PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

GEOMETRICAL OPTICS

Illustrative Example

1. A ray of light is incident on the (y-z) plane mirror along a unit vector $\hat{e}_1 = \frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$.

Find the unit vector along the reflected ray.

A. $\hat{e}_2 = \frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$

B. $\hat{e}_2 = \frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} - \frac{1}{\sqrt{3}}\hat{k}$

C. $\hat{e}_2 = -\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$

D. $\hat{e}_2 = \frac{1}{\sqrt{3}}\hat{i} - \frac{1}{\sqrt{3}}\hat{j} - \frac{1}{\sqrt{3}}\hat{k}$

Answer: C

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2. Two plane mirrors are combined to each other as such one is in (y-z) plane and other is in (x-z)plane.A ray of light along vector $\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$ is incident on the first mirror. Find the unit vector in the direction of emergence ray after successive reflections through these mirros.

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3. A ray of light is incident on a plane mirror along a vector $\hat{i}+\hat{j}-\hat{k}$.

The normal on incidence point is along $\hat{i}+\hat{j}$.Find a unit vector along the reflected ray.

A. $\dfrac{\hat{i}+\hat{j}-\hat{k}}{\sqrt{3}}$

B. $\dfrac{-\hat{i}-\hat{j}-\hat{k}}{\sqrt{3}}$

C. $\dfrac{\hat{i}+\hat{j}+2\hat{k}}{\sqrt{3}}$

D. $\dfrac{\hat{i}-2\hat{j}-2\hat{k}}{\sqrt{3}}$

Answer: B

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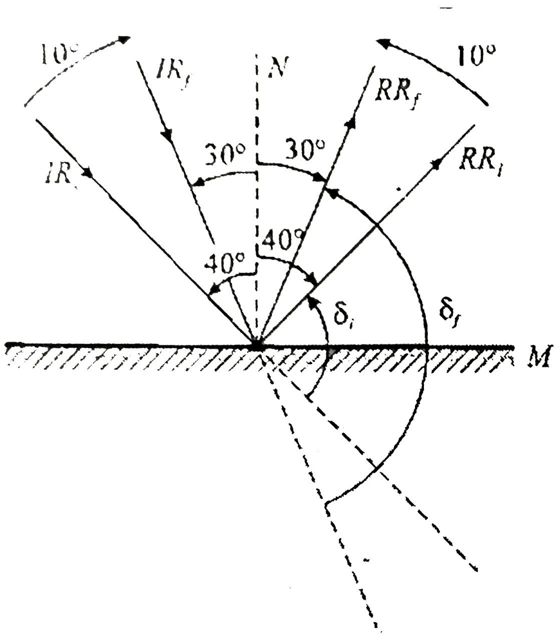
4. Figure shows a mirror M on which a light ray incident at an angle 40° from normal. If the ray is rotated by 10° clockwise find the change in angle of deviation of light after reflection.



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5. A man is standing in aroom of length 20m and height 3m at a distance 5m from one wall. On the facing wall a mirror is hanging. Find the minimum size of mirror required in which man will be able to see complete height of wall behind him.

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6. rays of light strike a horizontal plane mirror at an angle of 45°. At what angle should be a second plane mirror be placed in order that the reflected ray finally be reflected horizontally from the second mirror.

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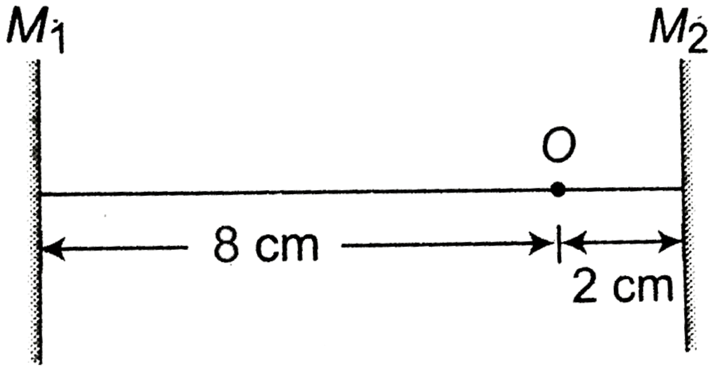

7.

Figure shows two plane mirrors and an object O placed between them what will be distance of the first three imgages from the mirror M_2?

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8. Demostrate that a light beam reflected from three mutually perpendicular plane mirrors in succession reverses its direction.

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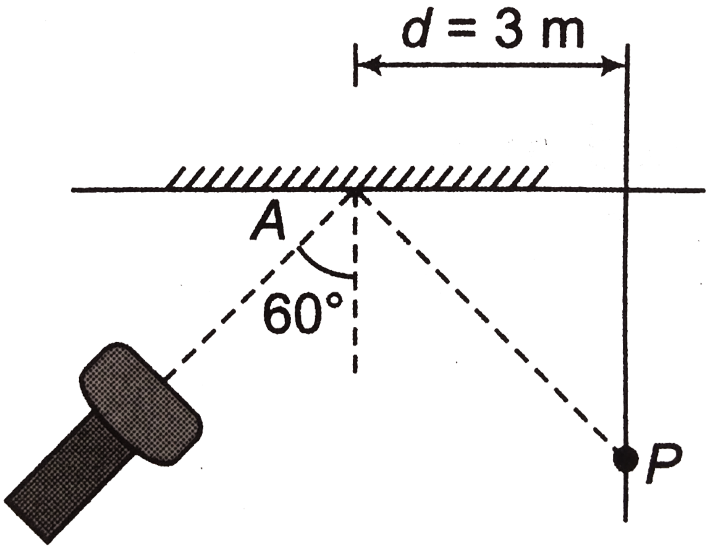
9. Figure shows a torch producing a straight light beam falling on a plane mirror at an angle 60° The reflected beam makes a spot P on the screen along y-axis . If at t=0, mirror starts ratating about the hinge A with an angular velocity $(\omega) = 1^\circ$ per second clockwise. Find the speed of the spot on screen after time t = 15 s.



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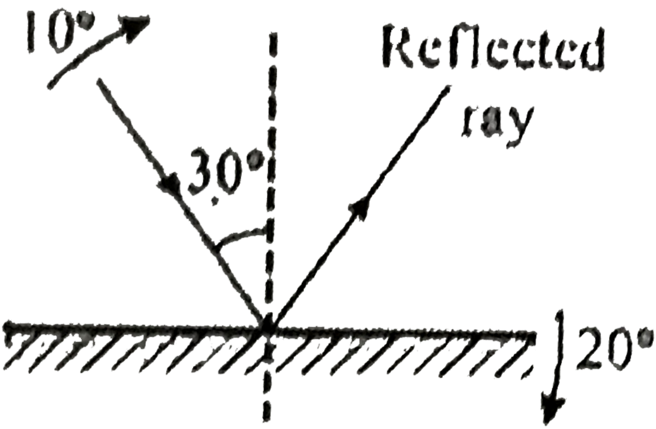
10. Figure shows a plane mirror onto which a light rays is incident. If the incident light ray is rotated by 10° and the mirror by 20°, as show in figure below, find the angle by which the reflected ray is rotated.



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11. A point object is placed at a distance 30 cm in front of a concave mirror of focal length 20 cm. Find the nature and location of image obtained.

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12. A thin rod of length $d/3$ is placed along the principal axis of a concave mirror of focal length = d such that its image, which is real and elongated, just touches the rod. Find the length of the image ?

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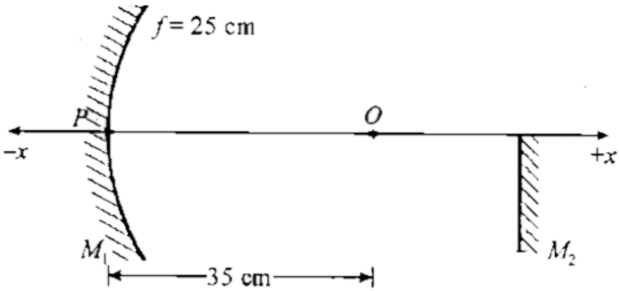
13. In figure shown find the distance from pole P of the concave mirror shown in figure, at which when a plane mirror is placed, image produced by both

mirror for the object O will coincide.



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14. An observer whose least distance of distinct vision is 'd' views the his own face in a convex mirror of radius of curvature 'r' .Prove that magnification produced can not exceed

$$\frac{r}{d+\sqrt{d^2+r^2}}$$

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15. 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?

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16. Using a certain concave mirror, the magnification is found to be 4 times as great when the object was 25 cm from the mirror as it was with the object at 40 cm from the mirror, the image, being real in each case.Find the focal length of the mirror.

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17. A concave and a convex mirror each 30 cm in radius are placed opposite to each other 60 cm apart on the same axis. An object 5cm in height is placed midway between them. Find the position and size of the image formed by two successive reflections, consider first reflection at convex and then at the concave mirror.

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18. A thief is running away in a car with velocity of $20m/s$. A police jeep is following him, which is sighted by thief in his rear view mirror, which is a convex mirror of focal length 10 m. He observes that the image of jeep is moving towards him with a velocity of $1cm/s$. if the magnification of mirror for the jeep at that time is $\frac{1}{10}$. Find

(a) the actual speed of jeep,

(b) rate at which magnification is changing.

Assume the police's jeep is on the axis of the mirror.

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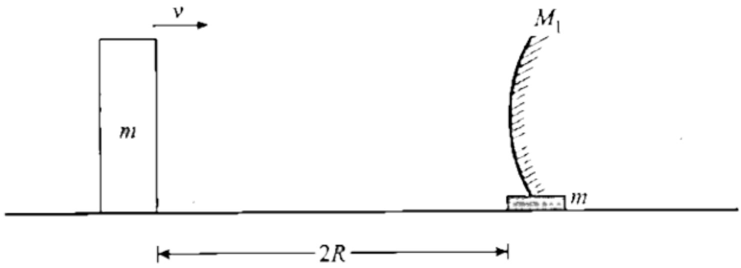
19. A Convex mirror of radius of curvature R is fixed on a standat rest with total mass m which is facing a block of equal mass m as shown in figure and is kept on a frictionless horizontal surfece. The separation between the block and mirror is 2R and block is moving at a speed v toward the mirror.

Consider elastic collision between block and stand, find the speed of image after time $3R / v$.



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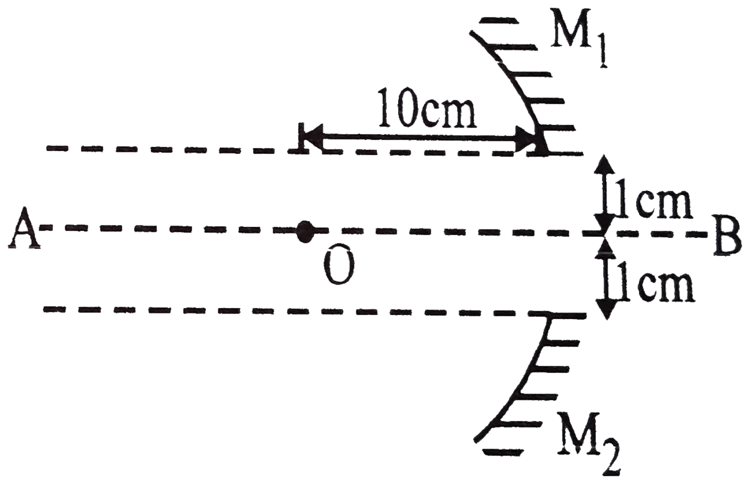
20. A concave mirror of focal length $20cm$ is cut into two parts from the middle and the two parts are moved perpendicularly by a distance $1cm$ from the previous principal axis AB .find the distance between the images formed by the two parts?



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21. An object is located at a distance 30cm on principal axis from the pole of a concave mirror of focal length 20cm. Suddenly the mirror is displaced by a distance 1.5 cm in the direction normal to its

principal axis. Calculate the displacement of image produced by the mirror due to this.

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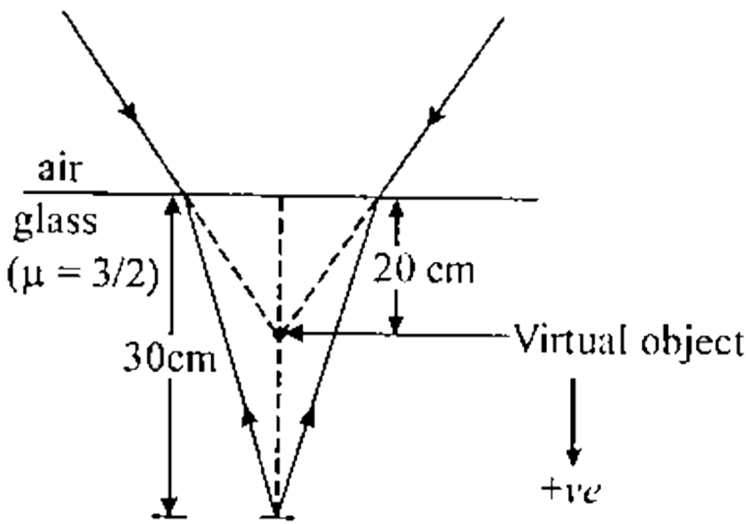
22. A converging beam of light rays incident on a glasa-air interface as shown in figure. Find where these rays will meet after refraction.



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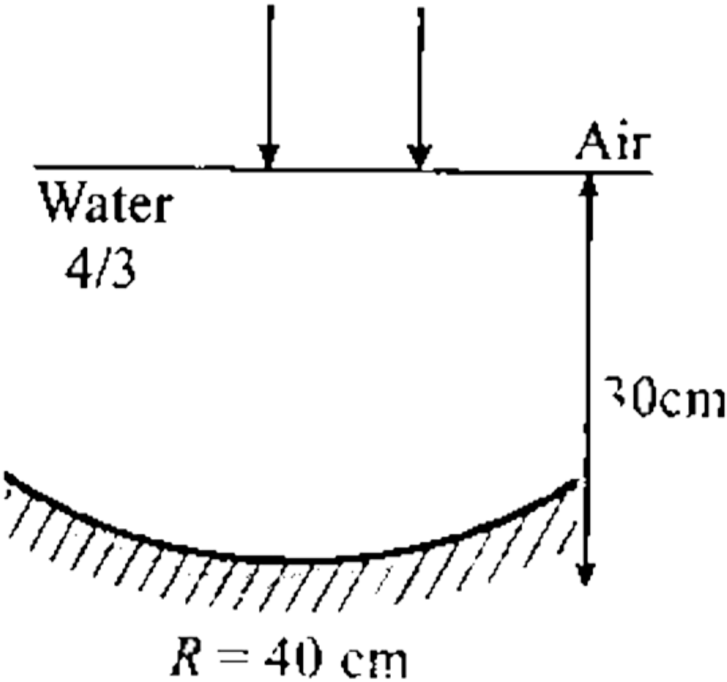
23. A concave mirror is placed inside water its shining surface upwards and principal axis vertical as shown in figure. Rays are incient parallel to the principal axis of the concave mirror. Find the position of the final image.



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24. A bird in air is dividing vertically over a tank with speed $6cm/s$. The base of the tank is silvered. The fish in the tank is rising upward along the same line with speed $4cm/s$. (Take: $\mu_{\text{water}} = 4/3$).

Find:

(a) The speed of the image of the fish asseen directly by the bird.

(b) The speed of the image of the bird relative to the fish looking upwards.

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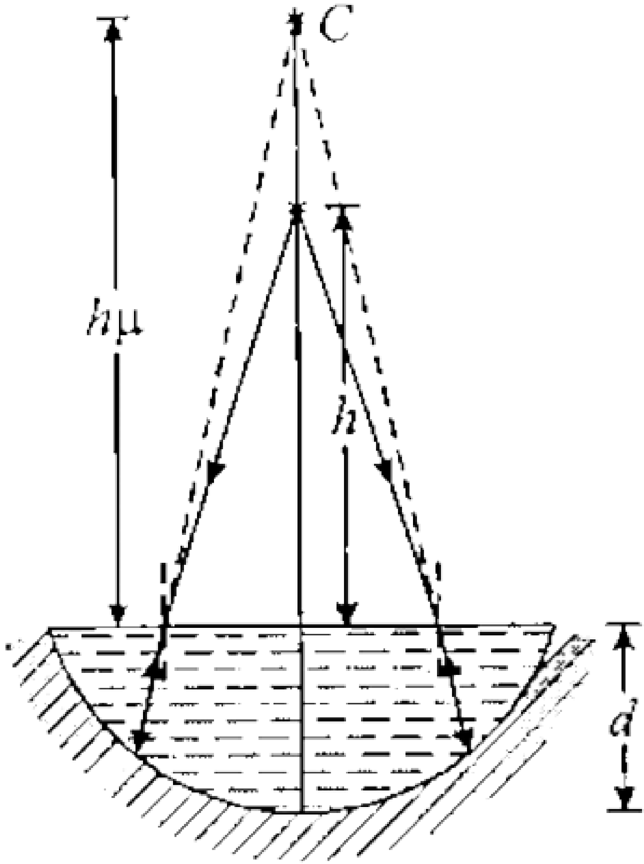
25. Figure shows a concave mirror of focal length F with its principal axis vertical. In mirror a transparent liquid of refractive index μ is filled upto height d. Find where on axis of mirror a pin should be placed so that its image will be formed on itself.



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26. The XY plane is the boundary between two tranparednt media. Medium 1 with $z \geq 0$ has a refraxtive index of $\sqrt{2}$ and medium 2 with $z \leq 0$ has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $6\sqrt{3}\hat{i} + 8\sqrt{3}\hat{j} - 10\hat{k}$ is incident on teh plane of separation. Find the unit vector in the direction of teh refracted ray in medium 2.

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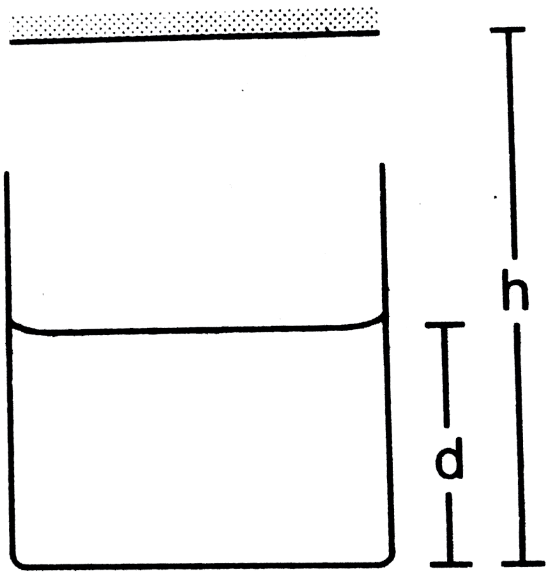
27. Consider the situation shown in figure. A plane mirror is fixed at a height h above the bottom of a beaker containing water (refractive index μ) up of a bottom formed by the mirror.



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28. A rectangular glass block of thickness 10 cm and refractive index 1.5 placed over a small coin. A beaker is filled with water of refractive index $4/3$ to a height of 10 cm and is placed over the glass block.

(a) Find the apparent position of the object when it is viewed at near normal incidence.

(b) if the eye is slowly moves away from the normal at a certain position, the object is found to disappear, due to total internal reflection. At what surface does this happen and why ?

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29. 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 poing object be placed if it is to image on to itself?

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30. A concave mirror has the form of a hemisphere with a radius of $R = 60cm$ A thin layer of an unknown transparent liquid is poured into the mirror ,The mirror-liquids system forms one real Image and another real image is formed by mirror alone ,with the sources in a certain position .One of them coincides with the source and the other is at distance of $l = 30cm$ from source.find the possible value(s) refractive index $\mu$of the liquid.

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31. In previous illustrations if image formed by the mirror coincides with the source and that produced by the combination is produced at a distance 30 cm from the source away from mirror then find the refractive index of the liquid.

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32. A person looking through a telescope T just sees the points on the rim at the bottom of a cylindrical vessel when the vessel is empty. When the vessel is completely filled with a liquid $(\mu, \ = 1.5)$, he observes a mark at the centre B,of the bottom without moving the telescope or the vessel. What is the height of the vessel if the diameter of it scross section is 10cm.

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33. An object is placed $20cm$ in front of a block of glass $10cm$ thick having its farther side silvered.

The image is formed $23.2cm$ behind the silvered face. The refractive index of glass is

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34. A light ray from air is incident on a glass plate of thickness t and refractive index μat an angle of incidence equal to the angle of total internal reflection of glass. Compute the displacement of the ray due to this plate in terms of thickness and refractive index of glass μ.

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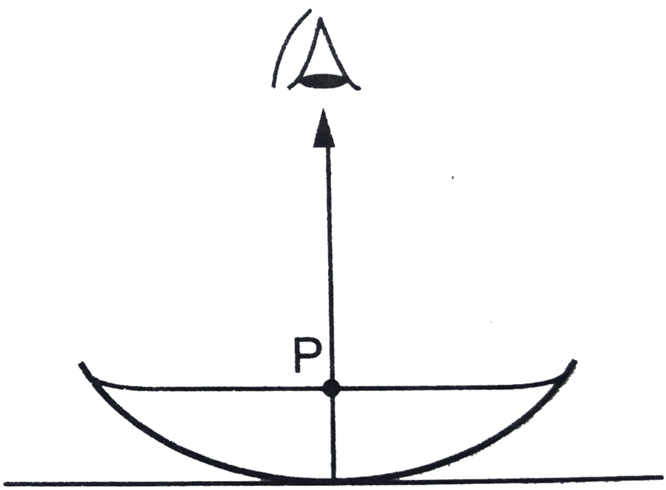
35. A concave mirror of radius 40 cm lies on a horizontla tale and wateis filled in it up t a heightof 5.00 cm. A small dust particle floats on the water surface at a point P vertically above tge pointof contact of the miror with the table. Locate the image of the dust particle as seen from a point directly above it. tEh refractie index of water is 1.33.



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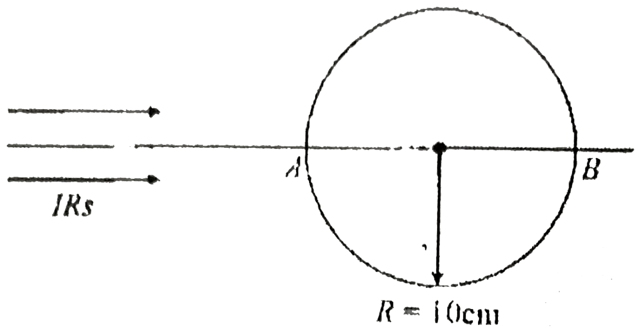
36. Figure shows a glass sphere of radius 10 cm. along its diameter AB from one side a parallel beam of paraxial rays incident on it. What should be the refractive index of glass so that after refraction all rays will converge at opposite end B.



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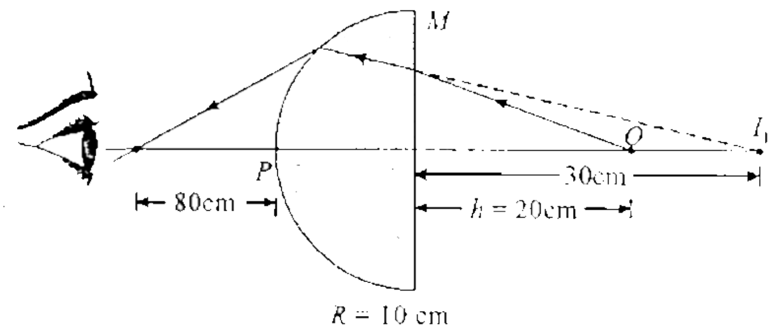
37. Figure shows a glass hemisphere M of $\mu = \frac{3}{2}$ and radius 10 cm. a point object O is placed at a distance 20 cm behind the flat face which is viewed by an observer from the curved side. Find location of final image after two refractions as seen by observer.



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38. A ray of light passes through a transparent sphere of refractive index μ and radius R. If b is the distance between the incident ray and diameter of the sphere which is parallel to that ray, What is the value of the deviation?

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

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

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

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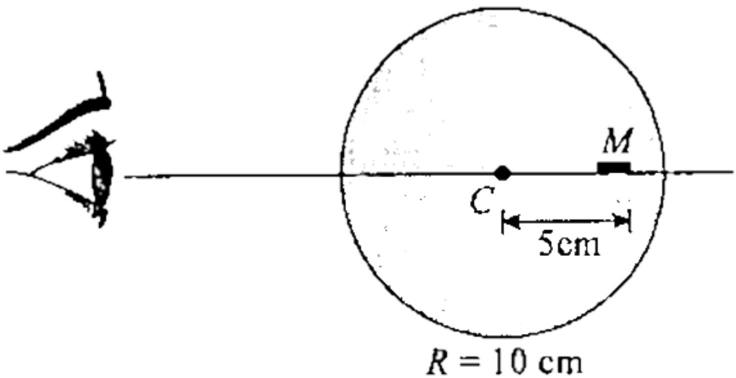
40. Figure shows a small object M of length 1mm which lies along a dimentrical line of a glass sphere of radius 1-



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41. A long cylindrical tube containing water in closed by an equinvex lens of local length 10 cm in air. A point source is placed along the axis of the tube outside it at a distance of 21 cm from the lens. Locate the final image of the source. Refractive index of the materials of the lens =1.5 and that of water =1.33.

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

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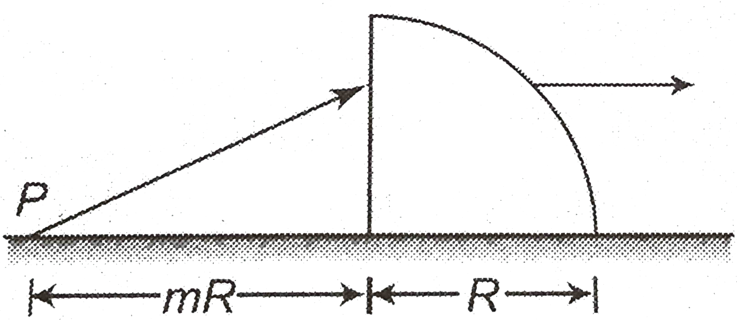
43.



A quarter cylinder of radius R and refractive index 1.5 is placed on a table.A point object P is kept at a distance of mR from it. Find the value of m for whicha ray from P will emerge parallel to the table as shown in the figure.

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44. Find at what angle a fish inside a lake will see a rising sun. (Take $\mu_{\omega} = 4/3$)

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45. Light falls from glass $(\mu = 1.5)$ to air. Find the angle of incidence for which the angle of deviation is 90°.

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46. Light is incident at an angle α on one planar end of a transparent cylindrical rod of refractive index μ. Determine the least value of μ so that the light entering the rod does not emerge from the curved surface of rod irrespective of the value of α

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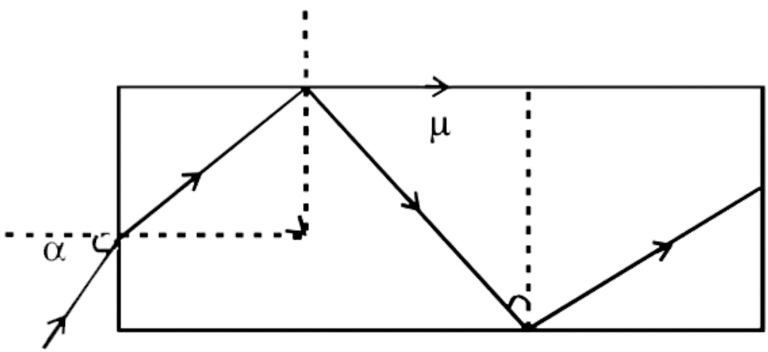

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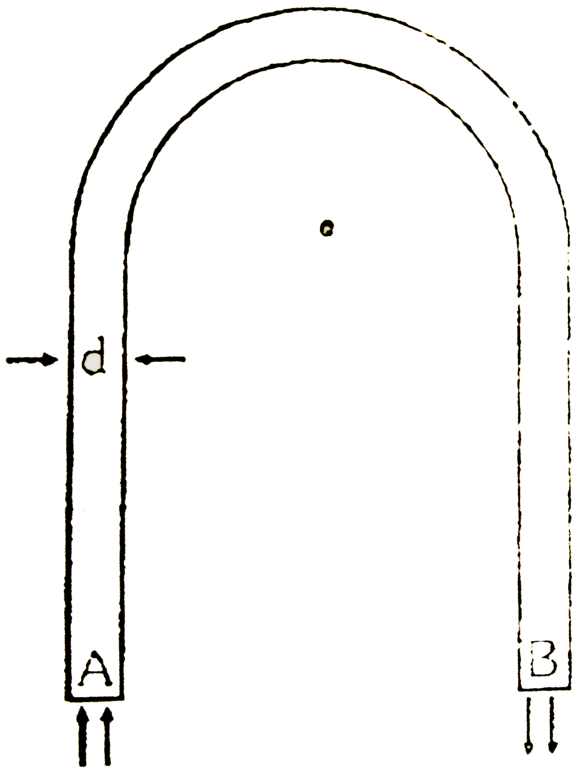
47. A rod made of glass $(\mu = 1.5)$ and of square cross-section is equal is bent into the shape shown in figure. A parallel beam of light falls perpendicurly on the plane flat surface . A . Referring to the diagram, d is the width of a side & R is radius of inner semicircle. find the maximum value of ratio $\frac{d}{R}$ so that all light entering the glass through surface A emerge from the glass through surface B.



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48. A prism has refracting angle 30° and $\mu = 2.$ One of the mat surface of the prism is polished to make it reflecting. Find the incidence angle of a light ray on other mat surface of prism so that after reflection the ray will retrace the path of incident ray.

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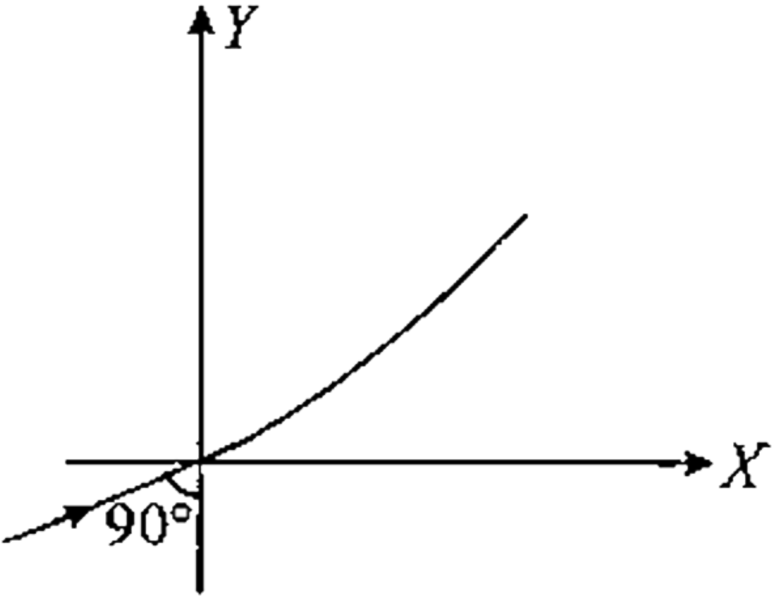
49. Find the variation of Refractive index assuming it to be a function of y such that a ray entering origin at grazing incident follows a parabolic path

$y = x^2$ as shown in figure.



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50. Find the angle of incidence of a light ray on an equilateral prism of refractive index $\mu = \sqrt{2}$ for which light will suffer minimum deviation also find this minimum deviation angle.

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51. The angle of incidence of a ray of light entering a 60° prism is 42°. If ray is just totally reflected at the second face of the prism, determine the refractive index of the prism material for the light.

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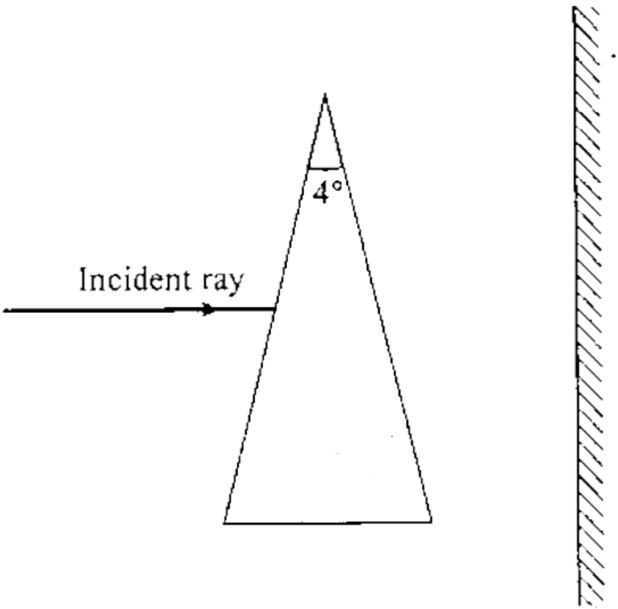
52. Figure shows a small angles prism angle 4° and $\mu = \frac{3}{2}$. A light ray almost normally incident on the prism is refracted and falls on a vertical mirror as shown. Find the total deviation of the ray after reflection from the mirror.



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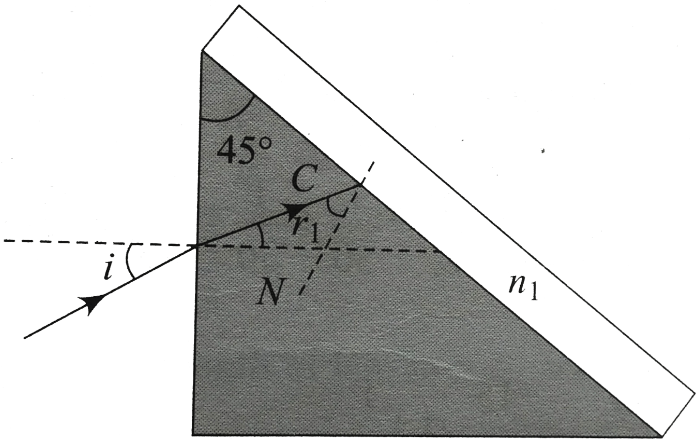
53. A right angles prism $(45^\circ, 90^\circ, 45^\circ)$ of refractive index n has a plate of refractive index $(n_1 < n)$ cemented to its diagonal face. The assembley is in air. A ray is incident on AB.

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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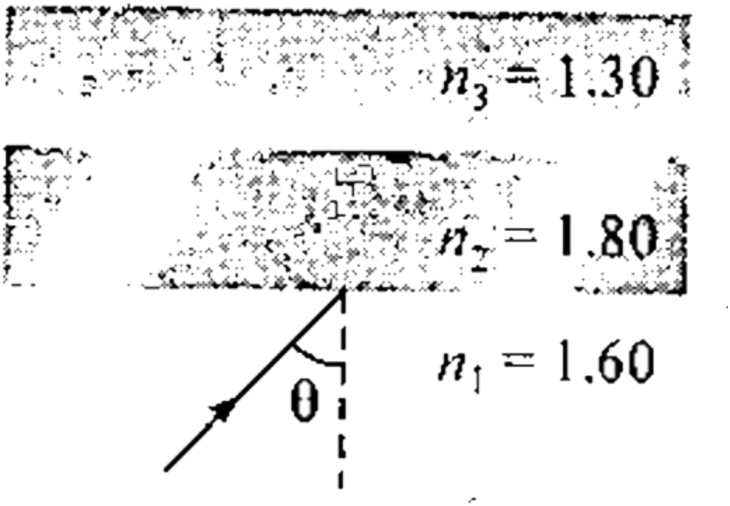
54. In figure, light refracts from material 1 into a thin layer of material 2, crosses that layer, and then is incident at the critical angle on the interface between materials 2 and 3.



(a) What is the angle θ?

(b) If θ is decreased, is there refraction of light into material 3 ?

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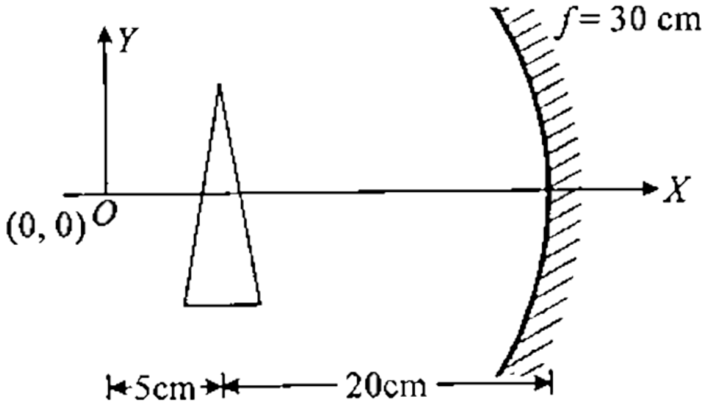
55. Find the co-ordinates of image of the point object 'O' formed after reflection from concavemirror as shown in figure assuming prism to be thin and small in size and of prism angle 2°. Refractive index of the prism material is $3/2$



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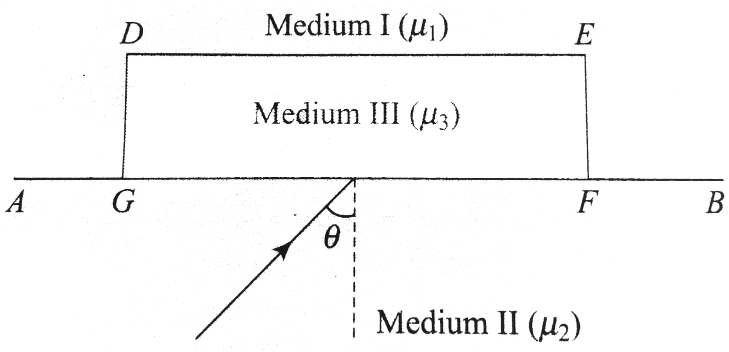
56. A monochromatic light is incident on the plane interface AB between two media of refractive indices μ_1 and $(\mu_2 > \mu_1)$ at an angle of incidence

θ as shown in Fig.

The angle θ is infinitesimally greater than the critical angle for the two media so that total internal reflection takes place. 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 into medium II.



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57. 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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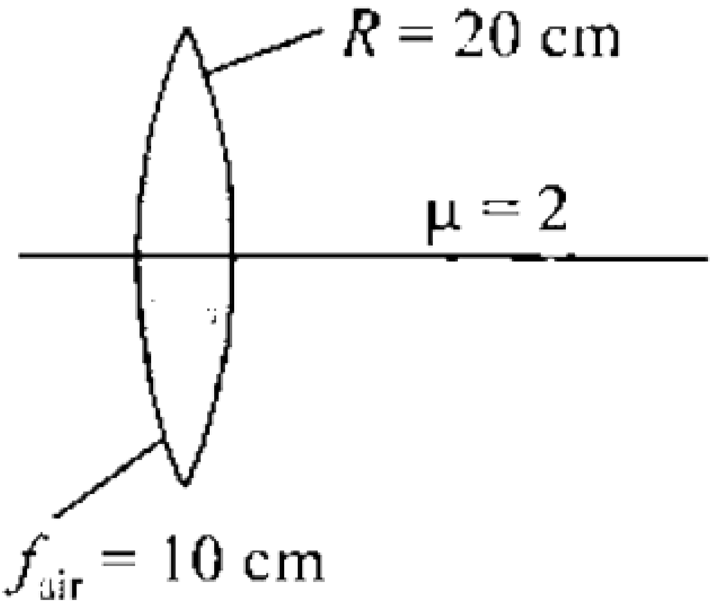
58. Focal length of a thin lens in air, is 10 cm. Now medium on one side of the lens is replaced by a medium of refractive index $\mu = 2$. The radius of curvature of surface of leng, in contact with the medium, is 20 cm. Find the point on principal axis where parallel rays incident on lens from air parallel to axis will converge.



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59. A biconvex lens has focal length 50 cm and the radius of curvature of one surface is double that of other. Find the radii of curvature if refractive index of lens material is 2.

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60. A convex lens of focal length 20 cm is placed at a distance 5 cm from a glass plate $\left(\mu = \frac{3}{2}\right)$ of thickness 3 cm. an object is placed at a distance 30 cm from lens on the other side of glass plate. Locate the final image produced by this optical setup.

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61. A diverging lens of focal length 20 cm is placed coaxially 5 cm toward left of a converging mirror of focal length 10 cm. Where would an object be placed toward left of the lens so that a real image is formed on object itself.

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62. A convex lens is held $45cm$ above the bottom of an empty tank. The image of a point at the bottom of a tank is formed $36cm$ above the lens. Now, a liquid is poured into the tank to a depth of $40cm$. It is found that the distance of the image of the same point on the bottom of the tank is $48cm$ above the lens. Find the refractive index of the liquid.

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63. An object of height 4 cm is kept to the left of and on the axis of a converging lens offocal length 10cm at a distance of 15cm from lens. A plane mirror is placed inclined at 45° to the lens axis, 10 cm to the right of the lens.Find the position and size of the image formed by the lens and mirror combination. Trace the path ofthe rays forming the image.

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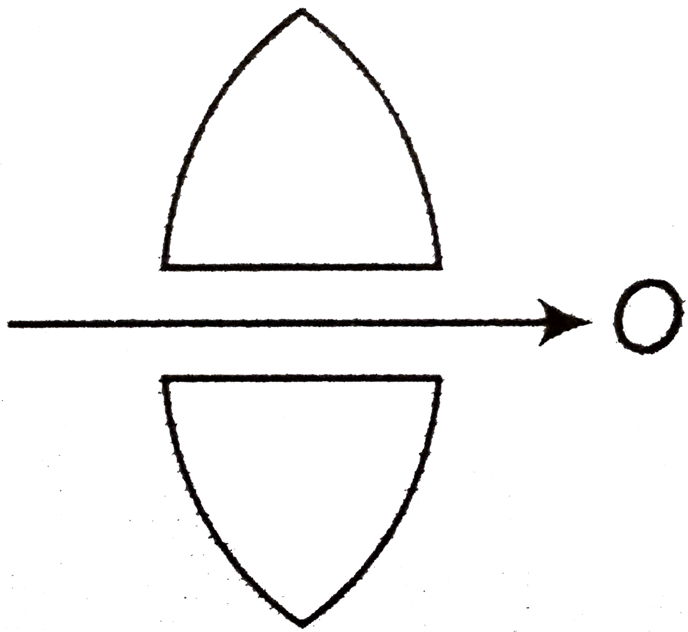
64.



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.

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

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66. Determine the position of the image produced by an optical system consisting of a concave mirror with a focal length of $10cm$ and a convergent lens with a focal length of $20cm$. The distance from the mirror to the lens is $30cm$ and from the lens to the object is $40cm$. Consider only two steps. Plot the image.

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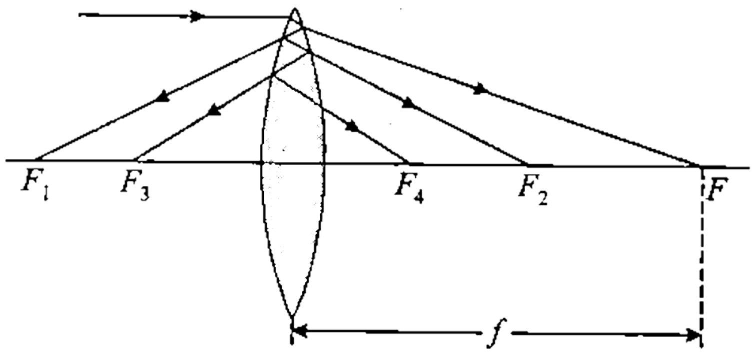
67. A strong source of light when used with a convex lens produces a number of images of the source owing to feeble internal reflections and refraction called flare spots as shown in figure . These extra images are F_1, F_2. If F_n is the position of n^{th} flare spot, then show that



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

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69. A point object is placed at a distance of 15 cm from a convex lens. The image is formed on the other side of lens at a distance 30 cm from lens. When a concave lens is placed in contact with convex lens, image is shifted away further by 30 cm. calculate the focal lengths of the two lenses.

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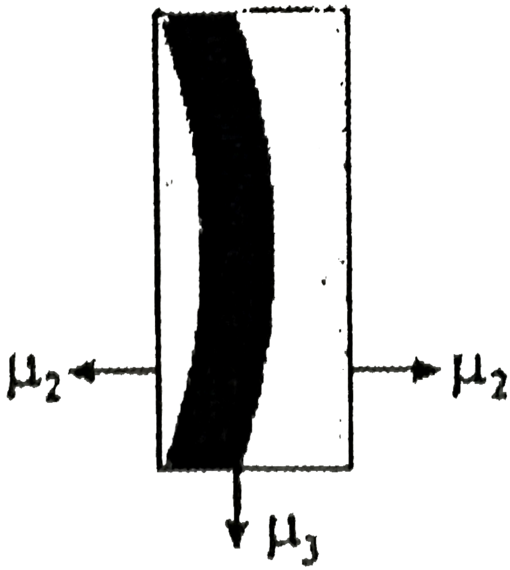
70. The figure below shows a thin plano-convex lens of refractive index μ_1 and a thin plano-concave lens of refractive index μ_2, both having same radius of curvature R of their curved surfaces. Another thin lens of refractive index μ_3 has same radius of curvature R on the two surface between the plano-convex and plano-concae lenses that the plane surfaces are parallel to each other. Find the focal length of the combination.



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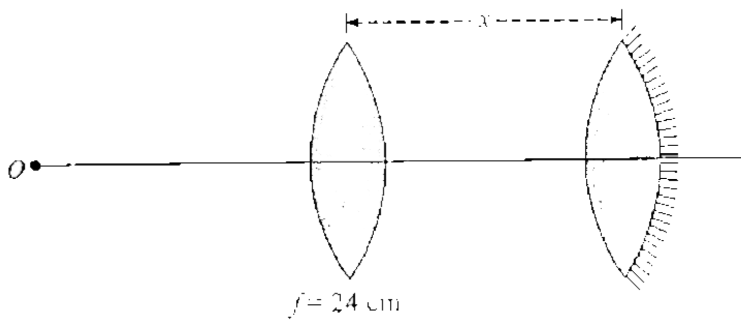
71. The convex surface of a thin concave-convex lens of glass of refractive index 1.5 has a radius of curvature 20 cm. The concave surface has a radius of curvature 60 cm. The convex side is silvered and placed on a horizontal surface as shown in figure. (a) Where should a pin be placed on the axis so 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.

72. The radius of curvature of the curved surfaces of an equiconvex lens is 32 cm and its refractive index is $\mu = 1.5$. One of its side is silvered and placed 14 c away from an object as shown in figure. At what distance x should a second convex lens of focal length 24 cm be placed so that the image coincides with the object.



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73. A point source of light is placed inside water and a thin converging lens ofrefractive index μ_2 is placed just outside the plane surface of water. The image of the source is formed at a distance x from the surface of water. If the lens is now placed just inside water and the image is now formed at a distances' from the surface of water, show that

$$\frac{1}{x} - \frac{1}{x_1} = \frac{\mu_1 - 1}{\mu_2 - 1} \times \frac{1}{f},$$

Where f is the focal length of the lens and μ_1 is the refractive index of water.

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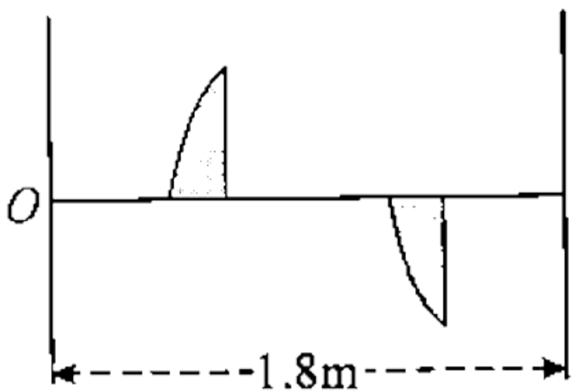
74. A thin plano-convex lens of focal length f is split into two halves. One of the halves is shifted along the optical axis as shown in figure. The separation between object and image planes is 1.8 m. The magnification of the image, formed by one of the ball lens is 2. Find the focal length of the lens and separation between the two halves. Draw the ray diagram for image formation.



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75. A thin converging lens is placed between an object and a screen whose position are fixed. There are two positions of the lens at which the sharp image of the object is formed on the screen. Find the transverse dimension of the object if at one position of the lens the image dimension equal $h' = 2.0mm$ and at the other, $h'' = 4.5mm$.

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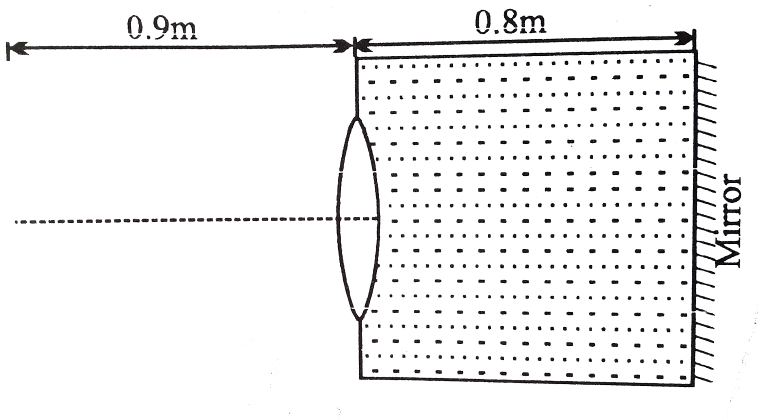
76. A thin equiconvex lens of glass of refractive index $\mu = 3/2$ & of focal length $0.3 m$in air is sealed into an opening at one end of a tank filled with water $(\mu = 4/3)$ .On the opposite side of the lens ,a mirror is placed inside the tank on the tank wall perpendicular to the lens axis ,as shown in figure .the separation between the lens and the mirror is $0.8 m$A small object is placed outside the tank in front of the lens at a distance of 0.9m form the lens along its axis .Find the position (relative to the lens)of the image of the object fromed by the stsyem.



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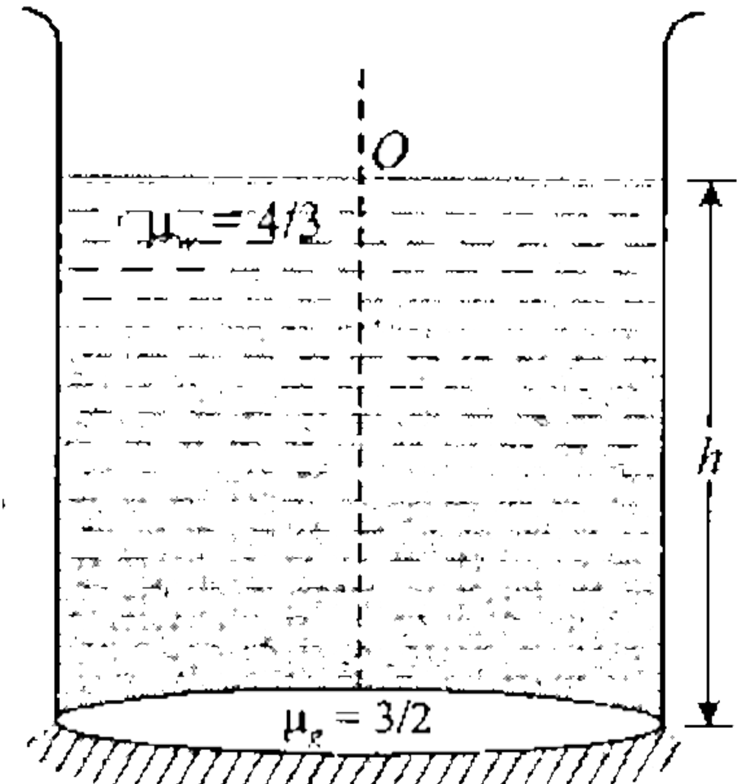
77. Bottom of a glass beaker is made of a thin equi-convex lens having bottom side silver polished as shown in the figure. Water is filled in the beaker upto a height 4m. The image of poin to bject,floating at middle point of beaker at the surface of water coincides with it. Find out ther adius of curvature of the lens.Given that refractive index of glass is 3/2 and that of water is 4/3.



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78. An achromatic convergent lens of focal length $150cm$ is made by combining flint and crown glass lenses. Calculate the focal length of both the lenses and point out which one is divergent if the ratio of the dispersive power of flint and crown glasses is $3:2$.

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79. Calculate the angle of a prism of dispersive power 0.021 and refractive index 1.53 to form an achromatic combination with prism of angle 4.2°,

and dispersive power 0.045, having refractive index 1.65. Find also the net deviation.

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80. A prism of angle 60° is made of glass of refractive index 1.50 for red and 1.56 for violet. Find the angular separation of these rays when a narrow pencil of composite light is incident at minimum deviation.

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81. A thin biconvex lens is placed with its principal axis first along a beam of parallel red light and then along a beam of parallel blue light. If the refractive indices of the lens for red and blue light are respectively 1.514 and 1.524 and if the radius of curvature of the faces are 30 cm and 20 cm, calculate the sepration of for red and blue light. If the focal length for the mean colour (yellow) is 23.1 cm, find the dispersive power of the material of the lens.

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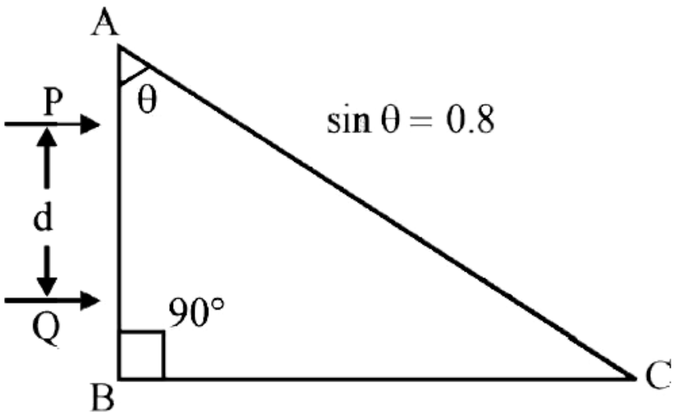
82. Two parallel beams of light P and Q (separation d) containing radiation of wavelengths $4000A$ and $5000A$ (which are mutually coherent in each wavelength separately) are incident normally on a prism as shown in fig. The refractive index of the prism as a function of wavelength is given by the relation. $\mu(\lambda) = 1.20 + \frac{b}{\lambda^2}$ Where λ is in A and b is positive constant. The value of b is such that the condition wave length and is not satisfied for the other.

(a) Find the value of b.

(b) find the deviation of the beams transmitted through the face AC. (c) A convergent lens is used to bring these transmitted beams into focus. If the intensities of transmission form the face AC, are 4I and I respectively, find the resultant intensity at the focus.`



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83. A short-sighted man, the accommodation of whose eye is between 12 cm and 60 cm wears

spectacles through which he can see remote objects distinctly. Determine the minimum distance at which the man can read a book through his spectacles.

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84. The focal lengths of the objective and eyepiece of a microscope are 4mm and 25 mm respectively, and the length of the tube is 16cm. If the final image is formed at infinity and the least distance of distinct vision is 25 cm, then calculate the magnifying power of the microscope.

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85. A telescope has an objective of focal length $50cm$ and an eyepiece of focal length $5cm$. The least distance of distinct vision is $25cm$. The telescope is focused for distinct vision on a scale $2m$ away from the objective. Calculate (a) magnification produced and (b) separation between objective and eyepiece.

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86. A compound microscope is used to enlarge an object kept at a distance $0.03m$ from cuts objective which consists of serval convex lenses in contact and has focal length $0.03m$. If a lens focal length $0.1m$is removed from the objective, find out the distance by which the eye-piece of the microscope must be moved to refocus the image.

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87. In a compound microscope, the objective and eye piece have focal lengths $0.95cm$ and $5cm$ respectively, and are kept at a distance of $20cm$.

The final image is formed at a distance of $25cm$ from the eye piece. Calculate the position of the object and the total magnification.

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

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89. A short-sighted person cannot see objects situated beyond 2m from him distinctly. What should be the power of the lens which he should use for seeing distant objects clearly?

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Practive Exercise 5.1

1. A person's eye is at a height of 1.5m.He stands in frount of a 0.3 m length palne mirror bottom of which is 0.8 m above ground.Find the length the of his image he will be able in this mirror

[0.6 m]

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2. An object of size 7.5 cm is placed in front of a convex mirror of radius of curvature 25 cm at a distance of 40 cm. The size of the image should be

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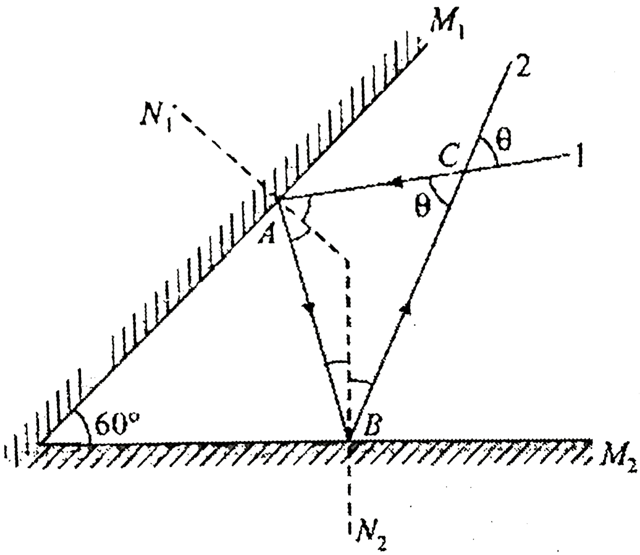
3. In figure shown a light ray I after getting reflected fron mirror M_1 strikes another mirror M_2

and reflected as ray 2, If angle between M_1 and M_2 is 60° find angle θ



$[60^\circ]$

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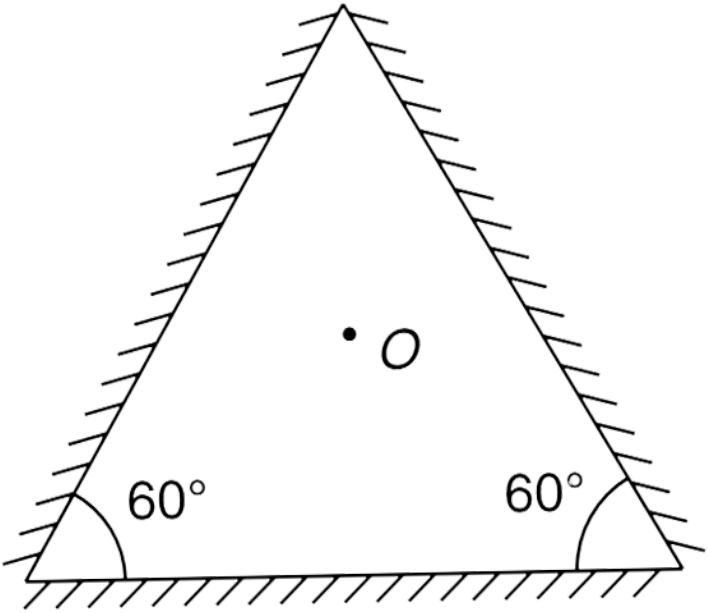
4. Three plane mirrors are kept as shown in the Figure A point object (O) is kept at the centroid of the triangle seen in the Figure. How many images will be formed?



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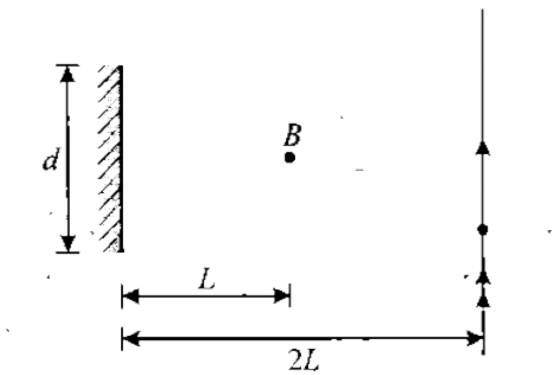
5. A point source of light B is placed at a distance L in front of the centre of a mirror of which d hung vertically on a wall.A man walks in front of the mirror along a line parallel to the mirror at a distance 2L from it as shown in figure . The greatest distance over which he can see the image of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



[3d]

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6. In a 3D coordinate system a plane mirror is placed parallel to XY plane and above the mirror a point object is moving at velocity $\overrightarrow{v}_0 = 5\hat{i} - 3\hat{j} - 1l\hat{k}m/s$ If mirror is also moving parallel to it self at velocity $\overrightarrow{v}_m = 2\hat{i} + \hat{j} - 3\hat{k}$, find the velocity of image produced in mirror,

$\left[5\hat{i} - 3\hat{j} + 5\hat{k}m/s\right]$

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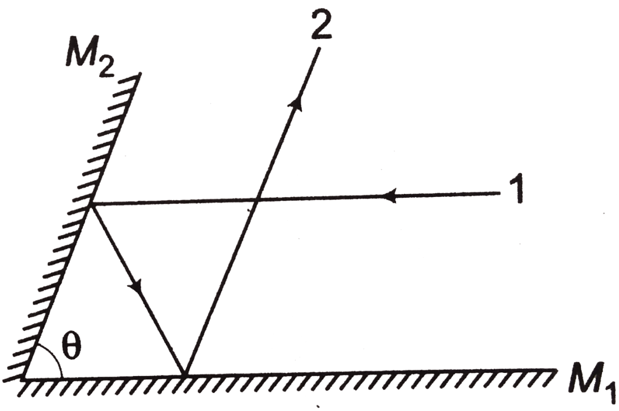
7. Two plane mirror M_1 and M_2 area inclined at angle θ as shown. A ray of light 1, which is parallel to M_1strikes M_2 and after two

reflection , the ray 2 become parrallel to M_2.Find the angle θ



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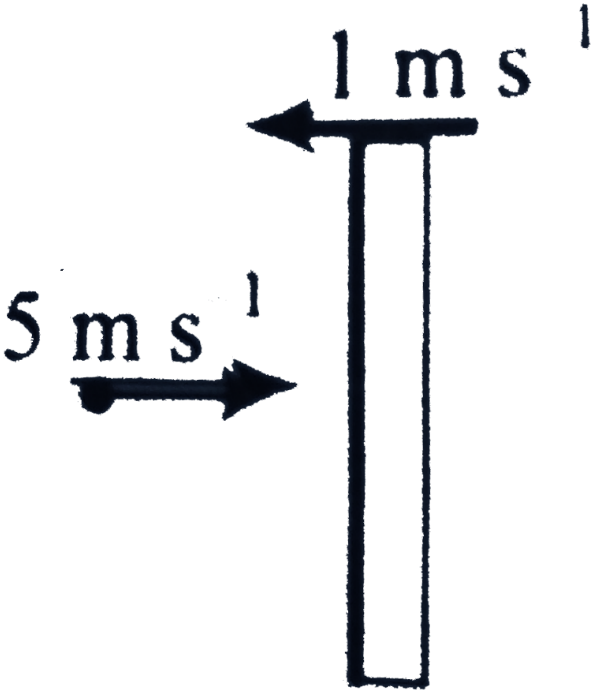
8. An object moves with $5ms^{-1}$ toward right while the mirror moves with $1ms^{-1}$ toward the left as shown in Figure. Find the velocity of image.



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9. A palen mirror placed along xy plane is moving with velocity $-3\hat{i} + 5\hat{k} - 4\hat{k}$. A point in front of

the plane mirror is moving with velocity $-2\hat{i}-4\hat{j}+4\hat{k}$. Find velocity of image

$\left[-2\hat{i}=14\hat{j}+4\hat{k}\right]$

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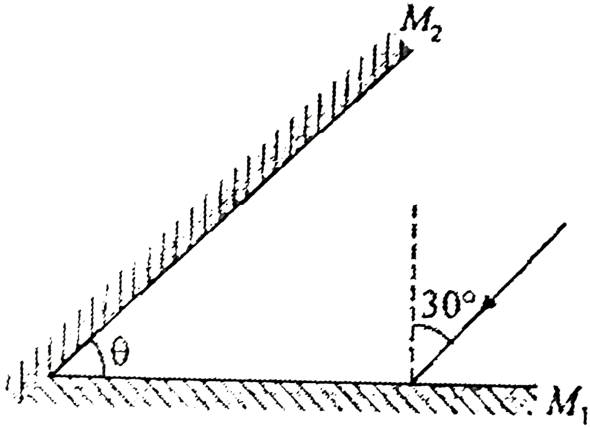
10. Two plane mirrors are inclined to each other as in figure A after three successive reflection falls on the mirror M_1 and finally retaces its path.Calculate the angle between the two plane mirror



$[15^\circ]$

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Practive Exercise 5.2

1. Find the distance from a convex mirror, of focal length 60 cm where an object of height 12 cm

should be placed so that its image is produced at 35 cm from mirror.Also find the height of image

[-84 cm, 5 cm]

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2. A 2 cm high object is placed on the principal axis of a concave mirror at a distance 12 cm from the ole of mirror, Find the location of the image and focal length of mirror if the image height is 5 cm and it is inverted

[30 cm, 8,6 cm]

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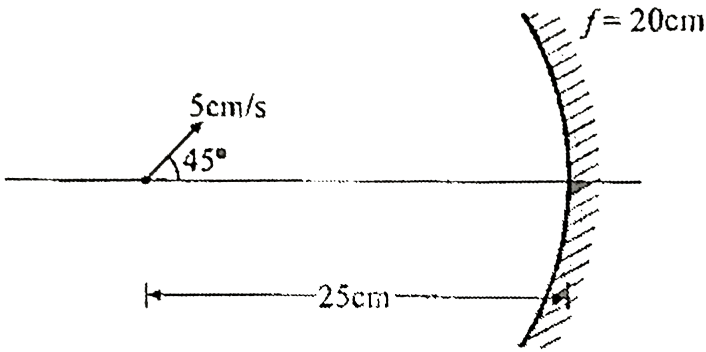
3. A point object on the principal axis of a concave mirror of focal length 20 cm, is moving at a speed of 5 cm/s at an single 45° to the principal axis as shown of 25 cm from the pole of mirror.Find the velocity components of image along and normal to principal axis at this instant



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4. A man uses a concave mirror for shaving and see his 2 times enlarged image when his face is at a distance 40 cm from mirror.Find focal length of mirror

[80 cm]

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5. A 2 cm high object is placed on the principal axis of a concave mirror at a distance of 12 cm from the pole.If the time image is inverted, real and 5 cm high, find the focal length of mirror.If the object starts moving at a speed of 1.2 cm/s toward the mirror find speed of image and its direction of motion

[7.5 cm/s]

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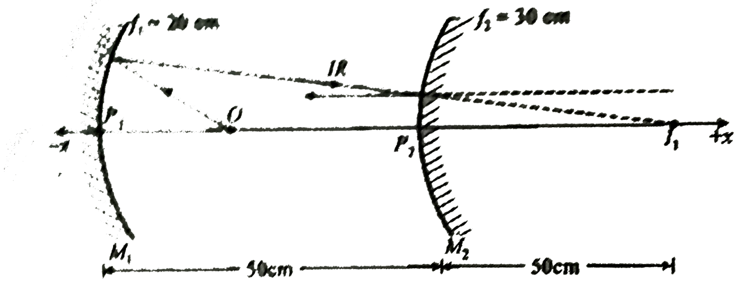
6. Figure shows two spherical mirrors M_1 and M_2 on same optical axis at a separation of 50 cm. Apoint object O is placed midway between mirrors in optical axis.Find location & nature of its image after two successive reflections first at M_1 then at M_2



[75 cm]

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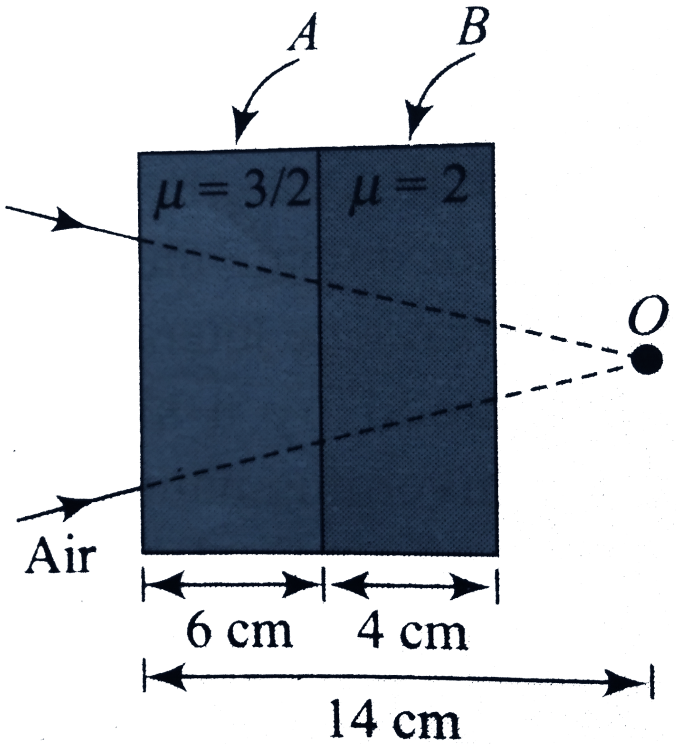
Practive Exercise 5.3

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



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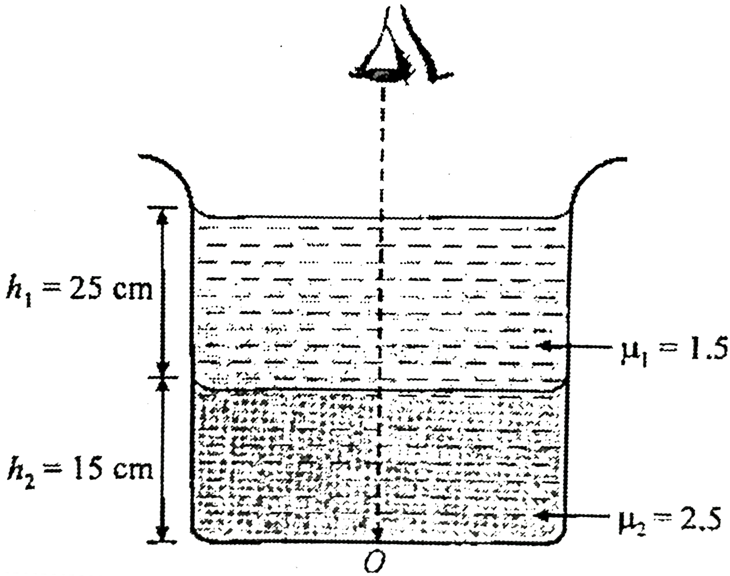
2. Find the apparent depth of an object O placed at the bottom of a beaker as shown in which two layers of transparent liquids are filled



[22.67 cm]

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3. A point object is placed $33cm$ from a convex mirror of curvature radius $= 40cm$ A glass plate of thickness $6 cm$ and refractive index 2.0 placed between the object and mirror,close to the mirror,find the distance of final image form the object?

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4. A light ray falling at 60° angle with the surface of fa glass slab of thickness 1 m and is refracted at angle 75° with the surface, Calculate the time taken by the light to cross the slab

$$\left[\frac{2}{3} \times 10^{-8} s\right]$$

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5. A surveyor on one bank of canal observed the image of the 4 inch and 17 ft marks on a vertical staff,which is partially immersed in the water and held against the bank directly opposite to him, coincides If the $17ft$ mark and the surveyor's eye are both $6ft$ above the water level ,estimate the width of the canal ,assuming that the reflective index of the water is $4/3$ .Zero mark is at the bottom of the canal.

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6. A ray of light is incident on a parallel slab of thickness t and refractive index n. If the angle of incidence θ is small, than the lateral displacement in the incident and emergent ray will be

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7. How much water should be filled in a container of height $21cm$, so that it appears half filled to the observer when viewed from the top of the container $(\mu = 4/3)$.

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8. A glass plate has a thickness t and refravtive index μ A light ray is allowed to incident in the plate from air. Find at what angle of incidence will the rays refracted and reflected by the plate be perpendicular to each other ? For this angle of incidence, calculate the lateral displacement of the ray

$$\frac{t(\mu^2 - 1)}{\mu\sqrt{1 + \mu^2}}$$

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9. A man standing on the edge of the swimming pool looking at a stone lying at the bottom of the pool. The depth of the swimming pool is equal to h. At what distance from the surface of water is the image of the stone formed if the line of vision makes an angle $\theta$with the normal to the surface?

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10. In a river 2m deep a water level measuring post embedded into the river stand vertically with 1 m of if above the water surface.If the angle of inclination of sum above the horizon is 30°, calculate the length of the post on the bottom surface of river , (μ for water = 4/3)

3.44 m

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11. A concave mirror of radius of curvature one meter is placed at the bottom of a tank of water. The mirror forms an image of the sun when it is directly overhead. Calculate the distance of the images from the mirror for (a) $80cm$ and (b) $40cm$ of water in the tank ($\mu = 4/3$ for water)

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12. A small object is placed at the centre of the bottom of a cylindrical vessel of radius 3 cm and height 4 cm filled completely with water. Consider the ray leaving the vessel through a corner. Suppose this ray and the ray along the axis of the vessel are used to trace the image. Find the apparent depth of the image and the ratio of real depth to the apparent depth under the assumptions taken. Refractive index -of water = 1-33.

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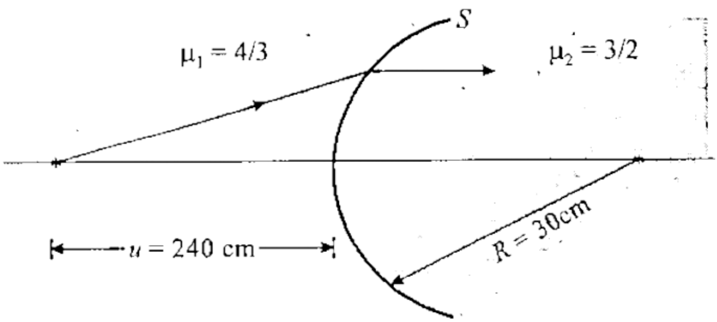
Practive Exercise 5.4

1. A spherical surface S separates two media 1 and 2 as shown in figure .Find where an object O is placed in medium -I so that the light rays from object after refraction becomes parallel to optic of this system



240 cm

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2. A glass sphere of radius 5 cm has a small bubble at a distance 2 cm from its centre. The bubble is viewed along a Diameter of the sphere from the side on which it lies.How far from the surface will it appear.Refractive index of glass is 1.5

2.5 cm behind the surface

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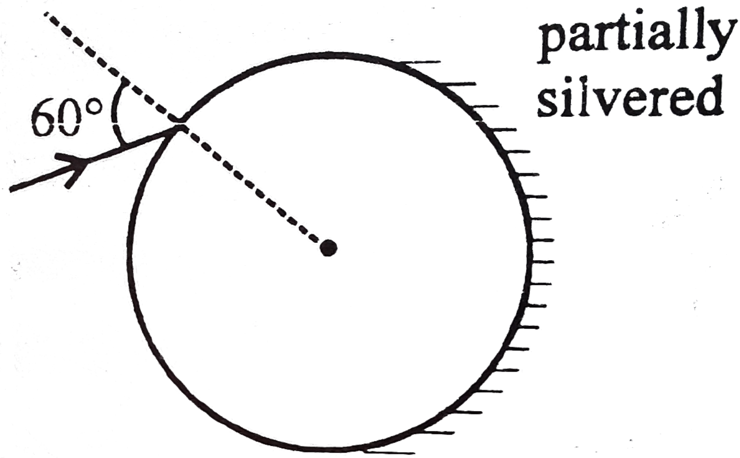
3. A ray is incident on a glass sphere as shown.The opposite surface of the sphere is partially silvered .If the net deviation of the ray transmitted at the partially silvered surface is $1/3^{rd}$ of the net deviation suffered by the ray reflected at the partially silvered surface(after emerging out of the sphere).Find the refractive index of the sphere.



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4. A parallel incident beam falls on a solid glass sphere at near normal incidence.Show that the image in terms of the index of refractive μ and the

sphere of radius R is given by

$$\frac{R(2-\mu)}{2(\mu-1)}$$

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5. A hollow sphere of glass of inner and outer radii R and 2R respectively has a small mark on its inner surface. This mark is observed from a point outside the sphere such that the centre of the sphere lies in between. Prove that the mark will appear nearer than it really it, by a distance $(\mu-1)(R)/(3\mu-1)$

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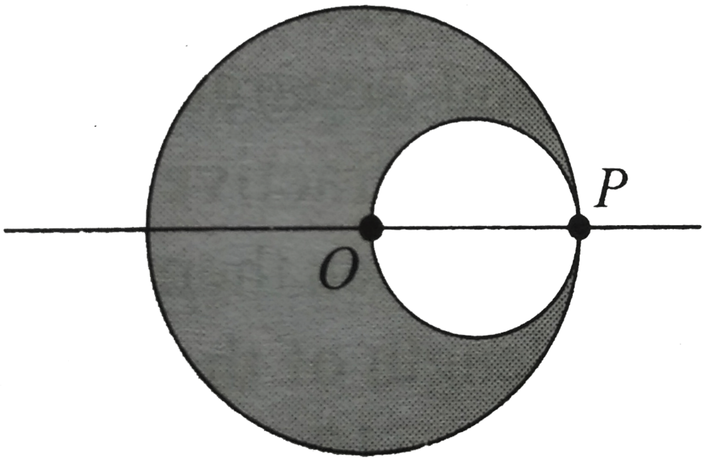
6. A transparent sphere of radius R ahs a cavity of radius $R/2$ as shown in figure,. Find the refractive index of the sphere if a parallel beam of light falling on left sureface focuses at point P.



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7. A ray incident at a point at an angle of incidence of 60° enters a glass sphere with refractive index $\sqrt{3}$ and it is reflected and refracted at the farther surface of the sphere. The angle between the reflected and refracted rays at this surface is:

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8. A glass sphere$(\mu = 1.5)$ with a radius of 15.9 cm has a tiny air bubble 5 cm its centre.This sphere is viewed looking down along the extended radius containing the bubble.What is the apparent depth of the bubble below the sirface of the sphere ?

8.57 cm from top

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9. A vertical beam of light of cross sectional radius $\frac{R}{2}$ is incident symmetrically on the curved surface of a glass hemisphere of refractive index $\mu = \frac{3}{2}$. Radius of the hemisphere is R and its base is on a horizontal table. Find the radius of luminous spot formed on the table. $\sin 20^\circ = \frac{1}{3}$ and $\sin 80^\circ = 0.98$

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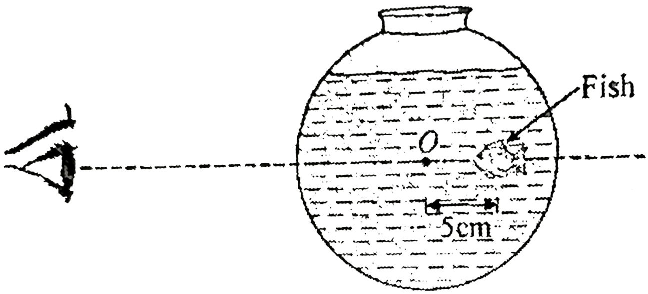
10. Figure shows a fish bowl of radius 10 cm in which along a diametrical line a fish F is moving at speed 2 mm/sec. Find the speed of fish as observed by an observer from outside along same line when fish is at a distance 5 cm from the centre of bowl to right of it as shown in figure



3.84 mm/s

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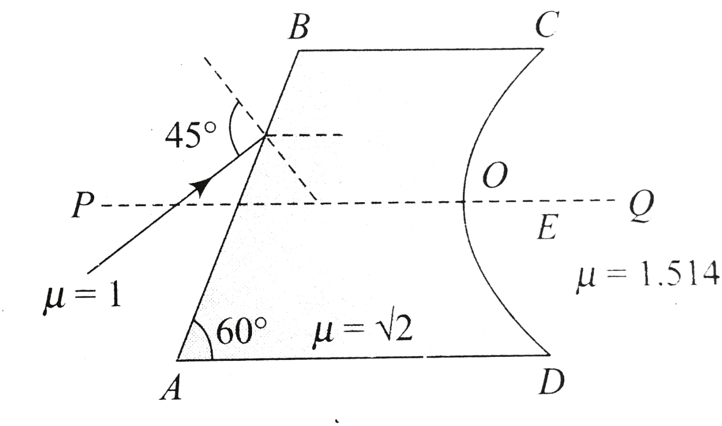
11. Figure shows an irregular block of material of refractive indec $\sqrt{2}$. A ray of light strikes the face AB as shown. After refraction, it is incident on a spherical surface CD of radius of curvature 0.4 m and enters a medium of refractive index 1.514 to meet PQ at E. Find the distance OE up to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



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Practive Exercise 5.5

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

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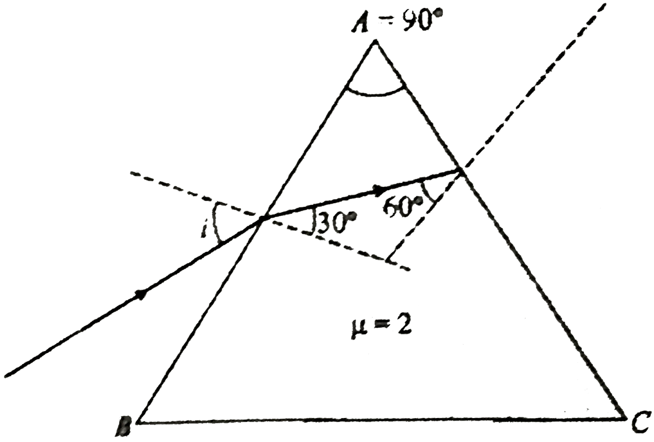
2. In figure shown find the angle of incidence of the light ray on face AB of the prism for which light will reach face AC at incidence angle 60°.



$[90^\circ]$

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3. 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, determine 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.

$$\left[y = \frac{x^2}{4}\right]$$

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4. A point source of light is placed directly below the surface of a lake at a distance h from the surface. Find the area surface of a lake at a distance h from the surface. Find the area on water

from which the light will come out from water.

$$\left[\frac{\pi h^2}{(\mu^2 - 1)}\right]$$

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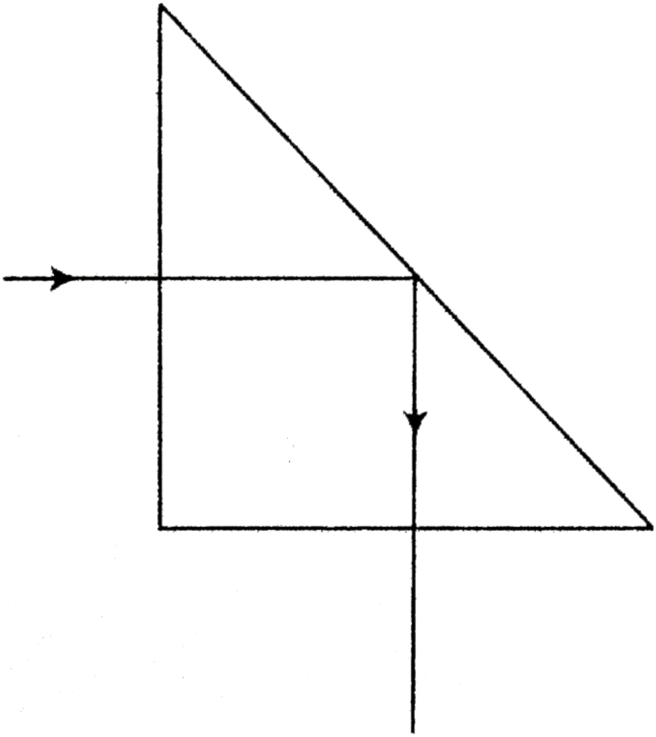
5. A ray of light incident normally on one of the faces of a right-angle isosceles prism is found to be totally reflected as shown in the figure. What is the minimum value of the refractive index of the material of the prism? When the prism is immersed in water, trace the path of the emergent ray for the same incident ray, indicating the values of all the angles $(\mu_{\omega} = 4/3)$.



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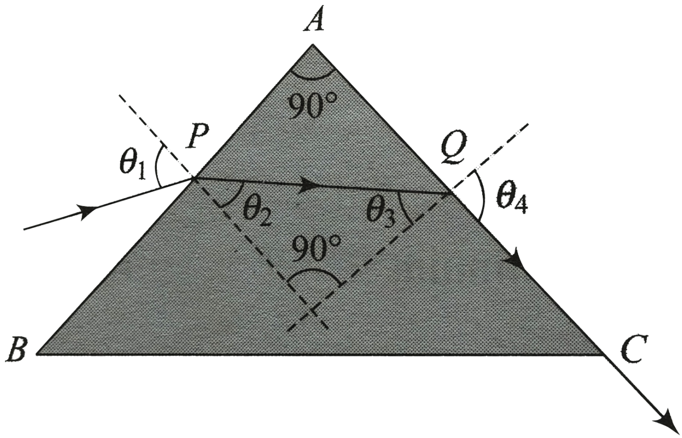
6. Figure.. Shows a triangular prism of refracting angle 90° . A ray of light incident at face AB at an angle θ_1, refracts at point Q with an angle of refraction 90°.

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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7. On one face of an equilateral prism a light rays strikes normally. If its $\mu = \frac{3}{2}$, find the angle between incident ray and the ray that leaves the prism.

$[60^\circ]$

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8. A light ray composed of two monochromatic components passes through a trihedral prism with refracting angle $\theta = 60^\circ$. Find the angle $\Delta\alpha$ between the components of the ray after its passage through the prism if their respective indies of refraction are equal to 1.515 and 1.520. the prism is oriented to provide the least deflection angle.

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9. A parallel beam of light falls normally on the first face of a prism of small angle .At the second face it is partly reflected,the reflected beam striking at the first face again, and emerging from it in a direction making an angle 6° 30' with the reversed direction of the incident beam. The refracted beam is found to have undergone a deviation of $1^{\circ}15'$ from the original direction.Find the refractive index of the glass and the angle of the prism.

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

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11. The refracting angle of a glass prism is 30°. A ray is incident onto one of the faces perpendicular to it. Find the angle δ between the incident ray and the ray that leaves the prism. The refractive index of glass is $\mu = 1.5$.

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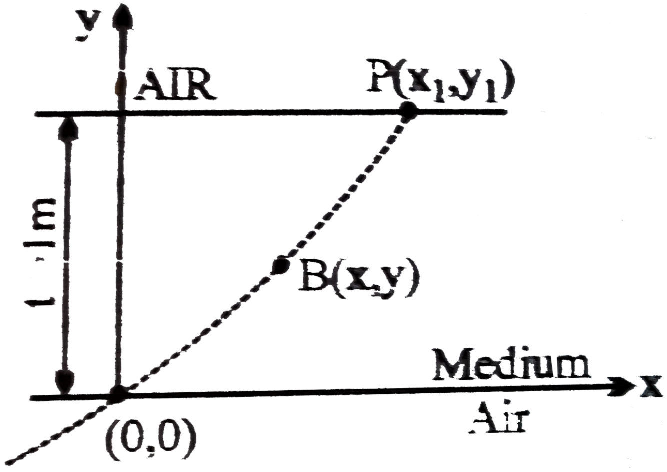
12. A ray of light travelling in air is incident at grazing angle (incident angle=90°) on a long rectangular slab of a transparent medium of thickness $t = 1.0$ (see figure). The point of incidence is the origin $A(O, O)$ .The medium has a variable index of refraction n(y) given by : $n(y) = \left[ky^{3/2}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

Watch Video Solution

Practive Exercise 5.6

1. A point source of light is kept at a distance of $15cm$ from a converging lens,on its optical axis.The focal length of the lens is $10cm$ and its diameter is $3cm$,A screen is placed on the other side of the lens ,perpendicular to the axis of lens,at a distance $20cm$ from it.Then find the area of the illuminated part of the screen?

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2. A 5.0 diopter lens forms a virtual image which is 4 times the object placed perpendicularly on the principal axis of the lens. Find the distance of the object from the lens.

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3. A point object is placed at a distance of 25 cm from a convex lens of focal length 20cm. 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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4. A convex lens of focal length 20 cm and a concave lens of focal length 10 cm are placed 10 cm apart with their principal axes coinciding. A beam of light travelling parallel to the principal axis and having a beam diameter 5.0 mm, is incident on the combination. Show that the emergent beam is parallel to the incident one. Find the beam diameter of the emergent beam.

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5. 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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6. A converging lens of focal length 20cm is separated 8 cm from a diverging lens of focal length 30 cm. A parallel beam of light falls on converging lens and after passing through diverging lens focussed at point P. Find the location of point P. Repeat the calculation for the case when the parallel beam first falls on diverging lens.

[4.2 cm from convex lens]

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7. Two symmetric double convex lenses A and B have same focal length but the radii of curvature differ so that $R_A = 0.9R_B$. If refractive index of A is 1.63 find the refractive index of B.

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8. An object is placed at 20 cm left of the convex lens of focal length 10 cm. If a concave mirror of focal length 5 cm is placed at 30 cm to the right of the lens, find the magnification and the nature of the final image. Draw the ray diagram and locate the position of the final image.

[At the object and of same size]

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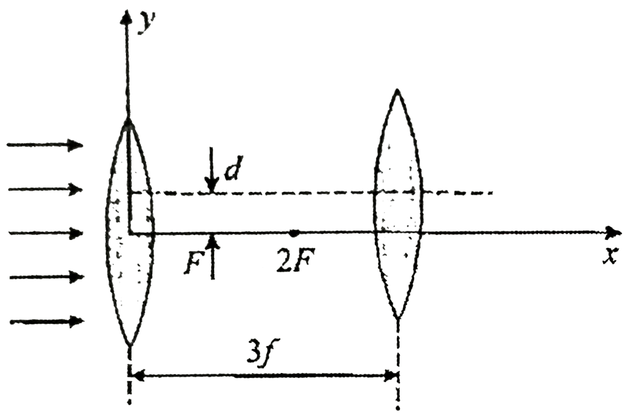
9. In the figure- it is shown,the focal length f of the two thin convex lenses is the same. They are separated by a horizontal distance 3f and their optical axes are displaced by a vertical separation $'d'(d << f)$ as shown. Taking the origin of coordinates O at the centre of the first lens , find the x and y coordinates of the point where aparallel beam of rays coming from the left finally gets focussed ?

((5f, 2d)]



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10. 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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11. A small pin of size 5 mm is placed along principal axis of a convex lens of focal length 6cm at a distance 11cm from the lens. Find the size of image of pin.

[7.2 mm]

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12. 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

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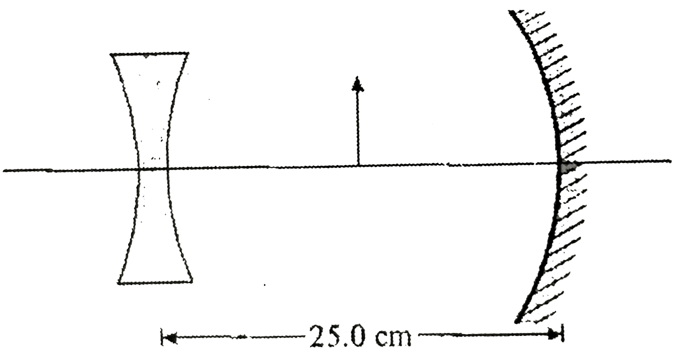
13. An object is placed midway between the lens and the mirror as shown in figure. The mirror's radius of curvature is 20.0 cm and the lens has a focal length of - 16.7 cm. Considering only the rays that leaves the object and travels first toward the mirror, locate the final image formed by this system. Is this image real or virtual ? Is it up right or inverted ? What is the over all magnification ?

[25.3 cm from mirror, virtual, erected, 8.048]



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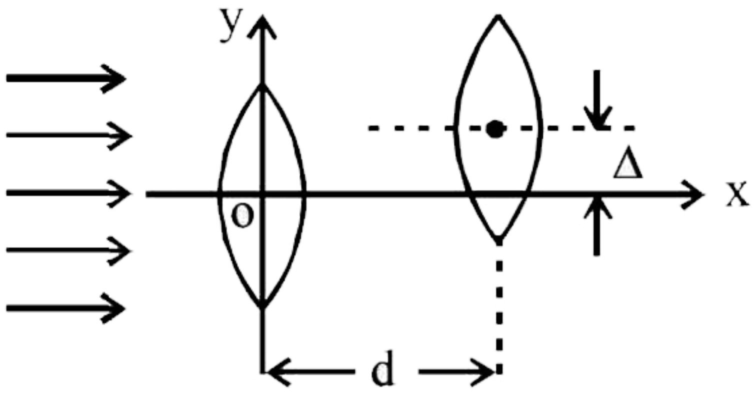
14. Two thin convex lenses of focal lengths f_1 and f_2 are separated by a horizontal distance d (where $d < f_1$,$d < f_2$) and their centres are displaced by a vertical separation $\triangle$ as shown in the fig.

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: `



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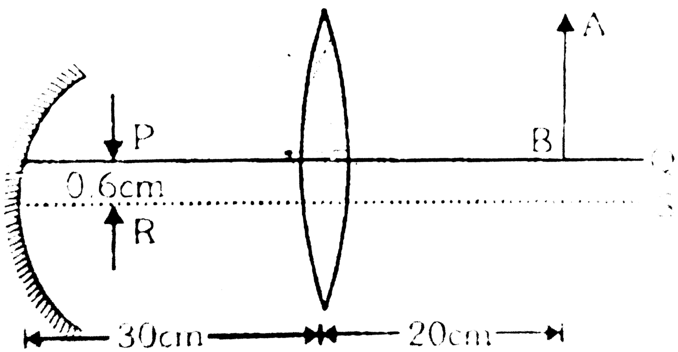
15. A convex lens of focal length 15 cm and a concave mirror of focal length 30 cm are kept with their optic axis PQ and RS parallel but separated in vertical directiion by 0.6 cm as shown . The distance between the lens and mirror is 30 cm . An upright object AB of height 1.2 cm is placed on the optic 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 the reflectiion 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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16. A convex lens of focal length $15cm$ is placed in front of a convex mirror. Both are coaxial and the lens is $5cm$ from the apex of the mirror. When an object is placed on the axis at a distance of $20cm$ from the lens, its is found that image coincides with the object. Calculate the radius of curvature of mirror.

[55cm]

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Practive Exercise 5.7

1. A thin lens of focal length $+10.0cm$ lies on a horizontal plane mirror. How far above the lens should an object be held if its image is to coincide with the object?

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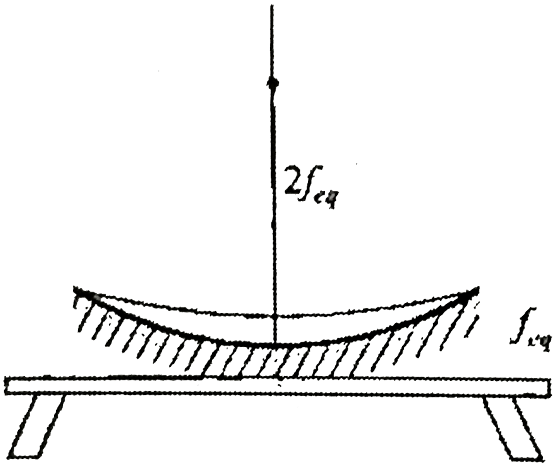
2. A concave-convex lens is placed on a horizontal table with its convex surface polished to make it reflecting as shown in figure. If radii of curvature of its two surfaces are 30 cm and 60 cm respectively find the position on its principal axis where a point object should be placed to obtain its image on

itself. $\left(\mu_{\text{lens}} = \frac{3}{2}\right)$



[24]

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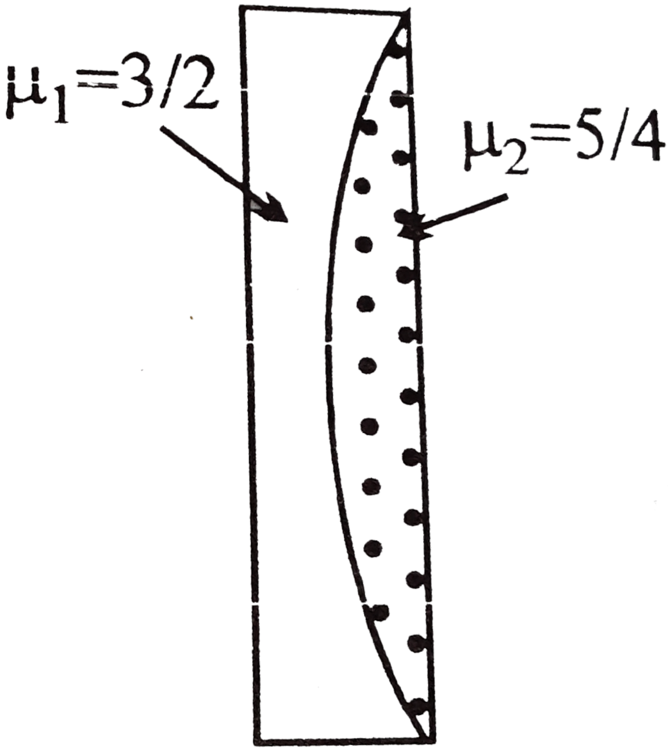
3. A thin plano-convax lens fits exactly into a plano concave lens with their plane surface parallel to each other as shown in the figure.the radius of the curvature of the curved surface $R = 30cm$ The lens are made of different material having refractive index$\mu_1 = \frac{3}{2}$and $\mu_2 = \frac{5}{4}$as shown in the figure



(i) if plane surface of the plano -convex lens is silvered,then calculate the equivalent focal length of this system and also calculate the nature of this equivalent mirror .

(ii) An object having transverse length $5cm$is placed on the axis of equivalent mirror(in part1) $atadis\tan ce$15cm` from the equivalent mirror along principal axis.Find the transverse magnification produced by equivalents mirror.

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4. Two identical thin converging lenses are kept in contact at a distance 12.5 cm from an object. If image produced is 4 times enlarged then what is the optical power of each lens.

$[5D]$

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5. A object is placed at a distance of 20 cm to the left of and on the axis of a convex lens L_1 of focal length 25 cm. A second convex lens L_2 of focal length 20 cm is placed coaxially to the right of the lens L_1 at a distance of 10 cm from L_1. Find the position of the image and its magnification.

$$\left[24.4cm, \frac{10}{9}\right]$$

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6. When a lens is inserted between an object and a screen which are fixed distance apart the size of the image is either 6 cm or $\frac{2}{3}cm$. Find size of the object

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7. A point source of light S is placed at the bottom of a vessel containing a liquid of refractive index $5/3$. A person is viewing the source from above the surface. There is an opaque disc of radius $1cm$ floating on the surface. The centre of disc lies

vertically above the source O. The liquid from the vessel is gradually drained out through a tap. What is the maximum height of the liquid for which the source cannot be seen at all.

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Practive Exercise 5.8

1. 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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2. The index of refraction of heavy flint glass is 1.68 at $434nm$ and 1.65 at $671nm$. Calculate the difference in the angle of deviation of blue $(434nm)$ and red $(671nm)$ light incident at 65° on one side of a heavy flint glass prism with apex angle 60°.

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3. The dispersive powers of crown and flint glasses are 0.03 and 0.05 respectively. The refractive indices for yellow light for these glasses are 1.517 and 1.621 respectively. It is desired to form an achromatic combination of prism of crown and flint glasses which can produce a deviation of 1° in the yellow ray. Find the refracting angles of the two prisms needed.

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4. A crown glass prism of angle of 5° is to be combined with a flint glass 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 combination when white light goes through it. Refractive indices for red, yellow and violet light are 1.514, 1.517 and 1.523 respectively for crown glass and 1.613, 1.620 and 1.632 for flint glass.

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5. The prism of a spectrometer has a refracting angle 60° and is made of glass whose refractive indices for red and violet are respectively 1.514 and

1.530.A while source is used and the instrument is set to give minimum deviation for red and the. Determine (a) angle of incidence, (b) the angle of the emergence for violet light and (c) the angular width of spectrum

$49^{\circ} 12', (b) 50^{\circ} 38', (c) 1^{\circ} 26$

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6. An equiconvex lens of crown glass abd an equiconvex lens of flint glass make an achromatic system.The radius of curvature of convex lens is 0.54 m. If the focal length of the combination for the mean colour is 1.54m and the refractive indices for crown glass are $\mu_R = 1.53$ and $\mu_V = 1.55$, find the dispersive power of the flint glass

0.055

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7. An achromatic lens -double is formed by in contact a convex lens of focal length 20 cm amd a concave lens of focal length 30 cm.The dispersive of the meterial of the convex lens is 0.18

(a) Determine the dispersive power of the meterial of the concave lens

(b) Calculate the focal of the lens-doublet

0.27 (b) 60 cm

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Practive Exercise 5.9

1. A projector lens has a focal length 10 cm.It throws an image of a $2cm \times 2cm$ slide on a screen 5 mater from the lens.Find (i) the size of the screen and (ii) the ratio of illumination of the slide and of the picture on the screen

2401

2. The focal length of the objective of a microscope is $\int_0 = 3mm$ and of the eyepiece $\int_e = 5cm.$ An object the magnification of the microscope of 3.1 mm from the objective.Find the magnification of the microscope for a normal eye, if the final image is produced at a distance 25 cm from the eye or eyepiece .Also final the separation between the lenses of microscope

180 13.46 cm

3. The optical powers of the objective and the ocular of a microscope are equal to 100 and $20D$ respectively. The microscope magnification is equal to 50. What will the magnification o fthe microscope be when the distance between the objected and the ocaular is increased by $2.0cm$?

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

$25 cm$ from eye of the observer. Calculate the length of the telescope.

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5. The eyepiece and objective of a miroscope, of focal length 0.3 m and 0.4m respectively, are seprarated by a distence of 0.2 m The eyepiece and the objective are to be interchanged such that the angular magnification of the instrument remains sane.What is the new separation between the lenses ?

0.2575 m

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Discussion Question

1. What is the function of the circular stop at the focal plane of the objective of a telescope? Givereasons.

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2. A beam of white lighe passing through a hollow prism gives no spectrum.

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3. The magnifying power of a telescope in normal adjustment is greater than that when it is focussed for least distance ofdistinct vision. Is this true or false? Give reasons.

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4. Can you think of a specific optical set up with a trihedral prism (no other device)in which a light ray passes undeviated through theprism. Think and draw the ray diagram.

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5. Can a real image be taken on a screen ?

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6. Can you obtain image produced by a convexlens on a screen without using any other device.

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7. It is difficult to thread a needle with one eye closed. Why?

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8. If a single lens isused to form an image, it is better to use a lens of large diameter, in which the outer parts near the rim are blocked off. Explain.

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9. What is the best position of the eye for viewing an object through a microscope?

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10. Can the optical length between two points everbeless than the geometrical path between these points?

Watch Video Solution

11. Can two lenses of the same material produce achromatism when placed in contact? Explain.

Watch Video Solution

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

Watch Video Solution

13. A iiver inside the sea observes a ship on the water surface. Does he finds the ship taller or smaller then its actual height above the water surface. Give reason and draw ray diagram to support your logic.

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14. Why does the moon, purely white during the day, have a yellowish hue after sunset ?

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15. How focal length of a spherical mirror changes when placed in different media.

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16. An air bubble inside water broadly behaves as a concave lens. Is the true or false.

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17. Why does an aeroplane flying at a great altitude not cast a shadow on the earth ?

Watch Video Solution

18. The magnifying power of a telescope in normal adjustment is greater than that when it is focussed for least distance ofdistinct vision. Is this true or false? Give reasons.

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19. When sun rays pass through a small hole in the foliage at the top of a high tree, they produce an elliptical spot of light on the ground. Explain why. When will the spot be a circle?

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20. If a mirror reverses right and left, why doesn't it reverse up and down?

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21. Is it possible to photograph a virtual image?

Watch Video Solution

22. Is it possible for a given lens to act as a converging lens in one medium, and as a diverging lens in another?

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23. A camera lens is marked $f/1.8$. What is the meaning of this mark?

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24. Some motor cars have additional yellow headlights. Why?

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25. Why are lenses often coated with thin films of transparent material ?

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26. If these are scratches on the lens of a camera, they do not appear on a photograph taken with the camera. Explain. Do the scratches affect the photograph at all ?

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27. The sun seems to rise before it actually rises and it seems to set long after it actually sets. Explain why.

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28. Does the focal length ofa lens depend on the medium in which the lens is immersed? Is it possible for a lens to act as aconverging lens in one medium and a diverging lens in another medium?

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29. Explain why the use of goggles enables an underwater swimmer to see clearly under the surface of a lake.

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Conceptual MCQs Single Option Correct

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

A. $\dfrac{d-b}{d-c-b+a}$

B. $\dfrac{d-c-b+a}{d-b}$

C. $\dfrac{b-d}{d-c-b+a}$

D. $\dfrac{d-c-b+a}{b-d}$

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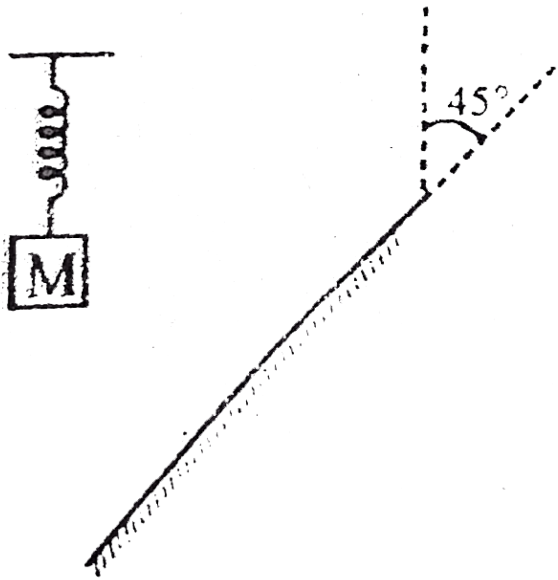
2. An insect of negligible mass is sitting on a block of mass M, tied with a spring of force constant K. The block performs simple harmonic motion with amplitude A infront of a plane mirror placed as shown. The maximum speed of insect relative to its image will be



A. $A\sqrt{\frac{k}{M}}$

B. $\frac{A\sqrt{3}}{2}\sqrt{\frac{k}{M}}$

C. $a\sqrt{3}\sqrt{\frac{k}{M}}$

D. $2A\sqrt{\frac{M}{k}}$

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3. Inside a solid glass sphere of radius R, a point source of light lies at a distance $x(x < R)$ from centre of the sphere. The solid is surrounded by air of refractive index 1. The maximum angle of incidence for rays incident on the spherical glass air interface directly from the point soure is:

A. $\cos^{-1}.\ \frac{x}{R}$

B. $\sin^{-1}.\ \frac{x}{(R)}$

C. $\cos^{-1}\sqrt{\frac{x}{R}}$

D. $\sin^{-1}\sqrt{\frac{x}{R}}$

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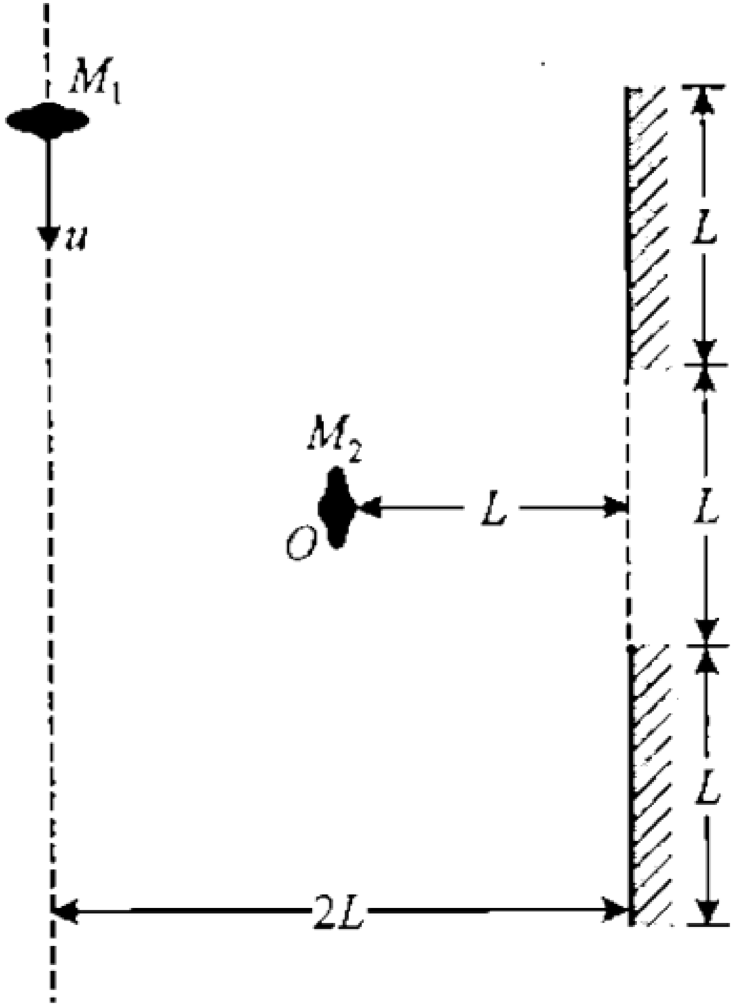
4. Two plane mirrors of length L are separated by distance L and a man M_2 is standing at distance L from the connecting line of mirrors as shown in figure. A man M_1 , is walking in a straight line at distance 2 L parallel to mirrors at speed u,then man at O will be able to see image of M_1 ,for total time:



A. $\frac{4L}{u}$

B. $\frac{3L}{u}$

C. $\frac{6L}{u}$

D. $\frac{9L}{u}$

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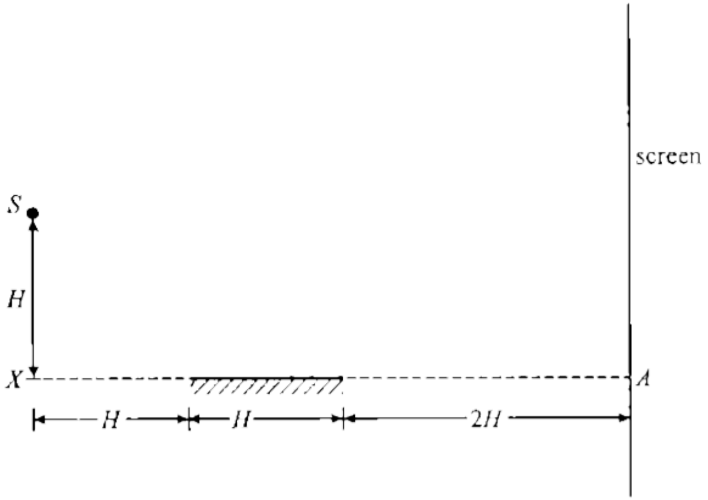
5. A point source has been placed as shown in the figure-. What is the length on the screen that will receive reflected light from the mirror ?



A. 2 H

B. 3 H

C. H

D. None of these

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

A. $f/2, I/2$

B. $f, I/4$

C. $2f/4, I/2$

D. $f, 3I/4$

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7. A ray of light falls on a plane mirror. When the mirror is turned, about an axis at right angles to the plane of mirror by 20° the angle between the incident ray and new reflected ray is 45°. The angle between the incident ray and original reflected ray was therefore.

A. 65°

B. 25°

C. 25° and 65°

D. 45°

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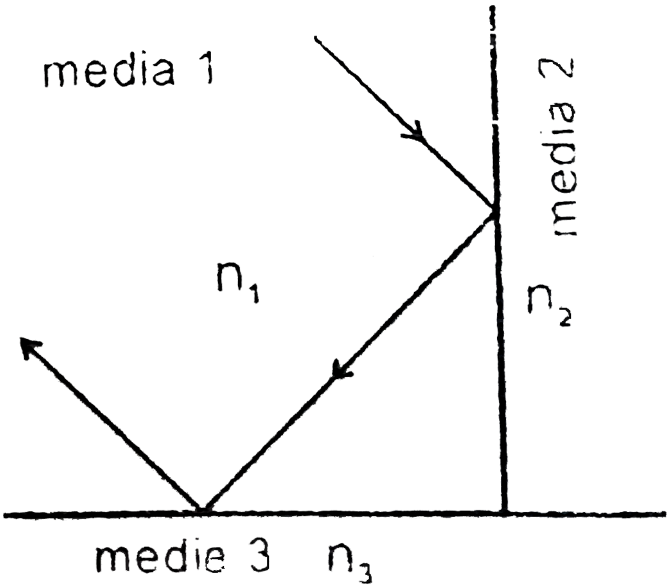
8. In the diagram shown, light is incident on the interface between media 1 (refractive index n_1) and 2 (refractive index n_2) at angle slightly greater than the critical angle, and is totally reflected. The light is then also totally reflected at the interface between media 1 and 3 (refractive index n_3), after which it travels in a direction opposite to its initial direction, The media must have a refractive indices

such that.



A. $\mu_1 - \mu_2 > \mu_3$

B. $\mu_1^2 - \mu_2^3 > \mu_2^2$

C. $\mu_1^2 - \mu_2^2 > \mu_3^2$

D. $\mu_1^2 + \mu_2^2 > \mu_3^2$

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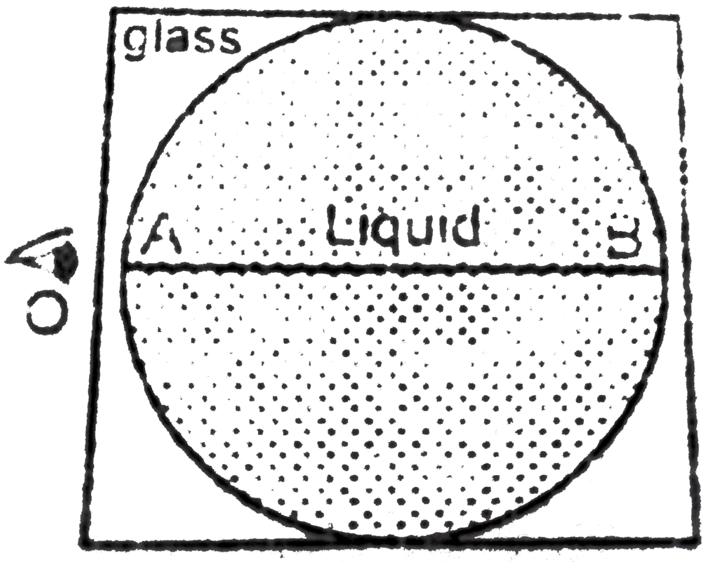
9. The observer 'O' sees the distance AB as infinitely large. If refractive index of liquid is μ_1 and that of glass is μ_2, then $\frac{\mu_1}{\mu_2}$ is :



A. 2

B. 43467

C. 4

D. None of these

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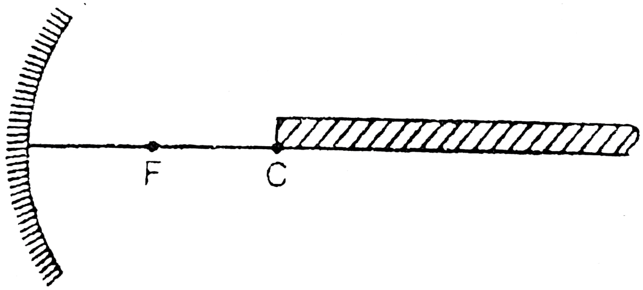
10. An infinitely long reactangular strip is placed on principal axis of a concave mirror as shown in figure. One end of the strip coincides with centre of curvature as shown. The hright of rectangular strip is very small in comparison to focal length of the mirror. Then the shape of image of strip formed by concave mirror is



A. Rectangle

B. Trapezium

C. Triangle

D. Square

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11. A concave spherical surface of radius of curvature $10cm$ separates two mediums X and Y of refractive indices $4/3$ and $3/2$ respectively. Centre of curvature of the surfaces lies in the medium X. An object is placed in medium X.

A. Image is always real

B. Image is real if the object distance is greater than 90cm

C. Image is always virtual

D. Image is virtual only if the object distance is less than 90cm

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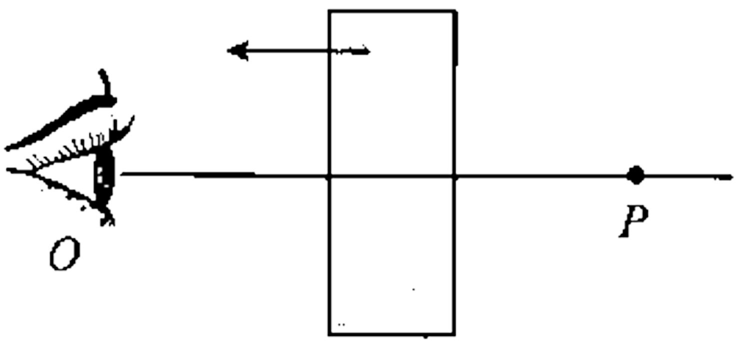
12. In the figure. shown- a slab of refractive index $\frac{3}{2}$ is movedat speed 1m/s towards a stationary observer. A point 'P' is observed by the observer with the help of paraxial rays through the slab. Both 'O' and observer lie in air. The velocity with which the image will moveis:



A. 2 m/s towards left

B. $\frac{4}{3}$ m/s towards left

C. 3 m/s towards left

D. Zero

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13. Light passes from air into flint glass with index of refraction n. The angle of incidence must the light have forthe component of its velocity perpendicular to the interface to remain same in both mediums is:

A. $\sin^{-1} n$

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

C. $\cos^{-1} n$

D. $\tan^{-1} n$

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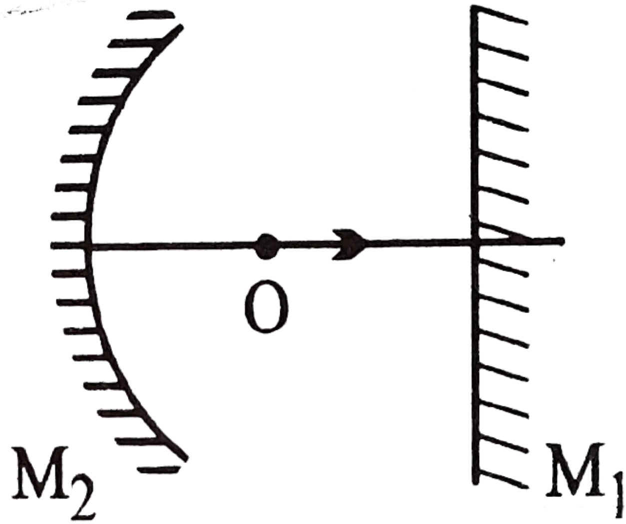
14. In the figure shown If the object O moves towards the palne mirror ,then the image I(which is formed after successive reflections from M_1, M_2

respectively will move:



A. Always towards right

B. Always towards left

C. Depends onposition of O

D. Cannot be determined

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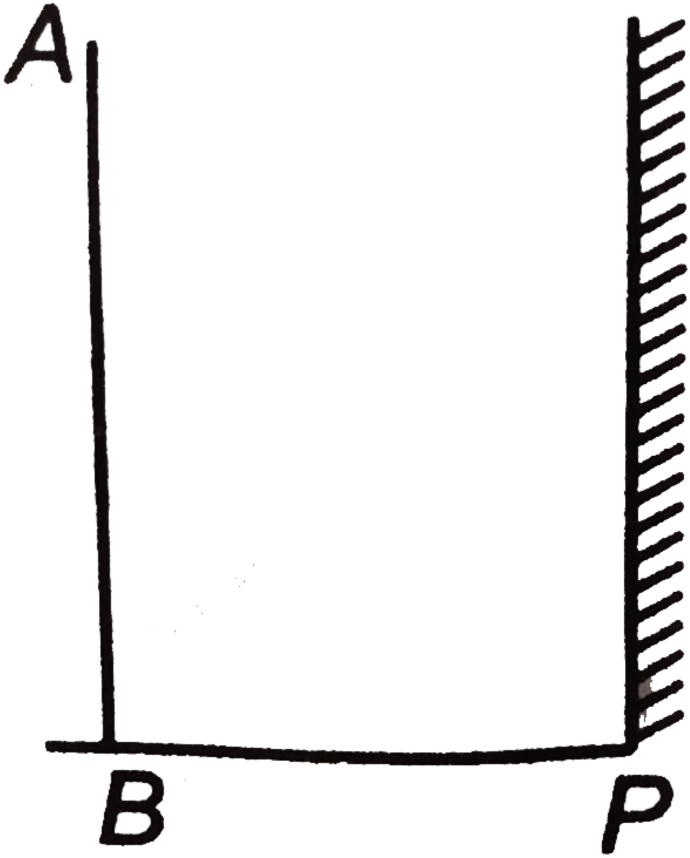
15. A person AB of height 170 cm is standing in front of a plane mirror. His eyes are at height 164 cm. At what distance from P should a hole be made in mirror so that he cannot see his hair?



A. 167cm

B. 161cm

C. 163cm

D. None of these

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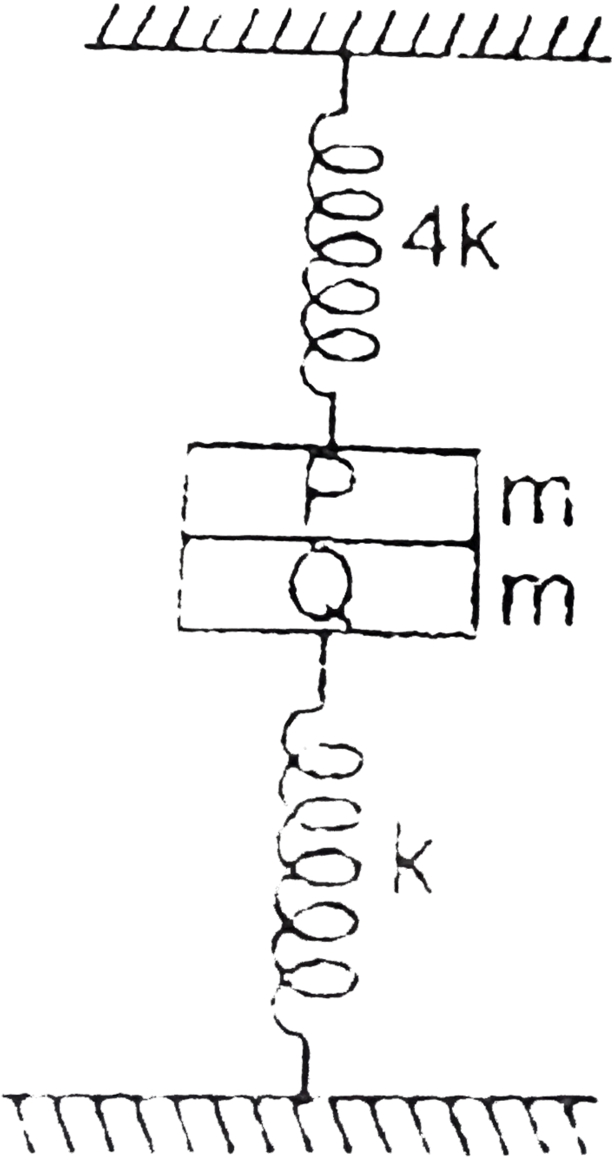
16. In the figure shown, blocks P and Q are in contact but do not stick to each other. The lower face of P behaves as a plane mirror. The springs are in their natural lengths. The system is released from rest. Then the distance between P and Q

when Q is at the lowest point first time will be



A. $\frac{2mg}{K}$

B. $\frac{4mg}{K}$

C. $\frac{3mg}{K}$

D. 0

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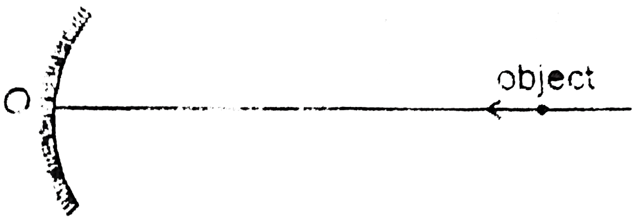
17. A point object is moving along principal axis of concave mirror with uniform velocity towards pole. Initially the object is at infinite distance from pole right side of the mirror as shown. Before the object collides with mirror, the number of times a which the distance between object and its image is $40cm$

are.



A. One time

B. Two times

C. Three times

D. Data insufficient

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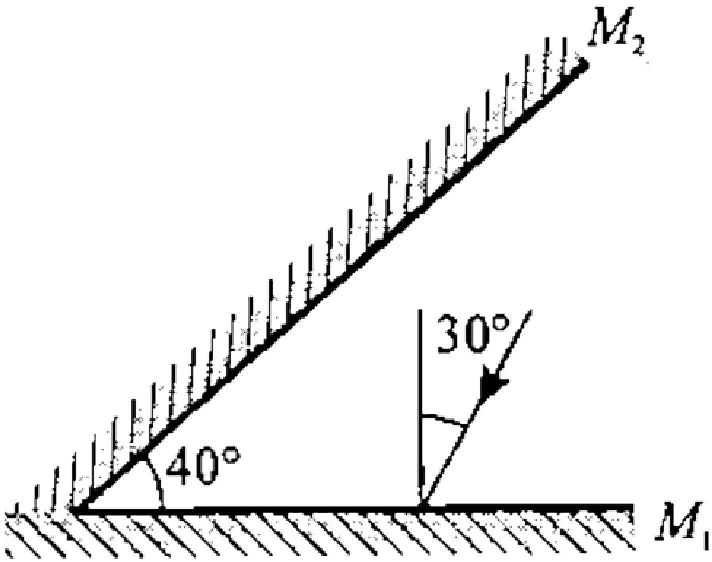
18. In the figure shown-, the maximum number of reflections light rays will undergo are:



A. 2

B. 3

C. 4

D. 1

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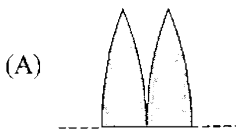
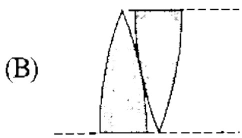
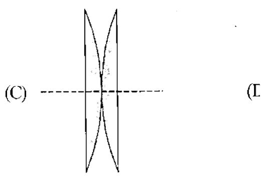
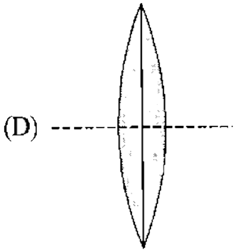
19. A convex lens is cut into twoparts in different ways that arearranged in four manners, as shown. Which arrangement will give maximum optical power?

A. 

B. 

C. 

D. 

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20. A parallel beam of light passes parallel to the principal axis and falls on one face of a thin convex lens offocal length f and after two internal reflections from the second face forms a real image. The distance of image from lens if the reflactive index of material of lens is 1.5 :

A. $f/7$

B. $f/2$

C. 7f

D. None of these

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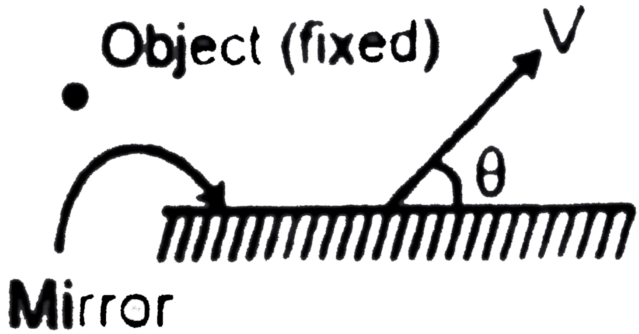
21. An object and a plane mirror are shown in figure. Mirror is moved with velocity V as shown.

The velocity of image is :



A. $2V \sin \theta$

B. 2V

C. $2V \cos \theta$

D. None of these

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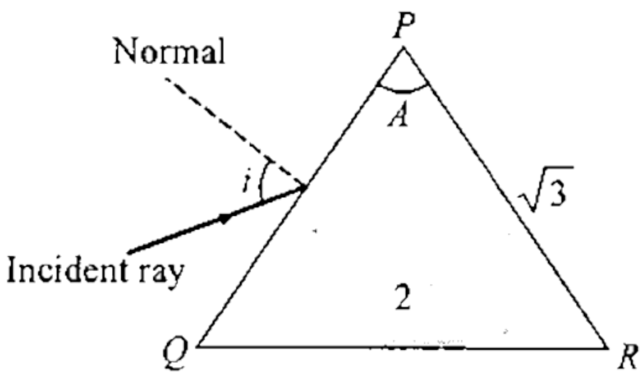
22. A prism of angle A and refractive index 2 is surrounded by medium of refractive index $\sqrt{3}$. A ray is incident on side PQ at an angle of incidence $i(0 \leq i \leq 90^{\circ})$ as shown in the figure-. The refracted ray is then incident on side PR of prism. The minimum angle A of prism for which ray incident on side PQ does not emerge out of prism from side PR (for any value of i) is:



A. 30°

B. 45°

C. 60°

D. 120°

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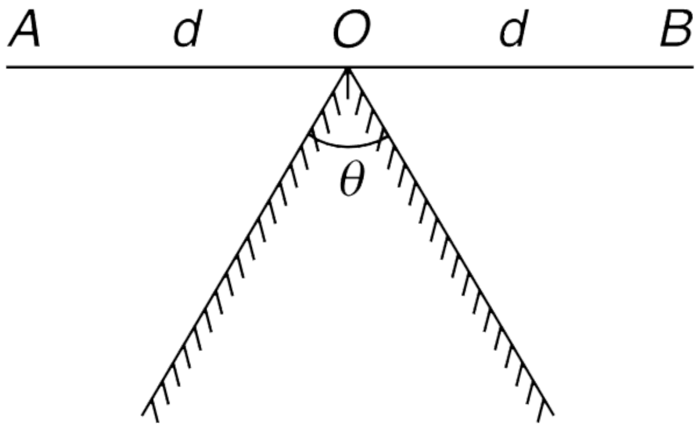
23. Two plane mirrors are joined together as shown. Two point objects A and B are placed symmetrically such that $OA = OB = d$. [AOB is a straight line]

(a) If the images of A and B coincide find θ (call it θ_0).

(b) Keeping the position of objects unchanged the angle between the two mirrors is increased to $\theta = \frac{4}{3}\theta_0$. Now find the distance between the images of A and B.



A. $\theta = 60^\circ$

B. $\theta = 90^\circ$

C. $\theta = 30^\circ$

D. $\theta = 45^\circ$

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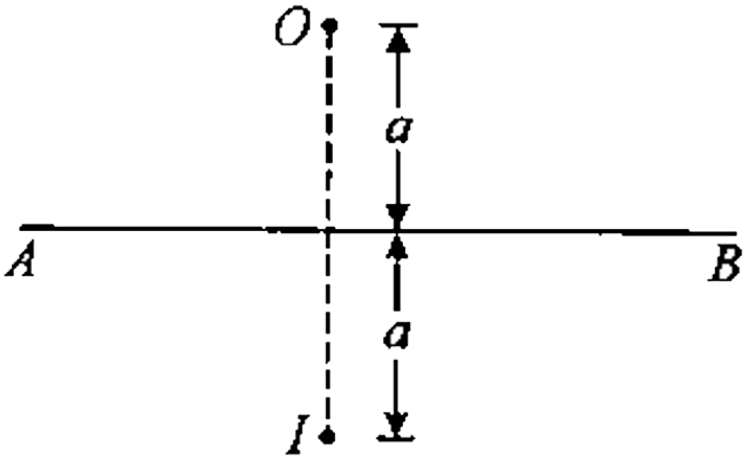
24. The position of a real point object and its point image are as shown in the figure-. AB is the principal axis. This can be achieved by using :



A. Convex mirror

B. Concave mirror

C. Plane mirror only

D. Convex mirror only

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25. The image of the moon is produced bya convex lens of focal length f. The area of image is directly proportional to:

A. f

B. f^2

C. $1/f$

D. $1/f^2$

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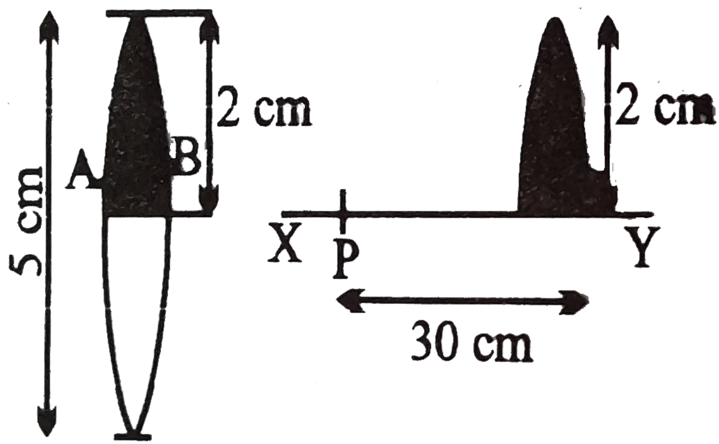
26. A converging lens of focal length $20 cm$and diameter$5 cm$is cut along the lineAB.The part of the lens shown shaded in the diagram is now used to form an image of a point Pplaced $30 cm$away from it on the lineXY.Which id perpendicualr to the plane of the lens.The image of$P$will be formed.



A. 0.5 cm above XY

B. 1 cm below XY

C. on XY

D. 1.5 cm below XY

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27. A man stands on a glass slab of height h and inside an elevator accelerated upwards with 'a'. μ_g If is refractive index of glass then the bottom of the slab appears to have shifted with respect to the man by a distance ,

A. less then h / μ_g

B. greater than h / μ_g

C. equal to h / μ_g

D. can't be said

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28. When an object is at a distance u_1 and u_2 from the optical centre of a lens, a real and virtual image are formed respectively, with the same magnification.The focal length of lens is:

A. $(u_1 + u_2)$

B. $u_1 + \frac{u_2}{2}$

C. $\frac{u_1 + u_2}{2}$

D. $\frac{u_1 - u_2}{2}$

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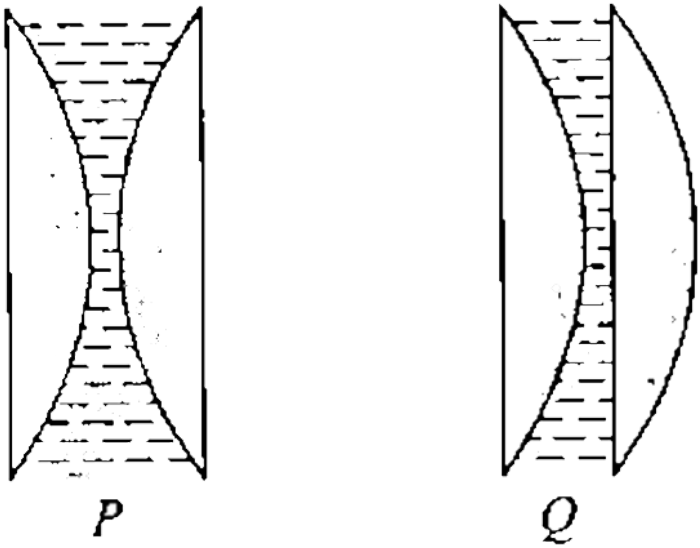
29. A liquid of refractive index 1.33 is placed between two identical plano-convex lenses, with refractive index 1.50. Two possible arrangement P and Q are shown in figure-. The system is:



A. Divergentin P, convergent in Q

B. Convergentin P, divergent in 2

C. Convergent in both

D. Divergent in both

Answer: C

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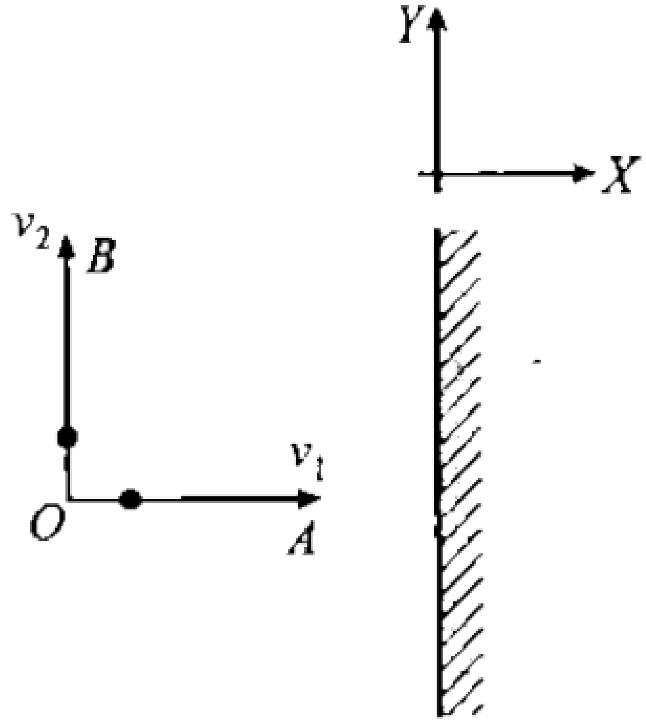
30. Two particles A & B of mass m_1 and m_2 respectively start moving from O with speeds v_1, and v_2. A moves towards the plane mirror and B moves parallel to mirror horizontally. The mirror is in y-z plane. The absolute-speed of image of centre of mass of the system (image of A + image of B)is:



A. Zero

B. $\dfrac{m_1 m_2}{m_1}$

C. $\dfrac{m_2 m_2}{m_1}$

D. None of these

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31. 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. $\frac{3g}{4}$

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

D. None of these

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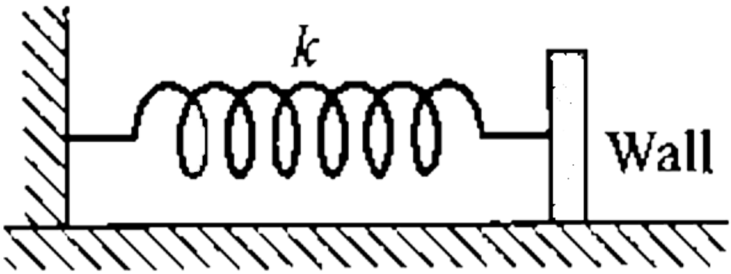
32. A plane mirror having a mass m is tied to the free end of a mass less spring of spring constant k. The other end of the spring is attached to a wall. The spring with the mirror held vertically to the floor on which it can slide smoothly. When the spring is at its natural length, the mirror is found to be moving at a speed of v cm/s. The separation between the images of a man standing before the mirror, when the mirror is in its extreme positions:



A. $v\sqrt{\frac{m}{k}}$

B. $\frac{v}{2}\sqrt{\frac{m}{k}}$

C. $2v\sqrt{\frac{m}{k}}$

D. $4v\sqrt{\frac{m}{k}}$

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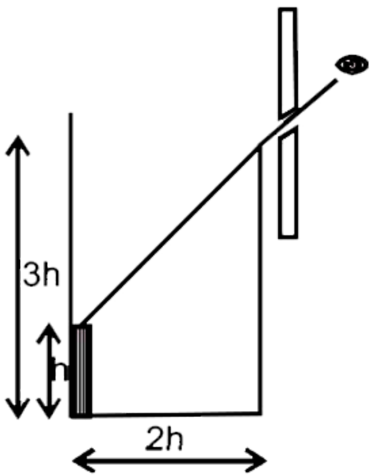
33. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is



A. $5/2$

B. $\sqrt{5/2}$

C. $\sqrt{3/2}$

D. $3/2$

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34. A ray of light is incident on the left vertical face of glass cube of refractive index n_2, as shown in figure. The plane of incidence is the plane of the page, and the cube is surrounded by liquid (refractive index $= n_1$). What is the largest angle of incidence θ_1 for which total internal reflection occurs at the top surfaces?

A. sin 1 = $\sqrt{\left(\frac{\mu_2}{\mu_1}\right)^2 - 1}$

B. sin 1 = $\sqrt{\left(\frac{\mu_2}{\mu_1}\right)^2 + 1}$

C. sin 1 = $\sqrt{\left(\frac{\mu_1}{\mu_2}\right)^2 + 1}$

D. sin 1 = $\sqrt{\left(\frac{\mu_1}{\mu_2}\right)^{2.} + 1}$

35. Two plane mirrors are inclined to each other at an angle θ. A ray of light is reflected at one mirror and then at the other. Find the total deviation of the ray.

A. $360^\circ = 2\theta$

B. $360^\circ + 2\theta$

C. $180^\circ - 2\theta$

D. $180^\circ + 2\theta$

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36. Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror and parallel to the second is reflected from the second mirror parallel to the first mirror. Determine the angle between the two mirrors:

A. 60°

B. 30°

C. 90°

D. 180°

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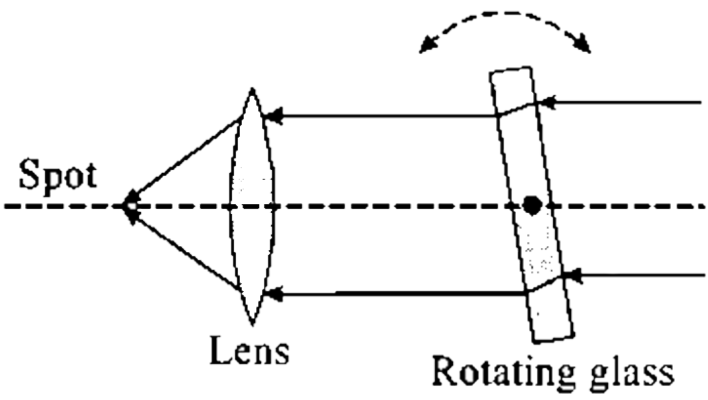
37. A slab of high quality flat glass, with parallel faces, is placed in the path of a parallel light beam before it is focussed to a spot by a lens. The glass is rotated slightly back and forth from the dotted centre about an axis coming out ofthe page, as shown in the diagram. According to ray optics the effect on the focussed spot is:



A. There is no movement of the spot

B. The spot moves towards then away from the lens

C. The spot moves up and down parallel to the lens

D. The spot moves along a line making an angle a (neither zero nor 90°)with axis of lens

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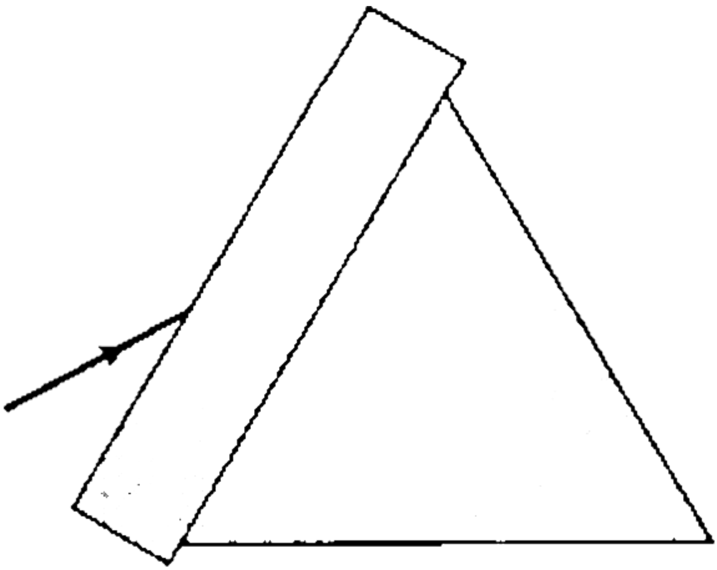
38. A parallel glass slab of refractive index $\sqrt{3}$ is placed in contact with an equilateral prism of

refractive index $\sqrt{2}$. A ray is incident on left surface of slab as shown. The slab and prism combination is surrounded by air. The magnitude of minimum possible deviation of this ray by slab-prism combination is:



A. 30°

B. 45°

C. 60°

D. $60^{\circ} - \sin^{-1}\sqrt{\frac{2}{3}}$

Answer: A

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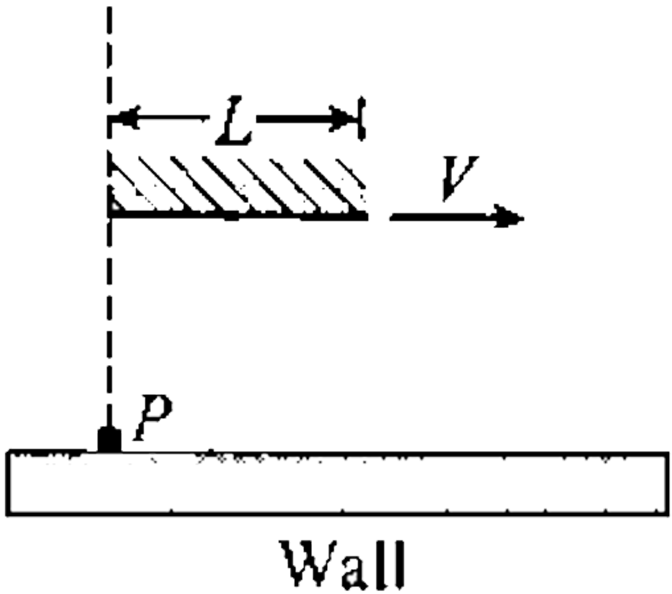
39. The mirror of length L moves horizontally as shown in the figure with a velocity v. The mirror is illuminated bya point source of light 'P' placed on the ground. The rate at which the length of the light spot on the ground increases is :



A. v

B. Zero

C. 2v

D. 3v

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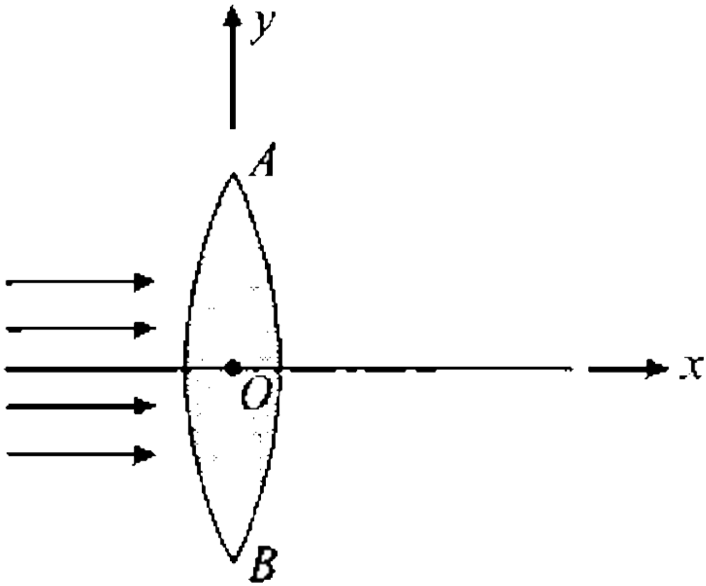
40. Monochromatic light rays parallel to x-axis strike a convex lens AB of refractive index 0.5. If the lens oscillates such that AB tilts upto a small angle θ (in radian) on either side of y-axis, then find the distance between extreme positions of oscillating image:



A. $f \sec \theta$

B. $f \sec^2 \theta$

C. $f(\sec \theta - 1)$

D. The image will not move

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41. The focal length of convex tens is f and the distance of an object from the principal focus is x. The ratio of the size of the real image to the size of the object is

A. $\dfrac{(f+x)}{f}$

B. $\dfrac{f}{x}$

C. $\sqrt{\dfrac{f}{x}}$

D. $\dfrac{f^2}{x^2}$

42. A light ray gets reflected from a pair of mutually $\perp$ mirrors, not necessarily along axes. The intersection point of mirrors is at origin. The incident light ray is along $y = x + 2$. If the light ray strikes both mirrors in succession, then it may get reflected finally along the line:

A. $y = 2x - 2$

B. $y = -x + 2$

C. $y = -x - 2$

D. $y = x - 4$

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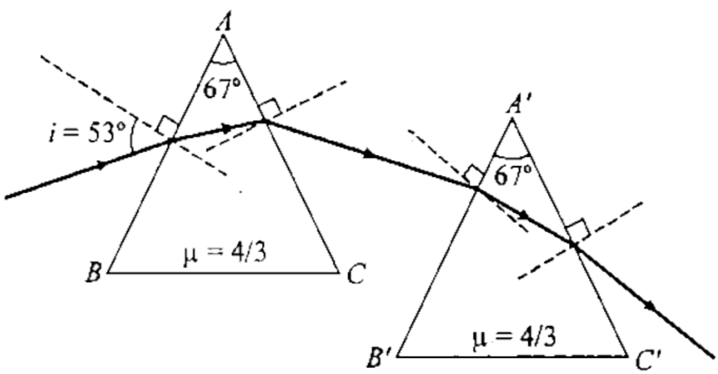
43. A ray is incident on the first prism at an angle of incidence 53° as shown in the figure. The angle between side CA and B'A' for the net deviation by both the prisms to be double of the deviation produced by the first prism, will be:



A. $\sin^{-1}.\ \frac{2}{3} + 53^{\circ}$

B. $\sin^{-1}.\ \frac{2}{3} + 37^{\circ}$

C. $\cos^{-1}.\ \frac{2}{3} + 53^{\circ}$

D. $2\sin^{-1}.\ \frac{2}{3}$

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Numerical MCQs Single Options Correct

1. An equilateral prism deviates a ray through 40° for two angles of incidence differing by 20°. The possible angles of incidences is

A. 1.567

B. 1.467

C. 1.5

D. 1.65

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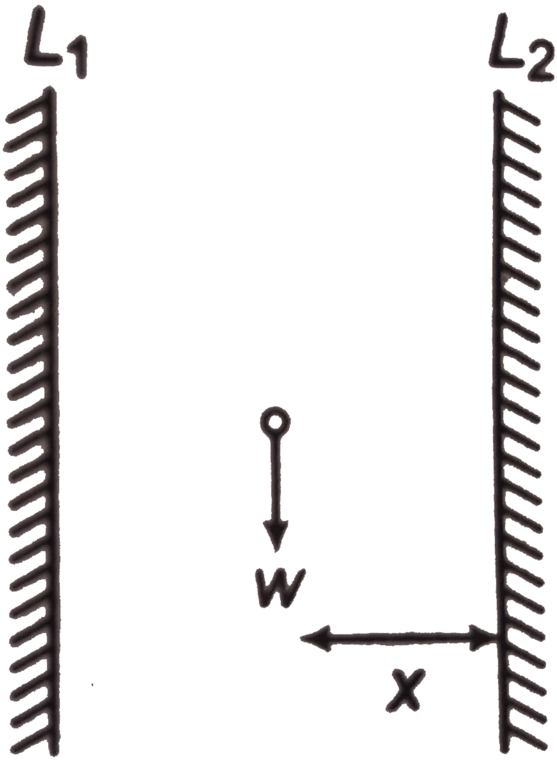
2. two plane mirror L_1 and L_2 are parallel to each other and 3m apart. A person standing x m from the right mirror L_2 looks into this mirror and sees a series of images, The distance between the first and second image is 4 m. Then, the value of x is



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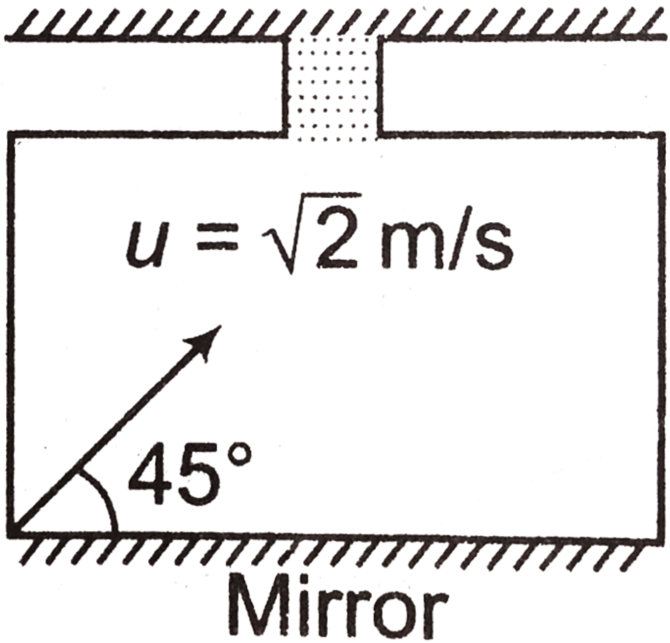
3. An elevator at rest which is at 10th floor of a building is having a plane mirror fixed to its floor. A particle is projected with a speed $(\sqrt{2}) m/s$ and at 45° with the horizontal as shown in the figure. At the very instant of projection, the cable of the elevator breaks and the elevator starts falling freely. what will be the separation between the particles and is image 0.5 s after the instant of projection?



A. $0.5m$

B. 1 m

C. 2 m

D. 1.5 m

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4. A plane mirror is moving with velocity $4\left(\hat{i}\right)+4\left(\hat{j}\right)+8\left(\hat{k}\right)$. A point object in front of the mirror moves with a velocity $3\left(\hat{i}\right)+4\left(\hat{j}\right)+5\left(\hat{k}\right)$. Here, $\hat{k}$ is along the normal to the plane mirror and facing towards the object. The velocity of the image is

A. $-3\hat{i}-4\hat{j}+5\hat{k}$

B. $3\hat{i}+4\hat{j}+11\hat{k}$

C. $-4\hat{i}+5\hat{j}+11\hat{k}$

D. $7\hat{i} + 9\hat{j} + 3\hat{k}$

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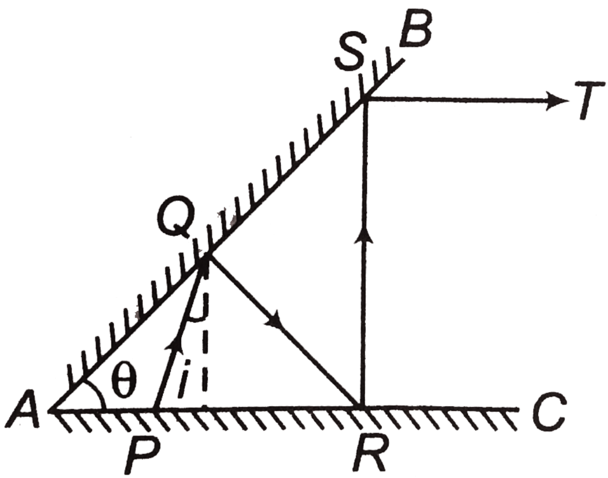
5. Two plane mirrors AB and AC are inclined at an angle $\theta = 20^\circ$. A ray of light starting from point P is incident at point Q on the mirror AB, then at R on mirror AC and again on S on AB. Finally the ray ST goes parallel to mirror AC. The angle which the ray makes with the normal at point Q on mirror AB is



A. 20°

B. 30°

C. 40°

D. 60°

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6. A person's eye is at a height of $1.5m$. He stands infront of a $0.3m$ long palane mirror which is $0.8m$ above the ground. The length of the image he sees of himself is:

A. 1.5 m

B. 1.0 m

C. 0.8 m

D. 0.6 m

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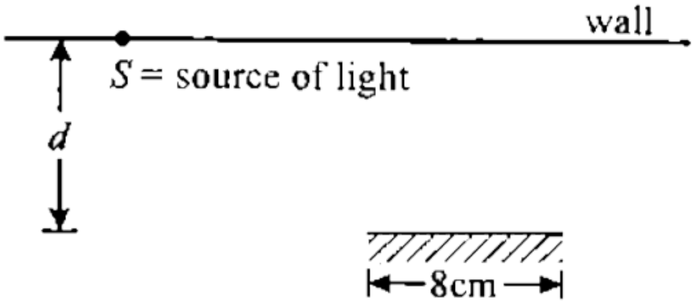
7. A plane mirror of length 8 cm is present near a wall in situation as shown in figure-. Then the length of spot formed on the wall is:



A. 8 cm

B. 4 cm

C. 16 cm

D. None of these

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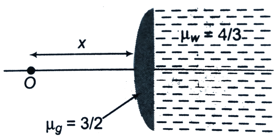
8. An object O is kept in air in front of a thin plano-convex lens of radius of curvature $10cm.$ Its refractive index at $3/2$ and the medium towards right of the plane surface is water of refractive index $4/3.$ What should be distance x of the object so that the rays becomes parallel finally?



A. 5 cm

B. 10 cm

C. 20 cm

D. None of these

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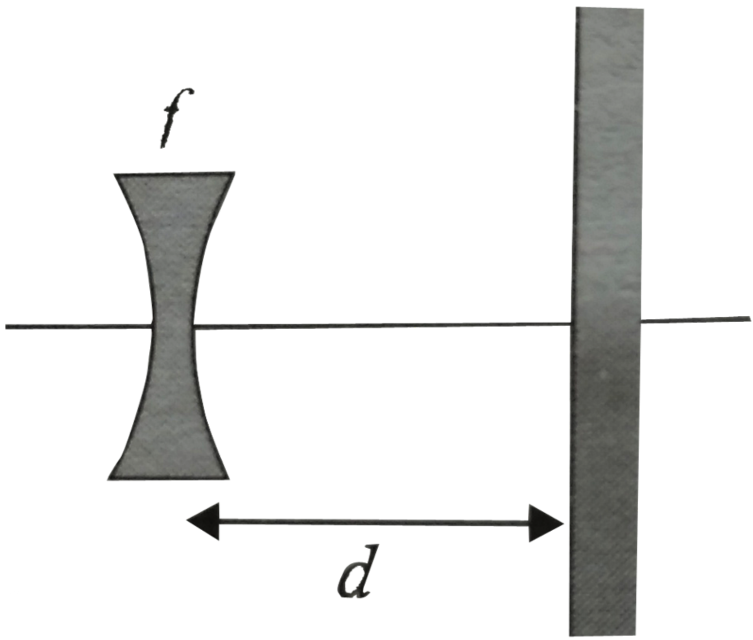
9. A diverging lens of focal length 10cm is placed 10cm in front of a plane mirror as shown in Fig. Light from a very far away source falls on the lens.

What is the distance of final image?



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10. A fish is near the centre of a spherical water filled($\mu = 4/3$)fish bowl,A child stands in air ata distance $2R$(R`is the radius of curvature of the sphere)from the centre of the bowl.At what distance from the centre would the child nose appear to the fish situated at the centrer:

A. 4R

B. 2R

C. 3R

D. 4R

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11. An object is placed at a distance of 15cm from a convex lenx of focal length 10cm. 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. 20 cm

B. 10 cm

C. 15 cm

D. 30 cm

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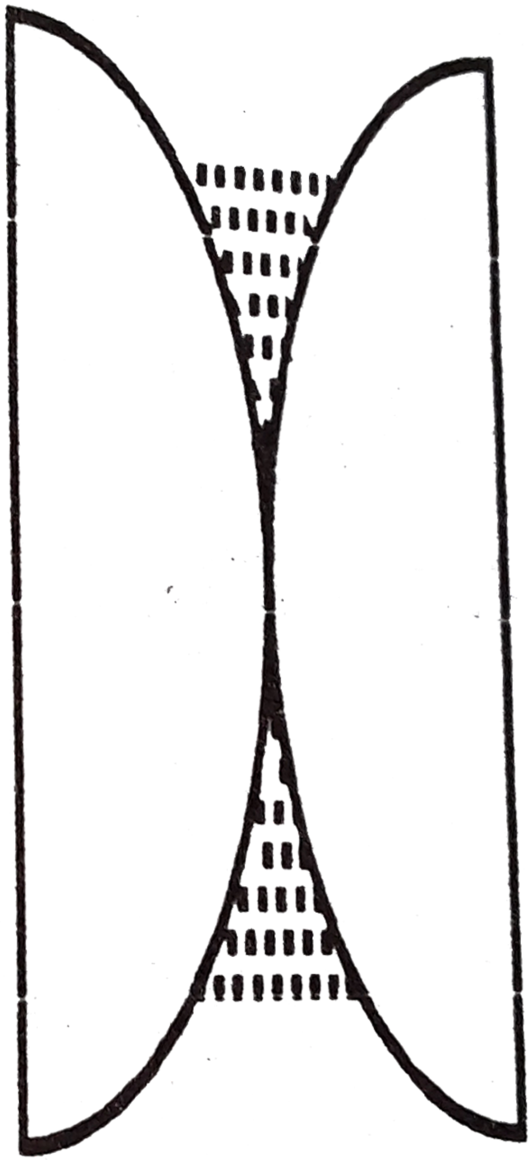
12. Two planoconvex lenses each of the focal length of $10cm$&refractive index $3/2$ are placed as shwon .In the space left water$(R.I. = 4/3)$is filled.Then whole arrangement is in air.The optical power of the system is(in diopters).



A. 6.67

B. -6.67

C. 33.3

D. 20

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13. The curvature radii of a concavo-convex glass lens are $20cm$and $60cm$.th convex surface of the lens is silvered .With the lens horizotnal ,the concave surface is filled with water.The focal length of the effective mirror is ($\mu$of glass=1.5, $\mu$of water= $4/3$

A. $90/13cm$

B. $80/13cm$

C. $20/3cm$

D. $45/8cm$

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14. A plano-convex lens when silvered on 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 20 cm.

Then the refractive index of the lens

A. $9/14$

B. $14/9$

C. $17/9$

D. None

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15. A prism has refractive index $\sqrt{\frac{3}{2}}$ and refractive angle 90°. Find the minimum deviation produced by prism

A. 40°

B. 45°

C. 30°

D. 49°

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16. A certain prism is found to produce a minimum of38°.It produces a deviation of $44^{\circ}$when the angle of incident is either42°or62° .What is the angle of incidence when it is undergoing minimum deviation?

A. 45°

B. 49°

C. 40°

D. 55°

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17. Light ray is incident on a prism of angle $A = 60^\circ$ and refractive index $\mu = \sqrt{2}$.the angle of

incidence at which the emergent ray grazes the surface is given by

A. $\sin^{-1}\left(\frac{\sqrt{3}-1}{2}\right)$

B. $\sin^{-1}\left(\frac{1-\sqrt{3}}{2}\right)$

C. $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

D. $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$

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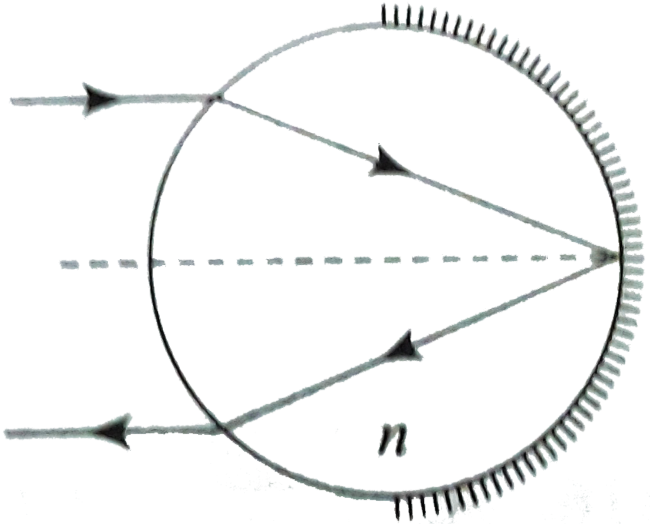
18. A transparent cylinder has its right half polished so as to act as a mirror. A paraxial light ray inciden from left, that is parallel to the principal to the incident ray as shown. The refractive index n of the material of the cylinder is



A. 1.2

B. 1.5

C. 1.8

D. 2.0

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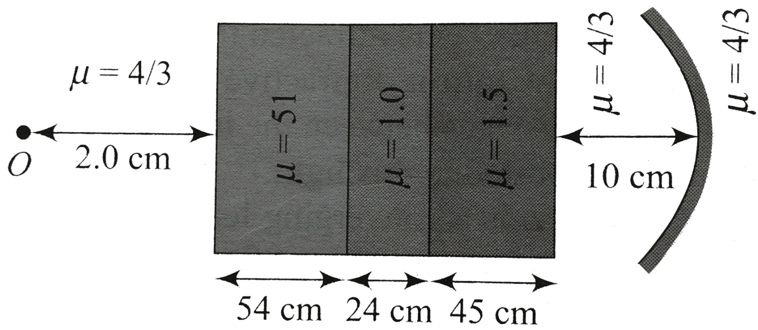
19. A composite slab consisting of different media is placed in front of a concave mirror of radius of curvature 150 cm as shown in figure., The whole arrangement is immersed in water. Locate the final

image of point object O.



A. To the left of Object

B. On the Object

C. To the right of Object

D. Date insufficient to calculate the image position

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20. A luminous point object is moving along the principal axis of a concave mirror of focal length 12cm towards it. When its distance from the mirror is 20cm its velocity is $4cm/s$. The velocity of the image in cm/s at that instant is

A. 6, towards the mirror

B. 6, away from the mirror

C. 9, away from the mirror

D. 9, toward the mirror

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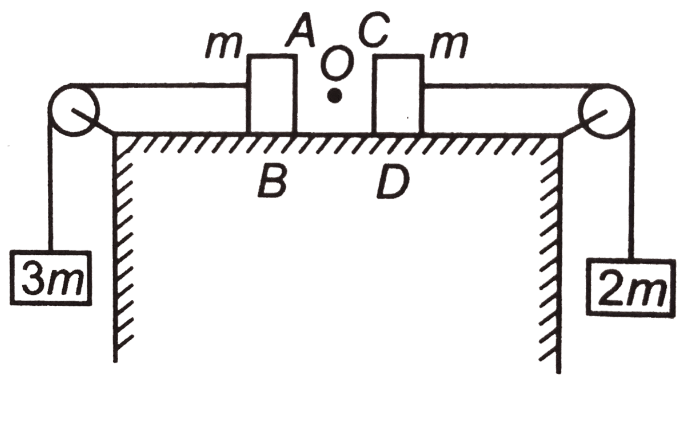
21. Two blocks each of masses m lie on a smooth table. They are attached to two other masses as shown in figure. The pulleys and strings are light. An object O is kept at rest on the table. The sides AB and CD of the two blocks are made reflecting. The acceleration of two images formed in those two reflecting surfaces with respect to each other is



A. 5g/6

B. 5g/3

C. g/3

D. 17g/6

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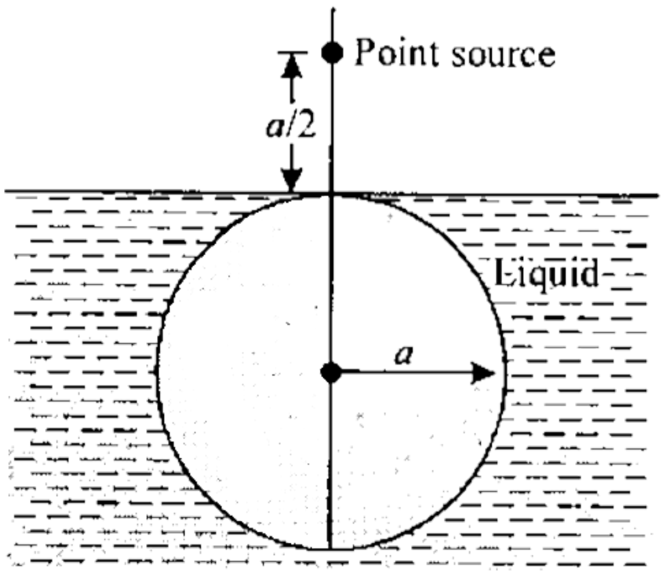
22. An opaque sphere of radius a is just immersed in a transparent liquid as shown in figure. A point source is placed on the vertical diameter of the sphere at a distance all from the top of the sphere.One ray originating from the point source after refraction from the air liquid interface forms tangent to the sphere. The angle of refraction for that particular ray is 30°. The refractive index of the liquid is:



A. $\frac{2}{\sqrt{3}}$

B. $\frac{3}{\sqrt{5}}$

C. $\frac{4}{\sqrt{5}}$

D. $\frac{4}{\sqrt{7}}$

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23. 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. $\theta < 53^\circ$

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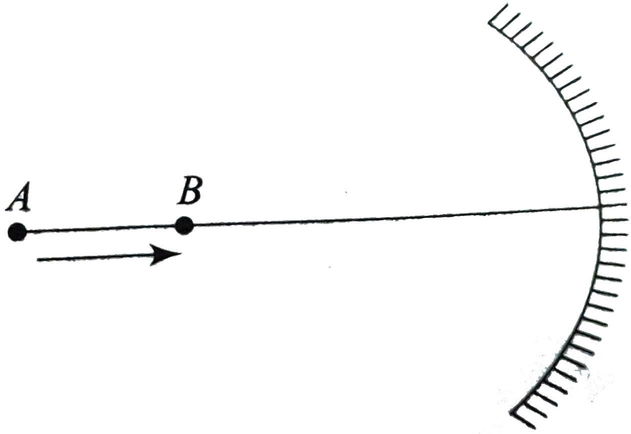
24. A linear object AB is placed along the axis of a concave mirror. This object is moving towards the mirror with speed U. The speed of the image of the point A is 4U and the speed of the image of B is alSO 4U btu in opposite direction. If the center of the line AB is at a distance L from the mirror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



A. $\frac{3L}{2}$

B. $\frac{5L}{3}$

C. L

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

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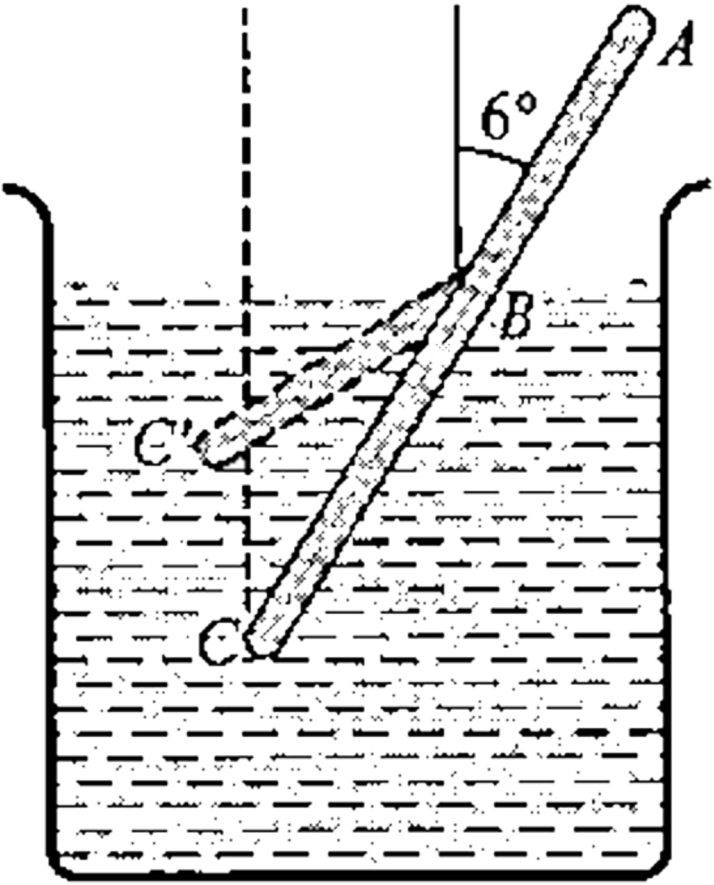
25. A small rod ABC is put in water making an angle 6° with vertical. If it is viewed paraxially from above, it will look like bent shaped ABC'. The angle of bending $(\angle CBC')$ will be in degree is

$\left(n_w = \dfrac{4}{3}\right)$.



A. 2°

B. 3°

C. 4°

D. 4.5°

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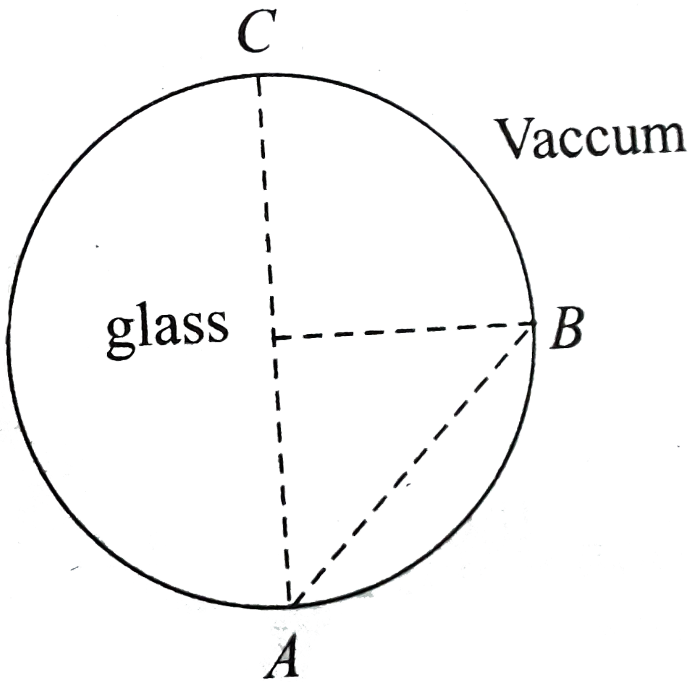
26. It is found that all electromagnetic signals sent from A towards B reach point C inside the glass sphere, as shown in figure. The speed of electromagnetic signals in glass cannot be:



A. $1.0 \times 10^8 m/s$

B. $2.4 \times 10^8 m/s$

C. $2 \times 10^7 m/s$

D. $4 \times 10^7 m/s$

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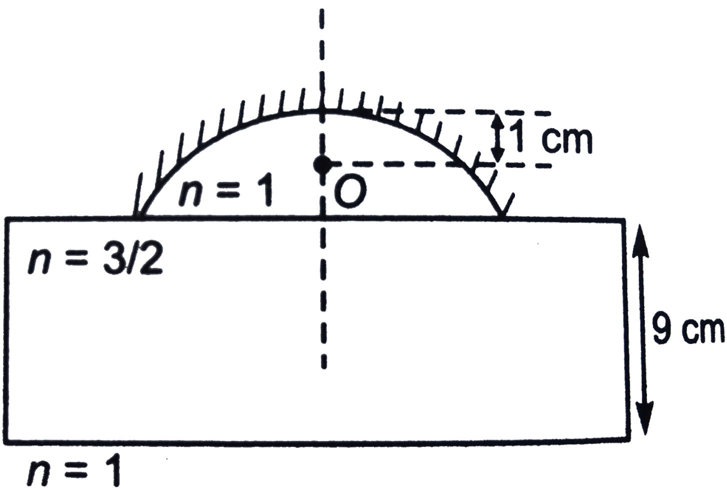
27. A concave mirror of focal length $2cm$ is placed on a glass slab as shown in the figure. The image of point object O formed due to reflection at mirror and then refraction by the slab



A. Will be virtual and will be at 2 cm from the pole of the concave mirror

B. Will be virtual and formed on the pole of the mirror

C. Will be real and on the object itself

D. None of these

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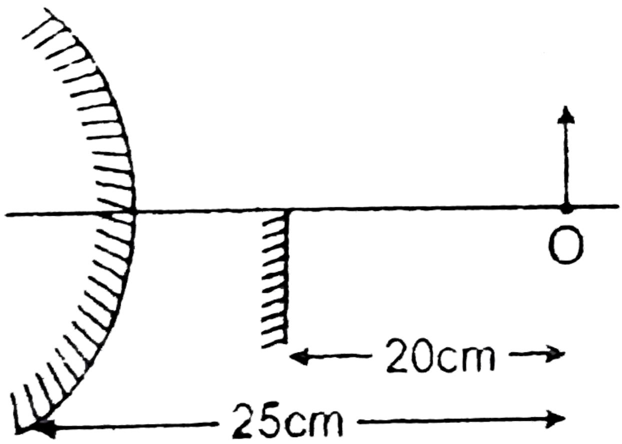
28. In the figure, an object is placed at distance $25cm$ from the surface of a convex mirror, and a

plane mirror is set so that image formed by the two mirrors lie adjacent to each other in the same plane. The plane mirror is placed at $20cm$ from the object. What is the radius of curvature of the convex mirror ?



A. $R = 80cm$

B. $R = 25cm$

C. $R = 75cm$

D. None of these

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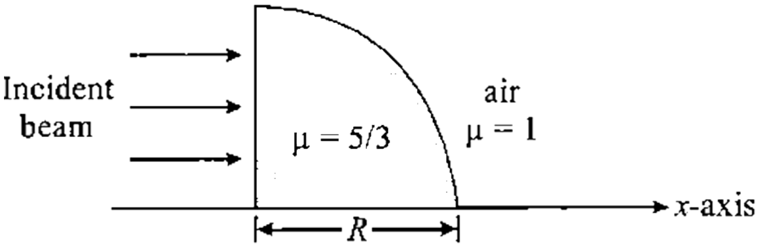
29. A uniform, horizontal parallel beam of light is incident upon a prism as shown. The prism is in the shape of a quarter cylinder, of radius 5cm, and has refractive index 5/3. The width of the regionat which the incident rays after normal incidence on plane surface and subsequent refraction at curved surface intersect on x axis is (Neglect the ray which travels along x-axis)



A. 4cm

B. $5/4cm$

C. $9/4cm$

D. $25/4cm$

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30. Sharp image of extended object which is placed perpendicular to the principle axis of a lens is η times that of the object for a particular position of object on a screen. Without disturbing the position of object and screen, by shifting lens a position can be obtained where the sharp image is $1/\eta$ times that of object. Ratio of difference between the two positions of lens to the focal length of lens is:

A. $\frac{\eta^2 - 1}{\eta}$ if $\eta > 1$

B. $\frac{\eta^2 - 1}{\eta}$ if $\eta \leq 1$

C. $\frac{\eta^2 - 1}{\eta}$ for all values of η

D. η

Answer: C

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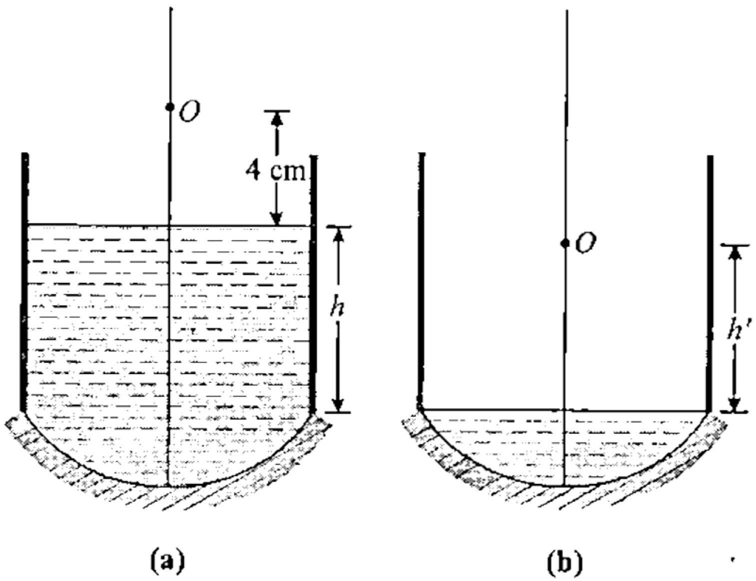
31. A beaker is filled with water as shown in figure (a). The bottom surface of the beaker is a concave mirror of large radius of curvature and small aperture. The height of water is $h = 40cm$. It is found that when an object is placed 4 cm above the water surface, the image coincides with the object. Now the water level h is reduced to zero but there will still be some water left in the concave part of the mirror as shown in figure (b).

The new height of the object h' above the new water surface so that the image again coincides with the object, will be (Refractive index of water $= 4/3$)



A. 34 cm

B. 10cm

C. 74cm

D. Zero

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32. Which of the following relations is correct for a spherical mirror if a point object is kept on the principal axis ['P' is pole 'C' is centre object is at point 'O'. Image is at point 'I'].

A. $\frac{OP}{OC} = \frac{IP}{IC}$

B. $\frac{OP}{IC} = \frac{IP}{OC}$

C. $\frac{PC}{PO} = \frac{PI}{PC}$

D. $\frac{IO}{CP} = \frac{IP}{CO}$

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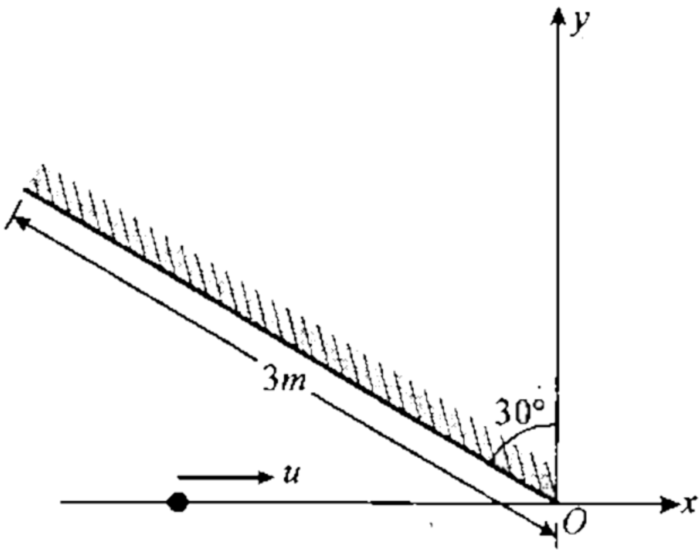
33. A plane mirror is placed with its plane at an angle 30° with the y-axis. Plane of the mirror is perpendicular to the xy-plane and the length of the mirror is 3m. An insect moves along x-axis starting from a distant point, with speed 2 cm/s. The druation of the time for which the insect can see its shown image in the mirror is:



A. 300s

B. 200s

C. 150s

D. 100s

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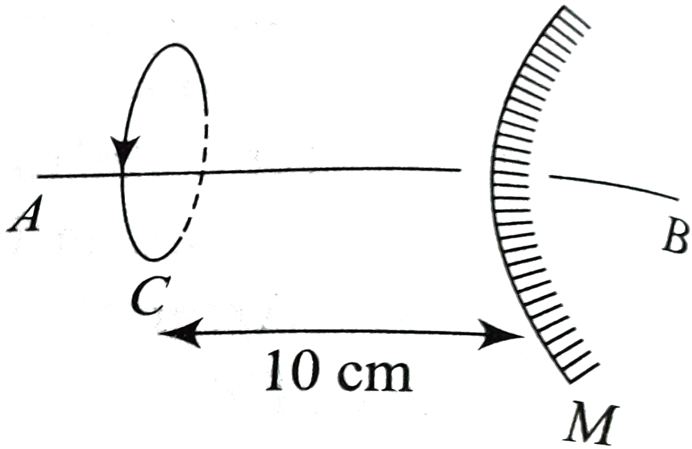
34. A partical revolves in clockwise direction (as seen from point A) in a circle C of radius 1 cm and completes one revolution in 2 sec. The axis of the circle and the principal axis of the mirror M coincides, call it AB. The radius of curvature of the mirror of 20cm. Then, the direction of revolution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



A. Clockwise, $1.57cm/s$

B. Clockwise, $3.14cm/s$

C. Anticlockwise, $1.57cm/s$

D. Anticlockwise, $3.14cm/s$

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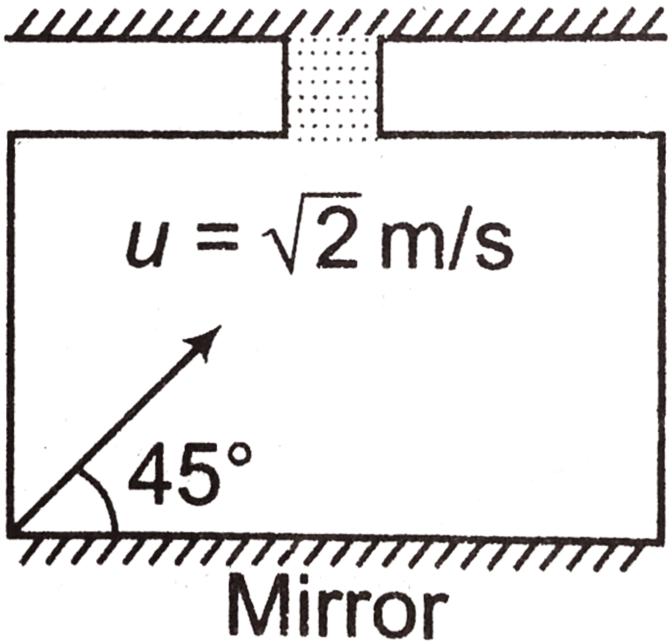
35. An elevator at rest which is at 10th floor of a building is having a plane mirror fixed to its floor. A particle is projected with a speed $\left(\sqrt{2}\right)m/s$ and at 45° with the horizontal as shown in the figure. At the very instant of projection, the cable of the elevator breaks and the elevator starts falling freely. what will be the separation between the particles and is image 0.5 s after the instant of projection?



A. 0.5 m

B. 1m

C. 2m

D. 1.5m

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36. A beam of light converges towards a point O ,behind a convex mirror of focal length 20 cm.Find the nature and position of image if the point O is-

(1) 10cm behind the mirror, (2) 30cm behind the mirror

A. 10 cm in front of mirror

B. 20 cm in front of mirror

C. 10/3 cm behind the mirror

D. 20/3 in front of mirror

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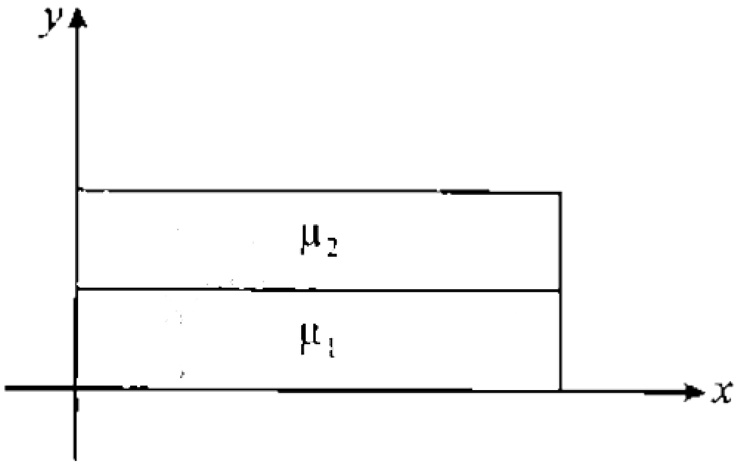
37. Two thin slabs of refractive indices μ_1 and μ_2 are placed parallel to each other in the x-z plane. If the direction of propagation of a ray in the two media are along the vectors $\overrightarrow{r}_1 = a\hat{i} + b\hat{j}$ and

$\overrightarrow{r}_2 = c\hat{i} + d\hat{j}$ then we have:



A. $\mu_1 a = \mu_2 b$

B. $\dfrac{\mu_1 a}{\sqrt{a^2 + b^2}} = \dfrac{\mu_2 a}{\sqrt{c^2 + d^2}}$

C. $\mu_1 (a^2 + b^2) = \mu_2 (c^2 + d^2)$

D. None of these

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38. A particle moves towards a concave mirror of focal length $30cm$ along its axis and with a constant speed of $4cm/\sec$. At the instant the particle is $90cm$ from the pole

A. $2cm/\sec$

B. $8cm/\sec$

C. $1cm/\sec$

D. $4cm/\sec$

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39. A screen beaming areal image of magnification formed by a convex lens is moved through a distance x. The objectis the moved until a new image of magnification is formedon the screen. The focal length of the lens is :

A. $\dfrac{x}{m_1 - m_2}$

B. $\dfrac{x}{m_1 - m_2}$

C. $\dfrac{x}{\sqrt{m_1 m_2}}$

D. None of these

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40. A ray incident at a point at an angle of incidence of 60° enters a glass sphere with refractive index $\sqrt{3}$ and it is reflected and refracted at the farther surface of the sphere. The angle between the reflected and refracted rays at this surface is:

A. 50°

B. 60°

C. 90°

D. 40°

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41. 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.

A. 1.6

B. 1.4

C. 1.9

D. 0.9

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42. A small filament is at the centre of a hollow glass sphere of inner and outer radii 8 cm and 9 cm respectively. The refractive index of glass is 1.50. Calculate the position of the image of the filament when viewed from outside the sphere.

A. 9cm

B. $-9cm$

C. $-19cm$

D. $+19cm$

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43. A double convex thin lens made of glass (refractive index $\mu = 1.5$) has both radii of curvature of magnitude 20 cm . Incident light rays parallel to the axis of the lens will converge at a distance L such that

A. 10 cm

B. 20cm

C. 30 cm

D. 40cm

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44. Time required for making a print at a distance of 40 cm from a 60 watt lamp is 12.8 second. It the distance is decreased to 25 cm, then time required in making the similar print will be :

A. 15 sec

B. 10sec

C. 5sec

D. Remains some

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

A. 50°

B. 58°

C. 64°

D. 60°

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46. A glass sphere $(\mu = 1.5)$ of radius 8 cm is placed in sunlight. Where is the image of the sun formed by the light passing through the sphere after refraction by second surface of sphere ?

A. 4 cm

B. 6cm

C. 15cm

D. 50 cm

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

A. $\frac{5}{3}$

B. $\frac{5}{4}$

C. $\frac{6}{3}$

D. None of these

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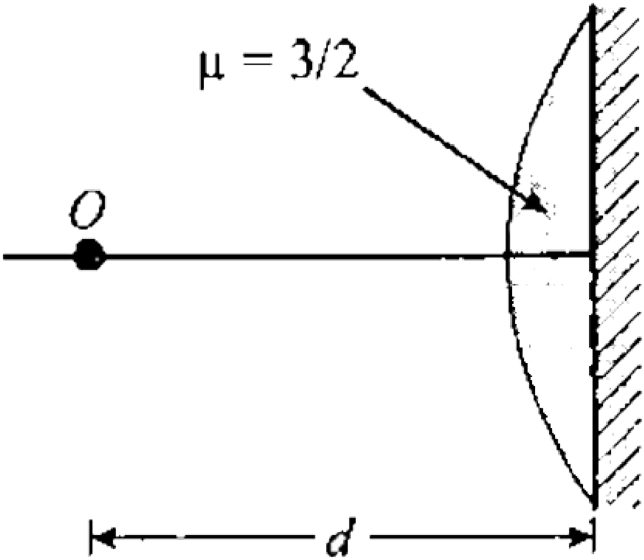
48. A plano-convex lens of focal length 10 cm is silvered at its plane face. The distance d at which an object must be placed in order to get its image on itself is:



A. 5cm

B. 20 cm

C. 10 cm

D. 2.5 cm

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49. 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. 0.5 cm

B. 0.3cm

C. 0.2cm

D. 1.0cm

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50. The dispersive power of the material of a lens is 0.04 and the focal length of the lens is $10cm$. Find the difference in the focal length (in mm) of the lens for violet and red colour.

A. 2mm

B. 4mm

C. 6mm

D. 8mm

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51. Two point objects are placed on principal axis of a thin converging lens. One is 20cm from the lens and other is on the other side of lens at a distance of 40 cm from the lens. The images of both objects coincide. The magnitude of focal length of lens is :-

A. $\frac{80}{3}cm$

B. $\frac{40}{3}cm$

C. 40cm

D. $\frac{20}{3}cm$

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Advance MCQs with One or More Options Correct

1. 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.

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

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

C. Intensity at centre of screen for $x = 90cm$ and $x = 110cm$ is same

D. radius of bright circle obtained on screen is equal to1cm for $x = 200cm$

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2. A point object is placed at 30 cm from a convex glass lens $\left(\mu_g = \frac{3}{2}\right)$ of focal 20 cm. The final image of object will beformed at infinity if :

A. Another concave lens of focal length 60 cm is placed in cotact with the previous lens

B. Another convex lens of focal legth 60 cm is placed at a distance of 30 from the first lens

C. The whole system is immersed in a liquid of refractive index 4/3

D. The whole system is immersed in liquid of refractive index 9/8

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

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

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

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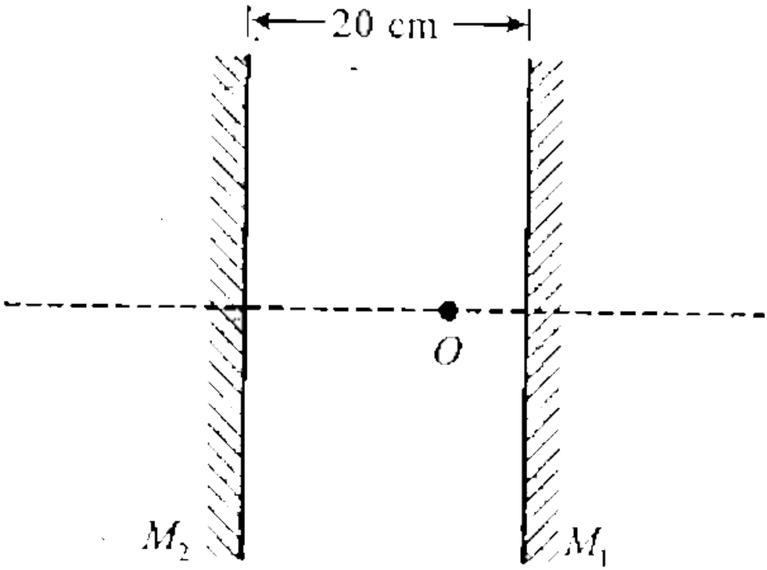
4. Two plane mirrors M_1 and M_2 are placed parallel to each other 20 cm apart. A luminous point object 'O' is placed between them at 5 cm from M_1 as shown in figure :



A. The distance (in cm) of three nearest from mirror M_1 are 5,35 and 45 respectively

B. The distance (in cm) of three nearest images from mirror M_2 are 5,35 and 45 respectively

C. The distance (in cm) three neatest images from mirror M_2 are 15, 25 and 55 respectively.

D. The distancec (in cm) of three nearest images from mirror M_2 are 15, 25 and 55 respectively

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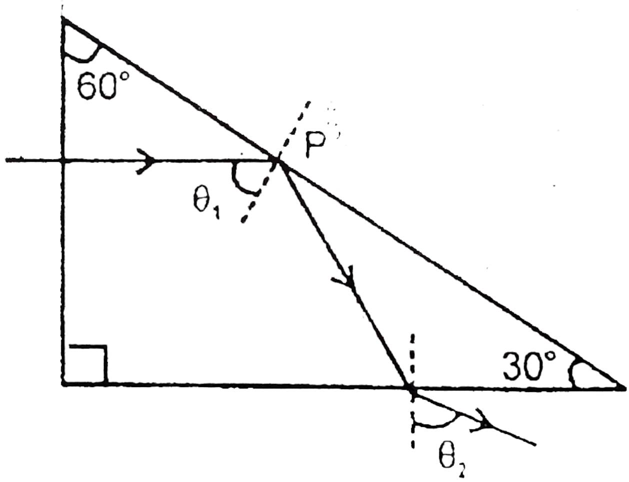
5.



A ray of light is incident normally on one face of a prism as shown in figure. The refractive index of the material of the prism is $\frac{5}{3}$ and the prism is immersed in water of refractive index $\frac{4}{3}$, then

A. The exit angle θ_2 of the ray is $\sin^{-1}\left(\frac{5}{8}\right)$

B. The exit angle θ_2 of the ray is $\sin^{-1}\left(\frac{5}{4\sqrt{3}}\right)$

C. Total internal reflection at point ceases if the refractive index of water in increased to $\frac{5}{2\sqrt{3}}$ by dissolving some substance

D. Total internal reflection at point P ceases if the refractive index of water is increased to $\frac{5}{6}$ by dissolving some substance

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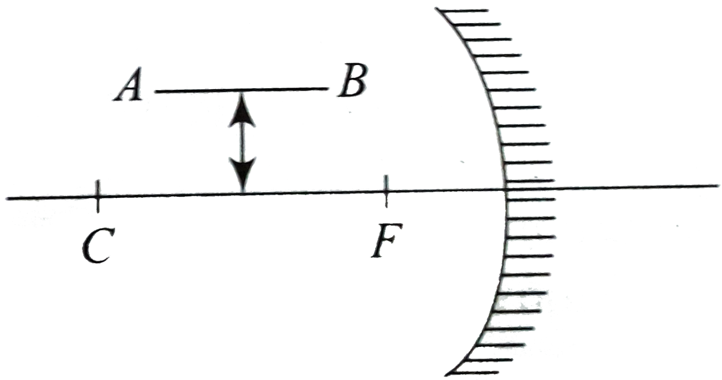
6. An object AB is placed parallel and close to the optical axis between focus F and center of curvature C of a converging mirror of focale length f as shown in Figure. Then,



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 straight line inclined to the optical axis

D. Image of AB will not be straight line

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7. 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 $\frac{\pi}{2} - \theta_C$, it will be at angle of incidence is θ_C

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

C. If angle of incidence is less than θ_C then deviation increases if angle of incidence is also increased

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

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8. A particle is moving towards a fixed convex mirror. The image of object also moves. If V_i is the speed of image and V_0 is the speed of the object, then :

A. $V_i \leq V_0$ 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 $|u| = |F|$

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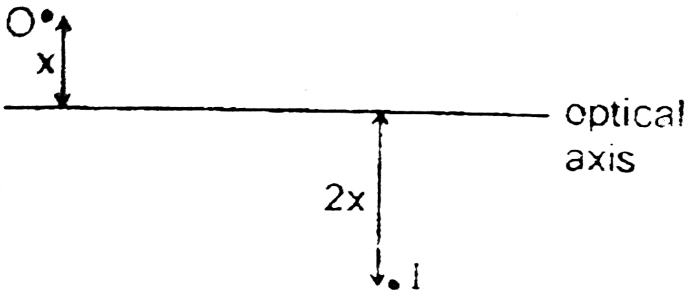
9. The positions of the object O (real or virtual) and the image I(real or virtual) with respect to the optical axis of a spherical mirror is shown. Then select the possible mirror and its position to realise it.



A. Concave mirror closer to object

B. Concave mirror closer to image

C. Convex mirror closer to object

D. Convex mirror closer to image

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10. A small air bubble is trapped inside a transparent cube of size $12cm$. When viewed from one of the vertical faces, the bubble apears to be at $5cm$. From it. When viewed from opposite face, it appears at $3cm$ from it.

A. The distance of the air bubble from the first face is $7.5cm$

B. The distance of the air bubble from the first face is 9 cm

C. Refractive index of the material of the prism is 2.0

D. Refractive index of the material of the prism is 1.5

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11. Which of the following statements are true for a plane mirror :

A. It can form real image of a real object

B. It neither converges nor diverges the parallel rays incident on it

C. It cannot form real image of a real object

D. None of these

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12. A convex lens forms an image of an object on a screen ,The height of the image is$9cm$The lens is now disiplaced between the object on the screen.the height of this image is$4cm$.the distance between the object and the screen is $90cm$

A. The distance between the two positions of the lens is 30 cm

B. The distance of the from the lens in its first position is 36 cm

C. The height of the object is 6 cm

D. The focal length of the lens is $21.6cm$

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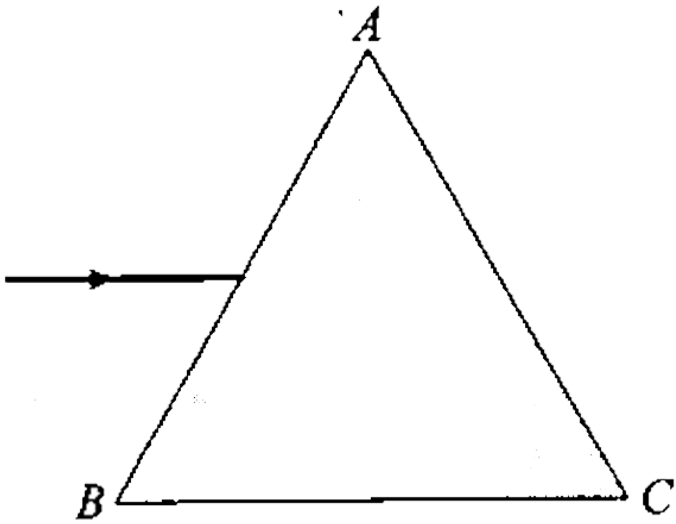
13. A ray of light is incident on an equilateral triangular prism parallel to its base as shown in the figure. The ray just fails to emerge from the face AC. If μ be the refractive index of the prism then the relation(s) is/are :



A. $2\sin^{-1}\left(\frac{1}{\mu}\right) = \pi/3$

B. $\sin^{-1}\left(\frac{1}{\mu}\right) + \sin^{-1}\left(\frac{1}{2\mu}\right) = \frac{\pi}{6}$

C. $\sin^{-1}\left(\frac{1}{\mu}\right) + \sin^{-1}\left(\frac{1}{2\mu}\right) = \frac{\pi}{3}$

D. $\sin^{-1}\left(\frac{1}{\mu}\right) + \sin^{-1}\left(\frac{\mu}{4}\right) = \frac{\pi}{3}$

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14. A convex lens forms a real of an object with magnification 0.5. If the object is displaced by 20 cm allong the principal axis, a real image equal to the size of the object is formed :

A. the focal length is 20 cm

B. the distance of the image from the lens initially is 25 cm

C. the distance of the object from the lens initially is 60 cm

D. the distance of the image finally the lens is 30 cm

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15. Sun ray are incident at an angle of 24° with the horizon. They be directed parallel to the horizon using a plane mirror for this plane mirror should be placed at an angle :

A. 12° to the horizontal

B. 48° to the horizontal

C. 72° to the horizontal

D. 78° to the horizontal

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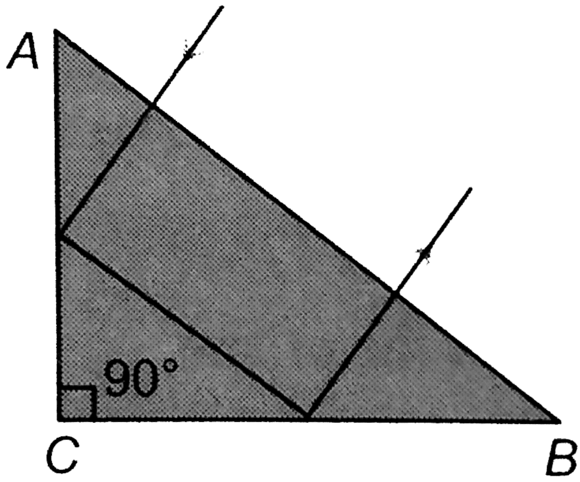
16. A ray of light incident normally on an isosceles right angled prism travels as shown in the figure.

The least value of the refractive index of the prism must be



A. $\mu > 1.2$

B. $\mu > 1.3$

C. $\mu > 1.5$

D. $\mu > 1.7$

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17. Two plane mirrors are inclined to each other with their reflecting daces making acute angle. A light ray is incident on one plane mirror. The total deviation after two successive reflections is :

A. Independent of the initial angle of incidence

B. Independent of the angle between the mirrors

C. Dependent on the initial angle of incidence

D. Dependent on the angle between the mirrors

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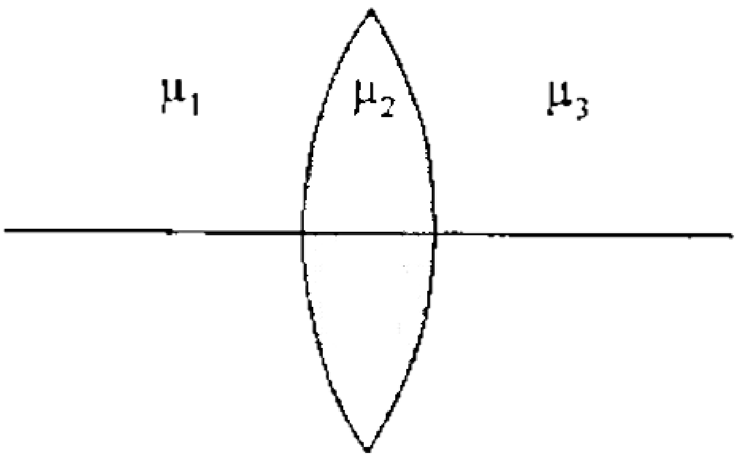
18. An equiconvex lens of refractive index μ_2 is placed such that the refractive :



A. Must be diverging if μ_2 is less than the arithrnetic mean of μ_1 and μ_3

B. Must be converging if μ_2 is greater than the arithumetic mean of μ_1 and μ_3

C. May be diverging if μ_2 is less than the arithmetic mean of m_1 and μ_3

D. Will neither be diverging nor converging if μ_2 is equal to arithmetic mean of μ_1 and μ_3

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19. A ray of light is incident on a prism of refracting angle A. if θ_C is the critical angle for the material of the prism with respect to the surrounding air, then:

A. An emergent ray will be there for all values of θ_C

B. An emergent ray will be there only for $A \leq 2\theta_C$

C. A ray incident at an angle I can pass through the prism if $\sin > \frac{\sin(A - \theta_C)}{\sin \theta_C}$ for $\theta_C < A < 2\theta_C$

D. None of above is correct

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20. A point source of light is placed at a distance h below the surface of a large and deep lake. If f is the fraction of light energy that escapes directly from water surface and μ is refractive index of water then:

A. f various as a function of h

B. f is independent of value of h

C. f depends only on the refractive index of water

D. f is independent of refractive index of water

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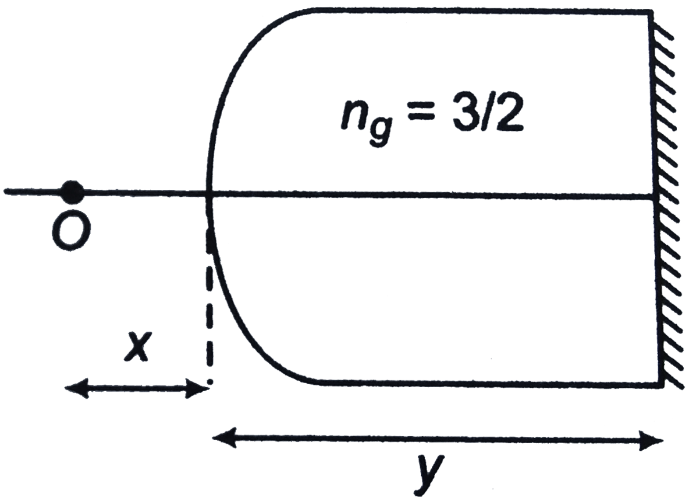
21. In the figure shown , a point object O is placed in air on the principal axis. The radius of curvature of the spherical surfaces is $60cm$. I is the final image formed after all reflections and refractions.



A. If $d_1 = 120cm$, then the $'I'_f$ is formed 'O' for any value of d_2

B. If $d_1 = 240cm$, then the $'I'_f$ is formed on 'O' only if $d_2 = 360cm$

C. If $d_1 = 240cm$, then the $'I'_f$ is formed on 'O' for all value of d_2

D. If $d_1 = 240cm$, then the $'I'_f$ cannot be formed on 'O'

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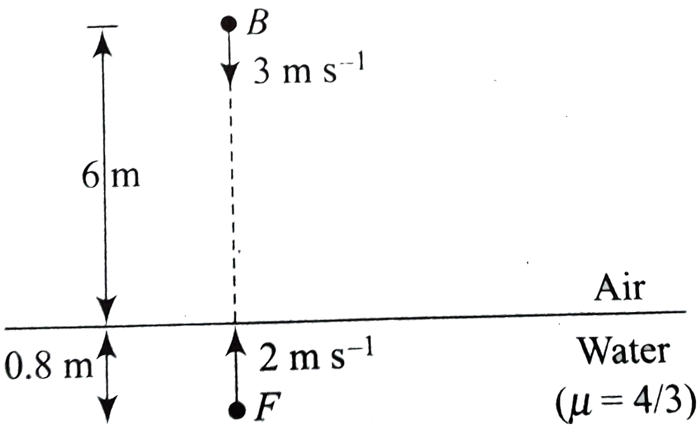
22. A fish F, in the pond is at a depth of 0.8m from the water surface and is moving vertically upward with velocity $2ms^{-1}$. At the same instant, a bird B is at a height of 6m from the water surface and is moving downward with velocity $3ms^{-1}$. At this instant. both are on the same vertical line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



A. height of B, observed by F (from itself)

B. depth of F, observed by B (from itself) is equal to 0.60m

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

D. none of these

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23. A man of height $170 cm$ wants to see his complete image in a plane mirror(while standing).His eyes are at a height of $160cm$from the ground.

A. Minimum length of the mirror $= 80cm$

B. Minimum length of the mirror $= 85cm$

C. Bottom of the mirror should be at a height $80cm$

D. Bottom of the mirror should be at a height 85 cm

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24. Two plane mirrors at an angle such that a ray incident on a mirror undergoes a total deviation of 240° after two reflections:

A. the angle between the mirrors is 60°

B. the number of images formed by this system will be 5, if an object is placed symmetrically between the mirrors

C. the number of images will be 5 if an object is kept unsymmetrical between the mirrors

D. a ray will retrace its path after 2 successive reflections, if the angle of incidence on one mirror is 60°

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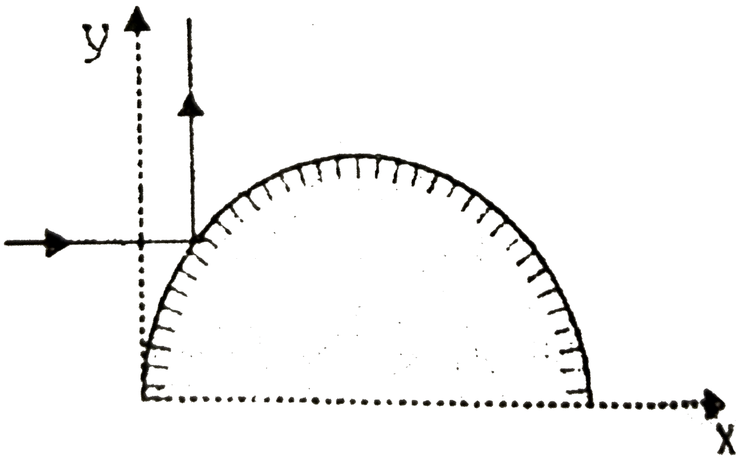
25. If the equation of mirror is given by $y = 2/\pi \sin \pi x (y > 0, 0 \leq x \leq 1)$ then find the point on which horizontal ray should be incident so that the reflected ray become perpendicular to the incident ray



A. $\left(\frac{1}{3}, \frac{\sqrt{3}}{\pi}\right)$

B. $\left(\frac{\sqrt{3}}{\pi}, \frac{1}{3}\right)$

C. $\left(\frac{2}{3}, \frac{\sqrt{3}}{\pi}\right)$

D. $(1, 0)$

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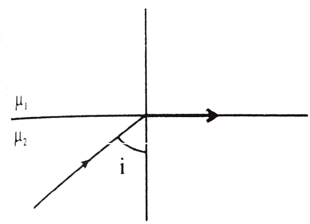
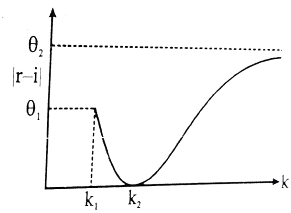
26. The figure shows a ray incident a angle $i=\pi/3$ of the plot drawn shown the variartion of $|r-i|$ versus $\frac{\mu_1}{\mu_2}$=k,($r=$ angle of refraction)





the value of$k_1$is

A. The value of k_1 is $\frac{2}{\sqrt{3}}$

B. The value of θ_1 is $\pi/6$

C. The value of θ_2 is $\pi/3$

D. The value of k_0 is 1

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27. For refractin of light through a prism

A. For every angle of deviation there are two angles of incidences

B. The light travelling inside an equilateral prism in necessarily parallel to the base when prism is set for minimum deviation

C. There are two angles of incidence for maximum deviation

D. Angle of minimum deviation will increase if refractive index of prism (μ_p) is increased keeping the refractive index of the outside medium (μ_s) uncharged if $\mu_P > \mu_S$.

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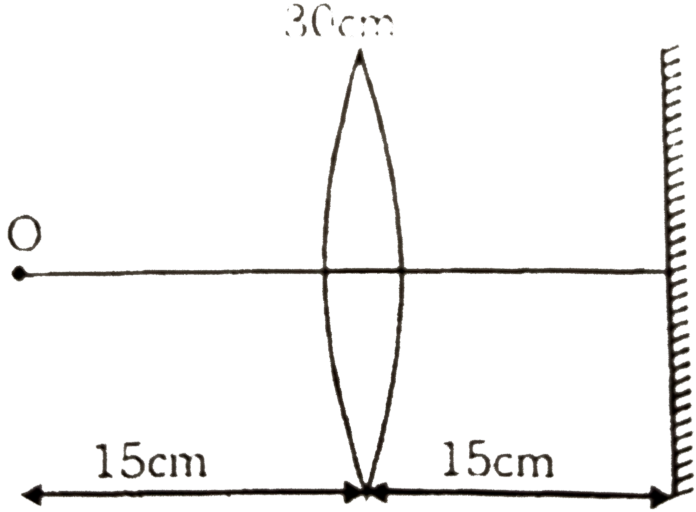
28. An object O is kept infront of a converging lens of focal length 30 cm behind which there is a plane mirror at 15 cm from the lens.



A. The final image is formed at 60 cm from the

lens towards right of it

B. The final image is at 60 cm from lens towards

left of it

C. The final image is real

D. The final image is virtual

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29. Choose the correct alternative corresponding to the object distance 'u', image distance 'v' and the focal length 'F' of a converging lens from the following.

(i) The average speed of the image as the object moves with uniform speed from distance $\frac{3F}{4}$ to $\frac{F}{2}$ is greater than the average speed of the image as the object moves with same speed from distance $\frac{F}{2}$ to $\frac{F}{4}$

(ii) The minium distance between a real object and its real image in case of a converging lens is 4F where F is its focal length.

A. both are correct

B. both are incorrect

C. (i) is correct (ii) is incorrect

D. (i) is incorrect, (ii) is correct

Answer: A

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30. An object and a screen are fixed at a distance d apart. When a lens of focal length f is moved between the object and the screen, sharp images of the object are formed on the screen for two positions of the lens.

The magnifications produced at these two positions are $M_1 \mathrm{and} M_2$-

A. $d > 2f$

B. $d > 4f$

C. $M_1 M_2 = 1$

D. $|M_1| - |M_2| = 1$

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Unsolved Numerical Problems

1. The left end of a long glass rod of index 1.6350 is grounded and polished to a convex spherical surface of radius 2.50 cm. A small object is located in the air and on the axis 9.0 cm from the vertex. Find the lateral magnification.

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2. Focal length of a convex lense in air is $10cm$. Find its focal length in water. Given that $\mu_g = 3/2$ and $\mu_w = 4/3$.

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3. Find the distance of an object from a convex lens if image is two times magnified. Focal length of the lens is $10cm$

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4. A pile 4m high driven into the bottom of a lake is 1m above the water . Determine the length of the shadow of the pile on the bottom of the lake if the sun rays make an angle of 45° with the water surface . The refractive index if water is $\frac{4}{3}$.`

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5. An object is placed $12cm$ to the left of a diverging lens of focal length $-6.0cm$. A converging lens with a focal length of $12.0cm$ is placed at a distance d to the right of the diverging lens. Find the distance d that corresponds to a final image at infinity.

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6. A solid glass sphere with radius R and an index of refraction 1.5 is silvered over one hemisphere. A small object is located on the axis of the sphere at a distance 2R to the left of the vertex of the unsilvered hemisphere. Find the position of final image after all refractions and reflection have taken place.

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7. A glass sphere with $10cm$ radius has a $5cm$ radius spherical hole at its centre. A narraow beam of parallel light is directed into the sphere. Where, if anywhere, will the sphere produce an image? The index of refraction of the glass is 1.50.

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8. A source of light is located at double focal length from a convergent lens. The focal length of the lens is $f = 30cm$. At what distance from the lens should a flat mirror be placed, so that the rays reflected from the mirror are parallel after passing through the lens for the second time?

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9. A parallel beam of rays is incident on a consisting pf three thin lenses with a common optical axis. The focal length of the lenses are equal to $f_1 = +10cm$ and $f_2 = -20cm$, and $f_3 = +9cm$ respectively. The distance between the first and the second lens is $15cm$ and between the second and the third is $5cm$. Find the position of the point at which the beam converges when it leaves the system of lenses.

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10. A ray of light is incident on the left vertical face of glass cube of refractive index n_2, as shown in figure. The plane of incidence is the plane of the page, and the cube is surrounded by liquid (refractive index $= n_1$). What is the largest angle of incidence θ_1 for which total internal reflection occurs at the top surfaces?

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11. One face of a prism with a refrective angle of 30° is coated with silver. A ray of light incident on another face at an angle of 45° is refracted and reflected from the silver coated face and retraces its path. What is the refractive index of the prism?

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12. In an isosceles prism of prism angle 45°, it is found that when the angle of incidence is same as the prism angle, the emergent ray grazes the emergent surface. Find the refractive index of the material of the prism.For what angle of incidence the angle of deviation will be minimum ?

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13. An astronomical telescope with objective of focal length 100 cm and eyepiece of focal length 10 cm is used by a shortsighted man whose far point is 33 cm from his eye, to form an image of an infinitely distant object at his far point. Find the separation of the lenses, and magnification obtained.

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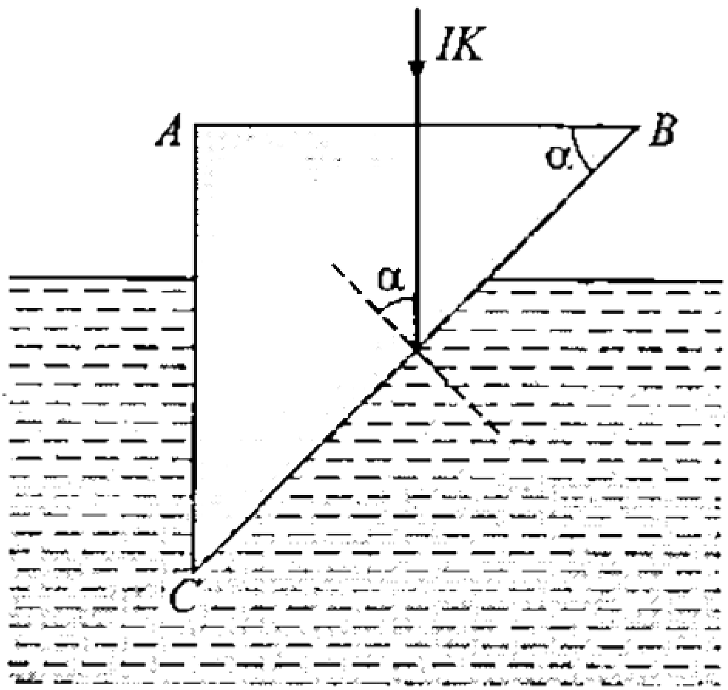
14. Figure shows a right angled prism ABC having refractive $\mu_g = \frac{3}{2}$ lowered into water $\left(\mu_\omega \frac{4}{3}\right)$. Find angle α so that the incident ray normal to face AB will be reflected at face BC completely.



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15. An equilateral prism deviates a ray through 40° for two angles of incidence. The two incidence angels differ by 20°. Find their values.

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16. A ray of light strikes a glass slab of thickness t.

(i) Prove that it emerges on the opposite face, parallel to the initial ray.

(ii) (ii) Prove that the value of deflection of beam which passed through the plate is :

$$t \sin i_1 \left[1 - \sqrt{\left(\frac{1 - \sin^2 i_1}{\cdot_a \mu_g^2 - \sin^1 i_1}\right)}\right]$$

(iii) Prove that for a small angle of incidence i_1, the internal shift x is given by

$$x = t i_1 \left(1 - \frac{1}{\cdot_a \mu_g}\right)$$

where $\cdot_a \mu_g$ is the refractive index of glass with respect to air.

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17. 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 is in contact with the table, the apparent depth of the center of the plane face of the lens is face of the lens is found to be $25/8$ cm. Find the focal length of the lens.

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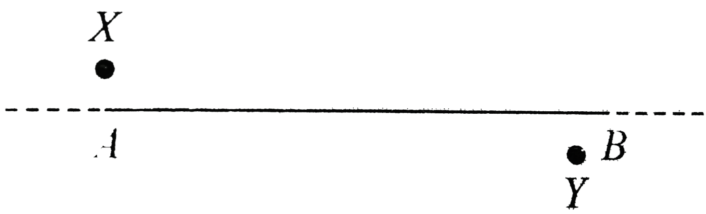
18. An image Y is formed of a point object x by a lens whose optic axis is AB as shown in Figure. Draw a ray diagram to locate the lens and its focus. If the image Y of object X is formed by a concave mirror (having the same optic axis AB) instead of lens, draw another ray diagram to locate the mirror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



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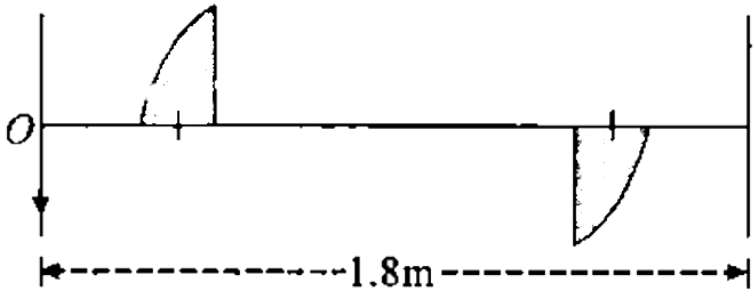
19. A thin plano-convex lens.of focal length f is split into two halves : One of the halves is shifted along the optical axis (figure)The separation between object and image planes is 1.8m.The magnification of the image formed by one of the half lensis 2.

Find the focal length of the lens and separation between the two halves. Draw the ray diagram for image formation.



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20. The focal lengths of the objective and the eye piece of a compound microscope are 1cm and 5cm respectively. An object placed at a distance of $1:1$ cm from the objective has its final image formed at

(i) infinity (ii) least distance of distinct vision. Find the magnifying power and the distance between the lenses. Least distance of distinct vision is 25 cm.

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21. Find the minimum size of mirror required to see the full image of a wall behind a man standing at the centre of room, where H is the height of wall.

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22. Two mirrors are inclined by an angle 30°. An object is placed making 10° with the mirror My Find the positions of the first two images formed by each mirror. Find the total number of images.

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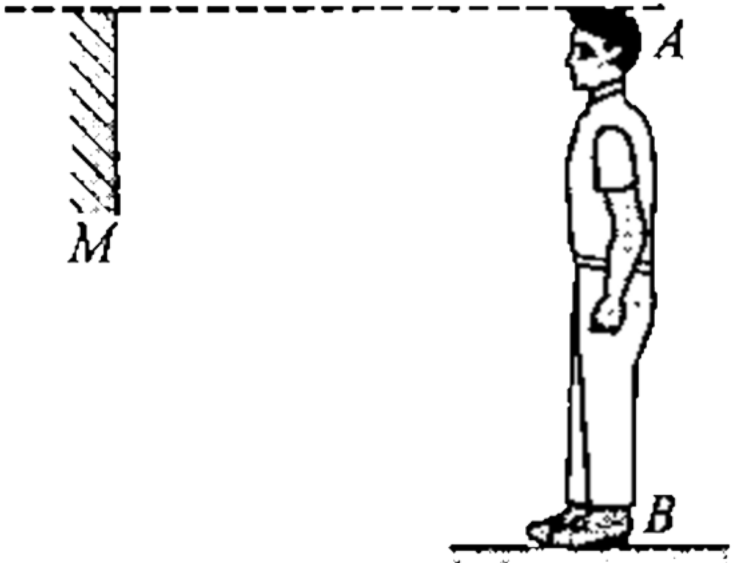
23. AB is a man of height 2m and M is a mirror of length 0.5m and mass 0.1 kg. Initially top of mirror M and A are at the same level and the M starts falling freely always remaining vertical. If the level of the eyes of the manis 1.5 cm below his head. A, find the time after which the man sees the reflection of his feet.



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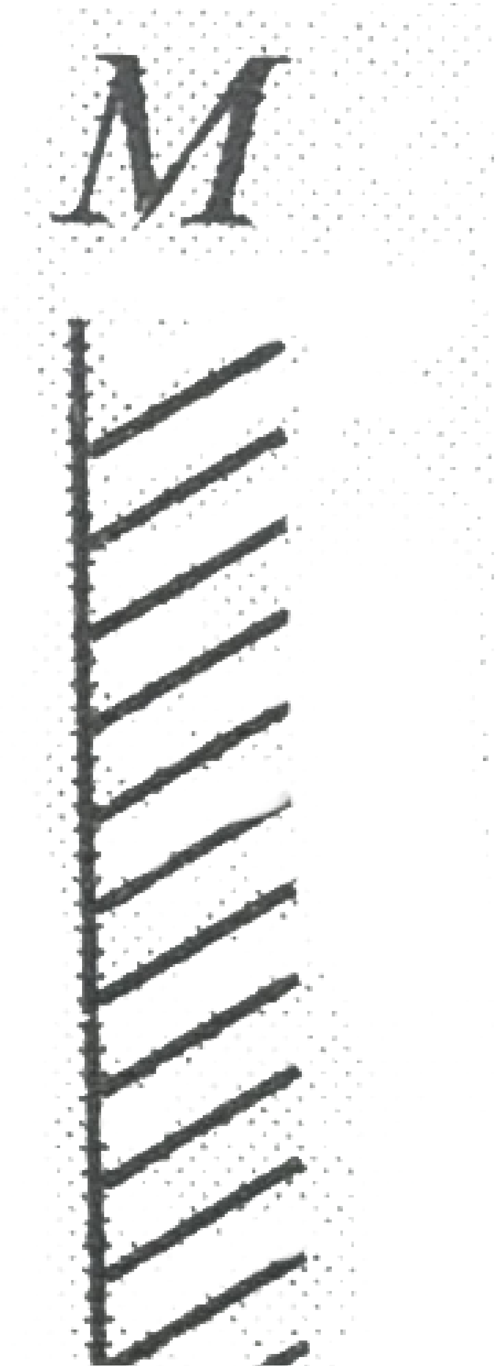
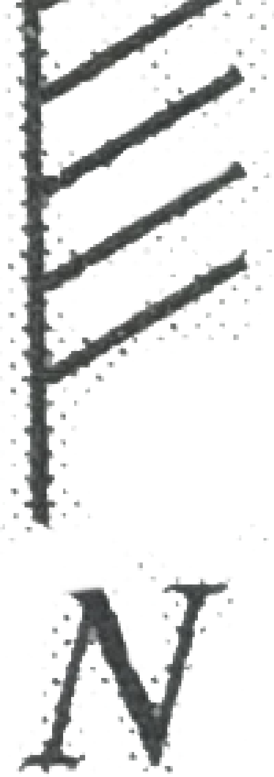
24. Figure. Shows a point object A and a plane mirror MN. Find the position of the image of object A, in mirror MN, by drawing ray diagram. Indicate the region in which the observer's eye must be present in order to view the image. (This region is called field of view.)





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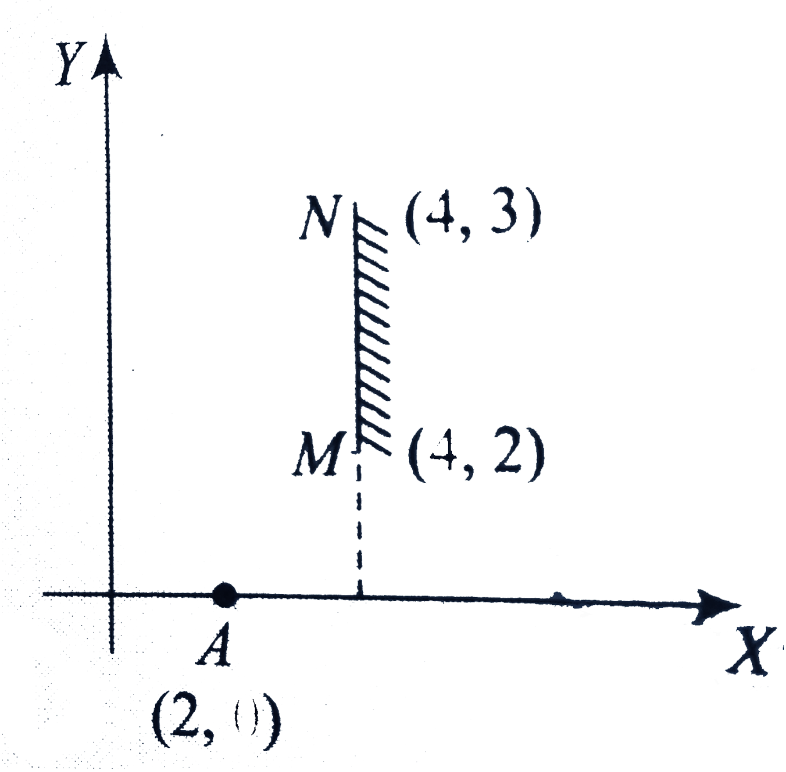
25. Find the region on Y-axis in which reflected rays are present. Object ia at $A(2, 0)$ and MN is a plane mirror, as shown in Figure.



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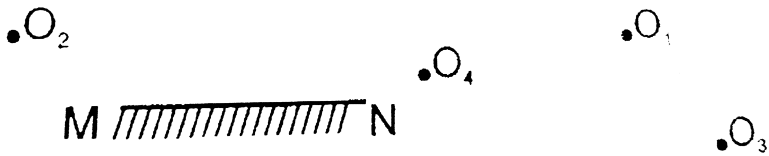
26. See the following figure. Which of the object(s) shown in O_2 figure will not form its image in the mirror.



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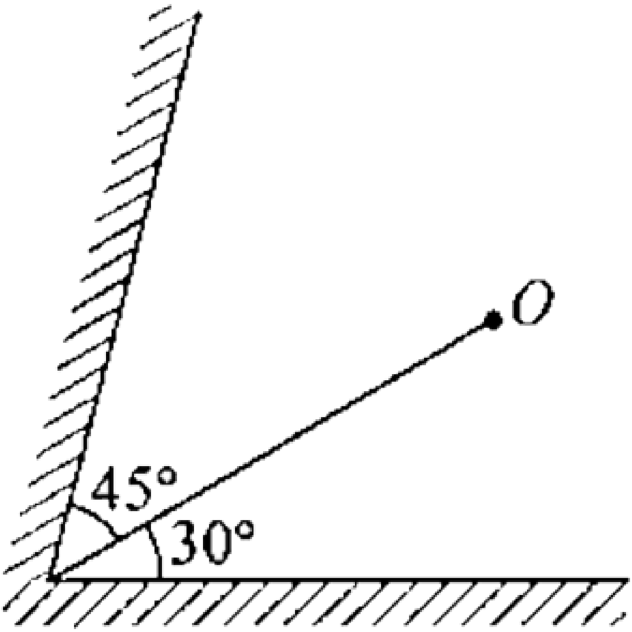
27. Two plane mirrors are inclined at an angle of 75° to each other. Find the total number of images formed when an object is placed as shown in figure



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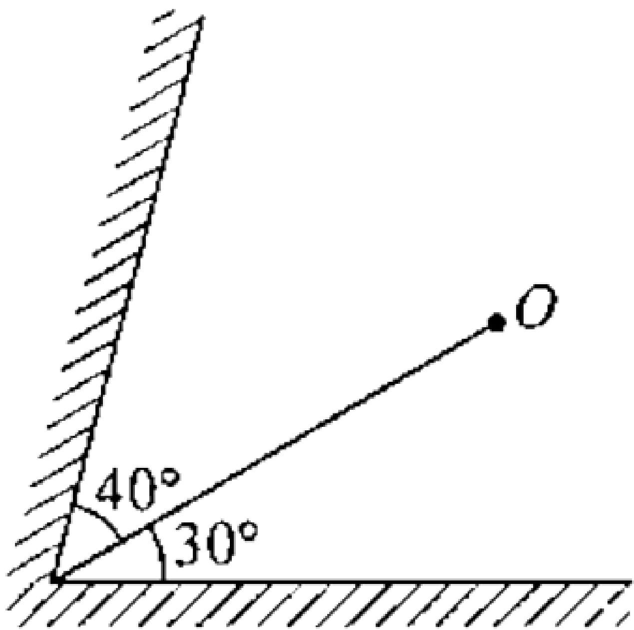
28. Two plane mirrors are inclined at an angle of 70° to each other. Find the total number of images formed when object is placed as shown. In figure-.

Total images = 5



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29. 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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30. A crown glass prism of refracting angle 8° is combined with a flint glass prism to obtain deviation without dispersion. If the refractive indicates for red and violet rays for the crown glass are 1.514 and 1.524 and for the flint glass are 1.645 and 1.665 respectivey, find the angle of flint glass prism and net deviation.

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31. An opaque cylindrical tank with an open top has a diameter of $3.00m$ and is completely filled with water .When the setting sun reaches an angle of 37° above the horizon,sunlight ceases to illuminate any part of the bottom of the tank .How deep is the tank?

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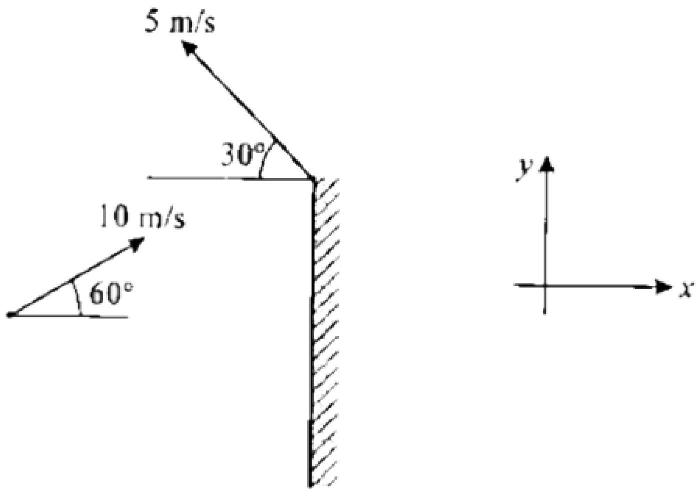
32. In the situation shown in figure, find the velocity vector of image in the co-ordinate system shown in figure



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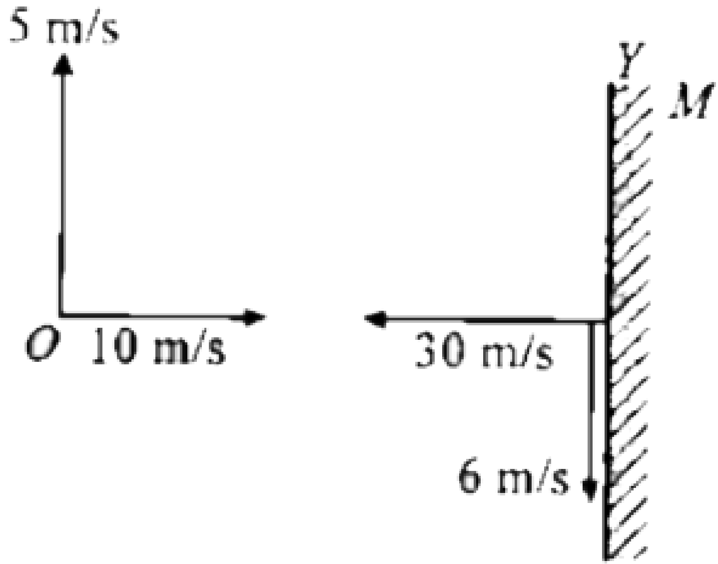
33. Find the velocity of the image of a moving object in situation shown in figure in which object and mirror velocities in horizontal and vertical directions are shown.



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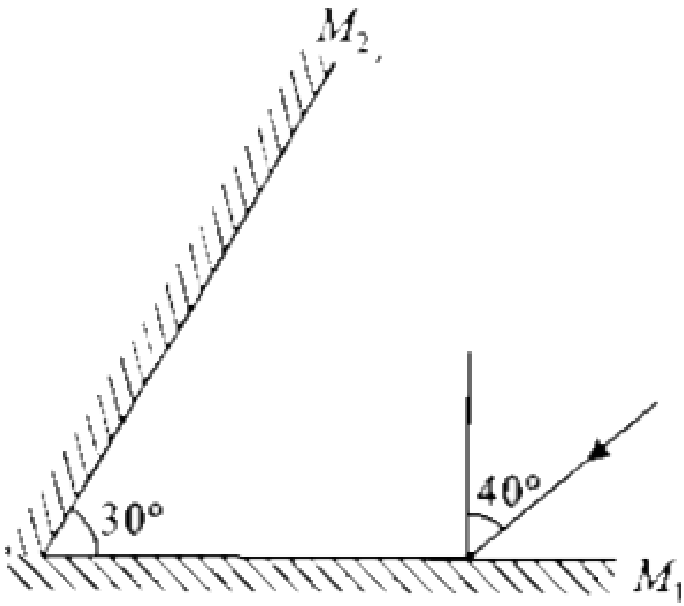
34. Two plane mirrors are inclined to each other at an angle 30° to each other. A ray of light is incident at an angle of 40° to the mirror (M_1). Find the total angle of deviation of the ray after the third successive due to mirrors.



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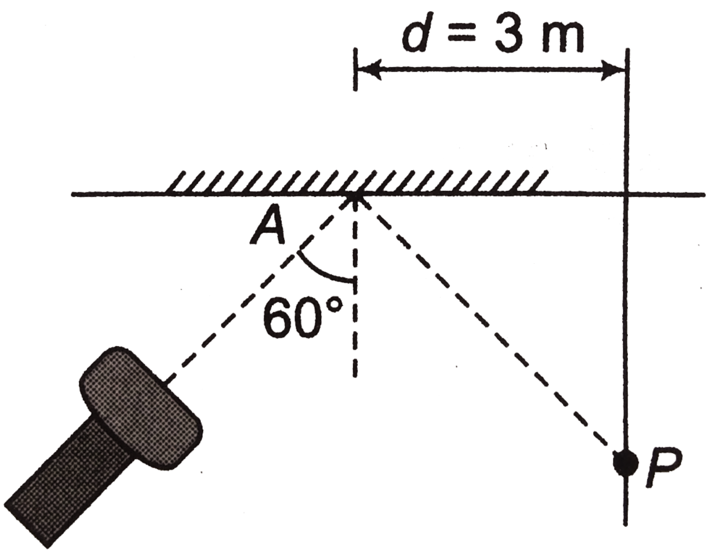
35. Figure shows a torch producing a straight light beam falling on a plane mirror at an angle 60° The reflected beam makes a spot P on the screen along y-axis . If at t=0, mirror starts ratating about the hinge A with an angular velocity $(\omega) = 1^{\circ}$ per second clockwise. Find the speed of the spot on screen after time t = 15 s.



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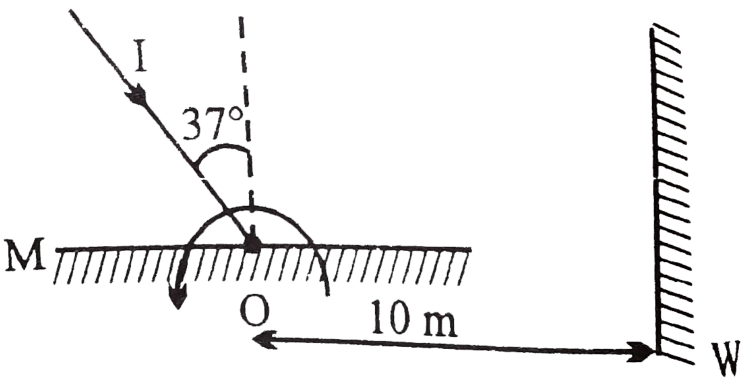
36. A light ray I is incident on a plane mirror M.The mirror is rotated in the direction as shown in the figure by an arrow at frequency $\frac{9}{\pi}\text{rev}/\text{sec}$,The light reflected by the mirror is received on the wall W at a distance $10m$from the axis of rotation .When the angle of incidence becomes 37° find the speed of the spot (a point) on the wall?



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37. A spherical light bulb with a diameter of $3.0 cm$ radiates equally in all the directions with a power of $4.5\pi W$. (a find the light intensity of the surface of the bulb.(b) Find the light set up with its axis pointing towards the bulb.The lens has a circular face with a diameter of $15.0 cm$and a focal length of $30.0 cm$Find the diameter of the image of the bulb formed on a screen kept at the location of the image .(d)Find the light intensity at the image.

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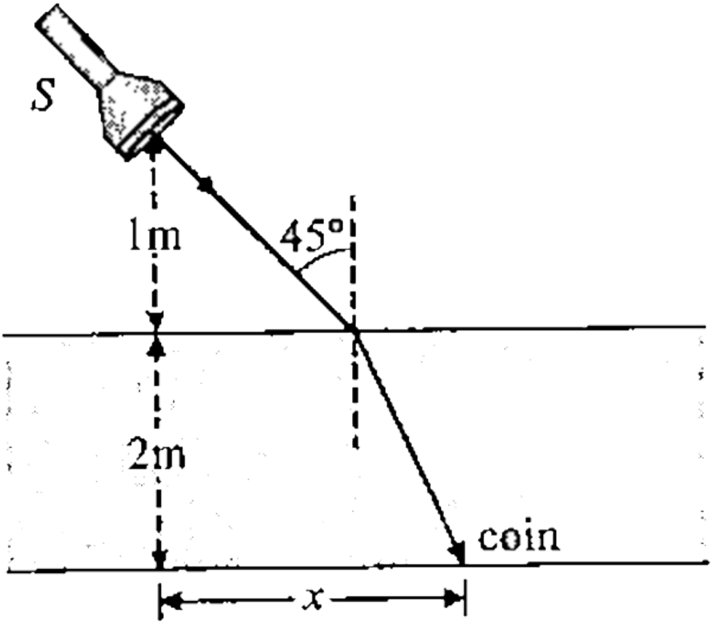
38. A coin lies on the bottom of a lake 2 m deep at a horizontal distance x from the spot light S which is a source of thin parallel beam of light situated 1 m above the surface of the liquid of refractive index p= as shown in figure. The liquid height is 2m. Find x so that a narrow beam of light from S when incident on the liquid surface at incidence angle

45° fells directly on the coin



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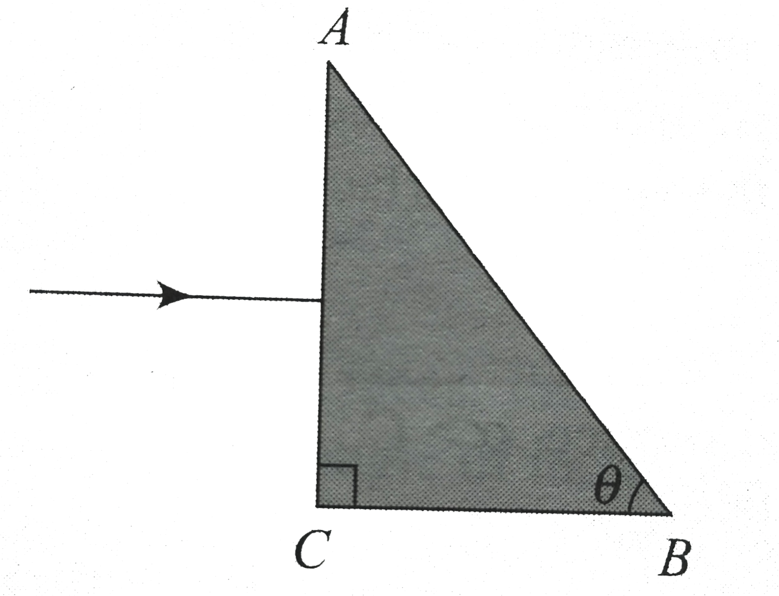
39. What should be the value of angle θ so that light entering normally through the surface AC of a prism $(n = 3/2)$ does not cross the second refracting surface AB?



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40. 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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41. 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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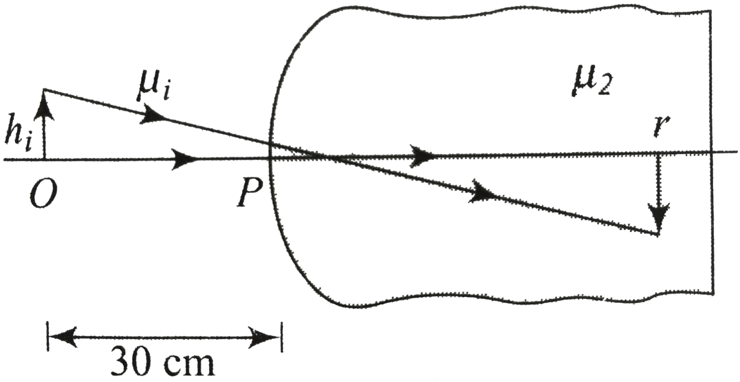
42. A small object of height 0.5 cm is placed in front of a convex surface of glass $(\mu - 1.5)$ of radius of curvature 10cm. Find the height of the image formed in glass.



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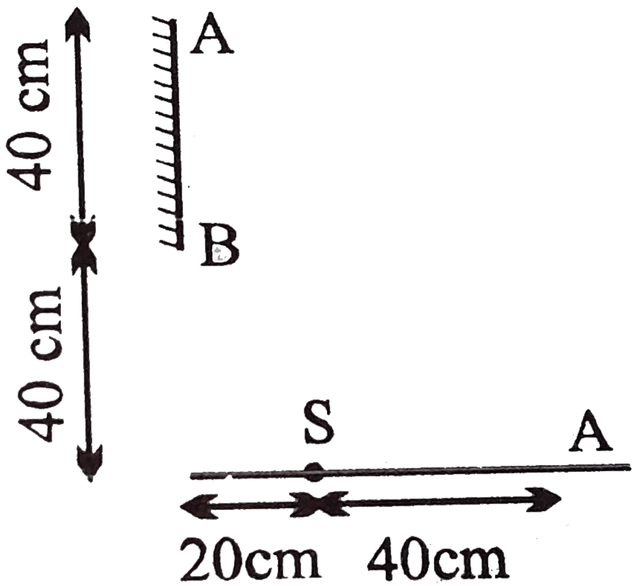
43. in figure shown AB is a plane mirror of length $40cm$ placed at a height $40cm$ from ground . There is a light source S at a point on the ground ,Find the maximum and minimum height of a man(eye height)required to see the image of the source If he is standing at a point A on ground shown in figure.



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44. A plane mirror of circular shape with radius $r = 20cm$ is fixed to the ceiling .A bulb is to be placed on the axis of the mirror.A circular area of radius $R = 1m$ on the floor is to be illuminated after reflection of light from the mirror. The height of the room is $3m$ What is maximum distance from the center of the mirror and the bulb so that the required area is illuminated?

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45. A room contains air in which the speed of sound is $340m/s$. The walls of the room are made of concrete in which the speed of sound is $1700 m / s$ (a) Find the critical angle for total internal refection of sound at the concrete-air boundary.(b) in which medium must the sound be travelling to undergo total internal reflection?

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46. A glass prism has refractive index $\sqrt{2}$ and refracting angle 30° . One of the refracting surface of the prism is silvered. A beam of monchromatic light will retrace it path it its angle of incidence on the unsilvered refracting surface of the prism is

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47. Photograph of the ground are taken form an air-craft ,flying at an altitude of 2000 m by a camera with a lens of focal length $50cm$. The size of the film in the camera is $18 \times 18cm$.What area of the ground can be photography by this camera at any one time.

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48. An equilateral prism deviates a ray through 23° for two angles of incidence differing by 23° find μ of

the prism?

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49. A plano convex lens $(\mu = 1.5)$ has a maximum thickness of $1mm$ .If diameter of its aperture $4cm$ Find

(i)Radius of curvature of curved surface

(ii) its focal length in air.

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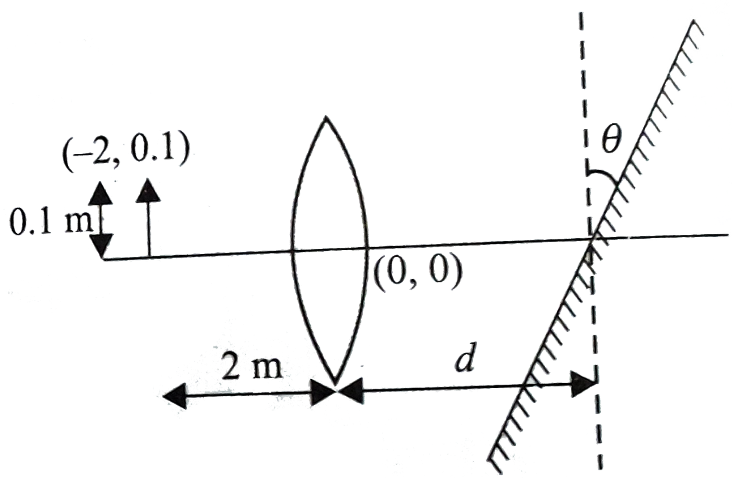
50. A convex lens of focal length 1.5m is placed in a system of coordinate axis such that its optical centre is at origin and principa, axis coinciding with the x-axis. An object and a plane mirror are arrange on theh principal axis as shown in figure. Find value of d (in m) so that y-coordinate of image (after refraction and reflection) is 0.3m. (Take $\tan\theta = 0.3$)



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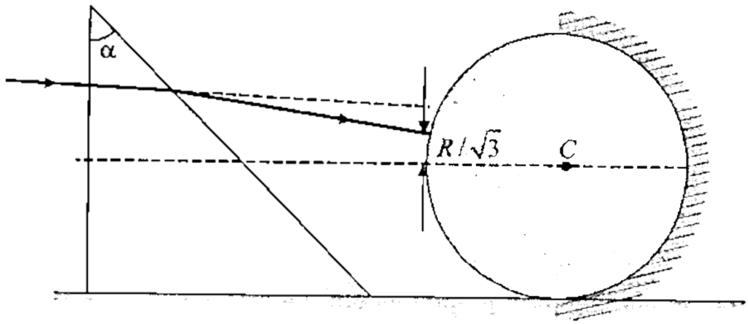
51. A ray in incident normally on a right angle prism whose refractive index is $\sqrt{3}$ and prism angle $\alpha = 30^\circ$. After crossing the prism, ray passes through a glass sphere. It strikes the glass sphere at $\frac{R}{\sqrt{3}}$ distance from principal axis, as shown in the figure. The is half polished. Find the totol angle of deviation of the incident ray after all reflections and refractions from this optical setup



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52. A short-sighted man, the accommodation of whose eye is between 12 cm and 60 cm wears spectacles through which he can see remote objects distinctly. Determine the minimum distance at which the man can read a book through his spectacles.

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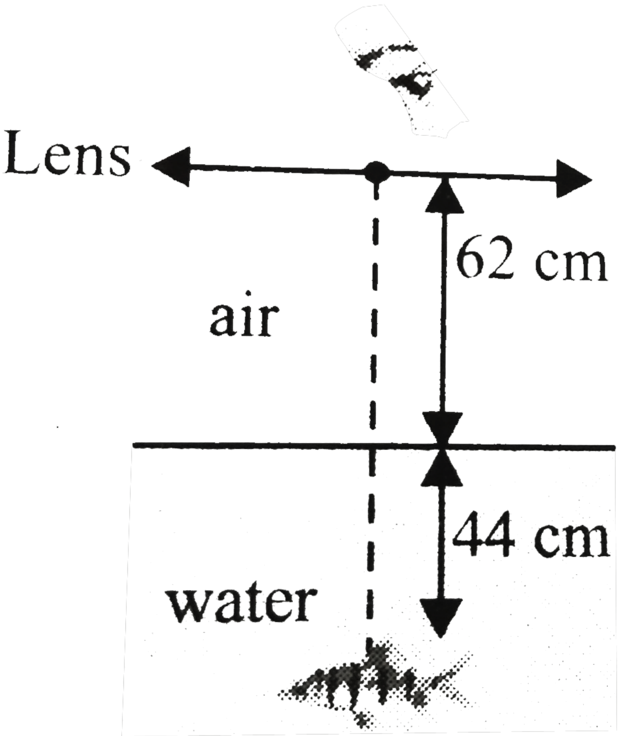
53. A stationary observer O looking at a fish F in water $(\mu_w = 4/3)$ through a converging lens of focal length $90.0cm$. The lens is allowed to fall frelly from a height $62.0cm$ with its axis vertical. The fish and the observer are on the principal axis of the lens. The fish moves up with constant 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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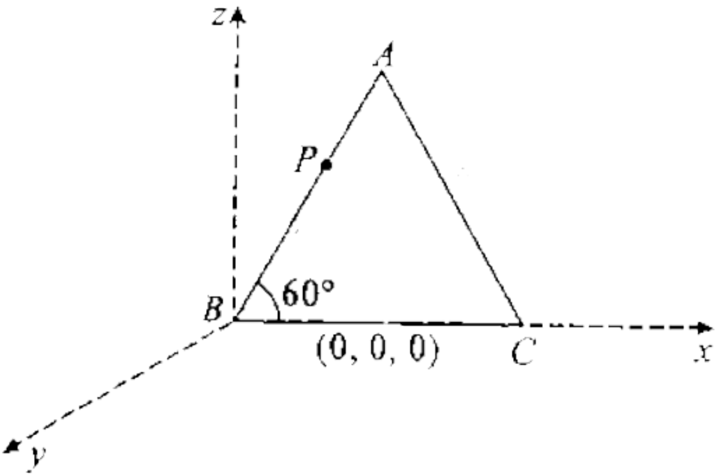
54. An equilateral prism ABC is placed in air with its base side BC lying horizontally along x-axis as shown in the figure. A ray given by $\sqrt{3}z + x = 10$ is incident at a point P on the face AB of the prism

(a) Find the value μ from which the ray grazes the face AB

(b) Find the direction of the initially refracted ray if $\mu = \frac{3}{2}$

(c) Find the equation of ray coming out of the prism if bottom BC is silvered ?



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55. A convex lens of focal length 20 cm and a concave lens of focal length 10 cm are placed 10 cm apart with their principal axes coinciding. A beam of light travelling parallel to the principal axis and having a beam diameter 5.0 mm, is incident on the combination. Show that the emergent beam is parallel to the incident one. Find the beam diameter of the emergent beam.

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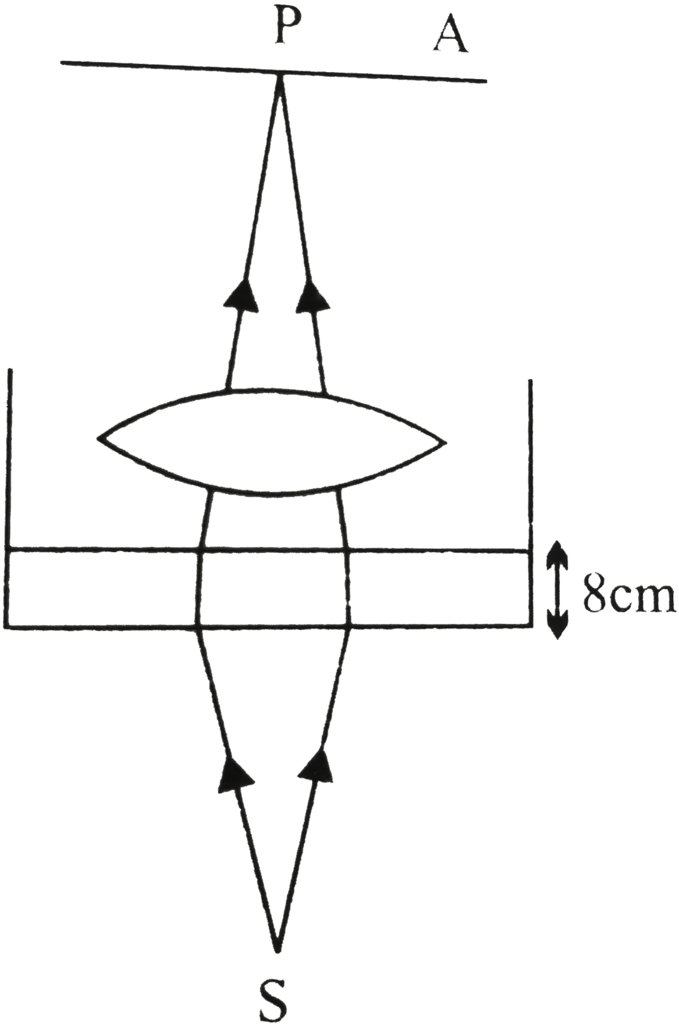
56. A thin convex lens of refractive index $\mu = 1.5$ is placed between a point source of Light S and a screen A, shown in figure,. Light rays from the source S are brought to focus on the screen A, forming a point image P. The distance SP is equal to 50cm. Water $(\mu = 4/3)$ is now poured into a vessel 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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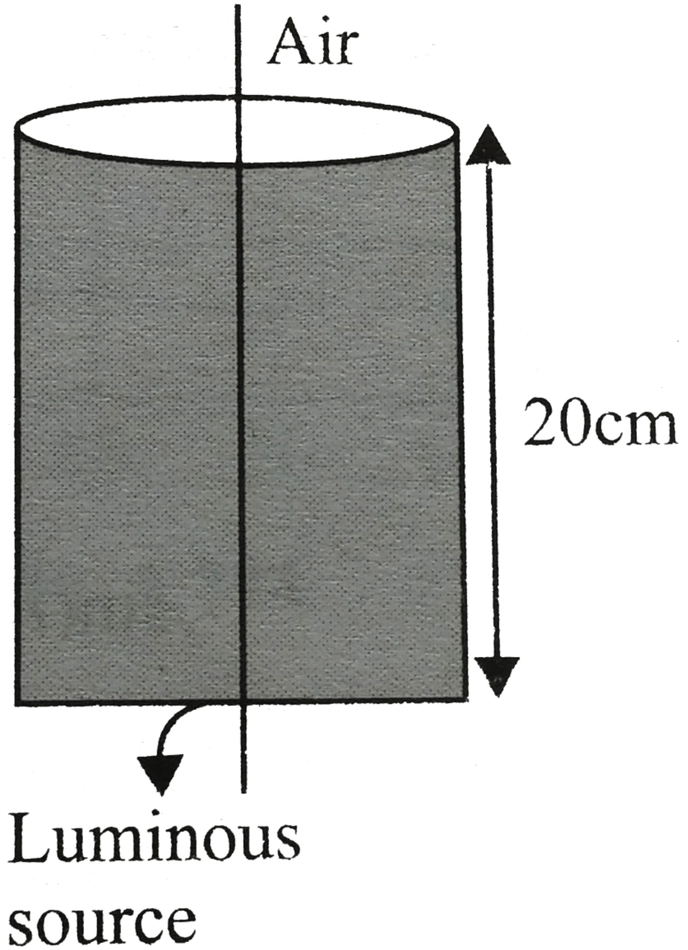
57. A thin equiconvex glass lens $(\mu_g = 1.5)$ is beign placed on the top of a vessel of height $h = 20cm$ as shown figure. A luminous point source is beign placed at the bottom of vessel on the principal axis of the lens. When the air is on both the side of the lens the image of luminous source is formed at a distance of 20cm from the lens out side the vessel. When the air inside the vessel is being replaced by a liquid of refractive index μ_l the image of the same source is being formed at a distance 30cm from the lens outside the vessel. Find the μ_l.



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58. Light passes symmetrically through a 60° prism of refractive index 1.54. After emergence out from the prism the light ray is incident on a plane mirror fixed to the base of the prism extending beyond it. Find the total deviation of the light ray after reflection from the mirror.

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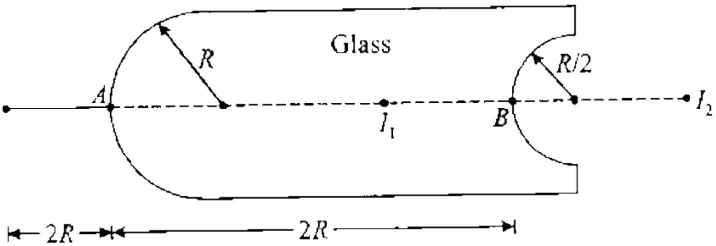
59. A glass rod has ends as shown in figure. The refractive index of glass is μ. The object O is at a distance 2R from the surface of larger radius of curvature. The distance between apexes of ends is

3R. Find the distance of image formed of the point object from right hand vertex. What is the condition on μ for formation of a real image



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60. When the object is placed 4 cm from the objective of a microscope, the final image formed coincides with the object. The final image is at the least distance of distinct vision (24 cm). If the magnifying power of the microscope is 15, calculate the focal lengths of the objective and eye-piece.

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

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62. The focal lengths of the objective and the eye-piece of an astronomical telescope are 0.25 m and 0.02m, respectively. The telescope is adjusted to view an object at a distance of 1.5 m from the objective, the final image being 0.25 m from the eye of the observer. Calculate the length of the telescope and the magnification produced by it.

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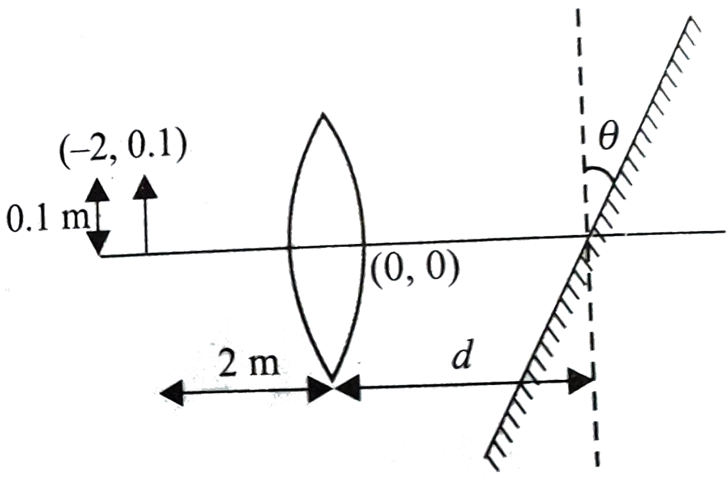
63. A convex lens of focal length 1.5m is placed in a system of coordinate axis such that its optical centre is at origin and principa, axis coinciding with the x-axis. An object and a plane mirror are arrange on theh principal axis as shown in figure. Find value of d (in m) so that y-coordinate of image (after refraction and reflection) is 0.3m. (Take $\tan\theta = 0.3$)



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64. A ball is kept at a height h above the surface of a heavy transparent sphere made of a material of refractive index The radius of the sphere is R. At t = 0, the ball is dropped to fall normally on the sphere. Find the speed of the image formed as a function of time for $t < \sqrt{\frac{2h}{g}}$. Consider only the image by a single refraction.

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65. A prism of angle 60° is made of glass of refractive index 1.50 for red and 1.56 for violet. Find the angular separation of these rays when a narrow pencil of composite light is incident at minimum deviation.

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66. An achromatic telescope objective of focal length 1.5m is consists of two thin lenses of dispersive power 0.050 and 0.075, respectively, placed in contact. Find the focal length of each lens.

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67. Calculate the focal length of a convex lens of crown glass of dispersive power 0.012 and concave lens of dispersive power 0.020 that from an achromatic coverging combination of focal length 0.3 m when placed in contact.

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68. In an astronomical telescope, focal length of objective lens is $75cm$ and that of eye piece is $5cm$

. Calculate the magnifying power and the distance between the two lenses, when final image of distant object is seen at a distance of $25cm$ from the eye.

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69. An astronomical telescope consisting of two convex lenses of focal length 50 cm and 5cm is focussed on the moon. What is the distance between the two lenses in this position ? If the telescope is then turned towards an object 10 m a way, how much would the eye-piece have to be moved to focus on the object without altering the accommodation of the eye ? Calculate the angular magnification produced by the telescope in the two adjustments.

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70. How would you use two plano-convex lenses of focal lengths 6cm and 4cm to design an eye-piece free from chromatic aberration. What will be its focal length and magnifying power for normal vision ? Will it be a positive or negative eye-piece ?

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71. A short-sighted person cannot see objects situated beyond 2m from him distinctly. What should be the power of the lens which he should use for seeing distant objects clearly ?

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72. An astronomical telescope in normal adjustment hasa tube length of 93 cm and magnification (angular) of 30. If the eye-piece is to be drawn out by 3 cm to focus a near object, with

the final image at infinity, find how far away is the object and the magnification (angular) is this case.

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73. The focal lengths of the objective and the eye-piece of an astronomical telescope are 0.25 m and 0.025 m, respectively. The telescope is focussed on an object 5m from the objective, the final image being formed 0.25 m from the eye of the observer. Calculate the length of the telescope and its magnifying power.

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74. A Keplerian telescope with magnification $T = 15$ was submerged into water which filled up the inside of the telescope. To make the system work as a telescope again within the former dimensions, the objective was replaced. What has the magnification of the telescope become equal to ? the refractive index of the glass of which the ocular is made is equal to $n = 1.50$.

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75. A man stands on vertical tower of height 20 cm. Calculate the distance up to which he will be able to see on the surface of the earth. Neglect the height of the man. Take the radius of the earth $= 6400$ km

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76. 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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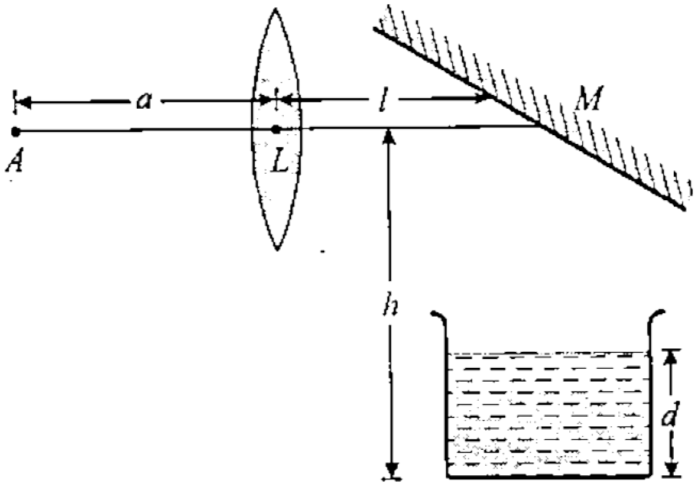
77. An object is at a distance of $a = 36$ cm from a lens with a focal length $f = 30$ cm. A flat mirror turned through 45° with respect to the optic axis of the lens is placed behind at a distance of $l = 1m$. At what distance h from the optic axis should the bottom of a tray filled with water upto depth 20 cm be placed to obtain a sharp image of the object at the bottom ?



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78. The focal length of a thin biconvex lens is $20cm$. When an object is moved from a distance of $25cm$ in front of it to $50cm$, the magni-fication of its image changes from $m_{25} \rightarrow m_{50}$. The ratio $\frac{m_{25}}{m_{50}}$ is.

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79. An object is placed 20 cm to the left of a convex lens of focal length 10 cm. If a concave mirror of focal length 5cm is placed 30 cm to the right of the lens, find the magnification and the nature of the final image. Draw the ray diagram and locate the position of the image.

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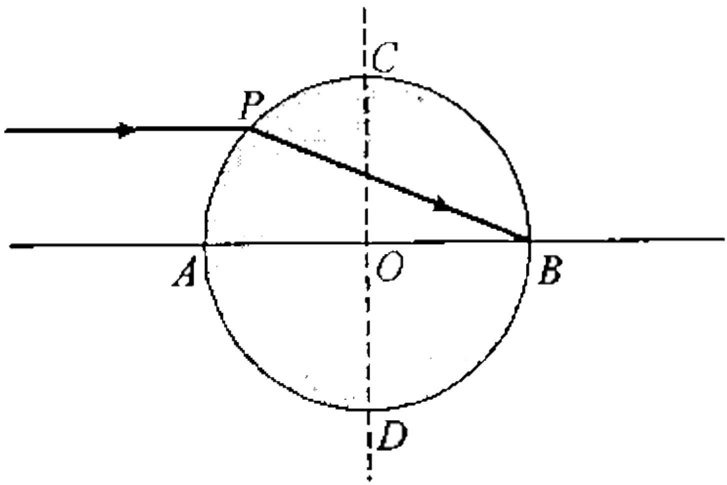
80. A glass sphere with centre O is shown in the figure, AOB and COD are two diameters at right angles to each other. A ray parallel to AOB strikes the sphere at P, a point mid-way between A and C. After refraction, it proceeds along PB. Find



(a) The path of ray beyond B,

(b) The refractive index of glass, and

(c) The deviation of the ray as it emerges out of the sphere.

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81. A hollow sphere of glass of inner and outer radii R and 2R respectively has a small mark on its inner surface. This mark is observed from a point outside the sphere such that the centre of the sphere lies in between. Prove that the mark will appear nearer than it really it, by a distance $(\mu - 1)(R)/(3\mu - 1)$

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82. Two thin similar watch glass pieces are joined together,front to front ,with near convex portion silvered and the combination of glass pieces is placed at a distance $a = 60cm$ from a screen.A small object is placed normal to the optical axis of the combination such that its image is two time the object. Now water is filled in between the glass. water$\mu = 4/3$,calculated the distance through,which the object must be displayed so that a sharp image is again formed on the screen.

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83. Two convex lenses of focal lengths f_1 and f_2 are placed coaxially, a distance d apart. If the axis of one of the lenses is lifted parallel to itself by Δ, find the distance by which the focal point is shifted and the distance of the focal point from the first lens.

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84. A prism of angle 60° deviates a ray of light through 31° for two angles of incidence, which differ by 17°. What is the refractive index of the glass of the prism ?

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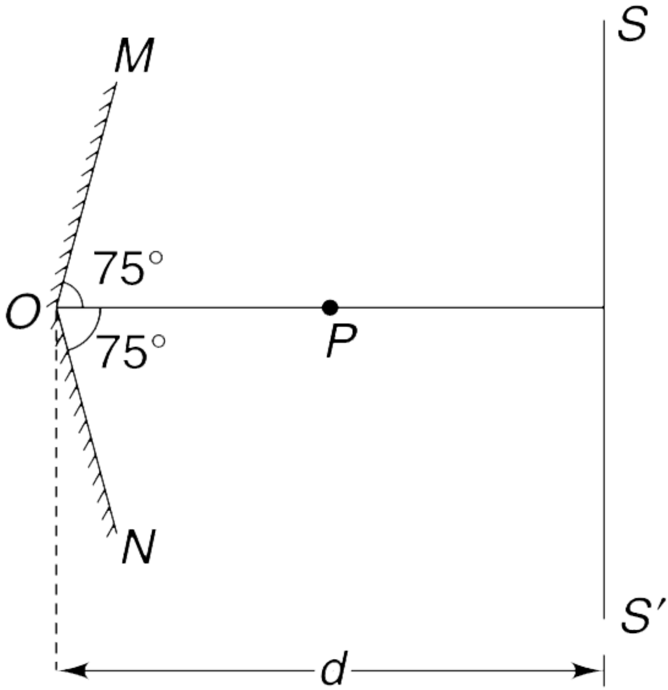
85. Two large plane mirrors OM and ON are arranged at 150° as shown in the figure. P is a point object and SS' is a long line perpendicular to the line OP. Find the length of the part of the line SS' on which two images of the point object P can be seen.



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86. A concave lens of focal length 20 cm is placed 15 cm in front of a concave mirror of radius of curvature 26 cm and further 10 cm away from the lens is placed an object. The principal axis of the lens and the mirror are coincident and the object is on the axis Find the position and nature of the image.

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87. A double convex lens is placed on a horizontal plane mirror. A pin held horizontally above the lens coincides with its own image when it is 18cm from the lens. The space between the lens and the mirror is filled with glycerine and water, turn by turn, and the positions of coincidence of the pin

with the image are 28 cm and 24 cm from the lens, respectively. Calculate the refractive index of glycerine, given that the refractive index of water is 4/3.

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88. A prism has refractive index $\sqrt{\frac{3}{2}}$ and refractive angle 90°. Find the minimum deviation produced by prism

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89. 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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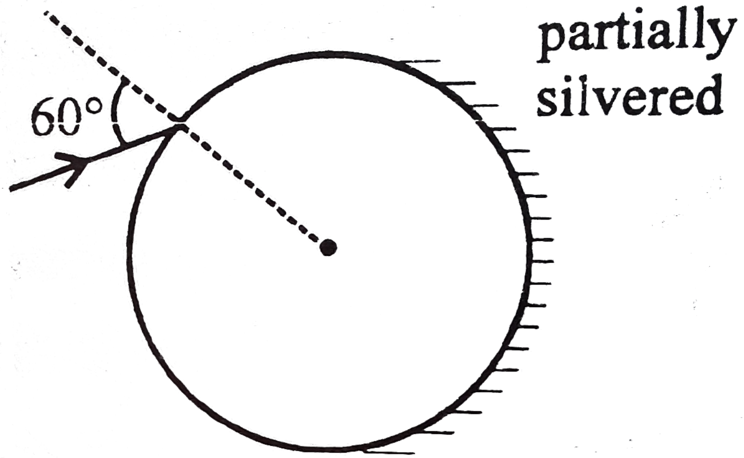
90. A ray is incident on a glass sphere as shown.The opposite surface of the sphere is partially silvered .If the net deviation of the ray transmitted at the partially silvered surface is $1/3^{rd}$of the net deviation suffered by the ray reflected at the partially silvered surface(after emerging out of the sphere).Find the refractive index of the sphere.



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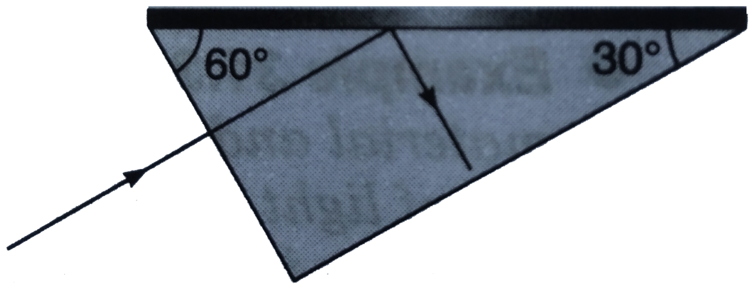
91. Light is incident normally on the short face of a $30^\circ - 60^\circ - 90^\circ$ prism. A liquid is poured on the hypotenuse of the prism. If the refractive index of the prism is $\sqrt{3}$, find the maximum refractive index of the liquid so that light is totally reflected.



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92. A convex lens of crown glass is perfectly cemented to a plano-concave lens of flint glass to form an achromatic combination of power $\div 5D$. Calculate the radii of curvature of the convex lens from the following data.

	Refractive index	Dispersive power
Crown glass	1.50	0.1
Flint glass	1.60	0.02

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93. A converging system of convex lenses free from chromatic aberration and of focal length 2.5 cm is to be constructed by using a convex lens of focal length 2 cm and dispersive power 0.04 and another convex lens of dispersive power 0.03. What should be the focal length of the second lens and at what distance from the first lens should it be placed ?

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94. For a ray of light refracted through a prism of angle 60°, the angle of incidence is equal to the angle of emergence, each equal to 45°. Find the refractive index of the material of the prism.

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95. In a biprism experiment, 21 fringes are seen distinctly on a screen at a distance 1 m, when the sources are 0.5 mm apart. What is the coherent length and coherent time of the set-up. $(\lambda = 6000 Å)$

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96. In a direct vision spectroscope there are two flint glass prisms each of angle 5° and dispersive power 0.36 and two crown glass prisms of dispersive power 0.24. Calculate the angle of each crown glass prism and the net dispersion produced by the system of prisms. $(\mu_{\text{crown}} = 1.5 \text{ and } \mu_{\text{flint}} = 1.68)$

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97. An achromatic doublet of focal length 50 cm is used as an objective of a telescope. The refractive indices of the glasses of the lenes for yellow are 1.6 and 1.5. The radius of curvature of the sides on contact is 15 cm. Find the radii of curvature of the other surfaces. The dispersive powers of the glasses are 0.33 adn 0.24.

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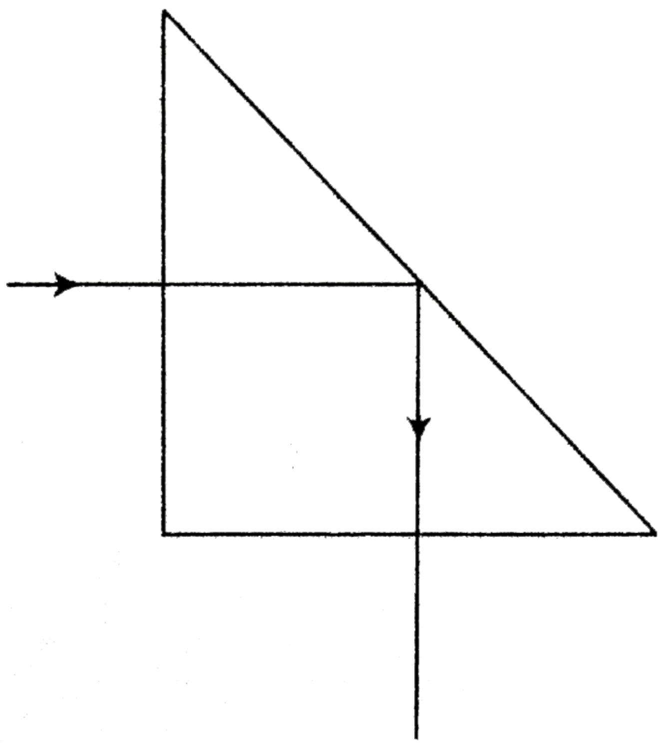
98. A ray of light incident normally on one of the faces of a right-angle isosceles prism is found to be totally reflected as shown in the figure. What is the minimum value of the refractive index of the material of the prism? When the prism is immersed in water, trace the path of the emergent ray for the same incident ray, indicating the values of all the angles ($\mu_\omega = 4/3$).



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99. In a double slit experiment ,the separation between the slits is $d = 0.25cm$ and the distance of the screen $D = 100\text{cm}$ from the slits .if the wavelength of light used in $\lambda = 6000\text{Å}$and $I_0$is the intensity of the central bright fringe.the intensity at a distance $x = 4 \times 10^{-5}$in form the central maximum is-

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100. The focal lengths of the objective and eye-piece of a compound microscope are 1 cm and 5 cm, respectively. An object is placed 11 mm from the objective and the final image is 25 cm from the eye. Find :

(a) magnification produced and

(b) the separation of the lenses.

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101. Two lenses in contact made of materials with dispersive powers in the ratio $2 : 1$ behaves as ab achromatic lens of focal length $10cm$.The individual focal length of the lenses are :

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102. A compound microscope has an objective of focal length 2 cm and eye-piece of focal length 5 cm. The distance between the two lenses is 25 cm. If the final image is at a distance of 25 cm from the eye-piece, find the magnifying power of the microscope. What would be the magnifying power if the microscope were reversed ?

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103. A convex lens of focal length $15cm$ is placed in front of a convex mirror. Both are coaxial and the lens is $5cm$ from the apex of the mirror. When an object is placed on the axis at a distance of $20cm$ from the lens, its is found that image coincides with the object. Calculate the radius of curvature of mirror.

[55cm]

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104. An object of height 4 cm is kept to the left of and on the axis of a converging lens offocal length 10cm at a distance of 15cm from lens. A plane mirror is placed inclined at 45° to the lens axis, 10 cm to the right of the lens.Find the position and size of the image formed by the lens and mirror combination. Trace the path ofthe rays forming the image.

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105. The refractive index of the material of a prism of refracting angle 45° is 1.6 for a certain monochromatic ray. What will be the minimum angle of incidence of this ray on the prism so that no TIR takes place as the ray comes out of the prism.

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

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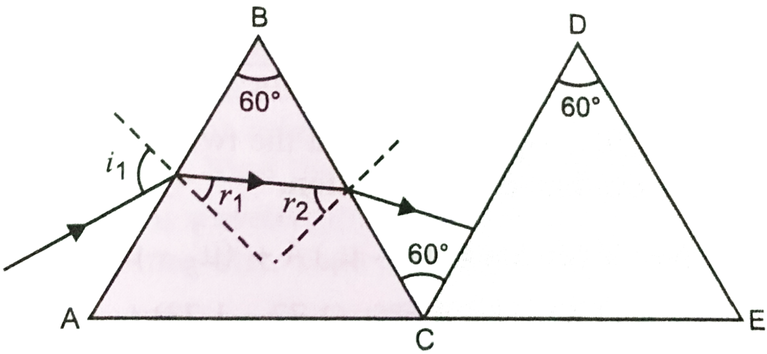
107. A ray of light is incident on a prism ABC of $\mu = \sqrt{3}$ as shown in Fig. Find the angle of incidence for which the deviation of light by the prism ABC is minimum.

By what angle should the second prism be rotated so that final ray suffers net minimum deviation ?



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