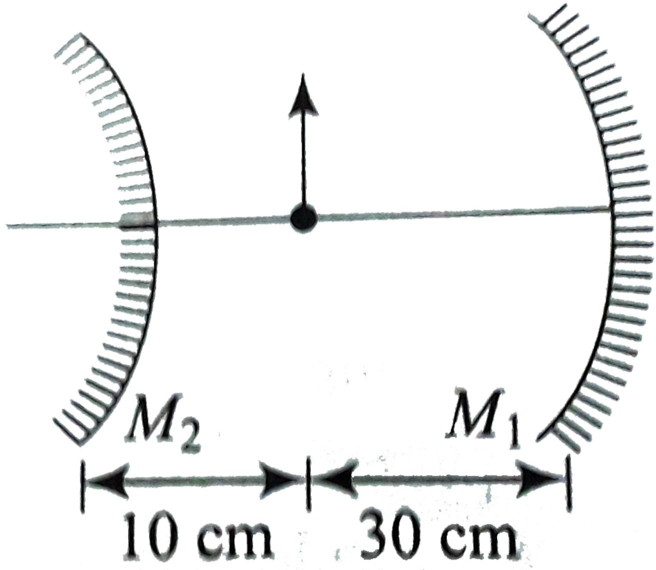
C. 4cm

D. 1cm

Answer: c.

View Text Solution

118. In Figure, find the total magnification after two successive reflections first ono M_1 and then on M_2.



A. $+1$

B. -2

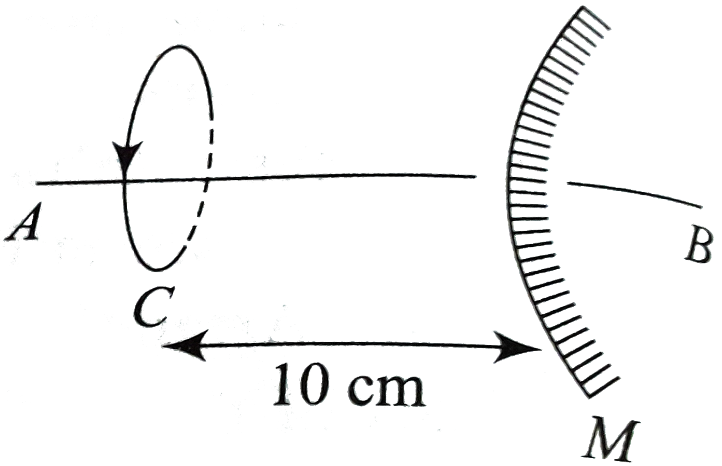
C. $+2$

D. -1

Answer: c.

View Text Solution

119. A partical revolves in clockwise direction (as seen from point A) in a circle C of radius 1 cm and completes one revolution in 2 sec. The axis of the circle and the principal axis of the mirror M coincides, call it AB. The radius of curvature of the mirror of 20cm. Then, the direction of revolution (as seen from A) of the image of the partical and its speed is



A. clockwise, 1.57cms^{-1}

B. clockwise, $3.14 cms^{-1}$

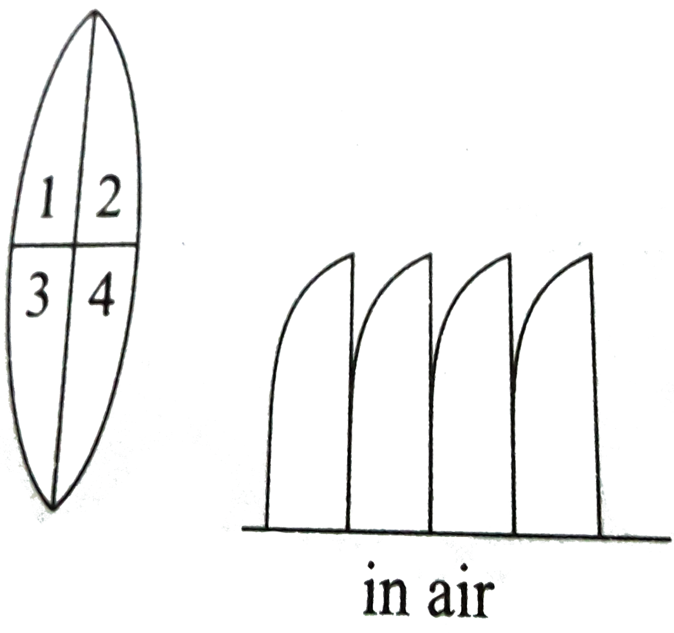
C. anticlockwise, $1.57 cms^{-1}$

D. anticlockwise, $3.14 cms^{-1}$

Answer: a.

Watch Video Solution

120. The given lens is broken into four parts rearranged as shown. If the initial focal length is f, then after rearrangement the equivalent focal length is



A. f

B. $f/2$

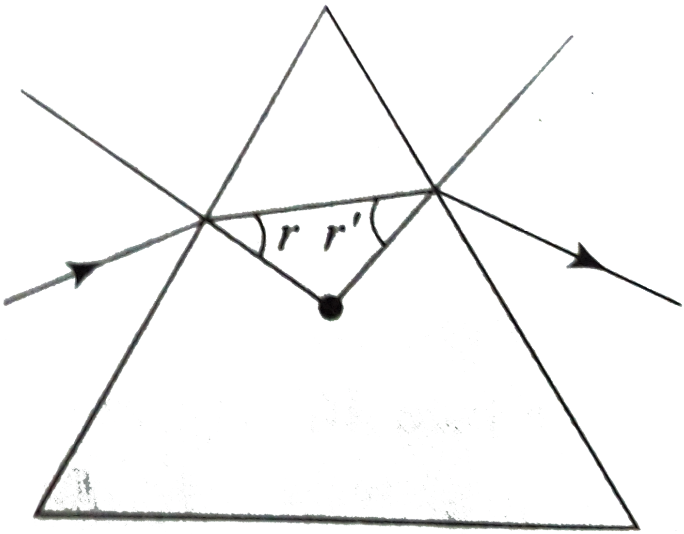
C. $f/4$

D. $4f$

Answer: b.

Watch Video Solution

121. Let r and r' denote the angles iniside an equilateral prism, as usual, in degrees. Consider that during some time interval from $t=0$ to$t=t$, r' varies with time as $r' = 10 + t^2$. During this time, r will vary as (assume that r and r' are in degree)



A. $50 - t^2$

B. $50 + t^2$

C. $60 - t^2$

D. $60 + t^2$

Answer: a.

Watch Video Solution

122. For a prism kept in air, it is found that for an angle of incidence 60°, the angle of refraction A, angle of deviation δ and anble of emergence e become equal. Then, the refractive index of the prism is

A. 1.73

B. 1.15

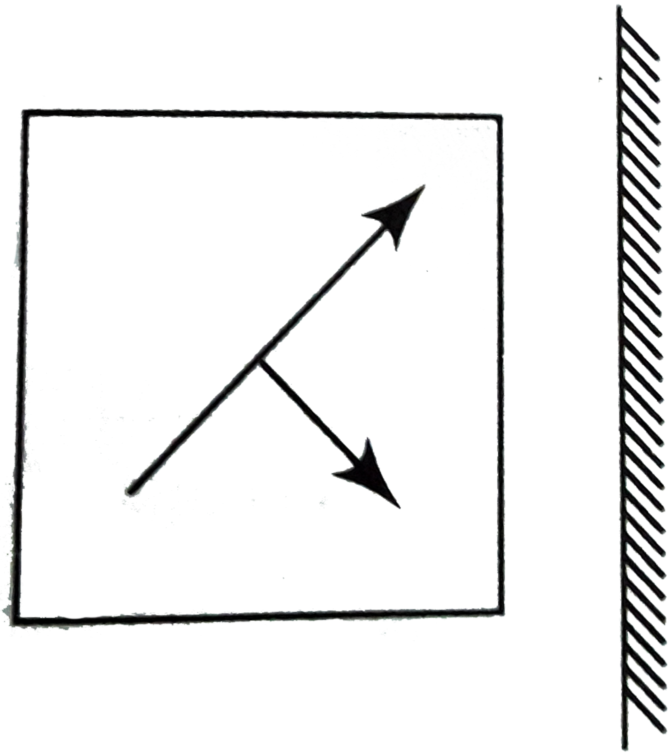
C. 1.5

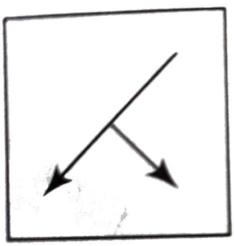
D. 1.33

Answer: a.

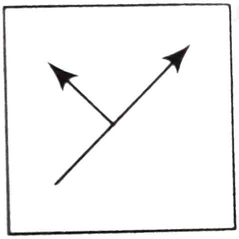
Watch Video Solution

123. Choose the correct mirror image of

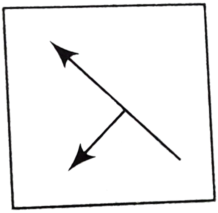




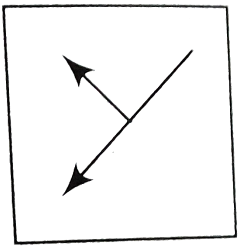
A. a.



B. b.



C. c.



D. d.

Answer: c.

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124. An object is approaching a fixed plane mirror with velocity $5ms^{-1}$ making an angle of 45° with the normal. The speed of image w.r.t. the mirror is

A. $5ms^{-1}$

B. $5/\sqrt{2}ms^{-1}$

C. $5\sqrt{2}ms^{-1}$

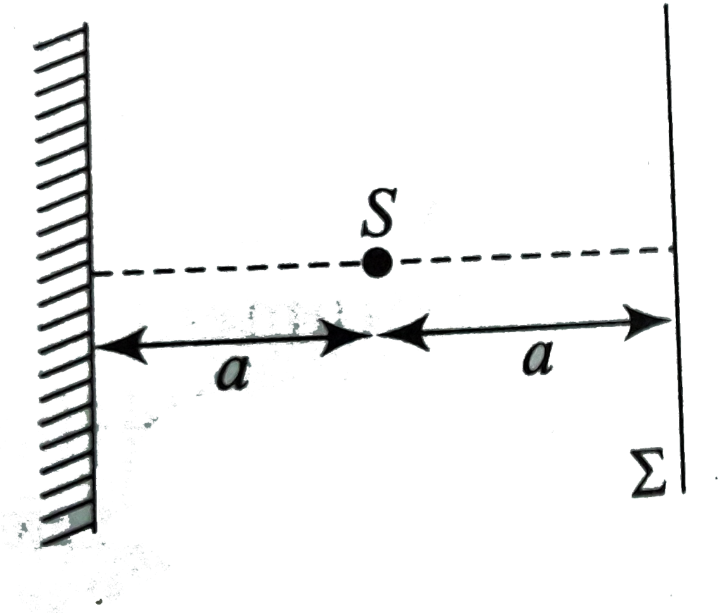
D. $10ms^{-1}$

Answer: a.

Watch Video Solution

125. A point source of light S is placed in front of a perfectly reflecting mirror as shown in Figure. Σ is a screen. The intensity at the center of screen is found to be I.

If the mirror is removed, then the intensity at the center of screen would be



A. I

B. $10I/9$

C. $9I/10$

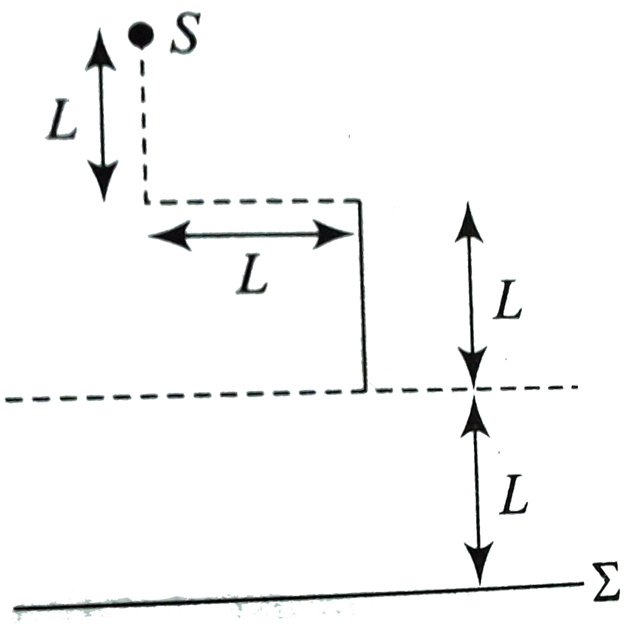
D. $2I$

Answer: c.

Watch Video Solution

126. A point source of light is placed in front of a plane mirror as shown in Figure.

Determine the length of reflected path of light on the screen Σ



A. L

B. $2L$

C. $3L/2$

D. $L/2$

Answer: C

Watch Video Solution

127. A concave refractive surface of a medium having refractive index μ produces a real image of an object (located outside the medium) irrespective of its location. Choose the correct option from the following.

A. Always

B. May be if refractive index of surrounding medium is greater than μ

C. May be if refractive index of surrounding medium is less than μ

D. None of the above

Answer: D

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128. A convex spherical refracting surface with radius R separates a medium having refractive index $5/2$ from air. As an object is moved towards the surface from far away from the surface along the principle axis, its image

A. changes from real to virtual when it is at a distance R from the surface

B. changes from virtual to real when it is at a distance R from the surface

C. changes from real to virtual when it is at a distance $2R/3$ from the surface

D. changes from virtual to real when it is at a distance $2R/3$ from the surface

Answer: c.

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129. A concave spherical refractive surface with radius R separates a medium of refractive index $5/2$ from air. As an object is approaching the surface from far away from the surface along the central axis, its image

A. always remains real

B. always remains virtual

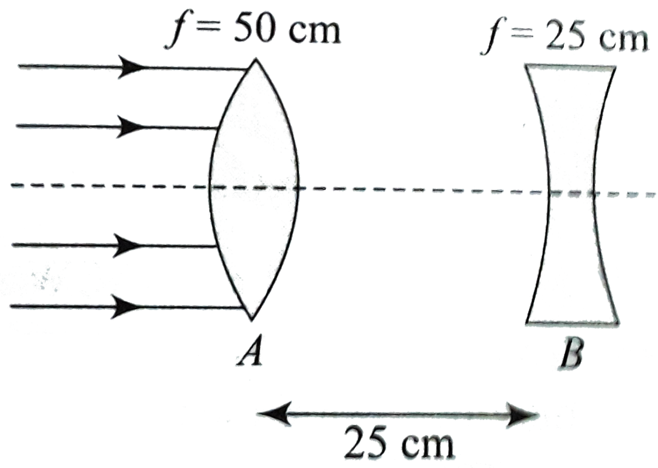
C. changes from real to virtual at a distance $2R/3$ from the surface

D. changes from virtual to real at a distance $2R/3$ from the surface

Answer: b.

Watch Video Solution

130. Two lenses shown in figure. Are illuminated by a beam of parallel light from the left. Lens B is then moved slowly toward lens A. the beam emerging from lens B is



A. always diverging

B. initially parallel and then diverging

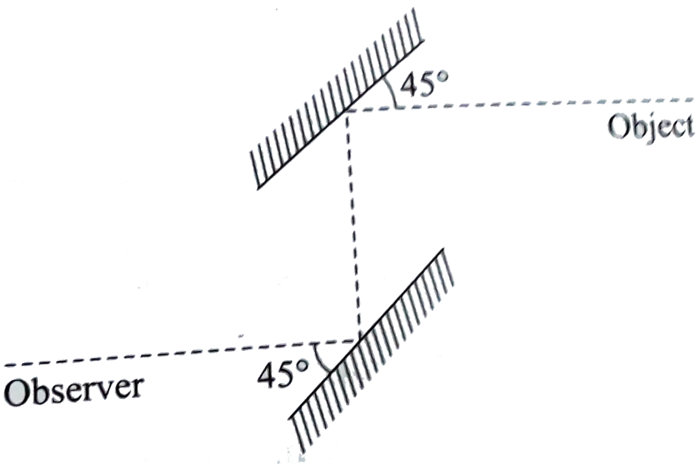
C. always parallel

D. initially converging and then parallel

Answer: b.

Watch Video Solution

131. In the arrangement shown in figure., the image of the extended object as seen by the observer is



A. real and inverted

B. real and erect

C. virtual and inverted

D. virtual and erect

Answer: d.

Watch Video Solution

132. The table below shows object and image distances for four objects placed in front of mirrors. For which one is the image formed by a convex spherical mirror? [Positive and negative signs are used in accordance with standard sign convention]

A. Object distance Image distance $-7.10cm$ $-18.0cm$

B. Object distance Image distance $-25.0cm$ $-16.7cm$

C. Object distance Image distance $-5.0cm$ $+1.0cm$

D. Object distance Image distance $-20.0cm$ $+5.71cm$

Answer: d.

Watch Video Solution

133. A fish looks upward at an unobstructed overcast sky. What total angle does the sky appear to subten?(Take refractive index of water as $\sqrt{2}$.)

A. 180°

B. 90°

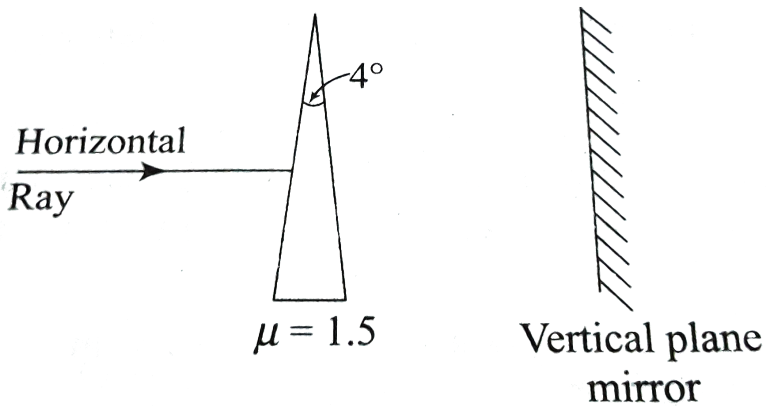
C. 75°

D. 60°

Answer: b.

Watch Video Solution

134. For the situations shown in figure, determine the angle by which the mirror should be rotated, so that the light ray will retrace its path after refraction through the prism and reflection from the mirror?



A. $1^{\circ} ACW$

B. $1^{\circ} CW$

C. $2^{\circ} ACW$

D. $2^{\circ} CW$

Answer: d.

Watch Video Solution

135. A real object is placed in front of a convex mirror (fixed).The object is moving toward the mirror. If v_0 is the speed of object and v_i is the speed of image, then

A. $v_i < v_0$ always

B. $v_i > v_0$ always

C. $v_i > v_0$ initially and then $v_0 > v_i$

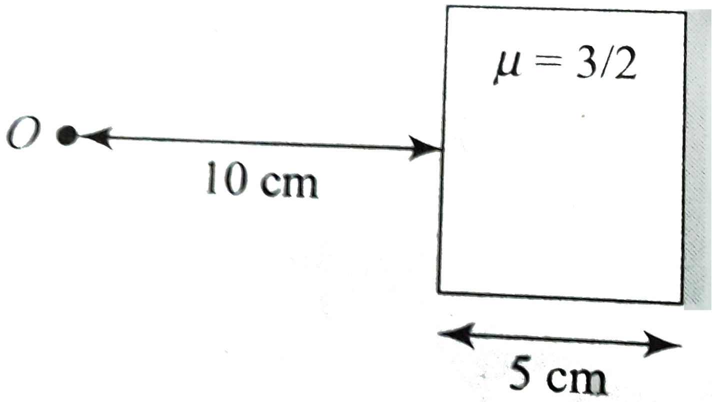
D. $v_i < v_0$ initially and then $v_i > v_0$

Answer: A

Watch Video Solution

136. A point is placed in front of thick plane mirror as shown in figure.

Find the location of final image w.r.t. object.



A. $15/2cm$

B. $15cm$

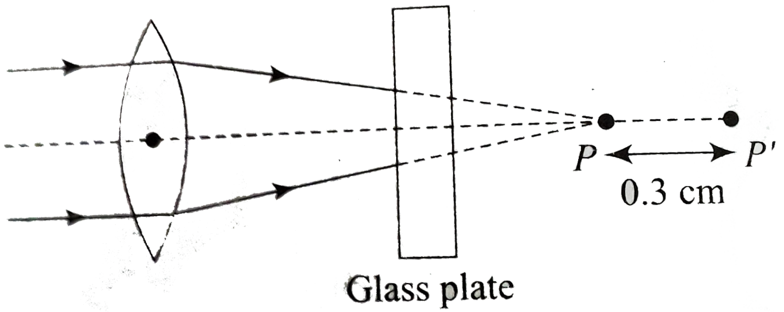
C. $40/3cm$

D. $80/3cm$

Answer: d.

Watch Video Solution

137. Rays from a lens are converging toward a point P, a shown in Figure. How much thick glass plate having refractive index 1.6 must be located between the lens and point P, so that the image will be formed at P'?



A. 0.8cm

B. 1.6cm

C. 5cm

D. 2.4cm

Answer: A

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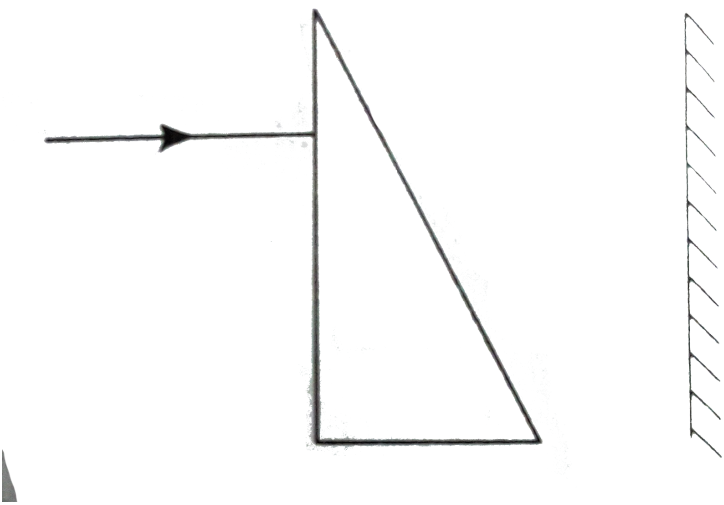
138. A right-angled prism of apex angle 4° and refractive index 1.5 is located in front of a vertical plane mirror as shown in figure. A horizontal ray of light is falling on the prism. Find the total deviation produced in the light ray as it emerges 2nd time from the prism.



A. $8^{\circ} CW$

B. $6^{\circ} CW$

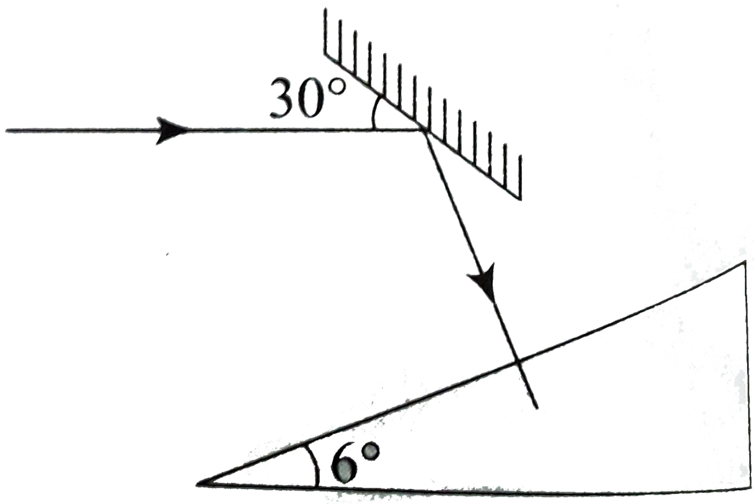
C. $180^\circ CW$

D. $174^\circ CW$

Answer: d.

Watch Video Solution

139. Find the net deviation produced in the incident ray for the optical instrument shown in figure. (Take refractive index of the prism material as 2.)



A. $66^\circ CW$

B. $66^\circ ACW$

C. $54^\circ ACW$

D. $54^\circ CW$

Answer: D

Watch Video Solution

140. When an object is placed 15cm from a lens, a virtual image is formed. Mark the correct statements.

A. The lens may be convex or concave

B. If the lens is diverging, the image distance has to be less than 15cm

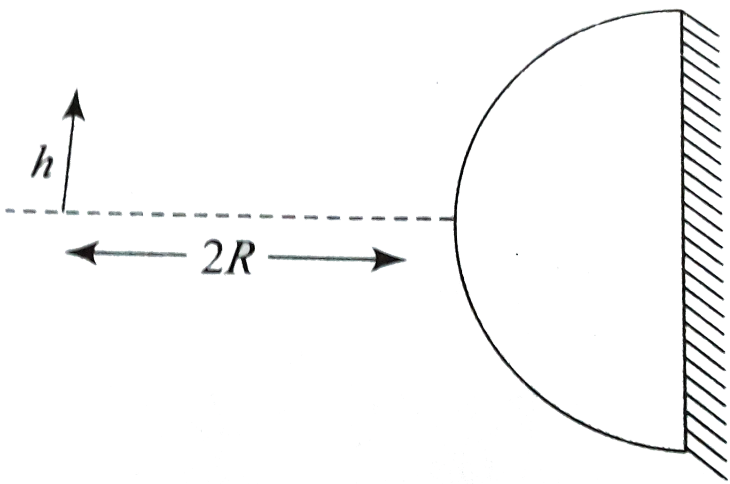
C. If the lens is converging, then its focal length has to be greater than 15cm

D. All of the above

Answer: d.

Watch Video Solution

141. A glass hemisphere of radius R and of material having refractive index 1.5 is silvered on its flat face as shown in figure., A small object of height h is located at a distance 2R from the surface of hemisphere as shown in the figure. The final image will form.



A. at a distance of Rfrom silvered surface, on the right side.

B. on the object itself

C. at hemispher surface

D. at a distance of 2R from the silvered surface, on left side

Answer: b.

Watch Video Solution

142. For a prism its refractive index is cot A/2 then minimum angle of deviation is :

A. $180^\circ - 3A$

B. $180^\circ + 3A$

C. $90^\circ - 3A$

D. $180^\circ - 2A$

Answer: d.

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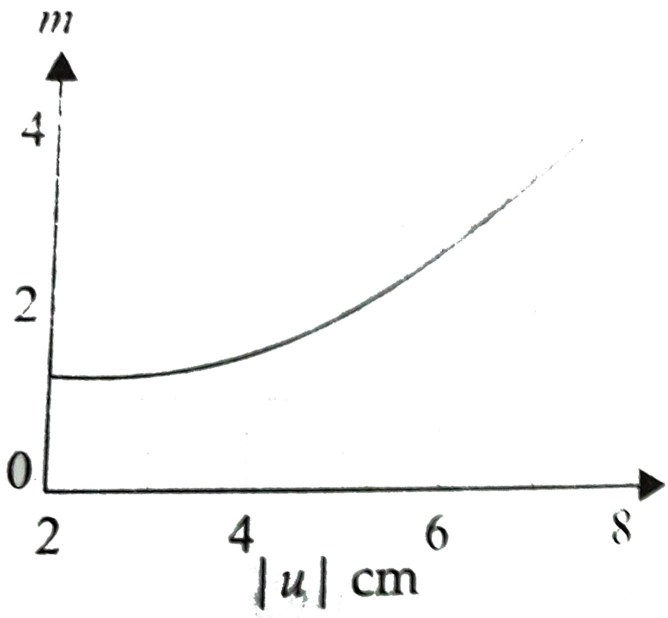
143. An object kept on the principal axis and infront of a spherical mirror, is moved along the axis itself. Its lateral magnification m is measured, and plotted versus object distance $|u|$ for a range of u, as shown in figure. The magnification of the object when it is placed at a distance 20cm in front of the mirror is



A. -1

B. 1

C. 8

D. 20

Answer: A

Watch Video Solution

144. A lens of focal length 20.0 cm and aperture radius 2.0cm is placed at a distance 30.cm from a point source of light. On the other side a screen is placed at a distance 50.0cm from the lens. The radius of spot of light formed on screen is (neglect spherical abberation through lens)

A. $1/2cm$

B. $1/3cm$

C. $1/5cm$

D. $1.0cm$

Answer: b.

Watch Video Solution

145. An object is placed at 21 cm in front of a concave mirror of radius of a curvature 10 cm. A glass slab of thickness 3 cm and u 15 is then placed close to the mirror in the space between the object and the mirror. The position of final image formed is

A. 4.67cm

B. 6.67cm

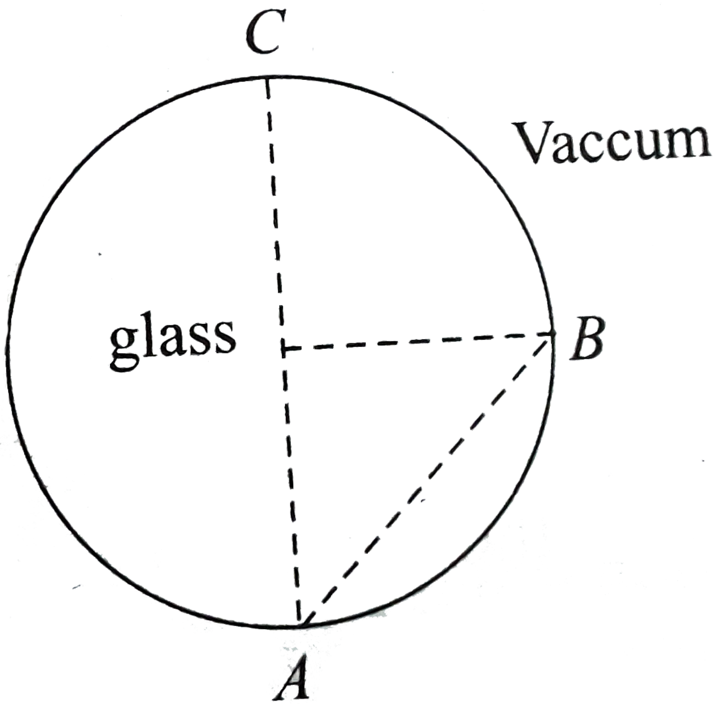
C. 5.67cm

D. 7.67cm

Answer: d.

Watch Video Solution

146. It is found that all electromagnetic signals sent from A towards B reach point C inside the glass sphere, as shown in figure. The speed of electromagnetic signals in glass cannot be:



A. $1.0 \times 10^8 ms^{-1}$

B. $2.4 \times 10^8 ms^{-1}$

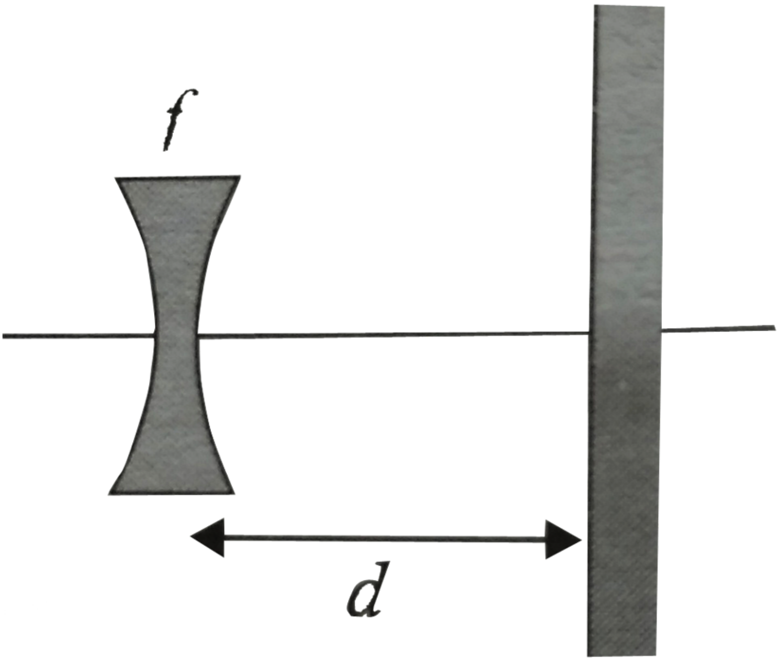
C. $2 \times 10^7 ms^{-1}$

D. $4 \times 10^7 ms^{-1}$

Answer: b.

Watch Video Solution

147. A diverging lens of focal length 10cm is placed 10cm in front of a plane mirror as shown in Fig. Light from a very far away source falls on the lens. What is the distance of final image?



A. 10cm from the mirror

B. infinite away from mirror

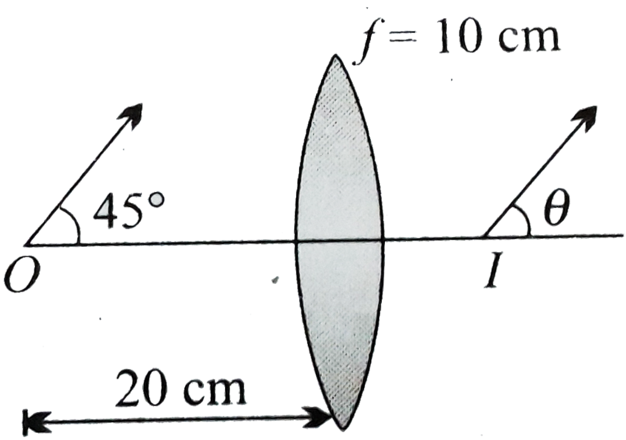
C. 20cm from mirror

D. no image will be formed behind mirror

Answer: c.

Watch Video Solution

148. An object starts moviing at an angle of 45° with the principal axis as shown in figure. In front of a biconvex lens of focal length $+10cm$. If θ denotes the angle at which image starts to move with principal axis, then



A. $\theta = \frac{3\pi}{4}$

B. $\theta = \frac{\pi}{2}$

C. $\theta = \frac{\pi}{4}$

D. $\theta = -\frac{\pi}{4}$

Answer: d.

Watch Video Solution

149. A concave mirror of radius of curvature 40cm forms an image of an object placed on the principal axis at a distance 45 cm in front of it. Now if the system (including object) is completely immersed in water $(\mu = 1.33)$, then

A. the image will shift towards the mirror

B. the magnification will reduce

C. the image will shift away from the mirror and magnification will increase.

D. the position of the image and magnification will not change.

Answer: d.

Watch Video Solution

150. A converging beam of rays is incident on a diverging lens. Having passed through the lens the rays intersect at a point $15cm$ from the lens. If the lens is removed, the point where the rays meet, move $5cm$ closer to the mounting that holds the lens. Find the focal length of the lens.

A. $f = 10cm$

B. $f = 15cm$

C. $f = 30cm$

D. $f = 40cm$

Answer: c.

Watch Video Solution

151. Consider a sphere of radius R made of glass of refractive index μ. A small object moves along the dismeter with a constant velocity u. Find the velocity of the image as seen by an observer outside when the object passes through center.

A. u

B. μu

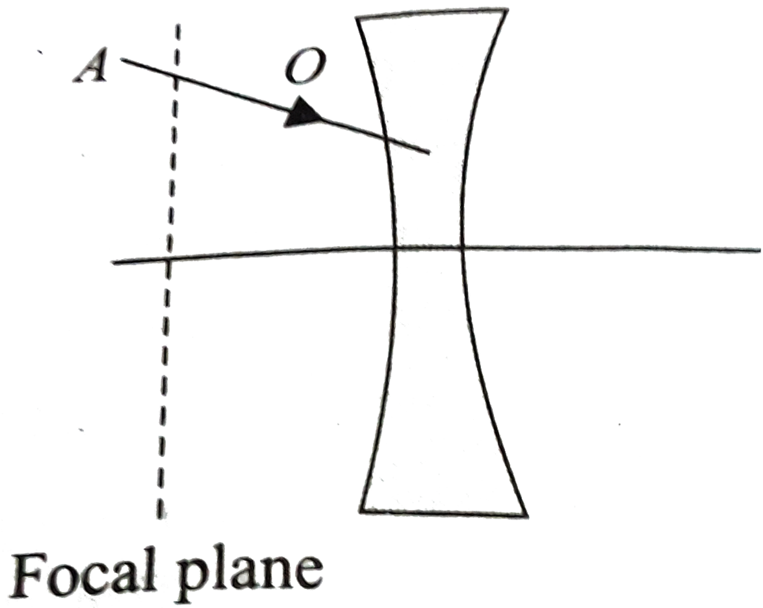
C. u / μ

D. zero

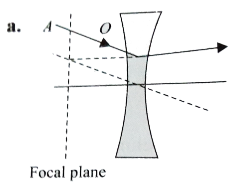
Answer: b.

Watch Video Solution

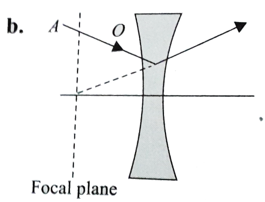
152. A ray of light AO is incident on a diverging lens as shown in figure. The focal plane of the lens is also given. The possible direction of the refracted ray will be

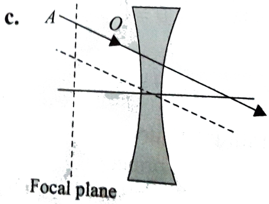


A.



B.



C. 

D. none of the above

Answer: a.

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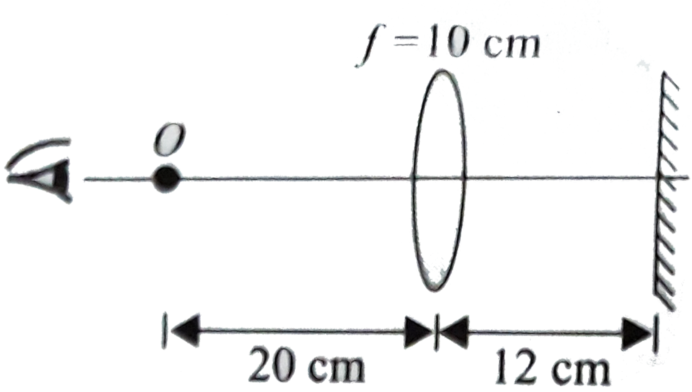
153. In the arrangement shown in figure, O is the object. An observer is to the left of convex lens and looking towards lens. The observer will see an image



A. behind the mirror

B. between lens and mirror

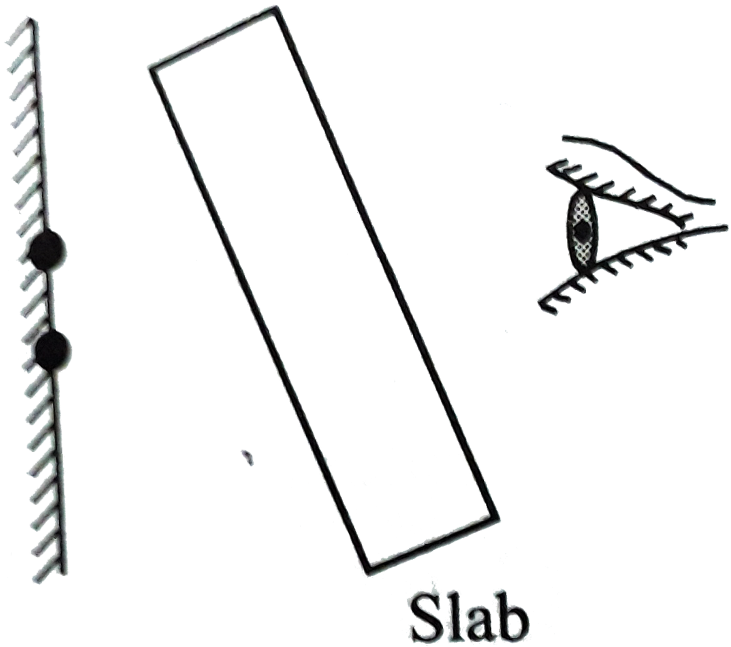
C. to the left of lens

D. no image will be seen

Answer: b.

Watch Video Solution

154. The observer at O views two closely spaced spots on a vertical wall through an angled glass slab as shown in figure. As seen by observer, the spots appear



A. shifted upward, such that distance between them remains same

B. shifted downward, such that distance between them remains same

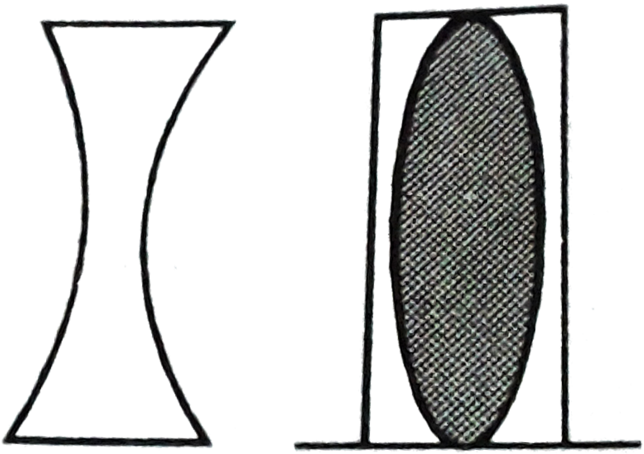
C. spaced farther apart

D. spaced closer together

Answer: a.

Watch Video Solution

155. An equiconcave diverging lens of focal length F is cut into two equal halves. The two halves are turned around and joined with some liquid between them.The lens obtained is converging with focal length F. If the refractive index of the liquid is 3 then what is the refractive index of the lens?



A. 4

B. 2

C. 5

D. 1.5

Answer: b.

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

A. $(2f, 2f)$

B. $\left(\frac{f}{2}, \frac{f}{2}\right)$

C. (f, f)

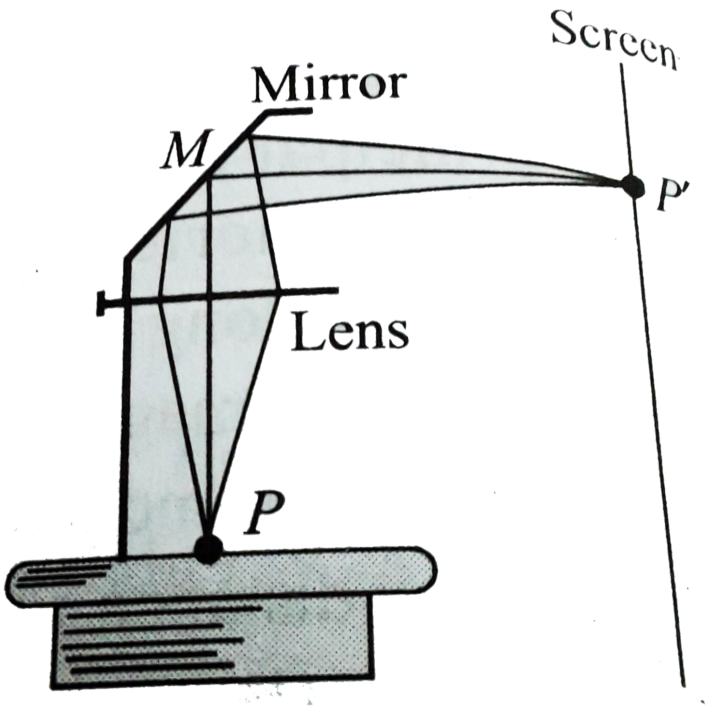
D. $(4f, 4f)$

Answer: a.

Watch Video Solution

157. The lens in an overhead projector forms an image P' of a point P on an overhead tranparency, If the screen is moved closer to the projector to keep the image on the screen in focus, the lens must be

(f, f) **d.** $(4f, 4f)$



A. moved up

B. moved towards left

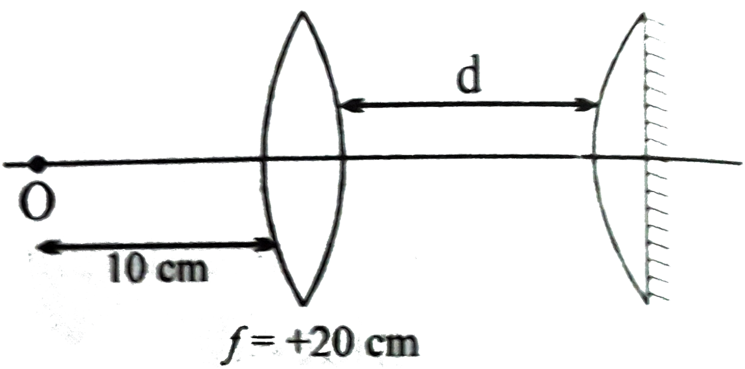
C. moved down

D. moved towards right

Answer: a.

Watch Video Solution

158. A convex lens of focal length 20cm and another plano convex lens of focal length 40cm are placed co-axially . The plano convex lens is silvered on plane surface. What should be the distance (in cm) so that final image of the object 'O' is formed on O itself.



A. 10cm

B. 40cm

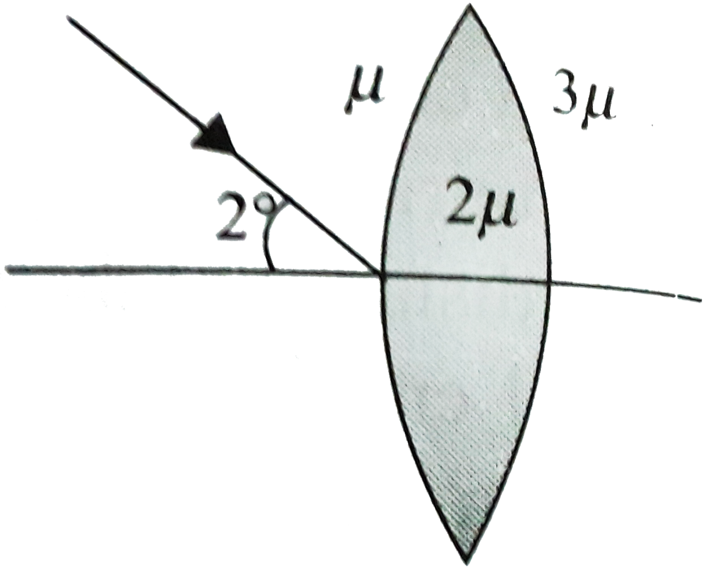
C. 20cm

D. 80cm

Answer: c.

Watch Video Solution

159. A light ray hits the pole of a thin biconvex lens as shown in fig. The angle made by the emergent ray with the optic axis will be approximately



A. 0°

B. $(1/3)^\circ$

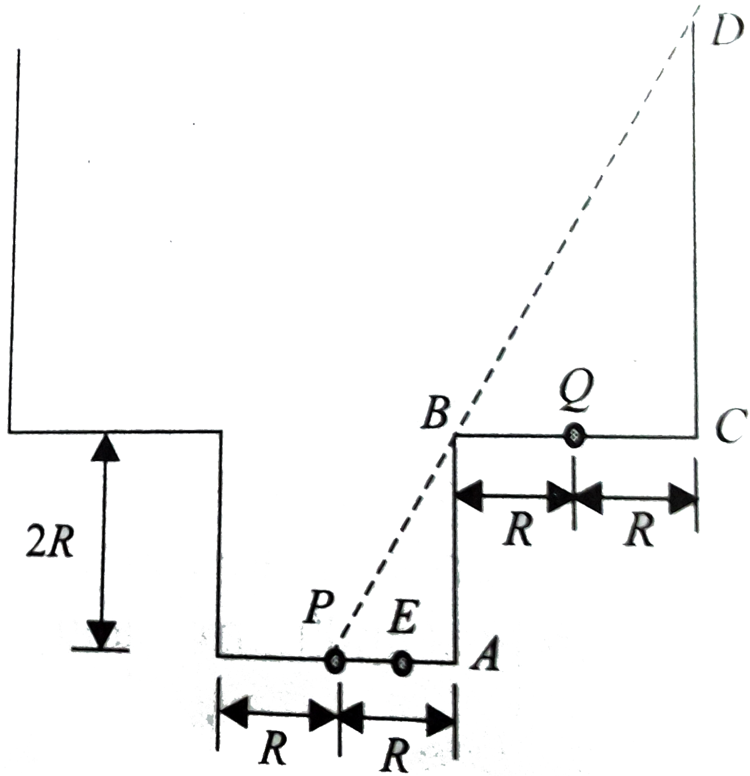
C. $(2/3)^\circ$

D. 2°

Answer: c.

Watch Video Solution

160. In a vessel, as shown in Figure., point P is just visible when no liquid is filled in vessel through a telescope in the air. When liquid is filled in the vessel completely, point Q is visible without movint the vessel or telescope. Find the refractive index of the liquid.



A. $\frac{\sqrt{14}}{3}$

B. $\frac{\sqrt{85}}{5}$

C. $\sqrt{2}$

D. $\sqrt{3}$

Answer: b.

Watch Video Solution

161. In the previous problem what will be refractive index of the liquid so that point E is visible $(PE = R/3)$ through the telescope in air when the vessel is filled with liquid completely, without moving the telesope and vessel.

A. 1.5

B. $\sqrt{3}$

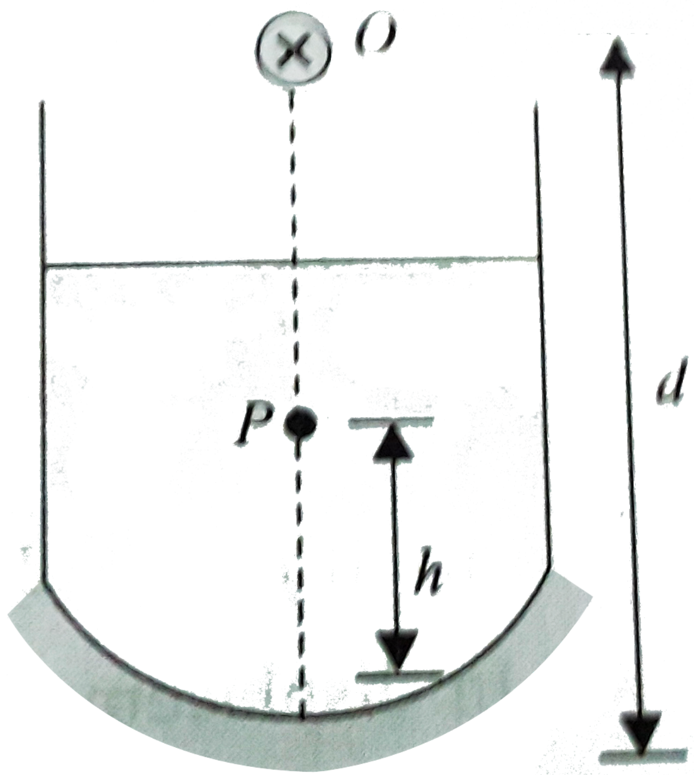
C. $\sqrt{2}$

D. none of these

Answer: d.

Watch Video Solution

162. A concave mirror of radius of curvature h is placed at the bottom of a tank containing a liquid of refractive index μ upto a depth d. An object P is placed at height h above the bottom of the miror. Outside the liquid, an observer O views the object and its image in the mirror. The apparent distance between these two will be



A. $h\left(1-\frac{1}{\mu}\right)$

B. $\frac{2h}{\mu-1}$

C. zero

D. $\frac{2h}{\mu}$

Answer: c.

Watch Video Solution

163. A cylindrical vessel of diameter 12 cm contains $800\pi\ cm^3$ of water. A cylindrical glass piece of diameter 8.0 cm and height 8.0 cm is placed in the vessel. If the bottom of the vessel under the glass piece is seen by the paraxial rays (see figure 18-E6), locate its image. The index of refraction of glass is 1.50 and that of water is 1.33.

A. 9.2 cm above the bottom

B. 12.5cm above the bottom

C. 7.1cm above th bottom

D. 7.1 cm below the bottom

Answer: c.

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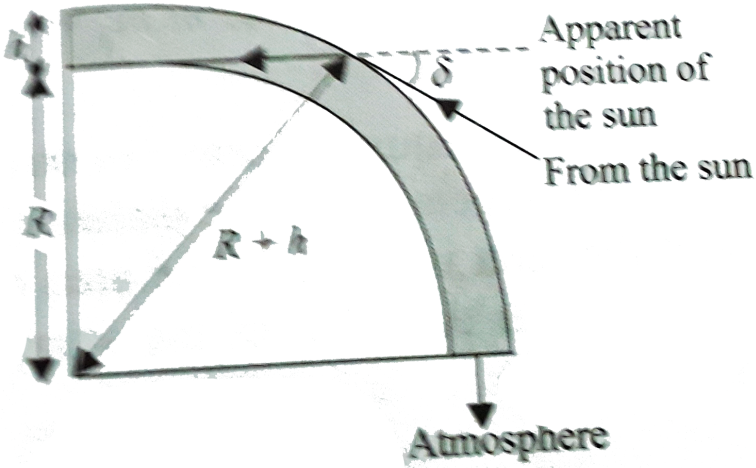
164. When the sun is either rising or setting and appears to be just in the horizon, it is in fact below the horizon. The explanation for this seeming paradox is that light from the sun bends slightly when entering the earth's atmosphere as shown in figure. Assume that the atmosphere has uniform density and hence uniform index of refraction n and extends to a height h above the earth's surface, at which point is abruptly stop. The angle δ above the Sun's true position is given by



A. $\sin^{-1}\left(\frac{nR}{R+h}\right)$

B. $\sin^{-1}\left(\frac{R}{R+h}\right)$

C. $\sin^{-1}\left(\frac{nR}{R+h}\right)+\sin^{-1}\left(\frac{R}{R+h}\right)$

D. $\sin^{-1}\left(\frac{nR}{R+h}\right)-\sin^{-1}\left(\frac{R}{R+h}\right)$

Answer: d.

Watch Video Solution

165. A lens form a diminshed and erect image of an object. The magnifiation is $\frac{1}{4}$. Find ratio of distances between object and focus and focus and image:

A. $4:1$

B. $1:4$

C. $8:1$

D. $2:1$

Answer: c.

Watch Video Solution

166. When an object is placed on the principal axis of a convex lens at two different positins, it produces the images with magnifications $+2$ and -4 respectively. How many times more away from the lens the image will be formed in the second position as compared to the first postion?

A. 2

B. 4

C. 5

D. 10

Answer: c.

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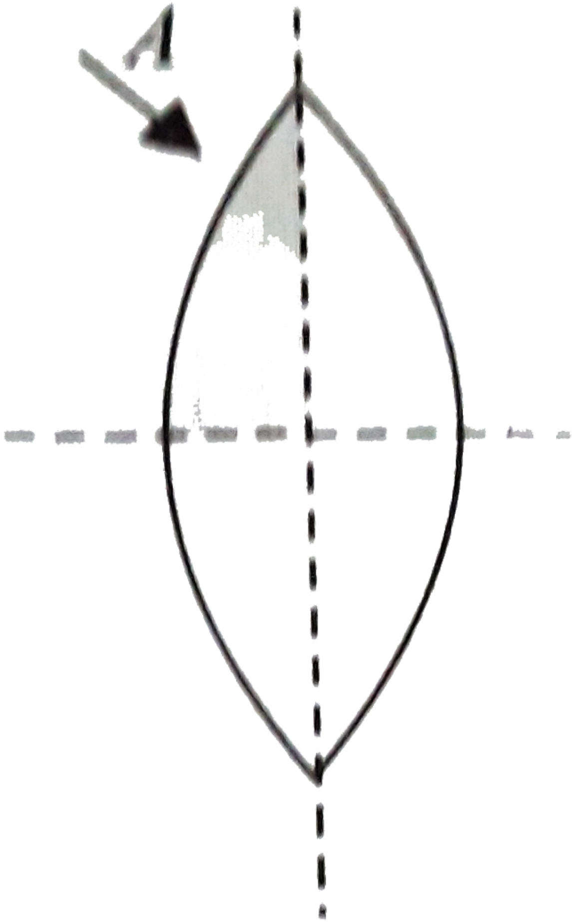
167. A convex lens of focal length f cut into parts first horizontally and then vertically. Find the focal length of part A of the lens, as shown:



A. $f/2$

B. f

C. 4f

D. 2f

Answer: d.

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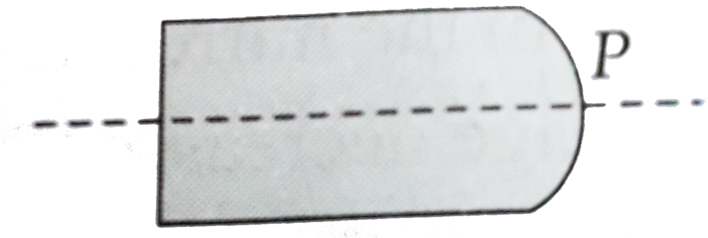
168. Find the distance of object placed in the slab of refractive index μ from point P of the curved surface of radius R so that image is formed at infinity:



A. $\dfrac{(\mu-1)R}{\mu}$

B. $\dfrac{\mu R}{(\mu-1)}$

C. $\dfrac{R}{(\mu-1)}$

D. $\dfrac{(\mu-1)R}{2\mu}$

Answer: b.

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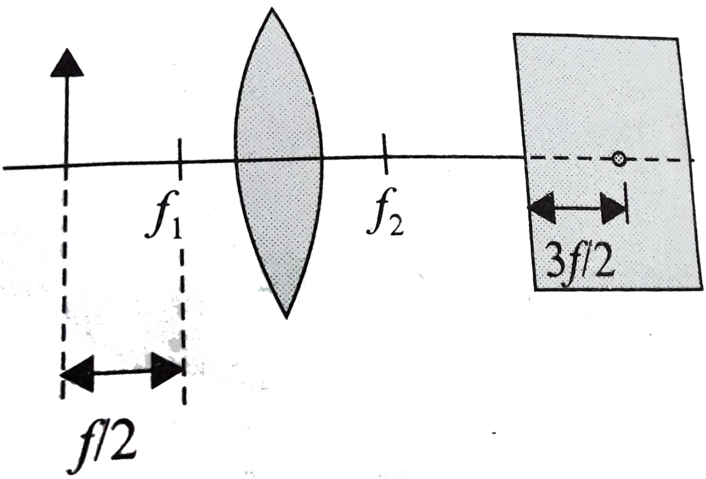
169. An object is placed at $f/2$ away from first focus of a convex lens where f is the focal length of the lens. Its image is formed at a distance $3f/2$ in a slab of refractive index $3/2$, from the face of the slab facing the lens. Find the distance of this face of the slab from the second focus of the lens.



A. $f/2$

B. $3f/2$

C. 2f

D. f

Answer: d.

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170. A fish in a lake (refractive index $4/3$ for water) is viewed through a convex lens. From water surface, the lens is placed in air at half of the distance of the fish from the water surface, so that the image is formed at the fish itself. The focal length of the lens is how many times the depth of fish in water?

A. 4

B. 6

C. 7.5

D. 9

Answer: c.

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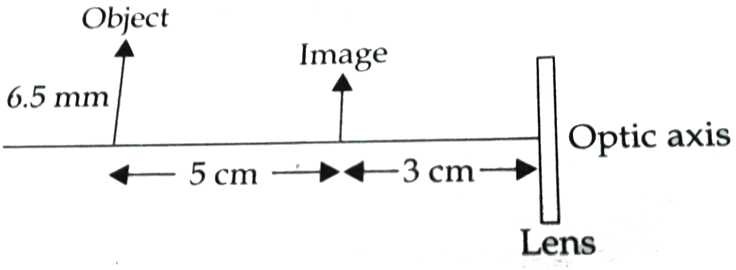
171. Shown an object and its image formed by a thin lens. Then the nature and focal length of lens is



A. $f = 4.8 cm$ converging lens

B. $f = -4.8 cm$ diverging lens

C. $f = 2.18 cm$ converging lens

D. $f = -2.18 cm$ diverging lens

Answer: b.

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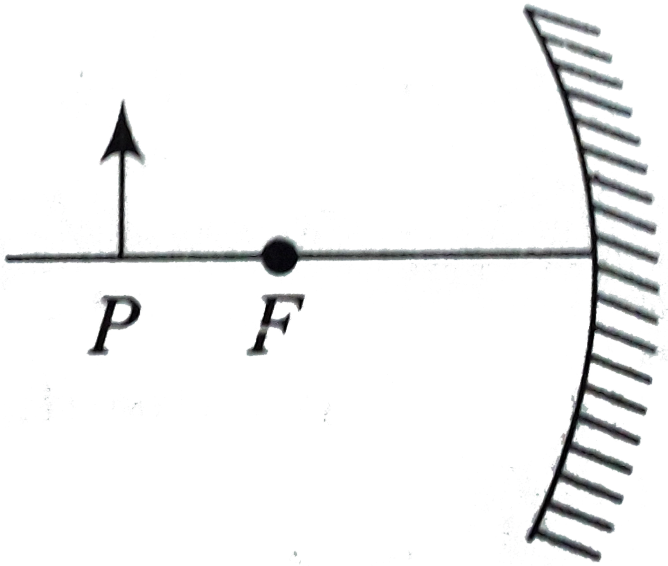
172. Figure shows an object located at point P, 0.25 meter from concave spherical mirror with principal focus F. The focal length of the mirror is 0.10m How does the image change if the object is moved from point P toward point F?



A. Its distance form the mirror decreases

B. The size of image decreases

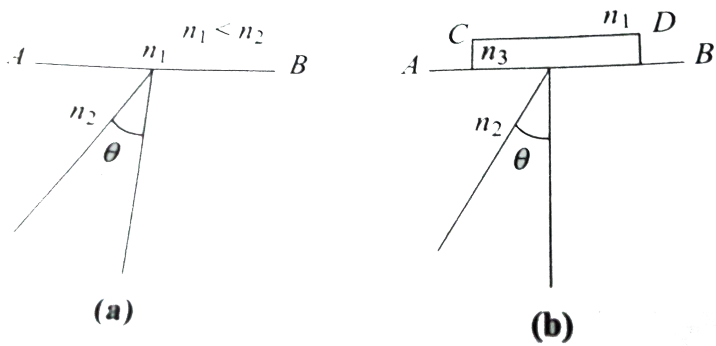
C. Its distance from the mirror increases

D. The size of image increases

Answer: c., d.

Watch Video Solution

173. In Figure, light is incident at an angle θ which is slightly greater than the critical angle. Now, keeping the incident angle fixed a parallel slab or refractive index n_3 is placed on surface AB. Which of the following statements are correct?



A. Total internal reflection occurs at AB for $n_3 < n_1$

B. Total internal reflection occurs at AB for $n_3 > n_1$

C. The ray will returen back to the same medium for all values of n_3

D. Total internal reflection occurs at CD for $n_3 < n_1$

Answer: a, c.

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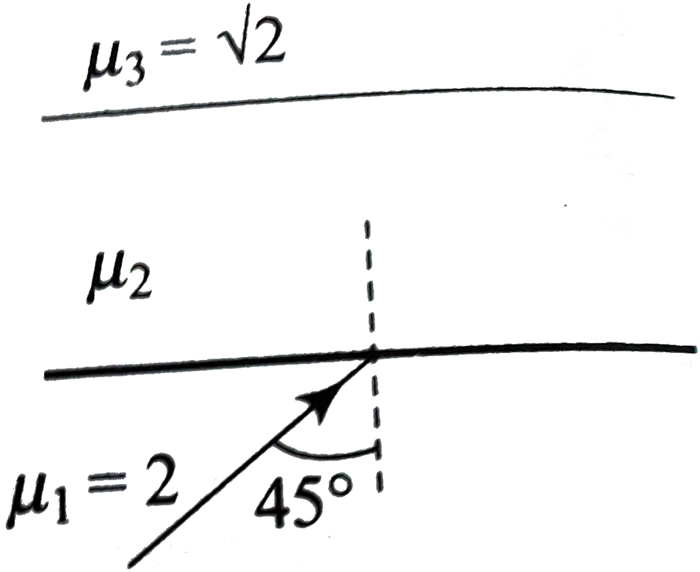
174. Figure, a light ray is incident on the lower medium boundary at an angle if 45° with the normal. Which of the following statement is/are true?



A. If $\mu_2 > \sqrt{2}$, then angle of deviation is 45°

B. If $\mu_2 < \sqrt{2}$, then angle of deviation is 90°

C. If $\mu_2 < \sqrt{2}$, then angle of deviation is 135°

D. If $\mu_2 > \sqrt{2}$, then angle of deviation is 0°

Answer: a.,b.

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175. In displacement method, the distance between object and screen is 96cm. The ratio of lengths of two images formed by a converging lens placed between them is 4. Then,

A. ratio of the length of object to the length of shorter image is 2

B. distance between the two positions of the lens is 32 cm

C. focal length of the lens is $64/3$ cm

D. when the shorter image is formed on screen, distance of the lens from the screen is 32cm.

Answer: a.,b.,c.,d.

Watch Video Solution

176. The distance between an electric lamp and a screen is $d = 1m$. A convergent lens of focal length $f = 21$cm is placed between the lamp and the lens such that a sharp image of the lamp filament is formed on the screen.

A. The positions of the lens from the lamp for which sharp images are formed on the screen are 35cm and 65cm.

B. The positions of the lens from the lamp for which sharp images are formed on the screen are 30cm and 70cm

C. Magnitude of the difference in magnification is $40/21$

D. The size of the lamp filament for which there are two sharp images of 4.5cm and 2cm, is 3cm

Answer: b.,c.

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177. A lense of focal length f is placed in between an object and screen at a distance D. The lens forms two real images of object on the screen for two of its different positions, a distance x apart. The two real images have magnification m_1 and m_2 respectively $(m_1 > m_2)$. Choose the correct statement(s).

A. $f = x / (m_1 - m_2)$

B. $m_1 m_2 = 1$

C. $f = (D^2 - x^2) / 4D$

D. $D \geq 4f$.

Answer: a.,b.,c.,d.

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178. An image of a bright square is obtained on a screen with the aid of a convergent lens. The distance between the square and the lens is

40cm. The area of the image is nine times larger than that of the square. Select the correct statement(s):

A. Image is formed at a distance of 120cm from the lens

B. Image is formed at a distance of 360cm from the lens

C. Focal length of the lens is 30cm

D. Focal length of the lens is 36cm

Answer: A::C

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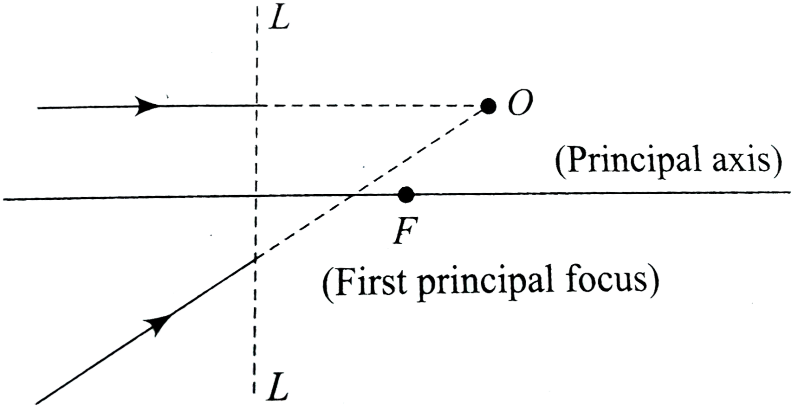
179. Consider the rays shown in figure, as paraxial. The image of the virtual point object O formed by the lens LL is



A. virtual

B. real

C. located below the principal axis

D. located to the left of the lens

Answer: a.,c.,d.

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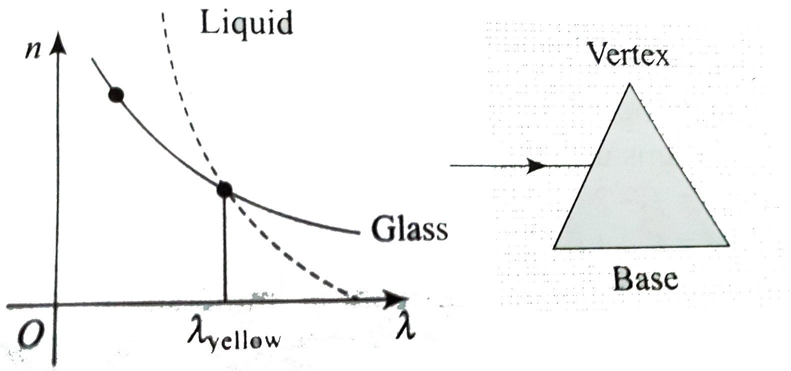
180. A glass prism is immersed in a hypothetical liquid. The curves showing the refractive index n as a function of wavelength λ for glass and liquid are as shown in Figs. When a ray of white light is incident on the prism parallel to the base



A. yellow ray travels without deviation

B. blue ray is deviated toward the vertex

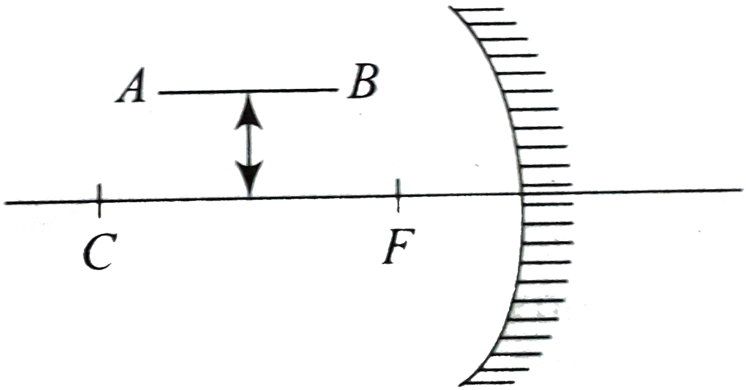
C. red ray is deviated towards the base

D. there is no dispersion

Answer: a., b., c.

Watch Video Solution

181. An object AB is placed parallel and close to the optical axis between focus F and center of curvature C of a converging mirror of focale length f as shown in Figure. Then,



A. Image of A will be closer than that of B from the mirror.

B. Image of AB will be parallel to the optical axis.

C. Image of AB will be a straight line inclined to the optical axis.

D. Image of AB will not be a straight line.

Answer: a.,c.

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182. Which of the following statement is $/$ are correct about the refraction of light from a plane surface when light rays is incident in denser medium. $[$ C is critical angle $]$

A. The maximum angle of deviation during refraction is $(\pi/2) - C$, it will be at angle of incidence C

B. The maximum angle of deviation for all angles of incidence is $\pi - 2C$, when angle of incidence is slightly greater than C

C. If angle of incidence is less than C, then deviation increases if angle of incidence ia also inicreased

D. If angle of incidence is greater than C, then angle of deviation decreases if angle of incidence is increased

Answer: a.,b.,c.,d.

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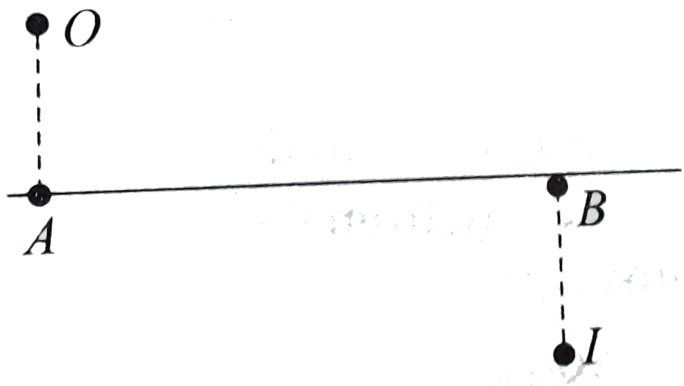
183. A luminous point object is placed at O, whose image is formed at I as shown in Figure. Line AB is optical axis. Which of the following statement is / are correct?



A. If a lens is used to obtain the image, then it must be a converging lens and its optical center will be the intersection point of line AB and OI

B. If a lens is used to obtain the image, then it must be a diverging lens and its optical center will be the intersection point of line AB and OI

C. If a mirror is used to obtain the image, then the mirror must be concave and the object and image subtend equal angles at the pole of the mirror.

D. I is a real image

Answer: a., c., d

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184. Mark the correct statement(s) w.r.t. a concave spherical mirror.

A. For real extended object, it can form a diminshed virtual image

B. For real extended object, it can form a magnified virtual image

C. For virtual extended object, it can form a diminshed real image

D. For virtual extended object, it can form a magnified real image

Answer: B::C

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185. Mark the correct statement(s) from the following:

A. Image formed by a convex mirror can be real

B. Image formed by a convex mirror can be virtual

C. Image formed by a convex mirror can be magnified

D. Image formed by a convex mirror can be inverted

Answer: a.,b.,c.,d.

Watch Video Solution

186. When a real object is placed 25cm from a lens, a real image if formed. Mark the correct statement(s) from the following:

A. The lens is a converging lens

B. The image may be magnified or diminished

C. The focal length of the lens is less that 25cm

D. The focal length of the lens may be grater than 25 cm

Answer: a,b,c

Watch Video Solution

187. Two converging lenses of focal lengths $f_1 = 10cm$ and $f_2 = 20cm$ are placed at some separation. A parallel beam of light is incident on first lens. Then,

A. for emergent beam form second lens to be parallel, the separation between the lenses has to be 30cm

B. for emergent beam from second lens to be parallel, the separation between the lenses has to be 60cm

C. if lenses are placed at such a separation that emergent beam from second lens is parallel, then the emergent beam width is

2cm if original beam has a width of 1cm

D. if lenses are placed at such a separation that emergent beam from second lens is parallel, then the emergent beam width is 4cm if original beam width is 1cm.

Answer: A::C

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188. A real object is moving toward a fixed spherical mirror. The image

A. must move away from the mirro

B. may move away from the mirror

C. may move toward the mirro if the mirror is concave

D. must move toward the mirror if the mirror is convex

Answer: b.,c.,d.

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189. A real point source is 5cm away from a plane mirror whose reflectinig ability is 50% , while the eye of an observer (pupil diameter 5mm) is 10cm away form the mirror. Asuume that both source and eye are on the same line perpendicular to the surface and refracted rays have no effect on intensity. Then,

A. the area of the mirro used in observing the image of source is $(25\pi/36)mm^2$

B. the area of the mirror used in observing the image of source is $25\pi mm^2$

C. the ratio of the intensities of light as received by the observer in the presence to that in the absence of mirror is $(10/9)$

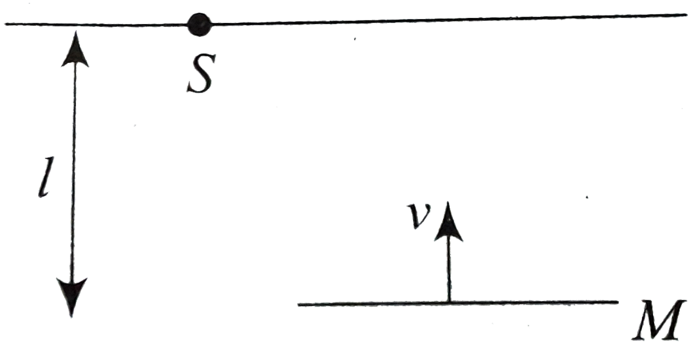
D. the ratio of the intensities of light as received in the presence to that in the absence of mirror is $19/18$

Answer: a.,d.

Watch Video Solution

190. A plane mirror M is arranged parallel to a wall W at a distance l from it. The light produced by a point source S kept on the wall is reflected by the mirror and produces a patch of light on the wall. The mirroo moves with velocity v towards the wall.

Which of the following statement(s) is / are correct?



A. The patch of light will move with speed v on the wall

B. The patch of light will not move on the wall

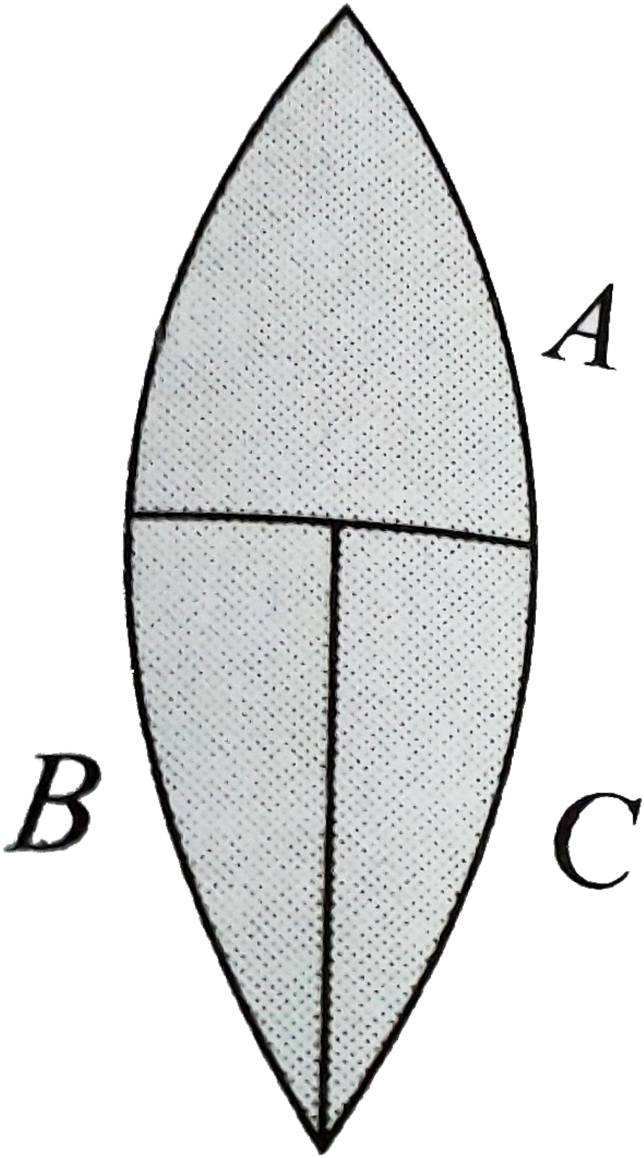
C. As the mirror comes closer, the patch of light will become larger and shift away from the wall with speed larger than v

D. The size of the patch of light on the wall remains the same

Answer: b.,d.

Watch Video Solution

191. A thin, symmetric double convex lens of power P is cut into three parts A, B, and C as shown in Figure. The power of



A. A is P

B. A is 2P

C. B is $P/2$

D. C is $P/4$

Answer: a.,c.

Watch Video Solution

192. A diverging lens of focal length f_1 is placed in front of and coaxially with a concave mirror of foacl length f_2. Their separation is d. A parallel beam of light incident on the lens returns as a parallel beam from the arrangement. Then,

A. the beam diameters of the incident and reflected beams must be the same

B. $d = 2|f_2| - |f_1|$

C. $d = |f_2| - |f_1|$

D. if the entire arrrangement is immersed in water, the conditions will remain unaltered

Answer: A::B

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193. A converging lens of focal length f_1 is placed in front of and coaxially with a convex mirror of focal length f_2. Their separation is d. A parallel beam of light incident on the lens returns as a parallel beam from the arrangement, Then,

A. the beam diameters of the incident and reflected beams must be the same

B. $d = f_1 - 2 \mid f_2 \mid$

C. $d = f_1 - \mid f_2 \mid$

D. if the entire arrangement is immersed in water, the conditions will remain unaltered

Answer: a.,b.

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194. Which of the following statements are correct?

A. A ray of light is incident on a plane mirror and gets reflected. If the mirror is rotated through an angle θ, then the reflected ray gets deviated through angle 2θ

B. A ray of light gets reflected successively from two mirrors which are mutually inclined. Angular deviation suffered by the ray does not depend upon an angle of incidence on first mirror

C. A plane mirror cannot form real image of a real object

D. If an object approached toward a plane mirror with velocity v, then the image approaches the object with velocity 2v.

Answer: a.,b.,c.,d.

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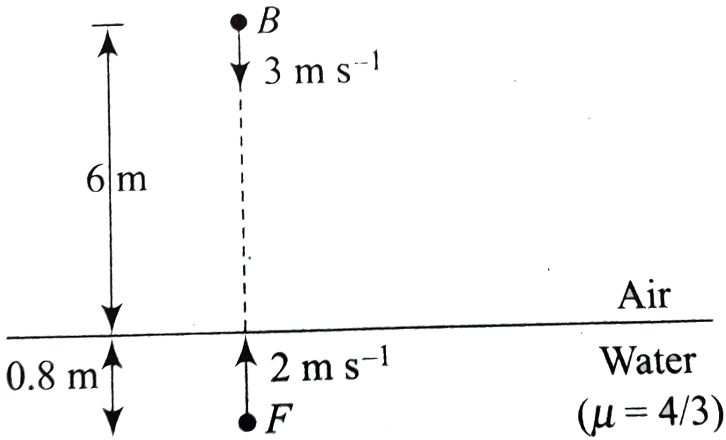
195. A fish F, in the pond is at a depth of 0.8m from the water surface and is moving vertically upward with velocity $2ms^{-1}$. At the same instant, a bird B is at a height of 6m from the water surface and is moving downward with velocity $3ms^{-1}$. At this instant. both are on the same vertical line as shown in figure . Which of the following statements are correct?



A. Height of B, observed by F(from itself), is equal to 5.30m

B. Depth of F, Observed by B (from itselft), is equal to 6.60m

C. Height of B, observed by F (From itself), is equal to 8.80m

D. None of the above

Answer: b.,c.

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196. In the previous question,

A. velocity of B, observed by F (relative to itself), is equal to $4.25ms^{-1}$

B. velocity of B, observed by F (relative to itself), is equal to $6ms^{-1}$

C. velocity of B, observed by F (relative to itself), is equal to $5.50ms^{-1}$

D. velocity of B, observed by F (relative to itself), is equal to $4.50ms^{-1}$

Answer: b.,d.

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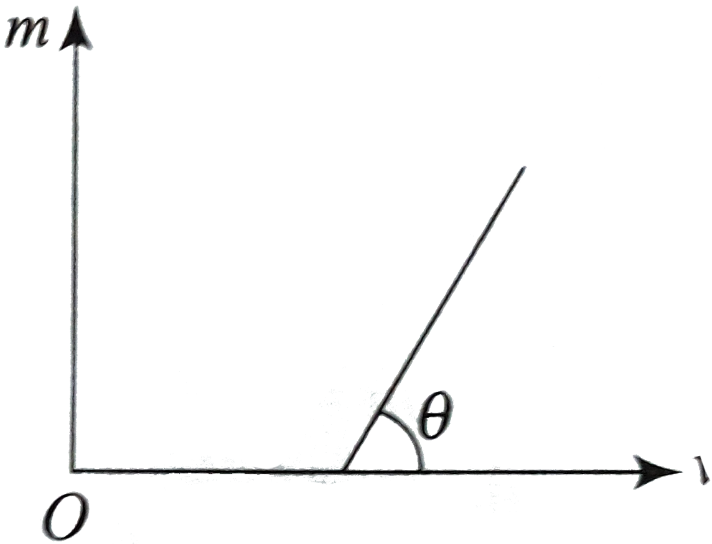
197. Figure, shows variation of magnification m (produced by a thin convex lens) and distance v of image from pole of the lens. When of the following statements are correct?



A. Focal length of the lens is equal to intercept on v-axis

B. Focal length of the lens is equal to inverse of slope of the line

C. Magnitude of intercept on m-axis is equal to unity

D. None of the above

Answer: a.,b.,c.

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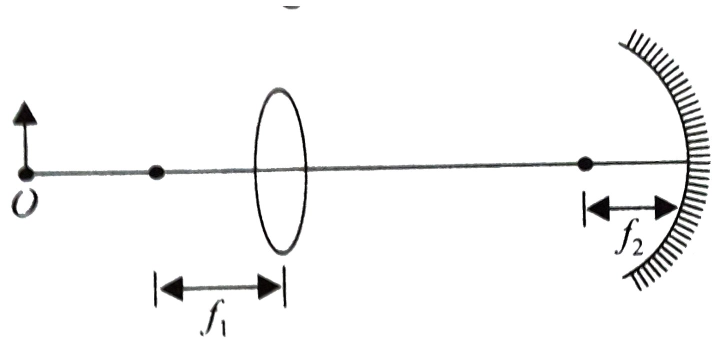
198. An object is placed in front of a converging lens at a distance equal to twice the focal length f_1 of the lens. On the other side of the lens is a concave mirror of focal length f_2 separated from the lens is a concave mirror of focal length f_2 separated from the lens by a distance $2(f_1 + f_2)$. Light from the object passes rightward through the lens, reflects from the mirror, passes leftward throught the lens, and forms a final image of the object.



A. The distance between the lens and the final image is equal to $2f_1$.

B. The distance between the lens and the final image is equal to $2(f_1 + f_2)$

C. The final image is real, inverted and of same size as that fo the object.

D. The final image is real, erect and of same size as that of the object.

Answer: a,c.

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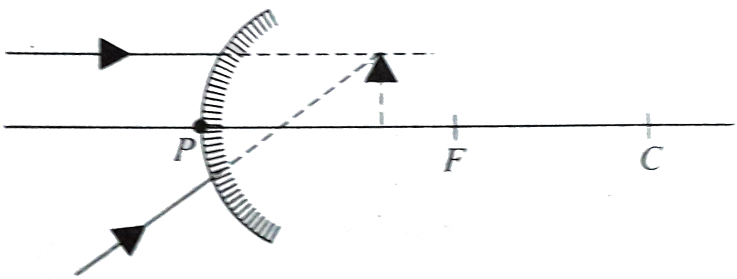
199. Converging rays strike a spherical convex mirror such that they can form the Image (in the absence of mirror) between pole and focus. Now what can you say about final image formed by mirror?



A. real

B. virtual

C. erect

D. inverted

Answer: a.,c.

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200. In the above question, if the rays were to converge between F and C of mirror, then find the nature of final image formed

A. real

B. virtual

C. erect

D. inverted

Answer: b.,d.

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201. In the above question, if the rays were to converge beyond C, then find the nature of final image formed.

A. real

B. virtual

C. erect

D. inverted

Answer: b.,d.

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202. A concave mirror forms an image of the sun at a distance of 12 cm from it.

A. the radius of curvature of this mirror is 6cm

B. to use it as a shaving mirro, it can be held at a distance of 8-10cm from the face

C. it an object is kept at a distance of 24cm from it, the image formed will be of the same size as the object

D. all the above alternative are correct.

Answer: b.,c.

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203. A real object is placed infront of a convex mirror (focal length f). It moves towards the mirror, the image also moves. If $V_i =$ speed of image and $V_0 =$ speed of the object and u is the distance of object from mirror along principal axis, then

A. $V_i < V_0$ if $|u| < |f|$

B. $V_i > V_0$ if $|u| > |f|$

C. $V_i < V_0$ if $|u| > |f|$

D. $V_i = V_0$ if $|u| = |f|$

Answer: a.,c.

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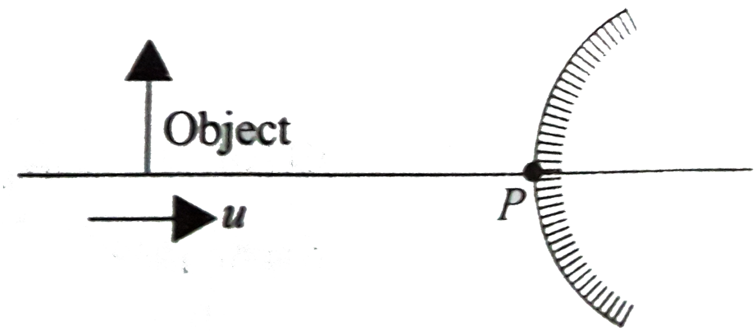
204. An object is moving towards a convex mirror with a constant velocity. P is the pole of mirror.



A. magnification of the image increases with time.

B. magnificatin of the image decreases with time

C. velocity of the image increases with time

D. velocity of the image decreases with time

Answer: a.,c.

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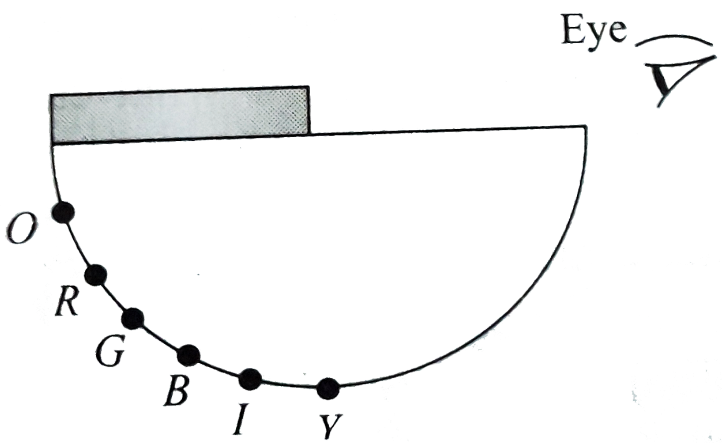
205. A person is looking at the flat surface of a transparent hemisphere of refractive index $\mu = \sqrt{2}$. Half of the flat surface is coloured black and half of curved surface is coloured in six equally spaced strips as shown in Figure. Then



A. the person can see green, orange and red

B. the person can see only yellow, indigo and blue

C. the ray coming from red and organge strips will be totally reflected

D. the ray coming from yellow, indigo and blue stips will be totally reflected

Answer: b.,c.

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206. Refractive index of an equilateral prism is $\sqrt{2}$

A. minimum deviation from this prism can be 30°

B. minimum deviation from this prism can be 45°

C. at angle of incidence 45° , deviation is minimum

D. at angle of incidence 60° , deviation is minimum

Answer: A::C

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207. A convex lens made of glass $(\mu_0 = 3/2)$ hs focal length f in air. The image of a object placed infront of it is inverted real and magnified. Now the whole arrangement is immersed in water ($\mu_w = 4/3)$ without changing the distance between object and lens. Then

A. the new focal length will becom 4f

B. the new focal length will become $f/4$

C. new image will be virtual and magnified

D. new image will be real, inverted and smaller in size

Answer: a.,c.

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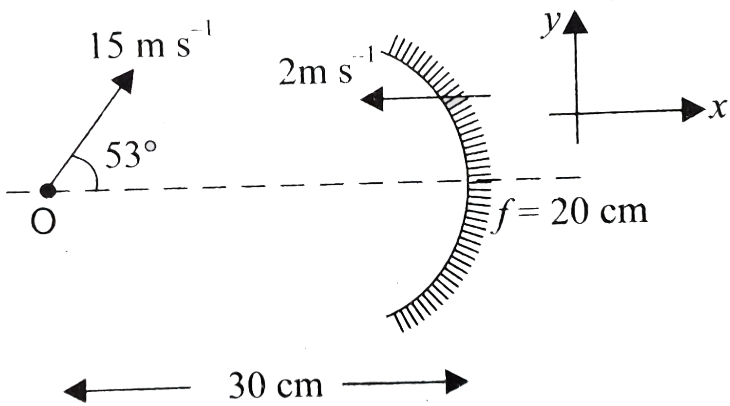
208. In the situation as shown in Figure, $\left(\cos 53^\circ = \frac{3}{5}\right)$



A. velocity of image wrt mirror is $-22\hat{i} - 24\hat{j}$

B. velocity of image wrt mirror is $-44\hat{i} - 24\hat{j}$

C. velocity of image wrt ground is $-46\hat{i} - 24\hat{j}$

D. velocity of image wrt ground is $-24\hat{i} - 24\hat{j}$

Answer: b.,c.

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209. A plano-convex lens $(f = 20cm)$ is silvered at plane surface. The focal length will be

A. The radius of curvature of curved surface of given plano-convex lens is equal to half of radius of curvature of a surface of equiconvex lens of focal length 20cm

B. An object placed at 15cm on the axis on the convex side of silvered plano-convex lens gives rise to an image at a distance 30cm from it

C. An object placed at a distance of 20cm on the axis on the convex side of silvered plano-convex lens gives rise to an image at 40cm from it

D. Silvered plano-convex lens acts as a concave mirror of focal length 10cm.

Answer: a.,b.,d.

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210. For a concave mirror

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

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

C. $\frac{f}{4}$

D. $\frac{4f}{3}$

Answer: A::B

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211. A linear object of size $1.5cm$ is placed at 10 cm from a lens of focal length 20 cm. The optic centre of lens and the object are displaced are displaced a distance Δ. Thed magnification of the image formed is m. (Take optic centre of origin). The coordinates of image of A and B are

(x_1, y_1) and (x_2, y_2) respectively then

A. $(x_1, y_1) = (-20cm, -1cm)$

B. $(x_2, y_2) = (-20cm, 2cm)$

C. $m = 3$

D. $m = 2$

Answer: a.,b.,d.

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212. Assertion:Although the surfaces of goggle lens are curved, It does not have any power.

Reason: In case of goggles, both the curved surfaces have equal radii of curvature and have centre of curvature on the same side.

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: a.

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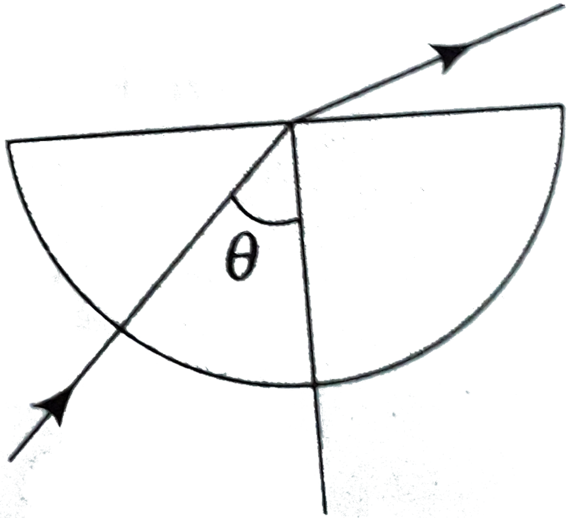
213. Statement I: A beam of white light enters the curved surface of a semicircular piece of glass along the normal. The imcoming beam is moved clockwise (so that the angle θ increases), such that the beam always enters along th enormal to the curved side. Just before the refracted beam disappears, it becomes predominantly red.

Statement II: The index of refraction for light at the red end of the visible spectrum is more than at the violet end.



A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: c.

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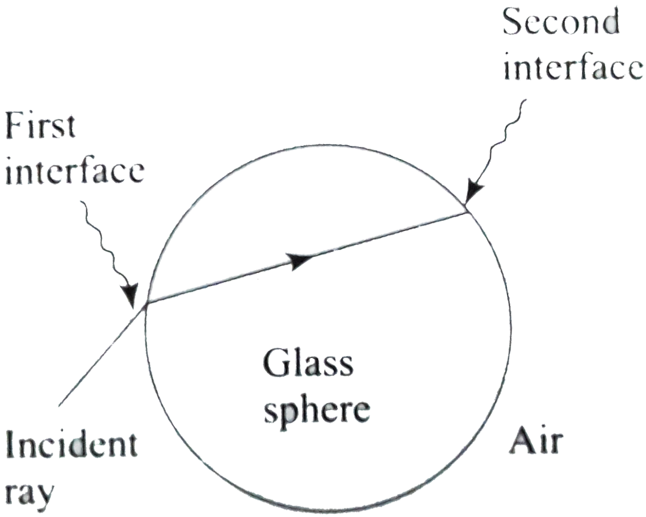
214. Statement I: A ray is incident from outside on a glass sphere surrounded by air as shown in Figure. This ray may suffer total internal reflection at the second interface.



Statement II: For a ray going from a denser to rarer medium, the ray may suffer total internal reflection.

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: d.

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215. Statement I: Keeping a point object fixed, if a plane mirror is moved, the image will also move.

Statement II: In case of a plane mirror, distance of object and its image is equal from any point on the mirror

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: d.

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216. Statement I: Lights of different colors travel with different speeds in vacuum.

Statement II: Speed of light depends on medium.

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: d.

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217. Statement I: A beam of light rays has been reflected from a rough surface.

Statement II: Amplitude of incident and reflected rays would be different.

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: b.

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218. STATEMENT-1 A virtual image can be photographed.

STATEMENT- 2 Only a real image can be formed on a screen

A. Statement 1 is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: b.

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219. STATEMENT-1 The focal length of a lens does not depend on the medium in which it is submerged.

$STATEMENT - 2\ \frac{1}{f} = \frac{\mu_2 - \mu_1}{\mu_1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: d.

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220. STATEMENT-1 We cannot produce a real image by plane or convex mirror under any circumstances.

STATEMENT-2 The focal length of a convex mirror is always taken as positive.

A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: d.

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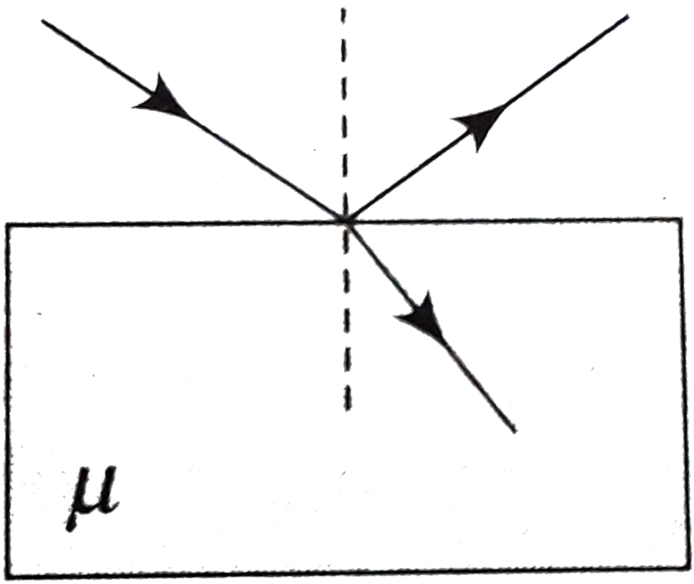
221. Statement I: A light ray is incident on a glass slab. Some portion of it is reflected and some is refracted. Refracted and reflected rays are always perpendicular to each other.

Statement II: Angle of incidence is equal to angle of reflection.



A. Statement is True, Statement II is True, Statement II is correct explanation for Statement I

B. Statement I is True, Statement II is True, Statement II is NOT a correct explanation for Statement I.

C. Statement I is True, Statement II is False.

D. Statement I is False, Statement II is True.

Answer: d.

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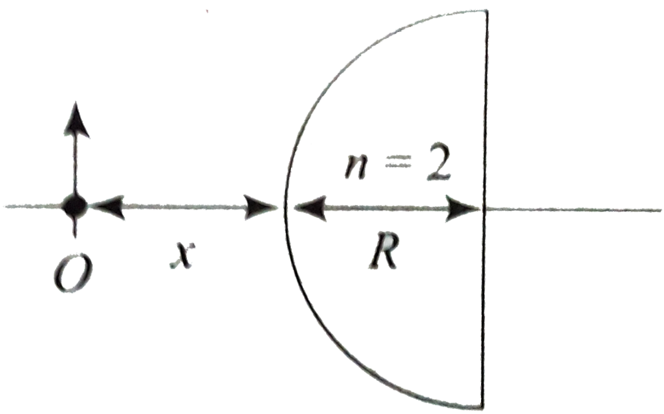
Assertion-Reasoninig

1. Consider a transparent hemispher $(n = 2)$ in front of which a small object is placed in air $(n = 1)$ as shown in figure.



Q. For which value of x, of the following , will the final image of the object O be virtual?

A. 2R

B. 3R

C. $R/2$

D. $1.5R$

Answer: c.

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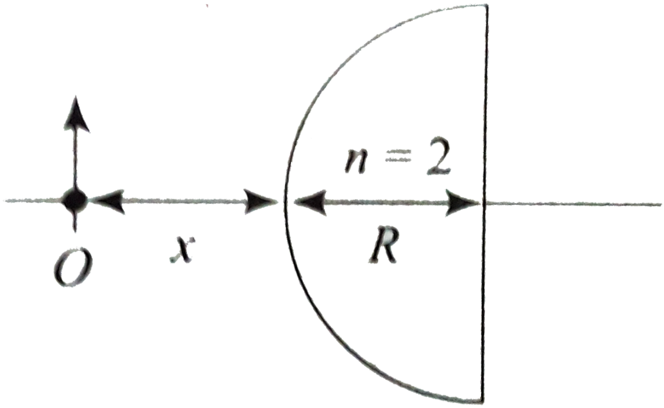
2. Consider a transparent hemispher $(n = 2)$ in front of which a small object is placed in air $(n = 1)$ as shown in figure.



Q. What is the nature of final image of the object when $x = 2R$?

A. Erect and magnified

B. Inverted and magnified.

C. Erect and same size.

D. Inverted and same size.

Answer: d.

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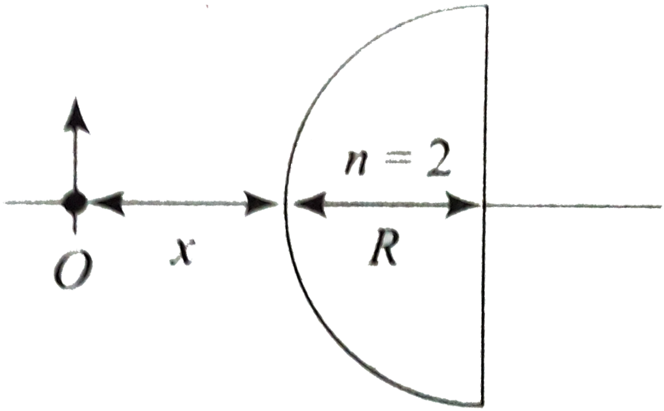
Linked Comprehension

1. Consider a transparent hemispher $(n = 2)$ in front of which a small object is placed in air $(n = 1)$ as shown in figure.



Q. Consider a ray starting from O which strikes the spherical surface at grazing incident $(i = 90^\circ)$. Takin $x = R$, what will be the angle (from normal) at which the ray may emerge from the plane surface.

A. 90°

B. 0°

C. 30°

D. 60°

Answer: a

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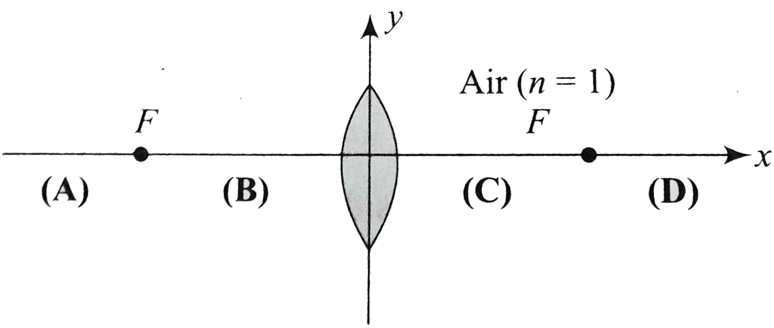
2. This question concerna a symmetrical lens shown, along with its two focal points. It is made of plastice with $n = 1.2$ and has focal length f. Four different regions are shown:

Here,

A. $-\infty x < \ -f$ B. $-f < x < 0$

C. $0 < x < f$ D. $f < x < \infty$



Q. If incident rays are converging, then in which region does the image appear?

A. A

B. B

C. C

D. D

Answer: d

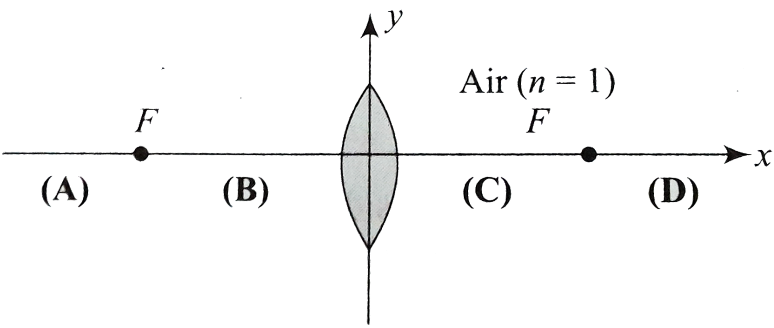
Watch Video Solution

3. This question concerna a symmetrical lens shown, along with its two focal points. It is made of plastice with $n = 1.2$ and has focal length f. Four different regions are shown:

Here,

A. $-\infty x < \ - f$ B. $-f < x < 0$

C. $0 < x < f$ D. $f < x < \infty$



Q. If incident rays are converging, then in which region does the image appear?

A. A

B. B

C. C

D. D

Answer: c

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4. This question concerns a symmetrical lens shown, along with its two focal points. It is made of plastic with $n = 1.2$ and has focal length f. Four different regions are shown:

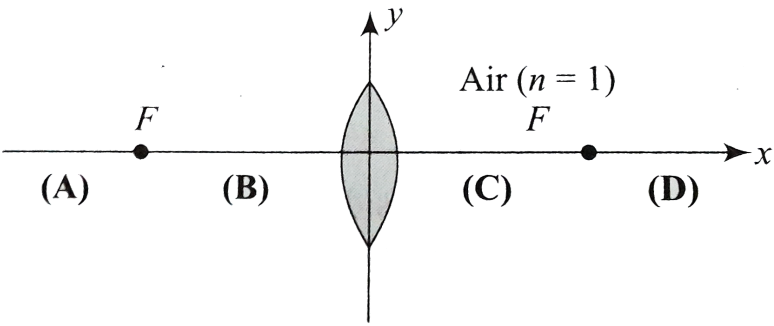
A. $-\infty < x < -f$

B. $-f < x < 0$

C. $0 < x < f$

D. $f < x < \infty$

A second lens is now placed adjacent to the first in contact with it. The new lens is concave, with a focal length $f = -3f$. In what region does the focal length of the two-lens system lie? Treat the lenses as thin.



A. A

B. B

C. C

D. D

Answer: d

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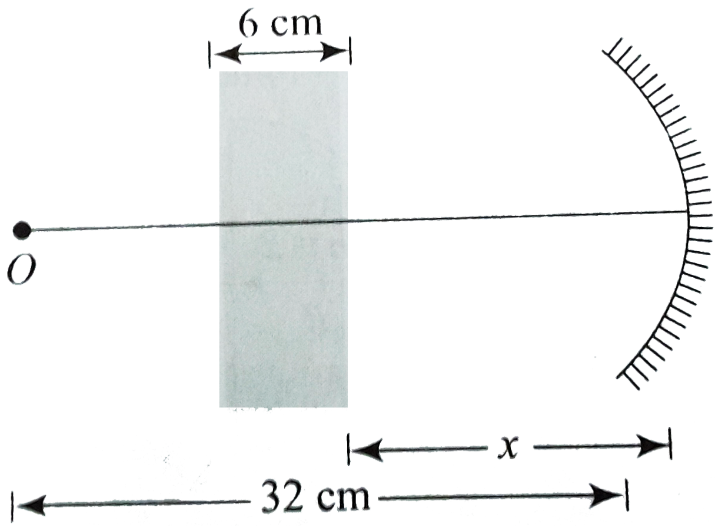
5. A point object O is placed in front of a concave mirror of focal length 10cm. A glass slab of refractive index $\mu = 3/2$ and thickness 6cm is inserted between the object and mirror.



Q. Find the position and nature of the final image when the distance x shown in figure, is 5cm.

A. 11cm, virtual

B. 17cm, real

C. 14cm, real

D. 20cm, virtual

Answer: b.

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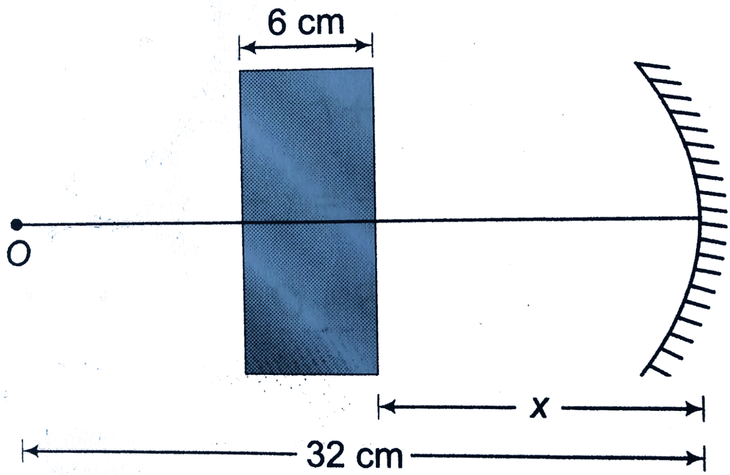
6. A point object O is placed in front of a concave mirror of focal length $10cm$. A glass slab of refractive index $\mu = \frac{3}{2}$ and thickness $6cm$ is

inserted between object and mirror. Find the position of final image when the

distance x shown in figure is



(a) $5cm$, (b) $20cm$

A. 17cm, virtual

B. 17cm, real

C. 12cm, virtual

D. 15cm, virtual

Answer: a

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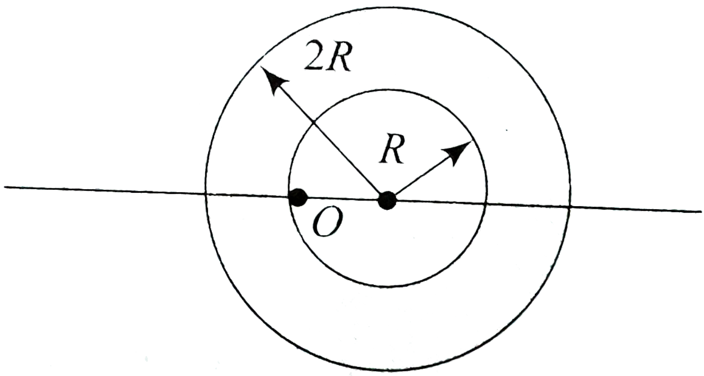
7. A glass sphere of radius 2R and refractive index n has a spherical cavity of radius R, concentric with it.



Q. When viewer is ono left side of the hollow sphere, what will be the shift in position of the object?

A. $\dfrac{(n+1)}{(n-1)}R$,right

B. $\dfrac{(n-1)}{(n+1)}R$,right

C. $\dfrac{(2n-1)}{(2n+1)}R$,left

D. $\dfrac{2(n-1)}{(n+1)}R$,left

Answer: b

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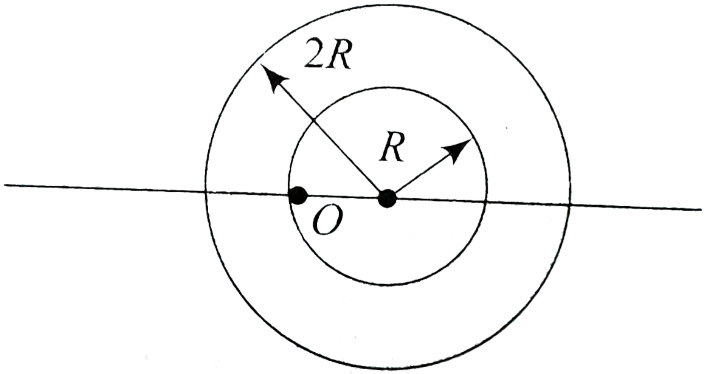
8. A glass sphere of radius 2R and refractive index n has a spherical cavity of radius R, concentric with it.

Q. When viewer is on right side of the hollow sphere, what will be apparent change in position of the object?



A. $\dfrac{(n-1)}{(3n+1)}R$,towards left

B. $\dfrac{(n+1)}{(3n-1)}R$,towards left

C. $\dfrac{(n+1)}{(3n+1)}R$,towards right

D. $\dfrac{(n-1)}{(3n-1)}R$,towards right

Answer: b

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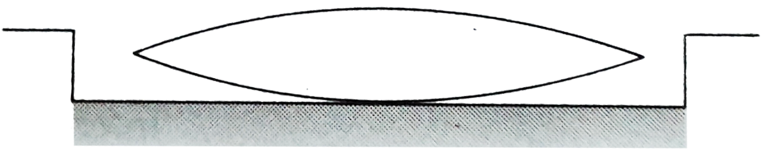
9. A thin equiconvex lens of refractive index $3/2$ is placed on a horizontal plane mirror as shown in figure. The space between the lens and the mirror is filled with a liquid of refractive index $4/3$. It is found that when a point object is placed 15 cm above the lens on its priincipal axis, the object coincides with its own image.



Q. The radius of curvature of the convex surface is

A. 10cm

B. 15cm

C. 20cm

D. 25cm

Answer: a

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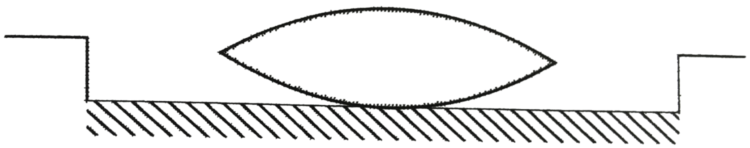
10. A thin biconvex lens of refractive index $3/2$ is placed on a horizontal plane mirror as shown in Figure . The space between the lens and the mirror is then fille with water or refractive index $4/3$. It is found that when a point object is placed 15 cm above the lens on its principal axis, the object coincides with its own image. On representing with another liquid, the object and the image again coincide at a distance 25 cm from the lens. Calculate the refractive index of the liquid.



A. 1.6

B. 2.6

C. 2.8

D. 3.2

Answer: a.

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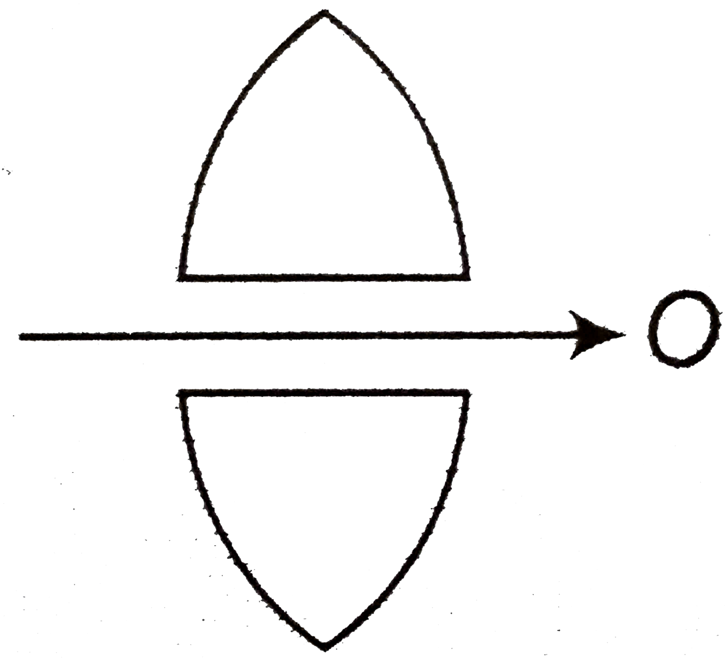

11.

A point object is placed at a distance of 0.3 m from a convex lens (focal length 0.2 m) cut into two halves each of which is displaced by 0.0005 m as shown in the figure. Find the position of the image . If more than one image is formed find their number and the distance between them.

A. 30cm, right of lens

B. 60cm, right of lens

C. 70cm, left of lens

D. 40cm, left of lens

Answer: b.

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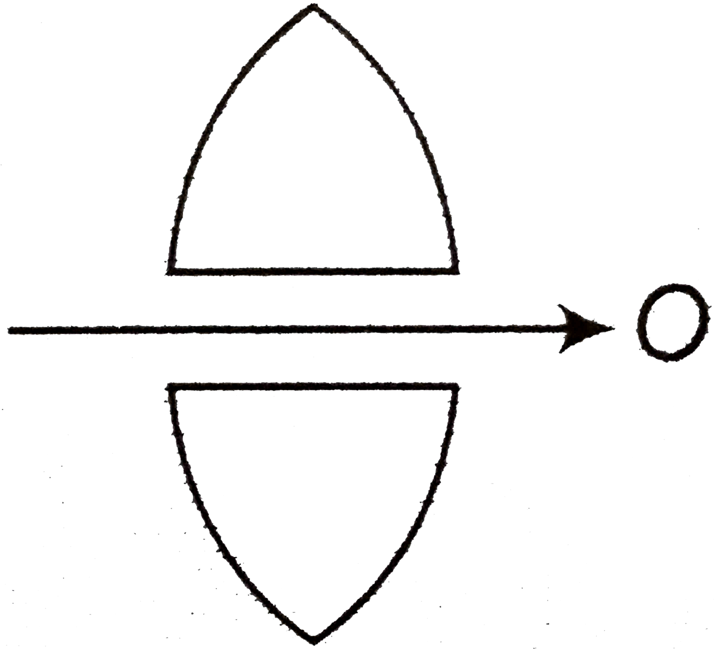
12. 

A point object is placed at a distance of 0.3 m from a convex lens (focal length 0.2 m) cut into two halves each of which is displaced by 0.0005 m as shown in the figure. Find the position of the image . If more than one image is formed find their number and the distance between them.

A. 2

B. 4

C. 6

D. 5

Answer: a.

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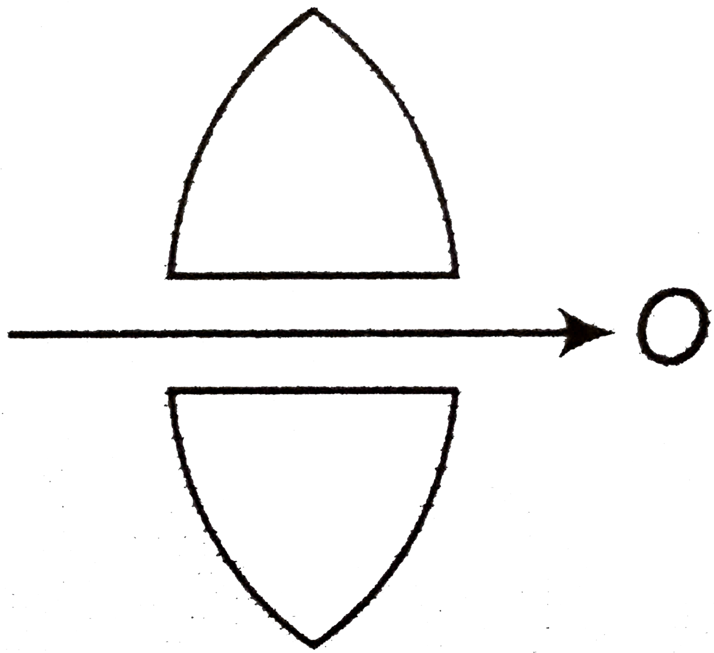
13. 

A point object is placed at a distance of 0.3 m from a convex lens (focal length 0.2 m) cut into two halves each of which is displaced by 0.0005 m as shown in the figure. Find the position of the image . If more than one image is formed find their number and the distance between them.

A. 0.1cm

B. 0.5cm

C. 0.3cm

D. 1cm

Answer: c.

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14. 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.

A. $x = 5cm$

B. $x = 20cm$

C. $x = 15cm$

D. $x = 25cm$

Answer: C

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15. 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.

A. $\Delta x = 1.15cm, up$

B. $\Delta x = 3.15cm, down$

C. $\Delta x = 0.05cm, up$

D. $\Delta x = 0.15cm, down$

Answer: a.

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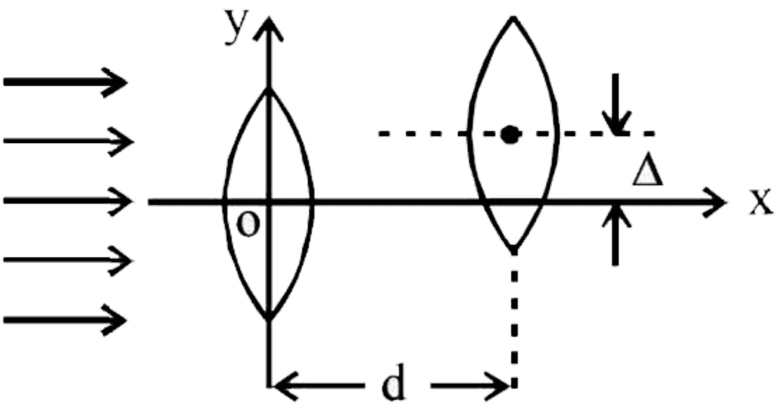
16. Two thin convex lenses of focal lengths f_1 and f_2 are separated by a horizontal distance d (where$d < f_1$,$d < f_2$) and their centres are displaced by a vertical separation $\triangle$ as shown in the fig.

Taking the origin of coordinates O, at the centre of the first lens the x and y coordinates of the focal point of this lens system, for a parallel beam of rays coming form the left, are given by: `



A. $\dfrac{(f_1 + d)\Delta}{(f_1 + f_2 - d)}$

B. $\dfrac{2(f_1 + d)}{(f_1 + f_2 - d)}$

C. $\dfrac{2(f_1 - d)\Delta}{(f_1 + f_2 + d)}$

D. $\dfrac{(f_1 - d)\Delta}{(f_1 + f_2 - d)}$

Answer: c

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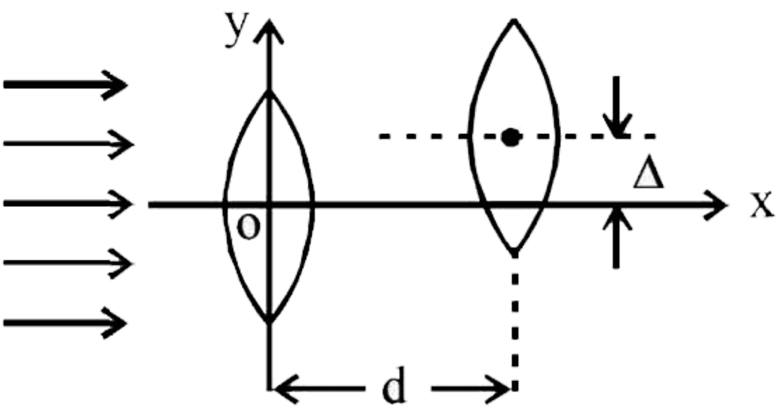
17. Two thin convex lenses of focal lengths f_1 and f_2 are separated by a horizontal distance d (where$d < f_1$,$d < f_2$) and their centres are displaced by a vertical separation $\triangle$ as shown in the fig.

Taking the origin of coordinates O, at the centre of the first lens the x and y coordinates of the focal point of this lens system, for a parallel beam of rays coming form the left, are given by: `



A. $\dfrac{d(f_1 - d) + f_1 f_2}{(f_1 + f_2 - d)}$

B. $\dfrac{f_1 f_2}{(f_1 + f_2 - d)}$

C. $\dfrac{d(f_1 - d)}{(f_1 + f_2 - d)}$

D. $\dfrac{2d(f_1 + d) - f_1 f_2}{(f_1 + f_2 - d)}$

Answer: a

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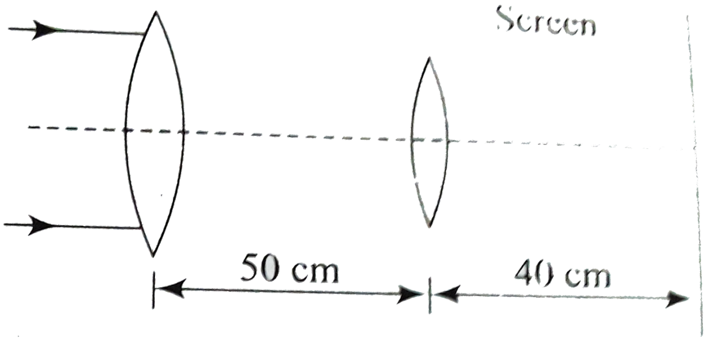
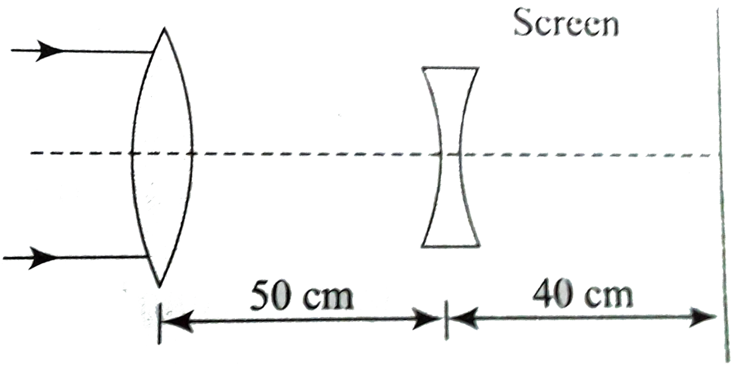
18. A parallel beam of light falls successively on a thin convex lens of focal length 40 cm and then ono a thin convex lens of focal length 10cm as shown in figure.

In figure, the second lens is an equi-concave lens of focal length 10cm and made of a material of refractive index 1.5. In both the cases, the second lens has an aperture equal to 1cm.



(a)



(b)

Q. Compare the area illuminated by the beam of light on the screen, which passes through the second lens in the two cases. The ratio (A_2 / A_1) will be

A. $72/5$

B. $81/4$

C. $56/3$

D. $29/2$

Answer: b.

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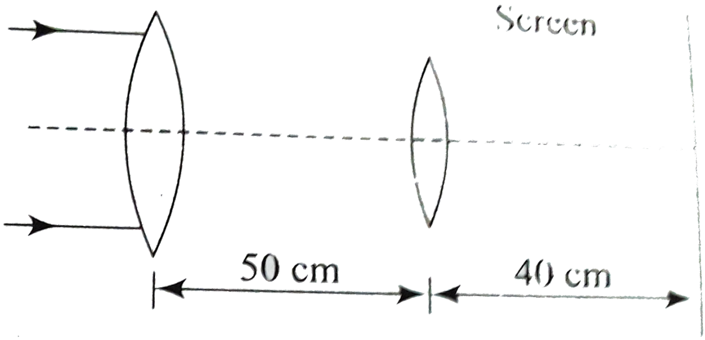
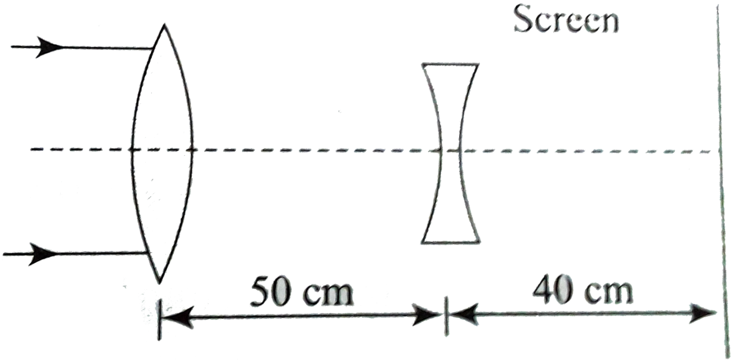
19. A parallel beam of light falls successively on a thin convex lens of focal length 40 cm and then ono a thini convex lens of focal length 10cm as shown in figure.

In figure, the second lens is an equiconcave lens of focal length 10cm and made of a material of refractive index 1.5. In both the cases, the second lens has an aperture equal to 1cm.



(a)



(b)

Q. Now, a liquid of refractive index μ is filled to the right of the second lens in case B such that the area illuminated in both the cases is the same. Determing the refractive index of the liquid.

A. 1

B. 2.5

C. 3

D. 1.5

Answer: c.

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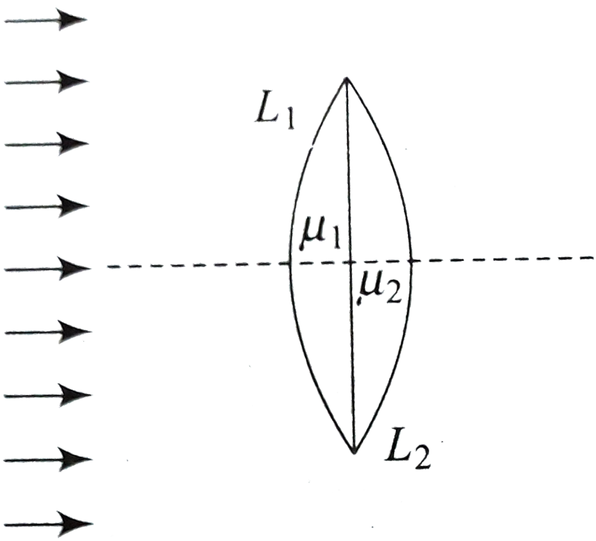
20. Two identical plano-convex lenses $L_1(\mu_1 - 1.4)$ and $L_2(\mu_2 - 1.5)$ of radii of curvature $R = 20cm$ are placed as shown in Figure.



Q. Find the position of the image of the parallel beam of light relative to the common principal axis.

A. $100/7cm$

B. $200/9$

C. $31.2cm$

D. $21.8cm$

Answer: b.

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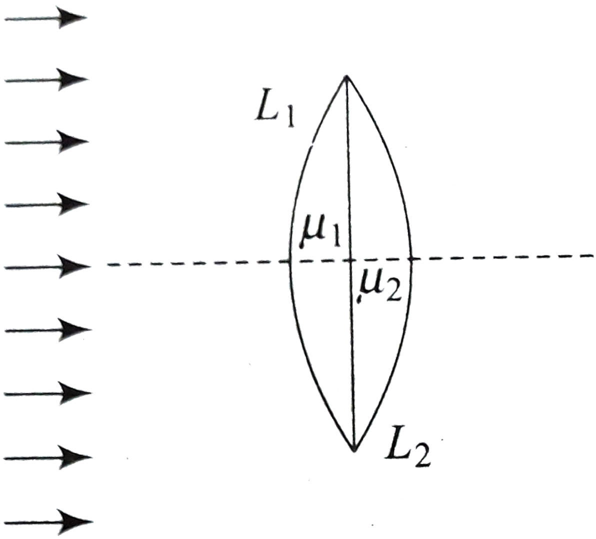
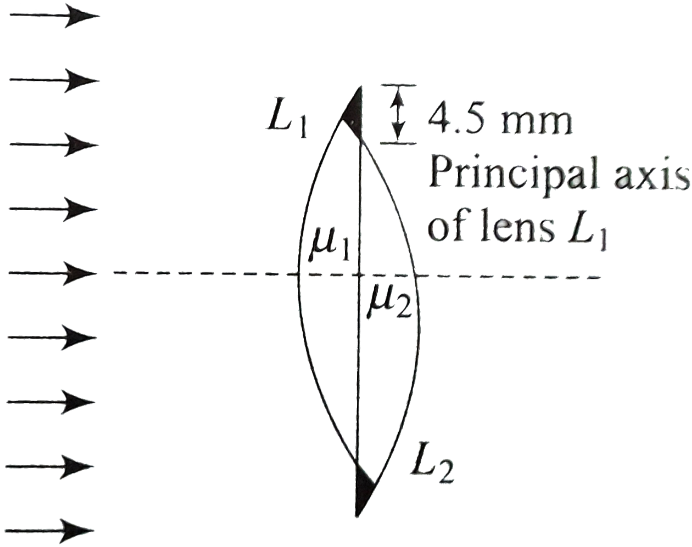
21. Two identical plano-convex lenses $L_1(\mu_1 - 1.4)$ and $L_2(\mu_2 - 1.5)$ of radii of curvature $R = 20cm$ are placed as shown in Figure.



Q. Now, the secocnd lens is shifted vertically downward by a small distance 4.5mm and the extended parts of L_1 and L_2 are blackened as shown in figure. Find the new position of the image of the parallel beam.



A. $200/9$ cm behind the lens 2.5 mm below the principal axis of L_1

B. $100/9cm$ in front of th elens 2mm below the prinicipal axis of L_1

C. $200/9cm$ in front of the lens 2.5mm below the principal axis of

L_1

D. $100/9$cm behind the lens 2mm below the princiipal axis of L_1

Answer: a.

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22. A beam of light converges towards a point O, behind a convex mirror of focal length 20cm.

Q. Find the magnification and nature of the image when point O is 10cm behind the mirror.

A. 2(virtual,inverted)

B. 3(real, inverted)

C. 5(virtual, enlarged)

D. 2 (real, erect)

Answer: d.

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23. A beam of light converges towards a point O, behind a convex mirror of focal length 20cm.

Q. Similarly, as in above question when point O is 30cm behind the mirror.

A. 2(virtual, inverted)

B. 3(real, inverted)

C. 3(virtual, enlarged)

D. $1($real, enlarged)

Answer: a.

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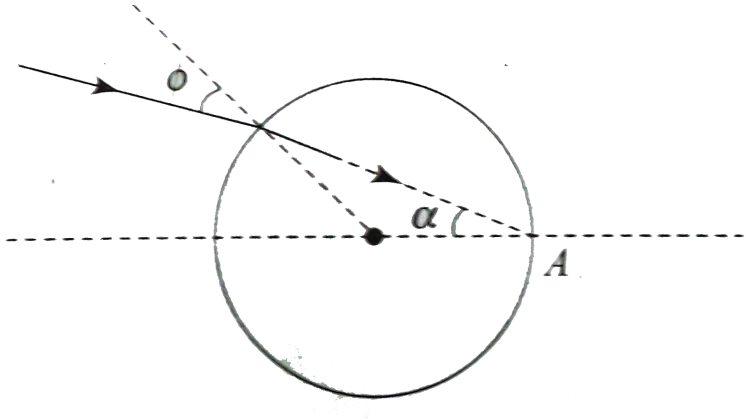
24. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. Select the correct statement:

A. Incident rays are partically reflected at point A

B. Incident rays are totalyy reflected at point A

C. Incident rays are totally transmitted through A

D. None of these

Answer: a.

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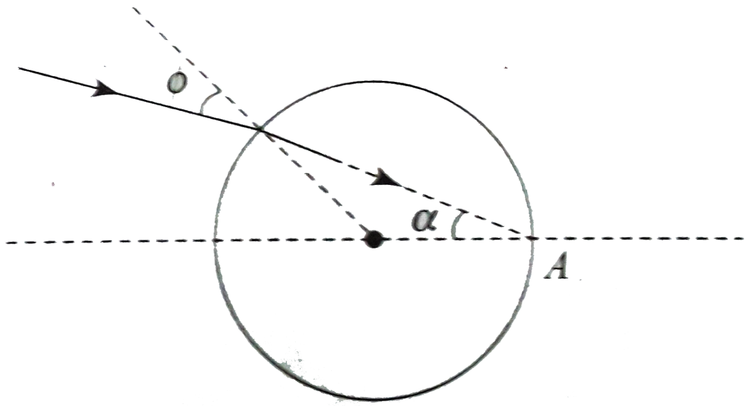
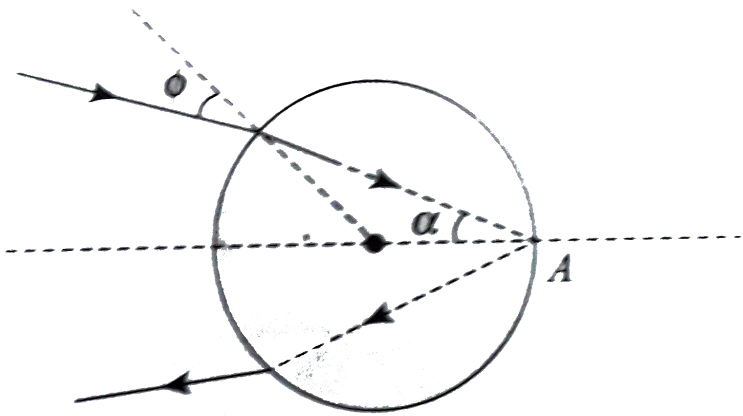
25. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. An expression of the angle between incident ray and emergent ray (angle of deviation) as shown in figure.



A. 0°

B. ϕ

C. $\alpha - \phi$

D. $\pi - 4\alpha + 2\phi$

Answer: d.

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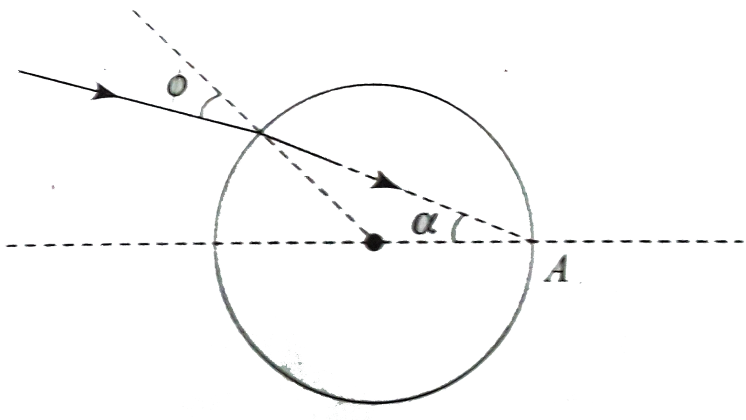
26. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. Considert eh figure of question 60, the angle ϕ for which minimum deviation is produced will be given by

A. $\cos^2\phi = \frac{\mu^2+1}{3}$

B. $\cos^2\phi = \frac{\mu^2-1}{3}$

C. $\sin^2\phi = \frac{\mu^2+1}{3}$

D. $\sin^2\phi = \frac{\mu^2-1}{3}$

Answer: b.

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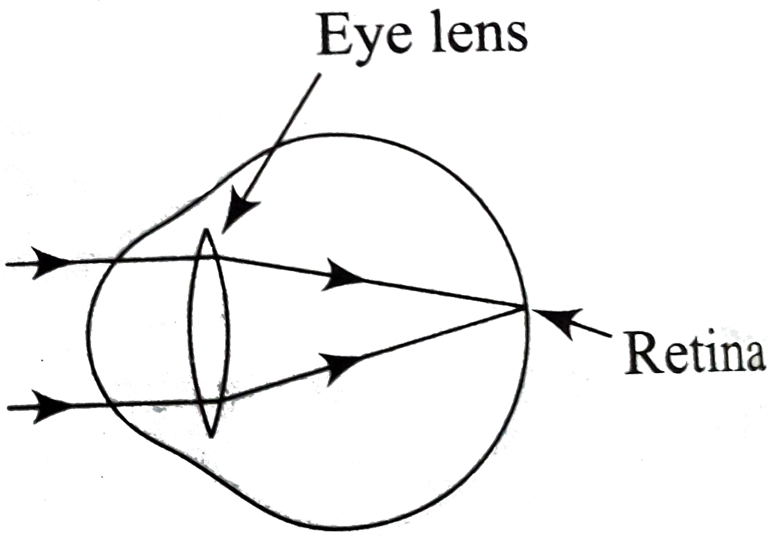
27. The ciliary muscles of eye control the curvature of the lens in the eye and hence can alter the effective focal length of the system. When the muscles are fully relaxed, the focal length is maximum. When the muscles are strained, the curvature of lens increases. That means radius of curvature decreases and focal length decreases. For a clear vision, the image must be on the retina. The image distance is therefore fixed for clear vision and it equals the distance of retina from eye lens. It is about 2.5cm for a grown up person.

A perosn can theoretically have clear vision of an object situated at any large distance from the eye. The smallest distance at which a person can clearly see is related to minimum possible focal length. The ciliary muscles are most strained in this position. For an average grown up person, minimum distance of the object should be around 25cm.

A person suffering from eye defects uses spectacles (eye glass). The function of lens of spectacles is to form the image of the objects within the range in which the person can see clearly. The image o the spectacle lens becomes object for the eye lens and whose image is formed on the retina.

The number of spectacle lens used for th eremedy of eye defect is decided by the power fo the lens required and the number of spectacle lens is equal to the numerical value of the power of lens with sign. For example, if power of the lens required is $+3D$ (converging lens of focal length $100/3cm$), then number of lens will be $+3$.

For all the calculations required, you can use the lens formula and lensmaker's formula. Assume that the eye lens is equiconvex lens. Neglect the distance between the eye lens and the spectacle lens.



Q. Minimum focal length of eye lens of a normal peson is

A. 25cm

B. 2.5cm

C. $25/9cm$

D. $25/11cm$

Answer: d.

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28. The ciliary muscles of eye control the curvature of the lens in the eye and hence can alter the effective focal length of the system. When the muscles are fully relaxed, the focal length is maximum. When the muscles are strained, the curvature of lens increases. That means radius of curvature decreases and focal length decreases. For a clear vision, the image must be on the retina. The image distance is therefore fixed for clear vision and it equals the distance of retina from eye lens. It is about 2.5cm for a grown up person.

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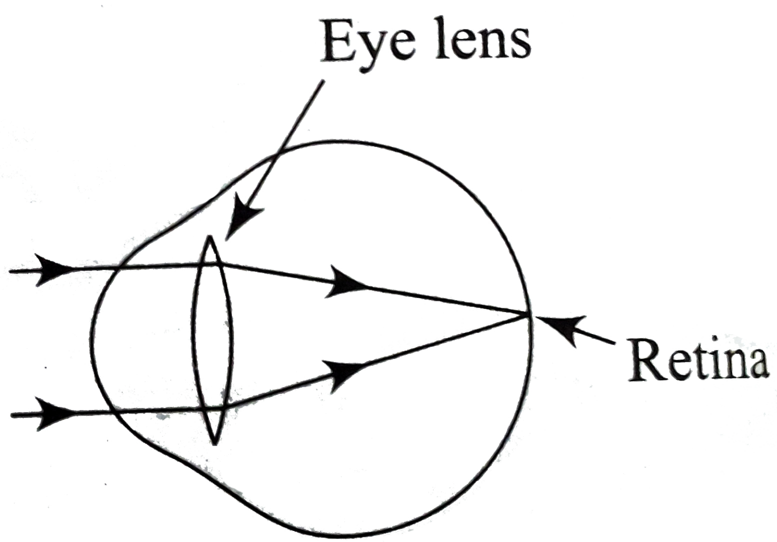

Q. Maximum focal length of a eye lens of a normal person is

A. 25cm

B. 2.5cm

C. $\frac{25}{9}$

D. $\frac{25}{11}$cm

Answer: b.

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29. The ciliary muscles of eye control the curvature of the lens in the eye and hence can alter the effective focal length of the system. When the muscles are fully relaxed, the focal length is maximum. When the muscles are strained, the curvature of lens increases. That means radius of curvature decreases and focal length decreases. For a clear vision, the image must be on the retina. The image distance is therefore fixed for clear vision and it equals the distance of retina from eye lens. It is about 2.5cm for a grown up person.

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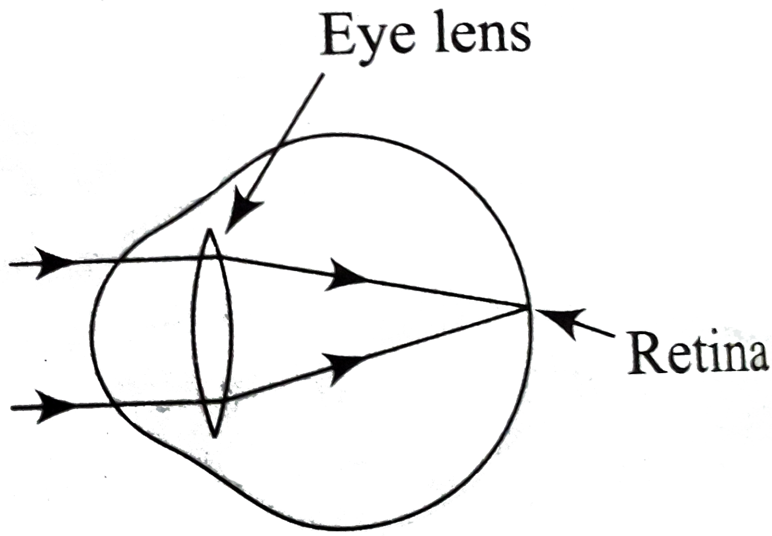

Q. A near sighted man can clearly see ojects only upto a distance of 100cm and not beyond this. The number of the spectacle lenses necessary for the remedy of this defect will be

A. $+1$

B. 1

C. $+3$

D. 3

Answer: b

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30. The ciliary muscles of eye control the curvature of the lens in the eye and hence can alter the effective focal length of the system. When the muscles are fully relaxed, the focal length is maximum. When the muscles are strained, the curvature of lens increases. That means radius of curvature decreases and focal length decreases. For a clear vision, the image must be on the retina. The image distance is therefore fixed for clear vision and it equals the distance of retina from eye lens. It is about 2.5cm for a grown up person.

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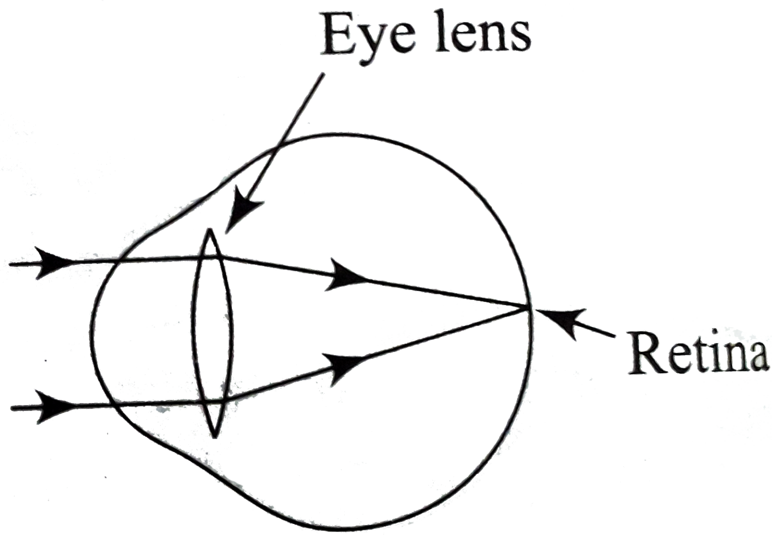
A person suffering from eye defects uses spectacles (eye glass). The function of lens of spectacles is to form the image of the objects within the range in which the person can see clearly. The image o the spectacle lens becomes object for the eye lens and whose image is formed on the retina.

The number of spectacle lens used for th eremedy of eye defect is decided by the power fo the lens required and the number of spectacle lens is equal to the numerical value of the power of lens with sign. For example, if power of the lens required is $+3D$ (converging lens of focal length $100/3cm$), then number of lens will be $+3$.

For all the calculations required, you can use the lens formula and lensmaker's formula. Assume that the eye lens is equiconvex lens. Neglect the distance between the eye lens and the spectacle lens.



Q. A far sighted man connot see objects clearly unless they are at least

100cm from his eyes. The number of the spectacle lenses that will make his range of clear vision equal to an average grown up person will be

A. $+1$

B. 1

C. $+3$

D. 3

Answer: c

Watch Video Solution

31. The ciliary muscles of eye control the curvature of the lens in the eye and hence can alter the effective focal length of the system. When the muscles are fully relaxed, the focal length is maximum. When the muscles are strained, the curvature of lens increases. That means radius of curvature decreases and focal length decreases. For a clear vision, the image must be on the retina. The image distance is therefore fixed for clear vision and it equals the distance of retina from eye lens. It is about 2.5cm for a grown up person.

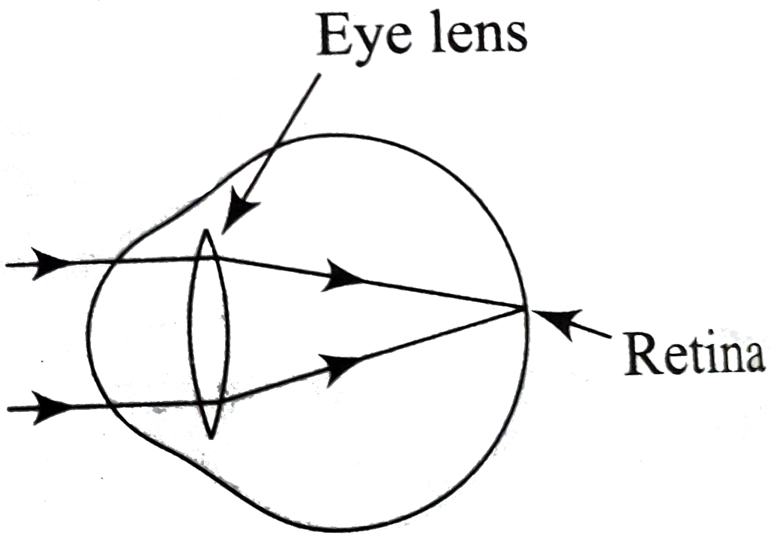
A perosn can theoretically have clear vision of an object situated at any large distance from the eye. The smallest distance at which a person can clearly see is related to minimum possible focal length. The ciliary muscles are most strained in this position. For an average grown up person, minimum distance of the object should be around 25cm.

A person suffering from eye defects uses spectacles (eye glass). The function of lens of spectacles is to form the image of the objects within the range in which the person can see clearly. The image o the spectacle lens becomes object for the eye lens and whose image is formed on the retina.

The number of spectacle lens used for th eremedy of eye defect is decided by the power fo the lens required and the number of spectacle lens is equal to the numerical value of the power of lens with sign. For example, if power of the lens required is $+3D$ (converging lens of focal length $100/3cm$), then number of lens will be $+3$.

For all the calculations required, you can use the lens formula and lensmaker's formula. Assume that the eye lens is equiconvex lens.

Neglect the distance between the eye lens and the spectacle lens.



Q. A person can see objects clearly from distance 10cm to ∞. Then, we can say that the person is

A. normal sighted person

B. near-sighted person

C. far-sighted person

D. a person with exceptional eye having no eye defect

Answer: d.

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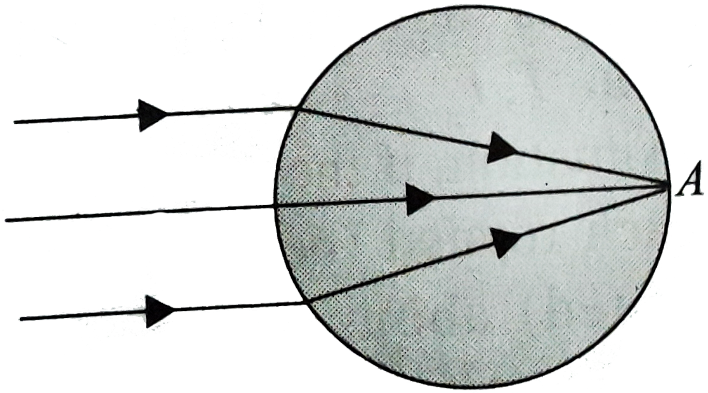
32. A parallel beam of light falls on a solid tranparent sphere.



Q. Which is corret?

A. If the beam is thick, then whole beam can be focussed at A.

B. the whole beam can be focussed at A only if the beam is thin enough

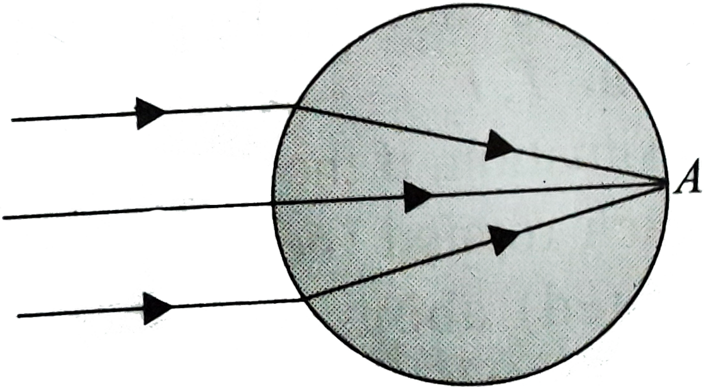
C. if the beam is thin, then the beam can't be focussed before A.

D. none of these

Answer: b.

Watch Video Solution

33. A parallel beam of light falls on a solid tranparent sphere.



Q. If however thin beam is focussed at A, then find the refractive index of the sphere,

A. 1.5

B. 1.7

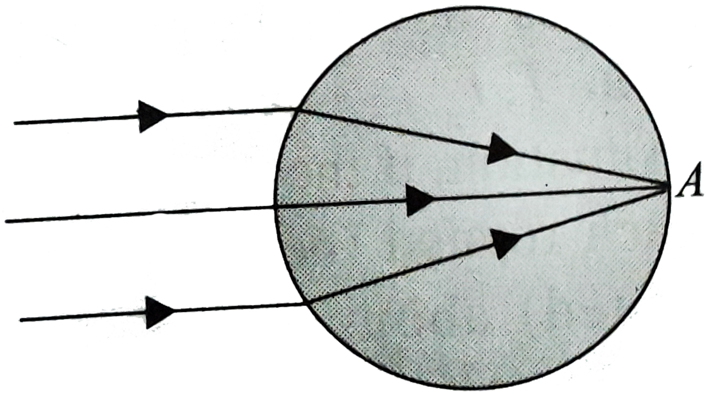
C. 2.0

D. 2.5

Answer: c.

Watch Video Solution

34. A parallel beam of light falls on a solid tranparent sphere.



Q. For what value of refractive index μ, the thin beam can be focussed at centre of sphere.

A. 1.5

B. 2

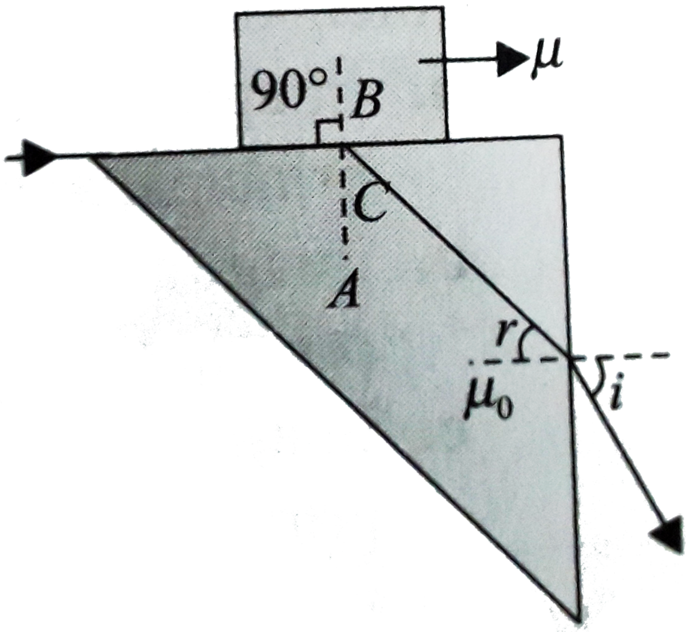
C. 2.5

D. none of these

Answer: d.

Watch Video Solution

35. Pulfrich refractometer is used to measure the refractive index of solids and liquid. It consist of right angled prism. A having its two faces perfectly plane. One of the face is horizontal and the other is vertical as shown is figure. The solid B whose refractive index is to be determined is taken having two faces cut perpendicular to one another. Light is incident in a direction parallel to the horizontal surface so that the light entering the prism A is at critical angle C. Finally, it emerges from the prism at an angle i. Let the refractive index of the solid be μ and that of the prism A be μ_0 (which is known). Here $\mu_0 > \mu$ and by measuring i, μ can be determinged.



Q. Refractive index of the solid (μ) in terms of μ_0 and i is

A. $\sqrt{\mu_0^2 + \sin^2 i}$

B. $\mu_0 + \sin^2 i$

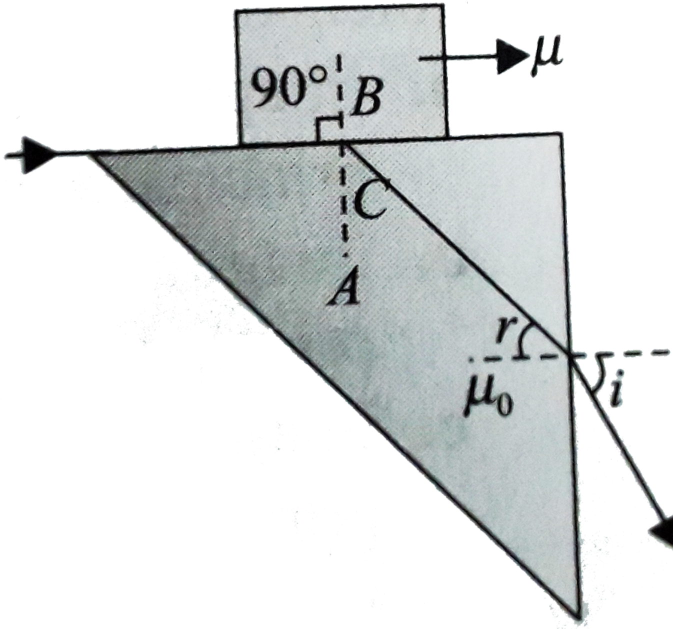
C. $\sqrt{\mu_0^2 - 2\sin^2 i}$

D. $\sqrt{\mu_0^2 - \sin^2 i}$

Answer: d.

Watch Video Solution

36. Pulfrich refractometer is used to measure the refractive index of solids and liquid. It consist of right angled prism. A having its two faces perfectly plane. One of the face is horizontal and the other is vertical as shown is figure. The solid B whose refractive index is to be determined is taken having two faces cut perpendicular to one another. Light is incident in a direction parallel to the horizontal surface so that the light entering the prism A is at critical angle C. Finally, it emerges from the prism at an angle i. Let the refractive index of the solid be μ and that of the prism A be μ_0 (which is known). Here $\mu_0 > \mu$ and by measuring i, μ can be determinged.



Q. Refractive index of the solid (μ) in terms of μ_0 and i is

A. 1.21

B. $\sqrt{2}$

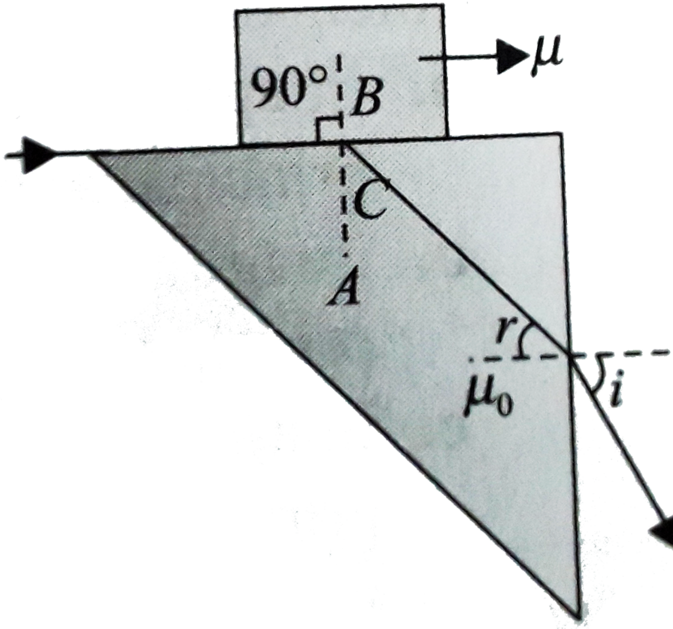
C. 1

D. $\sqrt{3}/2$

Answer: c.

Watch Video Solution

37. Pulfrich refractometer is used to measure the refractive index of solids and liquid. It consist of right angled prism. A having its two faces perfectly plane. One of the face is horizontal and the other is vertical as shown is figure. The solid B whose refractive index is to be determined is taken having two faces cut perpendicular to one another. Light is incident in a direction parallel to the horizontal surface so that the light entering the prism A is at critical angle C. Finally, it emerges from the prism at an angle i. Let the refractive index of the solid be μ and that of the prism A be μ_0 (which is known). Here $\mu_0 > \mu$ and by measuring i, μ can be determinged.



Q. Refractive index of the solid (μ) in terms of μ_0 and i is

A. $\sqrt{2}$

B. $\sqrt{3}$

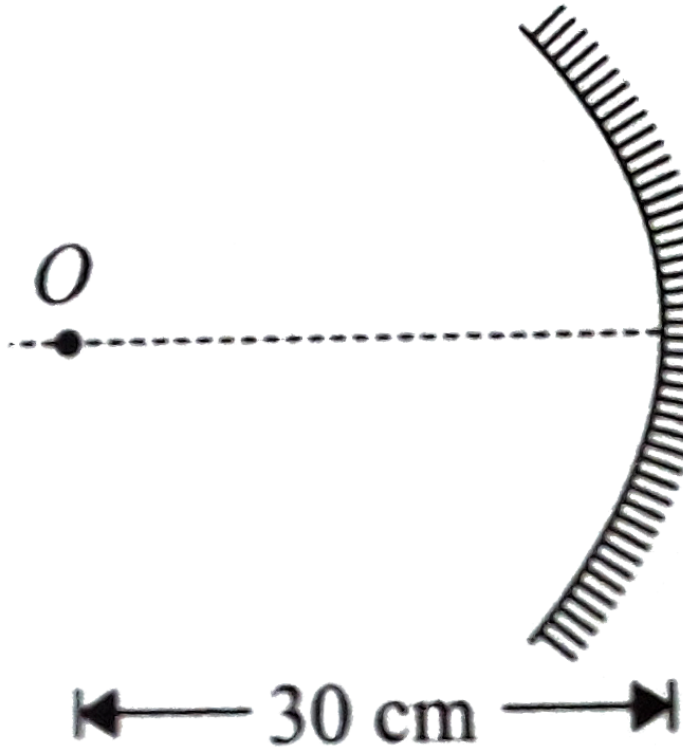
C. slightly greater than 2

D. slightly less than 2

Answer: c.

Watch Video Solution

38. An object is present on the principal axis of a concave mirror at a distance 30cm from it. Focal length of mirror is 20cm.



Q. Image formed by mirror is

A. At a distance of 60cm in front of mirror

B. At a distance 60cm behind the mirror

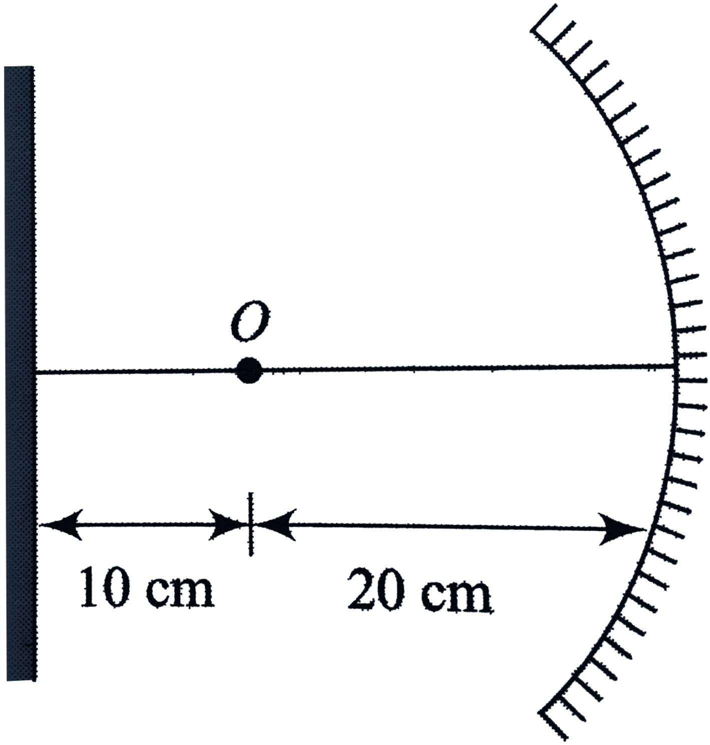
C. At a distance 12 cm in front of mirror

D. At a distance 12cm behind the mirror

Answer: a.

Watch Video Solution

39. An object is placed between a plane mirror and a concave mirror of focal length 15 cm as shown in Figure . Find the position of the images after two reflections.



A. image starts moving with $4 cms^{-1}$ away from the mirror

B. image starts moving with $4 cms^{-1}$ towards the mirror

C. image starts moving with $8 ms^{-1}$ towards the mirror

D. image starts moving with $8 cms^{-1}$ away from the mirror

Answer: d.

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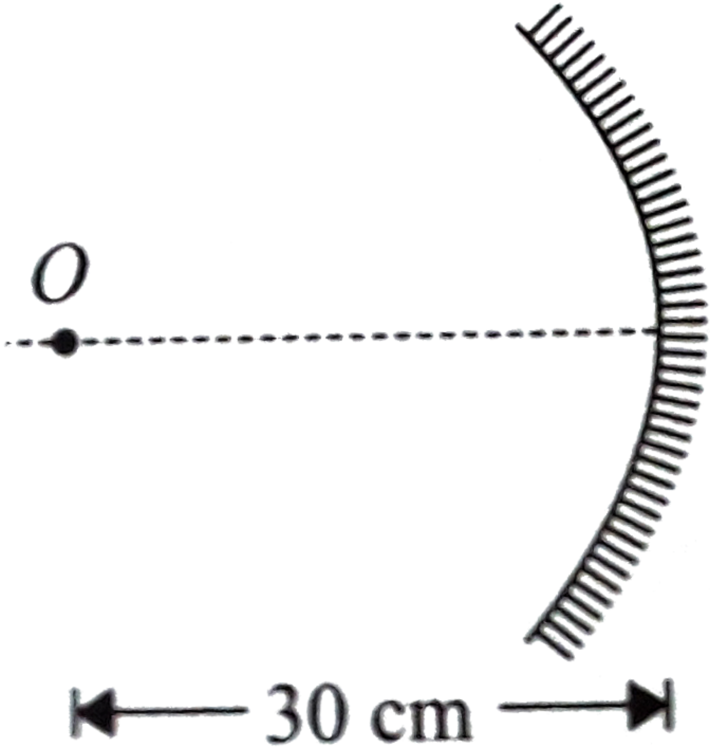
Watch Video Solution

40. An object is present on the principal axis of a concave mirror at a distance 30cm from it. Focal length of mirror is 20cm.



Q. If object starts moving with $2cms^{-1}$ perpendicular to principal axis above the principal axis then,

A. image moves with velocity $4cms^{-1}$ below the principal axis

B. image moves with velocity $4cms^{-1}$ above the principal axis

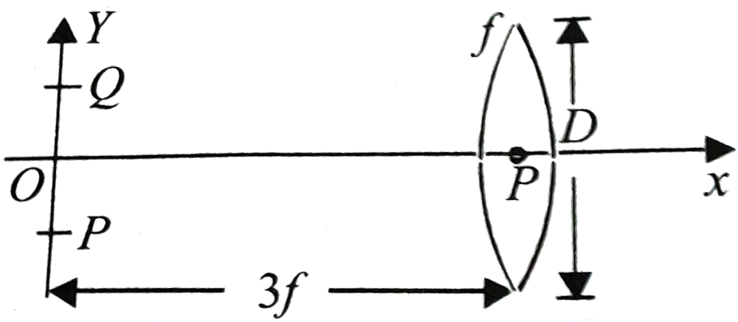
C. image moves with velocity $8cms^{-1}$ below the principal axis

D. image moves with velocity $8cms^{-1}$ above the principal axis

Answer: a.

Watch Video Solution

41. An object kept near a convex lens of focal length f, executes SHM between P and Q according to the equation $y = A\sin\omega t$, O being the mean position. Take x-axis as the principal axis of the lens and $A < < D$ to answer the following questions:



Q. The phase difference between the object and the image oscillations is

A. $\pi/2$

B. π

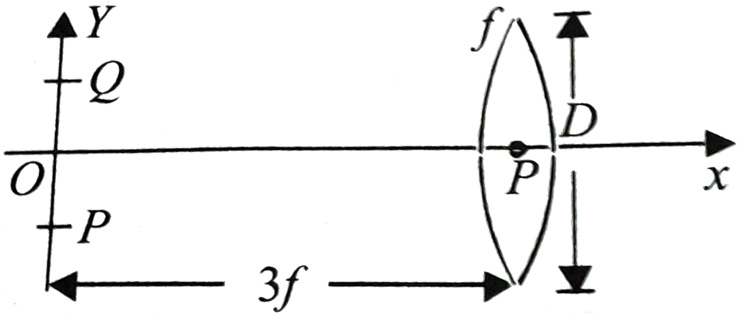
C. 0

D. None of these

Answer: b.

Watch Video Solution

42. An object kept near a convex lens of focal length f, executes SHM between P and Q according to the equation $y = A \sin \omega t$, O being the mean position. Take x-axis as the principal axis of the lens and $A < < D$ to answer the following questions:



Q. The amplitude of oscillation of the image is

A. A

B. 2A

C. $A/2$

D. Image does not oscillate

Answer: c

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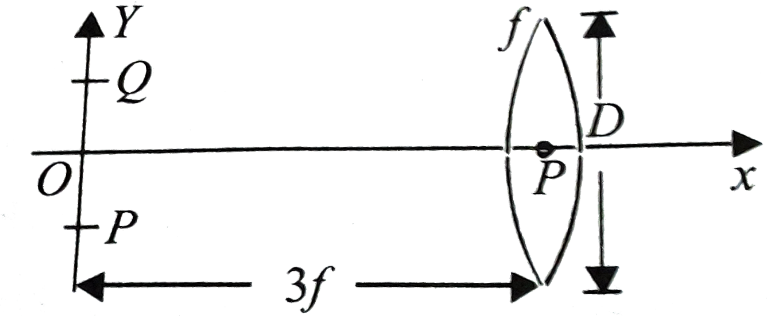
43. An object kept near a convex lens of focal length f, executes SHM between P and Q according to the equation $y = A\sin\omega t$, O being the mean position. Take x-axis as the principal axis of the lens and $A < < D$ to answer the following questions:



Q. The velocity of the image when the object crosses the mean position and goes toward Q is

A. $A\omega$

B. $-A\omega$

C. $A\omega/2$

D. None of these

Answer: c.

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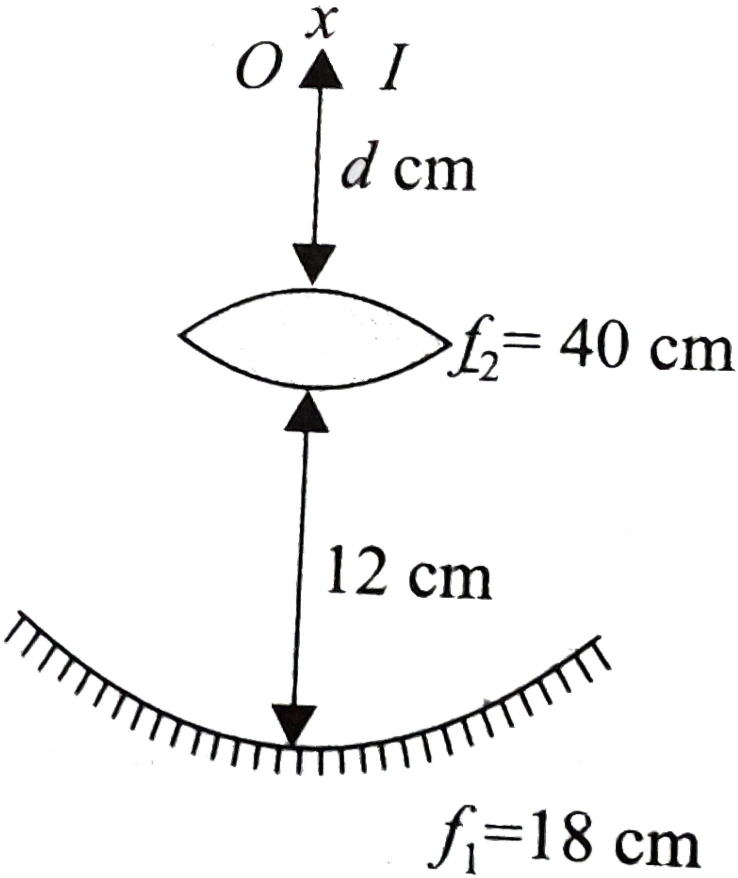
44. A convex lens of focal length 40cm is held at a distance 12cm coaxially above a concave mirror of focale length 18cm.



Q. A luminous point object placed d cm above the lens on its axis gives rise to an imag coincident iwth itself, then the value of d is equal to

A. 15cm

B. 30cm

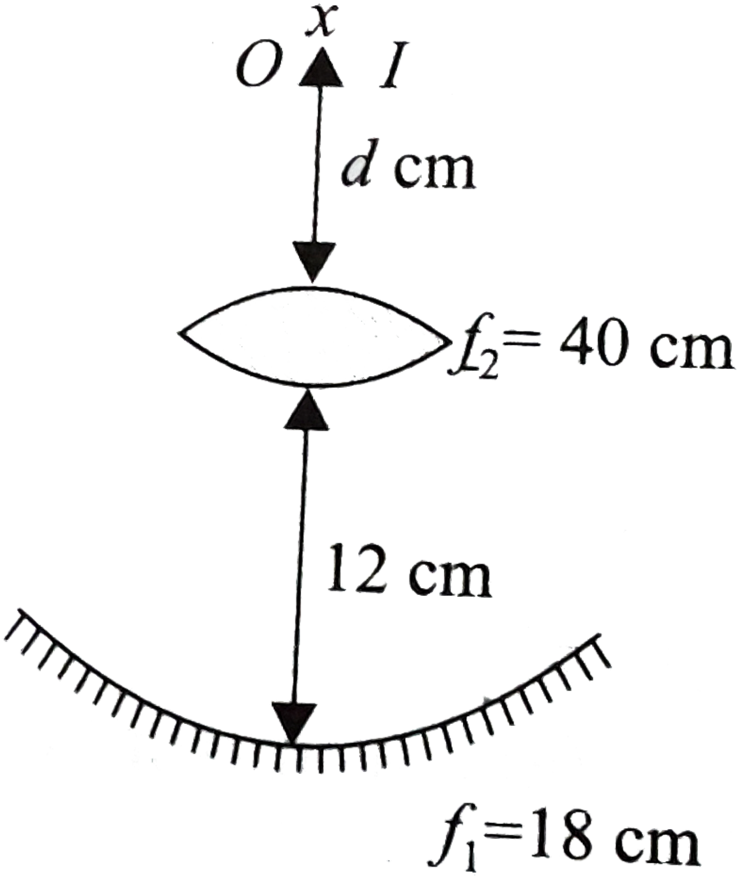
C. 24cm

D. 18cm

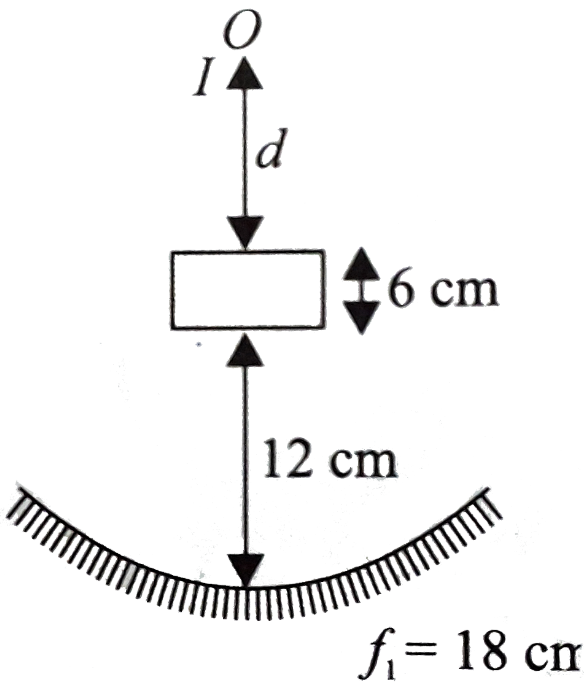
Answer: a.

Watch Video Solution

45. A convex lens of focal length 40cm is held at a distance 12cm coaxially above a concave mirror of focale length 18cm.



Q. If the convex lens is replaced by a glass plate of thickness 6cm, refractive index $\mu = \dfrac{3}{2}$ and gives rise to an image coincident with itself, then the value of d is equal to



A. 20cm

B. 30cm

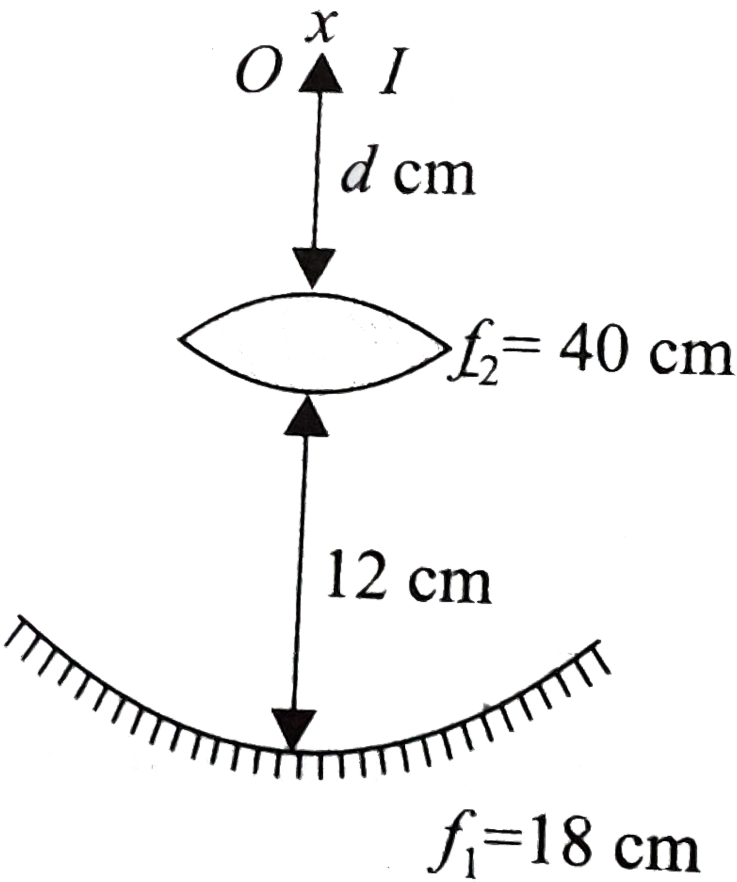
C. 40cm

D. 60cm

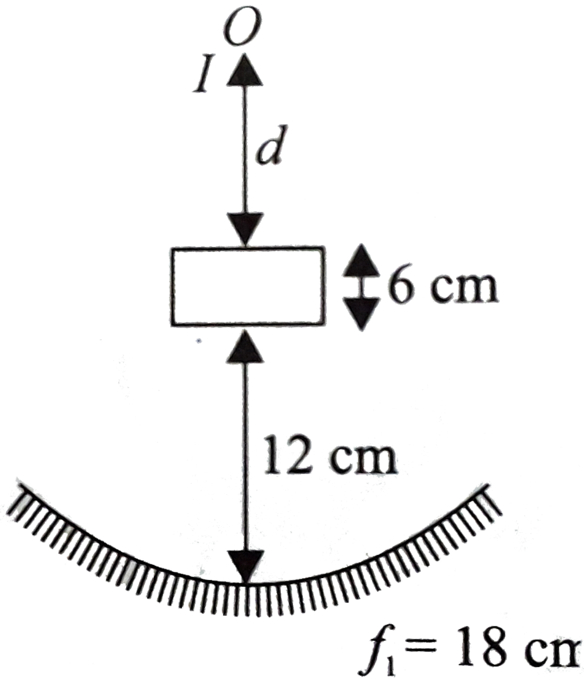
Answer: c.

Watch Video Solution

46. A convex lens of focal length 40cm is held at a distance 12cm coaxially above a concave mirror of focale length 18cm.



Q. If the convex lens is replaced by a glass plate of thickness 6cm, refractive index $\mu = \frac{3}{2}$ and gives rise to an image coincident with itself, then the value of d is equal to



A. 20cm

B. 30cm

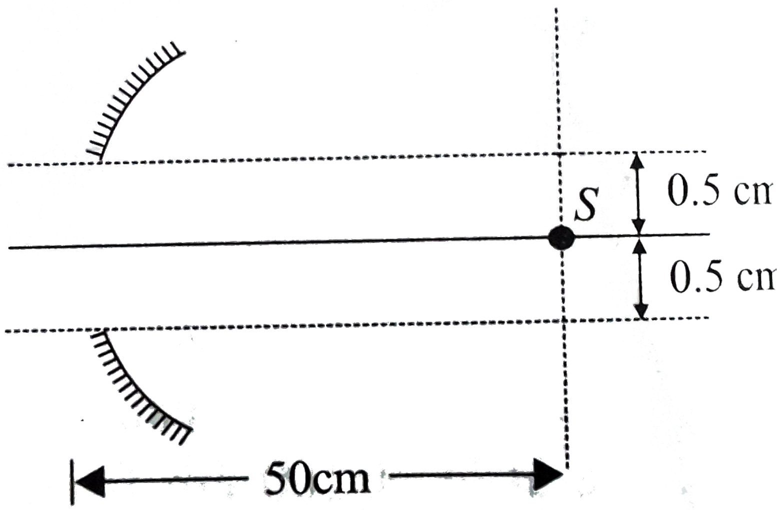
C. 40cm

D. 60cm

Answer: a.

Watch Video Solution

47. A concave mirror forms real image of a point source lying on the optical axis at a distance of 50cm from the mirror. The focal length of the mirror is 25cm. The mirror is cut in two, and its halves are drawn at a distance of 1 cm apart in a direction perpendicular to the optical axis.



Q. The distance between the two images formed by the two halves of the mirror is

A. 0.5cm

B. 1cm

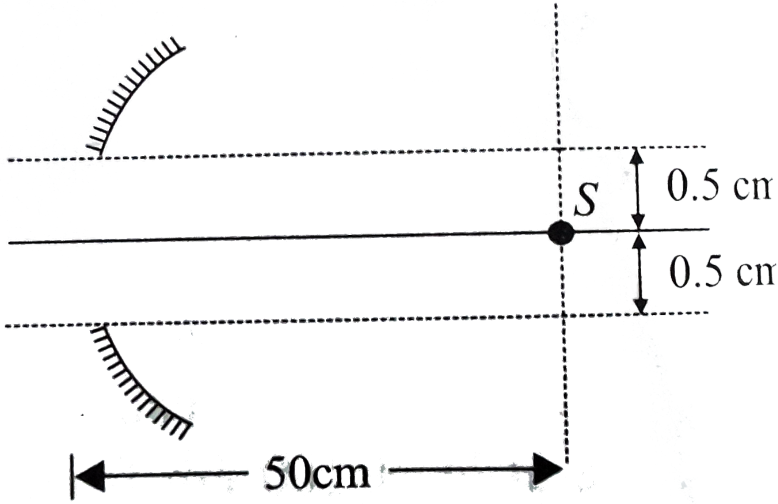
C. 1.5cm

D. 2cm

Answer: d.

Watch Video Solution

48. A concave mirror forms real image of a point source lying on the optical axis at a distance of 50cm from the mirror. The focal length of the mirror is 25cm. The mirror is cut in two, and its halves are drawn at a distance of 1 cm apart in a direction perpendicular to the optical axis.



Q. Two statements are provided. Choose which is true and which is false.

Statement I: Image formed by half cut mirror has just half the intensity as that of the intensity of image formed by complete mirror.

Statement II: More the lateral separation between the two halves of the mirror, less will be the separation between the two images, as show in the given situation.

A. T, T

B. T, F

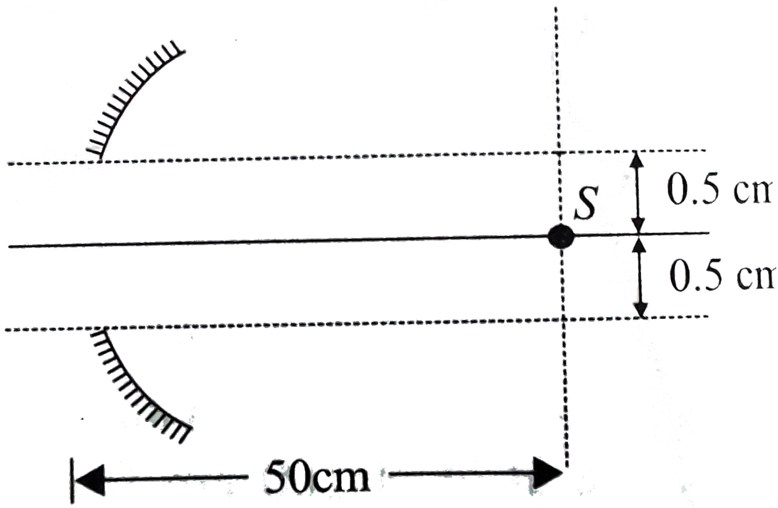
C. F, T

D. F, F

Answer: b.

Watch Video Solution

49. A concave mirror forms real image of a point source lying on the optical axis at a distance of 50cm from the mirror. The focal length of the mirror is 25cm. The mirror is cut in two, and its halves are drawn at a distance of 1 cm apart in a direction perpendicular to the optical axis.



Q. In the given situation, if the two halves are each rotated (before being separated) about S by 90°, with reference to original position, then the distance between the two images will be

A. 0.5cm

B. 2cm

C. 1cm

D. zero

Answer: d.

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50. An object AB of height 1cm lying on the axis of convex mirror of focal length20cm, at a distance of 30cm from its pole as shown in figure. Now the object starts moving with a constant speed $1cm/\sec$ towards the pole. Calculate

Q. Magnitude of velocity of image at the given instant

A. $0.08cms^{-1}$

B. $0.64cms^{-1}$

C. $0.16cms^{-1}$

D. $0.32cms^{-1}$

Answer: c.

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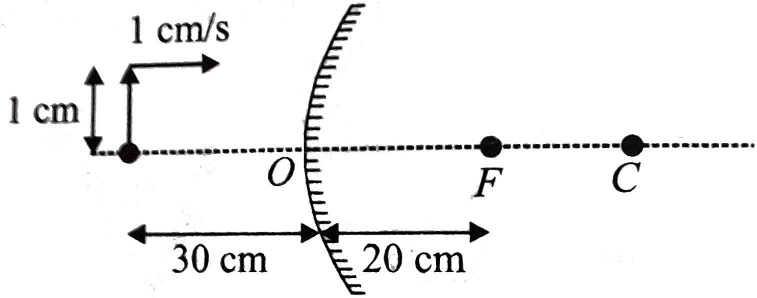
51. An object AB of height 1cm lying on the axis of convex mirror of focal length20cm, at a distance of 30cm from its pole as shown in figure. Now the object starts moving with a constant speed $1cm/\sec$ towards the pole. Calculate



Q. Rate of change of height of image.

A. $0.16 cm s^{-1}$

B. $0.004 cm s^{-1}$

C. $0.016 cm s^{-1}$

D. $0.0008 cm s^{-1}$

Answer: d.

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Integer

1. The magnification of an object placed in front of a convex lens is $+2$. The focal length of the lens is 2.0 metres. Find the distance by which object has to be moved to obtain a magnification of -2 (in metres).

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

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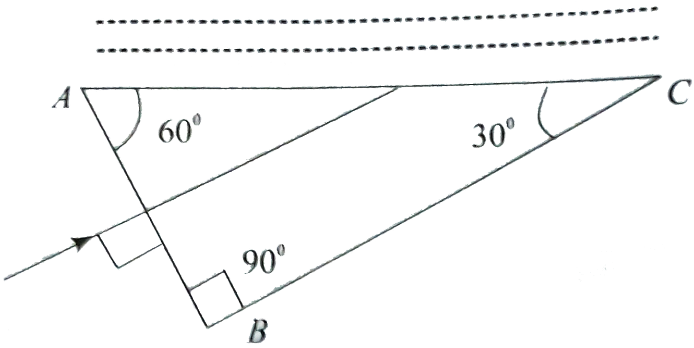
3. As shown in figure, light is incident normally on one face of the prism. A liquid of refractive index μ is placed on the horizontal face AC. The refractive index of prism is $3/2$. If total internal reflection taken place on face AC, m should be less than $\frac{I\sqrt{3}}{4}$, where I is ann integer.

Find the value of I.



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4. Where should a convex lens of focal length 9cm be placed (in cm) between two point sources S_1 and S_2 where are 24 cm apart, so that images of both the sources are formed at the same place. You have to find distance of lens from S_1 or S_2 whichever is lesser.

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5. A ray of light is incident at an angle of 60° on one face of a prism which has refracting angle of 30° . The ray emerging out of the prism makes an angle of 30° with the incident ray. If the refractive index of the material of the prism is $\mu = \sqrt{a}$, find the value of a .

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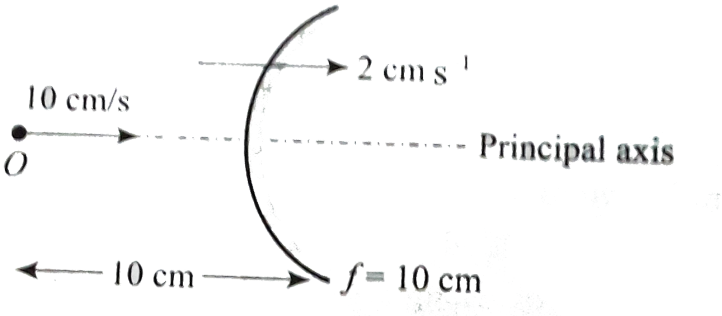
6. A container of uniform cross-section has a height of 14 m. Upto what height (in metre) water of refractive index $4/3$ should be filled for normal viewing.

Watch Video Solution

7. What is the velocity (in $\text{cm}s^{-1}$) of image in situation shown in figure, $(O =$ object, $f =$ focal length). Object moves with velocity

$10cm / s$ and mirror moves with velocityy $2cms^{-1}$ as shown.



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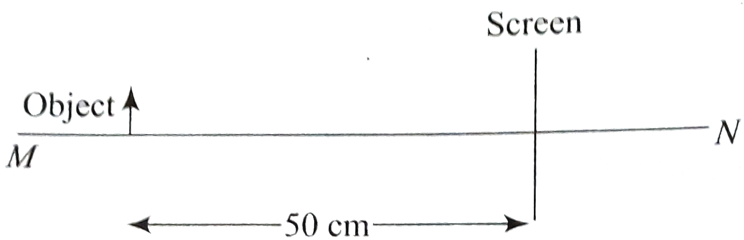
8. An object is placed 50cm from a screen as shown in figure.

A converging lens is moved such that line MN is its principal axis. Sharp images are formed on the screen in two positions of lens separated by 30cm. Find the focal length of the lens in cm.



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9. An extended object of size 2mm is placed on the principal axis of a converging lens of focal length 10cm. It is found that when the object is placed perpendicular to the principal axis the image formed is 4mm in size. The size of image when it is placed along the principal axis is ______________ mm.

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10. A point object is placed at a distance 25cm from a convex lens of focal length 20cm. If a glass slab of thickness t annd refractive index 1.5 is inserted between the lens and object, image is formed at . Thickness t is found to be K times of 5cm. Fink K.

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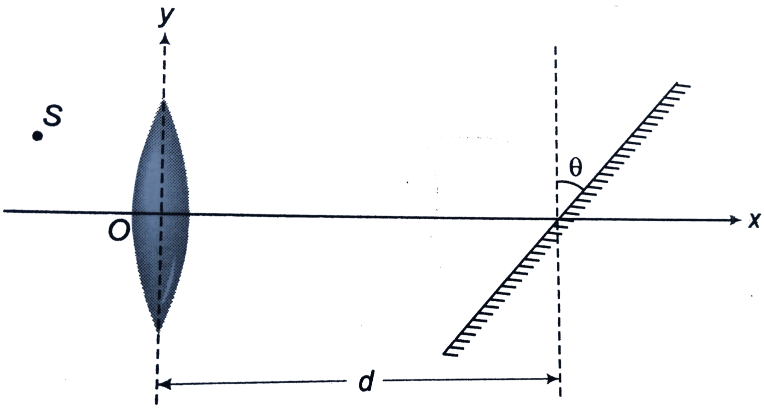
11. A thin converging lens of focal length $f = 1.5m$ is placed along y-axis such that its optical centre coincides with the origin. A small light source S is placed at $(-2.0m, 0.1m)$. Where should a plane mirror inclined at an angle θ, $\tan\theta = 0.3$ be placed such that y-coordinate of final image is $0.3m$, i.e. find d. Also find x-coordinate of final image.



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12. A convex lens A of focal length 20cm and a concave lens B of focal length 5cm are kept along the same axis with a distance d between them. I a parallel lbeam of leight falling on A leaved B as a parallel beam, then d is equal to ____________cm.

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13. A thin lens of refractive index 1.5 has focal length of $15cm$ in air. When the lens is placed is a medium of refractive index (4)/(3), its focal length will become .....cm.

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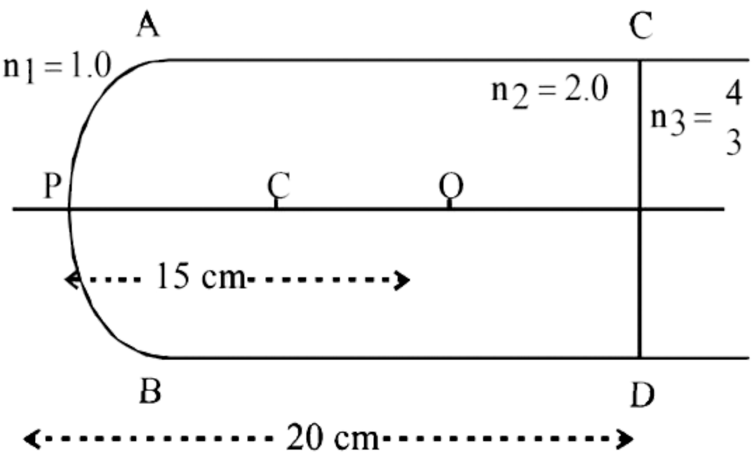

14.

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

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15. A thin rod of length $f/3$ is placed along the optical axis of a concave mirror of focal length f such that its image whichis real and elongated just touches the rod. Calculate the magnification.

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Archives

1. A ray of light undergoes deviation of 30° when incident on an equilateral prism of refractive index $\sqrt{2}$. The angle made by the ray inside the prism with the base of the prism is

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2. The resolving power of an electro microscope is higher than that of an optical microscope because the wavelength of electrons is ________________ than the wavelength of visible light.

Watch Video Solution

3. If ε_0 and μ_0 are, respectively, the electric permittivity and magnetic permeability of free space, ε and μ the corresponding quantities in a medium, the index of refraction of the medium in terms of the above parameters is ________________.

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4. A slit of width d is placed in front of a l ens of focal length 0.5m and is illuminated normally with light of wavelength $5.89 \times 10^{-7} m$. The first diffraction minima on either side of the central diffraction maximum are separated by $2 \times 10^{-3} m$. The width d of the slit is __________m.

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5. A ligth of wavelength 6000 Å, in air, enters, a medium with refractive index 1.5. Inside the medium, its frequency is __________________ Hz and its wavelength is __________________Å

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6. Twot thin lenses when placed in contact, then the power of combination is +10D. If they are kept 0.25m apart, then the power reduceds to +6D. The focal lengths of the lenses (in m) will be

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7. 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.

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True/False

1. The setting sun appears higher in the sky than it really is

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

Watch Video Solution

3. A convex lens of focal length 1 meter and a concave lens fo focal length 0.25 meter and kept 0.75 meter apart. A parallel beam of light first passes through the ocnvex lens, then through the concave lens and comes to a focus 0.5m away from the concave lens.

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4. A beam of white lighe passing through a hollow prism gives no spectrum.

Watch Video Solution

5. A parallel beam of white light falls on a combination of a concave and a convex lens, both of the same material. Their foacl lengths are 15cm and 30cm, respectively for the mean wavelength in white light. On the other side of the lens system, one sees colored patterns with violet color at the outer edge.

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Single Correct Answer Type

1. When a ray of light enters a glass slab from air.

A. its wavelength decreases

B. its wavelength increases

C. its frequency increases

D. neither its wavelength nor its frequency changes

Answer: a.

Watch Video Solution

2. In Young's double slit experiment, the sepcaration between the slits is halved and the distance between the slits and the screen is doubled. The fringe width is

A. unchanged

B. halved

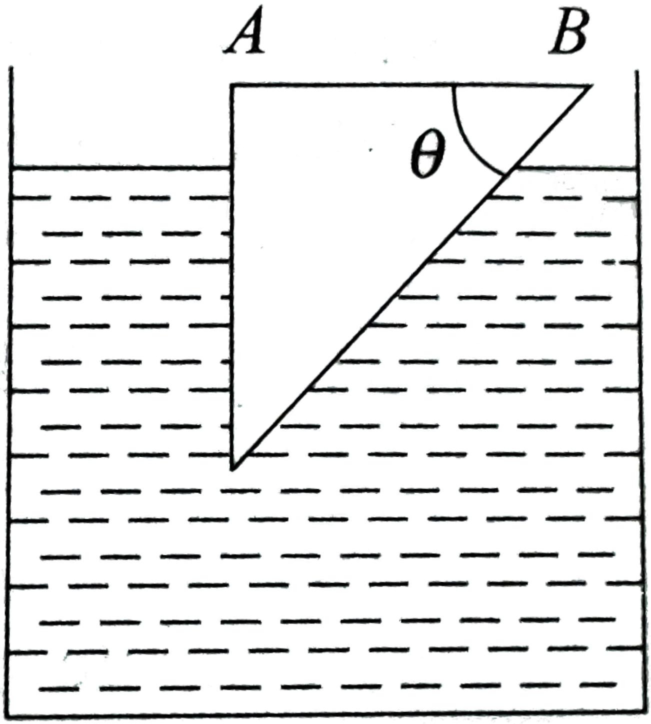
C. doubled

D. quadrupled

Answer: d.

Watch Video Solution

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



A. $\sin\theta \geq \frac{8}{9}$

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

C. $\sin\theta \leq \frac{2}{3}$

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

Answer: a.

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4. A convex lens of focal length 40 cm in contact with a concave lens with a focal length 25 cm. The power of combination is

A. -1.5 dioptres

B. -6.5 dioptres

C. $+6.5$ dioptres

D. $+6.67$ dioptres

Answer: A

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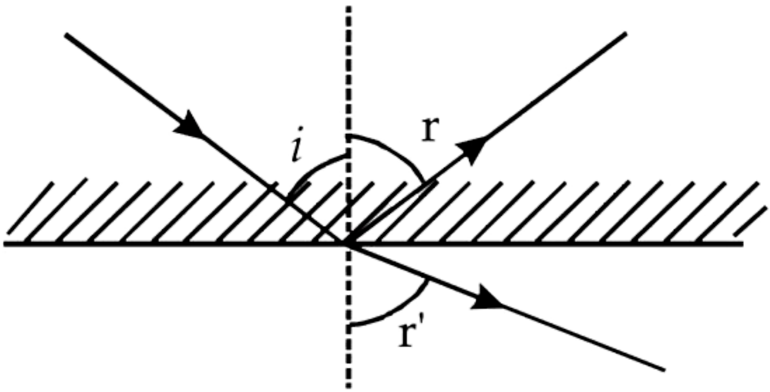

5.

A ray of light from a denser medium strike a rarer medium at an angle of incidence I (see Fig). The reflected and refracted rays make as angle of 90degrees with each other. The angles of reflection and refraction are r and r The critical angle is

A. $\sin^{-1}(\tan r)$

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

C. $\sin^{-1}\left(\tan r'\right)$

D. $\tan^{-1}(\sin i)$

Answer: A

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6. Two coherent monochromatic light beams of intensities I and 4I are superposed. The maximum and minimum possible intensities in the resulting beam are

A. 5I and I

B. 5I and 3I

C. 9I and I

D. 9I and 3I

Answer: C

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7. A short linear object of length b lies along the axis of a concave mirror of focal length fat a distance u from the pole of the mirror, what is the size of image?

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

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

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

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

Answer: D

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8. A beam of light consisting of red, green and blue colurs is incident on a right angled prism as shown in figure. The refractive indices of the maaterial of the prism for above red, green and blue wavelengths are 1.39, 1.44 and 1.47, respectivley .

A. separate part of the red color from the green and blue colors

B. separate part of the blue color from the red and green colors

C. separate all the three colors from one another

D. not separate even partially any color from the other two colors

Answer: A

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9. A thin prism P_1 with angle 4° and made from glass of refractive index 1.54 is combined with another prism P_2, made of glass of refractive index 1.72 to produce dispersion without deviation. The angle of prism P_2

A. 5.33°

B. 4°

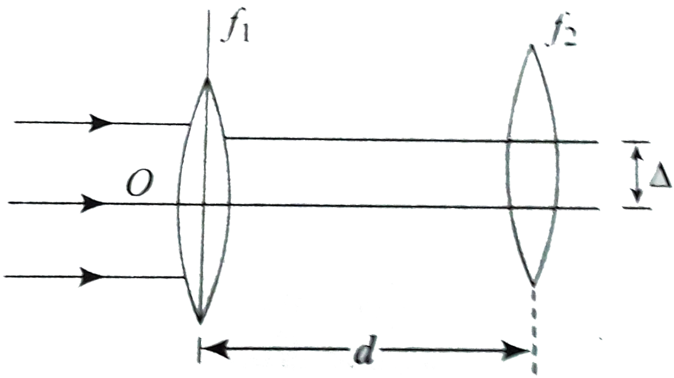
C. 3°

D. 2.6°

Answer: c.

Watch Video Solution

10. Two thin convex lenses of focal lengths f_1 and f_2 are separated by a horizontal distance $d(d < f_1$ and $d < f_2)$ and their centers are displaced by a vertical separation as shown in the figure. A parallel beam of rays coming from left. Take the origin of coordinates O at the center of first lens.



Q. Find the y-coordinate of the focal point of this lens system.

A. $x = \dfrac{f_1 f_2}{f_1 + f_2}, y = \Delta$

B. $x = \frac{f_1(f_2 + d)}{f_1 + f_2 - d}, y = \frac{\Delta}{f_1 + f_2}$

C. $x = \frac{f_1 f_2 + d(f_1 - d)}{f_1 + f_2 - d}, y = \frac{\Delta(f_1 - d)}{f_1 + f_2 - d}$

D. $x = \frac{f_1 f_2 + d(f_1 - d)}{f_1 + f_2 - d}, y = \frac{\Delta(f_1 - d)}{f_1 + f_2 - d}$

Answer: c.

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11. Spherical aberration in a thin lens can be reduced by

A. using a monochromatic light

B. usinig a boublet combination

C. using a circular annular mark over the lens

D. increasing the size of the lens

Answer: C

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12. A beam of light of wavelength 600nm from a distance source falls on a single slit 1mm wide and a resulting diffraction pattern is observed on a screen 2m away. The distance between the first dark frings on either side of central bright fringe is

A. 1.2cm

B. 1.2mm

C. 2.4cm

D. 2.4mm

Answer: d.

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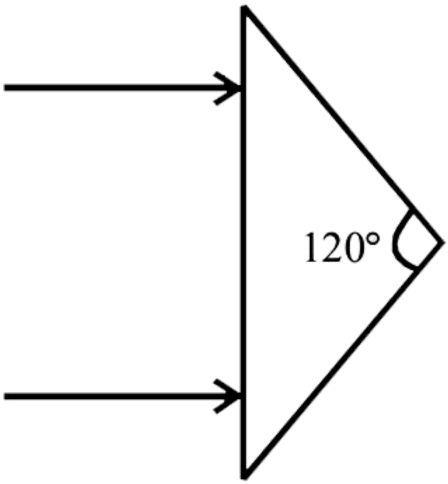
13.



An isosceles prism of angle 120degree has a refractive index 1.44. Two parallel monochromatic rays enter the prism parallel to each other in air as shown. The rays emerge from the opposite faces

A. are parallel to each other

B. are diverging

C. make an angle of $2\left[\sin^{-1}(0.72)-30^{\circ}\right]$ with each other

D. make an angle of $2\sin^{-1}(0.72)$ with each other

Answer: d.

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14. A diminished image of an object is to be obtained on a screen 1.0 m from it. This can be achieved by appropriately placing

A. a concave mirror of suitable focal length

B. a convex mirror of suitable focal length

C. a convex lens of focal length less than 0.25m

D. a concave lens of suitable focal length.

Answer: c.

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15. The focal lengths of the objective and the eyepiece of a compound microscope are 2.0cm and 3.0cm, respectively. The distance between the objective and the eyepiece is 15.0cm. Th final image formed by the eyepiece is at infinity. The two lenses are thin. The distance, in cm, of the object and the image produced by the objective, mesured from the objective lens, are respectively.

A. 2.4 and 12.0

B. 2.4 and 15.0

C. 2.0 and 12.0

D. 2.0 and 3.0

Answer: a.

Watch Video Solution

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

A. $+1.5$

B. -1.5

C. $+6.67$

D. -6.67

Answer: B

Watch Video Solution

17. A real image of a distant object is formed by a plano-convex lens on its principal axis. Spherical aberration is

A. is absent

B. is smaller if the curved surface of the lens faces the object

C. is smaller if the plane surface of the lens faces the object

D. is the same whichever side of the lens faces the object

Answer: b.

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18. A concave mirror is placed on a horizontal table with its axis directed vertically upward. Let O be the pole of the mirror C its center of curvature and F is the focus. A point object is placed at C. It has a real image, also located at C. If the mirror is now filled with water, the image will be

A. real, and will remain at C

B. real, and located at a point between C and ∞

C. virtual, and located at a point between C and O

D. real, and located at a point between C and O

Answer: d.

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19. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The center of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The ling PQ cuts the surface at a point O, and $PO = OQ$. The distance PO is equal to

A. 5R

B. 3R

C. 2R

D. 1.5R

Answer: a.

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

A. convergent lens of focal length 3.5R

B. convergent lens of focal length 3.0R

C. divergent lens of focal length 3.5R

D. divergent lens of focal length 3.0R

Answer: A

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

A. air and placed in air

B. air and immersed in L_1

C. L_1 and immersed in L_2

D. L_2 and immersed in L_1

Answer: d.

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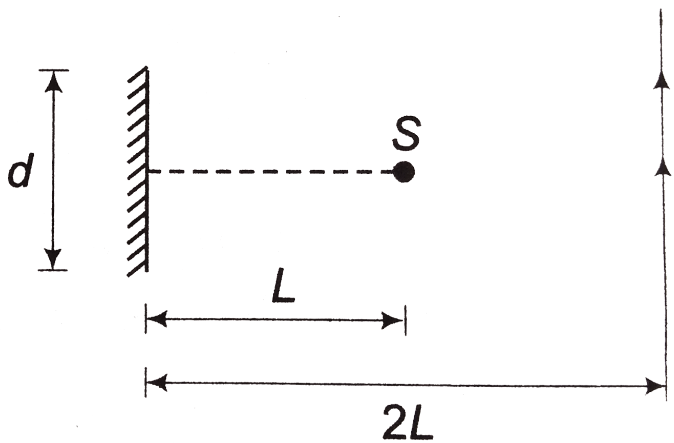
22. A point source of light S, placed at a distance L in front of the centre of a mirror of width d, hangs vertically on a wall. A man walks in front of the mirror along a line parallel to th mirror at a distane 2L form it as shown.The greatest distance over which he can see the image of the light source in the mirror is

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



A. $d/2$

B. d

C. 2d

D. 3d

Answer: D

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

A. zero

B. α

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

D. $2\sin^{-1}\left(\frac{1}{n}\right)$

Answer: b.

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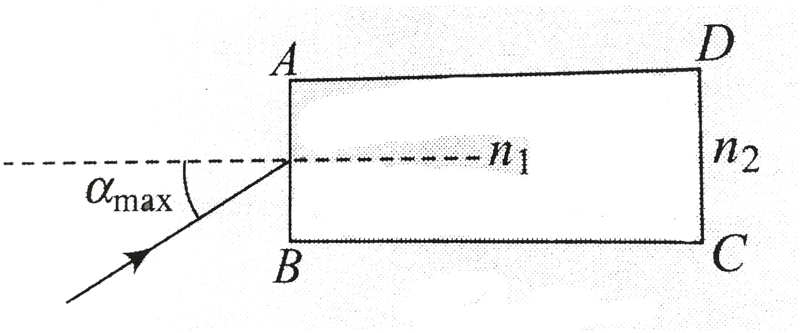
24. A rectangular slab ABCD, of refractive index n_1 , is immersed in water of refractive index $n_2(n_1 < n_2)$. A ray of light is incident at the surface AB of the slab as shown in Fig. Find the maximum value of angle of incidence $\alpha_{\max}$, such that the ray comes out only from the other surface CD.



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

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

C. $\sin^{-1}\left(\frac{n_1}{n_2}\right)$

D. $\sin^{-1}\left(\frac{n_2}{n_1}\right)$

Answer: a.

Watch Video Solution

25. In a compound microscope, the intermediate image is

A. virtual, erect, and magnified

B. real, erect, and magnified

C. real,inverted, and magnified

D. virtual, erect, and reduced

Answer: c.

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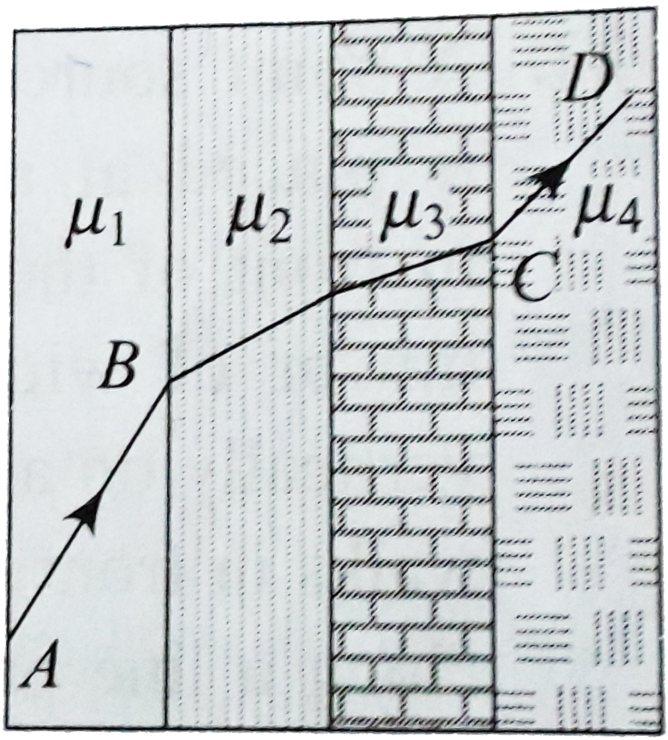
26. A ray of light passes through four transparent media with refractive indices $\mu_1, \mu_2, \mu_3,$ and μ_4 as shown in figure. The surfaces of all media are paralle. If the emerent ray CD is parallel to the incident ray AB, we must have



A. $\mu_1 = \mu_2$

B. $\mu_2 = \mu_3$

C. $\mu_3 = \mu_4$

D. $\mu_4 = \mu_1$

Answer: d.

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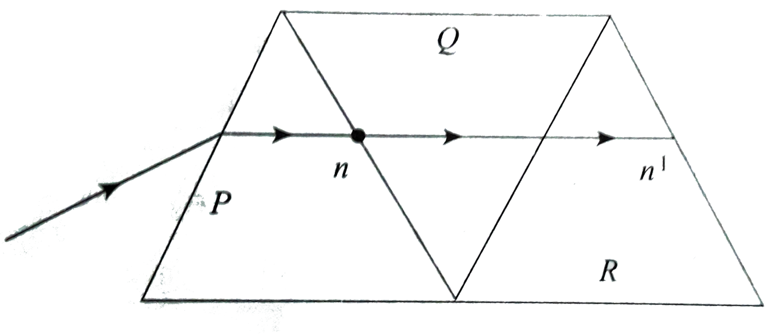
27. A given ray of light suffers minimum deviation in an equilateral prism P. Additional prism Q and R of identical shape and of the same material as P are now added as shown in figure. The ray will now suffer



A. greater deviation

B. no deviation

C. same deviation as before

D. total internal reflection

Answer: c.

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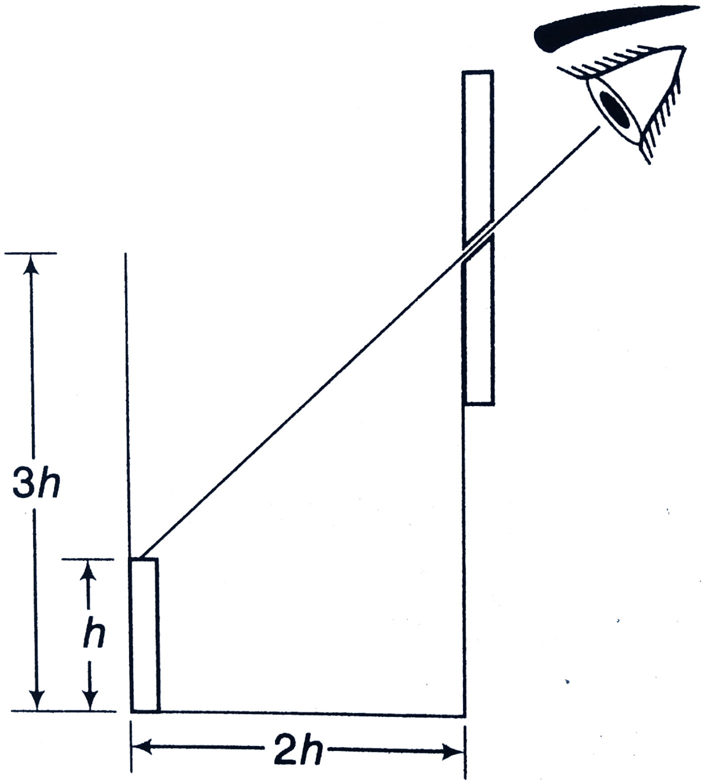
28. An observer can see through a pin-hole the top end of a thin rod of height h,placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then, the refractive index of the liquid is



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

A. $\frac{5}{2}$

B. $\sqrt{\frac{5}{2}}$

C. $\sqrt{\frac{3}{2}}$

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

Answer: b.

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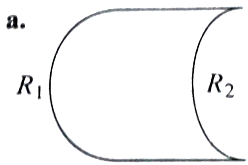
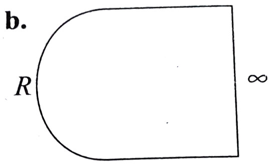
29. Which one of the following sperical lenses does not exhibit dispersion? The radii of curvature of the surfaces of the lenses are as given in the diagrams.

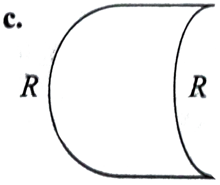
$R_1 \neq R_2$



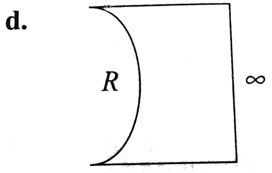
A.



B.



C.



D.

Answer: C

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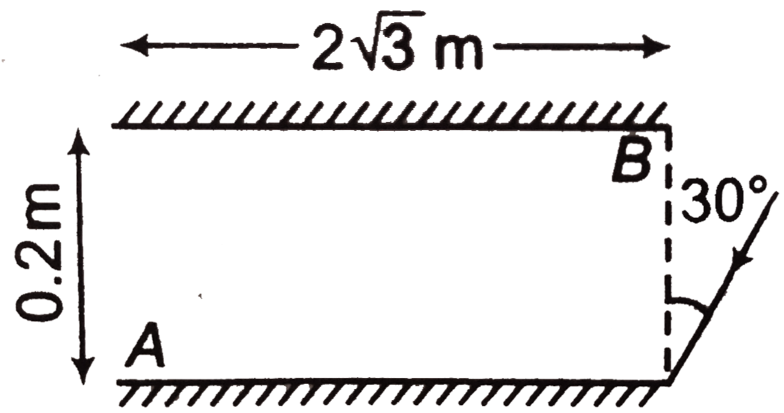
30. Two plane mirrors A and B are aligned parallel to each other as shown in the figure. A light ray is incident at an angle of 30° at a point just inside one end of A. The number of times the ray undergoes reflections (including the first one) before it emerges out is



A. 28

B. 30

C. 32

D. 34

Answer: B

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31. The size of the image of an object, which is at infinity, as formed by a convex lens of focal length 30 cm is 2 cm. If a concave lens of focal length 20 cm is placed between the convex lens and the image at a distance of 26 cm from the convex lens, calculate the new size of the image.

A. 1.25cm

B. 2.5cm

C. 1.05cm

D. 2cm

Answer: b.

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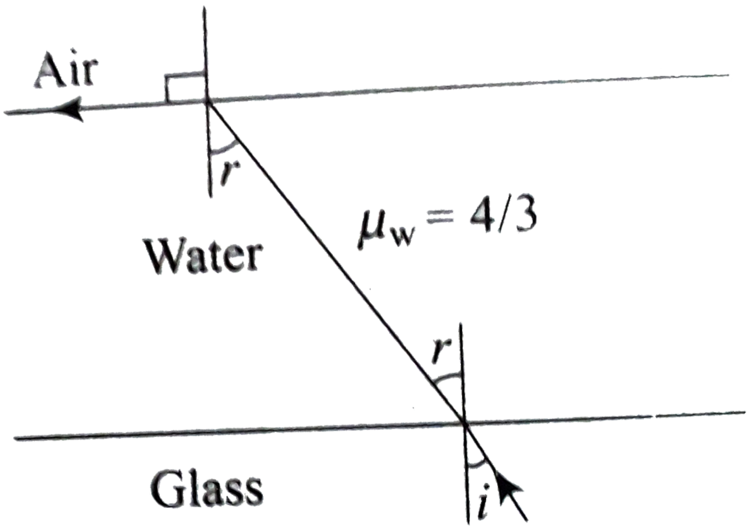
32. A ray of light is incident at the glass-water interface at an angle i. It merges finally parallel to the surface of water. Then, the value of μ_g would be



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

B. $1/\sin i$

C. $4/3$

D. 1

Answer: b.

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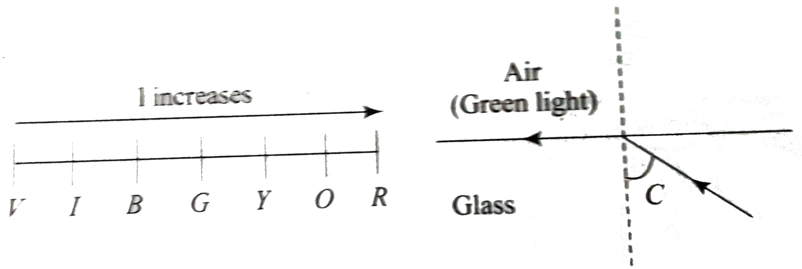
33. A beam of white light is incident on the glass-air interface from glass to air such that green light just suffers total internal reflection. The colors of the light which will come out to air are



A. Violet, Indigo, Blue

B. All colors except green

C. Yellow, Orange, Red

D. White light

Answer: c.

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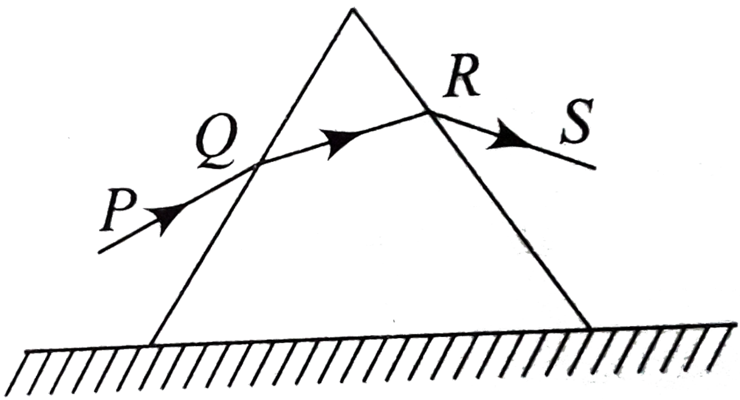
34. An equilateral prism is placed on a horizontal surface. A ray PQ is incident onto it. For minumum deviation,



A. PQ is horizontal

B. QR is horizontal

C. Rs is horizontal

D. any one will be horizontal

Answer: b.

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

A. 6cm

B. 4cm

C. 12cm

D. 9cm

Answer: a.

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

A. $-15, 10$

B. $-10, 15$

C. $75, 50$

D. $-75, 50$

Answer: a.

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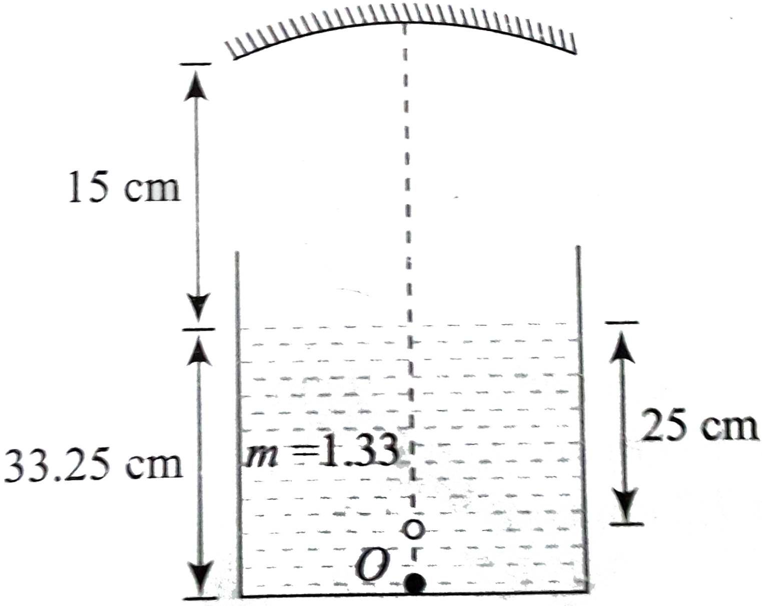
37. A container is filled with water $(\mu = 1.33)$ upto a height of 33.25cm. A convex mirror I s placed 15cm above the water level and image of an object placed at the bottom is formed 25cm below the water level. Focal length of the mirror is



A. 15cm

B. 20cm

C. $-18.31cm$

D. 10cm

Answer: C.

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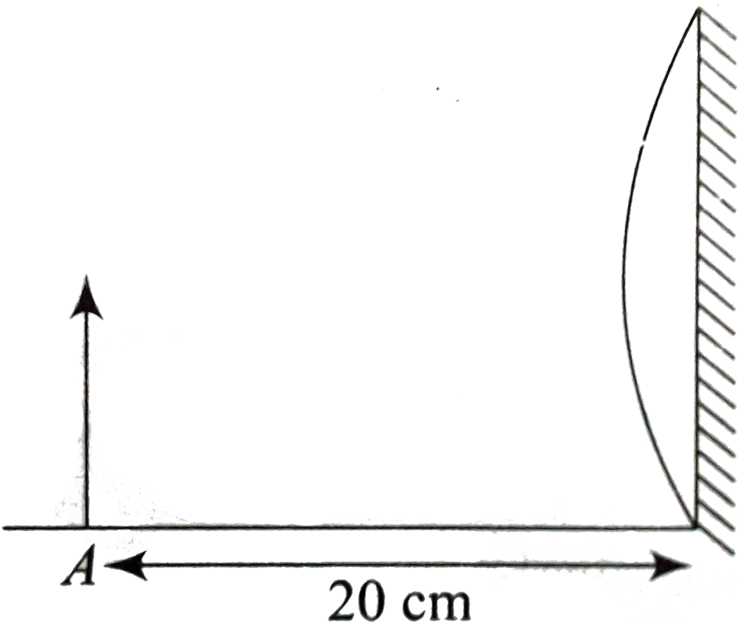
38. Focal length of the plano-convex lens is 15cm. A small object is placed at A as shown in figure. The plane surface is silvered. The image will form at



A. 60cm to the left of lens

B. 12cm to the left of lens

C. 60cm to the right of lens

D. 30cm to the left of lens

Answer: b.

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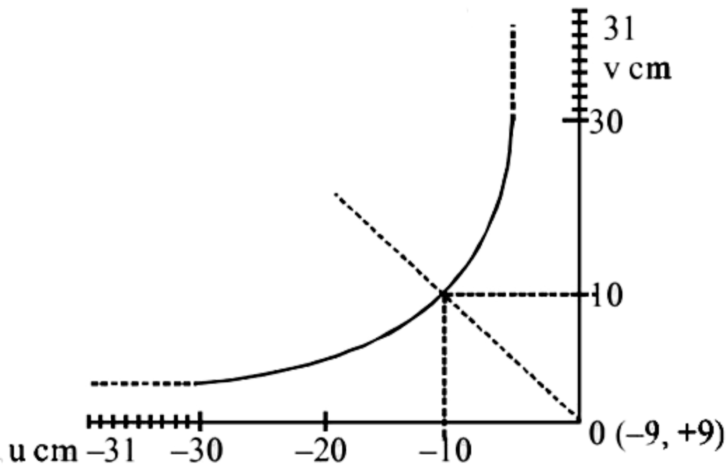
39. The graph shown relationship between object distance and image distance for a equiconvex lens. Then focal length of the lens is `



A. $0.50 \pm 0.05 cm$

B. $0.50 \pm 0.10 cm$

C. $5.00 \pm 0.05 cm$

D. $5.00 \pm 0.10cm$

Answer: c.

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40. A biconvex lens of focal length f forms a circular image of radius r of sun is focal plane. Then, which option is correct?

A. $\pi r^2 \propto f$

B. $\pi r^2 \propto f^2$

C. If lower half part is covered by black sheet, then area of the image is equal to $\pi r^2 / 2$

D. If f is double, intensity will increase

Answer: b.

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41. 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 then 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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42. 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.

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43. Rays of light from Sunn falls on a biconvex lens of focal length f an the circular image of Sun of radius r is formed on the focal plane of the lens. Then,

A. area of image is πr^2 and area is directly proportinal of f

B. area of image is πr^2 and area is directly proportinal to t^2

C. intensity of image increases if f is increases

D. If lower half of the lens is covered with black paper, area will become half

Answer: b.

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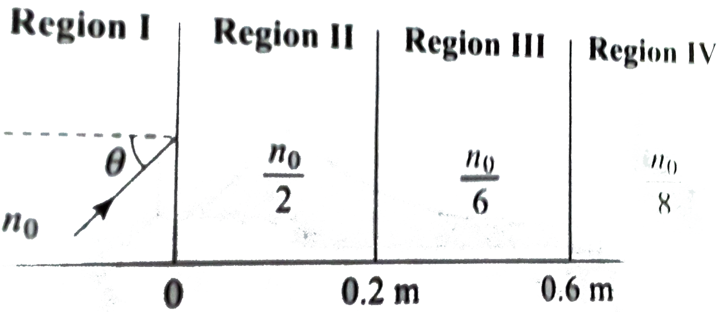
44. A light beam is traveling from Region I to region IV (refer figure). The refractive indices in Region I, II, III, and IV are $n_0, n_0/2, n_0/6$ and $n_0/8$, respectively. The angle of incidence θ for which the beam just misses entering Region IV is



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

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

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

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

Answer: b.

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45. Two beam of red and violet color are made to pass separately through a prism (angle of the prism is 60°). In the positionof minimum deviationi, the angle of refraction will be

A. 30° for both the colors

B. greater for the violet color

C. grater for the red color

D. equal but not 30° for both the colors

Answer: a.

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46. A ball is dropped from a height of 20m above the surface of water in a lake. The refractive index of water is $4/3$. A fish inside the lake , in the line fall of the ball, is looking at the ball. At an instant when the balll is 12.8m above the water surface, the fish sees the speed of ball as .

A. $9ms^{-1}$

B. $12ms^{-1}$

C. $16ms^{-1}$

D. $21.33ms^{-1}$

Answer: c.

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47. A biconvex lens of focal length 15cm is in front of a plane mirror. The distance between the lens and the mirror is 10cm. A small object is kept at distance of 30cm 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 16cm from the mirror

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

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

Answer: b.

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48. A bi-convex lens is formed with two thin plano-convex lenses as shown in the figure. Refreactive 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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49. A ray of light travelling in the direction $\frac{1}{2}\left(\hat{i}, +\sqrt{3}\hat{j}\right)$ is incident on a plane mirror. After reflection, it travels along the direction $\frac{1}{2}\left(\hat{i}-\sqrt{3}\hat{j}\right)$. The angle of incidence is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: a.

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50. The image of an object, formed by a plano-convex lens at a distance of 8m behind the lens, is real and is one-third the size of the object. The wavelength of light inside the lens is $\frac{2}{3}$ times the wavelength is free space. The radius of the curved surface of the lens is

A. 1m

B. 2m

C. 3m

D. 4m

Answer: c.

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Multiple Correct Answers Type

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

A. half the image will disappear

B. complete image will be formed

C. intensity of the image will increase

D. intensity of the image will decrease

Answer: b.,d.

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2. In an astronomincal telescope, the distance between the objective and the eyepiece is 36cm and the final image is formed at infinity. The focal length f_0 of the objective and the focall length f_e of th eeyepiece are

A. $f_0 = 45$ cm and $f_e = -9cm$

B. $f_0 = 50$ cm and $f_e = 10cm$

C. $f_0 = 7.2$ cm and $f_e = 5cm$

D. $f_0 = 30$ cm and $f_e = 6cm$

Answer: a.,b.

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3. A planet is observed by an astronomical refracting telescope having an objective of ofcal length 16m and an eyepiece of focal length 2 cm. Then,

A. the distance between the objective and the eyepiece is 16.02m

B. the angular mangification of the planet is -800

C. the image of the planet is inverted

D. the objective is larger than the eyepiece

Answer: a.,b.,c.,d.

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4. Which of the following forms a virtual and erect image for all position of the object ?

A. Convex lens

B. Concave lens

C. Convex mirror

D. Concave mirror

Answer: b.,c.

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5. A ray of light travelling in a transparent medium falls on a surface separating the medium from air at an angle of incidence 45°. The ray undergoes total internal reflection. If n is the refractive index of the medium with respect to air, select the possible value (s) of n from the following

A. 1.3

B. 1.4

C. 1.5

D. 1.6

Answer: c.,d.

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6. In a Young's double slit experiment, the separation between the two slits is d and the wavelength of the light is λ. The intensity of light falling on slit 1 is four times the intensity of light falling on slit 2. Choose the correct choice (s).

A. If $d = \lambda$, the screen will contain only on e maximum.

B. If $\lambda < d < 2\lambda$, at least one more maximum(besides the central maximum) will be observed on the screen

C. If the intensity of light falling on slit 1 is reduced so that it becomes equal to that of slit2, the intensites of the observed dark and bright firnges will increase

D. If the intensity of light fallin on slit 2 is increased so that is becomes equal to that of slit 1, th eintensites of the observed dark and bright fringes will increase

Answer: a.,b.

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7. A student performed the experiment of determination of focal length of a concave mirror by (u-v) method using an optical bench of length $1.5m$. The focal length of the mirror used is $24cm$. The maximum error in the location of the image can be $0.2cm$. The 5 sets of (u,v) values recorded by the student (in cm) are $(42, 56), (48, 48), (60, 33), (78, 39)$. the data set (s) that cannot come from experiment and is (are) incorrectly recorded, is (are)

(a) $(42, 56)$

(b)$(48, 48)$

(c)$(66, 33)$

(d) $(78, 39)$.

A. $(42, 56)$

B. $(48, 48)$

C. $(66, 33)$

D. $(78, 39)$

Answer: c.,d.

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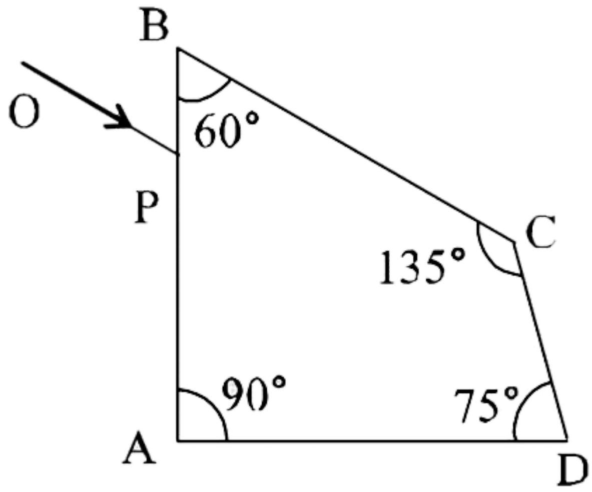
8. A ray OP of monochromatic light is incident on the face AB of prism ABCD mear vertex B at an incident angle of $60 degree$ (see figure). If the refractive index of the material of the prism is $\sqrt{3}$, which of the following is (are) are correct? `



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 emergetn ray is 90°

D. The anglel between the incidnet ray and the emergent ray is 120°

Answer: a.,b.,c.

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Assertion-Reasoninig Type

1. In each of the questions, assertion(A) is given by corresponding statement of reason (R) of the statemens. Mark the correct answer.

Q. Statement I: The formula connecting u,v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.

Statement II: Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces.

A. If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.

B. If both Statement I and Statement II are true but Statement II is not the correct explanation of Statement I.

C. If Statement I is true, but Statement II is false.

D. If Statement I is false, but Statement II is true.

Answer: c

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2. Statement-1

If the accelerating potential in an X-ray tube is increased, the wavelength of the characterstic X-rays do not change.

because

Statement-2

When an electron beam strikes the target in an X-ray tube, part of the kinetic energy is converted into X-ray energy.

A. If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.

B. If both Statement I and Statement II are true but Statement II is not the correct explanation of Statement I.

C. If Statement I is true, but Statement II is false.

D. If Statement I is false, but Statement II is true.

Answer: b.

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Integer Type

1. The focal length of a thin biconvex lens is 20cm. When an object is moved from a distance of 25cm in front of it to 50cm, the magnification of its image changes from m_{25} to m_{50}. The ration m_{25}/m_{50} is

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2. A large glass slab $(\mu = 5/3)$ of thickness 8cm is placed over a point source of light on a plane surface. It is seen that light emerges out of the top surface of the slab from a circular area of radius R cm. What is the value of R?

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3. Image of an object approaching a convex mirror of radius of curvature 20m slong its optical axis is observed to move from $\frac{25}{3}$m to $\frac{50}{7}$m in 30 seconds. What is the speed of the object in km per hour?

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4. Water (with refractive index $= 4/3$) in a tank is 18cm deep. Oil of refractive index $7/4$ lies on water making a convex surface of radius of curvature $R = 6cm$ as shown. Consider oil to act as a thin lens. An object S is placed 24cm above water surface. The location of its image is at 'x' cm above the bottom of the tank. Then x is

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