PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

RAY OPTICS

Type A

1. An intensity of illumination of 4 flux is required at a distance of 5m from an electric lamp. What

must be the luminous intensity of the lamp?

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2. 2.2% of the light emitted by asource of luminous intensity 500 condela falls normally on a circular surface of radius 10cm. Calculate the average illumination of the surface.

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3. The illuminance of a screen situated at a distance of 5m from an electric bulb of power 500 watt is 120 lumen/m^2. Assuming normal incidence of light on screen calculate (i) the luminous intensity of the bulb and (ii) the luminous efficiency of the bulb.

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4. A 16 cd lamp placed at a distance of 125 cm from a screen produces the same illuminance on the screen as that produced by a bulb placed at

a distance of 175 cm from the scree. If the bulb takes 0.85 A current at 110, find its efficiency.

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5. Two sources of light of equal illuminating power are placed at a distance of 1.2m from one another. Where should a screen be placed between the two sources so that intensity of illumination due to one of the sources is 4 times due to that of the other.

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6. To print a photograph from a negative, the time of exposure to light from a lamp placed 0.50m away is 2.5s. How much exposure time is required if the lamp is placed 1.0w away ?

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7. A lamp placed 70.0 cm from a screen on one side produces the same illumination as a standard 60 cd lamp placed 105 cm away on the other side of the screen. What is the luminous intensity of the first lamp ?

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8. Two sources of light are at distance 0.6m and 0.9m on either side of a screen for matching. When a glass plate is introduced between the weaker source and the screen, the other source has to be moved 0.2m farther to match the illumination. Calculate the percentage of the light stopped by the glass plate introduced.

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9. Two small lamps A and B the first placed at 0.6m to the left of a translucent screen and the second placed at 1m to the right of the screen produced equal illumination on both sides of the screen. A third lamp of the same luminous intensity as that of A is kept to the left of A at a distance of 0.4m from A. By what distance the source B should be moved to produce equal illumination again ?

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10. A point source emitting light uniformly in all directions is placed above a table-top at a distance of 0.50m from it. The luminous flux of the source is 1570 lumen. Find the illuminace at a small surface area of the table top (i) directly above the source and (ii) at a distance of 0.80 m from the source.

11. A small plane source of light has illuminating power of 150 cd along the direction of forward

normal. If the source is perfectly diffused, find the luminous flux emitted into a cone of solid angle 0.02 sr around a line making an angle of 60° with the forward normal.

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12. If anelectric lamp be suspended at a height h from a circular table of radius r, prove that the intensity of illumination at thecentre of the table is $\left(1+\frac{r^2}{h^2}\right)^{3/2}$ times that at the edge of the table.

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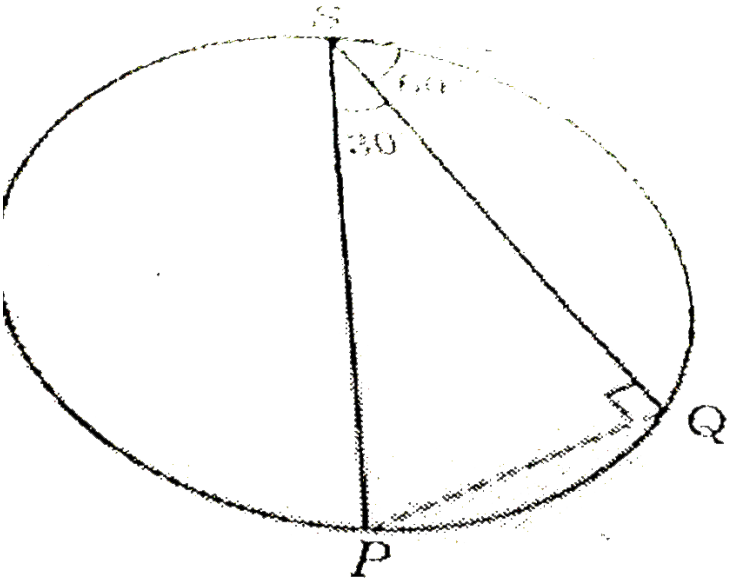
13. Fig. shows the transverse circular section of a tunnel. At the highest point S, a 100 W lamp is lighted. The diameter of the tunnel is 4m. Compare the intensities of illumination at the lowest point P of the tunnel and at a point Q on the wall making an angle of depression of 60° at

the bulb.



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14. Two lamp posts are 12 m apart and are fitted with 1000 cd lamp each at a height of 5m above the ground. Calculate the illumination on the

ground (i) under each lamp and (ii) midway between the two lamps.

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15. Calculate the intensity of illumination at a distance of 0.5m from a source of light of power 200 candela assuming normal incidence.

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Type B

1. The number of images formed by two plane mirrors inclined at 60° of an object placed symmetrically between mirror is

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2. What should be the angle between two plane mirrorrs so that whatever be the angle of incidence, the incident ray and the reflected ray from the two mirrorrs be parallel to each other

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

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4. A boy $1.5m$ tall with his eye level at $1.38m$ stands before a mirror fixed on a wall. Indicate by means of a ray diagram how the mirror should be positioned so that he can view himself

fully. What should be the minimum length of the mirror ? Does the answer depend on the eye level ?

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5. Find the height of the shortest plune mirror fixed vertically on the wall of a room in which a man standing at the centre of the room can see the full image of the wall behind him.

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6. A point object is held between two plane mirrors inclined at 45°. What is the number of images seen ?

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Type C

1. An object 0.05m high is placed at a distance of 0.5m from aconcave mirror of radius of curvature 0.2m. Find the position, nature and the size of the image fored.

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

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3. A $4.5cm$ needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and the magnification. Describe what happens as the needle is moved farther from the mirror.

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

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5. A concave mirror of focal length $10cm$ is placed at a distance of $35cm$ from a wall. How far from the wall should an object be placed to get its image on the wall ?

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6. An object is placed at a distance of 40 cm on the principle axis of a concave mirror of radius of curvature 30 cm. By now much does the image

move if the object is shifted towards the mirror through 15 cm ?

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

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

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9. An object is held in front of a concave mirror of focal length $15cm$. The image formed is 3

times the size of the object. Calculate two possible distances of the object from the mirror.

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10. The distance of an object and its real image, measured from the focus of a concave mirror, are a and b respectively. Show that $f^2 = ab$.

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11. When the distance of an object from a concave mirror is decreased from $15cm$ to 9 cm, the image gets magnified 3 times than that in first case. Calculate focal length of the mirror.

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12. Two objects A and B, when placed one after another in front of a conacve mirror of focal length $10cm$, from images of same size. Size of object A is four times that of B. If object A is placed at a distance of $50cm$ from the mirror,

what should be the distance of B from the mirror ?

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13. Use the mirror equation to deduct that :

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

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

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

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

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

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16. Use the mirror equation to deduct that :

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

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

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

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17. An object is placed at 0.06 m from a convex lens of focal length 0.1m. Calculate the position of the image?

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Type D

1. A ray of light passes through a plane boundary separating two media whose refractive indics are $\mu_1 = 3/2$ and $\mu_2 = 4/3$. (i) If the ray travels from medium 1 to medium 2 at an angle of incidence of 30°, what is the angle of refraction ? (ii) If the ray travels form medium 2 to medium 1 at the same angle of incidence, what is the angle of refraction ?

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2. A film of oil of refractive index 1.20, lies on water of refractive index 1.33. A light ray is incident at 30° in the oil on the oil-water boundary. Calculate the angle of refraction in water.

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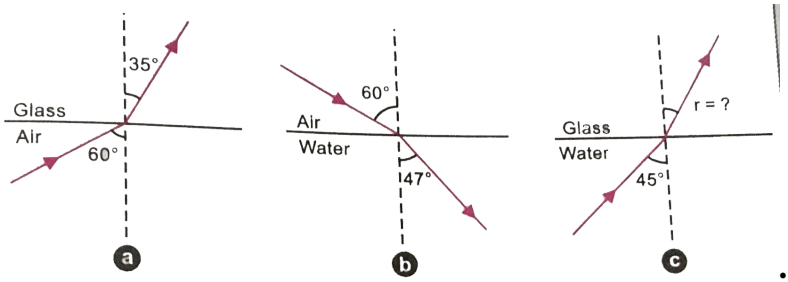
3. Fig. (a) and (b) show refraction of an incident ray in air at 60° with the normal to a glass-air and water-air interface respectively. Predict the

angle of refraction of an incident ray in water at 45° with the normal to a water glass interface. Take $.^a\mu_g = 1.32$.



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4. A rectangular glass slab rests at the bottom of a trough of water. A ray of light incident on water surface at an angle of 50° passes through

water into glass. What is angle of refraction in glass ? Take μ for water $4/3$ and μ for glass $3/2$.

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5. The apparent depth of an object at the bottom of tank filled with a liquid of refractive index 1.3 is 7.7 cm. what is the actual depth of the liquid in the tank ?

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

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7. The velocity of light In a transparent medium is $1.8 \times 10^8 ms^{-1}$, while that in vacuum is $3 \times 10^8 ms^{-1}$. Find the how much the botton of the vessel containing the liquid apperas to be raised if the depth of the liquid is 0.25 m.

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8. A small pin fixed on a table top is viewed from above from a distance of $50cm$. By what distance would the pin appear to be raised, if it be viewed from the same point through a $15cm$. Thick glass

slab held parallel to the table ? μ of glass 1.5 Does the answer depend on location of the slab ?

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

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10. The bottom of a container is a 4.0 cm thick glass $(\mu = 1.5)$ slab. The container contains two immiscible liquids A and B of depth 6.0 cm and 8.0 cm respectively. What is the apparent position of a scratch on the outer surface of the bottom of the glass slab when viewed through the container? Refractive indices of A and B are 1.4 and 1.3 respectively.

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

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12. One face of a glass cube of side $0.06m$ from the face opposite to the silvered face. Object is

0.07 m away from the unsilvered face. Looking from the object side, the image of the object appears to be $0.11m$ behind the silvered face. Calculate the refractive index of material of glass.

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13. A ray of light is incident at angle i on a rectangular slab of thickness t and refractive index μ. Show that the lateral displacement of the emergent ray is

$x = t \sin i \left[1 - \frac{\cos i}{\left(\mu^2 - \sin^2 i\right)^{1/2}}\right]$ Can x exceed t ?

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

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Type E

1. The critical angle for water is 48.2°. Find is refractive index.

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2. Find the value of critical angle for a material of refractive index $\sqrt{3}$.

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3. A ray of light passes from glass $(\mu_g = 1.52)$ to water $(\mu_w = 1.33)$. What is the critical angle of incidence?

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

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

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

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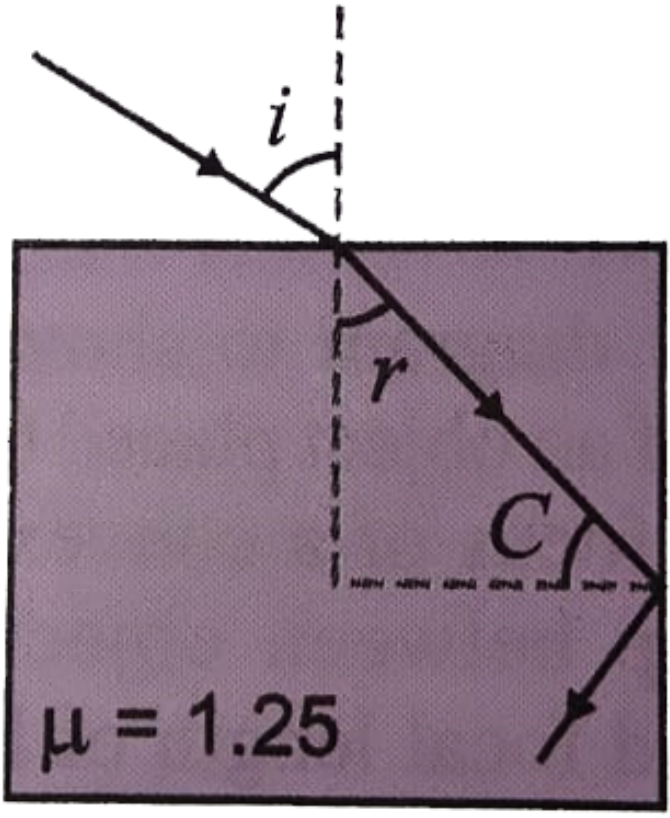
7. In Fig. find the maximum angle i for which light suffers total internal reflection at the vertical surface.



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

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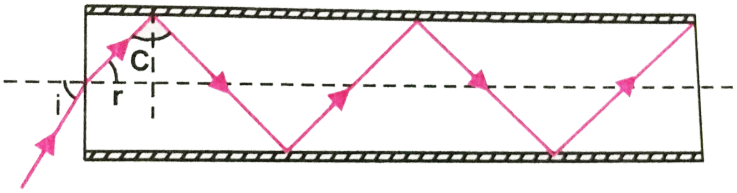
9. (a) Fig. shows a cross-section of a 'light pipe' made of a glass fibre of refractive index 1.68. The outer covering of the pipe is made of a material of refractive index 1.44. What is the axis of the pipe for which total reflection inside the pipe take place as shwon.

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



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

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Type F

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

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2. A glass dumbbell of length $30cm$ and refractive index 1.5 has ends of radius of curvature $3cm$. A point object is situated at a distance of $12cm$ from one end of dumbbell. Find the position of the image formed due to refraction ai one end only.

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

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4. What curvature must be given to the bounding surface of $\mu = 1.5$ for virtual image of an object in the medium of $\mu = 1at10cm$ to be formed at a distance of $40cm$. Calculate power of

the refracting surface and also two principal focal lengths of the surface.

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

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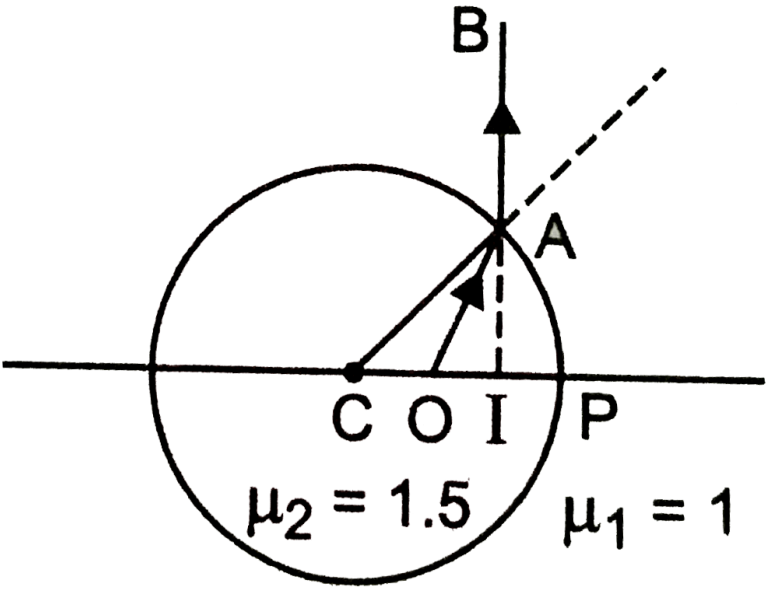
6. A small air bubble in a glass sphere of radius $2cm$ appears to be $1cm$ from the surface when looked at, along a diameter. If the refractive index of glass is 1.5, find the true position of the air bubble.



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

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

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9. 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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10. A convex surface of radiys of curvature 20 cm separates air from glass of refractive index 1.5.

Find the position and the nature of the image of a small object placed at 50 cm in front of the convex surface.

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Type G

1. A double convex lens is made of glass of refractive index 1.5. If its focal length is 30 cm, then radius of curvature of each of its curved surface is

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

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

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4. A biconvex lens has a focal length half the radius of curvature of either surface. What is the refractive index of lens material ?

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5. A double convex lens has focal length 25 cm. The radius of curvature of one of the surfaces is double of the other. Find the radii, if the refractive index of the material of the lens is 1.5.

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6. A plano-convex lens $\mu = 1.5$ has focal length of 18 cm in air. Calculate the radius of curvature of the spherical surface.

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

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8. The radii of curvature of double convex lens are 10 cm and 20 cm respectively. Calculate its focal length when it is immersed in a liquid of refractive index 1.65. State the nature of the lens in the liquid. The refractive index of glass is 1.5.

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9. If the refractive index from air to glass is 3/2 and that from air to water is 4/3, find the ratio of

focal length of a glass lens in water and in air.

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10. A double convex lens has a focal length of 25 cm in air. When it is dipped into a liquid of refractive index 4/3. its focal length is increased to 100 cm. Find the refractive index of the lens material.

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

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

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

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14. Calculate angle of dispersion between red and violet colours produced by a flint glass prism of refracting angle 60°. $\mu_v = 1.663$ and $\mu_r = 1.622$.

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

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

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

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18. The refractive indices of a prism for red, violet and yellow lights are $1.52, 1.62$ and 1.59 resp. What is the dispersive power of the prism ? If

mean deviation is 40°. What is angular dispersion produced by the prism ?

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19. The radii of curvature of a double convex lens are 30 cm and 60 cm and its refractive index is 1.5. calculate its focal length.

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Type H

1. An object is kept at 0.2m from a convex lens of focal length 0.15 m. Find the position of the image produced.

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

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3. A needle of height 5 cm placed 45 cm from a lens forms an image on a screen placed 90 cm on the other side of the lens the type of lens and its focal length are

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4. Converging light rays are falling on a convex lens. If the focal length of the lens is 30 cm, then find the position of the image.

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

(a) a convex lens of focal length $20cm$. (b) a concave lens of focal length $16cm$?

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6. A convergent beam of light passes through a diverging lens of focal length $0.2m$ and comes to focus at a distance of $0.3m$ behind the lens.

Find the position of the point at which the beam would converge in the absence of the lens.

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

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

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

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

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11. Use the thin lens formula to show that an object placed within the focus of a convex lens produces a virtual and enlarged image.

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12. Use the thin lens formula to deduce algebraically that a concave lens produces a virtual and diminished image independent of the location of the object.

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

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14. Aluminous object and a screen are placed on an optical bench and a converging lens is placed between them to throw a sharp image of the object on the screen, the linear magnification of the image is found to be 2.5. The lens is now moved 30 cm nearer the screen and a sharp image is again formed. Calculate the focal length of the lens.

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15. An object and a screen are placed 80 cm apart. There are two positions at which a convex lens forms a real image on the screen, the magnification in the cases being 3/2 and 2/3. Calculate the focal length of the lens.

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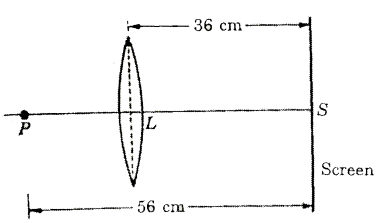
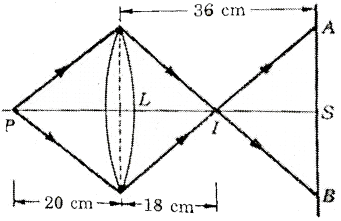
16. In Fig. a convex, lens L is placed at a distance of 36 cm from a screen. If a point-source P is placed at 56 cm from the screen then a circular spot of light of diameter equal to the diameter

of the lens is formed. Show the image formation by a ray diagram. Calculate upto what distance the source be displaced so that its clear image can be formed on the screen.





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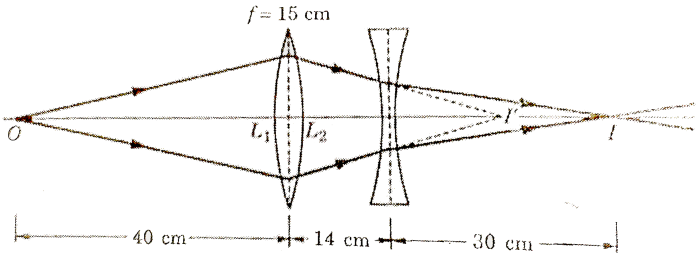
17. In the following ray diagram are given the position of an object O, image I and two lenses L_1 and L_2. The focal length of L_1 is also given.

Find the focal length of L_2.



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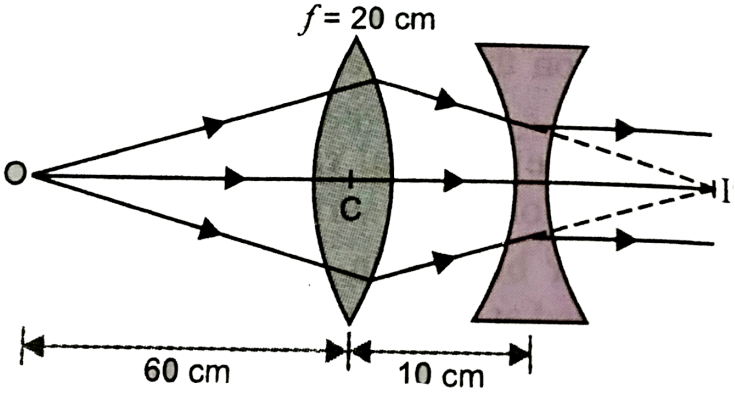
18. From the ray diagram shown in Fig. calculte the focal length of concave lens.



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19. Where should an object be placed from a converging lens of focal length 20 cm, so as to obtain a real image of magnification 2?

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Type I

1. If a spherical lens has a power of, -0.25 D, the focal length of this lens will be:

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2. The radius curvature of each surface of a convex lens of refractive index 1.5 is 40 cm. Calculate its power.

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3. Convex lens is made of glass of refractive index 1.5 If the radius of curvature of each of the two surfaces is $20cm$ find the ratio of the powers

of the lens, when placed in air to its power, when immersed in a liquid of refractive index 1.25.

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4. Two thin lenses of focal length $+10$ cm -5 cm are kept in contact. What is the (i) focal length and (ii) power of the combination ?

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5. A convex lens of focal length 30 cm and a concave lens of focal length 0.6m are placed in contact. Find the power of the combination.

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6. Two lenses of powers $-1.5D$ and $+2.75D$ are kept in contact. Find the focal length of the combination.

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

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8. Derive the relation : $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$,where f_1 and f_2 are focal length of two thin lenses and F is the focal length of the combination in contact.

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9. A small object is placed at a distance of 15 cm from two coaxial thin lenses in contact. The focal length of each lens is 25 cm. what will be the distance between the object and its image when both the lenses are (i) convex, (ii) concave.

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10. 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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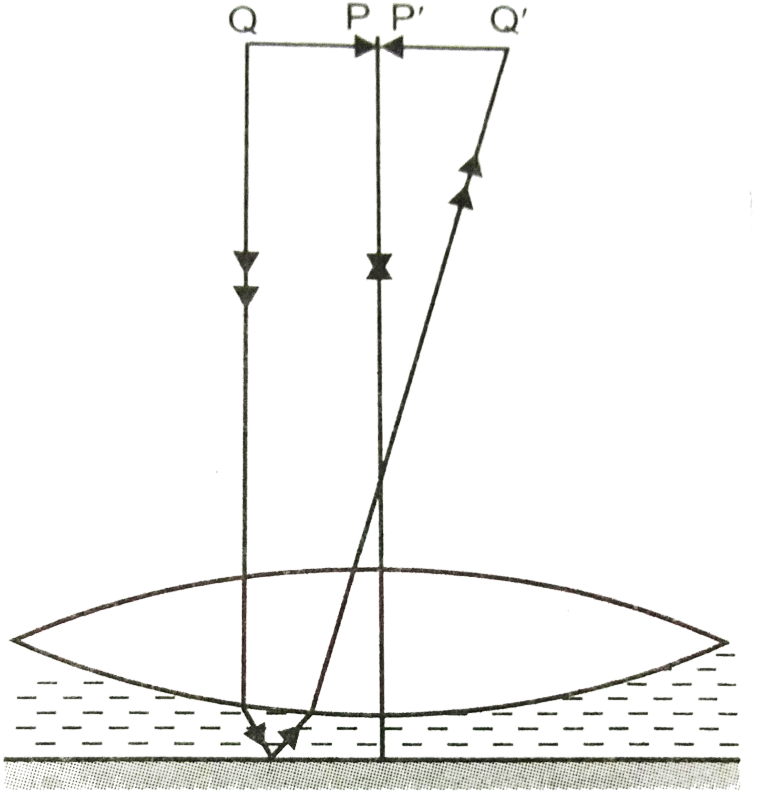
11. Fig. shows an equiconvex lens (of refractive index 1.5) in contact with a liquid layer on top of a plane mirror. A small needle with its tip on the principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of the needle from the lens

is measured to be $45.0cm$. The liquid is removed and the experiment is repeated. The new distance is measured to be $30.0cm$. What is the refractive index of the liquid ?



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12. Two thin lenses of focal lengths 15 cm and 30 cm resepectively are kept in contact with each other. What is the power of the combined system?

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Type J

1. A ray of light passes through an equilateral prism (refractive index 1.5) such that angle of

incidence is equal to angle of emergence and the latter is equal to $3/4th$ of the angle of prism. Calculate the angle of deviation.

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2. 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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3. Calculate the refractive index of the material of an equilaterial prism for which angle of minimum deviation is 60°.

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4. A ray of light incident at an angle of 48° is refracted through a prism in its position of minimum deviation. The angle of prism is 60°.

Calculate the refractive index of the material of the prism. $(\sin 48^\circ = 0.74, \sin 30^\circ = 0.50)$

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5. The refraction index of a prism of angle 60° is 1.62 for sodium light. What is the angle of minimum deviation.

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

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7. A prism is found to give a minimum deviation of 51°. The same prism gives a deviation of $62^\circ 48'$ for two values of the angles of incidence $40^\circ 6'$ and $82^\circ 42'$. Determine the refracting

angle of the prism and the refractive index of the prism material.

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8. The minimum deviation produced by a glass prism having an angle of 60° is 30°. If the velocity of light in vacuum is $3 \times 10^8 ms^{-1}$, calculate the velocity in glass.

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

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

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11. A ray of light is inclined to one face of a prism at an angle of 60°. If angle of prism is 60° and the ray deviated through an angle of 42° find

the angle which the emergent ray makes with second face of the prism.

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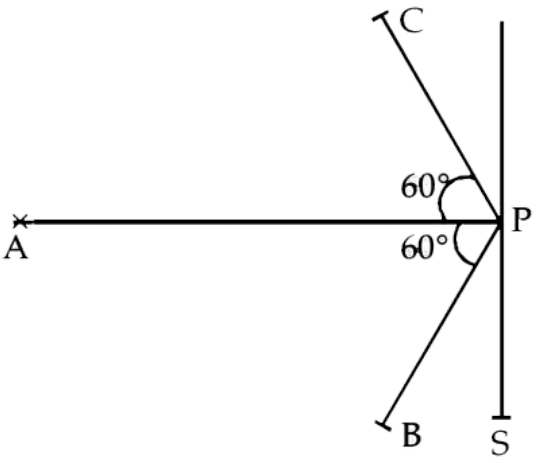
Problems

1. Screen S is illuminated by two point sources A and B. Another source C sends a parallel beam of light towards point P on the screen (see figure). Line AP is normal to the screen and the lines AP, BP and CP are in one plane. The distance AP, BP and CP are 3m, 1.5m and 1.5m respectively. The

radiant powers of sources A and B are 90 watts and 180 watts respectively. The beam from C is of intensity $20(\text{watts})/(m^2)$. Calculate the intensity at P on the screen. `



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2. A motor car is fitted with a convex driving mirror of focal length $20cm$. A second motor car is $6m$ away from the driving mirror of the first car. Calculate (i) position of second car as seen in the first car mirror.

(ii) if the second car is overtaking the first car at a relative speed of $15m/s$, how will its image be moving and in what direction ?

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3. Glycerine (refractive index 1.4) is poured into a large jar of radiys 0.2m to a depth of 0.1m. There is a small light source at the centre of the bottom of the jar. Find the area of the surface of glycerine through which the light passes.

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4. 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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5. A ray of light travelling in glass $\left(\mu_g = 3/2\right)$ is incident on a horizontal glass-air surface at the critical angle θ_C. If a thin layer of water $(\mu_w = 4/3)$ is now poured on the glass-air

surface. At what angle will the ray of light emerges into water at glass-water surface?

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6. 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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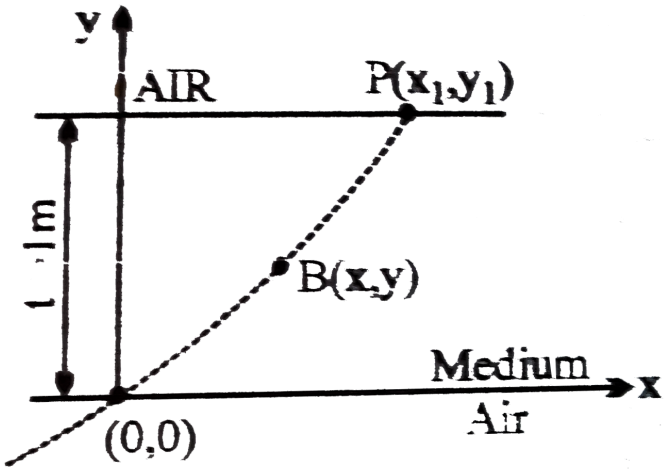
7. A ray of light travelling in air is incident at grazing angle (incident angle=90°) on a long rectangular slab of a transparent medium of thickness $t = 1.0$ (see figure). The point of incidence is the origin $A(O, O)$ .The medium has a variable index of refraction n(y) given by : $n(y) = \left[ky^{3/2} + 1\right]^{1/2}$,where k=$1.0m^{-3/2}$.the

refractive index of air is 1.0`



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

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

(ii) Determine the coordinates (x_1, y_1) of the point P.where the ray the ray intersects upper

surface of the slab -air boundary.

Indicate the path of the ray subsequently.

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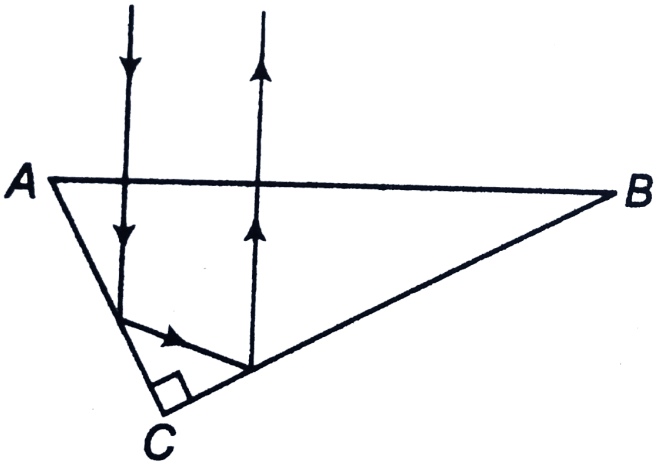
8. A right angled prism is to be made by selecting a proper material and the angles A and B `(B <= A), as shown in figure. It is desired that a ray of light incident on the face AB emerges parallel to the incident direction after two internal reflections.



(a) What should be the minimum refractive index n for this to be possible?

(b) For $n = \frac{5}{3}$ is it possible to achieve this with the angle B equal to 30 degrees?

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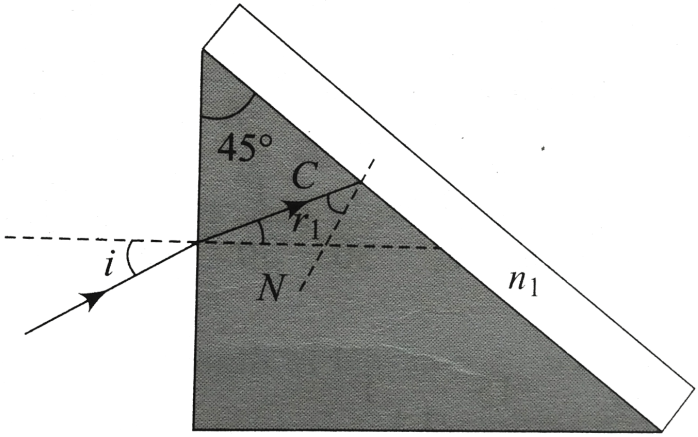
9. A right angles prism $(45^\circ, 90^\circ, 45^\circ)$ of refractive index n has a plate of refractive index $(n_1 < n)$ cemented to its diagonal face. The assembley is in air. A ray is incident on AB.

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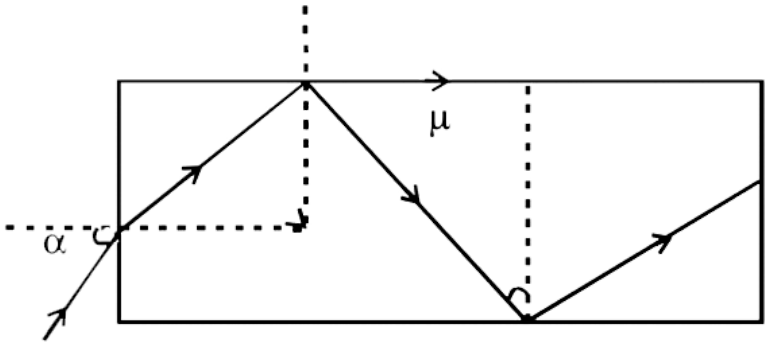
10. Light is incident at an angle α on one planar end of a transparent cylindrical rod of refractive index μ. Determine the least value of μ so that the light entering the rod does not emerge from

the curved surface of rod irrespective of the value of α `



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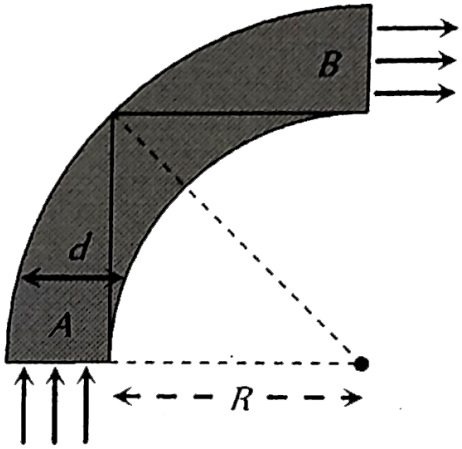
11. A rod of glass $(\mu = 1.5)$ and of square cross section is bent into the shape shown in the figure. A parallel beam of light falls on the plane

flat surface A as shown in the figure. If d is the width of a side and R is the radius of circular arc then for what maximum value of $\frac{d}{R}$ light entering the glass slab through surface A emerges from the glass through B



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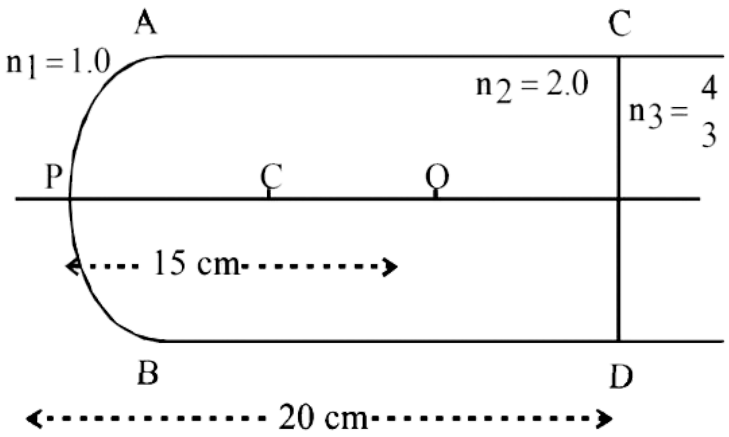

12.

A slab of a material of refractive index 2 shown in fig. has a curved surface APB of radius of curvature 10 cm and a plane surface CD. On the left of APB is air and on the right CD is water with refractive indices as given in the figure. An object O is placed at a distance of 15 cm from the pole P as shown. The distance of the final image of O from P, as viewed from the left is.....

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13. 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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14. 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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15. 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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16. Two point light sources are 24 cm apart. Where should a convex lens of focal length 9 cm be put in between them from one source so that

the images of both the sources are formed at the same place

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

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

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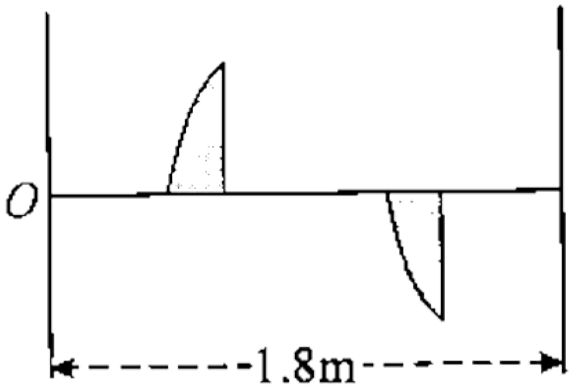
19. A thin plano-convex lens of focal length f is split into two halves. One of the halves is shifted along the optical axis as shown in figure. The separation between object and image planes is 1.8 m. The magnification of the image, formed by one of the ball lens is 2. Find the focal length of the lens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



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20. Two thin similar convex glass are joined together front to front, with its rear portion silvered such that a sharp image is formed $0.2m$ for an object at infinity. When the air between the glass pieces is replaced by water $\left(\mu = \frac{4}{3}\right)$, find the position of image.

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21. 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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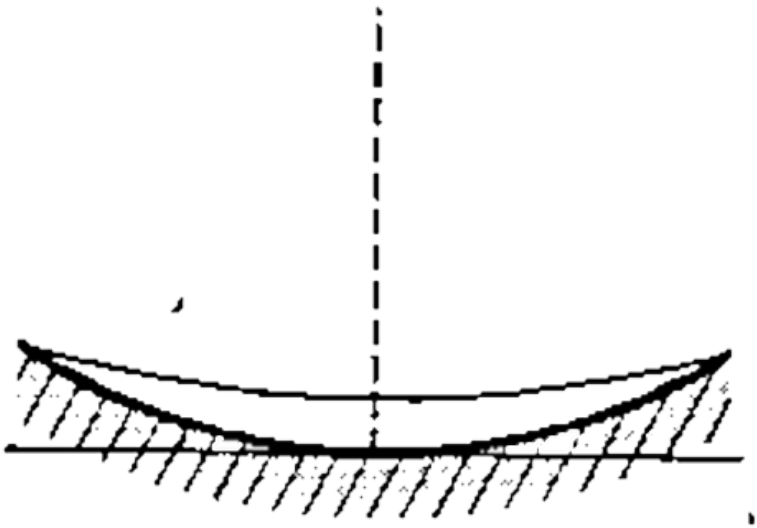
22. The convex surface of a thin concavo-convex lens of glass of refractive index 1.5 has a radius of curvature 20 cm. The concave surface has a radius of curvature 60 cm. The convex side is silvered and placed at horizontal surface as shown in figure.

(i) Where should a pin be placed on the optic axis such that its image is formed at the same place ?

(ii) If the concave part is filled with water of refractive index 4/3, find the distance through

which the pin should be moved so that the image of the pin again coincide with pin.



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23. 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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24. 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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25. A 60° prism has a refractive index of 1.5. Calculate (a) the angle of incidence for minimumdeviation (b) angle of minimum deviation (c) the angle of emergence of light at maximum deviation (d) angle of maximum deviation.

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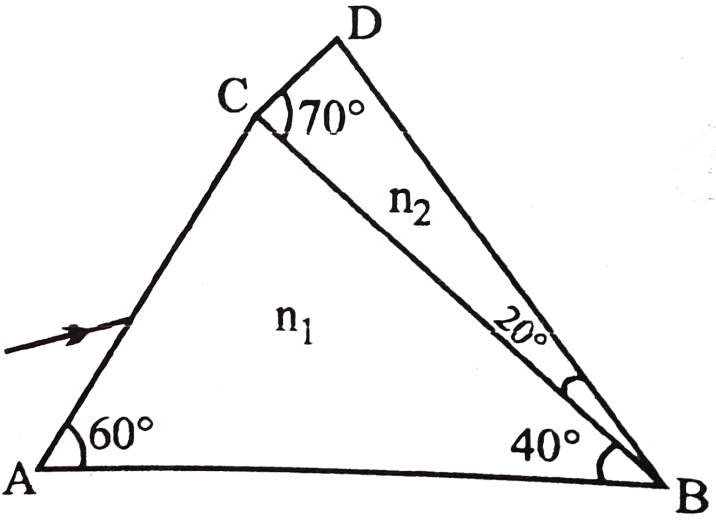
26. A prism of refractive index n_1 & another prism of reactive index n_2 are stuck together without a gap as shown in the figure.The angle of the prisms are as shown. $n_1 \& n_2$depend onλ ,the wavelength of light according to $n_1 = 1.20 + \frac{10.8 \times 10^4}{\lambda^2} \& n_2 = 1.45 + \frac{1.80 \times 10^4}{\lambda^2}$ where λ is in nm.



(i)Calculate the wavelength $\lambda_0$for which rays incident at any angle on the interfaceBCpass through without bending at that interface.

(ii) for light of wavelength λ_0,find the angle of incidencei on faceACsuch that the deviation produced by the combination of prism is minimum.

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Problems For Self Practice

1. A 60W lamp is rated at 0.8 watt/candela. Calculate (i) luminous intensity of the lamp, (ii) luminous flux of the lamp, and (iii) illuminance at a distance of 2m from the lamp.

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2. Iluminance of $2.4 \times 10^5 lm/m^2$ of the surface is produced by sunlight falling normally on the surface of the earth. The distance of the earth the sun is $1.5 \times 10^8 km$. Calculate the luminous intensity and luminous flux of the sun.

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3. The luminous effeciency of a lamp is $51mW^{-1}$ and its luminous intensity is 35 cd. Determine the power of the lamp.

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4. At what distance form a light source of 64 cd, will the intensity of illumination because 4 flux ?

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5. Calculate the illuminance at a surface distance 0.5m from a ligth source of luminous intensity 200 cd, assuming normal incidence. If the area of the surface be $0.25m^2$, what is the luminous flux on this area ?

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6. A good photographic print is obtained by an exposure of 2s at a distance of 1m from a 60 candela lamp. What time of exposure must be

given to get equally satisfactory results at a distance of 2m from a 200 cadela lamp ?

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7. Two lamps of illuminating powers 25 cd and 100 cd are placed at the end of a photometer bench 2.0 m long. At what point on the bench will the screen of the photometer be equally illuminated on both sides.

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8. Two light sources of intensities 8 cd and 12 cd are placed on the same side of a photometer screen at a distance of 40 cm from it. Where should a 80 cd source be placed to balance the illuminance ?

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9. A lamp is hanging at a height of $4m$ above a table. The lamp is lowered by $1m$. The percentage increase in illuminace will be

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10. In Bunsen's grease spot photometer, light from a lamp with dirty chimney is exactly balanced by that of a candle distant 10 cm from the spot. When the chimney is cleaned, the candle has to be shifted by 2 cm to obtain the balance. Calculate the percentage of light absorbed by dirty chimney.

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11. An electric bulb illuminates a plane surface. The intensity of illumination on the surface at a

point 2m away from the bulb is 5×10^{-4} phot. The line joining the bulb to the point makes an angle of 60° with the normal to the surface. calculate the intensity of the bulb in candela ? (1 phot $= 1m/cm^2$).

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12. A lamp is hanging along the axis of a circular table of radius r. at what height should the lamp be placed above the table so that the intensity of illumination at the edge of the table is $\frac{1}{8}$ of that at its centre ?

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13. An electric bulb is hanging above the centre of a circular table of radiys 3m at a height of 3m from the its centre. Find the ratio of illuminance at the centre and at a point on the edge of the table.

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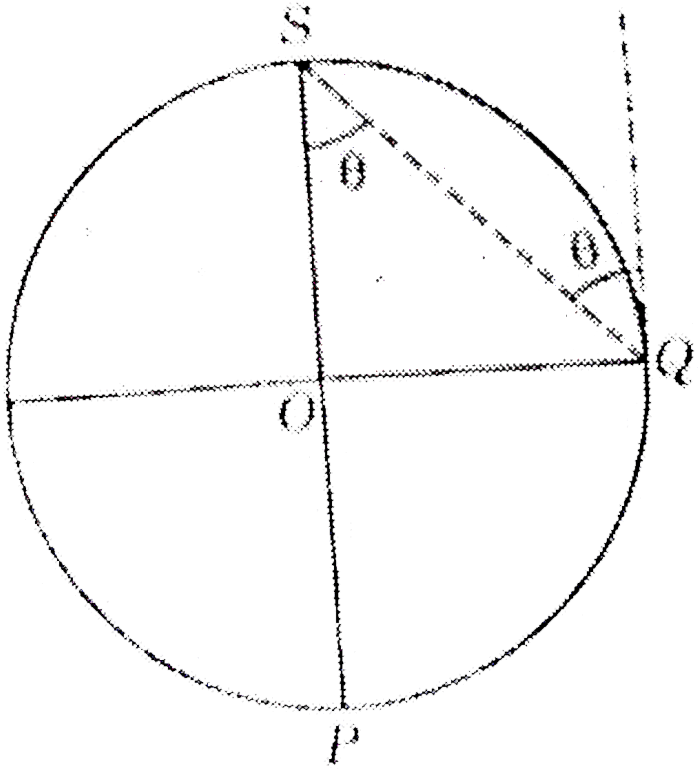
14. In Fig. the circular cross-section of tunnel is shown. A 100 W almp is lighted at the heighest

point S. The diameter of the tunnel is 2m. Compare the illuminance at the lowest point P and the point Q of the tunnel.



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15. A frosted bulb which may be taken as an isotropic source, gives as illumination of $8lm/m^2$ at a distance of 5m. Calculate (i) its luminous intensity and (ii) the total luminous flux from the blub.

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16. A man is running away from a plane mirror at the speed of $5ms^{-1}$. With what speed is he receding from his own image ?

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17. A plane mirror rotating at an angular velocity of 3 radian/s reflects a light beam. The angular velocity of the reflected beam is -

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18. A ray of light is incident at an angle of 60° on a horizontal plane mirror. Through what angle should the mirror be tilted to make the reflected ray horizontal ?

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19. 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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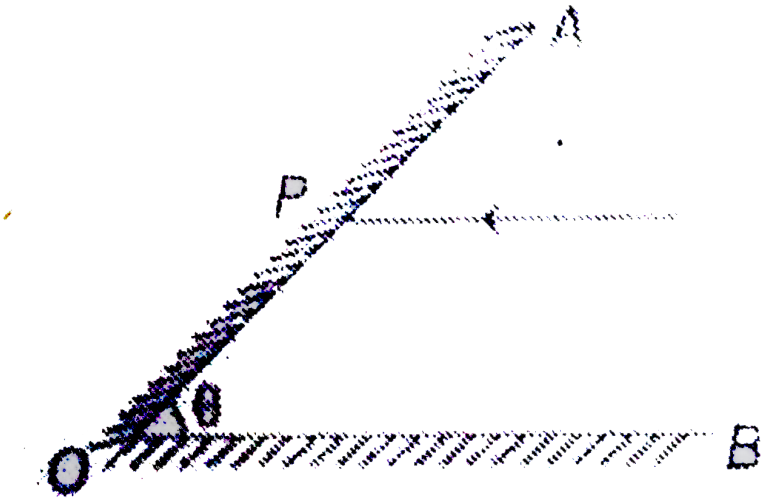
20. Two plane mirrors are inclined at angle θ as shown in figure. If a ray parallel to OB strikes the other mirror at P and finally emerges parallel to

OA after two reflections then θ is equal to



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21. An object 0.04 m high is placed at a distance of 0.8 m from a concave mirror of radius of curvature 0.4 m. find the position, nature and the size of the image formed.

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22. Find the size, nature and position of image formed by a concave mirror, when an object of size 1 cm is placed at a distance of 15 cm. Given focal length of mirror is 10 cm.

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23. An object is placed in front of a concave mirror of radius of curvature $40cm$ at a distance

of $10cm$. Find the position, nature and magnification of the image.

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24. An object is placed at a distance of 15 cm from a convex mirror and images is formed at a distance of 5 cm from the mirror. Calculate the radius of curvature of the mirror.

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25. A convex mirror and a concave mirror of radius 10cm each are placed 15cm apart facing each other. An object is placed midway between them. If the reflection first takes place in the concave mirror and then in convex mirror, the position of the final image is

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26. A candle flame 2 cm high is palced at distance of 2 metere from a wall. How far from the wall

must a concave mirror to placed in order to form an images of the flame 6 cm high on the wall ?

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27. A dentist concave mirror has a radius of curvature of $30cm$. How far must it be placed from a small cavity in order to get a virtual image magnified 5 times ?

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28. Find the position of an object which when placed in front of a concave mirror of focal length 20 cm, produces a virtual image which is twice the size of the object.

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29. A concave mirror forms a real image four times as tall as the object placed 10 cm infront of mirror. Find the position of the image and the radius of curvature of the mirror.

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

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31. A convex mirror produces a magnification of $1/2$ when the object is placed at a position A and a magnification of $1/3$ when the object is at

a position B. If the separation between the positions A and B be 30 cm, what is the focal length of the mirror ?

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32. An object of $1cm^2$ face area is placed at a distance of 1.5m from a screen. How far from the object should a concave mirror be placed so that it forms $4cm^2$ image of object on the screen? Also, calculate the focal length of the mirror.

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33. A rectangular tank 8m deep is full of water. By how much does the bottom appear to be raised if the refractive index of water is $4/3$?

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34. A travelling microscope is focussed on a mark made on a paper. When a slab of $1.45cm$ thickness is placed on the marl, the microscope has to be raised through 0.49 cm to focus the mark again. Calculate the refractive index of glass.

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35. A printed page is kept pressed by a glass cube $(\mu = 1.6)$ of edge 6.0cm. By what amount will the printed letters appear to be shifted when viewed from the top ?

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36. The velocity of light in glass is $2 \times 10^8 ms^{-1}$ while that in vaccum is $3 \times 10^8 ms^{-1}$. By how

much would an ink dot appeat to be raised when covered by a glass plate of 4.5 cm thickness.

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37. Calculate the index of refraction of a liquid from the following into glass:

(a) Reading for the bottom of an empty beaker: 11.324 cm

(b) Reading for the bottom of the beaker, when partially filled with the liquid: 11.802 cm

(c) Reading for the upper level of the liquid in the beaker: 12.895cm

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38. While determining the refractive index of a liquid experimentally, the microscope was focussed at the bottom of a beaker, when its reading was 3.965 cm. on pouring liquid upto a height 2.537 cm inside the beaker, the reading of the refocussed microscope was 3.348 cm. Find the refractive index of the liquid.

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39. A vessel contains water up to a height of 20 cm and above it an oil up to another 20 cm. The refractive indices of the water and the oil are 1.33 and F30 respectively. Find the apparent depth of the vessel when viewed from above.

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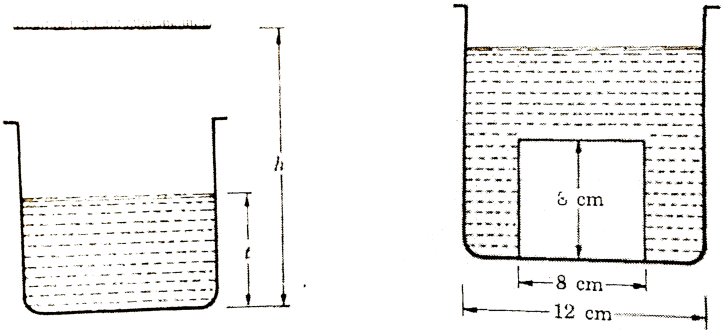
40. In Fig. a plane mirror lies at a height h above the bottom of a beaker containingwater (refractive index μ) upto a height f. Find the

position of the image of the



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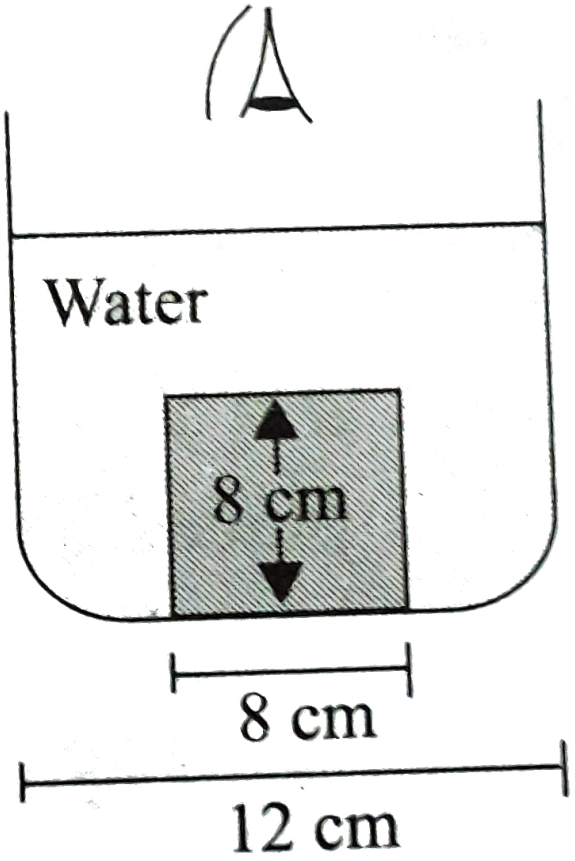
41. A cylindrical vessel of diameter 12 cm contains $800\pi cm^3$ of water. A cylindrical glass piece of diameter $8.0cm$ and height 8.0 cm is placed in the vessel. If the bottom of the vessel under the glass piece is seen by the paraxial

rays, locate its image. The index of refraction of glass is 1.50 and that of water is 1.33.



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42. If critical angle for a material to air is 30°, the refractive index of the material will be

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43. An optical fibre (mu = 1.72) is surrounded by a glass coating (mu= 1.50). Find the critical angle for total internal reflection at the fibre-glass interface.

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

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

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46. A luminous object O is located at the bottom of a big pool of liquid of refractive index μ and depth h. The object O emits rays upwards in all directions, so that a circle of light is formed at the surface of the liquid by the rays which are refracted into the air. what happens to the rays beyond the circle ? Determine the radius and the area of the circle .

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47. One end of a cylindrical rod is grounded to a hemispherical surface of radius $R = 20mm$.It is immersed in water$(\mu = 4/3)$.If the refractive index of the rod is$1.5$and an object is placed in water on the axis at a distance of$10cm$form the pole ,then the position of the image is ..... (determine)

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48. A spherical convex surface separates object and image space of refractive index 1.0 and $\frac{4}{3}$.

If radius of curvature of the surface is $10cm$, find its power.

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

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50. A glass sphere of radius 15 cm has a small bubble 6 cm from its centre. The bubble is viewed along a diameter of the sphere from the side on which it lies. How for from the surface will it appear to be if the refractive index of glass is 1.5 ?

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51. An object is placed $50cm$ from the surface of a glass sphere of radius $10cm$ along the diameter. Where will the final image be formed

after refraction at both the surfaces ? μ of glass $= 1.5.$

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52. A small object is 2 cm below the concave meniscus of water in a test tube . The radius of the meniscus is 5mm and μ for water is $4/3.$ Find the nature and position of the image.

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

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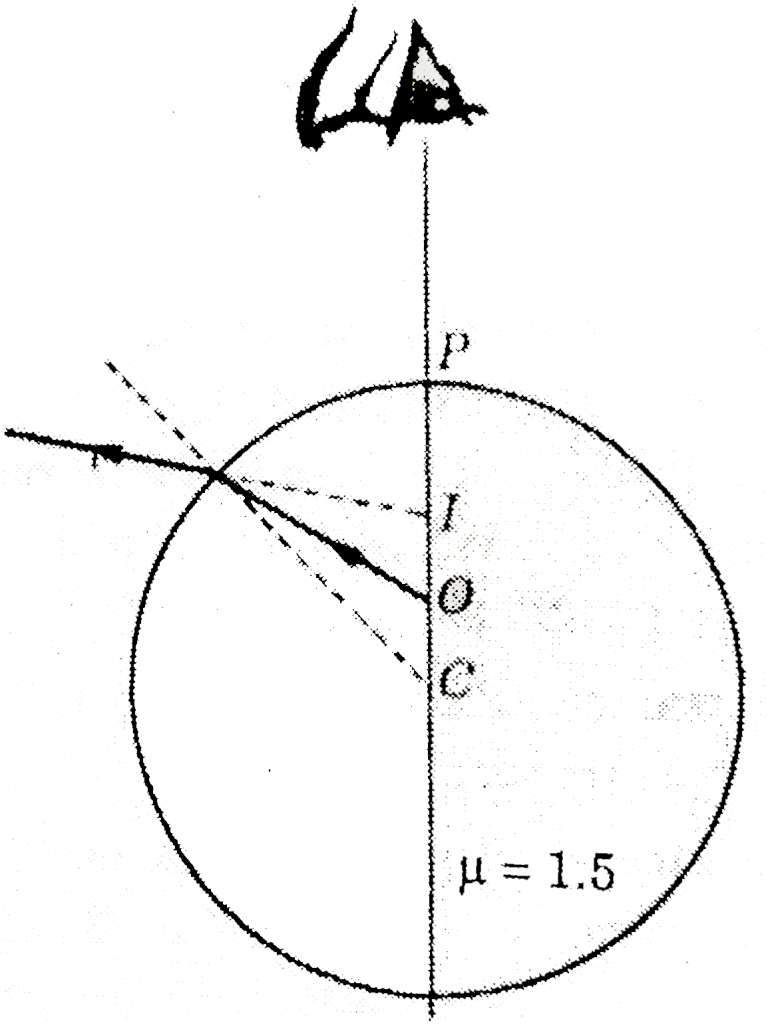
54. Fig shows a small air bubble inside a glass sphere $(\mu = 1.5)$ of radius 10 cm. the bubble is

4.0 cm below the surface and is viewed normally from the outside. Find the apparent depth of the bubble.



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55. A double convex lens has radii 20 cm. The index of refraction of glass is 1.5. Compute the focal length of this lens in air and when immersed in carbon disulphide of refractive index 1.63.

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

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57. Fig. 6(b).54. shows a thin lens with centres of curvature C_1 and C_2. If $\mu = 1.5$, what is its focal length ?

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58. A plano-convex lens $(\mu = 1.5)$ has a curved surface of radiys 15 cm. what is its focal length ?

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59. The focal length of a concave-convex lens of radii of curvature 5 cm and 10 cm is 20 cm. what will be its focal length in water ? Given $._{}^{a}\mu_{w} = 4/3.$

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60. A convex lens of refractive index 1.5 is immersed in a liquid of refractive index (i) 1.6 (ii) 1.3 and (iii) 1.5. what changes happens to the focal length of the lens in the three cases ?

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61. The two surfaces of a double concave lens are of curvature 10 cm and 40 cm. Find the focal length of the lens in water. The refractive index of water is $4/3$ and that of the lens of the material is 3/2.

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62. The focal length of a plano-convex lens is 20 cm in air. Refractive index of glass is 1.5. Calculate (i) the radius of curvature of lens surface and (ii)

its focal length when immersed in liquid of refractive index 1.6

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63. The focal length of a convex lens of glass $(\mu = 1.5)$ in air is 30 cm. Find its focal length when the lens is placed in water $(\mu = 4/3)$.

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64. A lens of refractive index μ becomes a lens of focal length f' when immersed in a liquid of refractive index μ'. If the focal length of the lens in air is f, prove that

$$f' = f.\frac{\mu'(\mu-1)}{(\mu-\mu')}.$$

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65. The radii of curvature of each surface of a convex lens is $20cm$ and the refractive index of the material of the lens is $3/2$ (i) Calculate its focal length (ii) If this is cut along the plane AB.

What will be formed ? (iii) What happens if the lens is cut along CD ?

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

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67. Where should an object be placed from a converging lens of focal length 10 c, so as to obtain a virtual image of magnification 2 ?

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

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69. A convex lens is placed on an optical bench and is moved till it gives a real image of an object at a minimum distance of 80 cm from the latter. Find the focal length of the lens. If the object is placed at a distance of 15 cm from the lens, find the position of the image.

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70. A convex lens of focal length 30 cm is placed between a screen and a square plate of area $4cm^2$. The image of the plate formed on the

screen is $16cm^2$. Calculate the distance between the plate and the screen.

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71. An object is 60 cm in front of a thin lens, the image being 300 cm on the other side of the lens. Calculate the displacement of the image, when the object is moves 20 cm nearer to the lens.

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72. A source of light and a screen are placed 90 cm apart. Where should a convex lens of 20 cm focal length be placed in order to form a real image of the source on the screen ?

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

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74. The distance between a convex lens and a plane mirror is 15 cm. The parallel rays incident on the convex lens, after reflection from the mirror, form image at the optical centre of the lens. Draw the ray-diagram and find out the focal length of the lens.

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75. A concave lens focal length 10 cm is placed on the axis of concave mirror of 10 cm radius at a distance of 5 cm from the mirror. An object is

placed so that the light coming from it first passes through the lens, the gets reflected from the mirror, again passes through the lens to form an inverted image coincident with the object itself. Determine the position of the object.

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76. A concave lens is placed in the path of convergent rays. The rays are focussed on the axis 15 cm behind the lens. Where would these

rays have been focussed in the absence of the lens ? Focal length of the lens is 30 cm.

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77. A needle 10 cm long is placed along the axis of a convex lens of focal length 10 cm such that the middle point of the neddle is at a distance of 10 cm from the lens. Find the length of the image of the neddle.

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78. When a slide is placed 15 cm behind the lens in a projector, an image is formed at 3 infront of the lens. (i) Show the image formation by a ray diagram. (ii) Find the focal length of the lens. (iii) What will be the distance between the lens and the slide in order to get and image at a distance 4 metre from the lens ? (iv) Determine the magnification for the case (iii).

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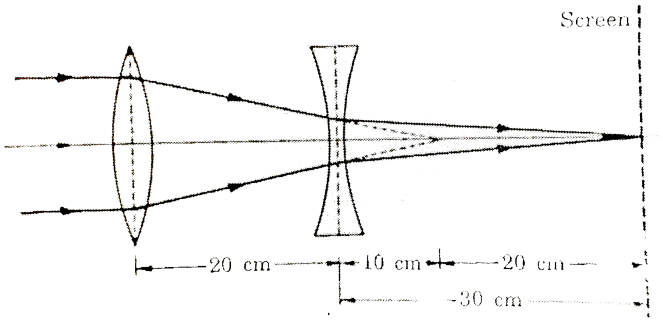
79. In the diagram shows below rays are coming from infinity and after passing through both the

lenses meet on a screen placed at a distance of 30 cm from the concave lens. Calculate the focal length of the concave lens.



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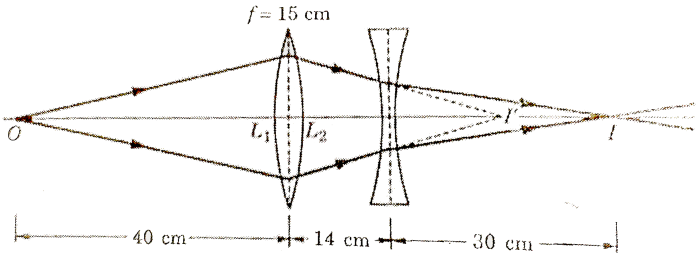
80. In the following ray diagram are given the position of an object O, image I and two lenses L_1 and L_2. The focal length of L_1 is also given.

Find the focal length of L_2.



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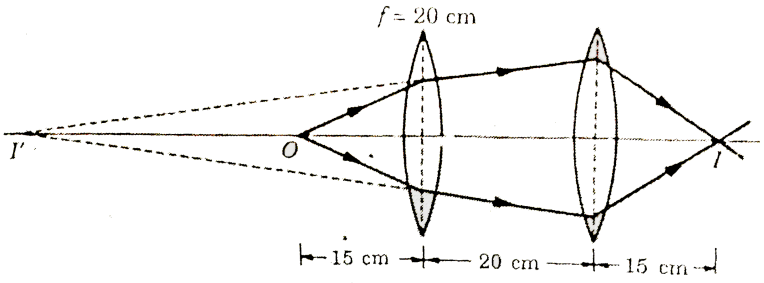
81. In the following diagram are shown the position of an object O, image I and two lenses. The focal length of one lens is also given.

Determine the focal length of the other lens.



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82. A compound lens has been formed by joinined a convex and a concave lens, each of focal length 30 cm. what is the focal length of the combination? What will be the power ?

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

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84. A what distance must an object be placed from convex lens of power 4D to obtain a real image three times the size of the object ?

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

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86. The power of a thin convex lens of glass is $5dioptre$. When it is immersed in a liquid of refractive index μ, it behave like a diverging lens

of focal length $1m$. Calculate μ of liquid, if μ of glass $= 3/2$.

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87. A concave lens is kept in contact with a convex lens of focal length $20cm$. The combination works as a converging lens of focal length $100cm$. Calculate power of concave lens.

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88. A compound lens is made of two lenses having powers $+15.5D$ and $-5.5D$. An object of 3cm height is placed at a distance of 30 cm from this compound lens. Find the size of the image.

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89. Ray coming from an object situated at infinity, fall on a convex lens and an image is formed at a distance of 16 cm from the lens. When a concave lens is kept in contact with the convex lens, the image is formed at a distance of

20 cm from the lens combination. Calculate the focal length of the concave lens.

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

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91. The refracting angle of a glass prism is 60°. The value of minium deviation for light passing through the prism is 40°. Calculate the value of refractive index of the material of the prism. Given $\sin 50^\circ = 0.766$.

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

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93. A ray of light incident at 49° on the face of an equilateral prism passes symmetrically. Calculate the refractive index of the material of the prism.

A. 2.02

B. 0.90

C. 1.5094

D. 3.4

Answer: C

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

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95. A ray incident normally on one face of a right-angled isosceles glass prism in air is deviated through 90°. What can you say about the refractive index of glass ?

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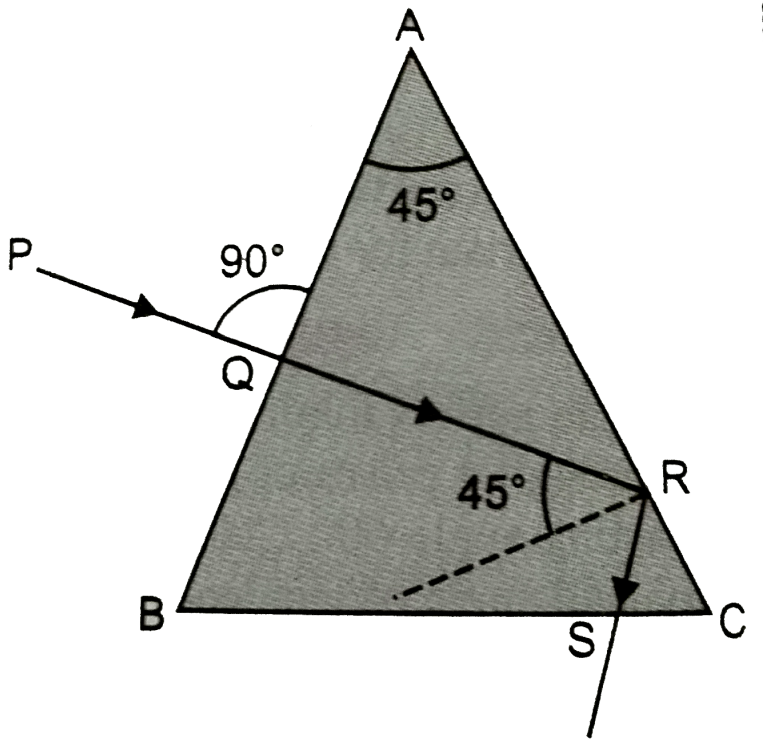
96. As shown in Fig. PQ is a ray incident on prism ABC. Show the corresponding refracted and emergent rays. The critical angle for the material of the prism is 45°. What is refractive

index of the material of prism ?



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97. Show that a light ray will pass through an equilateral glass prism $(\mu = 1.5)$. If the angle of

incidence is greater than 30°.

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98. A ray of light falls on a normally on a refracting face of a prism. Find the angle of prism if the ray just fails to emerge from the prism $(\mu = 3/2)$.

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99. A ray of light is incident on the glass prism at an angle of 40°. Find the angle of emergence, if the angle of prism is 60° and refractive index is 1.5.

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100. A ray of light falls on a glass prism at a angle of incidence of 30°. Find the direction of the emergent ray if the angle of the prism is 60° and refractive index is 1.50

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101. A ray of light suffers a deviation of 3.2° on passing through a thin prism of angle 5°. What is the refractive index of the material of the prism ?

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102. A thin glass prism placed in air produces minimum deviation of 4° in a light ray. If the prism is immersed in water, what will be the

minimum deviation produced by it ? Give $.^{a}\mu_G = 3/2$ and $.^{a}\mu_w = 4/3$.

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

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104. The deviation caused for red, yellow and violet colours for crown glass prism are $2.84^{\circ}, 3.28^{\circ}$ and 3.72° respectively. The dispersive power of prism material is:

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105. The refractive indices for lights of violet, yellow and red colours for a flint glass prism are respectively 1.632, 1.620 and 1.613. Find the dispersive power of the prism material.

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

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107. The refractive indices of crown glass for violet and red colours are respectively 1.523 and 1.513. Determine the dispersive power of this glass. If a crown glass prism produces a mean

deviation of 40°, what will be the angular dispersion ?

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

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

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

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

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