PHYSICS

BOOKS - AAKASH SERIES

GEOMETRICAL OPTICS

LECTURE SHEET (EXERCISE I LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. Two plane mirrors are inclined at an angle of 60° with each other. An incident ray hits one of the mirror at an angle of 80° with the normal. Its angle of deviation after two reflections is

A. 120°

B. 240°

C. zero

D. 60°

Answer: A

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2. A plane mirror is on y-z plane facing positive x-axis. A point object is present at (10,5). The mirror is translated by 2 units along positive x and 3 units along positive y-direction. Final image of the point object is at

A. (-10,-5)

B. (-8,-3)

C. (-6,5)

D. (-6,-2)

Answer: C

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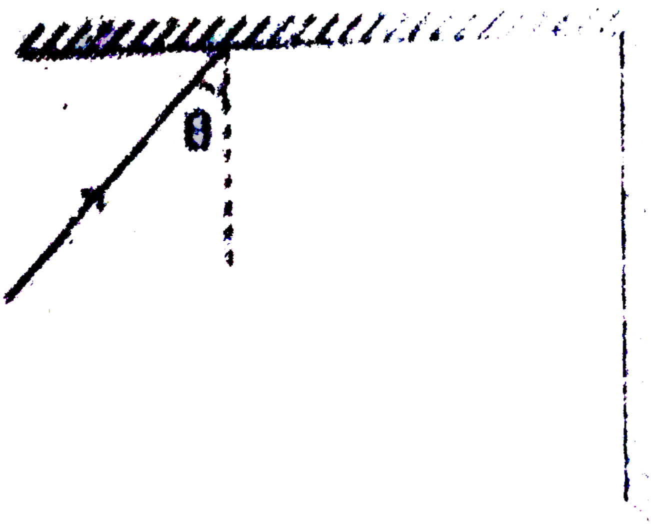
3. Two plane mirrors are arranged at right angles to each other as shown in figure.A ray of light is incident on the horizontal mirror at an angle θ. For what value of $\theta$the ray emerges parallel to the incoming ray after reflection from the vertical mirror ?



A. 60°

B. 30°

C. 45°

D. all of these

Answer: D

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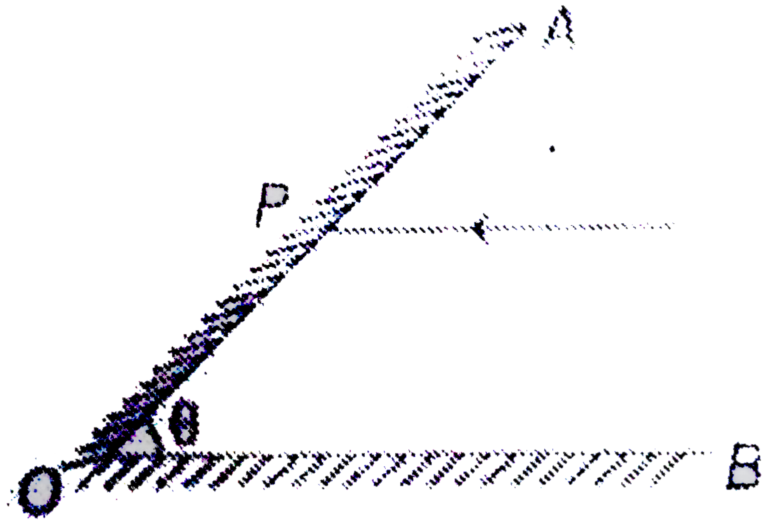
4. Two plane mirrors are inclined at angle θ as shown in figure. If a ray parallel to OB strikes the other mirror at P and finally emerges parallel to OA after two reflections then θ is equal to



A. 90°

B. 60°

C. 45°

D. 30°

Answer: B

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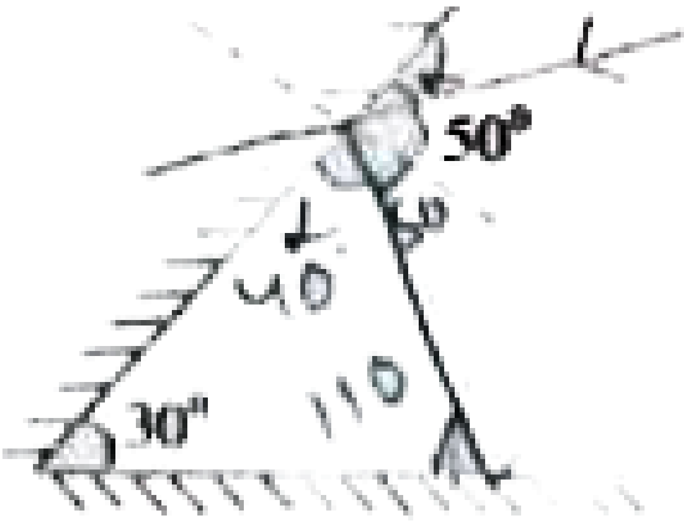
5. Calculate the deviation suffered by incident ray in situation as shown in figure after these successive reflections.



A. 380° clockwise

B. 380° anticlockwise

C. 220° anticlockwise

D. 120° clockwise

Answer: D

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6. Three plane mirrors are placed such that the angle between the first and second or second and third is the same θ. A light striking the first mirror, after reflection at the three mirrors emerges opposite to the initial direction. The value of θ can be

A. 60°

B. 150°

C. 120°

D. 45°

Answer: C

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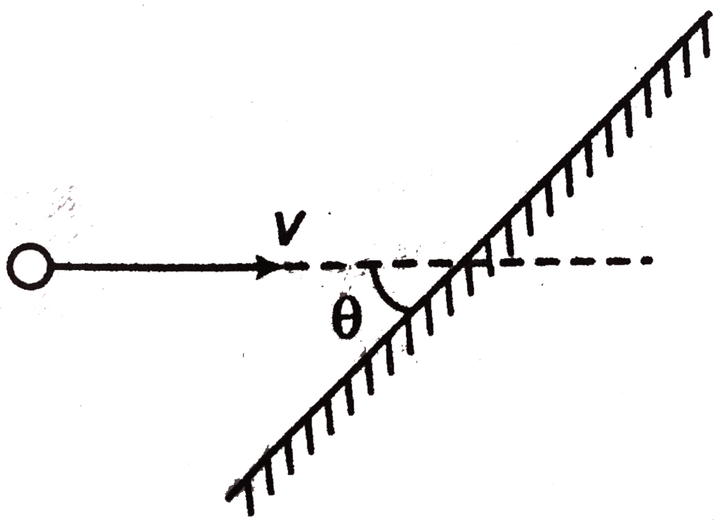
7. A point object is moving towards a plane mirror as shown in figure. Choose the correct options.



A. h

B. 2h

C. 3h

D. 4h

Answer: B

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8. An object is placed at 20 cm from a convex mirror of focal length 10 cm. The image formed by a mirror is

A. Real and at 20 cm from the mirror

B. Virtual and at 20 cm from the mirror

C. Virtual and at 20/3 cm from the mirror

D. Real and at 20/3 cm from the mirror

Answer: C

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9. An object 1 cm tall is placed 4 cm infront of a mirror. In order to produce an upright image of 3 cm height one needs a

A. Convex mirror of radius of curvature 12 cm

B. Concave mirror of radius of curvature 12 cm

C. Concave mirror of radius of curvature 4 cm

D. Plane mirror of height 12 cm

Answer: B

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10. Radius of concave mirror is 40 cm and the size of image (real) is twice as that of object, then the object distance is

A. 60 cm

B. 20 cm

C. 40 cm

D. 30 cm

Answer: D

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11. An object O is placed in front of a small plane mirror M_1 and a large convex mirror M_2 of focal length f. The distance between O and M_1 is x and the distance between M_1 and M_2 is y. The images of O formed by M_1 and M_2 coincide. The magnitude of f is

A. $x - y$

B. $\dfrac{x^2 - y^2}{2y}$

C. $\dfrac{x^2 + y^2}{2y}$

D. $\dfrac{x^2 + y^2}{x + y}$

Answer: B

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12. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is $20cm$ away from the mirror. The length of the image is

A. 5 cm

B. 10cm

C. 15cm

D. 20cm

Answer: A

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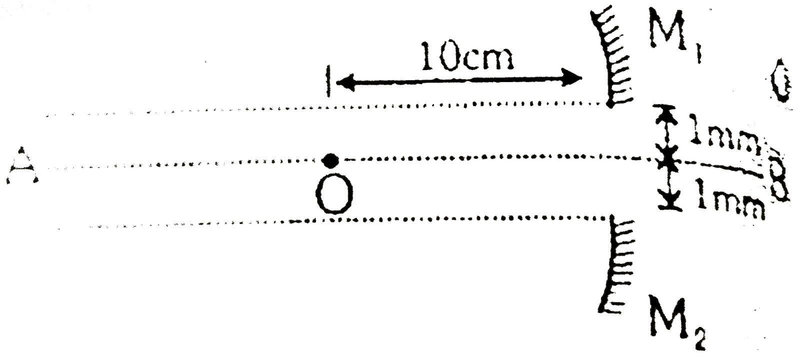
13. A concave mirror of focal length 20 cm is cut into two parts from the middle and the two parts are moved perpendicularly by a distance 1 mm from the previous principal axis AB. The distance between the images formed by the two parts is :



A. 2 cm

B. 6 cm

C. 3 cm

D. 4 cm

Answer: A

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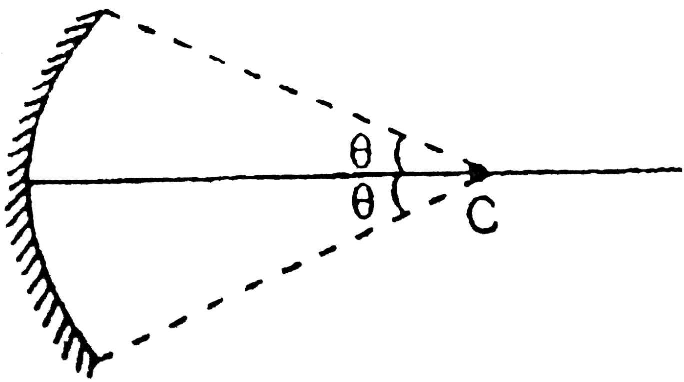
14. The circular boundary of the concave mirror subtends a cone of half angle θ at its centre of curvature. The minimum value of θ for which any ray incident on this mirror parallel to the principal axis suffers reflection more than once is



A. 30°

B. 45°

C. 60°

D. 75°

Answer: B

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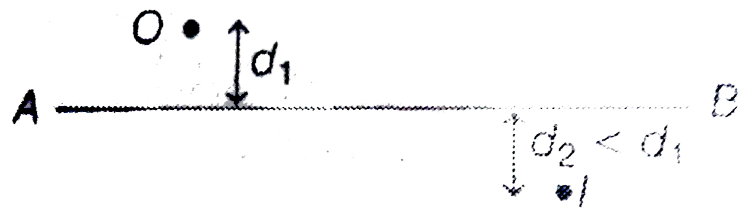
15. In the figureshownm the image of a real object is formed at point I. AB is the principal axis of the mirror. The mirror must be



A. concave & placed towards right I

B. concave & placed towards left of I

C. convex and placed towards right of I

D. convex & placed towards left of I

Answer: B

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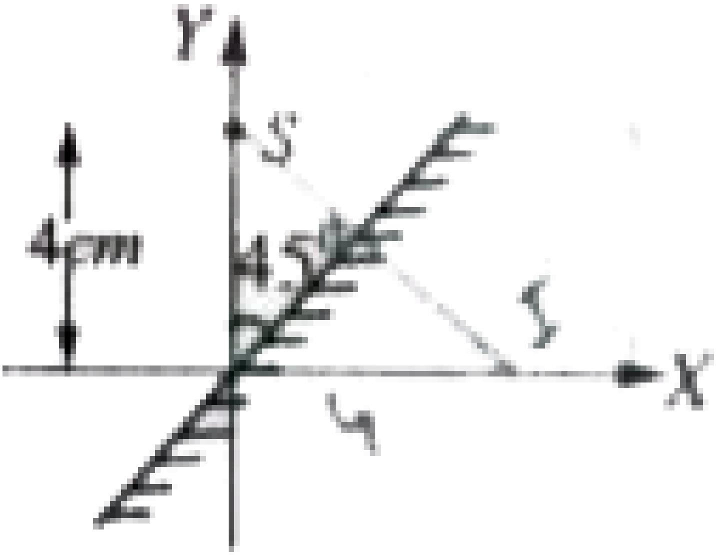
LECTURE SHEET (EXERCISE I LEVEL -II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. What are the co-ordinates of the imasge of S formed by a plane mirror as shown in figure?



A. (4 cm, 0)

B. (-4 cm, 0)

C. $\left(4\sqrt{2}cm, 0\right)$

D. (0,4cm)

Answer: A

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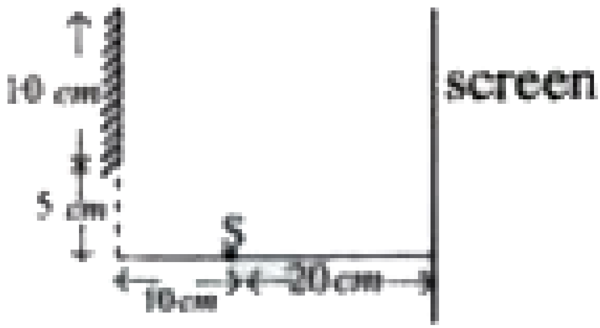
2. A luminous point source s is placed between a plane mirror and a screen in the situation as shown in figure. Then the length of screen which will receive direct light as well as reflected light is



A. 50 cm

B. 60 cm

C. 70 cm

D. 40 cm

Answer: D

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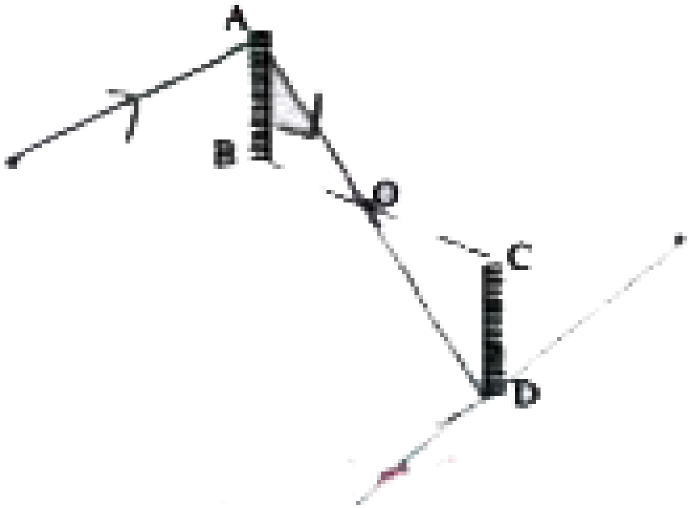
3. Two mirrors AB and CD are arranged along two parallel lines. The maximum number of images of object O that can be seen by any observer is



A. One

B. Two

C. Four

D. Infinite

Answer: A

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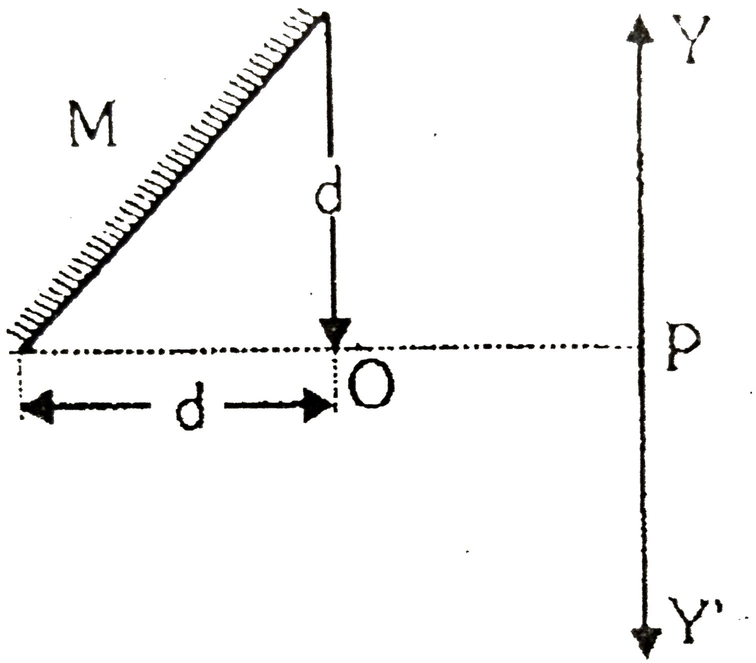
4. As shown in the figure a particle is placed at O in front of a plane mirror M . A man of P can move along patyh PY and PY' then which of the following is true?



A. For all point on PY, the man can see the image of O

B. Forall point on PY', the man can see the image, but for no point on PY he can see the image of O

C. For all point on PY' he can see the image but on PY he can see the image only upto a distance d from P.

D. He can see the image only upto a distance d on either side of P.

Answer: C

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5. A plane mirror is placed along positive x-axis facing towards positive y-axis. If the equation of a linear object is x=y, the equation of its image is

A. $x = y$

B. $2x + y = 0$

C. $x + y = 0$

D. $x - y = 0$

Answer: C

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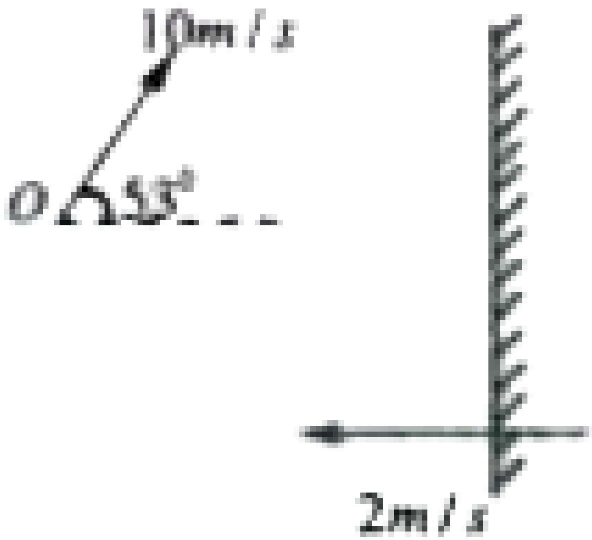
6. Find the velocity of image of a moving particle O in the situation as shown in the figure.



A. $\sqrt{164}$ m/s at $\tan^{-1}$ (4/5) with horizontal

B. 10 m/s, at 53° with horizontal

C. $\sqrt{68}$ m/s at $\tan^{-1}\left(\frac{1}{2}\right)$ with vertical

D. $\sqrt{104}$ m/s at $\tan^{-1}\left(\frac{1}{2}\right)$ with vertical

Answer: A

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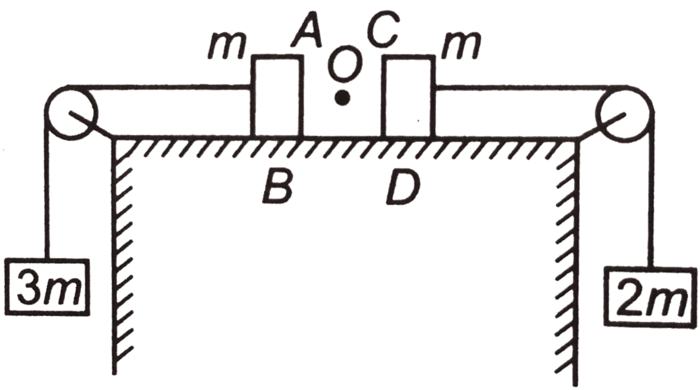
7. Two blocks each of masses m lie on a smooth table. They are attached to two other masses as shown in figure. The pulleys and strings are light. An object O is kept at rest on the table. The sides AB and CD of the two blocks are made reflecting. The acceleration of two images formed in those two reflecting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



A. 5g/6

B. 5g/3

C. g/3

D. 17g/6

Answer: D

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8. A particle is moving in a circle in front of a plane mirror in the situation as shown in figure. The plane of motion of the particle is perpendicular to the plane of mirror. Then the motion of image of particle with respected to the partickle is

A. along a parabola

B. oscillating normal to the mirror

C. oscillating parallel to the mirror

D. along a circle

Answer: B

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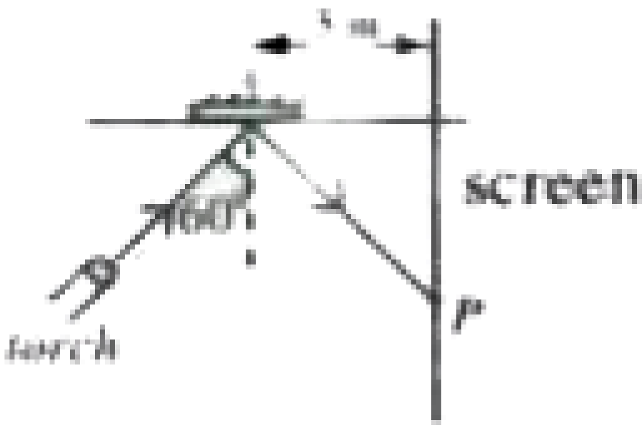
9. Figure shows a torch producing a straight light beam falling on a plane mirror at an angle 60°. The refected beam makes a spot P on the screen along y-axis. If at t=0 the mirror starts rotating about the hinge A with an angular velocity $\omega = 1^\circ$ per second clockwise, find the speed of the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



A. $\frac{\pi}{15} m / s$

B. $\frac{\pi}{30} m / s$

C. $\frac{2\pi}{15} m / s$

D. $\frac{\pi}{60} m / s$

Answer: C

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10. Which of the following equation is correct in the context of kohlarusch 's law

A. only A

B. only C

C. both A and C

D. both B and C

Answer: B

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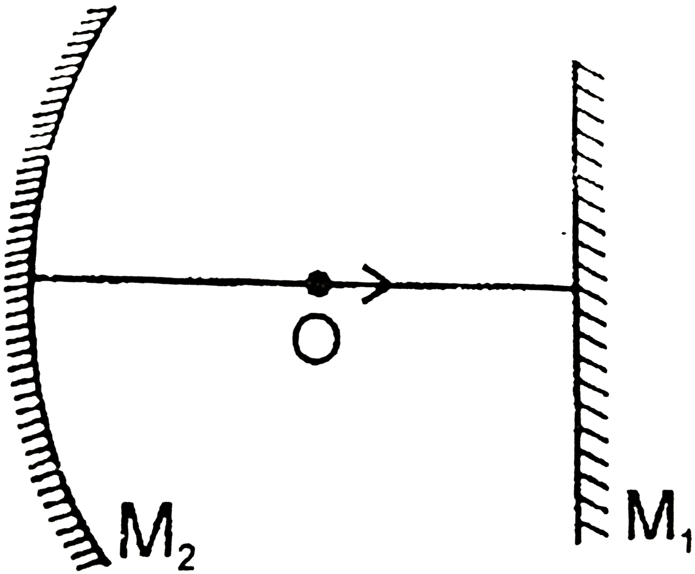
11. In the figure $M_1 \& M_2$ are two fixed mirrors as shown. If the object $'O'$ moves towards the plane mirror. Then the image I (which is formed after two successive reflections from $M_1 \& M_2$ respectively) will move



A. towards right

B. towards left

C. with zero velocity

D. cannot be determined

Answer: A

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12. A candle flame 1.6 cm high is imaged in a ball bearing of diameter 0.4 cm. If the ball bearing is 20 cm away from the flame, find the location and the height of the image.

A. 1.0 mm inside the ball bearing, 0.08 mm

B. 1.0 mm outside The ball bearing 0.06 cm

C. 2 m inside The ball bearing 0.08 cm

D. 1 m outside The balltearing 0.05 mm

Answer: A

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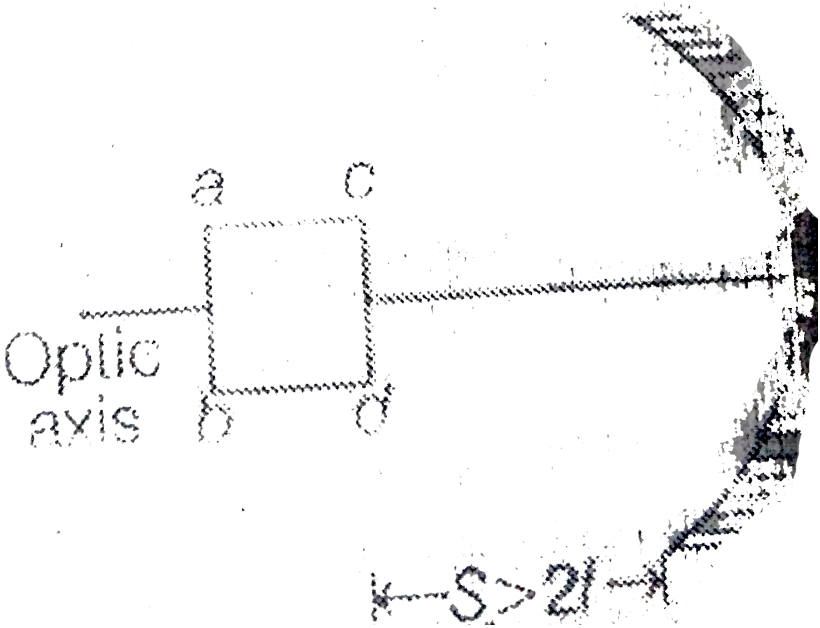
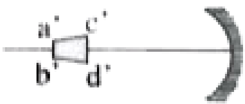
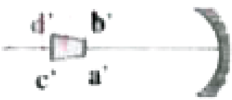
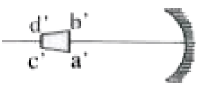
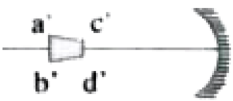
13. An object is placed in front of a concave mirror of focal length f as shown in figure. Choose the correct shape of the image.



A. 

B. 

C. 

D. 

Answer: B

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14. A small block of mass m and a concave mirror of radius R fitted with a stand lie on a smooth horizontal table with a separation d between them. The mirror together with its stand has a mass m. The block is pushed at t = 0 towards the mirror so that it starts moving towards the mirror at a constant speed V and collides with it. The collision is perfectly elastic. Find the velocity of the image (a) at a time $t < \frac{d}{V}$, (b) at a time $t > \frac{d}{V}$.

A. $\frac{-R^2V}{[2(d - Vt) - R]^2}, V\left[1 + \frac{R^2}{[2(Vt - d) - R]^2}\right]$

B. $\frac{R^2V}{[2(d + Vt) + R]^2}, V\left[1 + \frac{R^2}{2[Vt - d - R]^2}\right]$

C. $\frac{-R^2V}{[2(d - Vt) + R]^2}, V\left[1 - \frac{R^2}{[2(Vt - d) + R]^2}\right]$

D. $\frac{-R^2V}{[(d - Vt) - R]^2}, V\left[1 - \frac{R^2}{[2(Vt + d) - R]^2}\right]$

Answer: A

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

A. 5 cm behing the convex mirror and is virtual

B. 6 cm in front of the convex mirror is an is real

C. 6 cm behind the convex mirror and is virtual

D. 8 cm in front of the concave mirror and is real

Answer: C

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LECTURE SHEET (EXERCISE I LEVEL -II (ADVANCED) MORETHAN CORRECT ANSWER TYPE QUESTIONS)

1. 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 mirror 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 no.of images will be 6 if an object is kept unsymmetrically between the mirrors.

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

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

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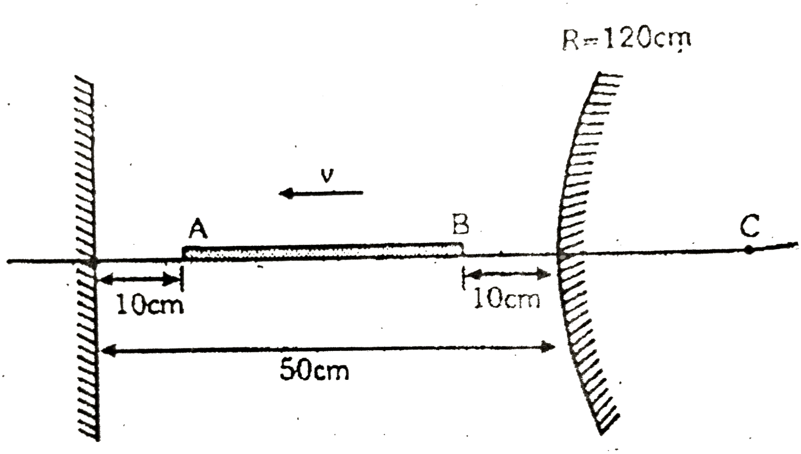
2. In the fig. shown consider the first reflection at the plane mirror and second at the convex mirror. AB is object.



A. the second image is real, inverted of 1/5th magnitication

B. the second image is virtual and erect with magnification 1/5

C. the second image moves towards the convex mirror

D. the second image moves away from the convex mirror.

Answer: B::C

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3. A magnified image of real object is to be obtained on a large screen 1 m from it. This can be achieved by

A. using a convex mirror of focal length less than 0.25 m

B. using a concave mirror of focal length less than 0.25 m

C. using a convex lens of focal length less than 0.25 m

D. using a concave lens of focal length less than 0.25 m

Answer: B::C

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4. A reflecting surface is represented by the equation $y = \frac{2L}{\pi}\sin\left(\frac{\pi x}{L}\right), 0 \le x \le L.$ A ray traveling horizontal becomes vertical after reflecting. The co-ordinates of the point(s) on which this ray is incident.

A. $\left(\frac{L}{4}, \frac{\sqrt{2}L}{\pi}\right)$

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

C. $\left(\frac{3L}{4}, \frac{\sqrt{2}L}{\pi}\right)$

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

Answer: B::D

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5. All the following statements are correct except (for real objects)

A. the magnification produced by a convex mirroris always less than or equal to one

B. a virtual, erect, same sized image can be obtained using a plane mirror

C. a virtual, erect, magnified image can be formed using a concave mirror

D. a real, inverted, same sized image can be formed using a convex mirror.

Answer: A::D

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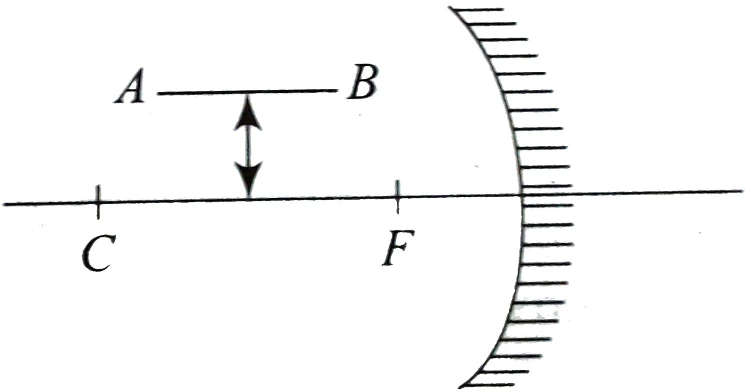
6. An object AB is placed parallel and close to the optical axis between focus F and center of curvature C of a converging mirror of focale length f as shown in Figure. Then,



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

B. Image of AB will be parallel to optical axis

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

D. Image of AB will not be a straight line

Answer: A::C

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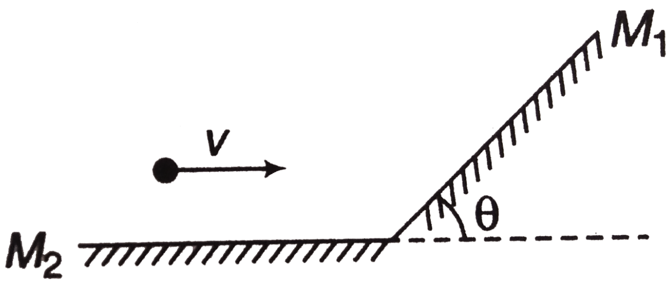
7. A point object is moving with a speed v before an arrangement of two mirrors as shown in figure. Find the magnitude of velocity of image in mirror M_1 with respect to image in mirror M_2



A. $v \sin \theta$

B. $2v \sin \theta$

C. 0

D. v

Answer: B

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LECTURE SHEET (EXERCISE I LEVEL -II (ADVANCED) LINKED COMPREHENSION ANSWER TYPE QUESTIONS)

1. A point object is placed infront of a plane mirror as shown in figure.

$X_{OM} \Rightarrow x$- co-ordinate of object relative to mirror

$X_{IM} \Rightarrow x -$ co -ordinate of image relative to mirror

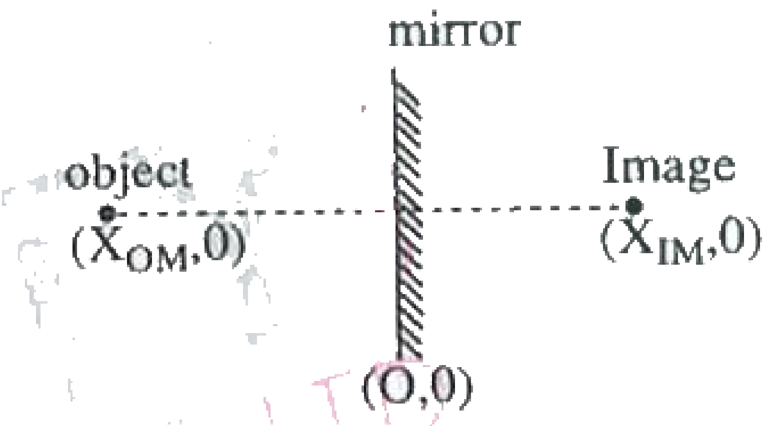
$X_{IM} = -X_{OM}$

differentiating $V_{1M} = -V_{OM}$

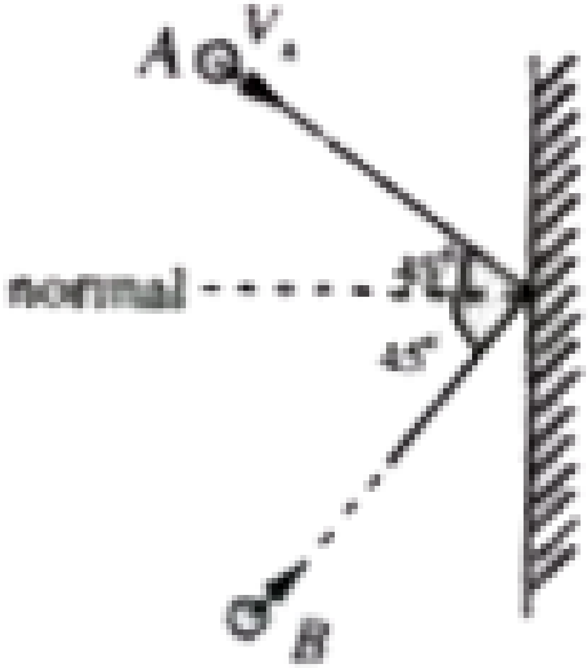
$V_I - V_M = -(V_0 - V_M)$

Velocity if image relative to mirror = velocity of object relative to mirror.

basing on this information answer the question



Two bodies A and B are moving towards a plane mirror with speeds V_A and V_B respectively as shown in fig. The speed of image of A with respect to the body B is



A. $V_A + V_B$

B. $V_A - V_B$

C. $\sqrt{V_A^2 + V_B^2}$

D. $\sqrt{V_1^2 - V_B^2}$

Answer: A

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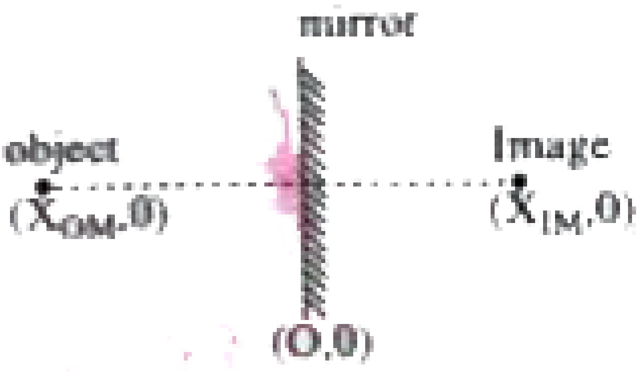
2.



The reflection surface of a plane mirror is vertical. A particle is projected in a vertical plane which is also perpendicular to the mirror. The initial velocity of the particle is 10 m/s and the angle of projection is 60°. The point of projection is at a distance 5 m from the mirror. The particle moves towards the mirror. Just before the particle touches the mirror, the magnitude of relative velocity of approach of the particle and its image is

A. 10 m/s

B. 5m/s

C. $10\sqrt{3}m/s$

D. $5\sqrt{3}m/s$

Answer: A

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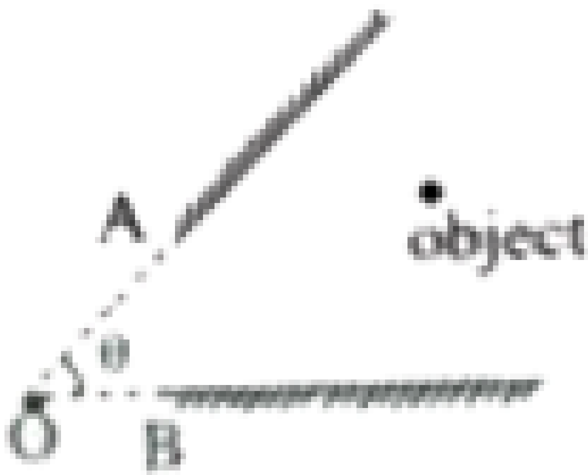
3. A point object is placed in fron of two plane mirrors as shown in figure.



Total number of images formed if 'theta=90^(@)`?

A. 3

B. 2

C. 1

D. 4

Answer: A

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4. A point object is placed in fron of two plane mirrors as shown in figure.

Total number of images formed if $OA = 0, OB = 0$ and $\theta = 110^\circ$?

A. 3 or 4

B. 3 only

C. 4 only

D. 2

Answer: A

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LECTURE SHEET (EXERCISE I LEVEL -II (ADVANCED) MATRIX MATCHING ANSWER TYPE QUESTIONS)

1. With reference to magnetic dipole, match the tems of Column I with the tems of Column Ii and Choose the correct option from the codes given below.

Column I		Column II	
(A)	Dipole moment	(p)	$-M \cdot B$
(B)	Equatiorial field for a short dipole	(q)	$M \times B$
(C)	Axial field for a short dipole	(r)	$-\mu_0 m / 4\pi r^3$
(D)	External field : Torque	(s)	**m**
(E)	External field : Energy	(t)	$\mu_0 2m / 4\pi r^3$

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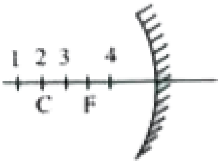
2. An extended object can be kept in front of a concave mirror at points, 1, 2, 3 and 4 and images are formed at different points. C and F have their usual meanings. Point 2 is centre of curvature of the mirror.



Column - I	Column - II
A) Object at point 1, then image is	p) real
B) Object at point 2, then image is	q) virtual
C) Object at point 3, then image is	r) enlarge
D) Object at point 4, then image is	s) diminish

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LECTURE SHEET (EXERCISE I LEVEL -II (ADVANCED) INTEGER TYPE QUESTIONS)

1. A point object is kept of a plane mirror. The plane mirror is performing SHM of amnplitude $2cm$. The plane mirror moves along the3 $x-$ axis is normal to the mirror. The amplitude of the mirror is scuh that the object is always infront of the mirror. The amplitude of SHM of the image is

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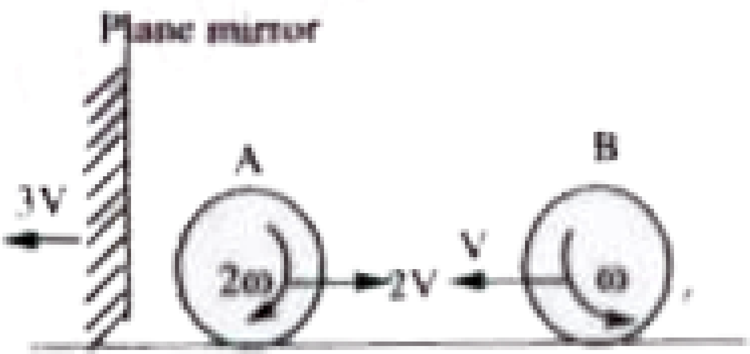
2. Two identical balls are rolling without slipping on a horizontal plane as shwon in figure. They undergo a perfect elastic collision. Just after collision, the velocity of image of the bottom point of A with respect to the plane mirros is x V, then x=



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3. An object is approaching a fixed plane mirror with velocity 3 ms/s at an angle of 45° with normal, in a medium of refractive index 4/3. The speed of the image with respect to the mirror is ________m/s.

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LECTURE SHEET (EXERCISE II LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. Absolute refractive index of a medium is X. Refractive index of same medium w.r.t to air is Y and absolute refractive index to air is Z. Then the relation between them is

A. X=Y/Z

B. Y=X/Z

C. Z=Y/X

D. Y=1/XZ

Answer: B

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2. The refractive indices of glycerine and diamond with respect to air are 1.4 and 2.4 respectively. Calculate the speed of light in glycerine and diamond. From these results, calculate the refractive index of diamong with respect to glycerine. $(c = 3 \times 10^8 m/s)$

A. $2.143 \times 10^8 m/s, 1.250 \times 10^8 m/s, 1.714$

B. $1.143 \times 10^8 m/s, 1.250 \times 10^8 m/s, 1.714$

C. $2.143 \times 10^8 m/s, 2.250 \times 10^8 m/s, 1.714$

D. $2.143 \times 10^8 m/s, 1.250 \times 10^8 m/s, 1.514$

Answer: A

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3. A monochromatic light passes through a glass slab $\left(\mu = \frac{3}{2}\right)$ of thickness 90 cm in time t_1. If it takes a time t_2 to travel the same distance through water $\left(\mu = \frac{4}{3}\right)$. The value of $(t_1 - t_2)$ is

A. 5×10^{-11} sec

B. 5×10^{-8} sec

C. 2.5×10^{-10} sec

D. 5×10^{-10} sec

Answer: A

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4. A glass slab of thickness 8 cms contains the same number of waves as 10 cms long path of water when both are traversed by the same monochromatic light. If the refractive index of water is 4/3, the refractive index of glass is

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

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

C. $\frac{16}{15}$

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

Answer: A

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5. The optical path of a monochromatic light is the same if it goes through 2.00 cm of glass or x cm of ruby. If the refractive index of glass is 1.510 and that of rby is 1.760 find the value of x.

A. 1.716 cm

B. 1.525 cm

C. 2.716 cm

D. 2.525 cm

Answer: A

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6. A ray of light incidents on a refracting surface at 30° with the surface . If the angle of refraction is 45° refractive index of the medium is

A. $\sqrt{3}$

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

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

D. $2\sqrt{3}$

Answer: C

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7. A unit vector along the incident ray of light is $\hat{i}$. The unit vector for the corresponding refracted ray of light is $\hat{r}.\widehat{n}$, a unit vector normal to the boundary of the medium and directed towards the incident medium. If μ is the refractive index of the medium, then snell's law (second law) of refraction is

A. $\hat{i}.\widehat{n} = \mu(\hat{r}.\widehat{n})$

B. $\hat{i} \times \widehat{n} = \mu(\widehat{n} \times \hat{r})$

C. $\hat{i} \times \widehat{n} = \mu(\hat{r} \times \widehat{n})$

D. $\mu\left(\hat{i} \times \widehat{n}\right) = \hat{r} \times \widehat{n}$

Answer: C

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8. The velocities of light in two different media are 2*10^8m/s and 2.5 * 10^8 m/s respectively.The critical angle for these media is

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

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

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

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

Answer: B

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9. Light takes t_1 second to travel a distance x cm in vacuum and the same light takes t_2 second to travel 10x cm in medium. The critical angle for the corresponding medium is

A. $\sin^{-1}\left(\frac{x_2 t_2}{x_1 t_1}\right)$

B. $\sin^{-1}\left(\frac{x_1 t_2}{x_2 t_1}\right)$

C. $\sin^{-1}\left(\frac{x_1 t_1}{x_2 t_2}\right)$

D. $\sin^{-1}\left(\frac{x_2 t_1}{x_1 t_2}\right)$

Answer: D

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10. A ray of light from a denser medium strikes a rare medium as shown in figure. The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are r and r'. The critical angle would be

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

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

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

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

Answer: A

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11. The refractive index of the core of an optical fibre is μ_2 and that of the cladding is μ_1. The angle of incidence on the face of the core of that the light ray just under goes total internal reflection at the cladding is

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

B. $\sin^{-1}\sqrt{\mu_2^2 - \mu_1^2}$

C. $\sin^{-1}\sqrt{\mu_2 - \mu_1}$

D. $\sin^{-1}\sqrt{\mu_1^2+\mu_2^2}$

Answer: D

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12. The refractive index of a prism for a monochromatic wave is $\sqrt{2}$and its refracting angle is 60° for minimum deviation, the angle of incidence will be

A. 30°

B. 45°

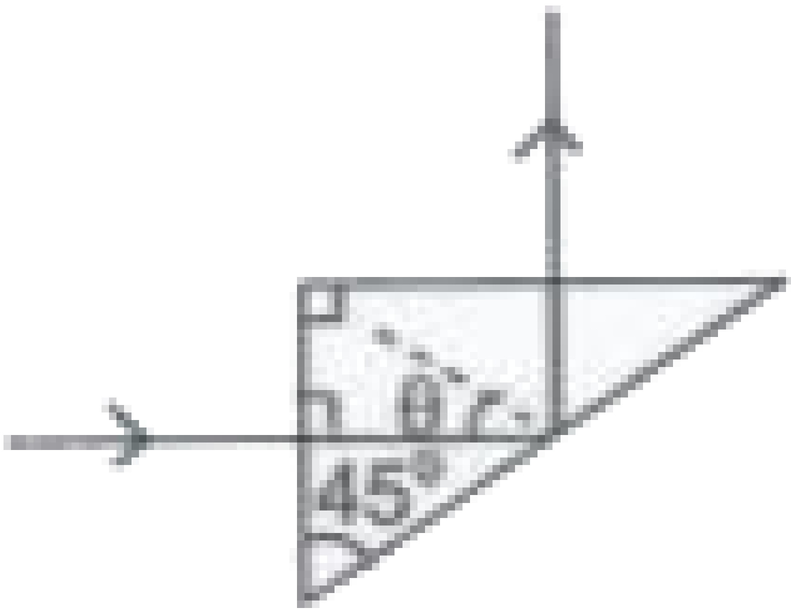
C. 60°

D. 75°

Answer: B

Watch Video Solution

13. A trianglular prims of glass is shown in the figure. A ray incident normally to one face is totally reflected. If $\theta = 45^\circ$ the refractive index of glass is



A. < 1.41

B. $= 1.41$

C. > 1.41

D. 1.732

Answer: C

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14. Under minimum deviation condition in a prism, if a ray is incident at an angle of 30°. The angle between the emergent ray and the second refracting surface of the prism is

A. 0°

B. 30°

C. 45°

D. 60°

Answer: D

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15. A ray of light passes through an equilateral glass prism will be such a manner that the angle of incidence is equal to the angle of emergence and each of these angles is equal to 3/4 of the angle of the prism. The angle of deviation is

A. 45°

B. 39°

C. 60°

D. 30°

Answer: D

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16. The refractive indices of violet and red light are 1.54 and 1.52 respectively. If the angle of prism is 10°, then the angular dispersion is

A. 0.02

B. 0.2

C. 3.06

D. 30.6

Answer: B

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17. The refractive indices of crown glass prism of C,D and F lines are 1.527, 1.530 and 1.535 respectively. Find the dispersive power of the crown glass prism.

A. 0.01509

B. 0.0519

C. 0.02108

D. 0.03402

Answer: A

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LECTURE SHEET (EXERCISE II LEVEL -II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. 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.

A. 45°

B. 60°

C. 75°

D. 30°

Answer: A

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2. A ray of light is incident on a rectangular plate at an angle of incidence 60°. The light ray suffers a deviation which is 25% of the angle of incidence. The refractive index of the glass will be

A. $\sqrt{3}$

B. $\sqrt{2}$

C. $\sqrt{3/2}$

D. 1.5

Answer: C

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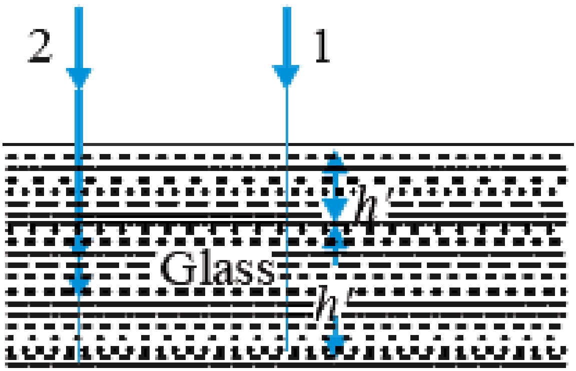
3. Two beam of lights are incident normally on water $(\mu = 4/3)$. If the beam 1 passes through a glass $(\mu = 3/2)$ slab of height h as shown in the figure, the time difference for both the beam for reaching the bottom is:



A. Zero

B. $\dfrac{h}{3C}$

C. $\dfrac{6h}{C}$

D. $\dfrac{h}{6C}$

Answer: D

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4. A ray of light entering from air to glas $(\mu = 1.5)$ is partly reflected and partly refracted. If the reflected and refracted rays are at right angles to each other, the angle of refraction is

A. $\sin^{-1}\left(\sqrt{\frac{2}{13}}\right)$

B. $\sin^{-1}\left(\frac{\sqrt{2}}{13}\right)$

C. $\sin^{-1}\left(\frac{2}{\sqrt{13}}\right)$

D. $\sin^{-1}\left(\frac{3}{\sqrt{13}}\right)$

Answer: C

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5. A glass cube of edge 1 cm and $\mu = 1.5$ has a spot at the centre. The area of the cube face that must be covered to prevent the spot from being seen is (in cm^2)

A. $\sqrt{5}\pi$

B. 5π

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

D. $\frac{\pi}{5}$

Answer: D

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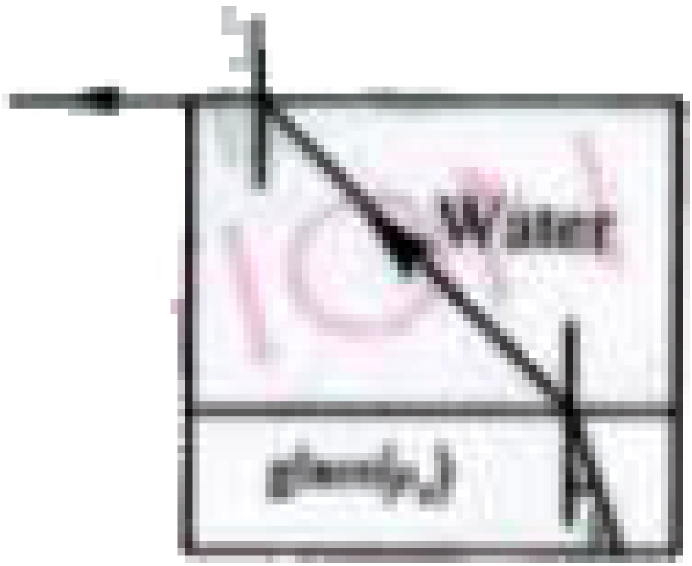
6. A ray of light travels in the way as shown in the figure. After passing through water, theray grazes along the water air interface. The value of μ_g interms of I is $(\mu_w = 4/3)$



A. $\frac{1}{\sin i}$

B. $\frac{3}{4 \sin i}$

C. $\frac{4}{3 \sin i}$

D. $\sin i$

Answer: A

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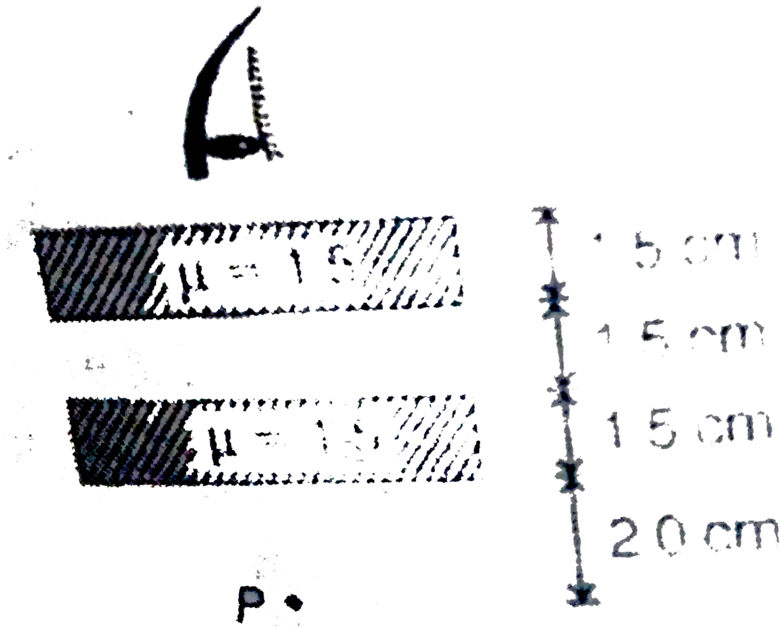
7. The image of point P when viewed from top of the slabs will be



A. 2 cm above P

B. 1.5 cm above P

C. 2 cm below P

D. 1 cm above P

Answer: D

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8. The angle of minimum deviation for a 75° prism of dense glass is found to be 45° when in air and 15° when immersed in certain liquid. The refractive index of the liquid is

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

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

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

D. $\sqrt{3}$

Answer: C

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9. A certain prism of refracting angle 60° and of refractive index 2 is immersed in a liquid of refractive index $\sqrt{2}$ then the angle of minimum deviation will be

A. 30°

B. 45°

C. 60°

D. 75°

Answer: A

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10. A ray of monochromatic light is incident on one refracting face of a prism of angle 75°. It passes thorugh the prism and is incident on the other face at the critical angle. If the refractive index of the material of the prism is $\sqrt{2}$, the angle of incidence on the first face of the prism is

A. 30°

B. 45°

C. 60°

D. 0°

Answer: B

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11. The light ray is incidence at angle of 60° on a prism of angle 45°. When the light ray falls on the other surface at 90°, the refractive index of the material of prism μ and the angle of deviation δ are given by

A. $\mu = \sqrt{2}, d = 30^{\circ}$

B. $\mu = 1.5, d = 15^{\circ}$

C. $\mu = \frac{\sqrt{3}}{2}, d = 30^{\circ}$

D. $\mu = \sqrt{\frac{3}{2}}, d = 15^{\circ}$

Answer: D

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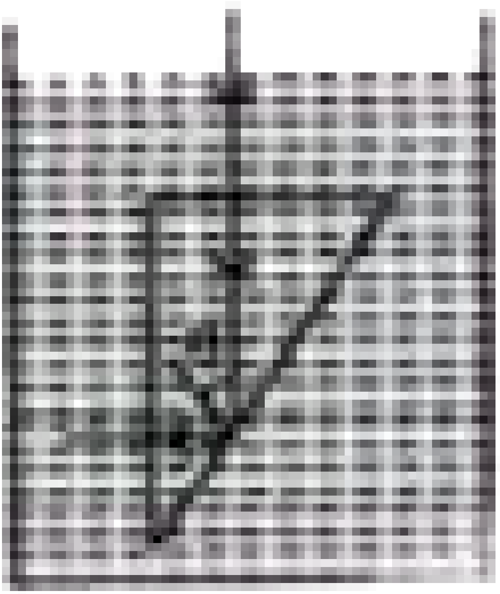
12. A prism of glass $(\mu = 1.5)$ is dipped in to water as shown in the figure. If the refractive index of water is 4/3, then the incident ray will be totally reflected if



A. $\sin\theta > \frac{8}{9}$

B. $\sin\theta < \frac{8}{9}$

C. $\sin\theta = \frac{9}{8}$

D. $\sin\theta = \frac{8}{9}$

Answer: A

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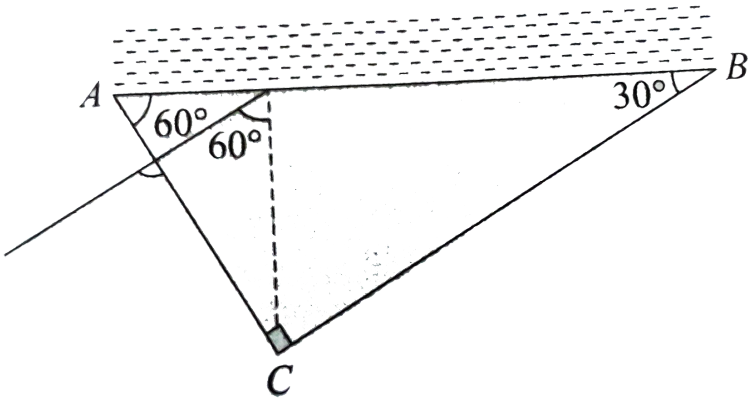
13. ACB is right-angled prism with other angles as 60° and 30°. Refractive index of the prism is 1.5. AB has thin layer of liquid on it as shown. Light falls normally on the face Ac. For total internal reflection, maximum refractive index of the liquid is



A. 1.5

B. 1.4

C. 1.3

D. 1.2

Answer: C

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

A. 30°

B. 36°

C. 18°

D. 72°

Answer: B

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15. Two prisms A and B are in contact with each other have angular dispersions of 2° and 4° respectively. The dispersive power of A is 0.002.

If the combination produces dispersion without deviation, the dispersive power of B is

A. 0.001

B. 0.004

C. 0.002

D. 0.006

Answer: B

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16. Two prisms A and B have dispersive powers of 0.012 and 0.018 respectively. The two prisms are in contact with each other. The prism A produces a mean deviation of 1.2°, the mean deviation produced by B if the combination is achromatic is

A. 3.6°

B. 0.8°

C. 0.4°

D. 1.8°

Answer: B

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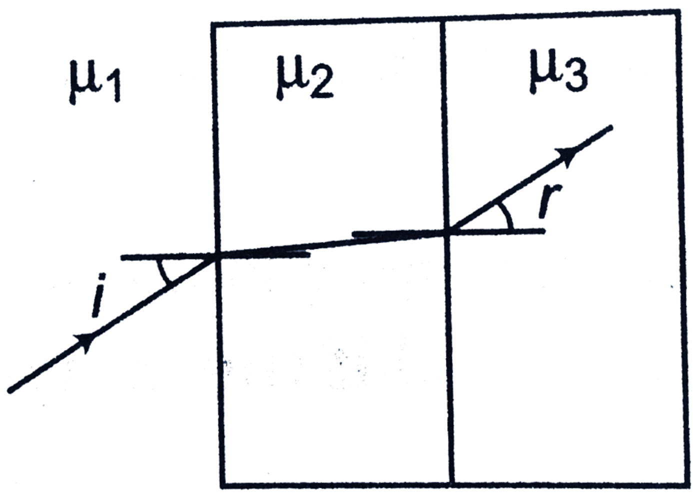
17. In the figure shown $\frac{\sin i}{\sin r}$ is equal to



A. $\frac{\mu_2^2}{\mu_3 \mu_1}$

B. $\frac{\mu_3}{\mu_1}$

C. $\frac{\mu_3 \mu_1}{\mu_2^2}$

D. None

Answer: B

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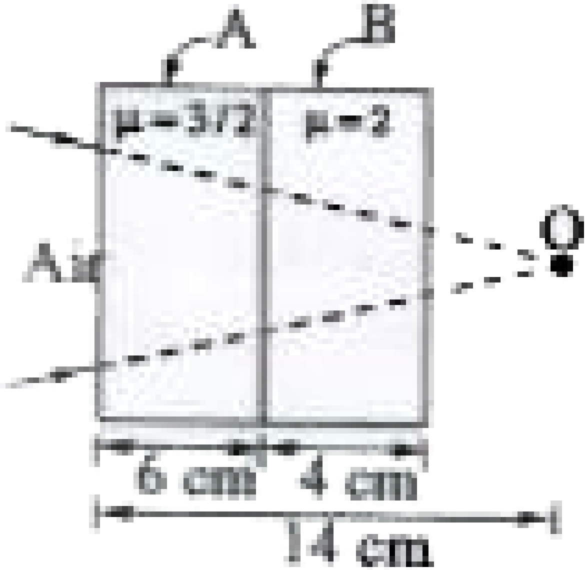
18. A convergent beam is incident on two slabs placed in contact as shown in fig. Finally the rays are converge at a distance (from left face of slab A is)



A. 10 cm

B. 18 cm

C. 8 cm

D. 6 cm

Answer: B

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19. A parallel sided block of glass of refractive index 1.5 which is 36 mm thick rests on the floor of a tank which is filled with water (refractive index = 4/3). The difference between apparent depth of floor at A and B when seen from vertically above is equal to

A. 2 mm

B. 3 mm

C. 4 mm

D. None of these

Answer: B

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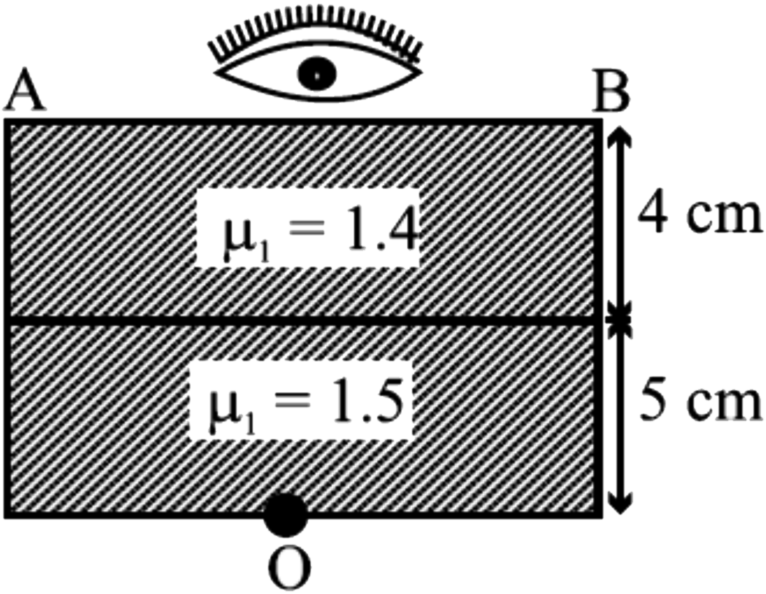
20. The apparent depth of an object O from AB is



A. $uIn(1+aH)$

B. $\dfrac{u}{(1+aH)\mu_0}$

C. $\dfrac{u}{In(1+aH)}$

D. None of these

Answer: B

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21. A point source S is placed at the bottom of different layers as shown in the figure. The refractive index of bottom most layer is μ_0. The refractive index of any other upper layer is $\mu(n)=\mu_0-\frac{\mu_0}{4n-18}$ where n=1,2............A ray of light with angle i slightly more than 30° starts from the source S. Total internal reflection takes place at the upper surface of a layer having n equal to

A. 3

B. 5

C. 4

D. 6

Answer: C

22. A person looking through a telescope focuses lens at a point on the edge of the bottom of an empty cylindrical vessel. Next he fills the entire vessel with a liquid oif refractive index μ, without disturbing the telescope. Now, he observes the mid point of the vessel. Determine the radius to depth ratio of the vessel

A. $\frac{1}{2}\sqrt{\frac{1-\mu^2}{\mu^2+1}}$

B. $\frac{1}{2}\sqrt{\frac{4-\mu^2}{\mu^2-1}}$

C. $\frac{1}{2}\sqrt{\frac{4+\mu^2}{\mu^2+1}}$

D. $\frac{1}{2}\sqrt{\frac{4+\mu}{\mu+1}}$

Answer: B

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

A. $\frac{1}{2\sqrt{3}}\hat{i} + \frac{1}{2\sqrt{3}}\hat{j} - \sqrt{\frac{5}{6}}\hat{k}$

B. $\frac{1}{2\sqrt{3}}\hat{i} + \frac{1}{2\sqrt{3}}\hat{j} - \frac{1}{2\sqrt{3}}\hat{k}$

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

D. None of these

Answer: A

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24. A body weighs w Newton on the surface of the earth. Its weight at a height equal to half the radius of the earth, will be $\frac{x}{y}w$ where x and y are coprimes . Find x and y

A. 1.5

B. 1.7

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

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

Answer: A

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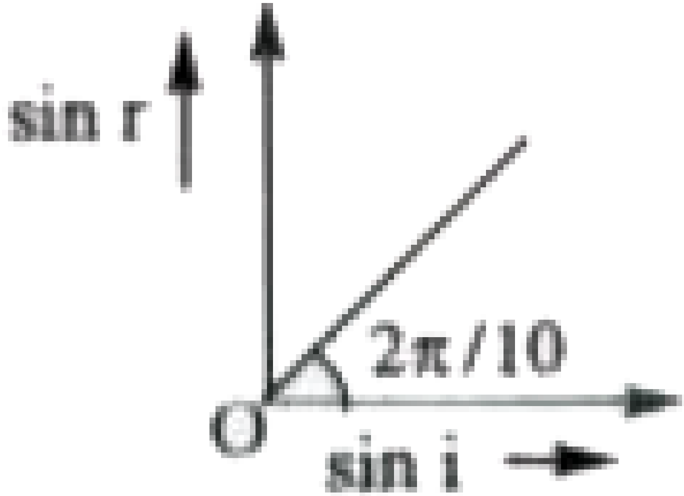
25. The graph between sine of angle of refraction (sin r) in medium 2 and sin of angle of incidence (sin i) in medium 1 indicates that

$\left(\tan 36^\circ = \frac{3}{4}\right)$



A. Total internal reflection can take place

B. Total internal reflection cannot take place

C. Any of a and b

D. Data is incomplete

Answer: B

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

A. 

B. 

C. 

D. 

Answer: A

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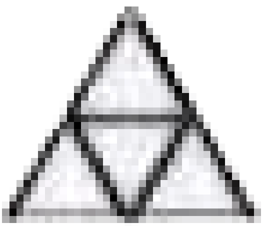
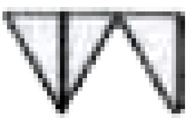
27. Four similar prisms of angle of prism are arranged. Which of the following arrangements give no net angular deviation?

A. 

B. 

C. 

D. 

Answer: B

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28. A light ray is incident upon a prism in minimum deviation position and suffers a deviation of 34°. If the shaded half of the prism is knocked off, the ray will

A. Suffer a deviation of 34°

B. Suffer a deviation of 68°

C. Suffer a deviation of 17°

D. Not come out of the prism

Answer: C

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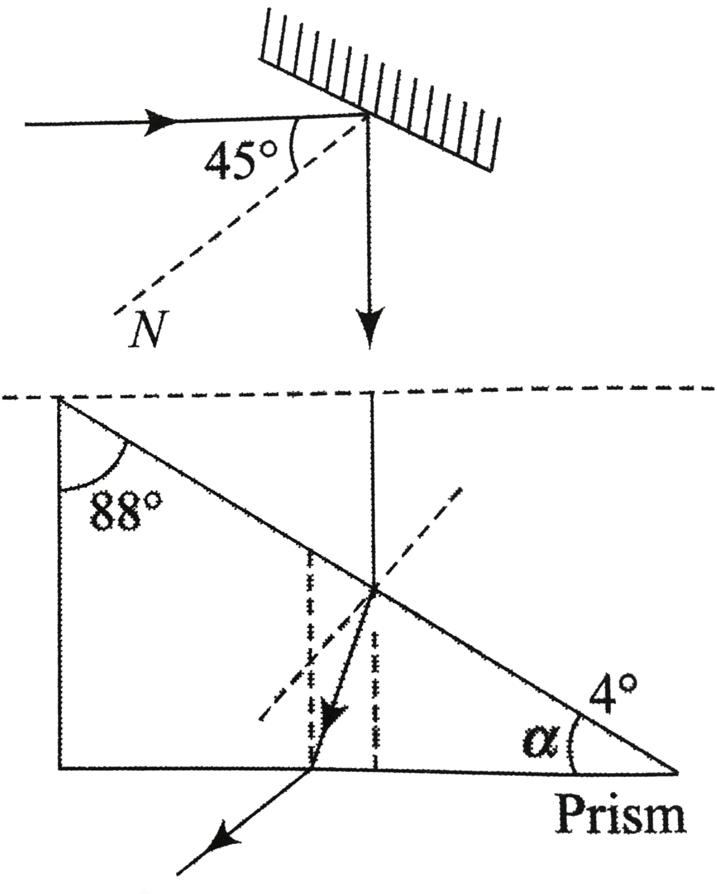
29. A ray of light strikes a plane mirror at an angle of incidence 45° as shown in Figure . After reflection,l the ray passes through a prism of refractive indes 1.5 whos apex angle is 4°. Through what angle must the mirror be rotated it total deviation of the ray be 90° ?



A. 1° clockwise

B. 1° anticlockwise

C. 2° clockwise

D. 2° anticlockwise

Answer: B

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30. The xz plane separates two media A and B with refractive indices μ_1 & μ_2 respectively. A ray of light travels from A to B. Its directions in the two media are given by the unit vectors, $\overrightarrow{r}_A = a\hat{i} + b\hat{j}$ & $\overrightarrow{r}_B = \alpha\hat{i} + \beta\hat{j}$ respectively where $\hat{i}$ & $\hat{j}$ are unit vectors in the x & y directions. Then :

A. $\mu_1 a = \mu_2 \alpha$

B. $\mu_1 \alpha = \mu_2 a$

C. $\mu_1 b = \mu_2 \beta$

D. $\mu_1 \beta = \mu_2 b$

Answer: A

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31. A microscope is focussed on a point object, and then its objective is raised through a height of 2cm when a glass slab of refractive index 1.5 is placed over this point object such that it is focussed again. The thickness of the glass slab is

A. 6 cm

B. 3 cm

C. 2 cm below P

D. 1.5 cm

Answer: A

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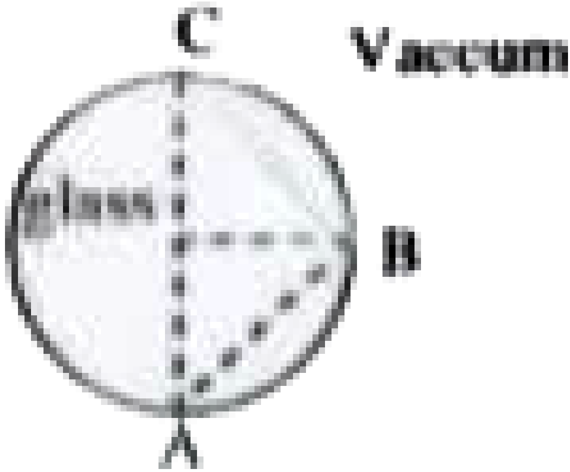
32. It is found that electromagnetic signals sent inside glass sphere from A towards B reach point C. the speed of electromagnetic signals in glass cannot be:



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

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

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

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

Answer: B

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33. A light ray is incident on a transparent slab of refractive index $\mu = \sqrt{2}$ at an angle of incidence $\pi/4$. Find the ratio of the lateral displacement suffered by the light ray to the maximum value which it could have suffered.

A. $\dfrac{\sqrt{3}-1}{\sqrt{6}}$

B. $\dfrac{\sqrt{3}-2}{\sqrt{5}}$

C. $\dfrac{\sqrt{1}-2}{\sqrt{5}}$

D. $\dfrac{\sqrt{1}-2}{\sqrt{7}}$

Answer: A

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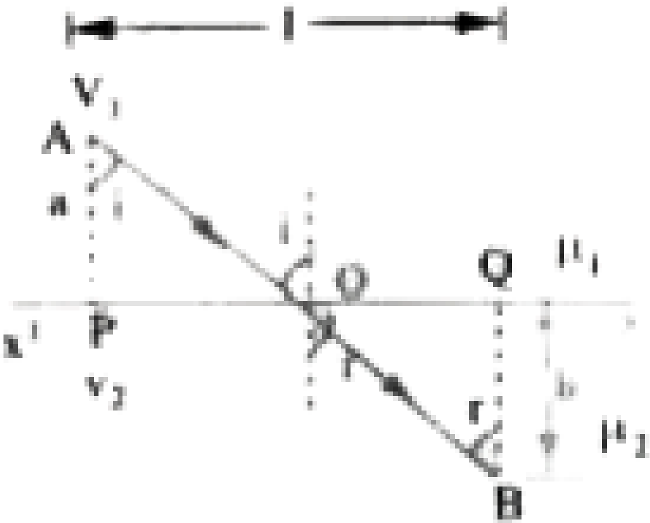
34. The time required for the light to go from A to B, when a ray of lilght goes from point A in a medium where the speed of light is v_1 to a point B in a medium where the speed of light is v_2 as shown in figure is



A. $t = \dfrac{a \sec i}{v_1} + \dfrac{b \sec r}{v_2}$

B. $t = \dfrac{a \sec i}{v_2} + \dfrac{b \sec r}{v_1}$

C. $t = \dfrac{a \sec i}{v_1} - \dfrac{b \sec r}{v_2}$

D. $t = \dfrac{a \sec i}{v_2} - \dfrac{b \sec r}{v_1}$

Answer: A

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35. The apparent depth of water in cylindrical water tank of diameter 2R cm is reducing at the rate of x cm/minute when water is being drained out at a constant rate. The amount of water drained in c.c. per minute is $(n_1 = \text{ refractive index of air}, \; n_2 = \text{ refractive index of water})$

A. $x\pi R^2 n_1 / n_2$

B. $x\pi R^2 n_2 / n_1$

C. $2\pi R n_1 / n_2$

D. $\pi R^2 x$

Answer: B

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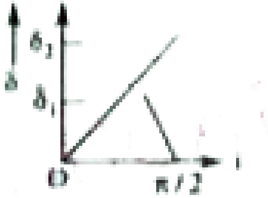
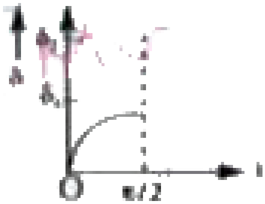
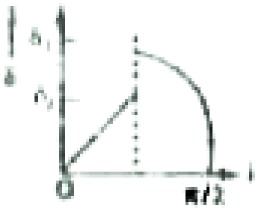
36. A ray of light travels from a medium of refractive index μ to air. Its angle of incidence in the medium is I, measured from the normal to the boundary, and its angle of deviation is δ. δ is plotted against I which of the following best respresents the resulting curve

A. 

B. 

C. 

D. 

Answer: A

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37. A man of height 1.47 m stands on a straight road on a hot day. The vertical temperature in the air results in a variation of refractive index with height y as $\mu = \mu_0 \sqrt{(1 + ay)}$ where μ_0 is the refractive index of air near the road a $= 1.5 \times 10^{-6}$/m. What is the apparent length of the road man is able to sec?

A. 700m

B. 2000 m

C. $7000\sqrt{2}$

D. infinite distance

Answer: B

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38. A glass slab of thickness 3 cm and refractive index 3/2 is placed on ink mark on a piece of paper. For a person looking at the mark at a distance 2 cm above it, the distance of the mark will appear to be in cm

A. 4 cm

B. 3 cm

C. 2 cm

D. 5cm

Answer: A

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39. Solar rays are incident at 45° on the surface of water $(\mu = 4/3)$. The length of the shadow of a pole of length 1.2 m formed at the bottom of the pond is $\frac{3.3}{n}$ where n is (if the pole is vertical assuming that 0.2 m of the pole is above the water surface)

A. 40

B. 4

C. 3

D. 0

Answer: B

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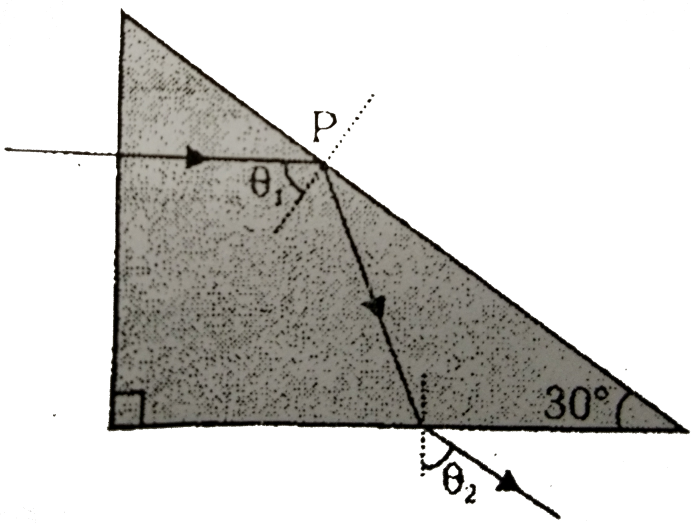
LECTURE SHEET (EXERCISE II LEVEL -II (ADVANCED) MORE THAN ONE CORRECT TYPE QUESTIONS)

1. A ray of light is incident normally on one face of $30^\circ - 60^\circ - 90^\circ$ prism of refractive index 5/3 immersed in water of refractive index 4/3 as shown in figure .



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

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 P ceases if the refractive index of water is increased to $5/2\sqrt{3}$ by dissolving some substance

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

Answer: A::C

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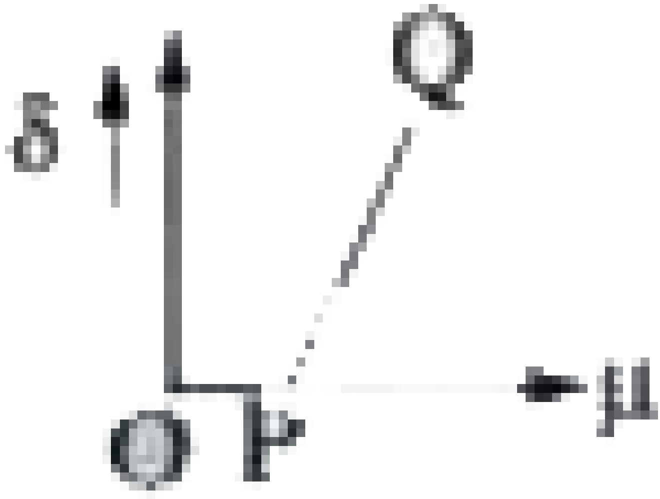
2. For a small angled prism, angle of minimum deviation (δ) varies with the refractive index of the prism as shown in the graph



A. Point p corresponds to $\mu = 1$

B. Slope of the line PQ=A/2

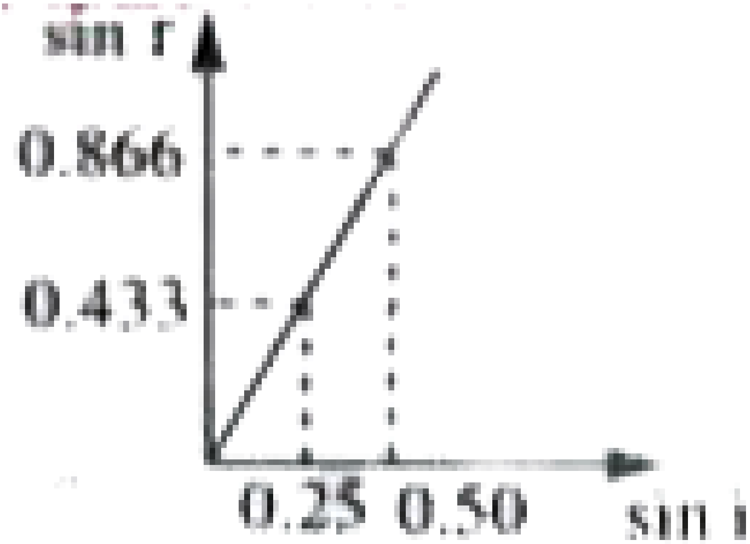
C. Slope =A

D. None of the above statements is true

Answer: A::C

Watch Video Solution

3. Light is incident from a medium A to medium B. The graph of sine of angkle of incidence I versus sine of angle of refraction r is shown in fig. Which of the following is/are correct?



A. Total internal reflection occurs above a certain value of i.

B. Total internal reflection will not occurs for any value of i

C. Wavelength of light in medium B is $\sqrt{3}$ times that in medium A.

D. Wavelength of light in medium B is $1/\sqrt{3}$ times that in medium A.

Answer: A::C

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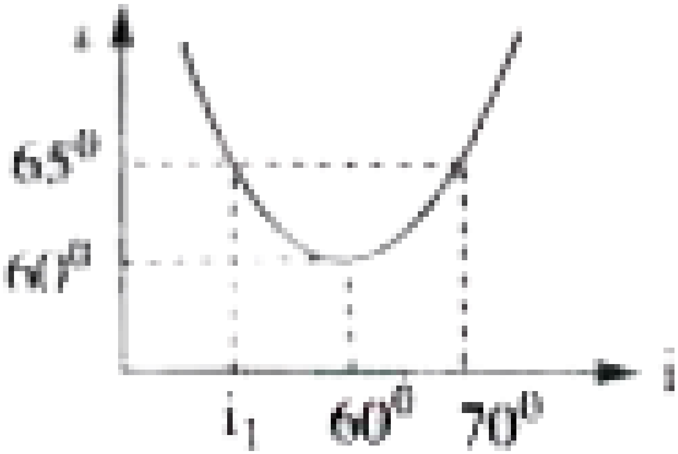
4. The angle of deviation (δ) vs angle of ancidence (i) is plotted for a prism. Pick up the correct statement.



A. The angle of prism is 60°

B. The refractive index of the prism in $n = \sqrt{3}$

C. For deviation to be 65° the angle of incidence $i_1 = 55^\circ$

D. The curve of δ vs I is parabolic

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

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5. For maximum deviation $D_{\max}$.

A. emergent ray must graze the surface (face)

B. incident ray must graze the surface

C. $D_{\max}=90^{\circ}+e-A$

D. $D_{\min}=90^{\circ}+i-A$

Answer: C

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6. A ray of monochromatic light is incident on the plane surface of separation between two media x and y with angle of incidence i in the medium x and angle of refraction r in the medium y. The graph shows the relation between sin i and sin r.

A. The speed of light in the medium y is $\sqrt{3}$ times than in medium x

B. The speed of light in the medum y is $\frac{1}{\sqrt{3}}$ times than in medium x

C. Total internal reflection can take place when the incidence is in x

D. Total internal reflection can take place when the incidence is in y

Answer: B::D

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7. 

n number of identical equilateral prisms are kept in contact as shown in figure. If deviation through a single prism is δ. Then (n,m are integers)

A. if n=2m, deviation through n prisms is zero

B. if n=2m+1, deviation through system of n prism is δ

C. if n=2m, deviation through system of n prism is δ

D. if n=2m+1` deviation through system of n prism is zero

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

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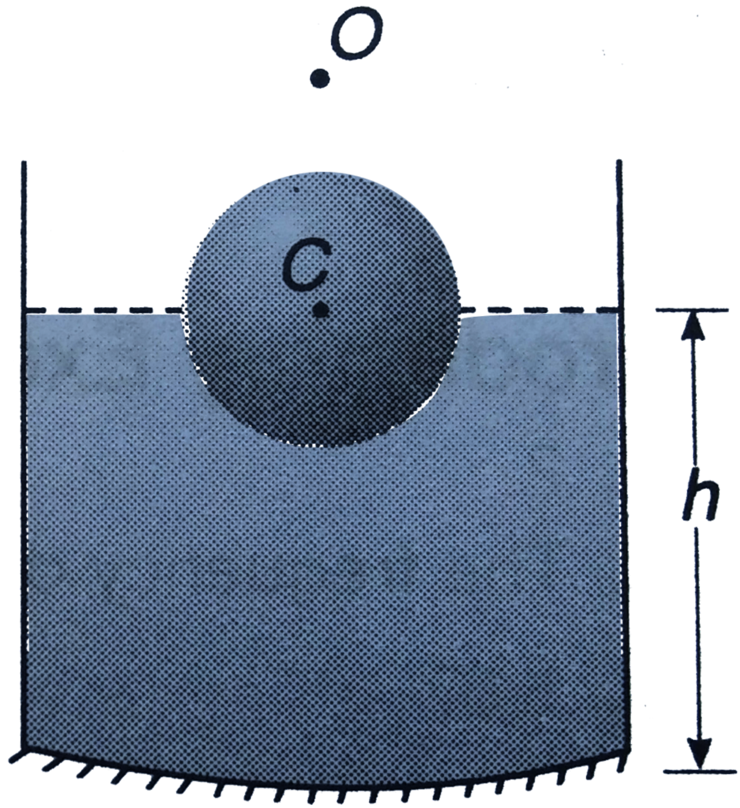
LECTURE SHEET (EXERCISE II LEVEL -II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. A transparent solid sphere of radius $2cm$ and density ρ floats in a transparent liquid of density 2ρ kept in a beaker. The bottom of the beaker is spherical in shape with radius of curvature $8cm$ and is silvered to make it concave mirror as shown in the figure. When an object is placed at a distance of $10cm$ directly above the centre of the sphere C, its final image coincides with it. Find h (as shown in the figure), the height of the liquid surface in the beaker from the apex of the bottom. Consider the paraxial rays only. The refractive index of the sphere is $3/2$ and that

of the liquid is $4/3$.



A. 6cm

B. 8cm

C. 12cm

D. 16cm

Answer: C

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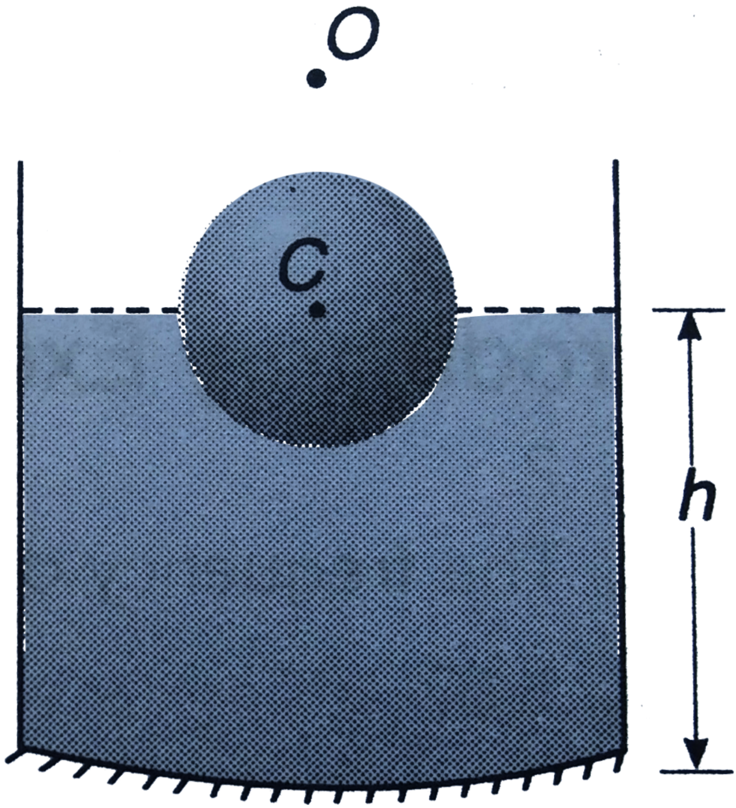
2. A transparent solid sphere of radius $2cm$ and density ρ floats in a transparent liquid of density 2ρ kept in a beaker. The bottom of the beaker is spherical in shape with radius of curvature $8cm$ and is silvered to make it concave mirror as shown in the figure. When an object is placed at a distance of $10cm$ directly above the centre of the sphere C, its final image coincides with it. Find h (as shown in the figure), the height of the liquid surface in the beaker from the apex of the bottom. Consider the paraxial rays only. The refractive index of the sphere is $3/2$ and that

of the liquid is $4/3$.



A. 2 cm

B. 5 cm

C. 6 cm

D. 9 cm

Answer: B

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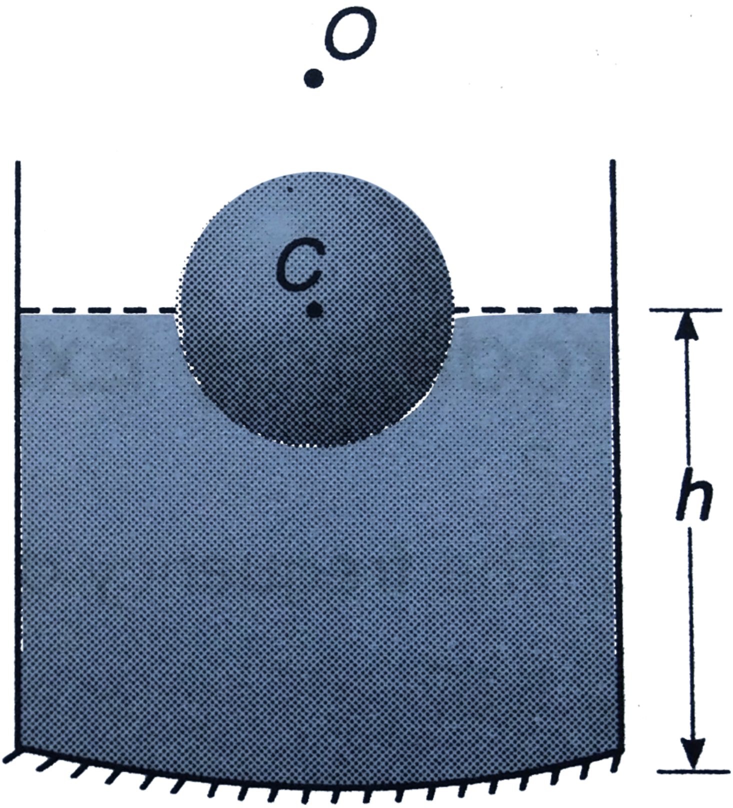
3. A transparent solid sphere of radius $2cm$ and density ρ floats in a transparent liquid of density 2ρ kept in a beaker. The bottom of the beaker is spherical in shape with radius of curvature $8cm$ and is silvered to make it concave mirror as shown in the figure. When an object is placed at a distance of $10cm$ directly above the centre of the sphere C, its final image coincides with it. Find h (as shown in the figure), the height of the liquid surface in the beaker from the apex of the bottom. Consider the paraxial rays only. The refractive index of the sphere is $3/2$ and that

of the liquid is $4/3$.



A. 8 cm

B. 9 cm

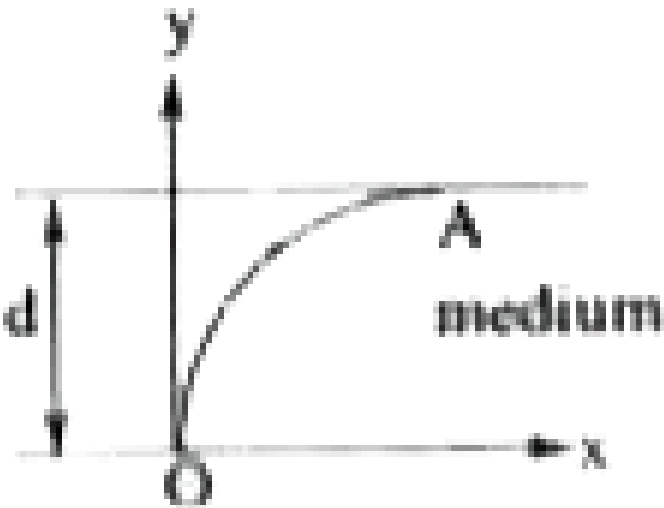
C. 14 cm

D. 15 cm

Answer: D

Watch Video Solution

4. A long rectangular slab of transparent medium of thickness d placed on a table with its length parallel to the x-axis and width parallel to the axis. A ray of light travelling inair makes a near normal incidence on the slab as shown. Taking the point of incidence as orign (0,0,0). The refraction index μ of the medium varies as $\mu = \dfrac{\mu_0}{1 - \left(\frac{x}{r}\right)}$ where μ_1 and $r(\, > d)$ are constants. The refractive index of air is μ_0



The x-coordinate of the point A where the ray intersects the upper surface of the slab air boundary is

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

B. $r\left\{1+\sqrt{1-\left(\frac{d}{r}\right)^2}\right\}$

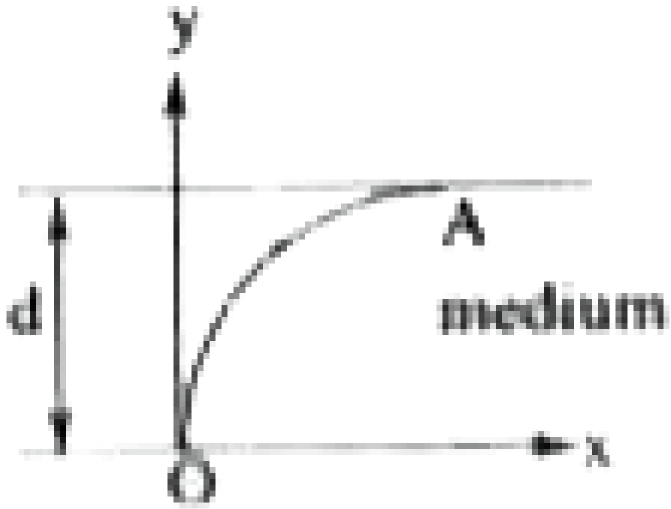
C. $r\left\{1-\sqrt{1+\left(\frac{d}{r}\right)^2}\right\}$

D. $r\left\{1+\sqrt{1+\left(\frac{d}{r}\right)^2}\right\}$

Answer: A

Watch Video Solution

5. A long rectangular slab of transparent medium of thickness d placed on a table with its length parallel to the x-axis and width parallel to the axis. A ray of light travelling inair makes a near normal incidence on the slab as shown. Taking the point of incidence as orign (0,0,0). The refraction index μ of the medium varies as $\mu = \dfrac{\mu_0}{1-\left(\frac{x}{r}\right)}$ where μ_1 and $r(>d)$ are constants. The refractive index of air is μ_0



The x-coordinate of the point A where the ray intersects the upper surface of the slab air boundary is

A. $\dfrac{-\mu_0}{\sqrt{1-\left(\frac{d}{r}\right)^2}}$

B. $\dfrac{\mu_0}{\sqrt{1-\left(\frac{d}{r}\right)^2}}$

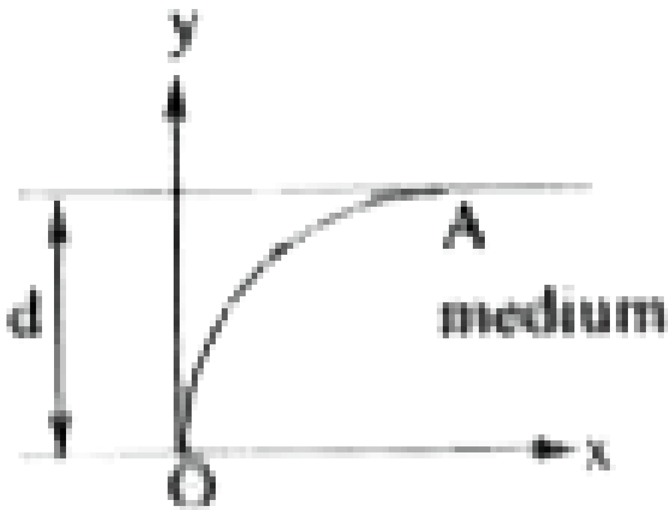
C. $\dfrac{-\mu_0}{\sqrt{1+\left(\frac{r}{d}\right)^2}}$

D. $\dfrac{\mu_0}{\sqrt{1+\left(\frac{d}{r}\right)^2}}$

Answer: B

Watch Video Solution

6. A long rectangular slab of transparent medium of thickness d placed on a table with its length parallel to the x-axis and width parallel to the axis. A ray of light travelling inair makes a near normal incidence on the slab as shown. Taking the point of incidence as orign (0,0,0). The refraction index μ of the medium varies as $\mu = \dfrac{\mu_0}{1 - \left(\frac{x}{r}\right)}$ where μ_1 and $r(> d)$ are constants. The refractive index of air is μ_0



The x-coordinate of the point A where the ray intersects the upper surface of the slab air boundary is

A. the ray retraces its path

B. the ray travels along the positive x-axis

C. the ray will travel parallel to y-axis

D. The ray will make certain angle $\theta(\ > 30^\circ)$ with positive y-axis and pass along the line

Answer: C

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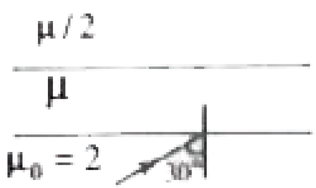
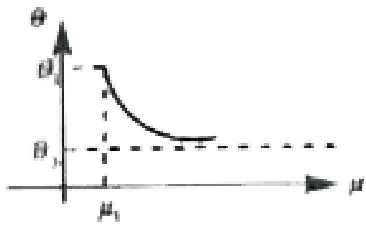
7. In the diagram shown ray of light is incident on the first medium boundary at angle 30° the medium has refractive index 2.





The second layer has refractive index $\mu/2$. A graph is given between deviation and refractive index μ. The deviation is measured by considering the final emergent ray and the incident ray.

Aswer the following questions

Value μ_1 will be

A. 1

B. 2

C. 3

D. 1.5

Answer: B

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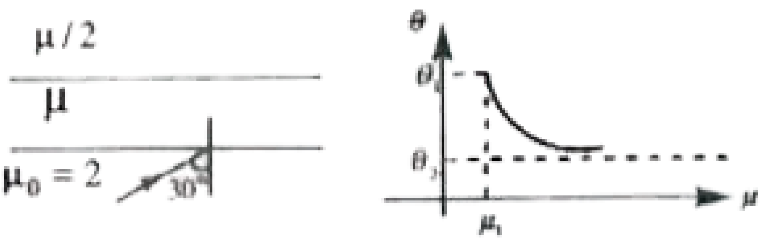
8. In the diagram shown ray of light is incident on the first medium boundary at angle 30° the medium has refractive index 2.



The second layer has refractive index $\mu/2$. A graph is given between deviation and refractive index μ. The deviation is measured by considering the final emergent ray and the incident ray.

Aswer the following questions

Value of θ_1 will be

A. 30°

B. 60°

C. 45°

D. 0°

Answer: B

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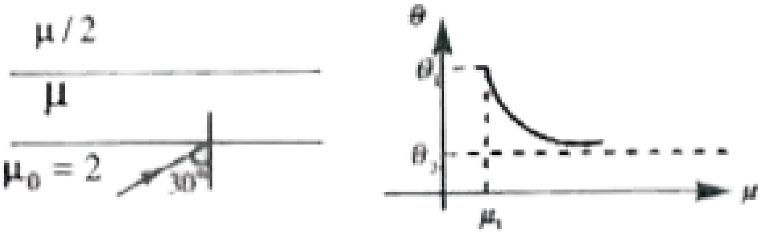
9. In the diagram shown ray of light is incident on the first medium boundary at angle 30° the medium has refractive index 2.



The second layer has refractive index $\mu/2$. A graph is given between deviation and refractive index μ. The deviation is measured by considering the final emergent ray and the incident ray.

Aswer the following questions

Value of θ_1 will be

A. 30°

B. 60°

C. 45°

D. 15°

Answer: A

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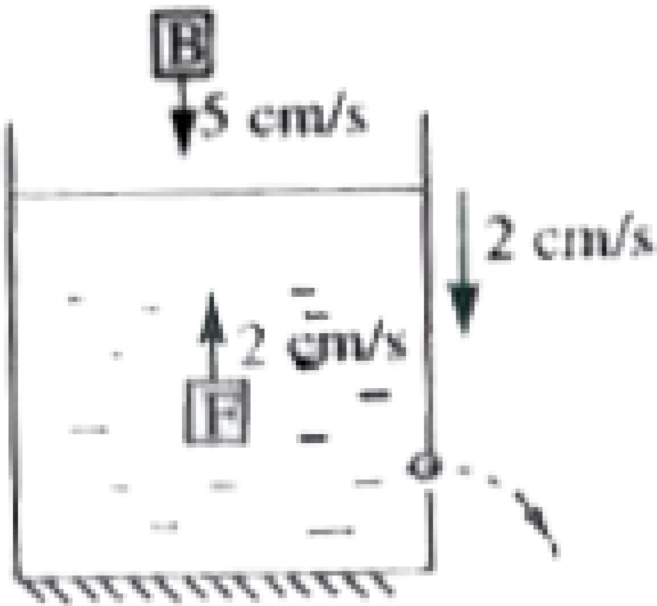
1. A bird B in air is diving vertically downwards over a water tank with speed 5 cm/s. Base of the tank is silvered. A fish F in the tank is rising vertically upwards along the same line with speed 2 cm/s. Water level is lowered at the rate of 2 cm/s. Take $\mu_{\text{water}} = 4/3$



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LECTURE SHEET (EXERCISE II LEVEL -II (ADVANCED) INTEGER TYPE QUESTIONS)

1. A beam of light falls on a glass plate $(\mu = 3/2)$ of thickness 6.0 cm at an angle of 60°. Find the deflection of the beam on passing through the plate. (in cm).

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2. The flat bottom of cylinder tank is silvered and water $\left(\mu = \frac{4}{3}\right)$ is filled in the tank upto a height h. A small bird is hovering at a height 3h from the bottom of the tank. When a small hole is opened near the bottom of the tank, the water level falls at the rate of 1 cm/s. The bird will perceive that his velocity of image is 1/x cm/sec (in downward directions) where x is

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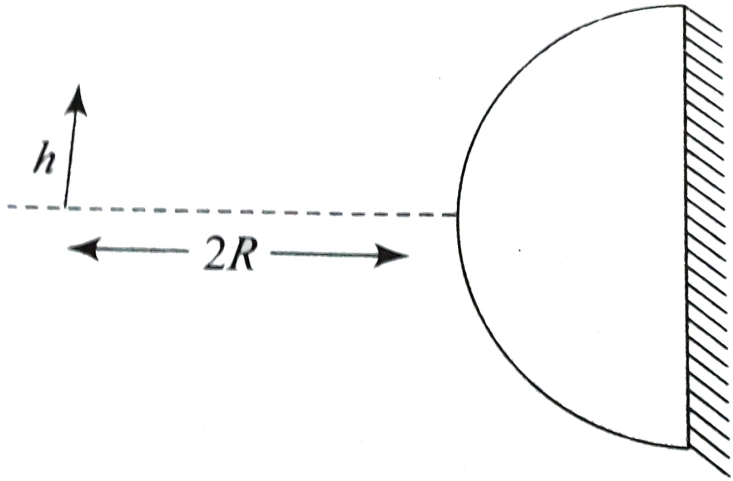
LECTURE SHEET (EXERCISE III LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

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



A. at a distane of R from silvered surface, on the right side

B. on the object itself

C. at hemisphere surface

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

Answer: B

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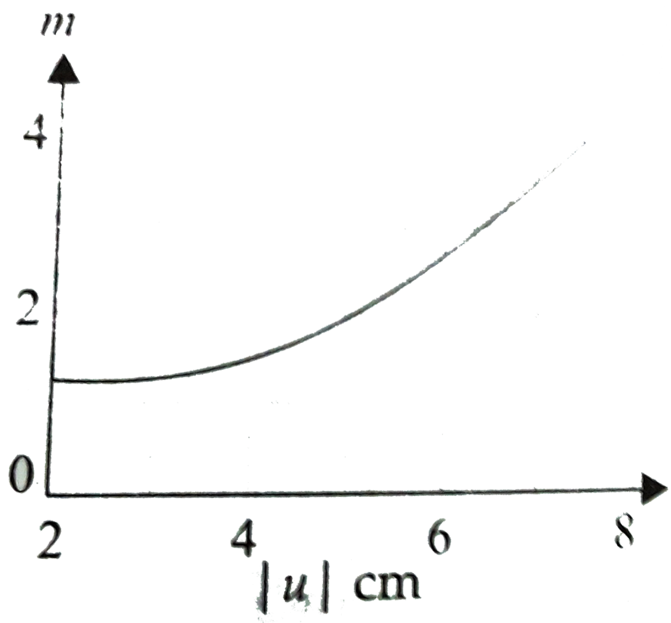
2. An object kept on the principal axis and infront of a spherical mirror, is moved along the axis itself. Its lateral magnification m is measured, and plotted versus object distance $|u|$ for a range of u, as shown in figure. The magnification of the object when it is placed at a distance 20cm in front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



A. -1

B. 1

C. 8

D. 20

Answer: A

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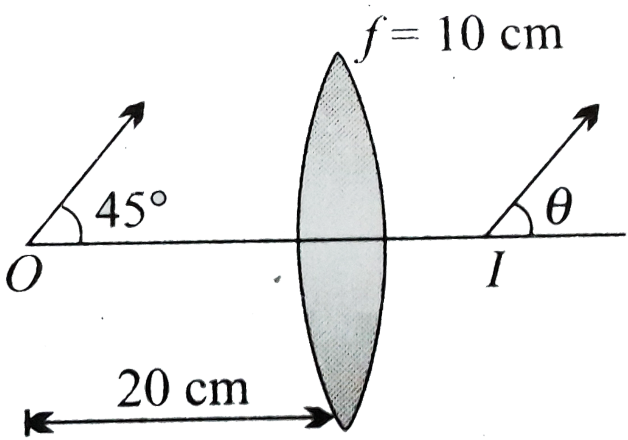
3. An object starts moviing at an angle of 45° with the principal axis as shown in figure. In front of a biconvex lens of focal length $+10cm$. If θ denotes the angle at which image starts to move with principal axis, then



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

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

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

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

Answer: D

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

A. using a convex mirror of focal length less than 0.25 m

B. μu

C. u / μ

D. zero

Answer: B

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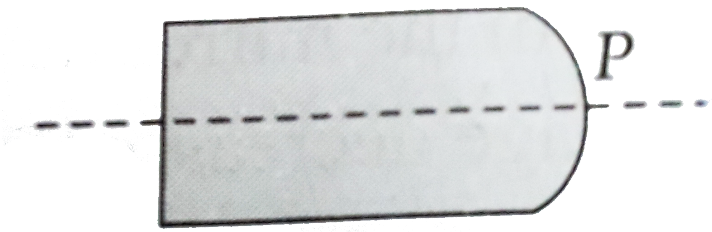
5. Find the distance of object placed in the slab of refractive index μ from point P of the curved surface of radius R so that image is formed at infinity:



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

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

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

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

Answer: B

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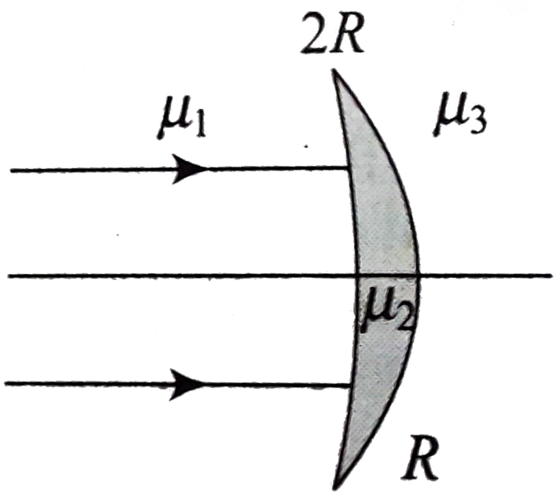
6. Figure, shows a concavo-convex lens μ_2. What is the condition on the refractive indiecs so the at the lens is diverging?



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

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

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

D. None of these

Answer: B

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

A. 3 dipoter

B. 5 diopter

C. 2 diopter

D. 9 diopter

Answer: B

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LECTURE SHEET (EXERCISE III LEVEL -II (ADVAMCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A glass sphere $(\mu = 1.5)$ of radius 20 cm has a small air bubble 4 cm below its centre. The sphere is viewed from outside and along a vertical line through the bubble. The apparent depth of the bubble below the surface of sphere is (in cm)

A. 13.33

B. 26.67

C. 15

D. 30

Answer: B

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2. A ray enters a glass sphere of refractive index $\mu = (\sqrt{3})$ at an angle of incidence of 60°, ray is reflected and refracted at the farther surface of the sphere. The angle between the reflected and refracted rays at this surface is

A. 90°

B. 60°

C. 70°

D. 40°

Answer: A

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

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

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

C. 90°

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

Answer: C

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4. Radius of curvature of first surface of double convex lens is three times that of the other. If focal length of the lens is 30 cm and refractive index of the lens is 3/2, then radius of curvature of the first surface is

A. 20 cm

B. 40 cm

C. 60 cm

D. 80 cm

Answer: C

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5. A thin equi-convex lens is made of glass of refractive index 1.5 and its length is $0.2m$. If it acts as a concave lens of $0.5m$ focal length when dipped in a liquid, the refractive index of the liquid is

A. $\frac{17}{8}$

B. $\frac{15}{8}$

C. $\frac{13}{8}$

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

Answer: B

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6. A thin double convex lens is cut into two equal pieces A and B by a plane containing principal axis. The piece B is further cut into two more pieces pieces C and D by another plane perpendicular to the principal axis. If the focal power of the original lens is P, then thos of A and C are

A. $P, \frac{P}{4}$

B. $P, \frac{P}{2}$

C. $\frac{P}{2}, 2P$

D. $\frac{P}{2}, \frac{P}{4}$

Answer: B

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7. Two plano concave lenses of glass of refractive index 1.5 have radii of curvature 20 cm and 30 cm respectively. They are placed in contact with the curved surface towards each other and the space between them is filled with a liquid of refractive index 5/2. The focal length of the combination is (in cm)

A. 6

B. -92

C. 108

D. 12

Answer: D

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8. The two surfaces of a biconvex lens has same radii of curvatures . This lens is made of glass of refractive index 1.5 and has a focal length of 10 cm in air. The lens is cut into two equal halves along a plane perpendicular to its principal axis to yield two plane - convex lenses. The two pieces are glued such that the convex surfaces touch each other. If this combination lens is immersed in water (refractive index $=\frac{4}{3}$), its focal length (in cm) is

A. 5

B. 10

C. 20

D. 40

Answer: D

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9. Two converging glass lenses A and B have focal lengths in the ratio $2:1$. The radius of curvature of first surface of lens A is 1/4 th of the second surface where as the radius of curvature of first surface of lens B is twice that of second surface. Then the ratio between the radii of the first surfaces of A and B is

A. $5:3$

B. $3:5$

C. $1:2$

D. $5:6$

Answer: D

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

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

B. $\frac{1}{4}$

C. $\frac{1}{3}$

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

Answer: C

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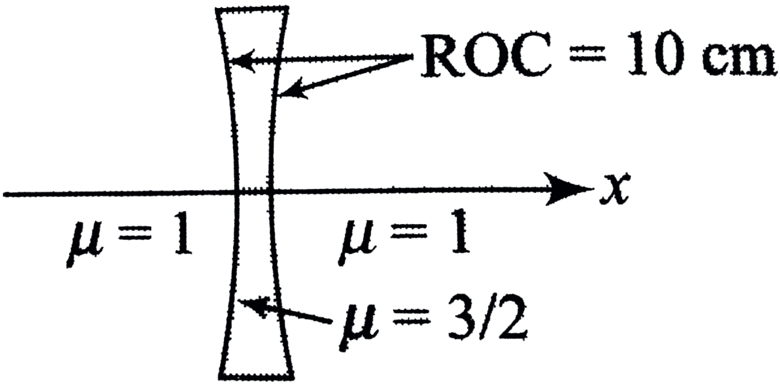
11. Find the focal length of the lens shown in Fig.



A. 1 image , at infinilty and 4 cm

B. 2 images at infinity and 960/19cm

C. 2 image both at infinity

D. 4 images, all at infinity

Answer: B

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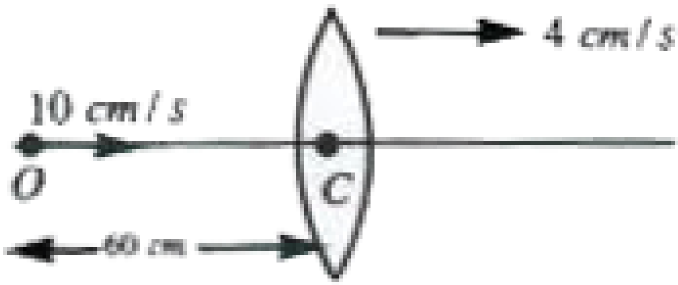
12. A point object O approaches a biconvex lens of focal length 40 cm along its optic axis with a speed of 10 m/s while the later receeds away from the former with a speed of 4 cm/s. Find the speed and direction of motion of the image when the object is at a distance of 60 cm from the lens.



A. 10 cm/s, leftwards

B. 10 cm/s, rightwards

C. 28 cm/s , righwards

D. 28 cm/s leftwards

Answer: C

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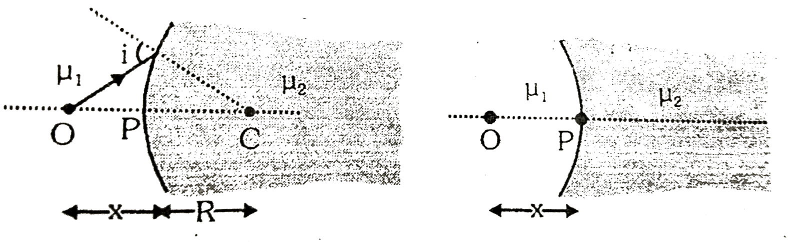
LECTURE SHEET (EXERCISE III LEVEL -II (ADVAMCED) MORE THAN ONE CORRECT TYPE QUESTIONS)

1. A curved surface of radius R separates two medium of refractive indices $\mu_1 \text{and} \mu_2$ as shown in figures A and B .



Choose the correct statement(s) related to the virtual image formed by object O placed at a distance x, as shown in figure

A. Virtual image is formed for any position of O if $\mu_2 < \mu_1$

B. Virtual image can be formed if $x > R$ and $\mu_2 < \mu_1$

C. Virtual images is formed if $x < r$ and $\mu_2 > \mu_1$

D. None of these

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

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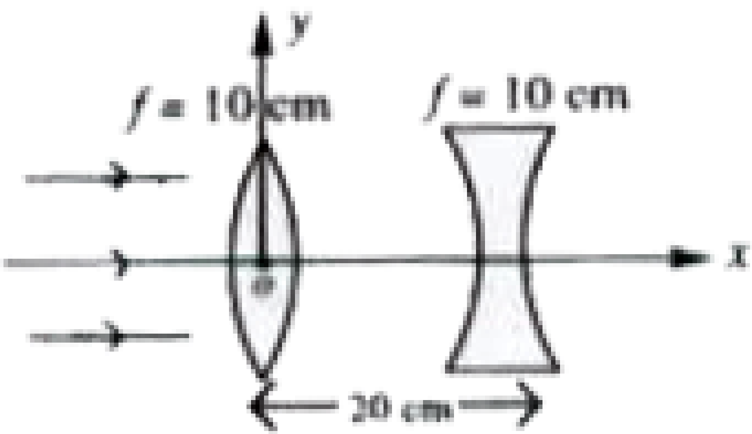
LECTURE SHEET (EXERCISE III LEVEL -II (ADVAMCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. A convex lens of focal length 10 cm and a concave lens of same focal length in value are placed co-axially at a separation of 20 cm as shown in figure. A point object is at infinity on the principal axis. Take the optic center of convex lens as origin of co ordinate system and the principal axis as x-axis as shown in figure.



The co-ordinates of the image formed after refraction through both the lenses is

A. (10 cm, 0)

B. (25cm, 0)

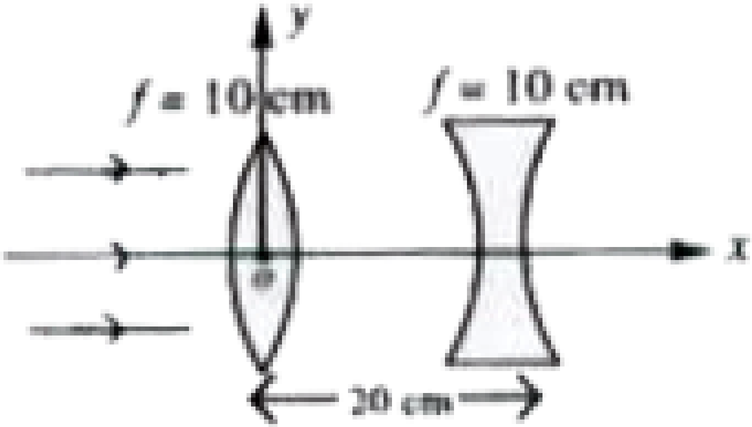
C. (-5m,0)

D. (15cm,0)

Answer: D

Watch Video Solution

2. A convex lens of focal length 10 cm and a concave lens of same focal length in value are placed co-axially at a separation of 20 cm as shown in figure. A point object is at infinity on the principal axis. Take the optic center of convex lens as origin of co ordinate system and the principal axis as x-axis as shown in figure.



The co-ordinates of the image formed after refraction through both the lenses is

A. (15 cm, 0.25cm)

B. (10 cm+0.25cm)

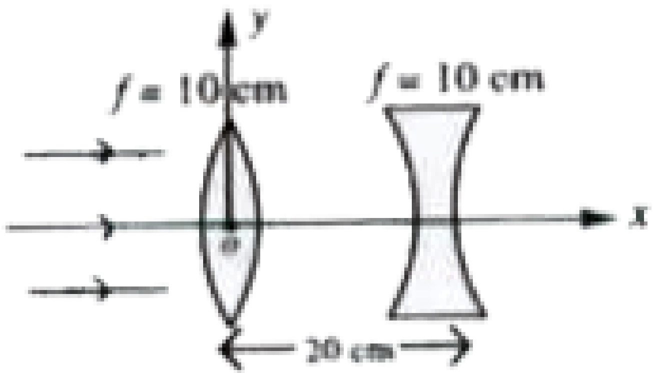
C. (25cm, -0.5cm)

D. (15cm,+0.5cmC)

Answer: A

Watch Video Solution

3. A convex lens of focal length 10 cm and a concave lens of same focal length in value are placed co-axially at a separation of 20 cm as shown in figure. A point object is at infinity on the principal axis. Take the optic center of convex lens as origin of co ordinate system and the principal axis as x-axis as shown in figure.



In the initial positin (as given in the passage) if the concave lens has a velocit of 9 cm/s towards the convex lens, the velocity of the final image will be

A. 10 cm/s along positive x-axis

B. 6.75 cm/s along negative x-axis

C. 8 cm/s along negative x-axis

D. 8 cm/s along positive x-axis

Answer: B

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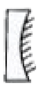
LECTURE SHEET (EXERCISE III LEVEL -II (ADVAMCED) MATRIX MATCHING TYPE QUESTIONS)

1. Thin lenses made of materials $\mu = 1.5$ with which are silvered at one surface are given in column I and their focal powers are given is column-II, Radius of curvature of each spherical surface is R. Match the two columns.

COLUMN -I	COLUMN -II
A) 	p) $-\frac{3}{R}$
B) 	q) $\frac{1}{R}$
C) 	r) $\frac{4}{R}$
D) 	s) $\frac{2}{R}$

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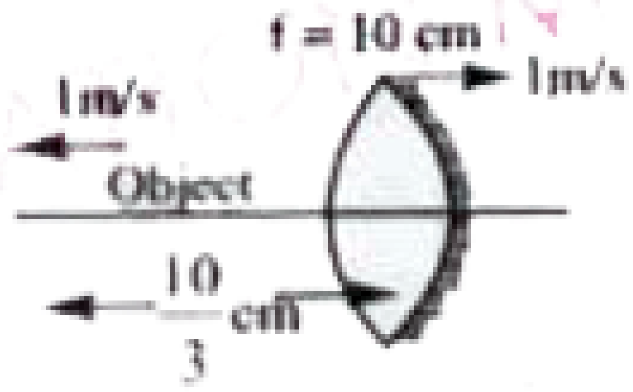
LECTURE SHEET (EXERCISE III LEVEL -II (ADVAMCED) INTEGER TYPE QUESTIONS)

1. One of the surfaces of a biconvex lens of a focal length 10 cm is silvered as shown in figure. Radius of curvature of silvered surface is 10 cm. At a given instant, if speed of object is 1m/s, then the speed of image at that instant is $(10 + \alpha)$ m/s. What will be the value of α? $(\mu = 1.5)$



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2. An object is kept at a distance of 4 cm form the first focus of a convex lens. A real image is formed at a distance of 9 cm from its second focus. What is the focal length of that lens is __________(in cm)

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PRACTICE SHEET (EXERCISE I LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. An infinitely long rod lies along the axis of a concave mirror of focal length f. The near end of the rod is distance $u > f$ from the mirror. Its image will have length

A. $\frac{uf}{u-f}$

B. $\frac{uf}{u+f}$

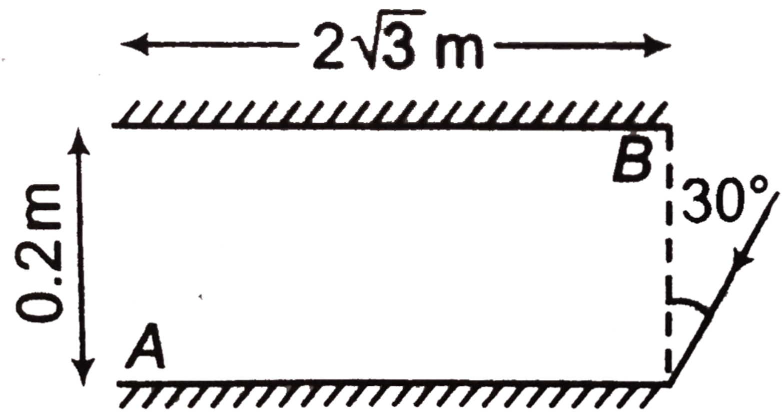
C. $\frac{f^2}{u+f}$

D. $\frac{f^2}{u-f}$

Answer: D

Watch Video Solution

2. Two plane mirrors A and B are aligned parallel to each other as shown in the figure. A light ray is incident at an angle of 30° at a point just inside one end of A. The number of times the ray undergoes reflections (including the first one) before it emerges out is



A. 28

B. 30

C. 32

D. 34

Answer: B

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3. A short linear object of length b lies along the axis of a concave mirror of focal length fat a distance u from the pole of the mirror, what is the size of image?

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

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

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

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

Answer: D

Watch Video Solution

4. A concave mirror has a focal length 20 cm. The distance between the two positions of the object for which the image size is double of the object size is

A. 20 cm

B. 40 cm

C. 30 cm

D. 60 cm

Answer: A

Watch Video Solution

5. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The center of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The ling PQ cuts the surface at a point O, and $PO = OQ$. The distance PO is equal to

A. 5R

B. 3R

C. 2R

D. 1.5R

Answer: A

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6. Two plane mirrors are inclined at 70°. A ray incident on one mirror at incidence angle θ after reflection falls on the second mirror and is reflected from there parallel to the first mirror, The value of θ is

A. 50°

B. 45°

C. 30°

D. 55°

Answer: A

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7. A light ray strikes a horizontal plane mirror and gets deviated by $\pi/3$. By what angle should the mirror be tilted so that the reflected ray becomes vertical?

A. $\pi/6$

B. $(\pi)/2$

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

D. $(\pi)/4$

Answer: A

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8. A narrow beam of light after reflection by a plane mirror falls on a scale at a distance 100 cm from the mirror. When the mirror is rotated a little, the light spot moves through 2 cm. The angle through which the mirror is rotated is

A. 0.02 rad

B. 0.01 rad

C. 200 rad

D. 0.01/188 π rad

Answer: B

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9. Three identical plane mirrora AB, BC, AC are arranged as shown in the figure. Find the total number of images of a point objectS formed by the three mirrors. (S is at the centre of the system)

A. 18

B. 12

C. 5

D. infinity

Answer: D

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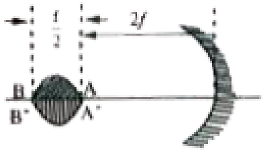
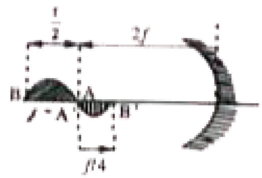
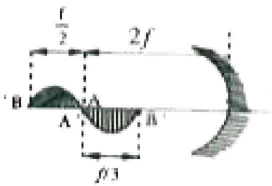
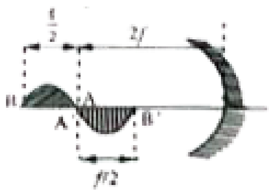
10. An object is placed on the principal axis of a concave mirror at a distance of 1.5 f(f is the focal length). The image will be at,

A. 

B. 

C. 

D. 

Answer: C

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11. Two plane mirrors are placed parallel to each other at a distance L apart. A point object O placed between them, at a distance $L/3$ from one mirror. Both mirrors form multiple image. The distance between any two images cannot be

A. 3L/2

B. 2L/3

C. 2L

D. None

Answer: A

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PRACTICE SHEET (EXERCISE I LEVEL -II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A clock fixed on a wall shows time 04:25:37. What time will its image in a plane mirror hanging on an opposite vertical wall show?

A. $07:43:32$

B. $07:43:32$

C. $07:34:23$

D. $43:27:36$

Answer: C

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2. A man of height 'h' is walking away from a street lamp with a constant speed 'v'. The height of the street lamp is 3h. The rate at which the length of the man's shadow is increasing when he is at a distance 10 h from the base of the street lamp is

A. v/2

B. v/3

C. 2v

D. v/6

Answer: A

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3. A point source of light is 60 cm from a screen and is kept at the focus of a concave mirror which reflects light on the screen. The focal length of the mirror is 20 cm. The ratio of average intensities of the illumination on the screen when the mirror is present and when the mirror is removed is:

A. $36:1$

B. $37:1$

C. $49:1$

D. $10:1$

Answer: D

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4. A police inspector is chasing a thief who is running away in a car with a speed 3m/s. The speed of police jeep is 12 m/s. Then the speed of image of police jeep as seen by thief in the rear view mirror when the police jeep is at a distance of 30 m is (value of focal length of the rear view mirror is 15 m)

A. 2m/s

B. 3m/s

C. 4m/s

D. 1m/s

Answer: D

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

A. 15 cm

B. 20 cm

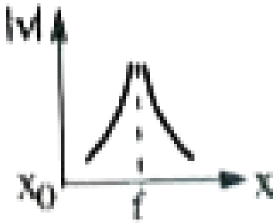
C. 10 cm

D. 40 cm

Answer: C

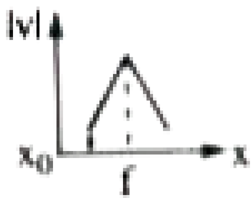
Watch Video Solution

6. A point source is situated at a distance $x < f$ from the pole of the concave mirror of focal length f. At time t=0 the point source starts moving away from the mirror with constant velocity. Which of the graphs below represents best, variation of image distance |v| with distance x between the pole of mirror and the source.

A. 

B. 

C. 

D. 

Answer: A

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

A. 10 cm

B. 30 cm

C. 15 cm

D. 20 cm

Answer: D

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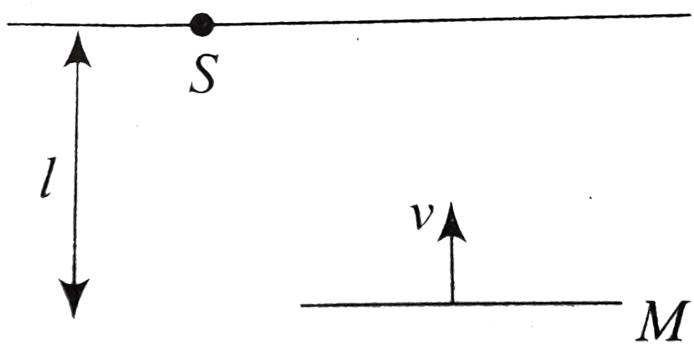
PRACTICE SHEET (EXERCISE I LEVEL -II (ADVANCED) MORE THAN ONE CORRECT TYPE QUESTIONS)

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

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



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

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

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

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

Answer: B::D

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2. Which of the following are correct about spherical mirrors

A. concave mirror forms virtual image of real object some times

B. convex mirror forms real image of virtual object some times

C. convex mirror forms real image of virtual object always

D. convex mirror virtual image of real object always

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

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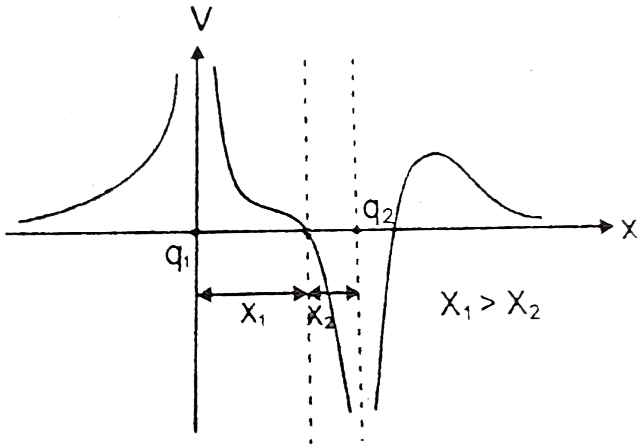
PRACTICE SHEET (EXERCISE I LEVEL -II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. 

Two point charges (q_1 and q_2) are placed on x-axis, figure shows graph potential (V) on x-axis. With x-co-ordinate:

A. $\left(\frac{10}{7}, 0\right)$

B. $\left(\frac{60}{7}, 0\right)$

C. $\left(\frac{-60}{7}, 0\right)$

D. $\left(\frac{-10}{7}, 0\right)$

Answer: A

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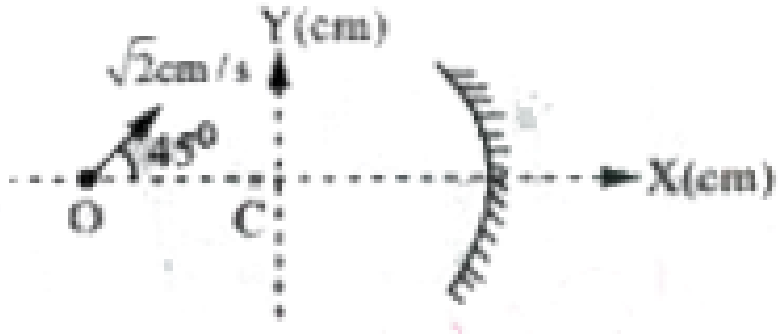
2.



A concave mirror of radius of curvature 10 cm whose principal axis co incides with x-axis and its centreof curvature at origin. A point object O with its initial co-ordinates (-2,0) is moving with a constant speed $\sqrt{2}$ cm/sec making an angle 45° with the x-axis as shown figure.

The image co -ordinates at tiem t=0

A. zero

B. 0.5 cm/s

C. 1 cm/s

D. 2 cm/s

Answer: D

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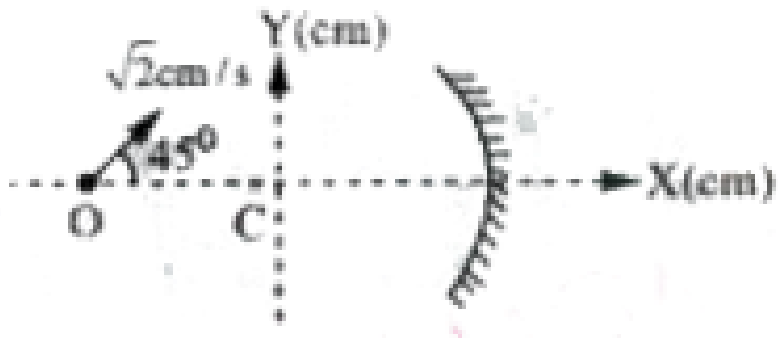
3. 

A concave mirror of radius of curvature 10 cm whose principal axis co incides with x-axis and its centreof curvature at origin. A point object O with its initial co-ordinates (-2,0) is moving with a constant speed $\sqrt{2}$ cm/sec making an angle 45° with the x-axis as shown figure.

The image co -ordinates at tiem t=0

A. 1s

B. 2s

C. 3s

D. 4s

Answer: B

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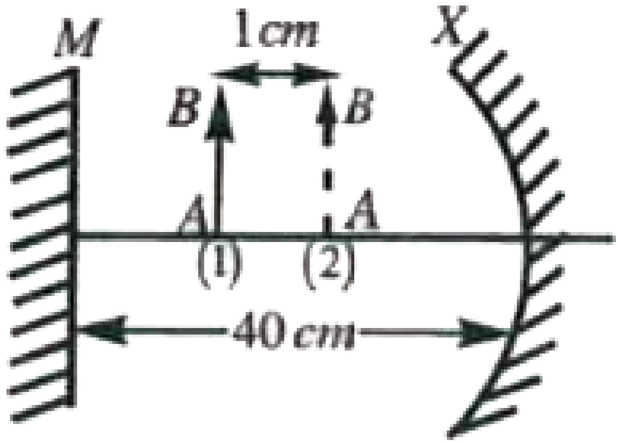
4. A plane mirror M and a concave mirror X are kept at a seperation of 40cm with their reflecting faces facing each other as shown in figure. An object AB is kept perpendicular to the principal axis in position (1). Considering successive reflections first at mirror X and then at M a real image is formed infront of M at a normal distance 8 cm form it. If the object is mived to new position (2), the real image is formed atg 20cm from M with the reflections as described earlier.



Focal length of mirror X is

A. 11cm

B. 12cm

C. 14cm

D. 15cm

Answer: D

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5. When an object is placed 40cm from a diverging lens, its virtual image is formed 20cm from the lens. The focal length and power of lens are

A. 18 cm

B. -12 cm

C. -6 cm

D. -24cm

Answer: B

Watch Video Solution

6. When an object is placed 40cm from a diverging lens, its virtual image is formed 20cm from the lens. The focal length and power of lens are

A. at distacne of $\frac{80}{3}$ cm from the pole of mirror X and in front of its reflecting surface.

B. at a distance of $\frac{40}{3}$ cm from the pole of mirror X and in front of its reflecting surface

C. mid point between X and Y

D. at any position between X and pole

Answer: A

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PRACTICE SHEET (EXERCISE I LEVEL -II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. Match the object natures in column I with the natures of their images formed by a plane mirror in column II.

Column - I	Column - II
A) Linear real object with its length parallel to the plane of mirror	p) inverted
B) Linear real object with its length perpendicular to the plane of mirror	q) erected
C) Linear virtual object with length parallel to the plane of mirror	r) real
D) Linear virtual object with length perpendicular to the plane of mirror	s) virtual

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PRACTICE SHEET (EXERCISE I LEVEL -II (ADVANCED) INTEGER TYPE QUESTIONS)

1. An object is at 20 cm from a concave mirror of focal length 10 cm, the nature of image is

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2. A 4 cm object is placed perpendicular to the principal axis of a convex mirror of focal length 7.5 cm. The distance of the image from the mirror if it is 0.6 cm in size is 51/x where x is

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PRACTICE SHEET (EXERCISE II LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. The minimum deviation produced by a hollow prism filled with a certain liquid to be 30°. The light ray is also found to be refracted at angle 30°. The refractive index of the liquid is

A. $\sqrt{2}$

B. $\sqrt{3}$

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

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

Answer: A

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2. For a prism of refractive index, 1.732, the angle of minimum deviation is equal to the angle of prism. Then the angle of the prism is

A. 30°

B. 45°

C. 60°

D. 80°

Answer: C

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3. When a glass prism of refracting angle 60° is immersed in a liquid its angle of minimum deviation is 30°. The critical angle of glass with respect to the liquid medium is

A. 30°

B. 45°

C. 60°

D. 50°

Answer: B

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

A. $2\sin A$

B. $2\cos A$

C. $1/2\cos A$

D. $\tan A$

Answer: B

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5. A thin plano - convex lens acts like a concave mirror of focal length 0.2 m, when silvered on its plane surface. The refractive index of the material of the lens is 1.5. The radius of curvature of the convex surface of the lens will be

A. 0.4 m

B. 0.2m

C. 0.1m

D. 0.75m

Answer: B

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6. At what distance from a convex mirror of focal length 2.5 m should as boy stand so that his image has a height equal to half the original height?

A. 2.5 m from the mirror

B. 5 m from the mirror

C. 7.5 m from the mirror

D. 10 m from the mirror

Answer: A

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7. An object of length 10 cm is placed at right angles to the principal axis of a mirror of radius of curvature 60 cm such that its image is virtual, erect and has a length 6 cm. What kind of mirror it is and also determine the position of the object ?

A. Concave 20 cm from the mirror

B. convex 20 m from the mirror

C. concave 10 cm from the mirror

D. convex 20 cm from the mirror

Answer: D

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8. A plane mirror is placed 22.5 cm in front of the concave mirror of focal length 10 cm. Find where an object a can be placed between the two mirrors, so that the first image in both the mirrors coincides.

A. 15 cm from the concave mirror

B. 15 cm from the plane mirror

C. 10 cm from the concave mirror

D. 10 cm from the plane mirror

Answer: A

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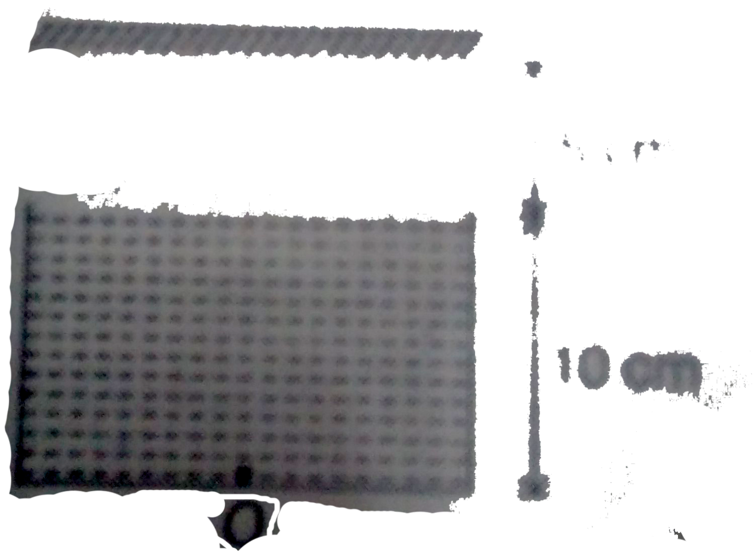
PRACTICE SHEET (EXERCISE II LEVEL -II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

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



A. 15 cm

B. 12.5 cm

C. 7.5

D. 10 cm

Answer: B

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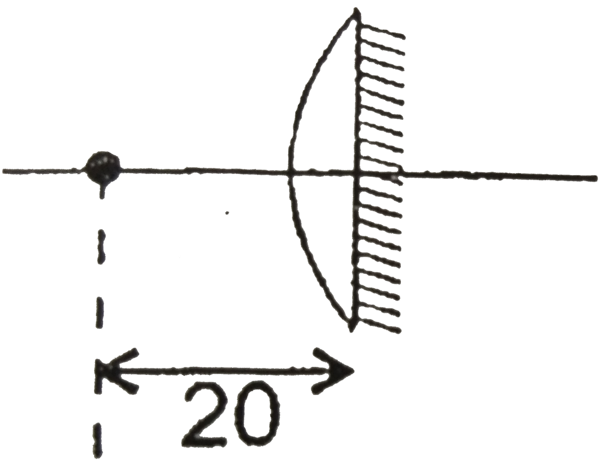
2. A point object is placed at a distance of $20cm$ from a thin plano-concex lens of focal length $15cm$. The plane surface of the lens is now silvered. The image created by the is at :



A. 12 cm to the left of lens system

B. 20 cm to the right of lens system

C. 12 cm to the right of lens system

D. 20 cm to the left of lens system

Answer: A

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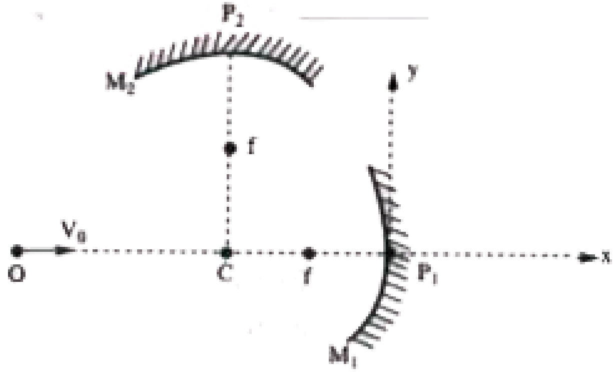
PRACTICE SHEET (EXERCISE II LEVEL -II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. Two identical concave mirrors M_1 & M_2 with principal axes perpendicular to each other and pole P_1 of mirro M_1 at origin is as shown. Let f be the focal length and C be the common centre of curvature for both mirrors. A point object O is at $(-5f, 0)$ and is moving with a velocity $\overrightarrow{C} = v_0 \hat{i}$ m/s.



Consider rays incident on mirror M_2 the co-ordinates of the final imasge formed is

A. at (-x,0) and moving along x-axis

B. at (-y,0) and moving along x-axis

C. at (+x,0) and moving along x-axis

D. at (-y,0) and moving along y-axis

Answer: B

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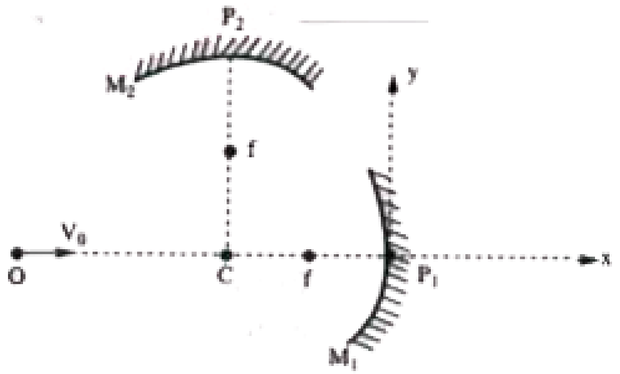
2. Two identical concave mirrors M_1 & M_2 with principal axes perpendicular to each other and pole P_1 of mirro M_1 at origin is as shown. Let f be the focal length and C be the common centre of curvature for both mirrors. A point object O is at $(-5f, 0)$ and is moving with a velocity $\vec{C} = v_0 \hat{i}$ m/s.



Consider rays incident on mirror M_2 the co-ordinates of the final imasge formed is

A. at position (-x,0) and moving along x-axis

B. at position (+x,0) and moving along x-axis

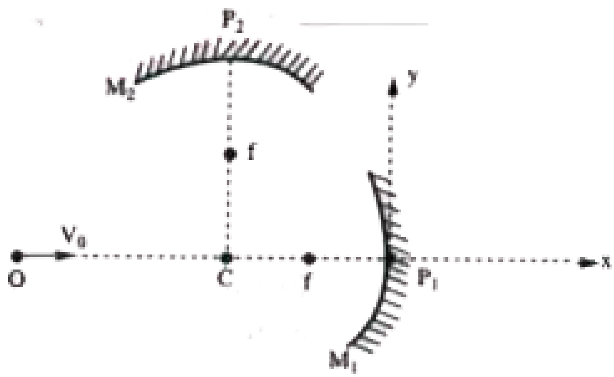
C. at position (-x,0) and moving along y-axis

D. at position (+y,0) and moving along y-axis

Answer: A

Watch Video Solution

3. Two identical concave mirrors M_1 & M_2 with principal axes perpendicular to each other and pole P_1 of mirro M_1 at origin is as shown. Let f be the focal length and C be the common centre of curvature for both mirrors. A point object O is at $(-5f, 0)$ and is moving with a velocity $\vec{C} = v_0 \hat{i}$ m/s.



Consider rays incident on mirror M_2 the co-ordinates of the final imasge formed is

A. Real and at 20 cm from the mirror

B. virtual

C. may be real or virtual

D. all of these

Answer: A

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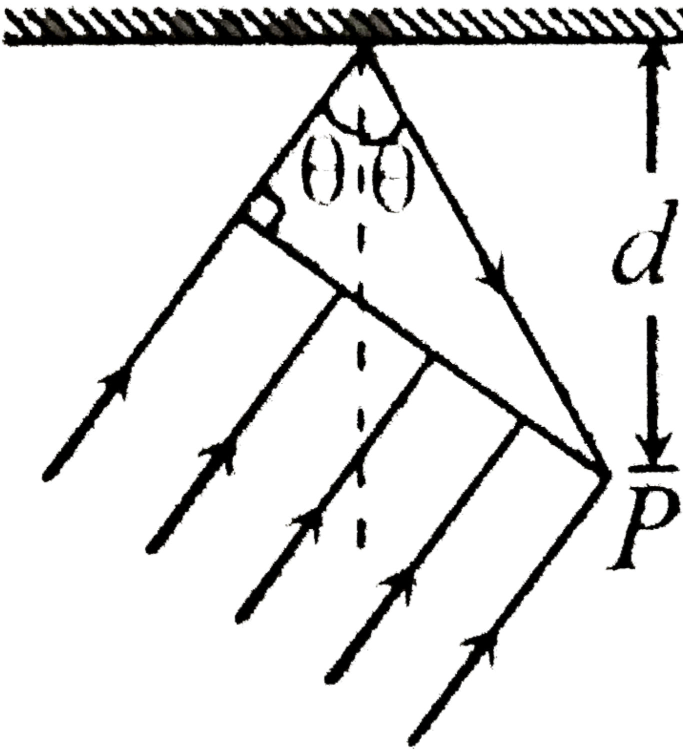

4.

A plane wave front of light is incident on a plane mirror. Intensity is maximum at P when

A. $18\frac{2}{3}$ cm

B. $15\frac{1}{3}cm$

C. 0.186 m`

D. $9\frac{1}{3}cm$

Answer: A

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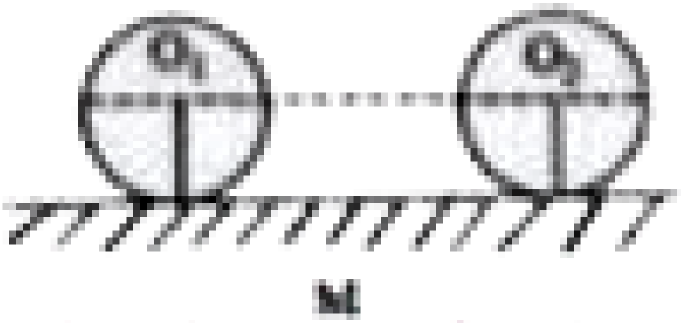
5. A cylindrical glass rod of raidus 0.1 m and $Ri\sqrt{3}$ lies on a horizontal plane mirror. A horizontal ray of light goind perpendicular to the axis of rod is incident on it



As what height from plane mirror should the ray be incident so that it emerges from the rod at a height 0.1 m above the mirror.

A. 21.5 cm

B. 31.5 cm

C. 11.5 cn

D. 41.5 cm

Answer: B

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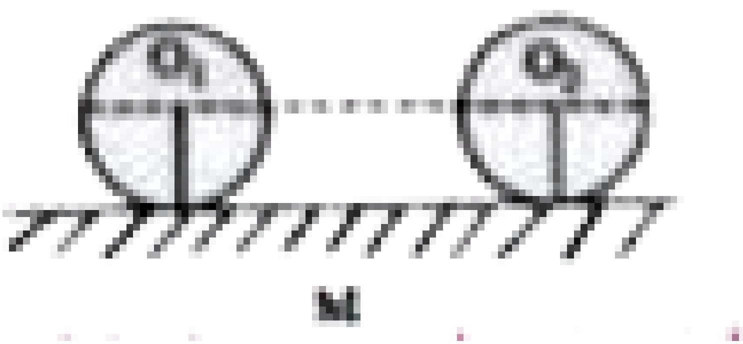
6. A cylindrical glass rod of raidus 0.1 m and $Ri\sqrt{3}$ lies on a horizontal plane mirror. A horizontal ray of light goind perpendicular to the axis of rod is incident on it



As what height from plane mirror should the ray be incident so that it emerges from the rod at a height 0.1 m above the mirror.

A. 30°

B. 45°

C. 75°

D. 60°

Answer: D

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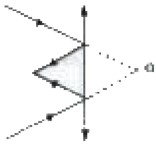
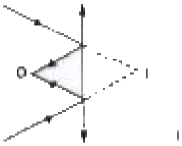
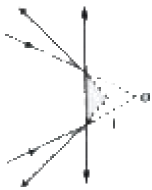
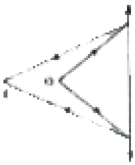
PRACTICE SHEET (EXERCISE II LEVEL -II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. Column I contains the path traced by light rays abnd the positions of object and image, with a reflecting spherical mirror. Choose the possible for type of mirror and the nature of image rom column II to each case in column -I

Column - I	Column - II
A) 	p) concex mirror
B) 	q) concave mirror
C) 	r) Image is real
D) 	s) Image is virtual

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PRACTICE SHEET (EXERCISE II LEVEL -II (ADVANCED) INTEGER TYPE QUESTIONS)

1. Two plane mirrors are making an angle of 60° to each other. A light ray falls on one of the mirrors. The light ray is incident parallel to angular bisector of mirrors. How many reflection does the light ray undergo?

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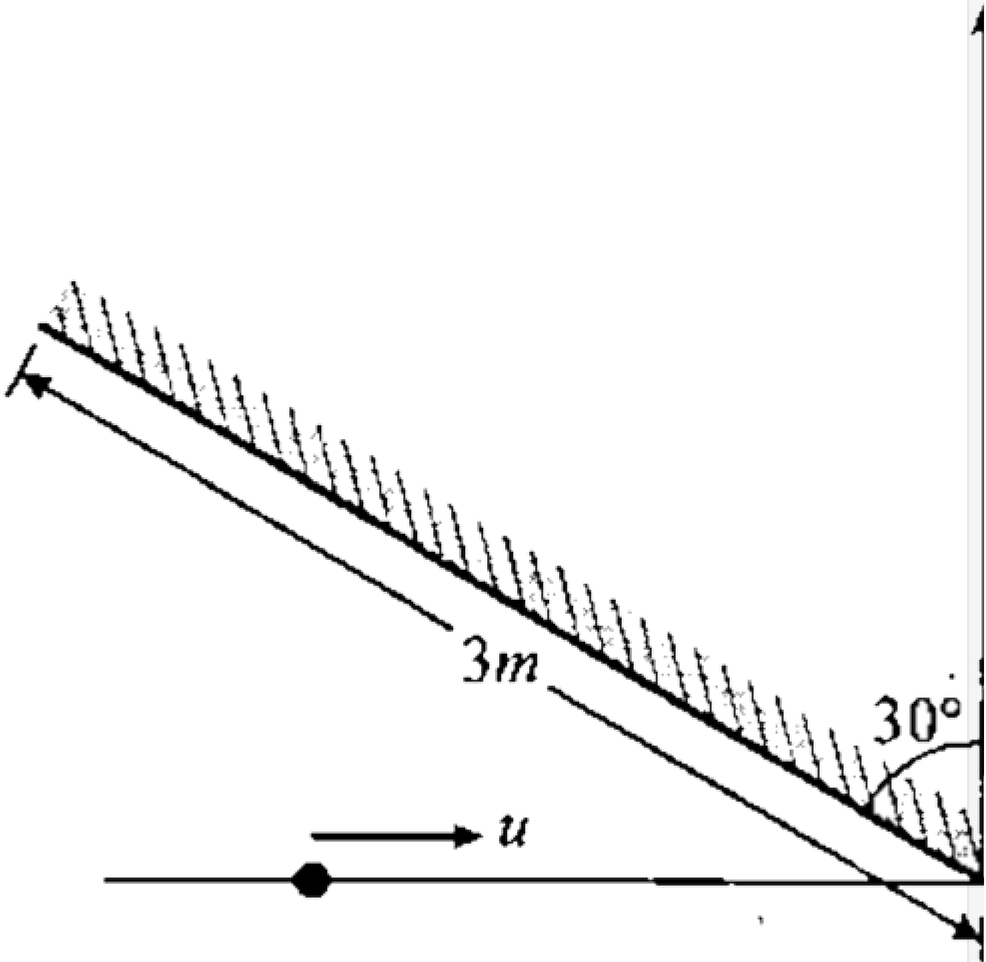
2. A plane mirror is placed with its plane at an angle 30∘ with the y-axis. Plane of the mirror is perpendicular to the xy-plane and the length of the mirror is 3m. An insect moves along x-axis starting from a distant point, with speed 2 cm/s. The duration of the time for which the insect can see its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



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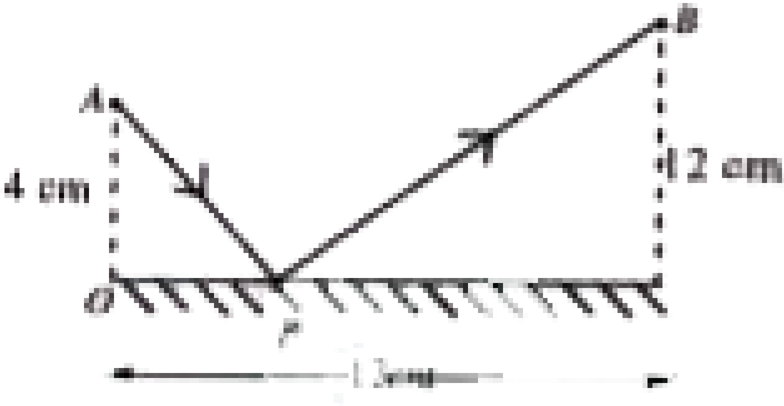
3. A ray of light is to travel from point A to point B in figure in the shortest possible time after reflecting from P. Then OP is ....cm.



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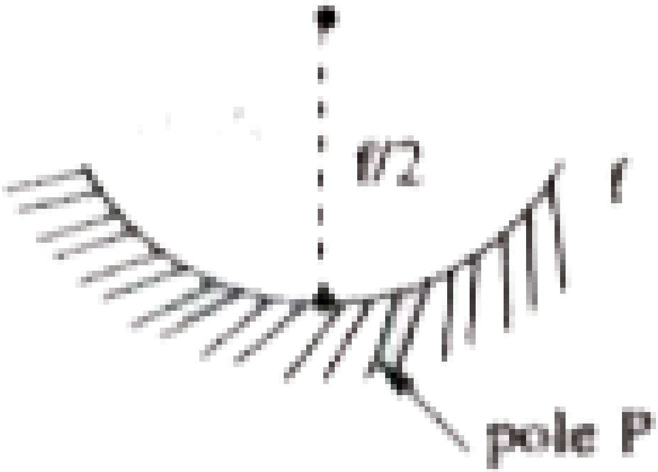
4. A particle is dropped along the axis from a height f/2 on a concave mirror of focal length f as shown in the figure. The acceleration due to gravity is g. Then the maximum speed of the image is given by $\frac{3}{4}\sqrt{xfg}$

where x=...........



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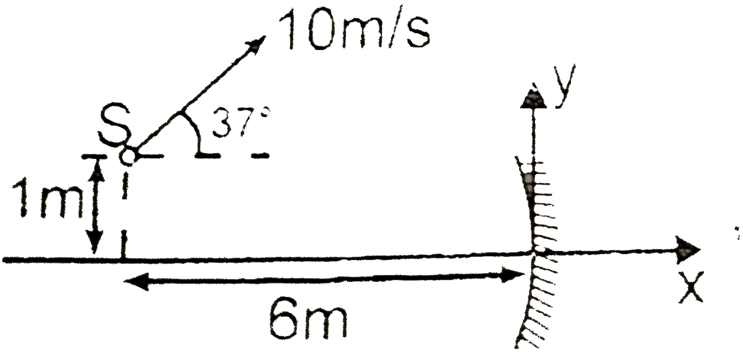
5. A point sourcs S is moving with a speed of $10m/s$ in $x-y$ plane as shown in the figure. The radius of curvature of the concave mirror is $4m$.

Determine the velocity vector of the image formed by paraxial rays.



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PRACTICE SHEET (EXERCISE III LEVEL -I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

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

A. 20 cm

B. 10 cm

C. 15 cm

D. 30 cm

Answer: B

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

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

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

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

D. Changes from virtual toreal when it is at a distance 2R/3 from the surface

Answer: C

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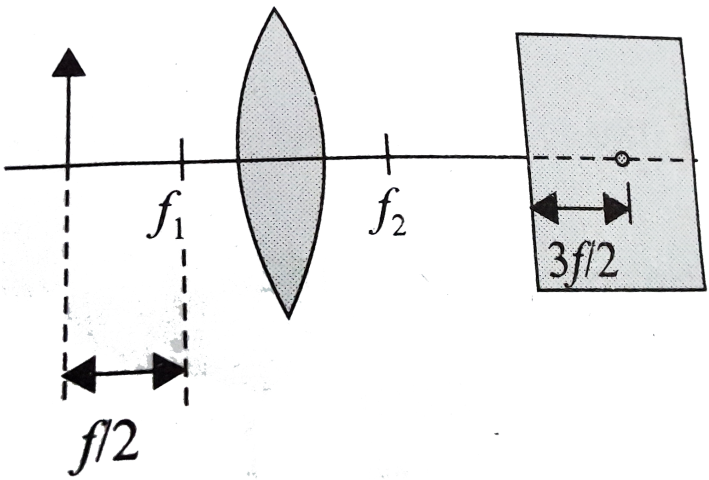
3. An object is placed at $f/2$ away from first focus of a convex lens where f is the focal length of the lens. Its image is formed at a distance $3f/2$ in a slab of refractive index $3/2$, from the face of the slab facing the lens. Find the distance of this face of the slab from the second focus of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



A. f/2

B. 3f/2

C. 2f

D. f

Answer: D

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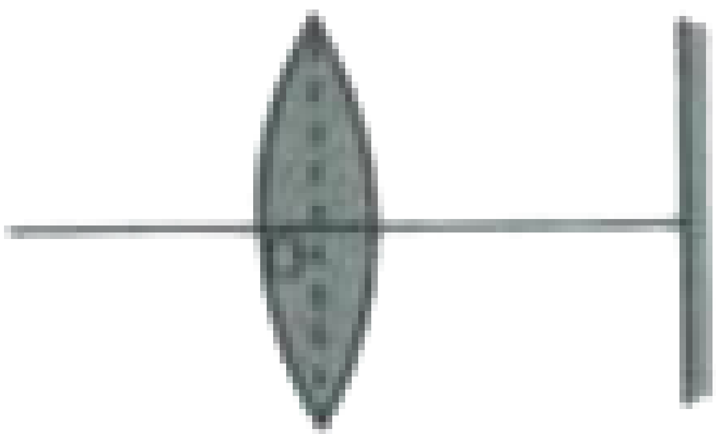
4. The distance between a convex lens and a plane mirror is 10 cm. The parallel rays incident on the convex lens after reflection from the mirror form image at the optical centre of the lens. Focal length of lens will be



A. 10 cm

B. 20 cm

C. 30 cm

D. cannot be determined

Answer: B

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5. A small fish 0.4 m below the surface of a lake is viewed through a simple converging lens of focal length 3 m. The lens is kept at 0.2 m above the water surface such that fish lies on the optical axis of the lens. The image of the fish seen by observer will be at $\left(\mu_{\text{water}} = \frac{4}{3}\right)$

A. A distance of 0.2 m from the water surface

B. A distance of 0.6 m from the water surface

C. A distance of 0.3 m from the water surface

D. The same location of fish

Answer: D

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6. A ray of light falls on the surface of a spherical glass paper weight making an angle α with the normal and is refracted in the medium at an angle β. The angle of deviation of the emergent ray from the direction of the incident ray is

A. $(\alpha - \beta)$

B. $2(\alpha - \beta)$

C. $(\alpha - \beta)/2$

D. $(\beta - \alpha)$

Answer: B

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PRACTICE SHEET (EXERCISE III LEVEL -II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. The focal length of a convex lens of R.I. 1.5 is f when it is placed inair. When it is immersed in a liquid it behaves as a converging lens its focal length becomes $xf(x > 1)$. The refractive index of the liquid.

A. $> 3/2$

B. $< 3/2$ and > 1

C. $< 3/2$

D. $= 3/2$

Answer: B

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2. A thin equi-convex lens is made of glass of refractive index 1.5 and its length is $0.2m$. If it acts as a concave lens of $0.5m$ focal length when dipped in a liquid, the refractive index of the liquid is

A. $1.2 \times 10^8 ms^{-1}$

B. $1.6 \times 10^8 ms^{-1}$

C. $1.8 \times 10^8 ms^{-1}$

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

Answer: B

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

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

B. (f, f)

C. $(4f, 4f)$

D. $(2f, 2f)$

Answer: D

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4. A mark on the surface of a glass spehre $(\mu = 1.5)$ is viewed from a diametrically opposite position. It appears to be at a distance 10 cm from its actual position. The radius of the sphere is

A. 5 cm

B. 10 cm

C. 15 cm

D. 25 cm

Answer: A

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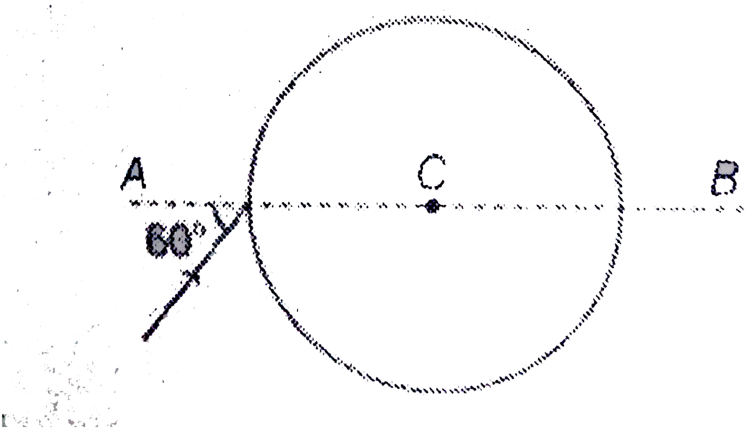
5. A ray of light falls on a transparent sphere with centre at C as shown in figure. The ray emerges from the sphere parallel to line AB. The refractive index of the sphere is



A. $\sqrt{2}$

B. $\sqrt{3}$

C. $3/2$

D. $1/2$

Answer: A

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

A. 3 cm below the surface

B. 5 cm below the surface

C. 8 cm below the surface

D. 10 cm below the surface

Answer: A

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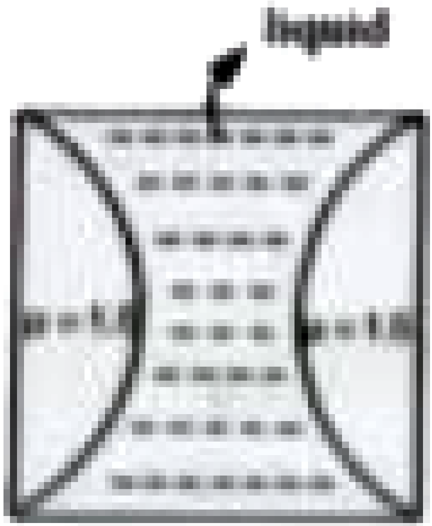
7. The effective focal length of the lens combination shown in figure is -60 cm. The radius of curvature of the curved surfaces of the plano-convex lenses are 12 cm each and refractive index of the material of the lens is

1.5. The refractive index of the liquid is



A. 1.33

B. 1.42

C. 1.53

D. 1.6

Answer: D

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

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

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

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

D. $\dfrac{R}{\mu_1 + \mu_2}$

Answer: A

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9. Two plano-convex lens of glass of refractive index 1.5 have radii of curvature 20cm and 30cm. They are placed in contact with curved surface towards each other and the space between them is filled with a liquid of refractive index $\frac{4}{3}$. Find the focal length of the system.

A. -50 cm

B. 95 cm

C. -72 cm

D. 40 cm

Answer: C

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10. An equiconvex lens of focal length20 cm is cut into two equal halves perpendicular to the principal axis and kept at a separation of 10 cm co-axially. What ils the focal length of the each part is?

A. 35 cm

B. 20 cm

C. 22.9 cm

D. 15 cm

Answer: C

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PRACTICE SHEET (EXERCISE III LEVEL -II (ADVANCED) MORE THAN ONE CORRECT TYPE QUESTIONS)

1. A thin equiconvex spherical glass lens $(\mu = 3/2)$ of radius of curvature 30 cm is placed on the x-axis with its optical centre at x=40 cm and principal axis coinciding with the x-axis. A light ray given by the equation $39y = -x + 1$ (x and y are is incident on the lens, in the direction of positive (in cm) X-axis. Then choose the correct alternative(s)

A. The equation of refracted ray is $39y = x + 1$

B. The equation of refracted ray is $130y = x - 170$

C. The equation of refracted ray if space on right side of the lens is filled with a liquid of refractive index 4/3 is $390y + x + 360 = 0$

D. The equation of refracted ray if space on right side of the lens is filled with a liquid of refractive index 4/3 is $390y - x + 350 = 0$

Answer: B::C

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2. A biconvex thin lens is prepared from glass of refractive index $\mu_2 = \frac{3}{2}$. The two conducting surfaces have equal radii of 20 cm each. One of the the surface is silvered from outside to make it reflecting. It is placed in a medium of refractive index $\mu_1 = \frac{5}{3}$. It acts as a

A. converging mirror

B. diverging mirror

C. concave mirror of focal length 12.5 cm

D. convex mirror of focal length 12.5 cm

Answer: A::C

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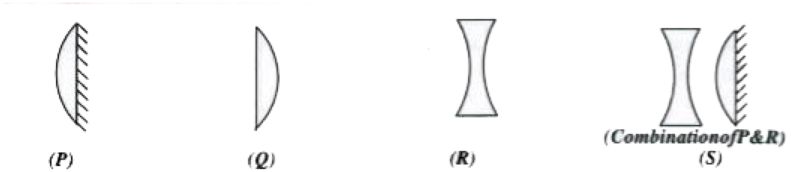
PRACTICE SHEET (EXERCISE III LEVEL -II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. Three diagrams are given each has equal radial of curvature of the curved surfaces. All the lenses have refractive index $\mu = 1.5$.



The ratio of focal lengths of P,Q,R is

A. $1:1:1$

B. $-1:2:1$

C. $-2:1:1$

D. $1:2: \ -1$

Answer: A

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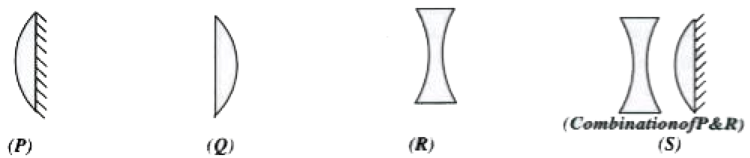
2. Three diagrams are given each has equal radial of curvature of the curved surfaces. All the lenses have refractive index $\mu = 1.5$.



The ratio of focal lengths of P,Q,R is

A. Convex mirror of focal length 40 cm

B. Plane mirror

C. Concave mirror of focal length 10 cm

D. None of these

Answer: C

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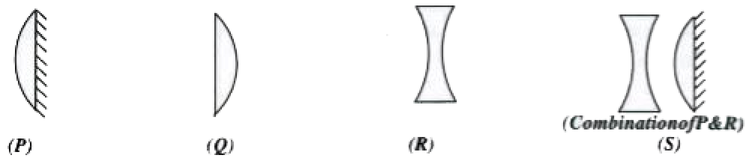
3. Three diagrams are given each has equal radial of curvature of the curved surfaces. All the lenses have refractive index $\mu = 1.5$.



The ratio of focal lengths of P,Q,R is

A. $1:2$

B. $2:1$

C. $1:1$

D. $3:2$

Answer: C

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PRACTICE SHEET (EXERCISE III LEVEL -II (ADVANCED) INTEGER TYPE QUESTIONS)

1. A small air bubble is situated at a distance of 3 cm from the center of a glass sphere of radius 9 cm. When viewed from the nearest side, the bubble appears to be at a distance of 5 cm from the surface. Its apparent distance when viewed from the farthest side is $n \times 5$ cm where n is?

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2. A thin biconvex lens of focal length 6.25 cm is made of material of refractive index 1.5. It is cut into two identical pieces perpendicular to its principal axis. One of the pieces is placed in water of refractive index $\frac{4}{3}$. The focal power of the piece immersed in water in diopter is

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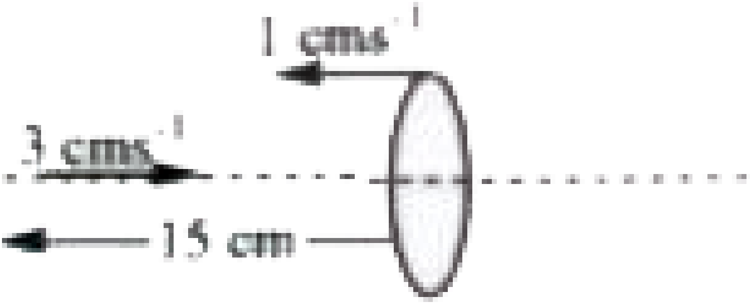
3. An object and a convex lens are approaching each other with speeds $3cm^{-1}$ and $1cm^{-1}$ along the principal axis a shown focal length of lens is 10 cm. If the speed of image relative to ground frame of reference is 5x.

Then find x.



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4. The focal length of a thin biconvex lens is 20cm. When an object is moved from a distance of 25cm in front of it to 50cm, the magnification of its image changes from m_{25} to m_{50}. The ration m_{25} / m_{50} is

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ADDITIONAL PRACTICE EXERCISE -I (LEVEL-I(MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A ray of light passes normally through a slab $(\mu = 1.5)$ of thickness t. If the speed of light in vacuum be C, then time taken by the ray to go across the slab will be

A. $\frac{t}{C}$

B. $\frac{3g}{2C}$

C. $\frac{2t}{3C}$

D. $\frac{4t}{9C}$

Answer: B

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2. A glass slab of thickness $4cm$ contains the same number of waves as $5cm$ of water, when both are traversed by the same monochromatic light. If the refractive index of water is $4/3$, then refractive index of glass is

A. 43954

B. 43955

C. 16/15

D. 43892

Answer: A

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3. The wavelength of light in vacuum is 5000Å when it travels normally through diamond of thickness 1.0 mm find the number of waves of light in 1.0 mm of diamond. (Refractive index of diamond =2.417)

A. 4834 waves

B. 5834 waves

C. 4384 waves

D. 6834 waves

Answer: A

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4. A glass plate has a thicknes t and refractive index μ. The angle of incidence of a ray from air into the plate is equal to the critical angle for glass air intrerface. The lateral shift (perpendicular distance between incident ray and emergent ray) of ray is given by

A. $t\left(1-\frac{1}{\sqrt{\mu^2+1}}\right)$

B. $\mu\left(t-\frac{1}{\sqrt{\mu^2+1}}\right)$

C. $\frac{t}{\mu}\left(1-\frac{1}{\mu^2+1}\right)$

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

Answer: C

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5. Wave length of light in denser mediumis 4000Å, it is grazing into a rarer medium. If critical angle for the pairof mediam is $\sin^{-1}\left(\frac{2}{3}\right)$ then

the wave length of light in rarer medium is

A. 4000Å

B. 2666Å

C. 8000Å

D. 6000Å

Answer: D

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6. A ray of light travels from an optically denser to rarer medium. The critical angle for the two media is C. The maximum possible deviation of the ray will be

A. $\pi - C$

B. $\frac{\pi}{2} + C$

C. $2C$

D. $\pi - 2C$

Answer: B

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7. A point source of light is placed at the bottom of a water lake. If the area of the illuminated circle on the surface is equal to 3 times the square of the depth of the lake. The refractive index of water is

A. $\sqrt{\pi + 1}$

B. $\sqrt{\frac{\pi}{3} + 1}$

C. $\frac{\pi}{3} + 1$

D. $\frac{\pi}{4} + 1$

Answer: B

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8. The refractive index of the material ofa double convex lens is 1.5 and its focal length is 5 cm. If the radii of curvature are equal, the value of the radius of curvature (in cm) is

A. 5

B. 6.5

C. 8

D. 9.5

Answer: A

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9. A biconvex thin lens is prepared from glass of refractive index $\mu_2 = \frac{3}{2}$. The two conducting surfaces have equal radii of 20 cm each. One of the the surface is silvered from outside to make it reflecting. It is placed in a medium of refractive index $\mu_1 = \frac{5}{3}$. It acts as a

A. 20 cm

B. 10 cm

C. 40 cm

D. 30 cm

Answer: A

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10. A diverging meniscus lens of radii of curvatures 25 cm and 50 cm has a refractive index 1.5. Its focal length is (in cm)

A. -50

B. -100

C. 100

D. 50

Answer: B

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11. A thin liquid convex lens is formed in glass. Refractive index of liquid is 4/3 and that of glass is 3/2. If f is the focal length of the liquid lens is air, its focal length and nature in the glass is

A. f, convex

B. f, concave

C. 2f, concave

D. 3f, concave

Answer: D

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12. The focal lengths of a lens are in the ratio 8:3 when it is immersed in two different liquids of refractive induces 1.6 and 1.2 respectively. The refractive index of the material of the lens is

A. 1.25

B. 1.5

C. 1.8

D. 2

Answer: D

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13. A double convex lens of focal length 30 cm is made of glass. When it is immersed in a liquid of refractive index 1.4, the focal length is found to be 126 cm. The critical angle between glass and the liquid is

A. $\sin^{-1}\left(\frac{3}{4}\right)$

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

C. $\sin^{-1}\left(\frac{7}{13}\right)$

D. $\sin^{-1}\left(\frac{7}{8}\right)$

Answer: D

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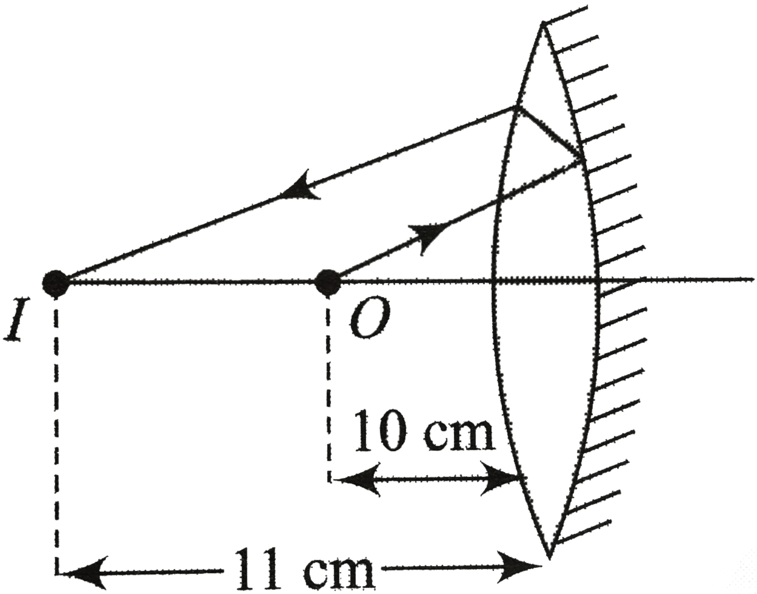
14. A pin is placed 10cm in front of a convex lens of focal length 20cm, made of a material having refractive index 1.5 . The surface of lens farther away from the pin is silvered and has a radius of curvature 22cm. Determine the position of the final image. Is the image real or virtual?



A. 10 cm

B. 11 cm

C. 12 cm to the right of lens system

D. 13 cm

Answer: B

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15. A convex lens is in contact with a concave lens. The magnitude of the ration of their focal lengths is $2/3$. Their equivalent focal length is 30cm. What are their individual focal lengths?

A. $-75cm, 50cm$

B. $-10cm, 15cm$

C. $-50cm, 75cm$

D. $-15cm, 10cm$

Answer: D

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16. A double convex lens is made of glass which has refractive inded 1.55 for voilet rays and 1.50 for red rays. If the focal length for violet rays is 20 cm, the focal length for red rays will be

A. 9 cm

B. 28 cm

C. 20 cm

D. 22 cm

Answer: D

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17. The refractive index of a lens material is 1.5 and focal length f. Due to some chemical changes in the material, its refractive index has increased by 2%. The percentage change in its focal length is

A. $+4.5\%$

B. -4.5%

C. $+5.6\%$

D. -5.67%

Answer: D

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18. A plano-convex lens of refractive index 1.5 and radius of curvature 30 cm is silvered at the curved surface. Now, the lens has been used to form the image of an object. What should be the distance of the object from the lense in order to have a real image of the size of the object?

A. 20 cm

B. 30 cm

C. 60 cm

D. 10 cm

Answer: A

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19. A ray of light is incident at 50° on the middle of one of two mirrors arranged at an angle of 60° between them. They ray then touches the second mirror, get reflected back to the first mirror, making an anlge of incidence of

A. 50°

B. 60°

C. 70°

D. 80°

Answer: C

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20. A 2.0 cm high object is placed on the principal axis of a concave mirror at a distance of 12 cm from the pole. Ilf the image is inverted, real and 5.0 cm high, find the location of the image the focal length of the mirror.

A. 30 cm,8.6 cm

B. 8.6 cm, 30 cm

C. 30 cm, 10 cm

D. 10 cm, 30 cm

Answer: A

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

A. 36 cm, 36 cm

B. 36 cm, 16 cm

C. 72 cm, 36 cm

D. None of these

Answer: A

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ADDITIONAL PRACTICE EXERCISE -I (LEVEL-II LECTURE SHEET (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

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

A. 12.5 cm

B. 25 cm

C. 50 cm

D. 100 cm

Answer: B

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2. A transparent cube of 15 cm edge contains a small air bubble. Its apparent depth when viewed through one face is 6 cm and when viewed through the opposite face is 4 cm. Then the refractive index of the material of the cube is

A. 2

B. 2.5

C. 1.6

D. 1.5

Answer: D

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3. A layer of oil 3 cm thick is floating on a layer of coloured water 5 cm thick. Refractive index of coloured water is $5/3$ and the apparent depth of the two liquids appears to be $36/7$cm. Find the refractive index of oil.

A. $\frac{7}{4}$

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

C. $\frac{7}{5}$

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

Answer: C

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4. A fish rising vertically to the surface of water in a lake uniformly at the rate of $3ms^{-1}$ observes a bird diving vertically towards the water at a rate of $9ms^{-1}$ vertically above it. If the refractive index of water is 4/3 the actual velocity of the dive of the bird is (in ms^{-1})

A. 6

B. 4.5

C. 1.5

D. 2

Answer: B

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

A. 26°

B. 0°

C. 30°

D. 15°

Answer: D

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6. A man in an empty swimming pool has a telescope focussed at 4o'clock sun. When the swimming pool is filled with water, the man observes the setting sun through telescope. If sunrises and sets at 6 o'clock, then refractive index of water is

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

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

C. $\frac{4\sqrt{2}}{3}$

D. None of these

Answer: A

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7. A ray of light is incident on one face of a transparent slab of thickness 15 cm. The angle of incidence is 60°. If the lateral displacement of the ray on emerging from the parallel plane is $5\sqrt{3}$ cm, the refractive index of the material of the slab is

A. 1.414

B. 1.532

C. 1.732

D. None of these

Answer: C

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8. A person looking through a telescope focuses lens at a point on the edge of the bottom of an empty cylindrical vessel. Next he fills the entire vessel with a liquid oif refractive index μ, without disturbing the telescope. Now, he observes the mid point of the vessel. Determine the radius to depth ratio of the vessel

A. $\frac{1}{2}\sqrt{\frac{1-\mu^2}{\mu^2+1}}$

B. $\frac{1}{2}\sqrt{\frac{4-\mu^2}{\mu^2-1}}$

C. $\frac{1}{2}\sqrt{\frac{4+\mu^2}{\mu^2+1}}$

D. $\frac{1}{2}\sqrt{\frac{4+\mu}{\mu+1}}$

Answer: B

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9. 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 are then for what maximum value of $\frac{d}{R}$ light entering the glass slab through surface A emerges from the glass through B

A. 1.5

B. 0.5

C. 1.3

D. None of these

Answer: B

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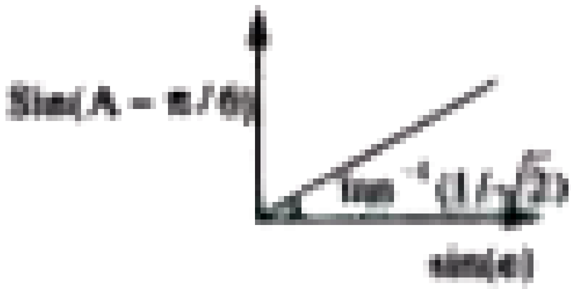
10. A light ray is incident at an angle of incedence $(\pi/4)$. The graph of $\sin(A - \pi/6)$ versus sin e is shown in fig. The minimum angle of devation corresponds to a prism with angle (e=angle of emergence)



A. 90°

B. 60°

C. 45°

D. 30°

Answer: B

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11. Light is incident from glass $(\mu = 1.50)$ to water $(\mu = 1.33)$ find the range of the angle of deviation for which there are two angles of incidence.

A. 0 to $\cos^{-1}(8/9)$

B. 0 to $\sin^{-1}(8/9)$

C. 0 to $\cos^{-1}(9/8)$

D. 0 to $\sin^{-1}(9/8)$

Answer: A

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12. A ray of light is incident at an angle of 75° into a medium having refractive index μ. The reflected and the refracted rays are found to suffer equal deviations in opposite direction. Then μ equals to

A. $\dfrac{\sqrt{3}+1}{\sqrt{3}-1}$

B. $\dfrac{\sqrt{3}+1}{2}$

C. $\dfrac{2\sqrt{2}}{\sqrt{3}+1}$

D. None of these

Answer: B

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13. A beam of parallel rays of width b cm propagates in glass at an angle θ to its plane face. What would the beam width b_1 be after it goes over to air thrugh this face? (The refractive index of the glass is μ)

A. $b\mu$

B. $b\mu\cos\theta$

C. $\dfrac{b\left(1-\mu^2\cos^2\theta\right)^{1/2}}{\sin\theta}$

D. $\dfrac{b\left(1-\mu^2\sin^2\theta\right)^{1/2}}{\cos\theta}$

Answer: C

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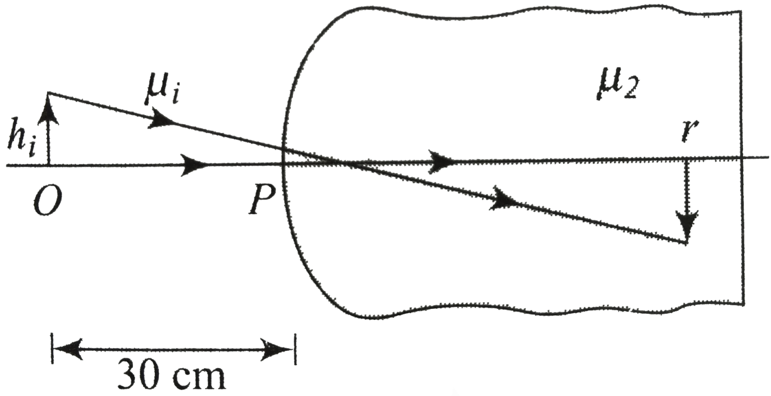
14. A small object of height 0.5 cm is placed in front of a convex surface of glass $(\mu - 1.5)$ of radius of curvature 10cm. Find the height of the image formed in glass.



A. 1 cm real, inverted, magnified, formed in the glass

B. 1 cm real, inverted magnified formed in the air

C. 1 cm virtual erected magnified formed in the air

D. 1 cm virtual erected magnified formed in the glass

Answer: A

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15. 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.

A. $\frac{\mu R^2 \mathrm{gt}}{\left[(\mu-1)\left(h-\frac{1}{2}\mathrm{gt}^2\right)-R\right]^2}$

B. $\left[\frac{\mu R^2 \mathrm{gt}}{(\mu-1)\left(h-\frac{1}{2}\mathrm{gt}\right)^2}\right]$

C. $\frac{\mu R^2 \mathrm{gt}}{(\mu-1)\left(h-\frac{1}{2}\mathrm{gt}^2\right)-R}$

D. $\frac{\mu R^2 \mathrm{gt}}{\mu\left(h-\frac{1}{2}\mathrm{gt}^2\right)}$

Answer: A

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

A. at 29 cm to the righ of 2nd face, m=-0.44

B. at 10 cm to the right of 2nd face, m=-0.3

C. at 10 cm to the left of 2nd face, m=-0.3

D. at 29 cm to the left of 2nd face, m=-0.44

Answer: A

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17. The radii of curvature of two spherical surfaces of a concave convex lens $(\mu = 1.5)$ are 20 cm and 40 cm. (i) What is its focal length when it is in air? Also find its focal length when it is immersed in a liquid of refractive index (ii) $\mu = 1.2$ (iii) $\mu = 2$

A. (80cm, 160cm, -160cm)

B. (80cm, 80cm,-80cm)

C. (160cm, 80cm, 80cm)

D. (80cm, 160cm, 160cm)

Answer: A

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18. A light ray travelling parallel to the principal axis of a convex lens of focal length 12 cm strikes the lens at a height of 5 mm from the principal axis. What is the angle of deviation produced?

A. 4°

B. 5°

C. 1°

D. 2.4°

Answer: B

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19. Twot thin lenses when placed in contact, then the power of combination is +10D. If they are kept 0.25m apart, then the power reduceds to +6D. The focal lengths of the lenses (in m) will be

A. (5cm, 50 cm)

B. (10cm, 40cm)

C. (20cm, 30cm)

D. (12.5cm, 50cm)

Answer: D

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20. A convex lens is placed some where between an object and a screen which are separated by 48 cm. If the numerical value of magnification produced by the lens is 3, what is the focal length of lens?

A. 6 cm

B. 12 cm

C. 24 cm

D. 9 cm

Answer: D

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21. A point object moves along the principal axis of a convex lens of focal length f such that its real image, also formed on the principal axis at a distance $\frac{4f}{3}$ (at t=0) moves away from the lens with uniform velocity α. Find the velocity of the point object as a function of time t.

A. $\left(\frac{f}{f+\alpha t}\right)^2\alpha$

B. $\left(\frac{\alpha}{f+\alpha t}\right)^2$

C. $\left(\frac{f/3+\alpha t^2}{f}\right)^2\alpha$

D. $\left(\frac{f}{\frac{f}{3}+\alpha t}\right)^2\alpha$

Answer: D

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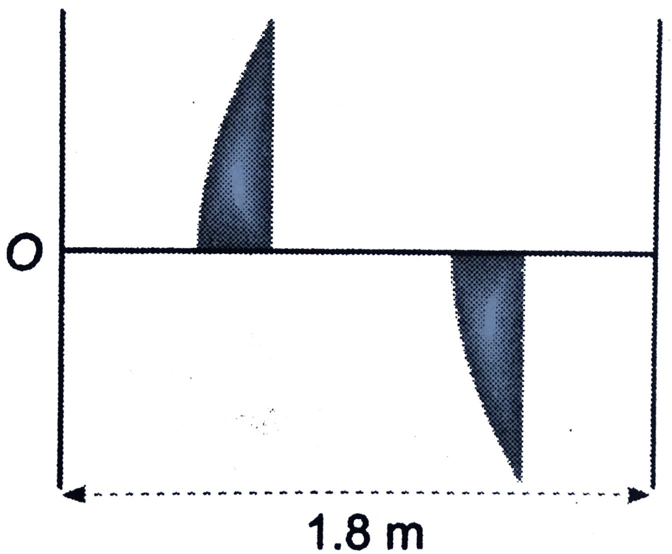
22. A thin plano-convex lens of focal length f is split into two halves. One of the halves is shifted along the optical axis as shown in figure. The sepration between object and image planes is $1.8m$. The magnification of the image formed by one of the half lens is 2. Find the focal length of the lens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



A. (0.3m, 0.2m)

B. (0.4m, 0.6m)

C. (0.1m,0.6m)

D. (0.4m,0.2m)

Answer: D

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23. A converging lens L_1 of focal length 20 cm is separated by 8 cm from a diverging lens L_2 of focal length 30cm. A parallel beam of light falls on L_1 after passing through L_2 is focussed at point P. Calculate V.

A. 40 cm

B. 20 cm

C. 42.2 cm

D. 60 cm

Answer: D

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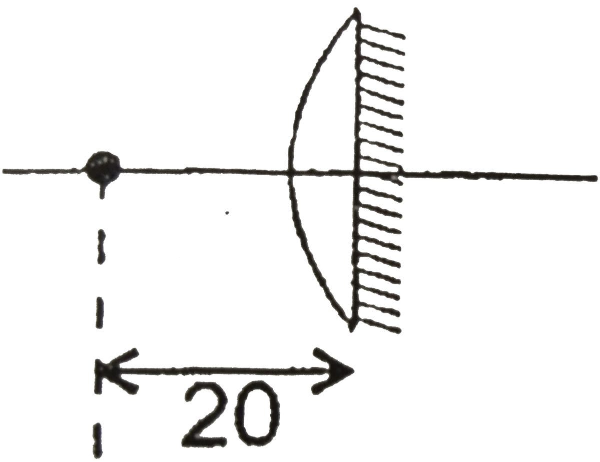
24. A point object is placed at a distance of $20cm$ from a thin plano-concex lens of focal length $15cm$. The plane surface of the lens is now silvered. The image created by the is at :



A. 12 cm to the left of lens system

B. 20 cm to the right of lens system

C. 12 cm to the right of lens system

D. 20 cm to the left of lens system

Answer: C

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25. A convex lens of focal length f and a plane mirror are y distance apart. An object O is kept on the principal axis of the lens at a distance x from the lens. The values of x and y for the final image of O to fall exactly (position and size) on the object O are :

A. 20 cm

B. 30 cm

C. 40 cm

D. 50 cm

Answer: A

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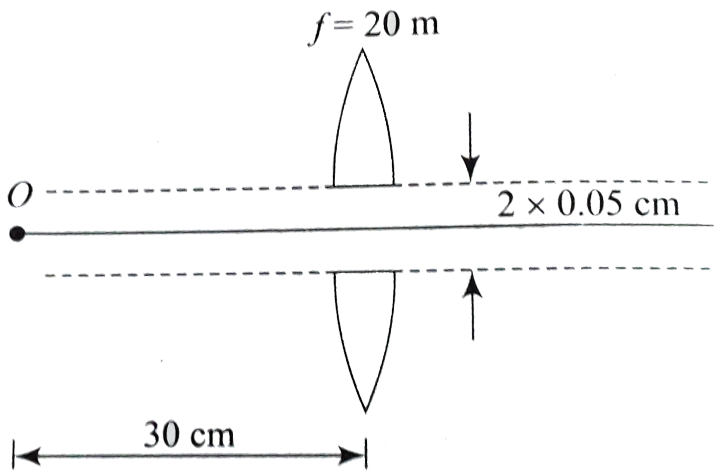
26. A point object O is placed at a distance of 0.3m from a convex lens (focal length 0.2m) cut into two halves each of which is displaced by 0.0005 m as shown in figure



Q. If this arrangement will generate more than one image, then what will be the total number of image?

A. 30 cm, 2 images, 0.5 cm

B. 40 cm, 2 images, 0.3 cm

C. 50 cm, 2 images, 0.4 cm

D. 60 cm, 2 images , 0.3 cm

Answer: B

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27. A small object stuck on the surface of a glass sphere $(n = 1.5)$ is viewed from the diametrically opposite position. Find transverse magnification.

A. $+2$

B. $+1$

C. $+3$

D. -2

Answer: D

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

A. 75 cm

B. 60 cm

C. 20 cm

D. 100 cm

Answer: C

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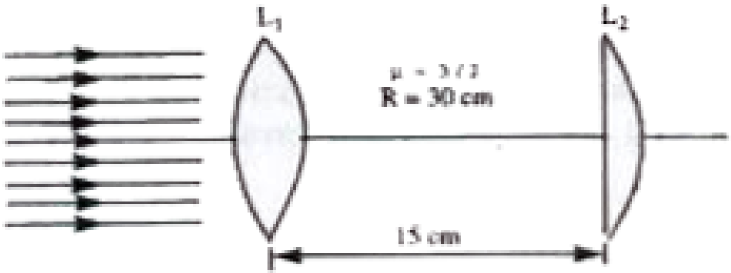
29. In the given diagram find the position where the equivalent lens can be placed for image formation by rays takes place at same place as in the given diagram. Assume that all the curved surfaces have same radii and same optical axis for both the lenses.



A. 2.5 cm from lens L_1

B. 3.0 cm from L_1

C. 7.5 cm from L_1

D. 10.0 cm from L_1

Answer: A

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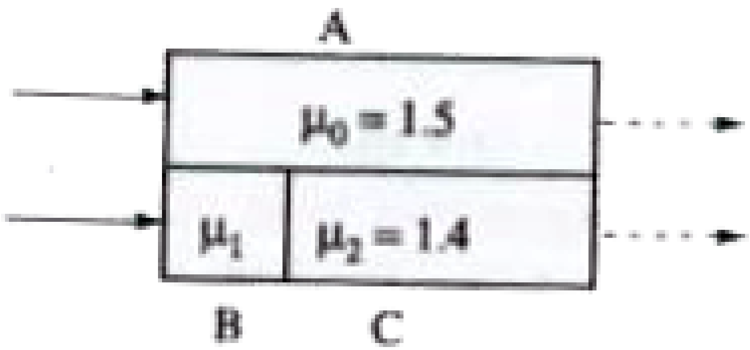
ADDITIONAL PRACTICE EXERCISE -I (LEVEL-II LECTURE SHEET (ADVANCED) MORE THAN ONE CORRECT TYPE QUESTIONS)

1. A slab of transparent materials is made as shown in the figure. Monochromatic parallel beams of light are normally incident on the slabs. The thickness of C is twice the thickness of B. The number of waves is A= the number of waves in the combination of B and C. The refractive index of material A is $\mu_0 = 1.5$ and that of C is $\mu_2 = 1.4$



A. The refractive index of B is 1.6

B. The frequency of light in B is two times the frequency of light in C.

C. The refractive index of B is 1.7

D. The frequency of light in B is the same as the frequency of light in C.

Answer: B

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2. The first factor length f_1 for refraction at a spherical surface is defined as the value of u corresponding to $v = \infty$ (as shown) with refractive indices of two mediums, as n_1 and n_2. The second focal length f_2 is defined as value of v for $u = \infty$.

A. f_2 is equal to $\dfrac{n_2 R}{(n_2 - n_1)}$

B. f_1 is equal to $\dfrac{n_2 R}{(n_2 - n_1)}$

C. f_2 is equal to $(-)\dfrac{n_1 R}{(n_2 - n_1)}$

D. f_1 is equal to $\dfrac{n_1 R}{(n_2 - n_1)}$

Answer: C::D

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3. A biconvex thin lens is prepared from glass of refractive index $\mu_2 = \dfrac{3}{2}$. The two conducting surfaces have equal radii of 20 cm each. One of the

the surface is silvered from outside to make it reflecting. It is placed in a medium of refractive index $\mu_1 = \frac{5}{3}$. It acts as a

A. converting mirror

B. diverging mirror

C. concave mirror of focal length 12.5 cm

D. convex mirror of focal length 12.5 cm

Answer: A::D

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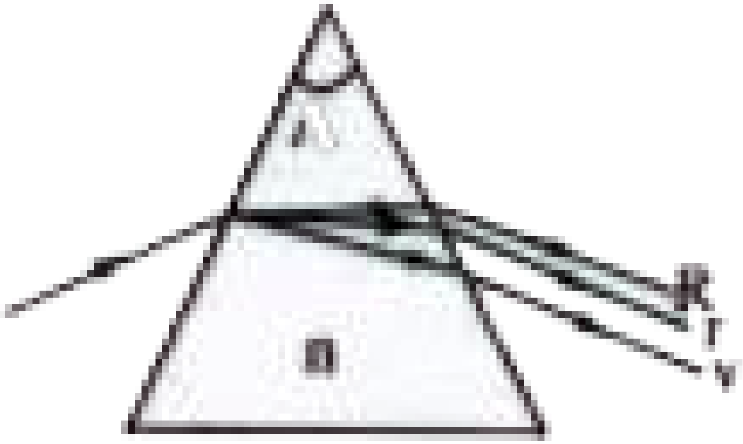
ADDITIONAL PRACTICE EXERCISE -I (LEVEL-II LECTURE SHEET (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. When a ray of sun light passes through the prism, each colour of light has its own speed in the glass. The seven colours come out of the prism with different angles of deviation. Red deviates least and blue deviates maximum. Thus a prism can disperse a white light into seven colours which is called colour spectrum.



For a thin prism, the angle of deviation is given as $\delta = (n - 1)A$. The angle of dispersion is given as $\phi = \delta_v - \delta_r$. The dispersive power of a prism is $\omega = \dfrac{\phi}{\delta_{\text{mean}}} = \dfrac{\phi}{\delta_y}$

Using the above ideas, give answer the following questions.

A prism has R.I. for violet and red $n_v = 1.523$, $n_r = 1.5145$. If the angle of prism is $A = 2^\circ$ the dispersive power of the prism is :

A. 0.01639

B. 1.593

C. 0.1639

D. 0.18

Answer: A::C

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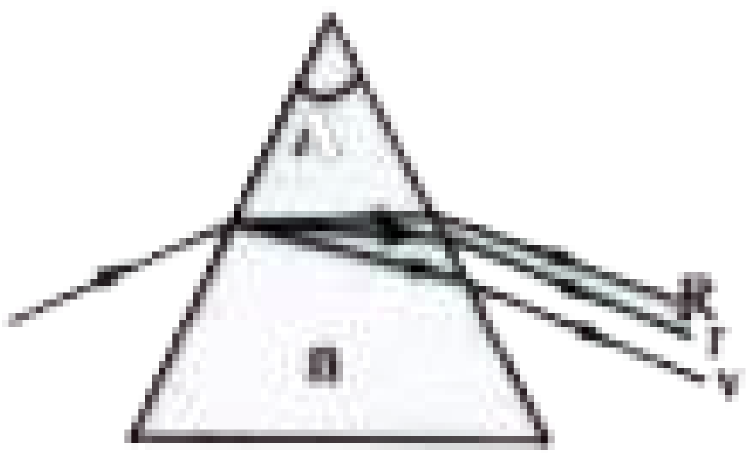
2. When a ray of sun light passes through the prism, each colour of light has its own speed in the glass. The seven colours come out of the prism with different angles of deviation. Red deviates least and blue deviates maximum. Thus a prism can disperse a white light into seven colours which is called colour spectrum.



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Using the above ideas, give answer the following questions.

A prism has R.I. for violet and red $n_v = 1.523$, $n_r = 1.5145$. If the angle of prism is $A = 2^\circ$ the dispersive power of the prism is :

A. $\dfrac{A'}{A}$

B. $\dfrac{A}{A'}$

C. $\dfrac{A - A'}{A + A'}$

D. $\sqrt{\dfrac{A'}{A}}$

Answer: A

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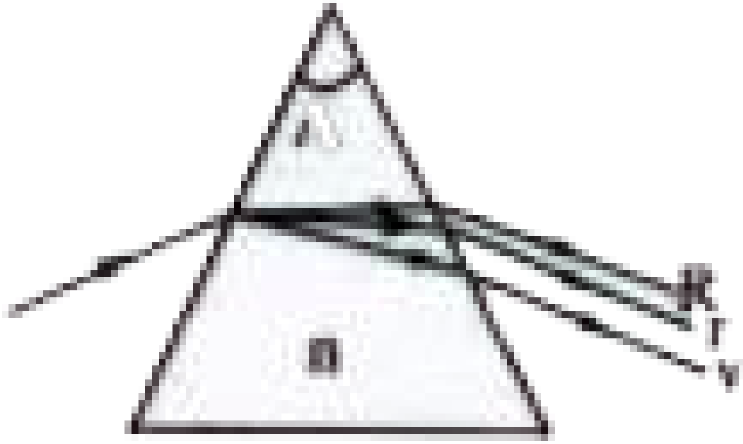
3. When a ray of sun light passes through the prism, each colour of light has its own speed in the glass. The seven colours come out of the prism with different angles of deviation. Red deviates least and blue deviates maximum. Thus a prism can disperse a white light into seven colours which is called colour spectrum.



For a thin prism, the angle of deviation is given as $\delta=(n-1)A$. The angle of dispersion is given as $\phi=\delta_v-\delta_r$. The dispersive power of a prism is $\omega=\dfrac{\phi}{\delta_{\text{mean}}}=\dfrac{\phi}{\delta_y}$

Using the above ideas, give answer the following questions.

A prism has R.I. for violet and red $n_v=1.523$, $n_r=1.5145$. If the angle of prism is $A=2^\circ$ the dispersive power of the prism is :

A. $\left(1-\dfrac{\omega_1}{\omega_2}\right)$

B. $\left(1-\dfrac{\omega_2}{\omega_1}\right)$

C. $\dfrac{\omega_2}{\omega_1}$

D. $\dfrac{\omega_1}{\omega_2}$

Answer: A

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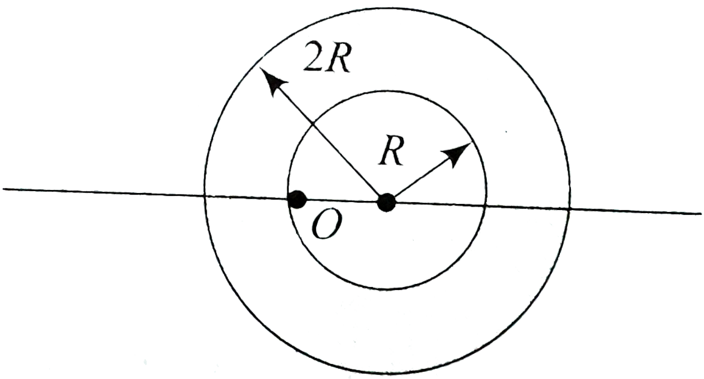
4. A glass sphere of radius 2R and refractive index n has a spherical cavity of radius R, concentric with it.



Q. When viewer is ono left side of the hollow sphere, what will be the shift in position of the object?

A. $\frac{(n+1)}{(n-1)}R$, right

B. $\frac{(n-1)}{(n+1)}$ R,left

C. $\frac{(2n-1)}{(2n+1)}$R, left

D. $\frac{(2n-1)}{(n+1)}$ R, left

Answer: A

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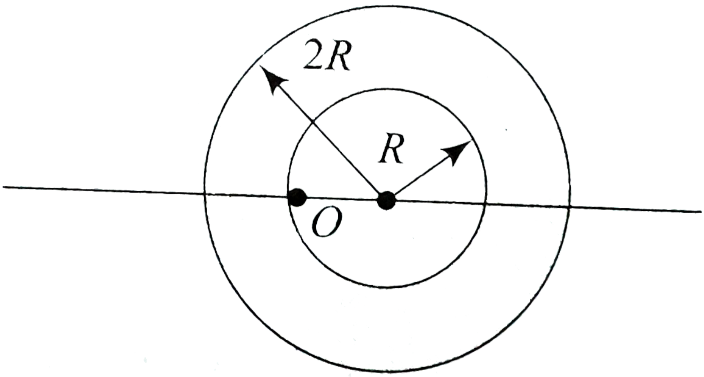
5. A glass sphere of radius 2R and refractive index n has a spherical cavity of radius R, concentric with it.



Q. When viewer is ono left side of the hollow sphere, what will be the shift in position of the object?

A. $\frac{(n-1)}{(3n+1)}R$ toward left

B. $\frac{(n+1)}{(3n-1)R}$, toward left

C. $\frac{(n+1)}{(3n+1)}R$, toward right

D. $\frac{(n-1)}{(3n-1)}R$, toward right

Answer: B

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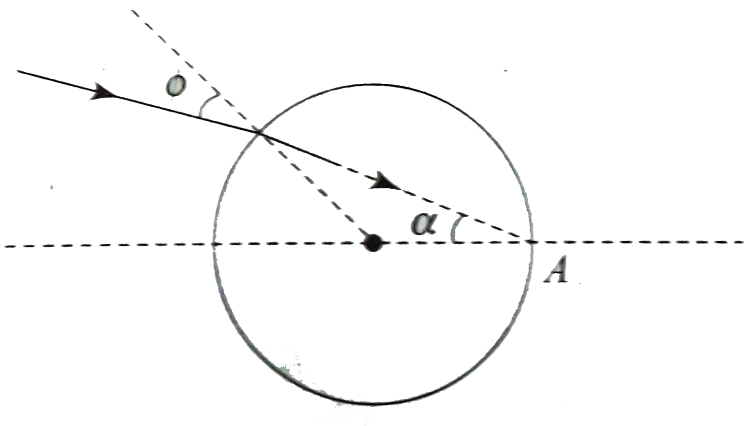
6. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. Select the correct statement:

A. Incident ray are partially reflected at point A

B. Incident ray are totally reflected at point A

C. Incident rays are totally transmitted through A

D. None of these

Answer: D

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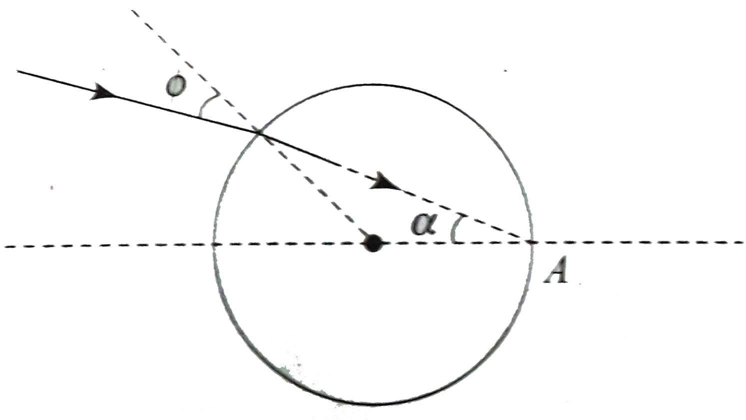
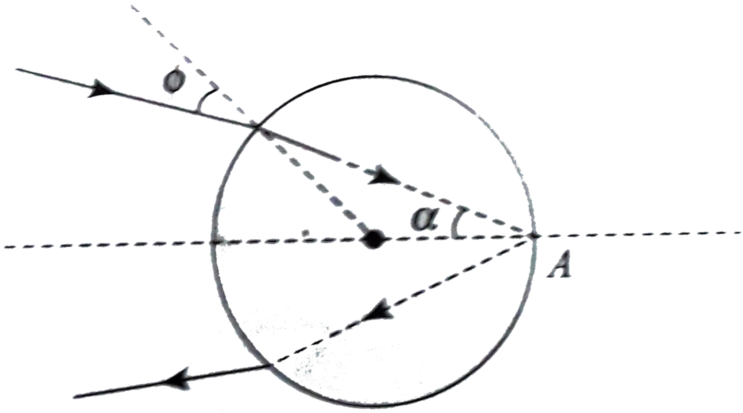
7. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. An expression of the angle between incident ray and emergent ray (angle of deviation) as shown in figure.



A. 0°

B. ϕ

C. $\alpha - \phi$

D. $\pi - 4\alpha + 2\phi$

Answer: A

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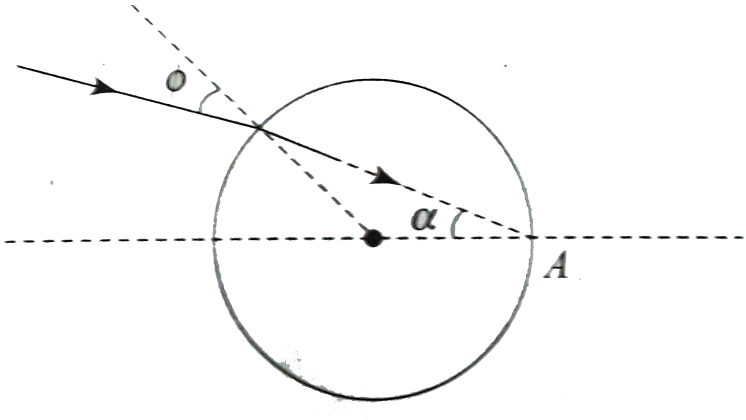
8. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. Considert eh figure of question 60, the angle ϕ for which minimum deviation is produced will be given by

A. $\cos^2\phi = \dfrac{\mu^2+1}{3}$

B. $\cos^2\phi = \dfrac{\mu^2-1}{3}$

C. $\sin^2\phi = \dfrac{\mu^2+1}{3}$

D. $\sin^2\phi = \dfrac{\mu^2-1}{3}$

Answer: D

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ADDITIONAL PRACTICE EXERCISE -I (LEVEL-II LECTURE SHEET (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. Real and inverted image of an object is formed at a distance d=40 cm from the object. The size of the image is hall of that of object.

Column - I	Column - II
A) The nature of lens used should be	p) concave
B) focal length of the lens	q) convex
C) distance of object from the lens	r) 80/3 cm
D) If mirror were used, then nature of mirror should be	s) 80/9 cm

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ADDITIONAL PRACTICE EXERCISE -I (LEVEL-II LECTURE SHEET (ADVANCED) INTEGER TYPE QUESTIONS)

1. A biconvex thin lens is prepared from glass of refractive index $\mu_2 = \frac{3}{2}$. The two conducting surfaces have equal radii of 20 cm each. One of the the surface is silvered from outside to make it reflecting. It is placed in a medium of refractive index $\mu_1 = \frac{5}{3}$. It acts as a

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2. How much height of water in cm would be filled in a container of height 14 cm,so that it appears half filled to the observer when viewed from the top of the container $\left(\mu_{\omega} = \frac{4}{3}\right)$

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3. The magnification of an object placed in front of a convex lens is $+2$. The focal length of the lens is 2.0 metres. Find the distance by which object has to be moved to obtain a magnification of -2 (in metres).

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4. Where should a convex lens of focal length 9cm be placed (in cm) between two point sources S_1 and S_2 where are 24 cm apart, so that images of both the sources are formed at the same place. You have to find distance of lens from S_1 or S_2 whichever is lesser.

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PRACTICE SHEET (ADVANCED) (STRAIGHT OBJECTIVE TYPE QUESTIOS)

1. A ray of light is incident at an anlgge of 60° on a $\sqrt{3}$ cm thick palte $(\mu = \sqrt{3})$. The shift in the path of the ray as it emerges out from the plate is (incm)

A. 1

B. 1.2

C. 0.5

D. 1.8

Answer: B

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2. A mark at the bottom of a liquid appears to rise by 0.1 m. The depth of the liquid is 1 m. The refractive index of the liquid is

A. 1.33

B. $\frac{9}{10}$

C. $\frac{10}{9}$

D. 1.5

Answer: A

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3. An under water swimmer is at a depth of 12 m below the surface of water. A bird is at a height of 18 m from the surface of water, directly above his eyes. For the swimmer the bird appears to be at a distance from the surface of water equal to (Refracting index of water is 4/3)

A. 24 m

B. 12 m

C. 36 m

D. 18 m

Answer: C

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4. A microscope is focussed on a coin lying at the bottom of a beaker. The microscope is now raised by 1 cm. To what depth should water be poured into the beaker so that the coin is again in focus?

(The refractive index of water is $\frac{4}{3}$)

A. 1 cm real, inverted, magnified, formed in the glass

B. 4/3 cm

C. 3 cm

D. 4 cm

Answer: A

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5. If a light ray incidents normally on one of the faces of the prism of refractive index 2 and the emergent ray just grazes the second face of the prism, then the angle of deviation is

A. 0°

B. 30°

C. 60°

D. 90°

Answer: D

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6. A parallel beam of white light falls on a convex lens. Images of blue, yellow and red light are formed on other side of the lens at a distance of 0.20 m, 0.205 m and 0.214 m respectively. The dispersive power of the material of the lens will be

A. $\frac{619}{1000}$

B. $\frac{9}{200}$

C. $\frac{14}{205}$

D. $\frac{5}{214}$

Answer: C

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7. A ray of light is incident on the face AB of a glass prism ABC having vertex anlge A equal to 30°. The face AC is silvered and a ray of light incident on the face AB retraces its path. If the refractive index of the material of prism is $\sqrt{3}$ find the angle of incidence on the face AB.

A. 60°

B. 30°

C. 45°

D. 25°

Answer: C

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8. The refracting angle of a prism is A, and refractive index of the material of the prism is $\cot\left(\frac{A}{2}\right)$. The angle of minimum deviation is

A. $\pi + 2A$

B. $\pi - 2A$

C. $\frac{\pi}{2} + A$

D. $\frac{\pi}{2} - A$

Answer: A

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9. A ray of light is incident on the hypotenuse of a right-angled prism after travelling parallel to the base inside the prism. If μ is the refractive index of the material of the prism, the maximum value of the base angle for which light is totally reflected from the hypotenuse is

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

B. $\tan^{-1}\left(\frac{1}{\mu}\right)$

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

D. $\cos^{-1}\left(\frac{1}{\mu}\right)$

Answer: B

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10. A plane mirror is fixed at the bottom of a tank containing water. A small object is kept at a height of 24 cm from the bottom and is viewed from a point vertically above it. The distance between the object and the image in the mirror as appears to the person is

A. 48 cm

B. 64 cm

C. 36 cm

D. 54 cm

Answer: D

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11. A ray of light travelling in glass having refractive index $_(a)\mu_g = 3/2$ is incident at a critical angle C on the glass air interface. If a thin layer of water is poured on glass air interface, then what will be the angle of emergence of this ray in air when it emerges from water air inteface?

A. 180°

B. 0°

C. 90°

D. 45°

Answer: C

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12. A light ray is normally incident onone face of equilateral glass prism of refractive index $\sqrt{2}$. The deviation of light ray is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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13. Light ray is incident on a prism of angle $A = 60^\circ$ are refractive index $\mu = \sqrt{2}$. The angle of incidence which the emergent rays grazes the surface is given

A. 75°

B. 95°

C. 100°

D. None of these

Answer: C

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

A. 0.5

B. 15

C. 0.05

D. 0.03

Answer: B

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15. A glass sphere of diameter 50 cm and $\mu = 1.5$ has a small air bubble. Looking from outside the diameter, the bubble appears to be at a distance 10 cm the surface. Find the apparent position of the bubble when it is viewed from the diametrically opposite position.

A. real image, at the pole of 2 nd face

B. real image, at the pole of 1st face

C. virtual image, at the pole of 1st face

D. virtual image, at the centre of the sphere

Answer: C

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16. A parallel beam falls on solid glass sphere of radius R and refractive index μ. What is the distance of final image after refractioin from two surfaces of sphere? What is the condition for the image to be real?

A. $\dfrac{R(\mu-2)}{2(\mu-1)}$ from 2nd surface , $\mu > 2$

B. $\dfrac{R(2-\mu)}{2(\mu-1)}$ from 2nd surface $\mu < 2$

C. $\dfrac{R(\mu-1)}{(2-\mu)}$ from 2nd surface $\mu < 2$

D. $\dfrac{R}{2}\left(\dfrac{\mu+2}{\mu-1}\right)$ from 2nd surface $\mu < 2$ for any value of μ

Answer: C

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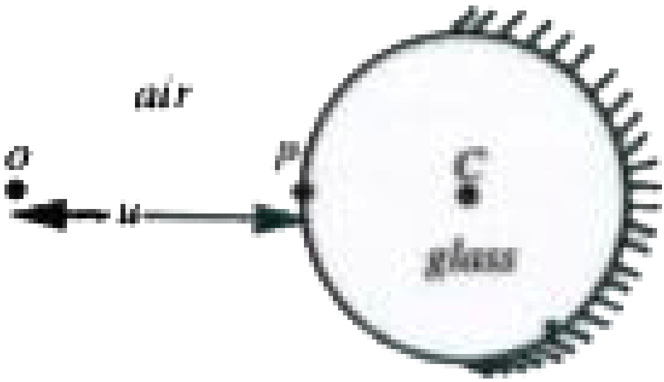
17. A transparent glass sphere of radius 10 cm and refractive index $\mu = 1.5$ has its one half silvered so that it acts like a concave mirror. Find the position of final image for an object O at (a) 30 cm to the left of the front surface of the ball.



A. 30 cm to the right of P, at the pole of mirrored surface

B. 20 cm to the left of P, at the center of sphere

C. 20.9 cm to the right of P, at the pole P.

D. 20.9 cm to the left of P, at the pole of mirrored surface

Answer: B

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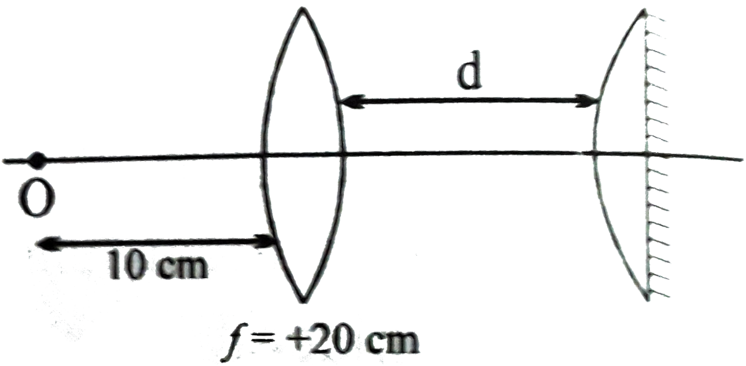
18. A convex lens of focal length 20cm and another plano convex lens of focal length 40cm are placed co-axially . The plano convex lens is silvered on plane surface. What should be the distance (in cm) so that final image of the object 'O' is formed on O itself.



A. 10

B. 15

C. 20

D. 25

Answer: D

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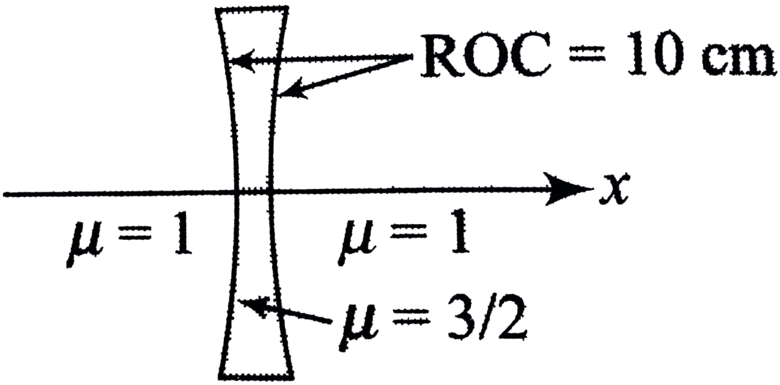
19. Find the focal length of the lens shown in Fig.



A. $\frac{2}{R}(\mu_1 - \mu_2)$

B. $\frac{R}{2}\frac{(\mu_2 - \mu_1)}{2(\mu_1 - 1)(\mu_2 - 1)}$

C. $\frac{R}{2}\left(\frac{\mu_2 - 1}{\mu_1 - 1}\right)$

D. $\frac{R}{2}\left(\frac{\mu_1 - 1}{\mu_2 - 1}\right)$

Answer: C

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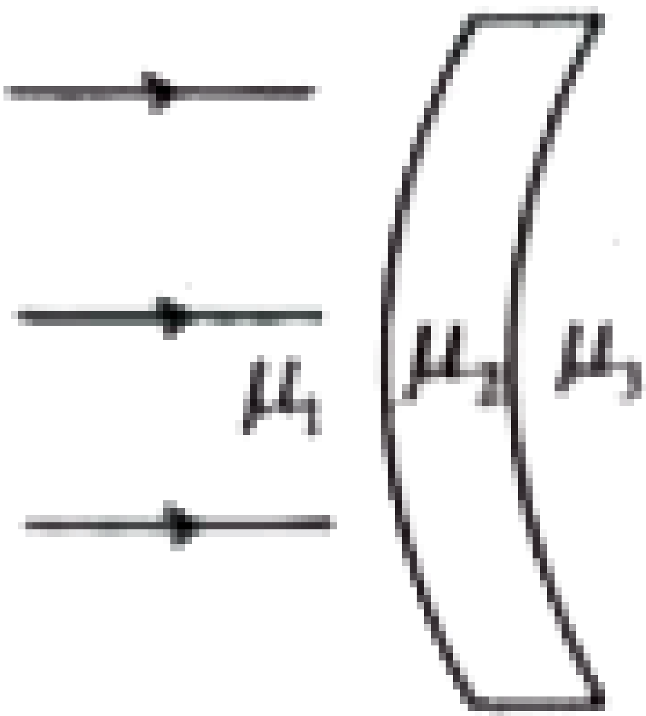
20. Light is incident on the thin lens as shown in figure. The refractive index of the material of the lens is μ_2. The radii of curvature of both the surfaces are R. The refractive index of the medium of left side is μ_1, while that of right side is μ_3. What is the focal length of the lens?



A. $\dfrac{\mu_2 R}{\mu_3 - \mu_1}$

B. $\dfrac{\mu_1 R}{\mu_3 - \mu_1}$

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

D. $\dfrac{\mu_3 R}{\mu_3 - \mu_1}$

Answer: B

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21. When an object is placed 40cm from a diverging lens, its virtual image is formed 20cm from the lens. The focal length and power of lens are

A. 22.5 cm, convex

B. 22.5 cm, concave

C. 50 cm, convex

D. 50 cm, concave

Answer: D

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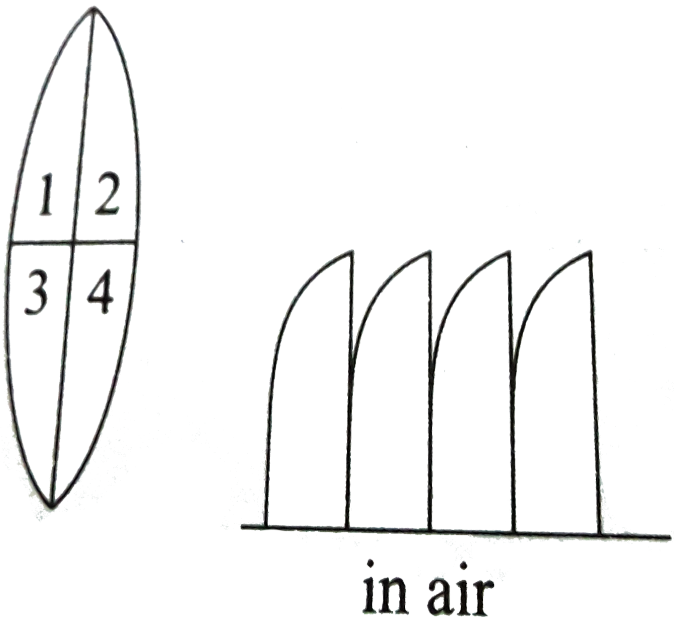
22. The given lens is broken into four parts rearranged as shown. If the initial focal length is f, then after rearrangement the equivalent focal length is



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

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

C. $8f$

D. $2f$

Answer: B

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23. A thin converging lens is placed between as fixed object and a screen. There are two positions of the lens for which a sharp image is formed on the screen. The height of one of the image is 2 cm while the magnification of the other image is 3. What is the height of the object?

A. 6 cm

B. 9 cm

C. 10 cm

D. 4 cm

Answer: A

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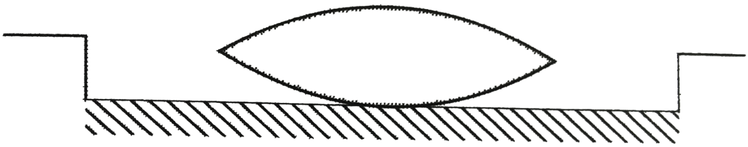
24. A thin biconvex lens of refractive index $3/2$ is placed on a horizontal plane mirror as shown in Figure . The space between the lens and the

mirror is then fille with water or refractive index $4/3$. It is found that when a point object is placed 15 cm above the lens on its principal axis, the object coincides with its own image. On representing with another liquid, the object and the image again coincide at a distance 25 cm from the lens. Calculate the refractive index of the liquid.



A. 1.4

B. 1.5

C. 1.6

D. 1.7

Answer: A

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25. A convex lens is placed between an object and a screen which are at a fixed distance apart for one position of the lens. The magnification of the image obtained on the screen is m_1. When the lens is moved by a distance d the magnification of the image obtained on the same screen m_2, Find the focal length of the lens.

A. $\dfrac{d}{(m_1 - m_2)}$

B. $\dfrac{d}{(m_1 + m_2)}$

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

D. $d\dfrac{m_2}{m_1}$

Answer: C

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26. The value of escape speed from the surface of earth is

A. real image, 36 cm in air

B. virtual image, 72cm in air

C. virtual image, 72 cm medium

D. real image 36 cm, in air

Answer: A

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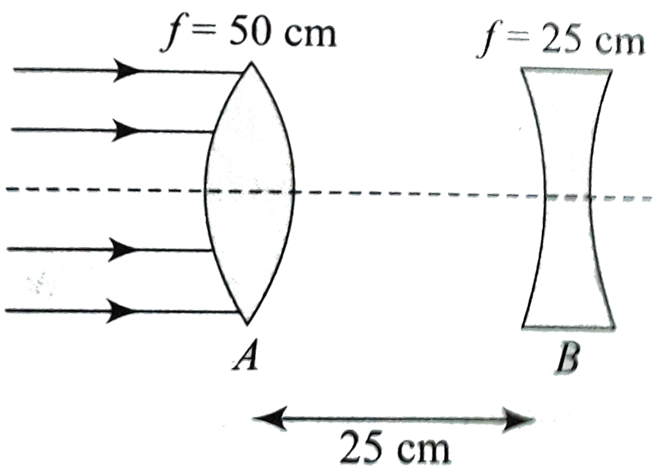
27. Two lenses shown in figure. Are illuminated by a beam of parallel light from the left. Lens B is then moved slowly toward lens A. the beam emerging from lens B is



A. always diverging

B. initially parallel and then diverging

C. always parallel

D. initially converging and then parallel

Answer: B

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28. A double convex lens forms a real image of an objectt on a screen which is fixed. Now lens is given a constant velocity v=1m/s along its axis and away from the screen for the purpose of forming image always on the screen the object is also required to be given appropriate velocity . Find the velocity (in m/s) of the object at the instant its size is doubled the size of the image.

A. 1 m/s

B. 2 m/s

C. 3 m/s

D. 4 m/s

Answer: B

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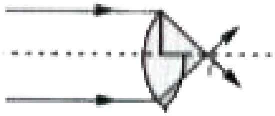
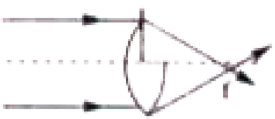
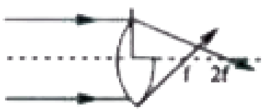
29. Choose the correct ray diagram of an equi convex lens which is cut as shown.

A. 

B. 

C. 

D. 

Answer: C

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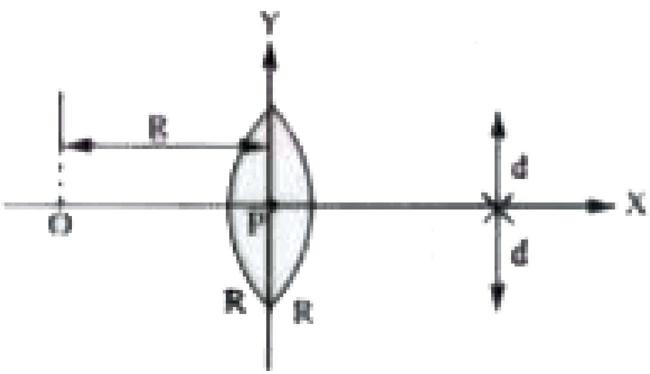
30. A biconvex thin lens of radius of curvature R is made up of variable refractive index $\mu = 2\left(1 + \frac{r}{d}\right)$. Assume $2d < \ < R$. There are infinite images of the point O, which is placed at a distance R on the principal axis from the lens as shown in the figure. The image is spread along the pricipal axis in a length of (r is the radial distance from P measured perpendicular to principal axis)



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

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

C. $\frac{3R}{5}$

D. $\frac{4R}{5}$

Answer: C

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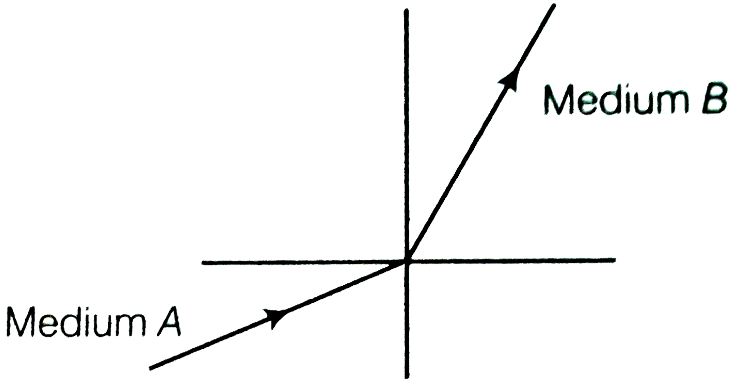
PRACTICE SHEET (ADVANCED) (MORE THAN ONE CORRECT TYPE QUESTIOS)

1. A light ray enters from medium A to medium B as shown in the figure.

The refractive index of medium B relative to A will be



A. In the above situation if $y_0 = a/2$, the co-ordinates of the point where the ray intersects the upper surface of the slab air boundary are $\left[aIn2, \dfrac{a}{2}\right]$

B. In the above situation if $y_0 = a/2$, the co-ordinates of the point where the ray intersects the upper surface of the slab air boundary are $\left[\dfrac{a}{2}\mathrm{In}2, \dfrac{a}{2}\right]$

C. the angle made by light ray with +ve x-axis, at the upper surface of slab air boundary, inside the medium is $\pi/3$

D. the angle made by light ray with +ve x-axis, at the upper surface of slab air, boundary, inside the medium is $\tan^{-1}\left(\dfrac{1}{2}\right)$

Answer: D

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2. A right-angled prism is made up of a material of refractive index μ. It is desired that a light ray incident normally on PQ emerges parallel to the incident direction after suffering two total internal reflections . In which of the following conditions is this possible ?

A. $\mu = \sqrt{2}$

B. $\mu = 2/\sqrt{3}$

C. $\mu = 1.3$

D. Nove possible

Answer: A::D

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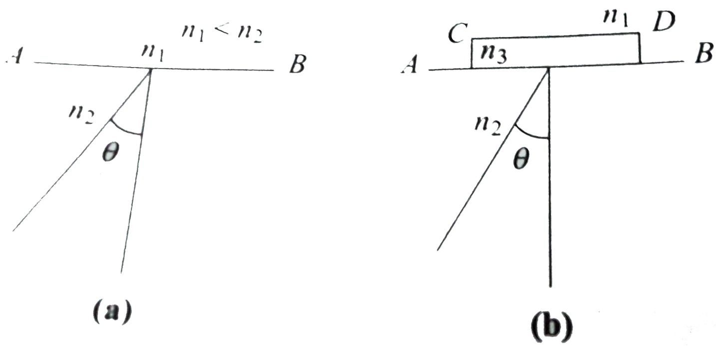
3. In Figure, light is incident at an angle θ which is slightly greater than the critical angle. Now, keeping the incident angle fixed a parallel slab or refractive index n_3 is placed on surface AB. Which of the following statements are correct?



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

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

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

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

Answer: A::B::C

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4. An image of a bright square is obtained on a screen with the aid of a convergent lens. The distance between the square and the lens is 40cm. The area of the image is nine times larger than that of the square. Select the correct statement(s):

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

B. image is formed at a distance of 360 form thelens

C. focal length of the lens is 30 cm

D. focal length of the lens is 36 cm

Answer: A::C

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PRACTICE SHEET (ADVANCED) (LINKED COMPREHENSION CORRECT TYPE QUESTIOS)

1. The refractive index of the material of the prism and liquid are 1.56 and 1.32 respectively. What will be the value of θ for the following refraction ?

A. $\sqrt{2}$

B. 2

C. 1.5

D. 2.2

Answer: A::C

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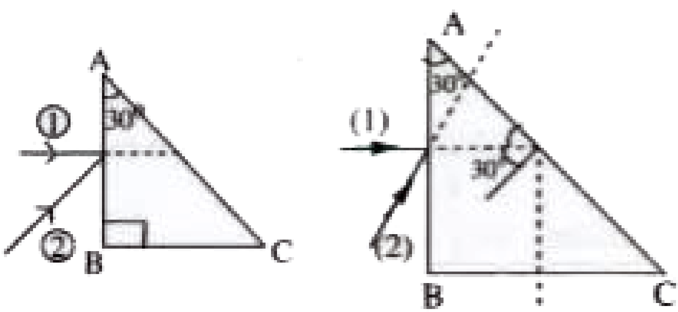
2. ABC is right angled prism kept in air. A ray (1) is incident on the face AB along the normal. Another ray (2) is incident on the face AB such that it emerges normally form the face AC. Then



The minimum value of refractive index of the material of the prism for which the ray 1undergoes TIR on the face AC is

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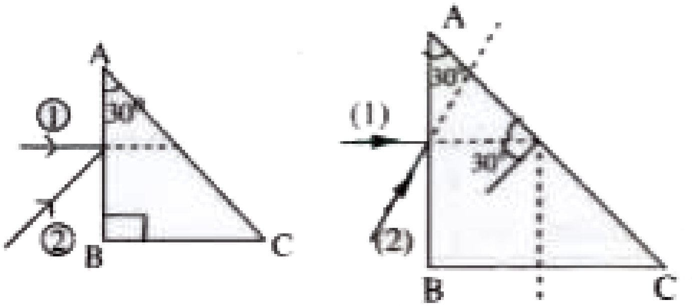
3. ABC is right angled prism kept in air. A ray (1) is incident on the face AB along the normal. Another ray (2) is incident on the face AB such that it emerges normally form the face AC. Then



The minimum value of refractive index of the material of the prism for which the ray 1undergoes TIR on the face AC is

A. 60°

B. 45°

C. 30°

D. 90°

Answer: D

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4. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

Find the linear magnification of the first image after refraction from the lens.

A. $+3$

B. -3

C. $+2$

D. -2

Answer: A

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5. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

Find the linear magnification of the second image after reflection from the mirror.

A. $+2$

B. -2

C. $+1/2$

D. $-1/2$

Answer: B

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6. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

If A'B' is the final image formed, A' corresponding to A and B' corresponding to B, find the distance of B' below optics axis of lens.

A. 0.3 m

B. 0.5 m

C. 0.6 m

D. None of these

Answer: C

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7. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

As in the lat problem, find the distance of A' below the optic axis of lens.

A. 1.5 cm

B. 0.6 cm

C. 1.8 cm

D. 2.1 cm

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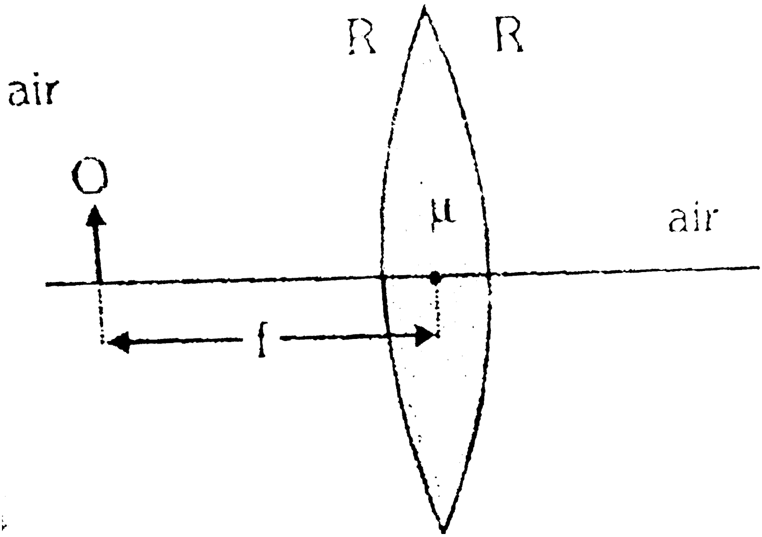
PRACTICE SHEET (ADVANCED) (MATRIX MATCHING TYPE QUESTIOS)

1. An object O (real) is placed at focus of an equi-biconvex lens as shown in. figure-I . The refractive index of lens is $\mu = 1.5$ and the radius of curvature of either suface of lens is R . The lens is surronded by air . In each statement of column-I some changes are made to situation given above and information regarding final image formed as a result is given in column-II . The distance between lens and object is unchanged in all statements of column-I. match the statements in column-I with resulting image in column-II.

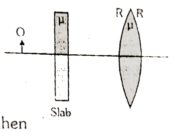


Column-I

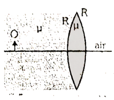
(A) If the refractive index of the lens is doubled (that is, made 2μ) then

(B) If the radius of curvature is doubled (that is, made 2R) then

(C) If a glass slab of refractive index μ = 1.5 is introduced between the object and lens as shown then



(D) If the left side of lens is filled with a medium of refractive index μ= 1.5 as shown, then



Column-II

(p) final image is real

(q) final image is virtual

(r) final image becomes smaller in size in comparison to size of image before the change was made

(s) final image is of same size of object.

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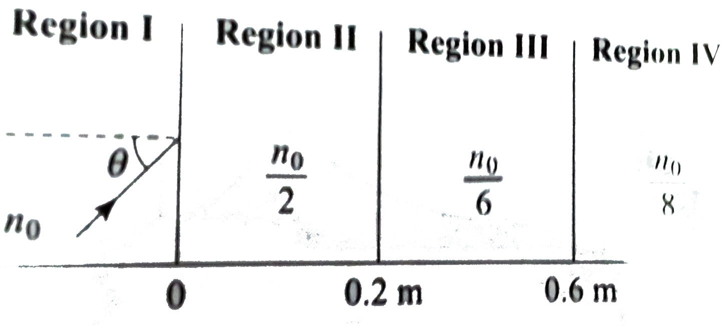
PRACTICE SHEET (ADVANCED) (INTEGER TYPE QUESTIOS)

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



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2. A fish which is at a depth of 12 cm in water $\left(\mu = \frac{4}{3}\right)$ is viewed by an observer on the bank of a lake. Its apparent depth as observed by the observer is :

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3. A thin prism P_1 of angle 4° and refractive index $1.54^\circ C$ is combined with another thin prism P_2 of refractive index 1.72 to produce dispersion without deviation. The angle of P_2 is

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4. A ray of light undergoes deviation of 30° when incident on an equilateral prism of refractive index $\sqrt{2}$. The angle made by the ray inside the prism with the base of the prism is

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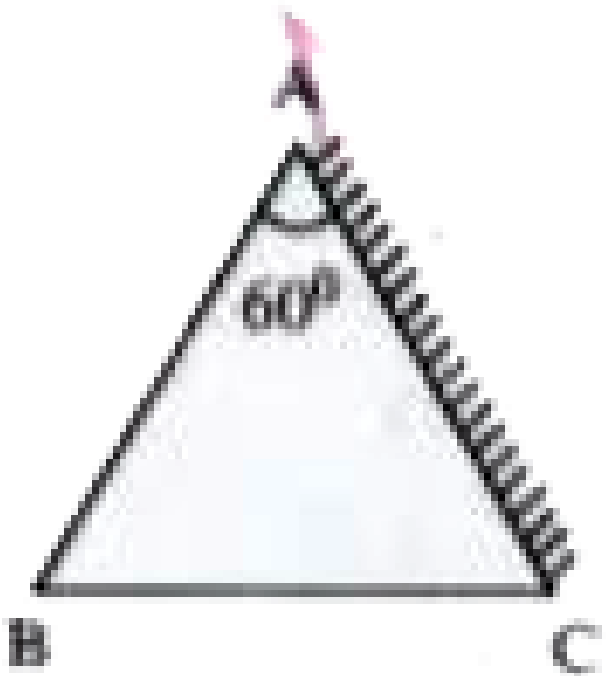
5. On face AC of an equilateraal prism ABC is silvered as shown in fig. The angle of incidence of a light ray inorder that it eventually leaves the prism in the opposite direction from base of prism is $n \times 15^\circ$ where n is

$(\mu = \sqrt{2})$



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6. A equilateral glass prism has a refractive index $\sqrt{2}$. A light ray is incident at 45° on one face. Total deviation of ray is $n \times 15^\circ$ where n is

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

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8. Light passes symmetrically through an equilateral prism. After emergence, it is incident on a plane mirror fixed to the base of the prism extending beyond it. Find the deviation produced (μ of the prism material is $\sqrt{2}$).

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9. An extended object of size 2mm is placed on the principal axis of a converging lens of focal length 10cm. It is found that when the object is placed perpendicular to the principal axis the image formed is 4mm in size. The size of image when it is placed along the principal axis is _____________ mm.

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10. A point object is placed at a distance 25cm from a convex lens of focal length 20cm. If a glass slab of thickness t annd refractive index 1.5 is inserted between the lens and object, image is formed at . Thickness t is found to be K times of 5cm. Fink K.

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LECTURE SHEET (EXERCISE-I (LEVEL-I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. Two plane mirrors are inclined at an angle of 60° with each other. An incident ray hits one of the mirror at an angle of 80° with the normal. Its angle of deviation after two reflections is

A. 120°

B. 240°

C. 0

D. 60°

Answer: A

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2. A plane mirror is on y-z plane facing positive x-axis. A point object is present at (10,5). The mirror is translated by 2 units along positive x and 3 units along positive y-direction. Final image of the point object is at

A. $(-10, -5)$

B. $(-8, -3)$

C. $(-6, 5)$

D. $(-6, -2)$

Answer: C

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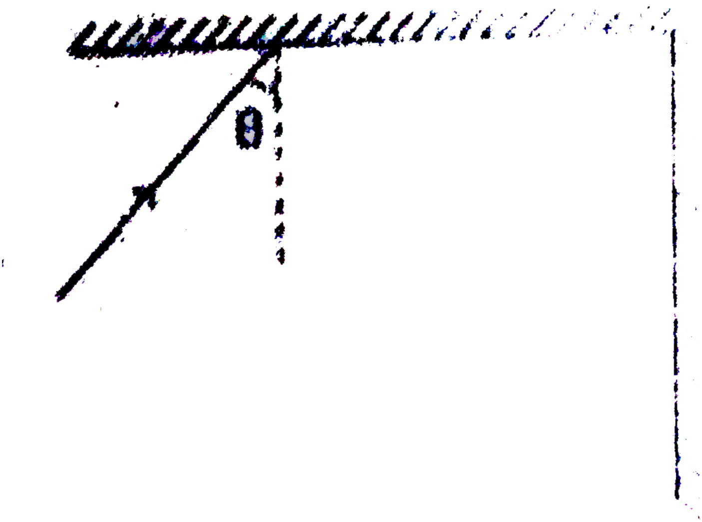
3. Two plane mirrors are arranged at right angles to each other as shown in figure.A ray of light is incident on the horizontal mirror at an angle θ. For what value of $\theta$the ray emerges parallel to the incoming ray after reflection from the vertical mirror ?



A. 60°

B. 30°

C. 45°

D. all of these

Answer: D

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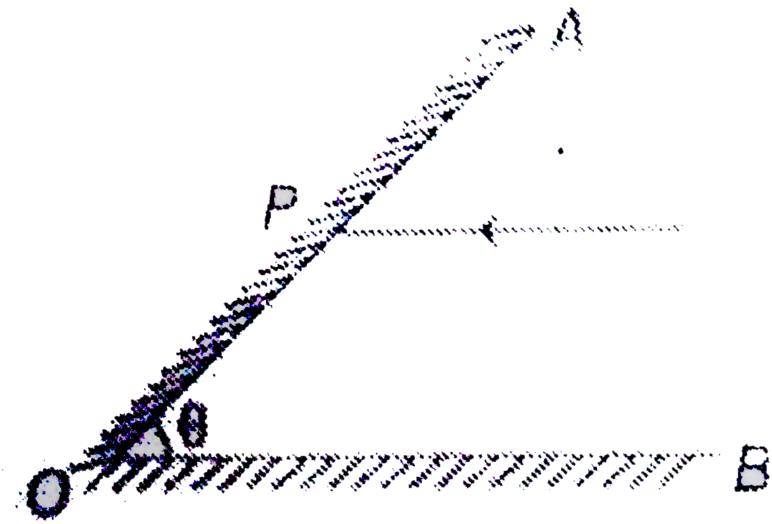
4. Two plane mirrors are inclined at angle θ as shown in figure. If a ray parallel to OB strikes the other mirror at P and finally emerges parallel to OA after two reflections then θ is equal to



A. 90°

B. 60°

C. 45°

D. 30°

Answer: B

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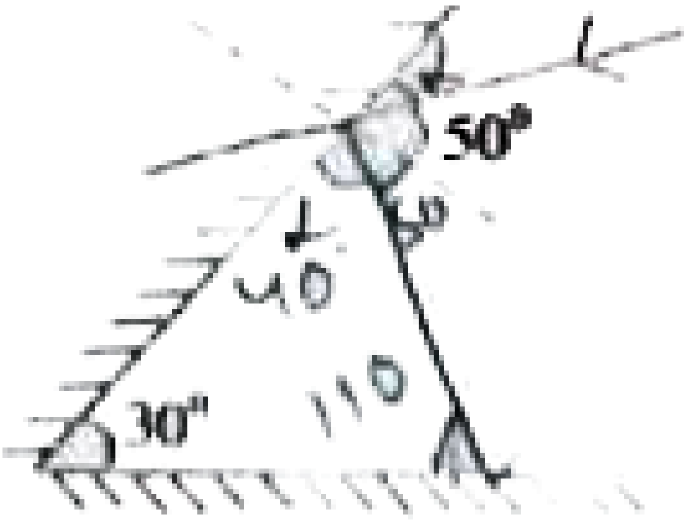
5. Calculate the deviation suffered by incident ray in situation as shown in figure after these successive reflections.



A. 380° clockwise

B. 380° anticlockwise

C. 220° anticlockwise

D. 220° clockwise

Answer: D

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6. Three plane mirrors are placed such that the angle between the first and second or second and third is the same θ. A light striking the first mirror, after reflection at the three mirrors emerges opposite to the initial direction. The value of θ can be

A. 60°

B. 150°

C. 120°

D. 45°

Answer: C

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7. Sun rays are reflected from a horizontal mirror and fall on a vertical screen. A vertical object of height h is placed on the mirror as shown in the figure.Length of the shadow on the screen is

A. h

B. 2h

C. 3h

D. 4h

Answer: B

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8. An object is placed at 20 cm from a convex mirror of focal length 10 cm. The image formed by a mirror is

A. Real and at 20cm from the mirror

B. Virtual and at 20cm from the mirror

C. Virtual and at 20/3cm from the mirror

D. Real and at 20/3cm from the mirror

Answer: C

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9. An object 1 cm tall is placed 4 cm infront of a mirror. In order to produce an upright image of 3 cm height one needs a

A. Convex mirror of radius of curvature 12cm

B. Concave mirror of radius of curvature 12 cm

C. Concave mirror of radius of curvature 4 cm

D. Plane mirror of height 12 cm

Answer: B

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10. Radius of concave mirror is 40 cm and the size of image (real) is twice as that of object, then the object distance is

A. 60cm

B. 20cm

C. 40cm

D. 30cm

Answer: D

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11. An object O is placed in front of a small plane mirror M_1 and a large convex mirror M_2 of focal length f. The distance between O and M_1 is x and the distance between M_1 and M_2 is y. The images of O formed by M_1 and M_2 coincide. The magnitude of f is

A. $x-y$

B. $\dfrac{x^2-y^2}{2y}$

C. $\dfrac{x^2+y^2}{2y}$

D. $\dfrac{x^2+y^2}{x+y}$

Answer: B

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12. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is $20cm$ away from the mirror. The length of the image is

A. 5cm

B. 10cm

C. 15cm

D. 20cm

Answer: A

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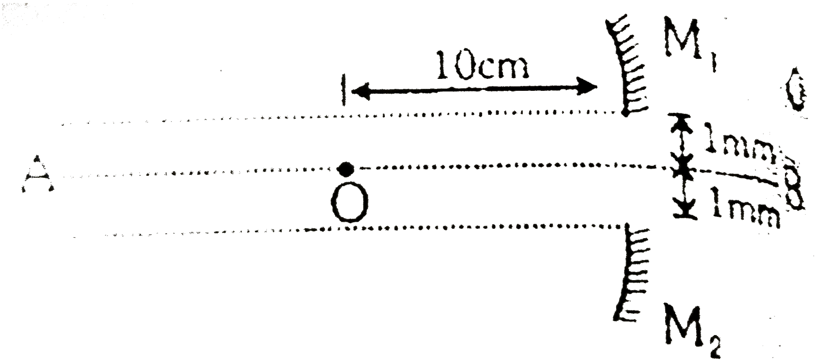
13. A concave mirror of focal length 20 cm is cut into two parts from the middle and the two parts are moved perpendicularly by a distance 1 mm from the previous principal axis AB. The distance between the images formed by the two parts is :



A. 2cm

B. 6cm

C. 3cm

D. 4cm

Answer: A

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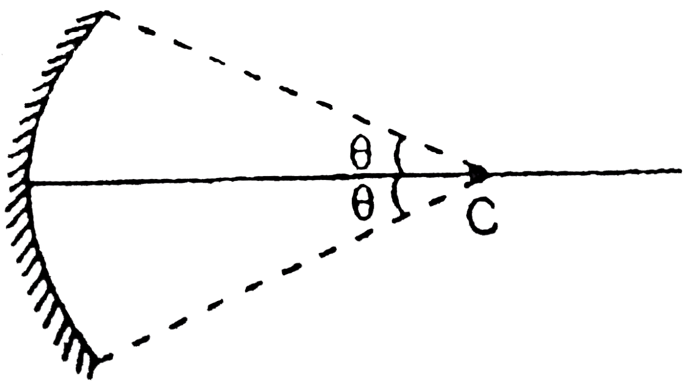
14. The circular boundary of the concave mirror subtends a cone of half angle θ at its centre of curvature. The minimum value of θ for which any ray incident on this mirror parallel to the principal axis suffers reflection more than once is



A. 30°

B. 45°

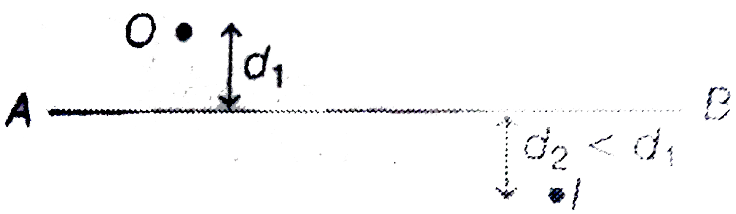
C. 60°

D. 75°

Answer: B

Watch Video Solution

15. In the figureshownm the image of a real object is formed at point I. AB is the principal axis of the mirror. The mirror must be



A. concave & placed towards right I

B. concave & placed towards left of I

C. convex and placed towards right of I

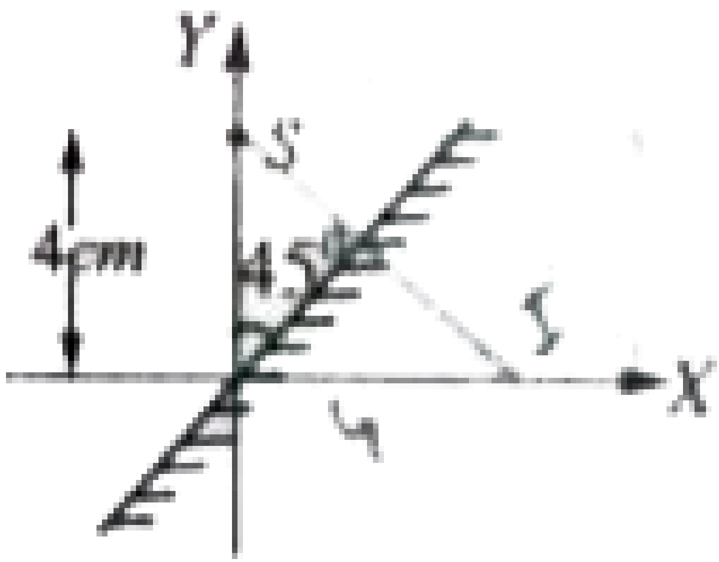
D. convex & placed towards left of I

Answer: B

Watch Video Solution

LECTURE SHEET (EXERCISE-I (LEVEL-II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. What are the co-ordinates of the imasge of S formed by a plane mirror as shown in figure?



A. (4 cm, 0)

B. (-4 cm, 0)

C. $(4\sqrt{2}cm, 0)$

D. (0, 4cm)

Answer: A

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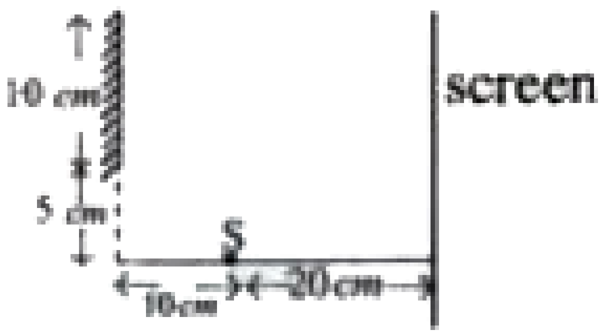
2. A luminous point source s is placed between a plane mirror and a screen in the situation as shown in figure. Then the length of screen which will receive direct light as well as reflected light is



A. 50cm

B. 60cm

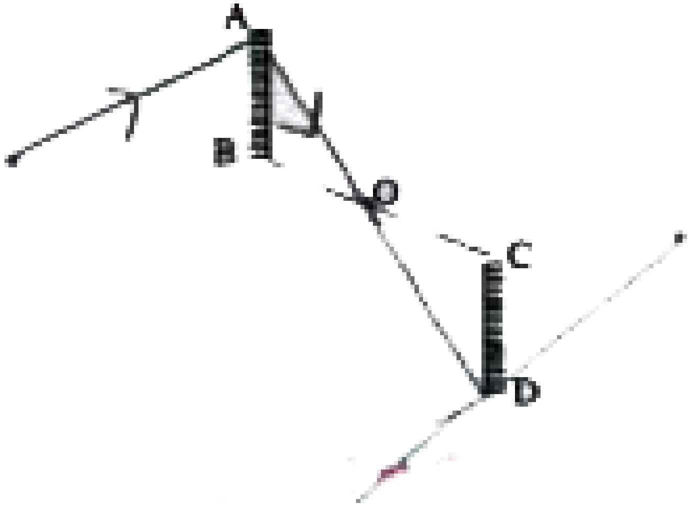
C. 70cm

D. 40cm

Answer: D

Watch Video Solution

3. Two mirrors AB and CD are arranged along two parallel lines. The maximum number of images of object O that can be seen by any observer is



A. one

B. two

C. four

D. infinite

Answer: A

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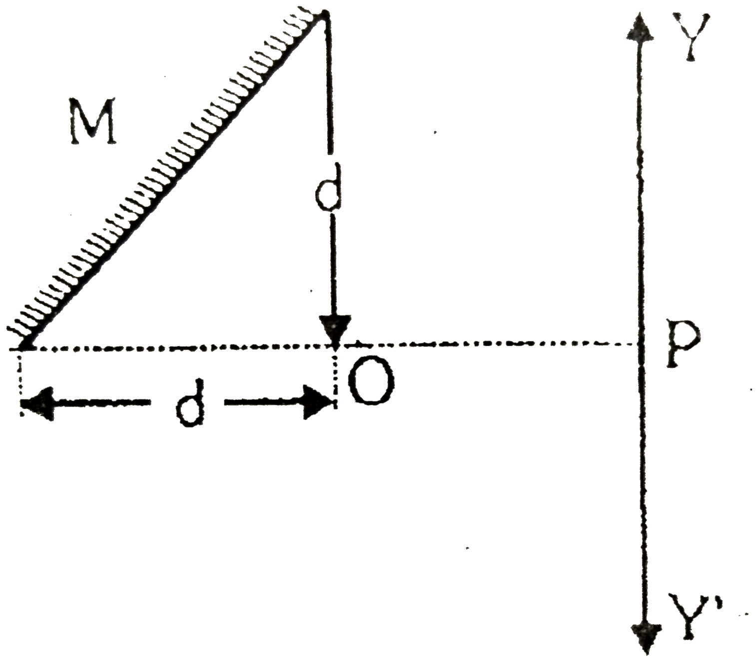
4. As shown in the figure a particle is placed at O in front of a plane mirror M . A man of P can move along patyh PY and PY' then which of the following is true?



A. For all point on PY, the man can see the image of O

B. For all point on PY', the man can see the image, but for no point on PY he can see the image of O

C. For all point on PY' he can see the image but on PY he can see the image only upto a distance d from P.

D. He can see the image only upto a distance d on either side of P.

Answer: C

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5. A plane mirror is placed along positive x-axis facing towards positive y-axis. If the equation of a linear object is x=y, the equation of its image is

A. $x = y$

B. $2x + y = 0$

C. $x + y = 0$

D. $x - y = 0$

Answer: C

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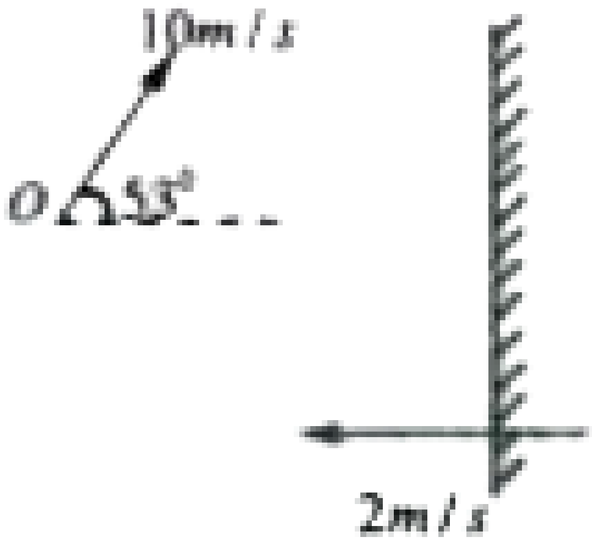
6. Find the velocity of image of a moving particle O in the situation as shown in the figure.



A. $\sqrt{164}$ m/s, at $\tan^{-1}$ (4/5) with horizontal

B. 10m/s at 53° with horizontal

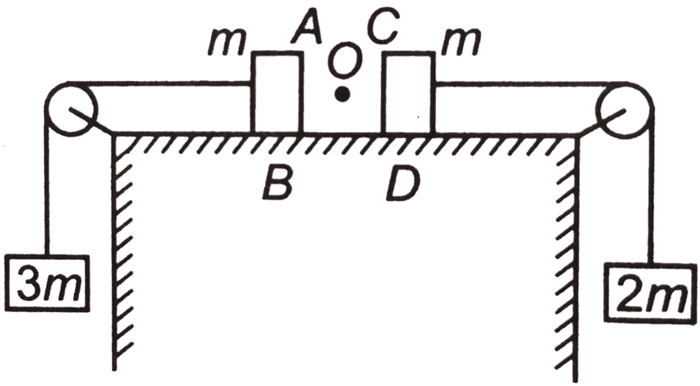
C. $\sqrt{68}$ m/s , at $\tan^{-1}\left(\frac{1}{2}\right)$ with vertical

D. $\sqrt{104}$m/s, at $\tan^{-1}\left(\frac{1}{2}\right)$ with vertical

Answer: A

Watch Video Solution

7. 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

Answer: D

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8. A particle is moving in a circle in front of a plane mirror in the situation as shown in figure. The plane of motion of the particle is perpendicular to the plane of mirror. Then the motion of image of particle with respected to the partickle is

A. along a parabola

B. oscillating normal to the mirror

C. oscillating parallel to the mirror

D. along a circle

Answer: B

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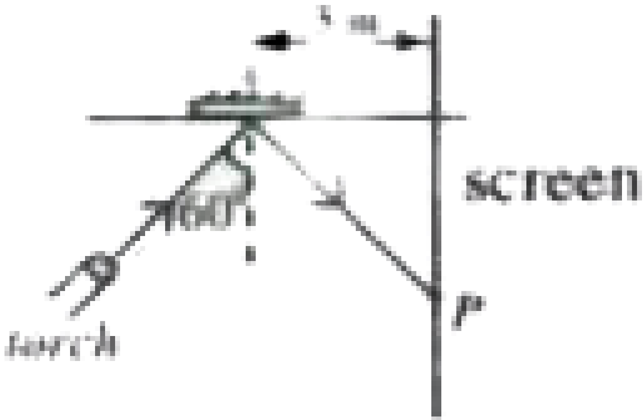
9. Figure shows a torch producing a straight light beam falling on a plane mirror at an angle 60°. The refected beam makes a spot P on the screen along y-axis. If at t=0 the mirror starts rotating about the hinge A with an angular velocity $\omega = 1^\circ$ per second clockwise, find the speed of the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



A. $\frac{\pi}{15} m / s$

B. $\frac{\pi}{30} m / s$

C. $\frac{2\pi}{15} m / s$

D. $\frac{\pi}{60} m / s$

Answer: C

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10. A point source of light S is placed in front of two large mirrors as shown. Which of the following observes will see only one image of S?

A. only A

B. only C

C. both A and C

D. both B and C

Answer: B

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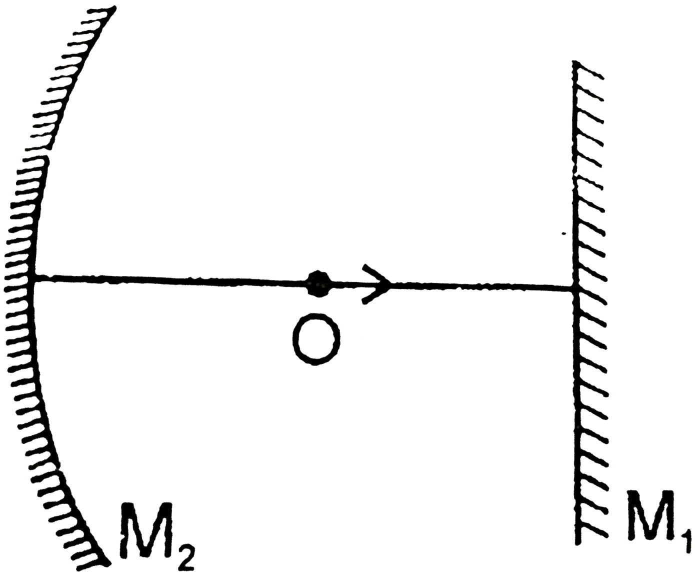
11. In the figure $M_1 \& M_2$ are two fixed mirrors as shown. If the object $'O'$ moves towards the plane mirror. Then the image I (which is formed after two successive reflections from $M_1 \& M_2$ respectively) will move



A. towards right

B. towards left

C. with zero velocity

D. cannot be determined

Answer: A

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12. A candle flame 1.6 cm high is imaged in a ball bearing of diameter 0.4 cm. If the ball bearing is 20 cm away from the flame, find the location and the height of the image.

A. 1.0 mm inside the ball bearing, 0.08 mm

B. 1.0 mm outside The ball bearing 0.06 cm

C. 2 m inside The ball bearing 0.08 cm

D. 1 m outside The ballbearig 0.05 mm

Answer: A

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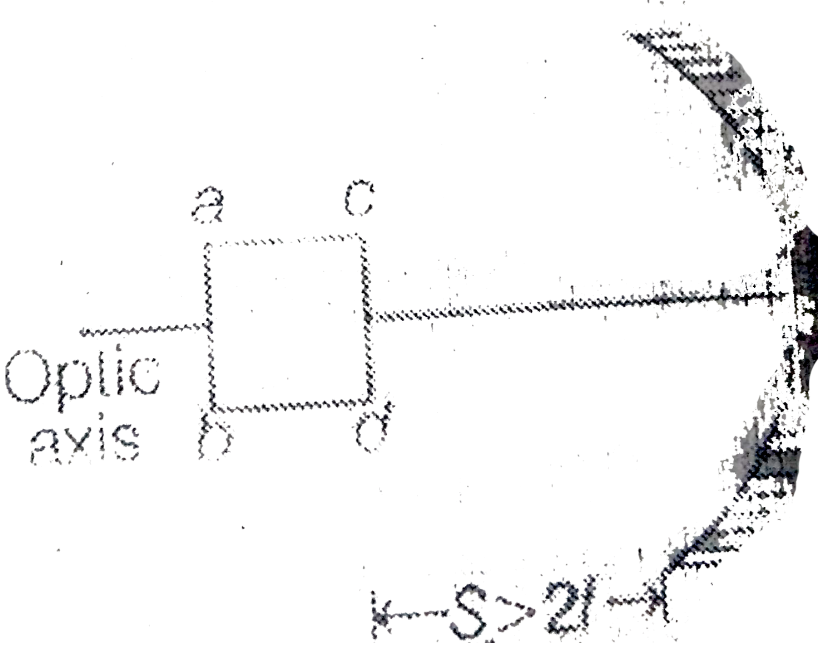
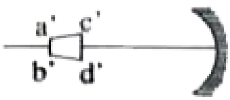
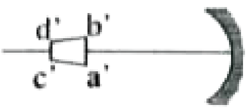
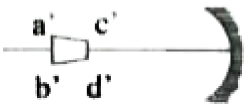
13. An object is placed in front of a concave mirror of focal length f as shown in figure. Choose the correct shape of the image.



A. 

B. 

C. 

D. 

Answer: B

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14. A small block of mass m and a concave mirror of radius R fitted with a stand lie on a smooth horizontal table with a separation d between them. The mirror together with its stand has a mass m. The block is pushed at t = 0 towards the mirror so that it starts moving towards the mirror at a constant speed V and collides with it. The collision is perfectly elastic. Find the velocity of the image (a) at a time $t < \frac{d}{V}$, (b) at a time $t > \frac{d}{V}$.

A. $\frac{-R^2V}{[2(d-Vt)-R]^2}.V\left(1+\frac{R^2}{[2(Vt-d)-R]^2}\right)$

B. $\frac{R^2V}{[2(d+Vt)+R]^2}.V\left(1+\frac{R^2}{[2(Vt-d)-R]^2}\right)$

C. $\frac{-R^2V}{[2(d-Vt)-R]^2}.V\left(1-\frac{R^2}{[2(Vt-d)+R]^2}\right)$

D. $\frac{-R^2V}{[2(d-Vt)-R]^2}.V\left(1-\frac{R^2}{[2(Vt+d)-R]^2}\right)$

Answer: A

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

A. 5 cm behind the convex mirror and is virtual

B. 6 cm in front of the convex mirror is and is real

C. 6 cm behind the convex mirror and is virtual

D. 8 cm in front of the concave mirror and is real

Answer: C

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LECTURE SHEET (EXERCISE-I (LEVEL-II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS))

1. 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 mirror 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 no. of images will be 6 if an object is kept unsymmetrically between the mirrors.

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

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

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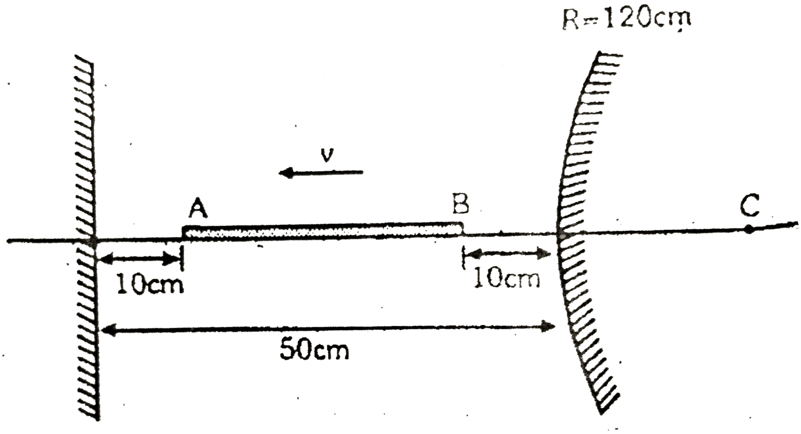
2. In the fig. shown consider the first reflection at the plane mirror and second at the convex mirror. AB is object.



A. the second image is real, inverted of 1/5th magnification

B. the second image is virtual and erect with magnification 1/5

C. the second image moves towards the convex mirror

D. the second image moves away from the convex mirror.

Answer: B::C

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3. A magnified image of real object is to be obtained on a large screen 1 m from it. This can be achieved by

A. using a convex mirror of focal length less than 0.25 m

B. using a concave mirror of focal length less than 0.25 m

C. using a convex lens of focal length less than 0.25 m

D. using a concave lens of focal length less than 0.25 m

Answer: B::C

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4. A reflecting surface is represented by the equation $y = \frac{2L}{\pi}\sin\left(\frac{\pi x}{L}\right), 0 \leq x \leq L.$ A ray traveling horizontal becomes vertical after reflecting. The co-ordinates of the point(s) on which this ray is incident.

A. $\left(\frac{L}{4}, \frac{\sqrt{2}L}{\pi}\right)$

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

C. $\left(\frac{3L}{4}, \frac{\sqrt{2}L}{\pi}\right)$

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

Answer: B::D

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5. All the following statements are correct except (for real objects)

A. the magnification produced by a convex mirror is always less than or equal to one

B. a virtual, erect, same sized image can be obtained using a plane mirror

C. a virtual, erect, magnified image can be formed using a concave mirror

D. a real, inverted, same sized image can be formed using a convex mirror.

Answer: A::D

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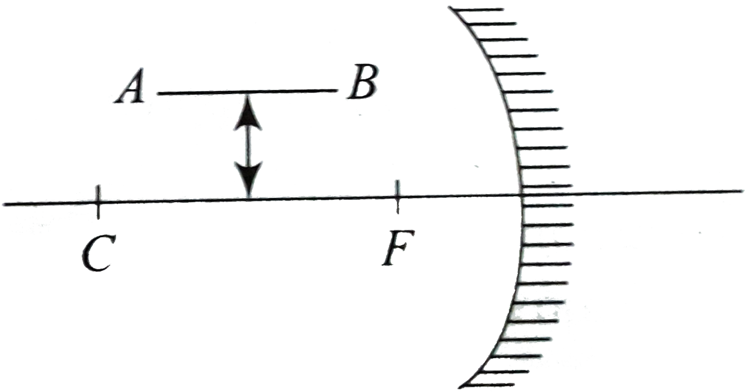
6. An object AB is placed parallel and close to the optical axis between focus F and center of curvature C of a converging mirror of focale length f as shown in Figure. Then,



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

B. Image of AB will be parallel to optical axis

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

D. Image of AB will not be a straight line

Answer: A::C

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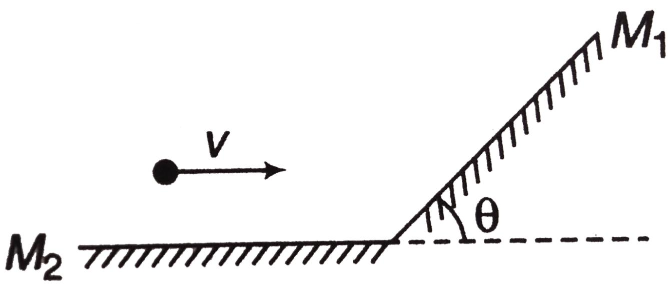
LECTURE SHEET (EXERCISE-I (LEVEL-II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS))

1. A point object is moving with a speed v

before an arrangement of two mirrors as shown in

figure. Find the magnitude of velocity of image in

mirror M_1 with respect to image in mirror M_2



A. $v\sin\theta$

B. $2v\sin\theta$

C. θ

D. v

Answer: B

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2. A point object is placed infront of a plane mirror as shown in figure.

$X_{OM} \Rightarrow x$- co-ordinate of object relative to mirror

$X_{IM} \Rightarrow x -$ co -ordinate of image relative to mirror

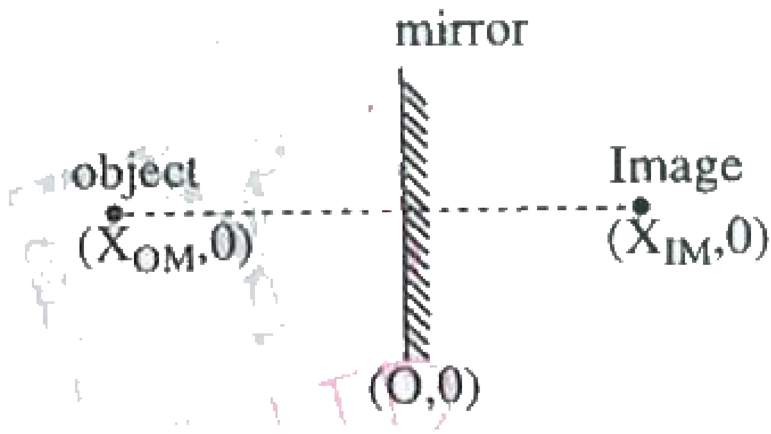
$X_{IM} = \ - X_{OM}$

differentiating $V_{1M} = \ - V_{OM}$

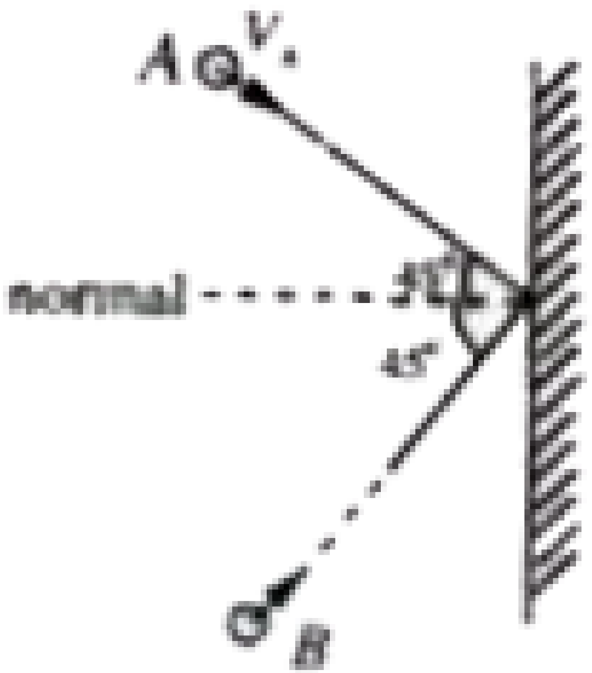
$V_I - V_M = \ - (V_0 - V_M)$

Velocity if image relative to mirror = velocity of object relative to mirror.

basing on this information answer the question



Two bodies A and B are moving towards a plane mirror with speeds V_A and V_B respectively as shown in fig. The speed of image of A with respect to the body B is



A. $V_A + V_B$

B. $V_A - V_B$

C. $\sqrt{V_A^2 + V_B^2}$

D. $\sqrt{V_A^2 - V_B^2}$

Answer: A

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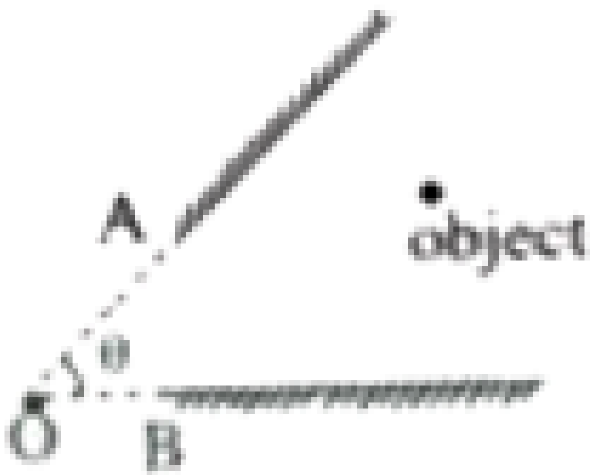
3. A point object is placed in fron of two plane mirrors as shown in figure.



Total number of images formed if 'theta=90^(@)`?

A. 3

B. 2

C. 1

D. 4

Answer: A

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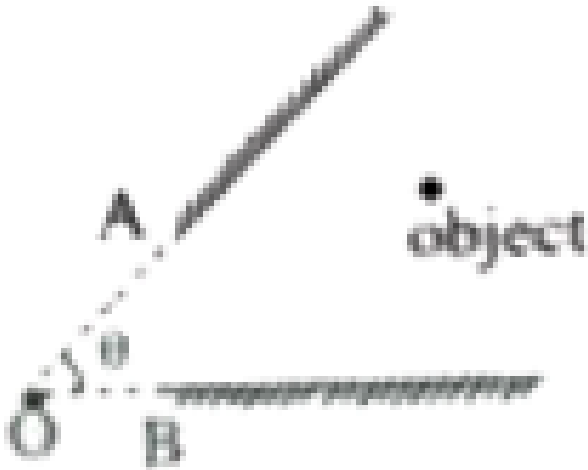
4. A point object is placed in fron of two plane mirrors as shown in figure.



Total number of images formed if 'theta=90^(@)`?

A. 3 or 4

B. 3 only

C. 4 only

D. 2

Answer: A

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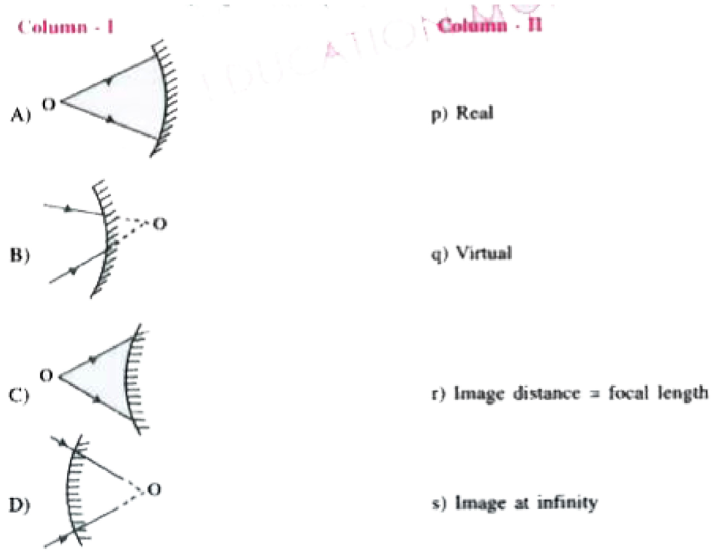
LECTURE SHEET (EXERCISE-I (LEVEL-II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS))

1. The given situations in Column -I, choose the possible options from Column -II regarding the image formed when $u \neq \infty$. (u is the object distance from the pole of the mirror)



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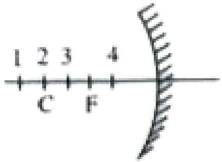
2. An extended object can be kept in front of a concave mirror at points, 1, 2, 3 and 4 and images are formed at different points. C and F have their usual meanings. Point 2 is centre of curvature of the mirror.



Column - I	Column - II
A) Object at point 1, then image is	p) real
B) Object at point 2, then image is	q) virtual
C) Object at point 3, then image is	r) enlarge
D) Object at point 4, then image is	s) diminish

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LECTURE SHEET (EXERCISE-I (LEVEL-II (ADVANCED) INTEGER TYPE QUESTIONS))

1. A point object is kept of a plane mirror. The plane mirror is performing SHM of amnplitude $2cm$. The plane mirror moves along the3 $x-$ axis is normal to the mirror. The amplitude of the mirror is scuh that the object is always infront of the mirror. The amplitude of SHM of the image is

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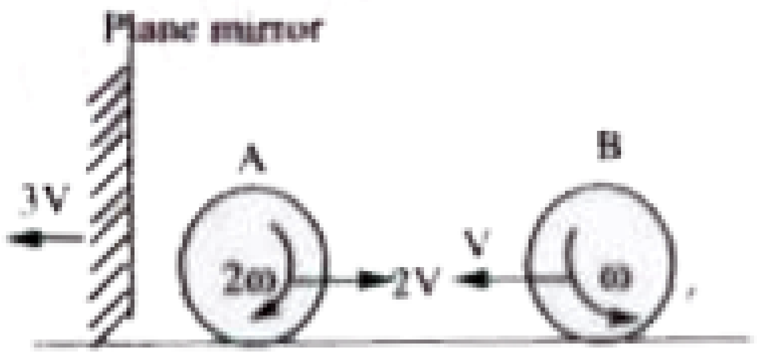
2. Two identical balls are rolling without slipping on a horizontal plane as shwon in figure. They undergo a perfect elastic collision. Just after collision, the velocity of image of the bottom point of A with respect to the plane mirros is x V, then x=



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3. An object is approaching a fixed plane mirror with velocity 3 ms/s at an angle of 45° with normal, in a medium of refractive index 4/3. The speed of the image with respect to the mirror is ________m/s.

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LECTURE SHEET (EXERCISE-II (LEVEL-I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. Absolute refractive index of a medium is X. Refractive index of same medium w.r.t to air is Y and absolute refractive index to air is Z. Then the relation between them is

A. $X = Y/Z$

B. $Y = X/Z$

C. $Z = Y/X$

D. $Y = 1/XZ$

Answer: B

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2. The refractive indices of glycerine and diamond with respect to air are 1.4 and 2.4 respectively. Calculate the speed of light in glycerine and diamond. From these results, calculate the refractive index of diamong with respect to glycerine. $(c = 3 \times 10^8 m/s)$

A. $2.143 \times 10^8 m/s, 1.250 \times 10^8 m/s, 1.714$

B. $1.143 \times 10^8 m/s, 1.250 \times 10^8 m/s, 1.714$

C. $2.143 \times 10^8 m/s, 2.250 \times 10^8 m/s$

D. $2.143 \times 10^8 m/s, 1.250 \times 10^8 m/s, 1.514$

Answer: A

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3. A monochromatic light passes through a glass slab $\left(\mu = \frac{3}{2}\right)$ of thickness 90 cm in time t_1. If it takes a time t_2 to travel the same distance through water $\left(\mu = \frac{4}{3}\right)$. The value of $(t_1 - t_2)$ is

A. 5×10^{-11} sec

B. 5×10^{-8} sec

C. 2.5×10^{-10} sec

D. 5×10^{-10} sec

Answer: A

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4. A glass slab of thickness 8 cms contains the same number of waves as 10 cms long path of water when both are traversed by the same monochromatic light. If the refractive index of water is 4/3, the refractive index of glass is

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

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

C. $\frac{16}{15}$

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

Answer: A

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5. The optical path of a monochromatic light is the same if it goes through 2.00 cm of glass or x cm of ruby. If the refractive index of glass is 1.510 and that of rby is 1.760 find the value of x.

A. 1.716 cm

B. 1.525 cm

C. 2.716 cm

D. 2.525 cm

Answer: A

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6. A ray of light incidents on a refracting surface at 30° with the surface . If the angle of refraction is 45° refractive index of the medium is

A. $\sqrt{3}$

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

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

D. $2\sqrt{3}$

Answer: C

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7. A unit vector along the incident ray of light is $\hat{i}$. The unit vector for the corresponding refracted ray of light is $\hat{r}.\widehat{n}$, a unit vector normal to the boundary of the medium and directed towards the incident medium. If μ is the refractive index of the medium, then snell's law (second law) of refraction is

A. $\hat{i}. Hatn = \mu(\hat{r}.\widehat{n})$

B. $\hat{i} \times \widehat{n} = \mu(\widehat{n} \times \hat{r})$

C. $\hat{i} \times \widehat{n} = \mu(\hat{r} \times \widehat{n})$

D. $\mu\left(\hat{i} \times \widehat{n}\right) = \hat{r} \times \widehat{n}$

Answer: C

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8. The velocities of light in two different media are 2*10^8m/s and 2.5 * 10^8 m/s respectively.The critical angle for these media is

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

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

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

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

Answer: B

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9. Light takes t_1 second to travel a distance x cm in vacuum and the same light takes t_2 second to travel 10x cm in medium. The critical angle for the corresponding medium is

A. $\sin\left(\frac{x_2 t_2}{x_1 t_1}\right)$

B. $\sin^{-1}\left(\frac{x_1 t_2}{x_2 t_1}\right)$

C. $\sin^{-1}\left(\frac{x_1 t_1}{x_2 t_2}\right)$

D. $\sin^{-1}\left(\frac{x_2 t_1}{x_1 t_2}\right)$

Answer: D

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10. A ray of light from a denser medium strikes a rare medium as shown in figure. The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are r and r'. The critical angle would be

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

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

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

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

Answer: A

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11. The refractive index of the core of an optical fibre is μ_2 and that of the cladding is μ_1. The angle of incidence on the face of the core of that the light ray just under goes total internal reflection at the cladding is

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

B. $\sin^{-1}\sqrt{\mu_2^2-\mu_1^2}$

C. $\sin^{-1}\sqrt{\mu_2-\mu_1}$

D. $\sin^{-1}\sqrt{\mu_1^2+\mu_2^2}$

Answer: D

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12. The refractive index of a prism for a monochromatic wave is $\sqrt{2}$and its refracting angle is 60° for minimum deviation, the angle of incidence will be

A. 30°

B. 45°

C. 60°

D. 75°

Answer: B

Watch Video Solution

13. A trianglular prims of glass is shown in the figure. A ray incident normally to one face is totally reflected. If $\theta = 45^\circ$ the refractive index of glass is

A. < 1.41

B. $= 1.41$

C. > 1.41

D. 1.732

Answer: C

Watch Video Solution

14. Under minimum deviation condition in a prism, if a ray is incident at an angle 30°, the angle between the emergent ray and the second refracting surface of the prism is

A. 0°

B. 30°

C. 45°

D. 60°

Answer: D

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15. A ray of light passes through an equilateral glass prism will be such a manner that the angle of incidence is equal to the angle of emergence and each of these angles is equal to 3/4 of the angle of the prism. The angle of deviation is

A. 45°

B. 39°

C. 60°

D. 30

Answer: D

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16. The refractive indices of violet and red light are 1.54 and 1.52 respectively. If the angle of prism is 10°, then the angular dispersion is

A. 0.02

B. 0.2

C. 3.06

D. 30.6

Answer: B

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17. The refractive indices of crown glass prism of C,D and F lines are 1.527, 1.530 and 1.535 respectively. Find the dispersive power of the crown glass prism.

A. 0.01509

B. 0.05109

C. 0.02108

D. 0.03402

Answer: A

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LECTURE SHEET (EXERCISE-II (LEVEL-II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. 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.

A. 45°

B. 60°

C. 75°

D. 30°

Answer: A

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2. A ray of light is incident on a rectangular plate at an angle of incidence 60°. The light ray suffers a deviation which is 25% of the angle of incidence. The refractive index of the glass will be

A. $\sqrt{3}$

B. $\sqrt{2}$

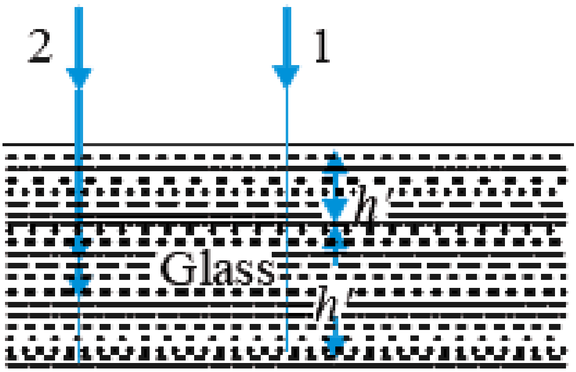
C. $\sqrt{3/2}$

D. 1.5

Answer: C

Watch Video Solution

3. Two beam of lights are incident normally on water $(\mu = 4/3)$. If the beam 1 passes through a glass $(\mu = 3/2)$ slab of height h as shown in the figure, the time difference for both the beam for reaching the bottom is:



A. zero

B. $\frac{h}{3C}$

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

D. $\frac{h}{6C}$

Answer: D

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4. A ray of light entering from air to glas $(\mu = 1.5)$ is partly reflected and partly refracted. If the reflected and refracted rays are at right angles to each other, the angle of refraction is

A. $\sin^{-1}\left(\sqrt{\frac{2}{13}}\right)$

B. $\sin^{-1}\left(\frac{\sqrt{2}}{13}\right)$

C. $\sin^{-1}\left(\frac{2}{\sqrt{13}}\right)$

D. $\sin^{-1}\left(\frac{3}{\sqrt{13}}\right)$

Answer: C

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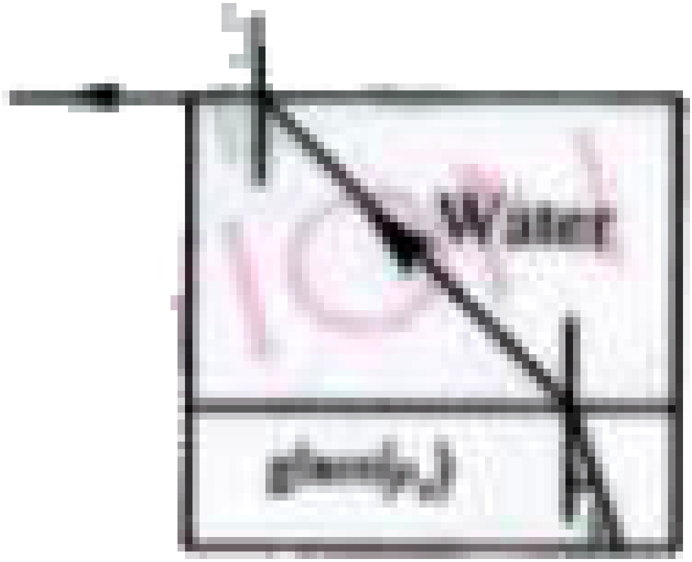
5. A ray of light travels in the way as shown in the figure. After passing through water, theray grazes along the water air interface. The value of

μ_g interms of I is $(\mu_w = 4/3)$



A. $\dfrac{1}{\sin i}$

B. $\dfrac{3}{4\sin i}$

C. $\dfrac{4}{3\sin i}$

D. sin i

Answer: A

Watch Video Solution

6. The angle of minimum deviation for a 75° prism of dense glass is found to be 45° when in air and 15° when immersed in certain liquid. The refractive index of the liquid is

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

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

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

D. $\sqrt{3}$

Answer: C

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7. A certain prism of refracting angle 60° and of refractive index 2 is immersed in a liquid of refractive index $\sqrt{2}$ then the angle of minimum deviation will be

A. 30°

B. 45°

C. 60°

D. 75°

Answer: A

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8. A ray of monochromatic light is incident on one refracting face of a prism of angle 75°. It passes thorugh the prism and is incident on the other face at the critical angle. If the refractive index of the material of the prism is $\sqrt{2}$, the angle of incidence on the first face of the prism is

A. 30°

B. 45°

C. 60°

D. 0°

Answer: B

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9. The light ray is incidence at angle of 60° on a prism of angle 45°. When the light ray falls on the other surface at 90°, the refractive index of the material of prism μ and the angle of deviation δ are given by

A. $\mu = \sqrt{2}, d = 30^\circ$

B. $\mu = 1.5, d = 15^\circ$

C. $\mu = \frac{\sqrt{3}}{2}, d = 30^\circ$

D. $\mu = \sqrt{\frac{3}{2}}, d = 15^\circ$

Answer: D

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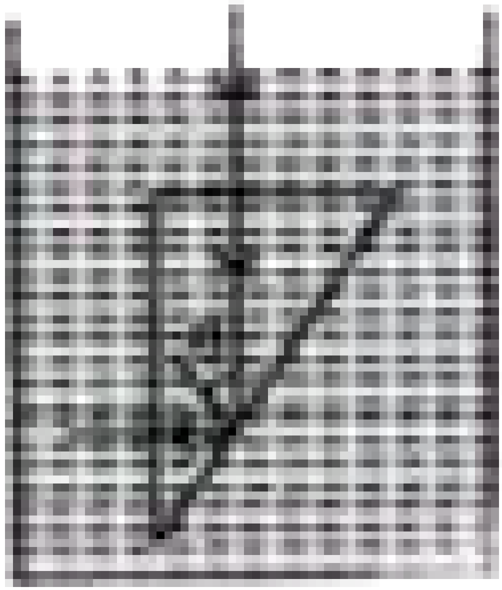
10. A prism of glass $(\mu = 1.5)$ is dipped in to water as shown in the figure. If the refractive index of water is 4/3, then the incident ray will be totally reflected if



A. $\sin\theta > \frac{8}{9}$

B. $\sin\theta < \frac{8}{9}$

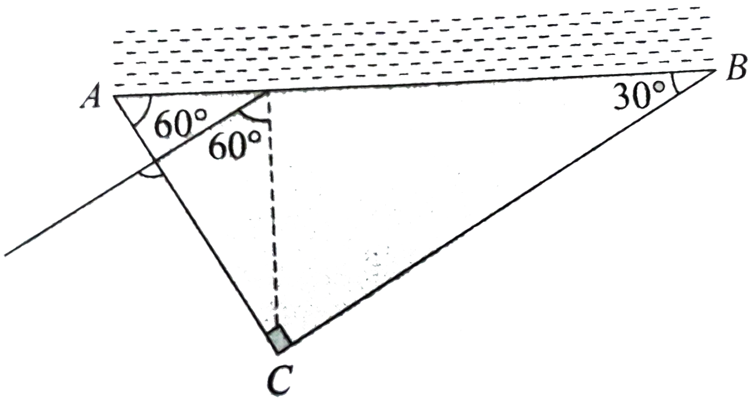
C. $\sin\theta = \frac{9}{8}$

D. $\sin\theta = \frac{8}{9}$

Answer: A

Watch Video Solution

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



A. 1.5

B. 1.4

C. 1.3

D. 0.12

Answer: C

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12. Two prisms A and B are in contact with each other have angular dispersions of 2° and 4° respectively. The dispersive power of A is 0.002. If the combination produces dispersion without deviation, the dispersive power of B is

A. 0.001

B. 0.004

C. 0.002

D. 0.006

Answer: B

Watch Video Solution

13. Two prisms A and B have dispersive powers of 0.012 and 0.018 respectively. The two prisms are in contact with each other. The prism A produces a mean deviation of 1.2°, the mean deviation produced by B if the combination is achromatic is

A. 3.6°

B. 0.8°

C. 0.4°

D. 1.8°

Answer: B

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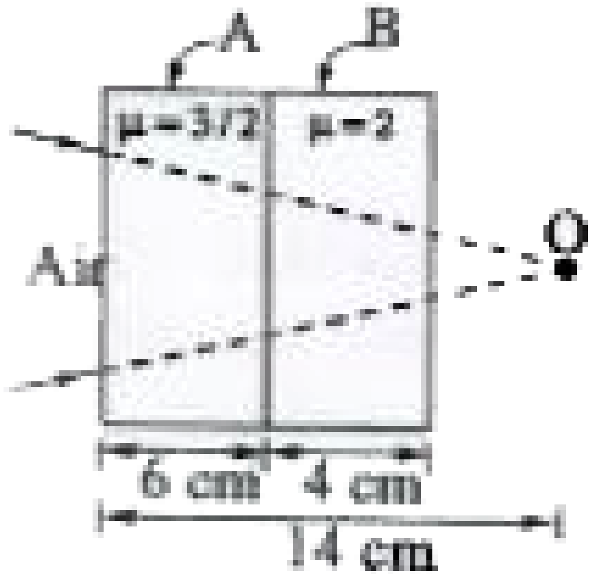
14. A convergent beam is incident on two slabs placed in contact as shown in fig. Finally the rays are converge at a distance (from left face of slab A is)



A. 10 cm

B. 18cm

C. 8cm

D. 6cm

Answer: B

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15. A parallel sided block of glass of refractive index 1.5 which is 36 mm thick rests on the floor of a tank which is filled with water (refractive index = 4/3). The difference between apparent depth of floor at A and B when seen from vertically above is equal to

A. 2mm

B. 3mm

C. 4mm

D. none of these

Answer: B

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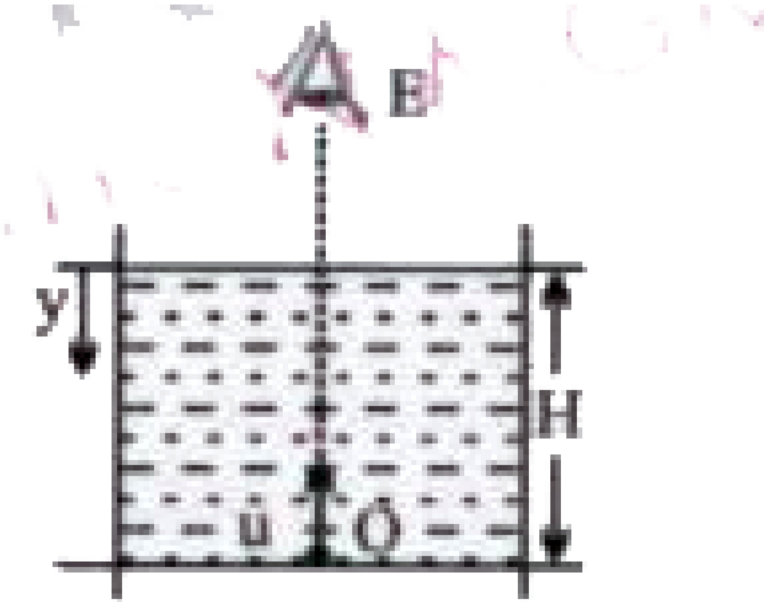
16. An insect starts moving up in a liquid from point O of variable refracive index $\mu = \mu_0(1 + ay)$ where y is depth of liquid from the surface. If u is the speed of insect, its apparent speed to the observer E is



A. u ln(1 + aH)

B. $\dfrac{u}{(1+aH)\mu_0}$

C. $\dfrac{u}{\ln(1+aH)}$

D. none

Answer: B

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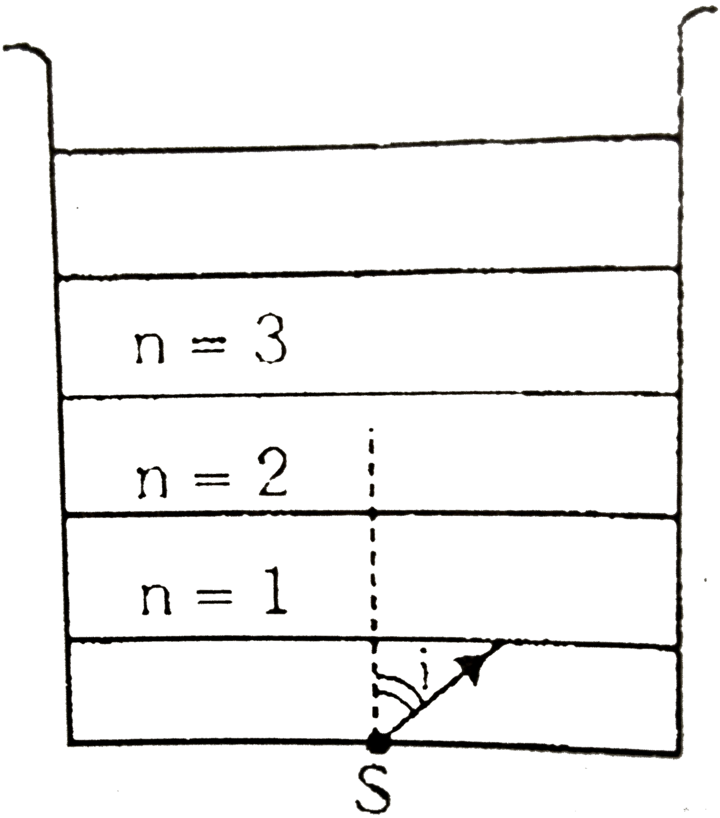
17. A point source S is placed at the bottom of different layers as shown in figure . The refractive index of bottommost layer is μ_0 . The refractive index of any other upper layer is $\mu(n) = \mu_0 + \frac{\mu_0}{4n - 18}$ A ray of light with angle $i = 30^\circ$ starts from the source S. Total internal reflection takes place at the upper surface of layer having n equal to



A. 3

B. 5

C. 4

D. 6

Answer: C

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18. A person looking through a telescope focuses lens at a point on the edge of the bottom of an empty cylindrical vessel. Next he fills the entire vessel with a liquid oif refractive index μ, without disturbing the telescope. Now, he observes the mid point of the vessel. Determine the radius to depth ratio of the vessel

A. $\frac{1}{2}\sqrt{\frac{1-\mu^2}{\mu^2+1}}$

B. $\frac{1}{2}\sqrt{\frac{4-\mu^2}{\mu^2-1}}$

C. $\frac{1}{2}\sqrt{\frac{4+\mu^2}{\mu^2+1}}$

D. $\frac{1}{2}\sqrt{\frac{4+\mu}{\mu+1}}$

Answer: B

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

A. $\frac{1}{2\sqrt{3}}\hat{i} + \frac{1}{2\sqrt{3}}\hat{j} - \sqrt{\frac{5}{6}}\hat{k}$

B. $\frac{1}{2\sqrt{3}}\hat{i} + \frac{1}{2\sqrt{3}}\hat{j} - \frac{1}{2\sqrt{3}}\hat{k}$

C. $\hat{i} + \hat{j} + \hat{k}$

D. none of these

Answer: A

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

A. 1.5

B. 1.7

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

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

Answer: A

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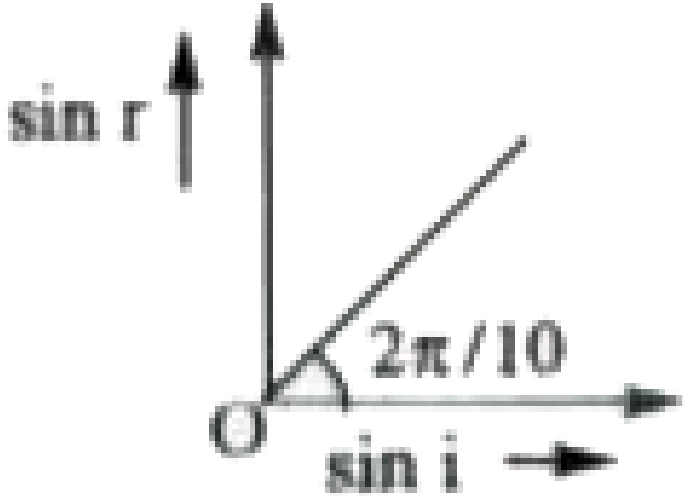
21. The graph between sine of angle of refraction (sin r) in medium 2 and sin of angle of incidence (sin i) in medium 1 indicates that

$\left(\tan 36^\circ = \frac{3}{4}\right)$



A. Total internal reflection can take place

B. Total internal reflection cannot take place

C. Any of (a) and (b)

D. Data is incomplete

Answer: B

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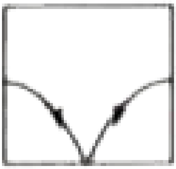
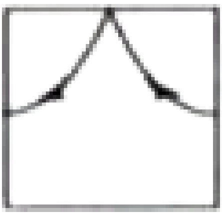
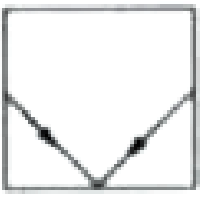
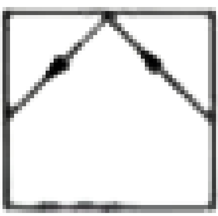
22. A cubic container is filled with a liquid whose refractive index increases linearly from top to bottom. Which of the following represents the path of a ray of light inside the liquid ?

A. 

B. 

C. 

D. 

Answer: A

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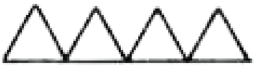
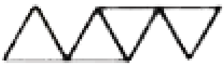
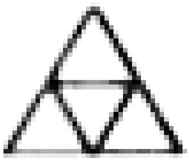
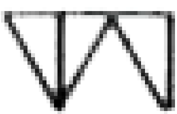
23. Four similar prisms of angle of prism are arranged. Which of the following arrangements give no net angular deviation?

A. 

B. 



C.



D.

Answer: B

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24. A light ray is incident upon a prism in minimum deviation position and suffers a deviation of 34°. If the shaded half of the prism is knocked off, the ray will

A. Suffer a deviation of 34°

B. Suffer a deviation of 68°

C. Suffer a deviation of 17°

D. Not come out of the prism

Answer: C

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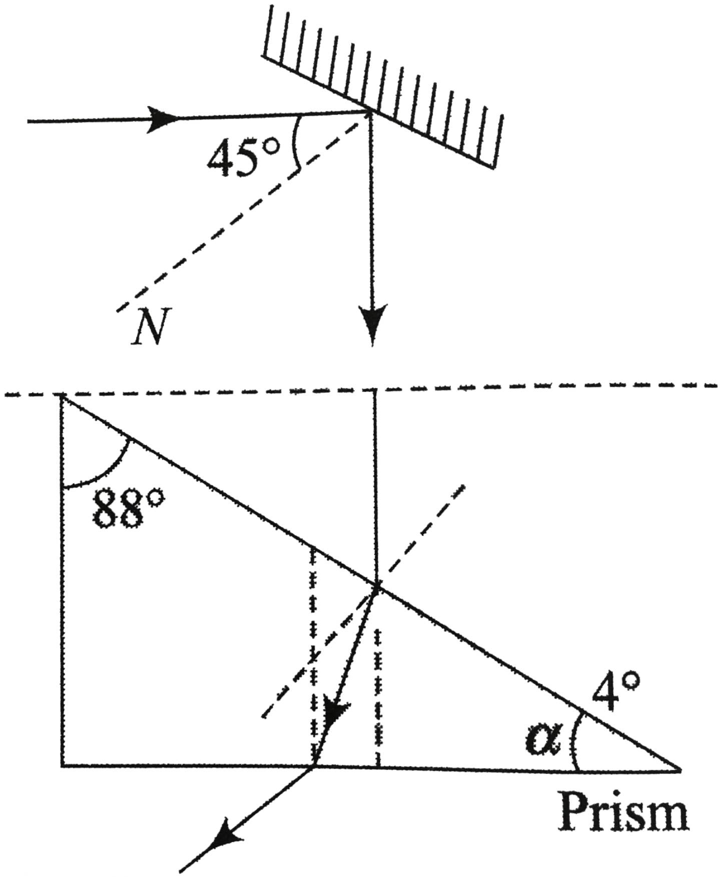
25. A ray of light strikes a plane mirror at an angle of incidence 45° as shown in Figure . After reflection,l the ray passes through a prism of refractive indes 1.5 whos apex angle is 4°. Through what angle must the mirror be rotated it total deviation of the ray be 90° ?



A. 1° clockwise

B. 1° anticlockwise

C. 2° clockwise

D. 2° anticlockwise

Answer: B

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26. The xz plane separates two media A and B with refractive indices μ_1 & μ_2 respectively. A ray of light travels from A to B. Its directions in the two media are given by the unit vectors, $\overrightarrow{r}_A = a\hat{i} + b\hat{j}$ & $\overrightarrow{r}_B = \alpha\hat{i} + \beta\hat{j}$ respectively where $\hat{i}$ & $\hat{j}$ are unit vectors in the x & y directions. Then :

A. $\mu_1 a = \mu_2 \alpha$

B. $\mu_1 \alpha = \mu_2 a$

C. $\mu_1 b = \mu_2 \beta$

D. $\mu_1 \beta = \mu_2 b$

Answer: A

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27. A microscope is focussed on a point object, and then its objective is raised through a height of 2cm when a glass slab of refractive index 1.5 is placed over this point object such that it is focussed again. The thickness of the glass slab is

A. 6cm

B. 3cm

C. 2cm

D. 1.5cm

Answer: A

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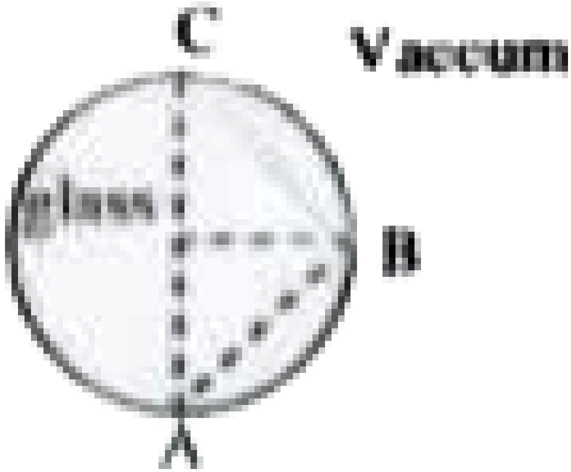
28. It is found that electromagnetic signals sent inside glass sphere from A towards B reach point C. the speed of electromagnetic signals in glass cannot be:



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

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

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

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

Answer: B

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29. A light ray is incident on a transparent slab of refractive index $\mu = \sqrt{2}$ at an angle of incidence $\pi / 4$. Find the ratio of the lateral displacement suffered by the light ray to the maximum value which it could have suffered.

A. $\dfrac{\sqrt{3}-1}{\sqrt{6}}$

B. $\dfrac{\sqrt{3}-2}{\sqrt{5}}$

C. $\dfrac{\sqrt{1}-2}{\sqrt{5}}$

D. $\dfrac{\sqrt{1}-2}{\sqrt{7}}$

Answer: A

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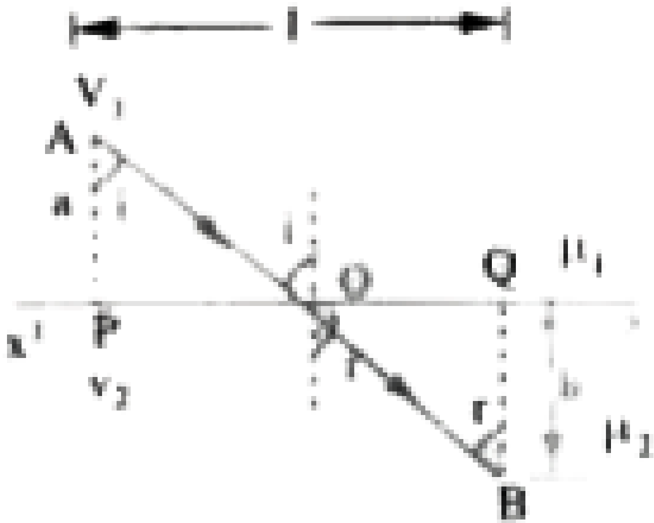
30. The time required for the light to go from A to B, when a ray of lilght goes from point A in a medium where the speed of light is v_1 to a point B in a medium where the speed of light is v_2 as shown in figure is



A. $t = \frac{a \sec i}{v_1} + \frac{b \sec r}{v_2}$

B. $t = \frac{a \sec i}{v_2} + \frac{b \sec r}{v_1}$

C. $t = \frac{a \sec i}{v_1} - \frac{b \sec r}{v_2}$

D. $t = \frac{a \sec i}{v_2} - \frac{b \sec r}{v_1}$

Answer: A

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31. The apparent depth of water in cylindrical water tank of diameter 2R cm is reducing at the rate of x cm/minute when water is being drained out at a constant rate. The amount of water drained in c.c. per minute is

$(n_1 = \text{ refractive index of air}, \ n_2 = \text{ refractive index of water})$

A. $x\pi R^2 n_1 / n_2$

B. $x\pi R^2 n_2 / n_1$

C. $2\pi R n_1 / n_2$

D. $\pi R^2 x$

Answer: B

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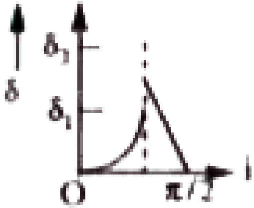
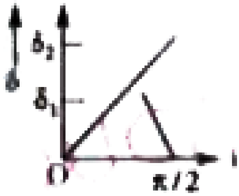
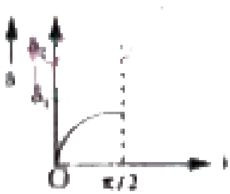
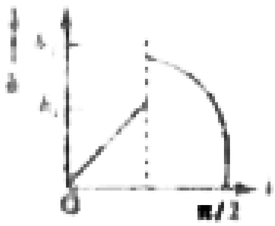
32. A ray of light travels from a medium of refractive index μ to air. Its angle of incidence in the medium is I, measured from the normal to the boundary, and its angle of deviation is δ. δ is plotted against I which of the following best respresents the resulting curve

A. 

B. 

C. 

D. 

Answer: A

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33. A man of height 1.47 m stands on a straight road on a hot day. The vertical temperature in the air results in a variation of refractive index with height y as $\mu = \mu_0\sqrt{(1+ay)}$ where μ_0 is the refractive index of air near the road a $= 1.5 \times 10^{-6}$/m. What is the apparent length of the road man is able to sec?

A. 700m

B. 2000m

C. $700\sqrt{2}$

D. infinite distance

Answer: B

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34. A glass slab of thickness 3 cm and refractive index 3/2 is placed on ink mark on a piece of paper. For a person looking at the mark at a distance 2 cm above it, the distance of the mark will appear to be in cm

A. 4cm

B. 3cm

C. 2cm

D. 4cm

Answer: A

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35. Solar rays are incident at 45° on the surface of water $(\mu = 4/3)$. The length of the shadow of a pole of length 1.2 m formed at the bottom of the pond is $\frac{3.3}{n}$ where n is (if the pole is vertical assuming that 0.2 m of the pole is above the water surface)

A. 40

B. 4

C. 3

D. 0

Answer: B

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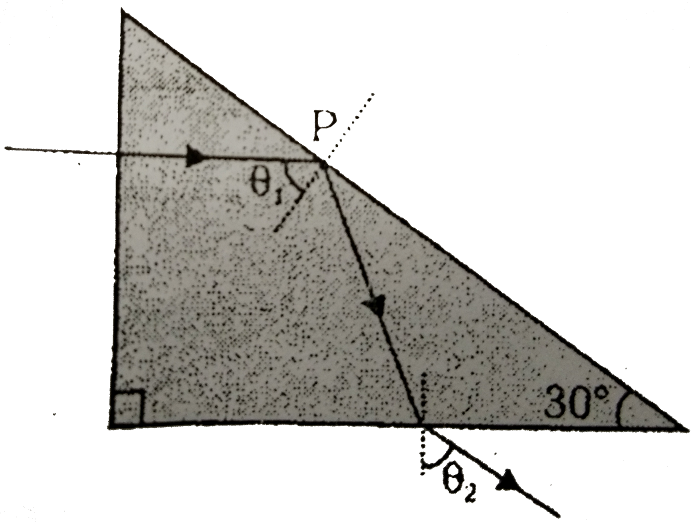
36. A ray of light is incident normally on one face of $30^\circ - 60^\circ - 90^\circ$ prism of refractive index 5/3 immersed in water of refractive index 4/3 as shown in figure .



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

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

C. total internal reflection at point P ceases if the refractive index of water is increased to $5/2\sqrt{3}$ dissolving some substance.

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

Answer: A::C

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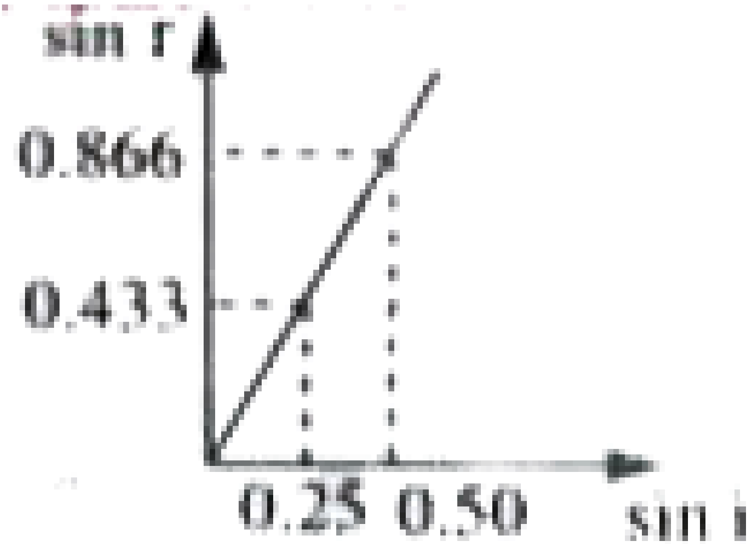
37. Light is incident from a medium A to medium B. The graph of sine of angkle of incidence I versus sine of angle of refraction r is shown in fig.

Which of the following is/are correct?



A. Total internal reflection occurs above a certain value of i.

B. Total internal reflection will not occur for any value of i

C. Wavelength of light in medium B is $\sqrt{3}$ times that in medium A.

D. Wavelength of light in medium B is 1/ 13 times that in medium A.

Answer: A::C

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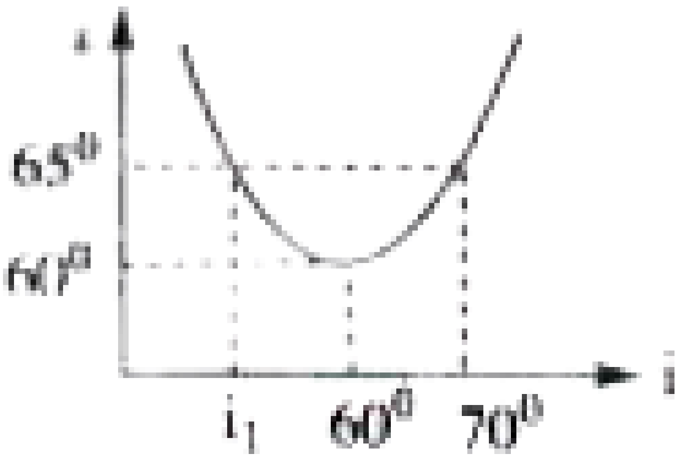
38. The angle of deviation (δ) vs angle of ancidence (i) is plotted for a prism. Pick up the correct statement.



A. The angle of prism is 60°

B. The refractive index of the prism is $n = \sqrt{3}$

C. For deviation to be 65° the angle of incidence $i_1 = 55^\circ$

D. The curve of δ vs “i' is parabolic

Answer: A::B::C

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39. For maximum deviation $D_{\max}$.

A. emergent ray must graze the surface (face)

B. ncident ray must graze the surface

C. $D_{\max} = 90^\circ + e - A$

D. $D_{\max} = 90^\circ + i - A$

Answer: C

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40. A ray of monochromatic light is incident on the plane surface of separation between two media x and y with angle of incidence i in the medium x and angle of refraction r in the medium y. The graph shows the relation between sin i and sin r.

A. The speed of light in the medium y is $\sqrt{3}$ times than in medium x

B. the speed of light in the medium y is $\frac{1}{\sqrt{3}}$ times than in medium x

C. Total internal reflection can take place when the incidence is in x

D. Total internal reflection can take place when the incidence is in y

Answer: B::D

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41. 

n number of identical equilateral prisms are kept in contact as shown in figure. If deviation through a single prism is δ. Then (n,m are integers)

A. if n=2m, deviation through n prisms is zero

B. if n=2m+1, deviation through system of n prism is δ

C. if n=2m, deviation through system of n prism is δ

D. if n=2m+1, deviation through system of n prism is zero

Answer: A::B

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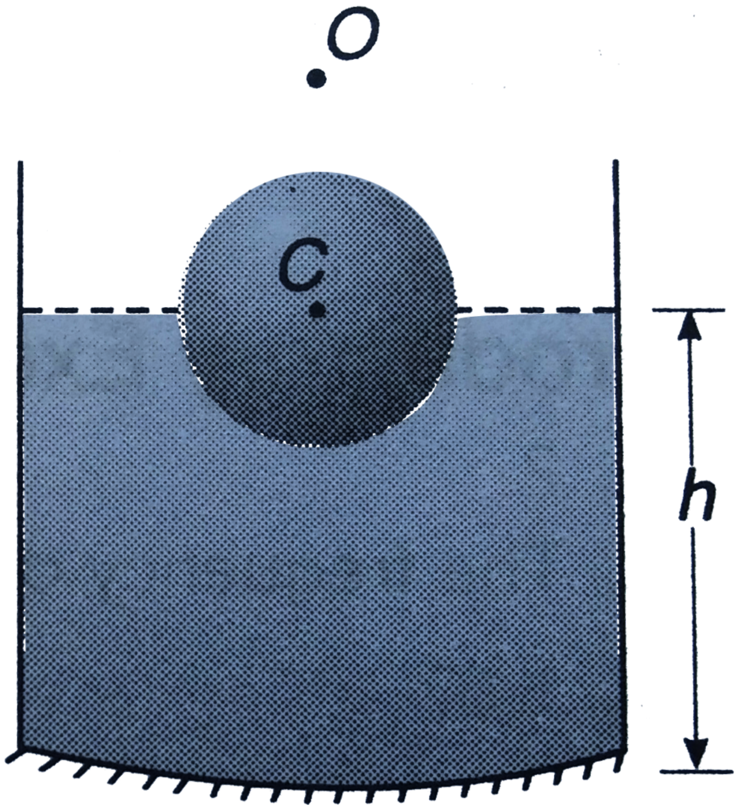
LECTURE SHEET (EXERCISE-II (LEVEL-II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS))

1. A transparent solid sphere of radius $2cm$ and density ρ floats in a transparent liquid of density 2ρ kept in a beaker. The bottom of the beaker is spherical in shape with radius of curvature $8cm$ and is silvered to make it concave mirror as shown in the figure. When an object is placed at a distance of $10cm$ directly above the centre of the sphere C, its final image coincides with it. Find h (as shown in the figure), the height of the liquid surface in the beaker from the apex of the bottom. Consider the paraxial rays only. The refractive index of the sphere is $3/2$ and that

of the liquid is $4/3$.



A. 6cm

B. 8cm

C. 12cm

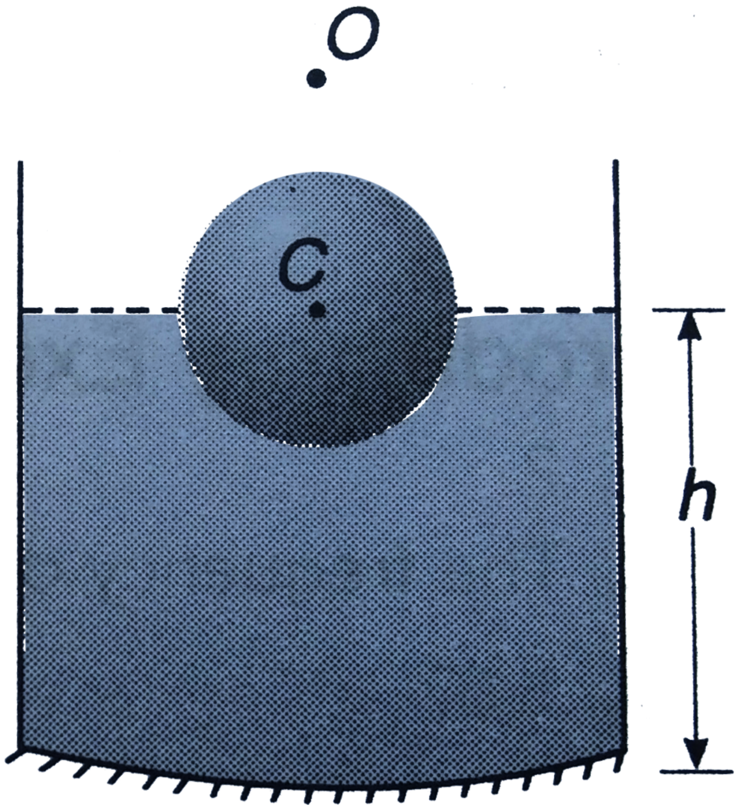
D. 16cm

Answer: C

Watch Video Solution

2. A transparent solid sphere of radius $2cm$ and density ρ floats in a transparent liquid of density 2ρ kept in a beaker. The bottom of the beaker is spherical in shape with radius of curvature $8cm$ and is silvered to make it concave mirror as shown in the figure. When an object is placed at a distance of $10cm$ directly above the centre of the sphere C, its final image coincides with it. Find h (as shown in the figure), the height of the liquid surface in the beaker from the apex of the bottom. Consider the paraxial rays only. The refractive index of the sphere is $3/2$ and that

of the liquid is $4/3$.



A. 2cm

B. 5cm

C. 6cm

D. 9cm

Answer: B

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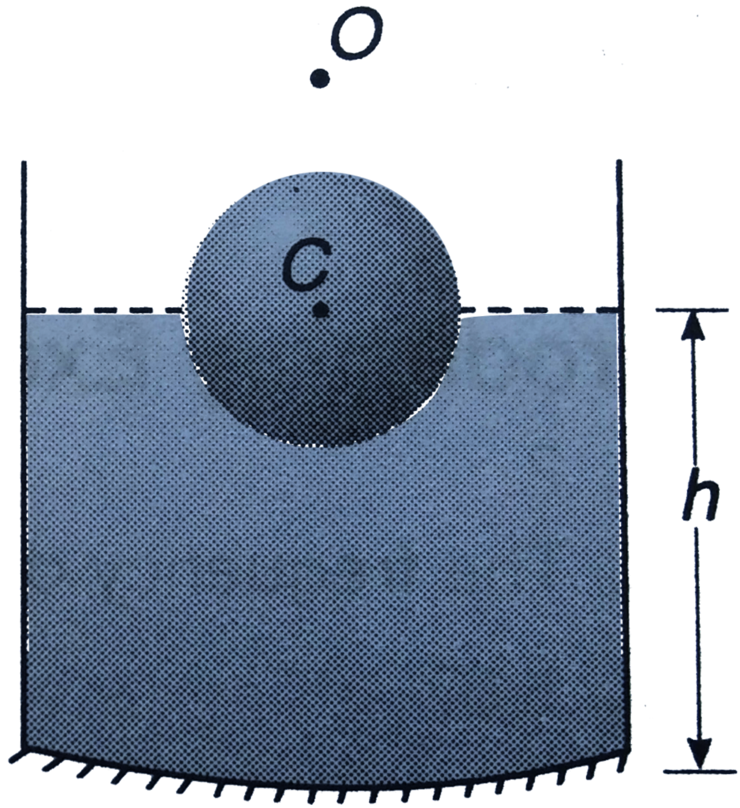
3. A transparent solid sphere of radius $2cm$ and density ρ floats in a transparent liquid of density 2ρ kept in a beaker. The bottom of the beaker is spherical in shape with radius of curvature $8cm$ and is silvered to make it concave mirror as shown in the figure. When an object is placed at a distance of $10cm$ directly above the centre of the sphere C, its final image coincides with it. Find h (as shown in the figure), the height of the liquid surface in the beaker from the apex of the bottom. Consider the paraxial rays only. The refractive index of the sphere is $3/2$ and that

of the liquid is $4/3$.



A. 8cm

B. 9cm

C. 14cm

D. 15cm

Answer: D

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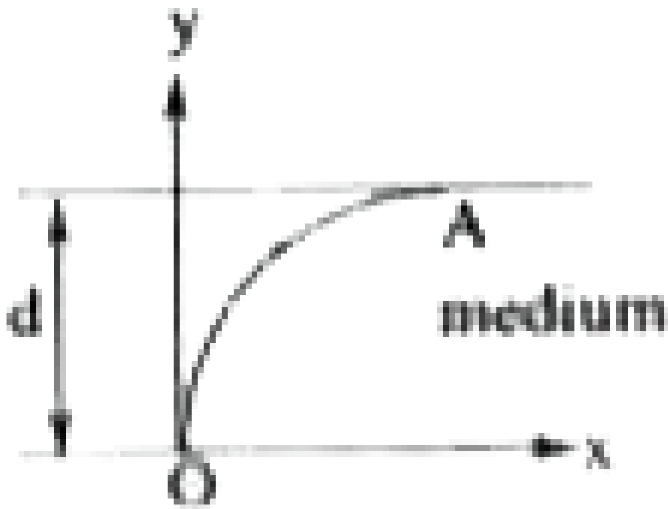
4. A long rectangular slab of transparent medium of thickness d placed on a table with its length parallel to the x-axis and width parallel to the axis. A ray of light travelling inair makes a near normal incidence on the slab as shown. Taking the point of incidence as orign (0,0,0). The refraction index μ of the medium varies as $\mu = \dfrac{\mu_0}{1 - \left(\frac{x}{r}\right)}$ where μ_1 and $r(> d)$ are constants. The refractive index of air is μ_0



The x-coordinate of the point A where the ray intersects the upper surface of the slab air boundary is

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

B. $r\left\{+\sqrt{1-\left(\frac{d}{r}\right)^{2}}\right\}$

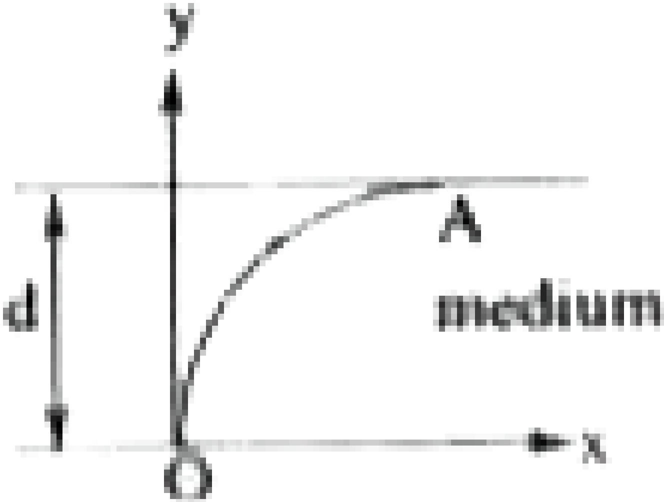
C. $r\left\{1-\sqrt{1+\left(\frac{d}{r}\right)^{2}}\right\}$

D. $r\left\{1+\sqrt{1+\left(\frac{d}{r}\right)^{2}}\right\}$

Answer: A

Watch Video Solution

5. A long rectangular slab of transparent medium of thickness d placed on a table with its length parallel to the x-axis and width parallel to the axis. A ray of light travelling inair makes a near normal incidence on the slab as shown. Taking the point of incidence as orign (0,0,0). The refraction index μ of the medium varies as $\mu=\dfrac{\mu_0}{1-\left(\frac{x}{r}\right)}$ where μ_1 and $r(>d)$ are constants. The refractive index of air is μ_0



The x-coordinate of the point A where the ray intersects the upper surface of the slab air boundary is

A. the ray retraces its path

B. they ray travels along the positive x - axis

C. the ray will travel parallel to y-axis

D. the ray will make certain angle $\theta(>30^\circ)$ with positive y-axis and pass along the line

Answer: C

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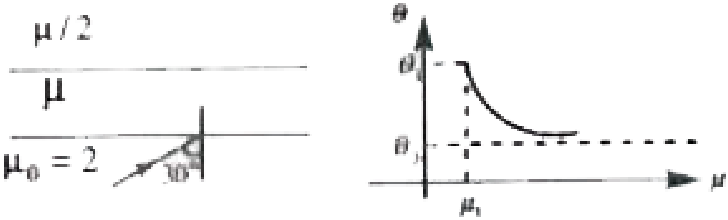
6. In the diagram shown ray of light is incident on the first medium boundary at angle 30° the medium has refractive index 2.



The second layer has refractive index $\mu/2$. A graph is given between deviation and refractive index μ. The deviation is measured by considering the final emergent ray and the incident ray.

Aswer the following questions

Value μ_1 will be

A. 1

B. 2

C. 3

D. 1.5

Answer: B

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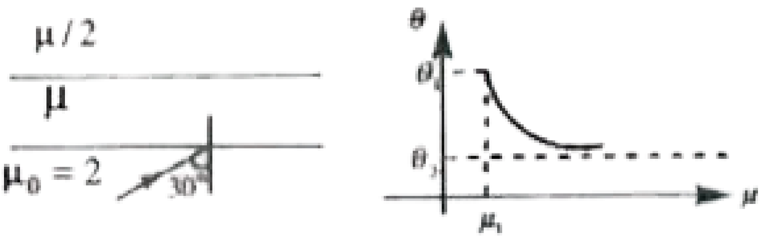
7. In the diagram shown ray of light is incident on the first medium boundary at angle 30° the medium has refractive index 2.



The second layer has refractive index $\mu/2$. A graph is given between deviation and refractive index μ. The deviation is measured by considering the final emergent ray and the incident ray.

Aswer the following questions

Value of θ_1 will be

A. 30°

B. 60°

C. 45°

D. 0°

Answer: B

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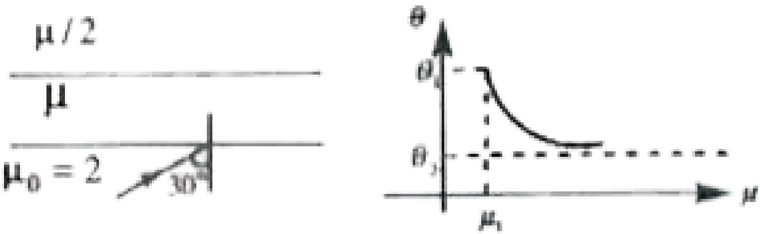
8. In the diagram shown ray of light is incident on the first medium boundary at angle 30° the medium has refractive index 2.



The second layer has refractive index $\mu/2$. A graph is given between deviation and refractive index μ. The deviation is measured by considering the final emergent ray and the incident ray.

Aswer the following questions

Value of θ_1 will be

A. 30°

B. 60°

C. 45°

D. 15°

Answer: A

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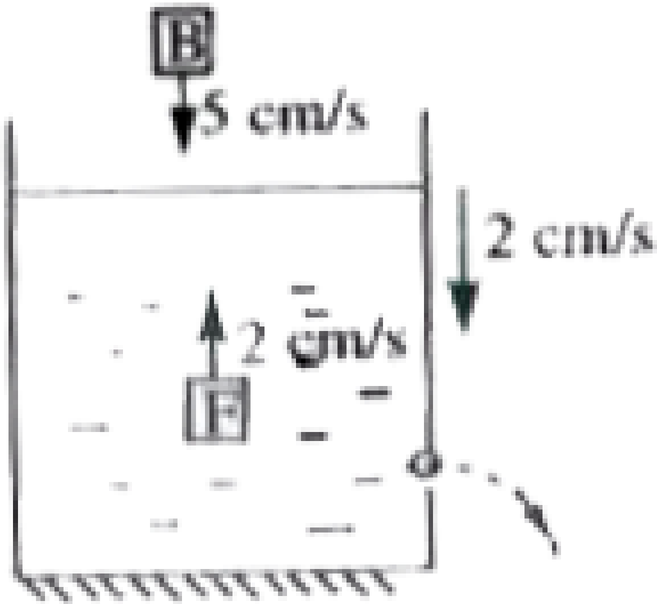
LECTURE SHEET (EXERCISE-II (LEVEL-II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS))

1. A bird B in air is diving vertically downwards over a water tank with speed 5 cm/s. Base of the tank is silvered. A fish F in the tank is rising vertically upwards along the same line with speed 2 cm/s. Water level is lowered at the rate of 2 cm/s. Take $\mu_{\text{water}} = 4/3$



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LECTURE SHEET (EXERCISE-II (LEVEL-II (ADVANCED) INTEGER TYPE QUESTIONS))

1. A beam of light falls on a glass plate $(\mu = 3/2)$ of thickness 6.0 cm at an angle of 60°. Find the deflection of the beam on passing through the plate. (in cm).

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2. The flat bottom of cylinder tank is silvered and water $\left(\mu = \frac{4}{3}\right)$ is filled in the tank upto a height h. A small bird is hovering at a height 3h from the bottom of the tank. When a small hole is opened near the bottom of the tank, the water level falls at the rate of 1 cm/s. The bird will perceive that his velocity of image is 1/x cm/sec (in downward directions) where x is

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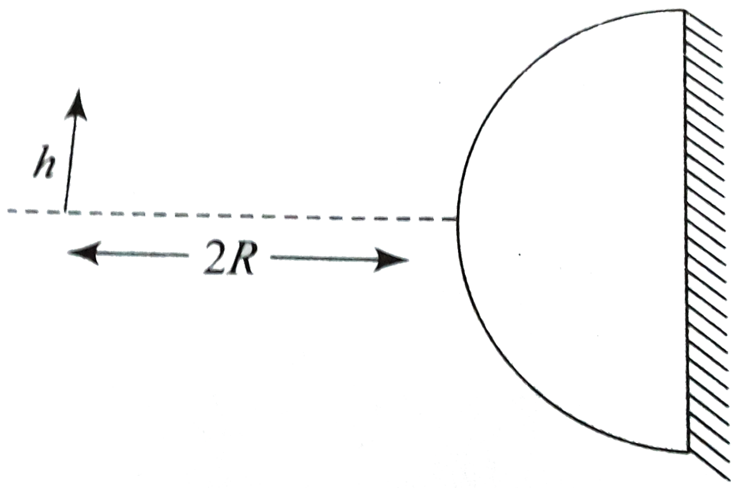
LECTURE SHEET (EXERCISE-III (LEVEL-I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS))

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



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

B. on the object itself

C. at hemisphere surface

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

Answer: B

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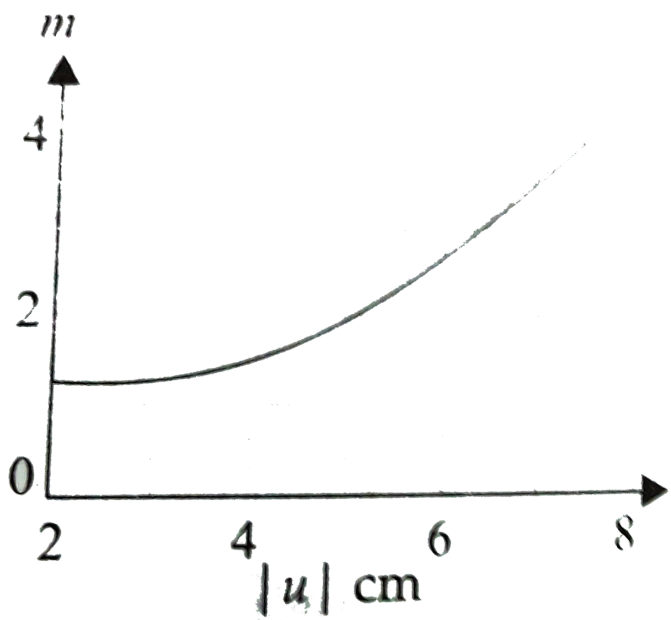
2. An object kept on the principal axis and infront of a spherical mirror, is moved along the axis itself. Its lateral magnification m is measured, and plotted versus object distance $|u|$ for a range of u, as shown in figure. The magnification of the object when it is placed at a distance 20cm in front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



A. -1

B. 1

C. 8

D. 20

Answer: A

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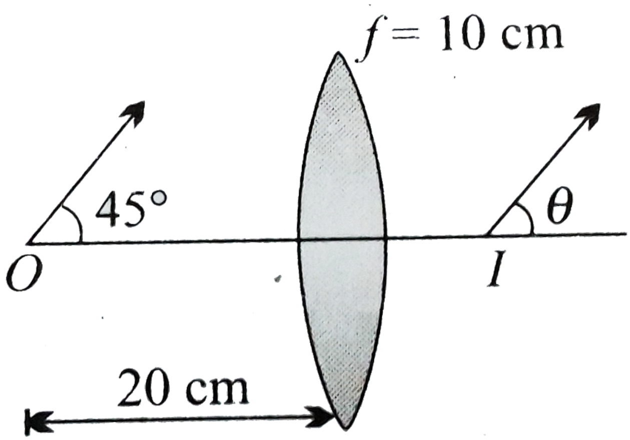
3. An object starts moviing at an angle of 45° with the principal axis as shown in figure. In front of a biconvex lens of focal length $+10cm$. If θ denotes the angle at which image starts to move with principal axis, then



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

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

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

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

Answer: D

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

A. u

B. μu

C. u / μ

D. zero

Answer: B

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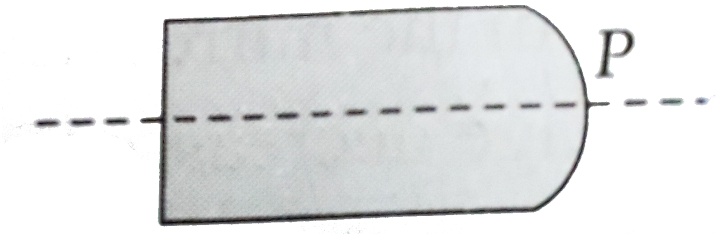
5. Find the distance of object placed in the slab of refractive index μ from point P of the curved surface of radius R so that image is formed at infinity:



A. $\frac{(\mu-1)r}{\mu}$

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

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

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

Answer: B

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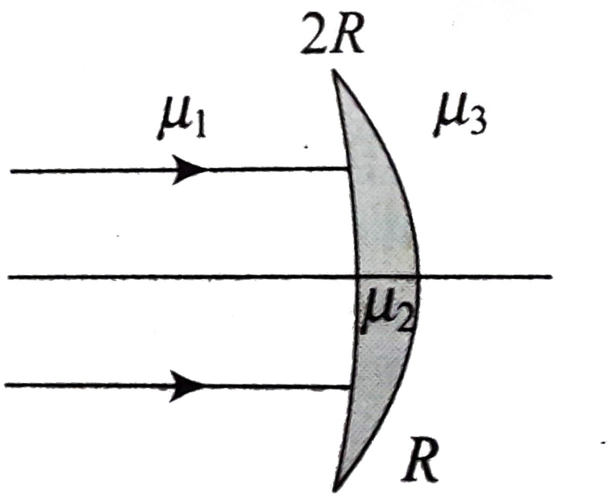
6. Figure, shows a concavo-convex lens μ_2. What is the condition on the refractive indiecs so the at the lens is diverging?



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

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

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

D. none of these

Answer: B

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

A. 3 diopter

B. 5 diopter

C. 2 diopter

D. 9 diopter

Answer: B

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LECTURE SHEET (EXERCISE-III (LEVEL-II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. A glass sphere $(\mu = 1.5)$ of radius 20 cm has a small air bubble 4 cm below its centre. The sphere is viewed from outside and along a vertical line through the bubble. The apparent depth of the bubble below the surface of sphere is (in cm)

A. 13.33

B. 26.67

C. 15

D. 30

Answer: B

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2. A ray enters a glass sphere of refractive index $\mu = \left(\sqrt{3}\right)$ at an angle of incidence of 60°, ray is reflected and refracted at the farther surface of the sphere. The angle between the reflected and refracted rays at this surface is

A. 90°

B. 60°

C. 70°

D. 40°

Answer: A

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

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

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

C. 90°

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

Answer: C

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4. Radius of curvature of first surface of double convex lens is three times that of the other. If focal length of the lens is 30 cm and refractive index of the lens is 3/2, then radius of curvature of the first surface is

A. 20cm

B. 40cm

C. 60cm

D. 80cm

Answer: C

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5. A thin equi-convex lens is made of glass of refractive index 1.5 and its length is $0.2m$. If it acts as a concave lens of $0.5m$ focal length when dipped in a liquid, the refractive index of the liquid is

A. $\frac{17}{8}$

B. $\frac{15}{8}$

C. $\frac{13}{8}$

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

Answer: B

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6. A thin double convex lens is cut into two equal pieces A and B by a plane containing principal axis. The piece B is further cut into two more pieces pieces C and D by another plane perpendicular to the principal axis. If the focal power of the original lens is P, then thos of A and C are

A. $P, \frac{P}{4}$

B. $P, \frac{P}{2}$

C. $\frac{P}{2}, 2P$

D. $\frac{P}{2}, \frac{P}{4}$

Answer: B

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7. Two plano concave lenses of glass of refractive index 1.5 have radii of curvature 20 cm and 30 cm respectively. They are placed in contact with the curved surface towards each other and the space between them is filled with a liquid of refractive index 5/2. The focal length of the combination is (in cm)

A. 6

B. -92

C. 108

D. 12

Answer: D

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8. The two surfaces of a biconvex lens has same radii of curvatures . This lens is made of glass of refractive index 1.5 and has a focal length of 10 cm in air. The lens is cut into two equal halves along a plane perpendicular to its principal axis to yield two plane - convex lenses. The two pieces are glued such that the convex surfaces touch each other. If this combination lens is immersed in water (refractive index $=\frac{4}{3}$), its focal length (in cm) is

A. 5

B. 10

C. 20

D. 40

Answer: D

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9. Two converging glass lenses A and B have focal lengths in the ratio $2:1$. The radius of curvature of first surface of lens A is 1/4 th of the second surface where as the radius of curvature of first surface of lens B is twice that of second surface. Then the ratio between the radii of the first surfaces of A and B is

A. $5:3$

B. $3:5$

C. $1:2$

D. $5:6$

Answer: D

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

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

B. $\frac{1}{4}$

C. $\frac{1}{3}$

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

Answer: C

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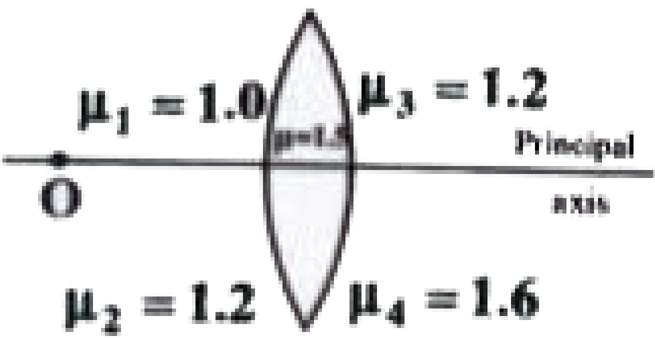
11. A convex lens of focal length 24 cm in air is surrounded by different mediums as show in the fig. A point object O is placed along the principle axis at a distance 30 cm from the lens. Find the number and position of the images formed.



A. 1 image, at infinity and 4 cm

B. 2 images at infinity and 960/19cm

C. 2 image both at infinity

D. 4 images, all at infinity

Answer: B

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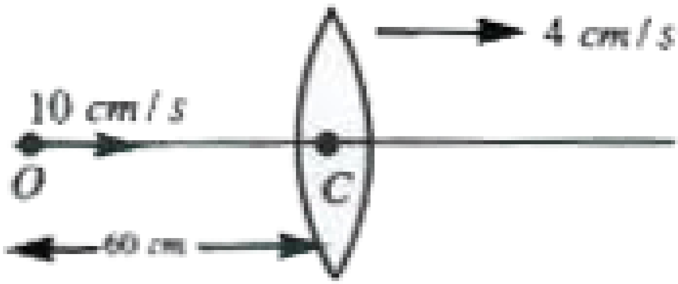
12. A point object O approaches a biconvex lens of focal length 40 cm along its optic axis with a speed of 10 m/s while the later receeds away from the former with a speed of 4 cm/s. Find the speed and direction of motion of the image when the object is at a distance of 60 cm from the lens.



A. 10 cm/s, leftwards

B. 10 cm/s, right wards

C. 28 cm/s rightwards

D. 28 cm/s leftwards

Answer: C

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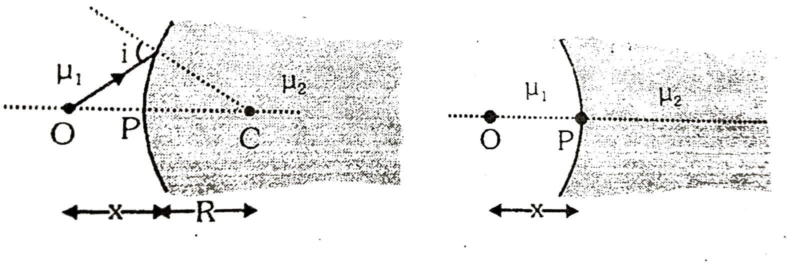
LECTURE SHEET (EXERCISE-III (LEVEL-II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS))

1. A curved surface of radius R separates two medium of refractive indices μ_1 and μ_2 as shown in figures A and B .



Choose the correct statement(s) related to the virtual image formed by object O placed at a distance x, as shown in figure

A. Virtual image is formed for any position of O if $\mu_2 < \mu_1$

B. Virtual image can be formed if x gt R and $\mu_2 > \mu_1$

C. Virtual image is formed if x lt R and $\mu_2 > \mu_1$

D. none of these

Answer: A::B

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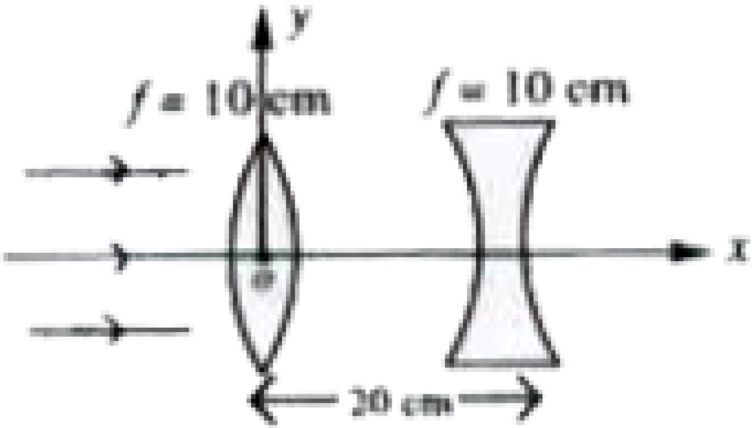
LECTURE SHEET (EXERCISE-III (LEVEL-II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS))

1. A convex lens of focal length 10 cm and a concave lens of same focal length in value are placed co-axially at a separation of 20 cm as shown in figure. A point object is at infinity on the principal axis. Take the optic center of convex lens as origin of co ordinate system and the principal axis as x-axis as shown in figure.



The co-ordinates of the image formed after refraction through both the lenses is

A. (10 cm, 0)

B. (25 cm, 0)

C. (-5 cm, 0)

D. (15 cm, 0)

Answer: D

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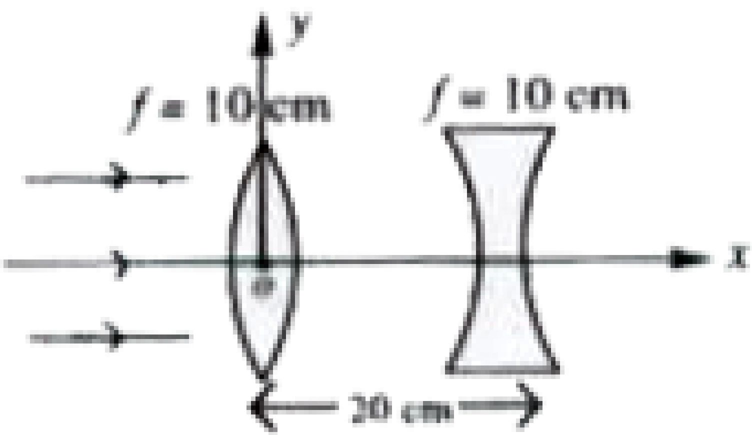
2. A convex lens of focal length 10 cm and a concave lens of same focal length in value are placed co-axially at a separation of 20 cm as shown in figure. A point object is at infinity on the principal axis. Take the optic center of convex lens as origin of co ordinate system and the principal axis as x-axis as shown in figure.



The co-ordinates of the image formed after refraction through both the lenses is

A. (15 cm, -0.25 cm)

B. (10 cm, +0.25 cm)

C. (25 cm, -0.5 cm)

D. (15 cm, +0.5 cm)

Answer: A

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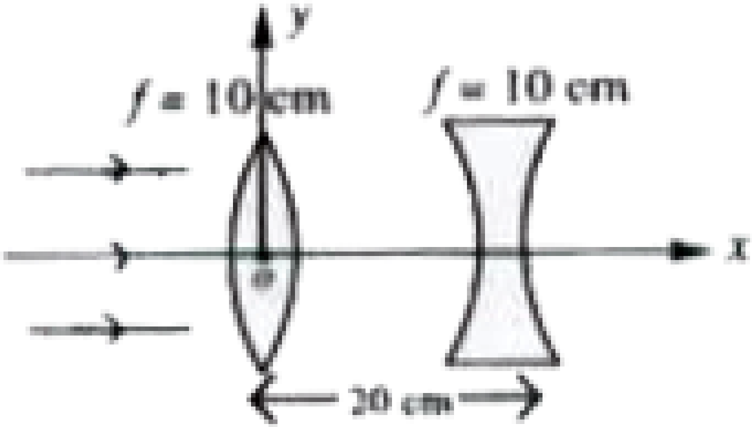
3. A convex lens of focal length 10 cm and a concave lens of same focal length in value are placed co-axially at a separation of 20 cm as shown in figure. A point object is at infinity on the principal axis. Take the optic center of convex lens as origin of co ordinate system and the principal axis as x-axis as shown in figure.



The co-ordinates of the image formed after refraction through both the lenses is

A. 10 cm/s along positive x-axis

B. 6.75 cm/s along negative x-axis

C. 8 cm/s along negative x-axis

D. 8 cm/s along positive x-axis

Answer: B

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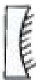
LECTURE SHEET (EXERCISE-III (LEVEL-II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS))

1. Thin lenses made of materials $\mu = 1.5$ with which are silvered at one surface are given in column I and their focal powers are given is column-II, Radius of curvature of each spherical surface is R. Match the two columns.

COLUMN -I	COLUMN -II
A) 	p) $-\frac{3}{R}$
B) 	q) $\frac{1}{R}$
C) 	r) $\frac{4}{R}$
D) 	s) $\frac{2}{R}$

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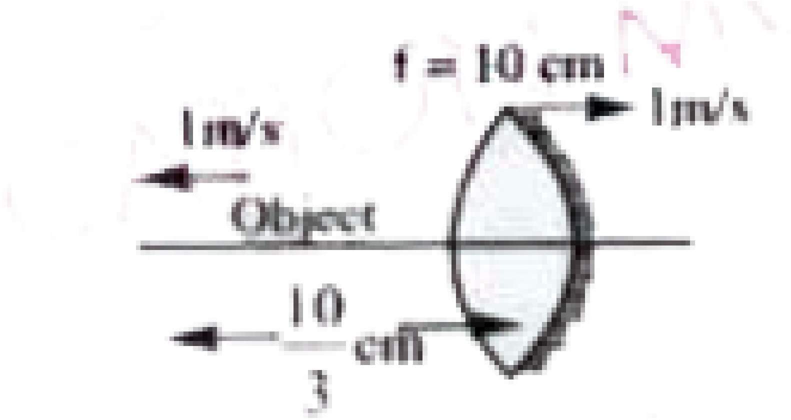
LECTURE SHEET (EXERCISE-III (LEVEL-II (ADVANCED) INTEGER TYPE QUESTIONS))

1. One of the surfaces of a biconvex lens of a focal length 10 cm is silvered as shown in figure. Radius of curvature of silvered surface is 10 cm. At a given instant, if speed of object is 1m/s, then the speed of image at that instant is $(10 + \alpha)$ m/s. What will be the value of α? $(\mu = 1.5)$



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2. An object is kept at a distance of 4 cm form the first focus of a convex lens. A real image is formed at a distance of 9 cm from its second focus. What is the focal length of that lens is ________(in cm)

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PRACTICE SHEET (EXERICSE-I (LEVEL-I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. An infinitely long rod lies along the axis of a concave mirror of focal length f. The near end of the rod is distance $u > f$ from the mirror. Its image will have length

A. $\frac{uf}{u-f}$

B. $\frac{uf}{u+f}$

C. $\frac{f^2}{u+f}$

D. $\frac{f^2}{u-f}$

Answer: D

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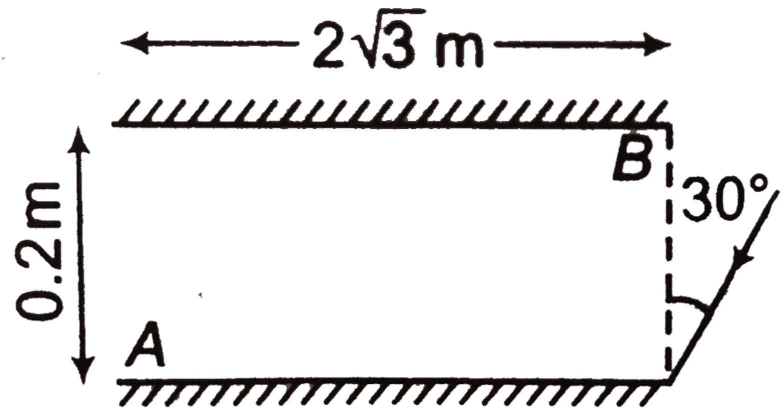
2. Two plane mirrors A and B are aligned parallel to each other as shown in the figure. A light ray is incident at an angle of 30° at a point just inside one end of A. The number of times the ray undergoes reflections (including the first one) before it emerges out is



A. 28

B. 30

C. 32

D. 34

Answer: B

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3. A short linear object of length b lies along the axis of a concave mirror of focal length fat a distance u from the pole of the mirror, what is the size of image?

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

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

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

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

Answer: D

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4. A concave mirror has a focal length 20 cm. The distance between the two positions of the object for which the image size is double of the object size is

A. 20cm

B. 40cm

C. 30cm

D. 60cm

Answer: A

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5. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The center of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The ling PQ cuts the surface at a point O, and $PO = OQ$. The distance PO is equal to

A. 5R

B. 3R

C. 2R

D. 1.5R

Answer: A

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6. Two plane mirrors are inclined at 70°. A ray incident on one mirror at incidence angle θ after reflection falls on the second mirror and is reflected from there parallel to the first mirror, The value of θ is

A. 50°

B. 45°

C. 30°

D. 55°

Answer: A

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7. A light ray strikes a horizontal plane mirror and gets deviated by $\pi/3$. By what angle should the mirror be tilted so that the reflected ray becomes vertical?

A. $\frac{\pi}{6}$

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

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

D. $\frac{\pi}{4}$

Answer: A

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8. A narrow beam of light after reflection by a plane mirror falls on a scale at a distance 100 cm from the mirror. When the mirror is rotated a little, the light spot moves through 2 cm. The angle through which the mirror is rotated is

A. 0.02 rad

B. 0.01 rad

C. 200 rad

D. $\frac{0.01}{180}\pi rad$

Answer: B

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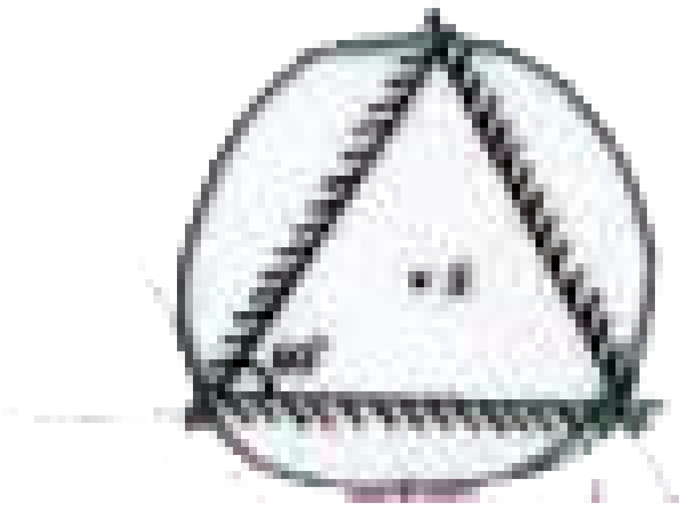
9. Three identical plane mirrora AB, BC, AC are arranged as shown in the figure. Find the total number of images of a point objectS formed by the three mirrors. (S is at the centre of the system)



A. 18

B. 12

C. 5

D. infinity

Answer: D

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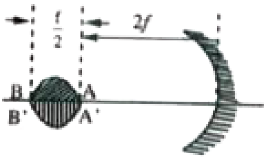
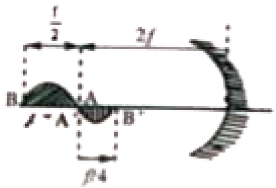
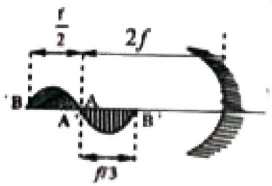
10. AB is the semi circular object of diameter (f/2) where f is the focal length, placed on the principal axis of a concave mirror with point A at the centre of curvature. A'B' is the image formed . The correct option is (Assume diameter of the object is along principal axis)



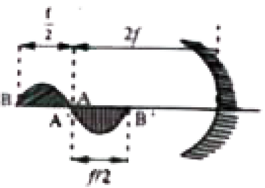
A.



B.



C.



D.

Answer: C

Watch Video Solution

11. Two plane mirrors are placed parallel to each other at a distance L apart. A point object O placed between them, at a distance $L/3$ from one mirror. Both mirrors form multiple image. The distance between any two images cannot be

A. 3L/2

B. 2L/3

C. 2L

D. none

Answer: A

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PRACTICE SHEET (EXERICSE-I (LEVEL-II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. A clock fixed on a wall shows time 04:25:37. What time will its image in a plane mirror hanging on an opposite vertical wall show?

A. $07:43:32$

B. $07:43:32$

C. $07:34:23$

D. $43:27:36$

Answer: C

Watch Video Solution

2. A man of height 'h' is walking away from a street lamp with a constant speed 'v'. The height of the street lamp is 3h. The rate at which the length of the man's shadow is increasing when he is at a distance 10 h from the base of the street lamp is

A. v/2

B. v/3

C. 2v

D. v/6

Answer: A

Watch Video Solution

3. A point source of light is 60 cm from a screen and is kept at the focus of a concave mirror which reflects light on the screen. The focal length of the mirror is 20 cm. The ratio of average intensities of the illumination on the screen when the mirror is present and when the mirror is removed is:

A. $36:1$

B. $37:1$

C. $49:1$

D. $10:1$

Answer: D

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4. A police inspector is chasing a thief who is running away in a car with a speed 3m/s. The speed of police jeep is 12 m/s. Then the speed of image of police jeep as seen by thief in the rear view mirror when the police jeep is at a distance of 30 m is (value of focal length of the rear view mirror is 15 m)

A. 2m/s

B. 3m/s

C. 4m/s

D. 1m/s

Answer: D

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

A. 15cm

B. 20cm

C. 10cm

D. 40cm

Answer: C

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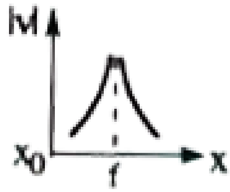
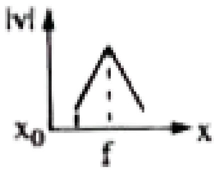
6. A point source is situated at a distance $x < f$ from the pole of the concave mirror of focal length f. At time t=0 the point source starts moving away from the mirror with constant velocity. Which of the graphs below represents best, variation of image distance |v| with distance x between the pole of mirror and the source.

A. 

B. 

C. 

D. 

Answer: A

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

A. 10cm

B. 30cm

C. 15cm

D. 20cm

Answer: D

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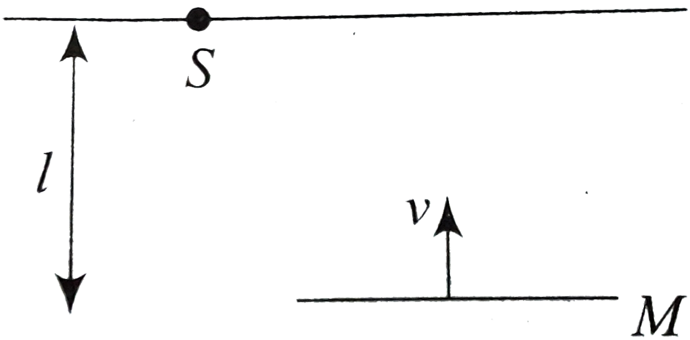
PRACTICE SHEET (EXERICSE-I (LEVEL-II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS))

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

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



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

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

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

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

Answer: B::D

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2. Which of the following are correct about spherical mirrors

A. concave mirror forms virtual image of real object some times

B. convex mirror forms real image of virtual object some times

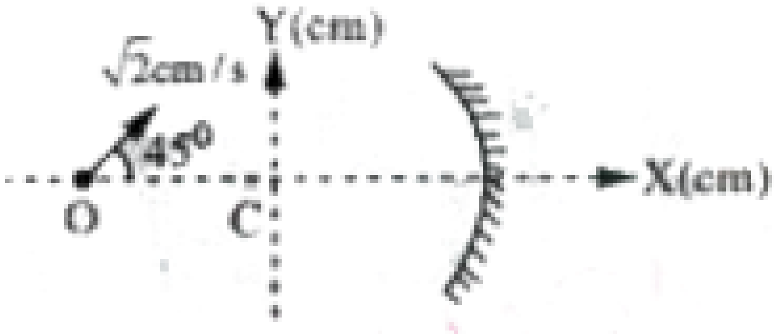
C. convex mirror forms real image of virtual object always

D. convex mirror virtual image of real object always

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

Watch Video Solution

PRACTICE SHEET (EXERICSE-I (LEVEL-II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS))

1. 

A concave mirror of radius of curvature 10 cm whose principal axis co incides with x-axis and its centreof curvature at origin. A point object O with its initial co-ordinates (-2,0) is moving with a constant speed $\sqrt{2}$ cm/sec making an angle 45° with the x-axis as shown figure.

The image co -ordinates at tiem t=0

A. $\left(\frac{10}{7}, 0\right)$

B. $\left(\frac{60}{7}, 0\right)$

C. $\left(-\frac{60}{7}, 0\right)$

D. $\left(-\frac{10}{7}, 0\right)$

Answer: A

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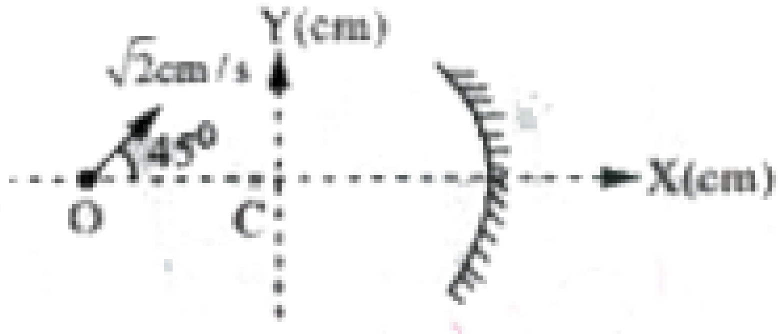
2. 

A concave mirror of radius of curvature 10 cm whose principal axis co incides with x-axis and its centreof curvature at origin. A point object O with its initial co-ordinates (-2,0) is moving with a constant speed $\sqrt{2}$ cm/sec making an angle 45° with the x-axis as shown figure.

The image co -ordinates at tiem t=0

A. zero

B. 0.5cm/s

C. 1cm/s

D. 2cm/s

Answer: D

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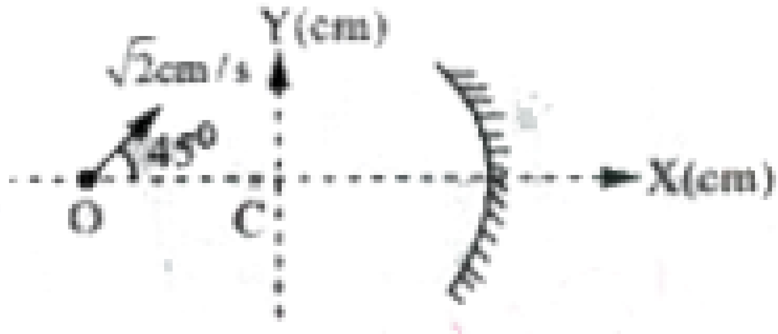
3. 

A concave mirror of radius of curvature 10 cm whose principal axis co incides with x-axis and its centreof curvature at origin. A point object O with its initial co-ordinates (-2,0) is moving with a constant speed $\sqrt{2}$ cm/sec making an angle 45° with the x-axis as shown figure.

The image co -ordinates at tiem t=0

A. 1s

B. 2s

C. 3s

D. 4s

Answer: B

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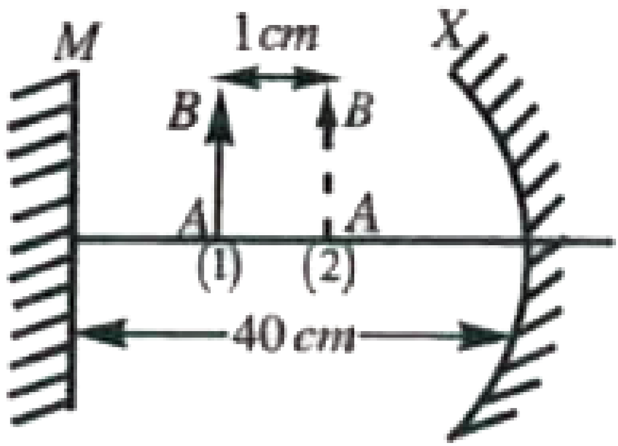
4. A plane mirror M and a concave mirror X are kept at a seperation of 40cm with their reflecting faces facing each other as shown in figure. An object AB is kept perpendicular to the principal axis in position (1). Considering successive reflections first at mirror X and then at M a real image is formed infront of M at a normal distance 8 cm form it. If the object is mived to new position (2), the real image is formed atg 20cm from M with the reflections as described earlier.



Focal length of mirror X is

A. 11cm

B. 12cm

C. 14cm

D. 15cm

Answer: D

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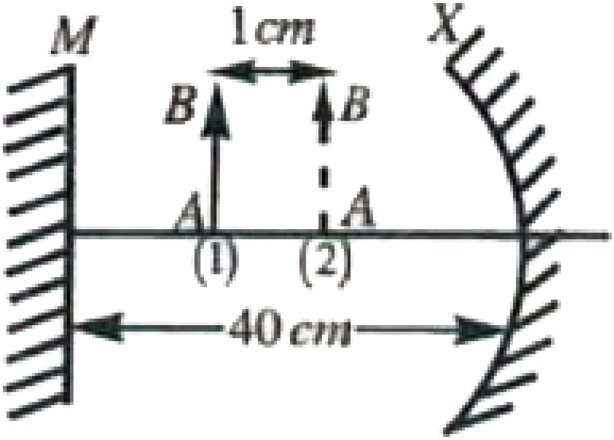
5. A plane mirror M and a concave mirror X are kept at a seperation of 40cm with their reflecting faces facing each other as shown in figure. An object AB is kept perpendicular to the principal axis in position (1). Considering successive reflections first at mirror X and then at M a real image is formed infront of M at a normal distance 8 cm form it. If the object is mived to new position (2), the real image is formed atg 20cm from M with the reflections as described earlier.



Focal length of mirror X is

A. $-18cm$

B. $-12cm$

C. $-6cm$

D. $-24cm$

Answer: B

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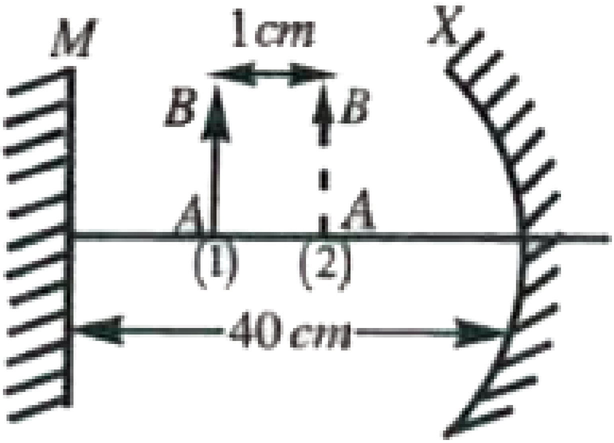
6. A plane mirror M and a concave mirror X are kept at a seperation of 40cm with their reflecting faces facing each other as shown in figure. An object AB is kept perpendicular to the principal axis in position (1). Considering successive reflections first at mirror X and then at M a real image is formed infront of M at a normal distance 8 cm form it. If the object is mived to new position (2), the real image is formed atg 20cm from M with the reflections as described earlier.



Focal length of mirror X is

A. at distance of $\frac{80}{3}$ cm from the pole of mirror X and in front of its reflecting surface.

B. at a distance of $\frac{40}{3}$ cm from the pole of mirror X and in front of its reflecting surface.

C. mid point between X and Y

D. at any position between X and pole

Answer: A

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PRACTICE SHEET (EXERICSE-I (LEVEL-II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS))

1. Match the object natures in column I with the natures of their images formed by a plane mirror in column II.

Column - I	Column - II
A) Linear real object with its length parallel to the plane of mirror	p) inverted
B) Linear real object with its length perpendicular to the plane of mirror	q) erected
C) Linear virtual object with length parallel to the plane of mirror	r) real
D) Linear virtual object with length perpendicular to the plane of mirror	s) virtual

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PRACTICE SHEET (EXERICSE-I (LEVEL-II (ADVANCED) INTEGER TYPE QUESTIONS))

1. Two identical point particle A and B are placed infront of a concave mirror of focal length 20 cm at distances 10 cm and 30 cm respectively. The particles oscillate perpendicular to the principal axis, such that the displacement equation for both the particles is given by $Y_A = Y_B = 0.1 \sin(\pi t)$ cm. Find the maximum separation between the images of A and B measured perpendicular to the principal axis in mm.

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2. A 4 cm object is placed perpendicular to the principal axis of a convex mirror of focal length 7.5 cm. The distance of the image from the mirror if it is 0.6 cm in size is 51/x where x is

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PRACTICE SHEET (EXERICSE-II (LEVEL-I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. The minimum deviation produced by a hollow prism filled with a certain liquid to be 30°. The light ray is also found to be refracted at angle 30°. The refractive index of the liquid is

A. $\sqrt{2}$

B. $\sqrt{3}$

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

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

Answer: B

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2. For a prism of refractive index, 1.732, the angle of minimum deviation is equal to the angle of prism. Then the angle of the prism is

A. 30°

B. 45°

C. 60°

D. 80°

Answer: B

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3. When a glass prism of refracting angle 60° is immersed in a liquid its angle of minimum deviation is 30°. The critical angle of glass with respect to the liquid medium is

A. 30°

B. 45°

C. 60°

D. 50°

Answer: B

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

A. 2 sin A

B. 2 cos A

C. 1/2 cos A

D. tan A

Answer: A

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5. A thin plano - convex lens acts like a concave mirror of focal length 0.2 m, when silvered on its plane surface. The refractive index of the material of the lens is 1.5. The radius of curvature of the convex surface of the lens will be

A. 0.4

B. 0.2m

C. 0.1m

D. 0.75

Answer: D

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6. At what distance from a convex mirror of focal length 2.5 m should a body stand so that his image has a height equal to half the original height ? The height of object is perpendicular to the principal axis .

A. 2.5 m from the mirror

B. 5 m from the mirror

C. 7.5 m from the mirror

D. 10 m from the mirror

Answer: A

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7. An object of length 10 cm is placed at right angles to the principal axis of a mirror of radius of curvature 60 cm such that its image is virtual, erect and has a length 6 cm. What kind of mirror it is and also determine the position of the object ?

A. Concave 20 cm from the mirror

B. Convex 20 m from the mirror

C. Concave 10 cm from the mirror

D. Convex 20 cm from the mirror

Answer: D

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8. A plane mirror is placed 22.5 cm in front of the concave mirror of focal length 10 cm. Find where an object a can be placed between the two mirrors, so that the first image in both the mirrors coincides.

A. 15 cm from the concave mirror

B. 15 cm from the plane mirror

C. 10 cm from the concave mirror

D. 10 cm from the plane mirror

Answer: A

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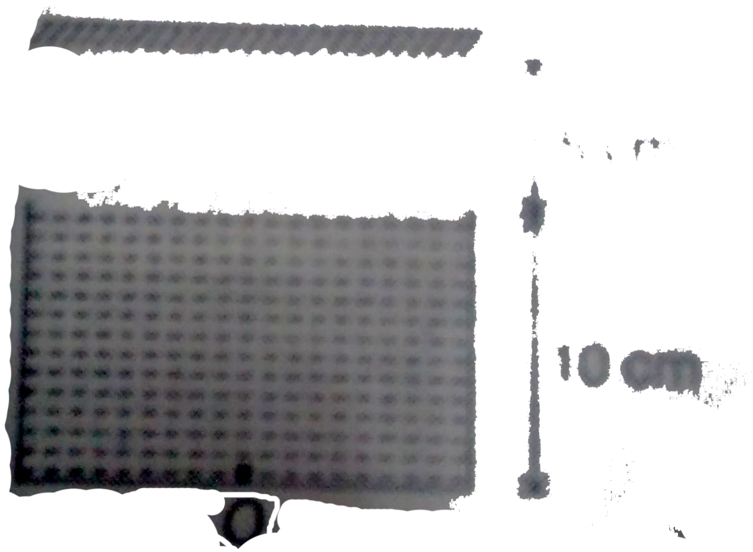
PRACTICE SHEET (EXERICSE-II (LEVEL-II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS))

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



A. 15cm

B. 12.5cm

C. 7.5cm

D. 10cm

Answer: B

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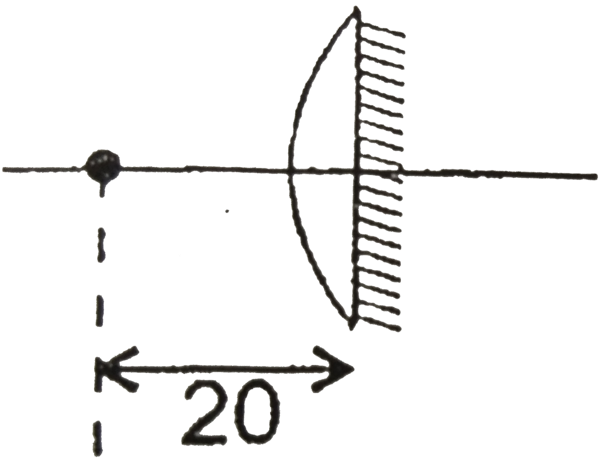
2. A point object is placed at a distance of $20cm$ from a thin plano-concex lens of focal length $15cm$. The plane surface of the lens is now silvered. The image created by the is at :



A. 12 cm to the left of lens system

B. 20 cm to the right of lens system

C. 12 cm to the right of lens system

D. 20 cm to the left of lens system

Answer: A

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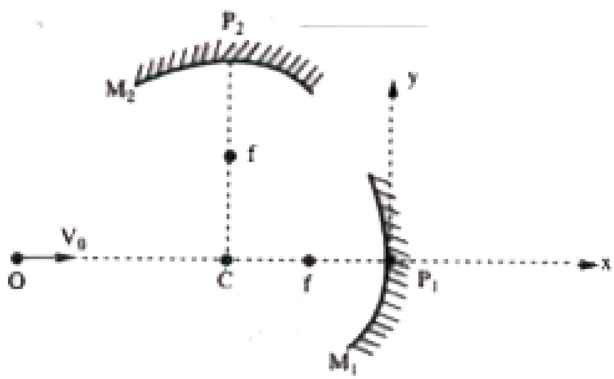
PRACTICE SHEET (EXERICSE-II (LEVEL-II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS))

1. Two identical concave mirrors M_1 & M_2 with principal axes perpendicular to each other and pole P_1 of mirro M_1 at origin is as shown. Let f be the focal length and C be the common centre of curvature for both mirrors. A point object O is at $(-5f, 0)$ and is moving with a velocity $\overrightarrow{C} = v_0 \hat{i}$ m/s.



Consider rays incident on mirror M_2 the co-ordinates of the final imasge formed is

A. at (-x,0) and moving along x - axis

B. at (-y,0) and moving along x - axis

C. at (+x, 0) and moving along x - axis

D. at (-y,0) and moving along y - axis

Answer: B

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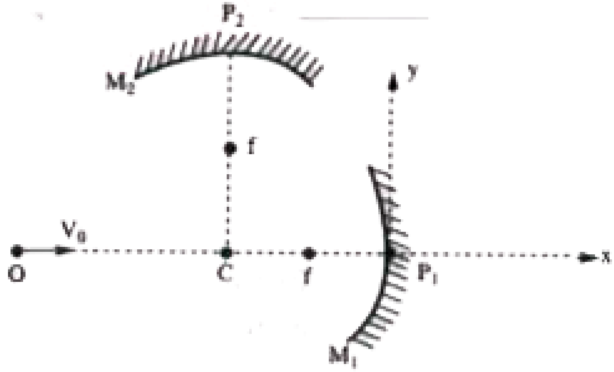
2. Two identical concave mirrors M_1 & M_2 with principal axes perpendicular to each other and pole P_1 of mirro M_1 at origin is as shown. Let f be the focal length and C be the common centre of curvature for both mirrors. A point object O is at $(-5f, 0)$ and is moving with a velocity $\overrightarrow{C} = v_0 \hat{i}$ m/s.



Consider rays incident on mirror M_2 the co-ordinates of the final imasge formed is

A. at position (-x, 0) and moving along x -axis

B. at position (+x,0) and moving along x- axis

C. at position (-x, 0) and moving along y - axis

D. at position (+y,0) and moving along y - axis

Answer: A

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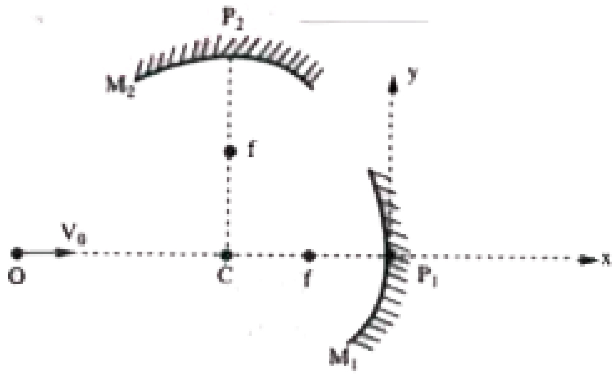
3. Two identical concave mirrors M_1 & M_2 with principal axes perpendicular to each other and pole P_1 of mirro M_1 at origin is as shown. Let f be the focal length and C be the common centre of curvature for both mirrors. A point object O is at $(-5f, 0)$ and is moving with a velocity $\vec{C} = v_0\hat{i}$ m/s.



Consider rays incident on mirror M_2 the co-ordinates of the final imasge formed is

A. real

B. virtual

C. may be real or virtual

D. all of these

Answer: A

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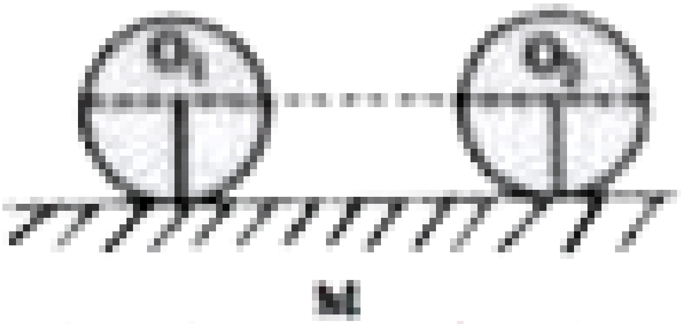
4. A cylindrical glass rod of raidus 0.1 m and $Ri\sqrt{3}$ lies on a horizontal plane mirror. A horizontal ray of light goind perpendicular to the axis of rod is incident on it



As what height from plane mirror should the ray be incident so that it emerges from the rod at a height 0.1 m above the mirror.

A. $18\frac{2}{3}cm$

B. $15\frac{1}{3}cm$

C. $6\frac{2}{3}cm$

D. $9\frac{1}{3}cm$

Answer: A

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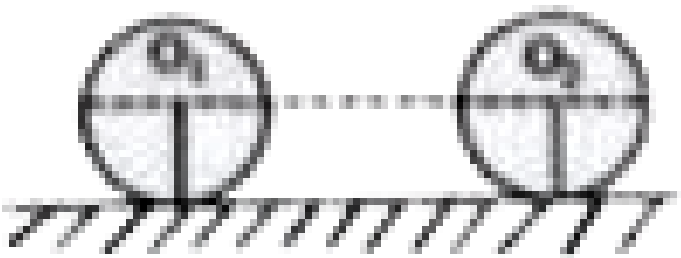
5. A cylindrical glass rod of raidus 0.1 m and $Ri\sqrt{3}$ lies on a horizontal plane mirror. A horizontal ray of light goind perpendicular to the axis of rod is incident on it



M

As what height from plane mirror should the ray be incident so that it emerges from the rod at a height 0.1 m above the mirror.

A. 21.5cm

B. 31.5cm

C. 11.5cm

D. 41.5cm

Answer: B

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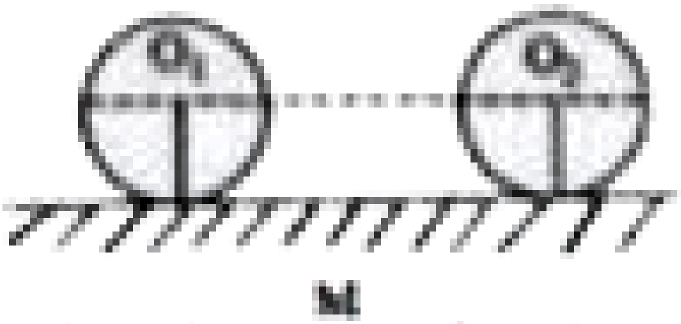
6. A cylindrical glass rod of raidus 0.1 m and $Ri\sqrt{3}$ lies on a horizontal plane mirror. A horizontal ray of light goind perpendicular to the axis of rod is incident on it



As what height from plane mirror should the ray be incident so that it emerges from the rod at a height 0.1 m above the mirror.

A. 30°

B. 45°

C. 75°

D. 60°

Answer: D

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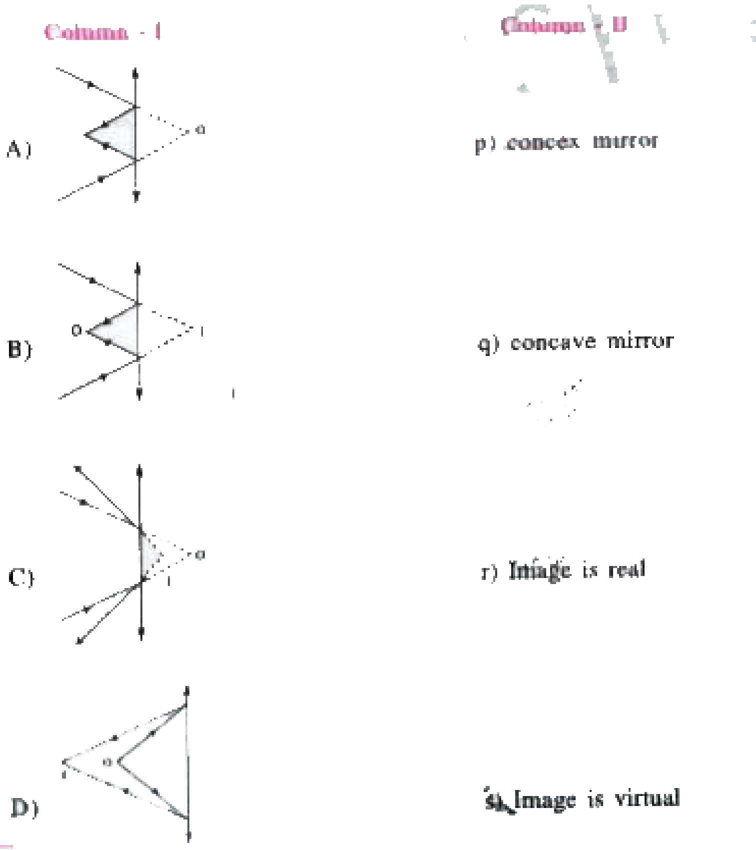
PRACTICE SHEET (EXERICSE-II (LEVEL-II (ADVANCED) MATRIX MATCHING TYPE QUESTIONS))

1. Column I contains the path traced by light rays abnd the positions of object and image, with a reflecting spherical mirror. Choose the possible for type of mirror and the nature of image rom column II to each case in column -I



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PRACTICE SHEET (EXERICSE-II (LEVEL-II (ADVANCED) INTEGER TYPE QUESTIONS))

1. Two plane mirrors are making an angle of 60° to each other. A light ray falls on one of the mirrors. The light ray is incident parallel to angular bisector of mirrors. How many reflection does the light ray undergo?

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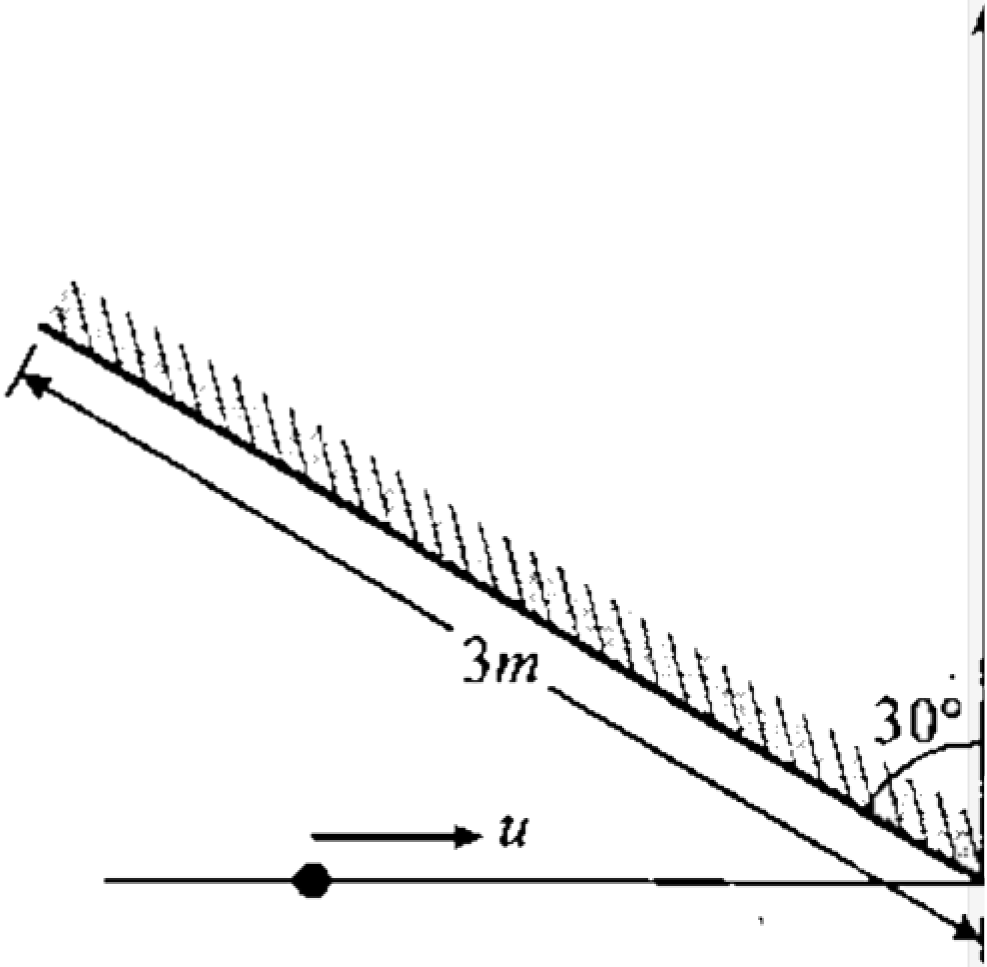
2. A plane mirror is placed with its plane at an angle 30∘ with the y-axis. Plane of the mirror is perpendicular to the xy-plane and the length of the mirror is 3m. An insect moves along x-axis starting from a distant point, with speed 2 cm/s. The duration of the time for which the insect can see its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



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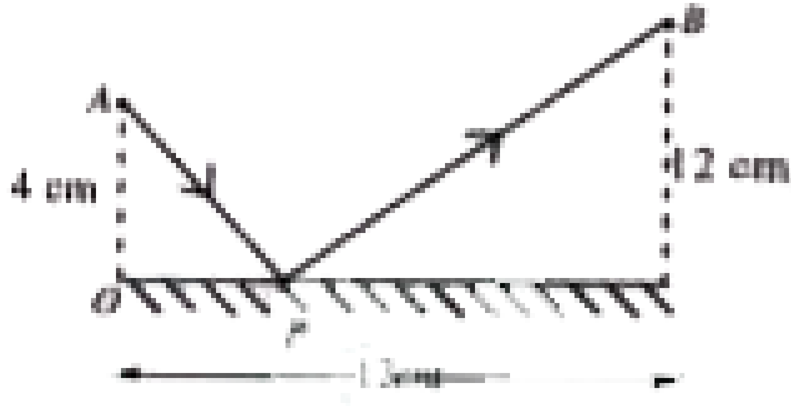
3. A ray of light is to travel from point A to point B in figure in the shortest possible time after reflecting from P. Then OP is ....cm.



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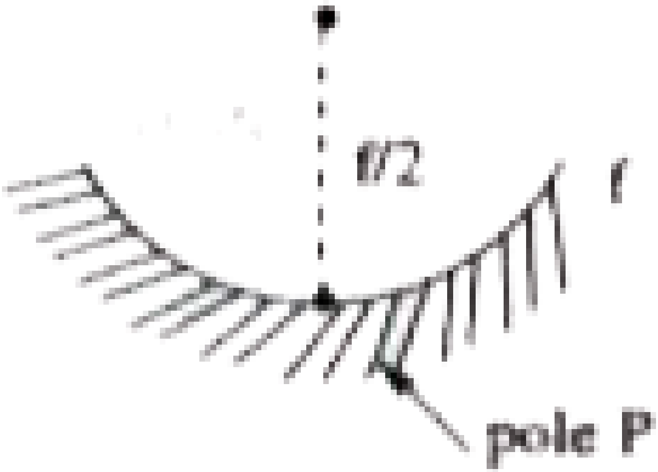
4. A particle is dropped along the axis from a height f/2 on a concave mirror of focal length f as shown in the figure. The acceleration due to gravity is g. Then the maximum speed of the image is given by $\frac{3}{4}\sqrt{xfg}$

where x=...........



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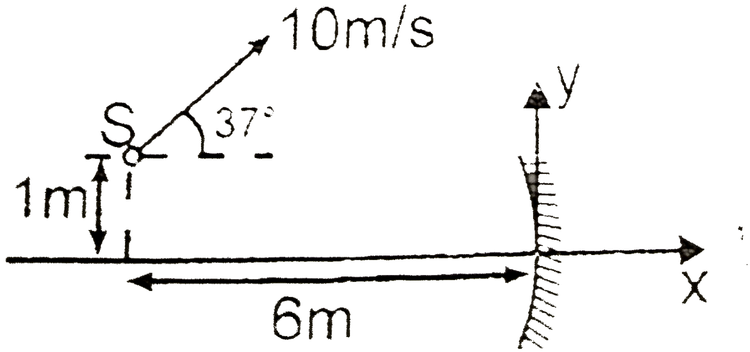
5. A point sourcs S is moving with a speed of $10m/s$ in $x-y$ plane as shown in the figure. The radius of curvature of the concave mirror is $4m$.

Determine the velocity vector of the image formed by paraxial rays.



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PRACTICE SHEET (EXERICSE-III (LEVEL-I (MAIN))

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

A. 20cm

B. 10cm

C. 15cm

D. 30cm

Answer: B

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

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

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

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

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

Answer: C

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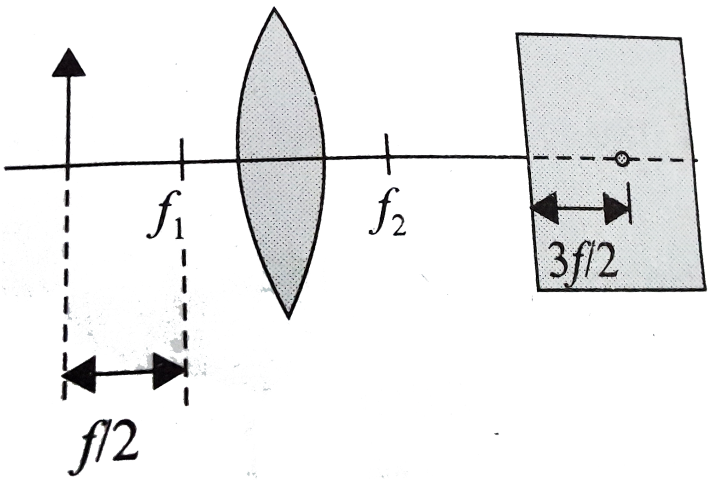
3. An object is placed at $f/2$ away from first focus of a convex lens where f is the focal length of the lens. Its image is formed at a distance $3f/2$ in a slab of refractive index $3/2$, from the face of the slab facing the lens. Find the distance of this face of the slab from the second focus of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



A. f/2

B. 3f/2

C. 2f

D. f

Answer: D

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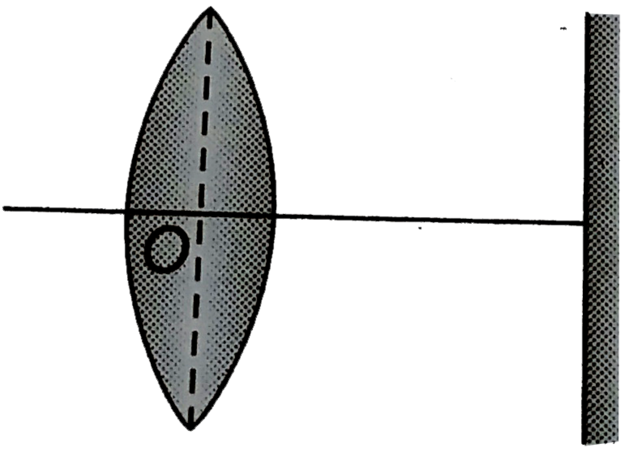

4.

The distance between a convex lens and a plane mirror is 10 cm. The parallel rays incident on the convex lens after reflection from the mirror forms image at the optical centre of the lens. Focal length of lens will be

A. 10cm

B. 20cm

C. 30cm

D. cannot be determined

Answer: B

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5. A small fish 0.4 m below the surface of a lake is viewed through a simple converging lens of focal length 3 m. The lens is kept at 0.2 m above the water surface such that fish lies on the optical axis of the lens. The image of the fish seen by observer will be at $\left(\mu_{\text{water}}=\frac{4}{3}\right)$

A. A distance of 0.2m from the water surface

B. A distance of 0.6m from the water surface

C. A distance of 0.3m from the water surface

D. The same location of fish

Answer: D

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6. A ray of light falls on the surface of a spherical glass paper weight making an angle α with the normal and is refracted in the medium at an angle β. The angle of deviation of the emergent ray from the direction of the incident ray is

A. $(\alpha - \beta)$

B. $2(\alpha - \beta)$

C. $(\alpha - \beta) / 2$

D. $(\beta - \alpha)$

Answer: B

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PRACTICE SHEET (EXERICSE-III (LEVEL-II (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS))

1. The focal length of a convex lens of R.I. 1.5 is f when it is placed inair. When it is immersed in a liquid it behaves as a converging lens its focal length becomes $xf(x > 1)$. The refractive index of the liquid.

A. $> 3/2$

B. $< 3/2$ and > 1

C. $< 3/2$

D. $= 3/2$

Answer: B

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2. A thin equi-convex lens is made of glass of refractive index 1.5 and its length is $0.2m$. If it acts as a concave lens of $0.5m$ focal length when dipped in a liquid, the refractive index of the liquid is

A. $1.2 \times 10^8 ms^{-1}$

B. $1.6 \times 10^8 ms^{-1}$

C. $1.8 \times 10^8 ms^{-1}$

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

Answer: B

Watch Video Solution

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

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

B. $(f, f,)$

C. $(4f, 4f)$

D. $(2f, 2f)$

Answer: D

Watch Video Solution

4. A mark on the surface of a glass spehre $(\mu = 1.5)$ is viewed from a diametrically opposite position. It appears to be at a distance 10 cm from its actual position. The radius of the sphere is

A. 5cm

B. 10cm

C. 15cm

D. 25cm

Answer: A

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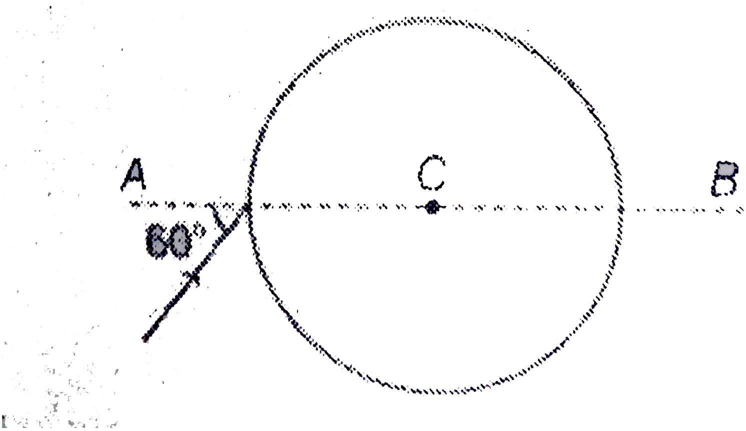
5. A ray of light falls on a transparent sphere with centre at C as shown in figure. The ray emerges from the sphere parallel to line AB. The refractive index of the sphere is



A. $\sqrt{2}$

B. $\sqrt{3}$

C. $3/2$

D. $1/2$

Answer: A

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

A. 3 cm below the surface

B. 5 cm below the surface

C. 8 cm below the surface

D. 10 cm below the surface

Answer: A

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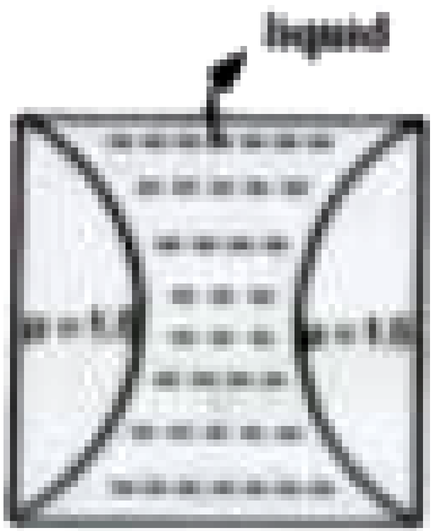
7. The effective focal length of the lens combination shown in figure is -60 cm. The radius of curvature of the curved surfaces of the plano-convex lenses are 12 cm each and refractive index of the material of the lens is 1.5. The refractive index of the liquid is



A. 1.33

B. 1.42

C. 1.53

D. 1.6

Answer: D

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

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

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

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

D. $\dfrac{R}{\mu_1 + \mu_2}$

Answer: A

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9. Two plano-convex lens of glass of refractive index 1.5 have radii of curvature 20cm and 30cm. They are placed in contact with curved surface towards each other and the space between them is filled with a liquid of refractive index $\frac{4}{3}$. Find the focal length of the system.

A. $-50cm$

B. 95cm

C. $-72cm$

D. 40cm

Answer: C

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10. An equiconvex lens of focal length20 cm is cut into two equal halves perpendicular to the principal axis and kept at a separation of 10 cm co-axially. What ils the focal length of the each part is?

A. 35cm

B. 20cm

C. 22.9cm

D. 15cm

Answer: C

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PRACTICE SHEET (EXERICSE-III (LEVEL-II (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS))

1. A thin equiconvex spherical glass lens $(\mu = 3/2)$ of radius of curvature 30 cm is placed on the x-axis with its optical centre at x=40 cm and principal axis coinciding with the x-axis. A light ray given by the equation $39y = -x + 1$ (x and y are is incident on the lens, in the direction of positive (in cm) X-axis. Then choose the correct alternative(s)

A. The equation of refracted ray is 3y = x + 1

B. The equation of refracted ray is 130y = x - 170

C. The equation of refracted ray if space on right side of the lens is filled with a liquid of refractive index 4/3 is 390y + x + 350 = 0

D. The equation of refracted ray if space on right side of the lens is filled with a liquid of refractive index 4/3 is 390y - x + 350 = 0

Answer: B::C

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2. A biconvex thin lens is prepared from glass of refractive index $\mu_2 = \frac{3}{2}$. The two conducting surfaces have equal radii of 20 cm each. One of the the surface is silvered from outside to make it reflecting. It is placed in a medium of refractive index $\mu_1 = \frac{5}{3}$. It acts as a

A. Converging mirror

B. Diverging mirror

C. Concave mirror of focal length 12.5 cm

D. Convex mirror of focal length 12.5cm

Answer: A::C

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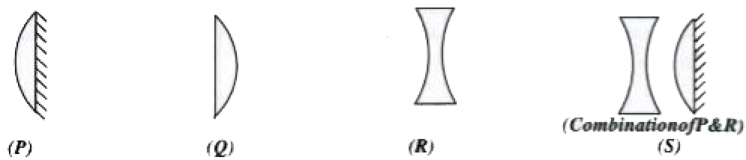
PRACTICE SHEET (EXERICSE-III (LEVEL-II (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS))

1. Three diagrams are given each has equal radial of curvature of the curved surfaces. All the lenses have refractive index $\mu = 1.5$.



The ratio of focal lengths of P,Q,R is

A. $1 : \ -2 : 1$

B. $-1 : 2 : 1$

C. $-2 : 1 : 1$

D. $1 : 2 : \ -1$

Answer: A

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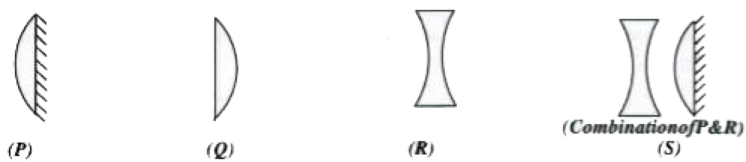
2. Three diagrams are given each has equal radial of curvature of the curved surfaces. All the lenses have refractive index $\mu = 1.5$.



The ratio of focal lengths of P,Q,R is

A. Convex mirror of focal length 40 cm

B. Plane mirror

C. Concave mirror of focal length 10 cm

D. None of these

Answer: C

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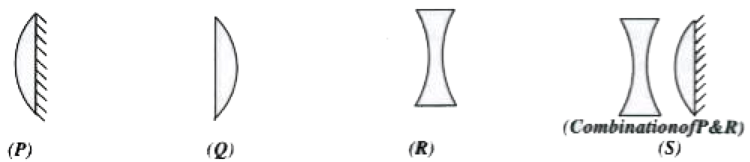
3. Three diagrams are given each has equal radial of curvature of the curved surfaces. All the lenses have refractive index $\mu = 1.5$.



The ratio of focal lengths of P,Q,R is

A. $1:2$

B. $2:1$

C. $1:1$

D. $3:2$

Answer: C

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PRACTICE SHEET (EXERICSE-III (LEVEL-II (ADVANCED) INTEGER TYPE QUESTIONS))

1. A small air bubble is situated at a distance of 3 cm from the center of a glass sphere of radius 9 cm. When viewed from the nearest side, the bubble appears to be at a distance of 5 cm from the surface. Its apparent distance when viewed from the farthest side is $n \times 5$ cm where n is?

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2. A thin biconvex lens of focal length 6.25 cm is made of material of refractive index 1.5. It is cut into two identical pieces perpendicular to its principal axis. One of the pieces is placed in water of refractive index $\frac{4}{3}$. The focal power of the piece immersed in water in diopter is

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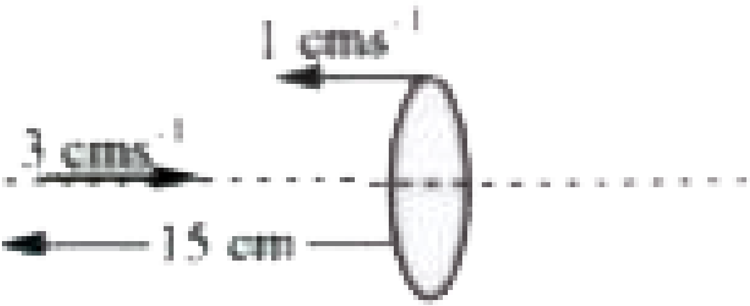
3. An object and a convex lens are approaching each other with speeds $3cm^{-1}$ and $1cm^{-1}$ along the principal axis a shown focal length of lens is 10 cm. If the speed of image relative to ground frame of reference is 5x.

Then find x.



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4. The focal length of a thin biconvex lens is 20cm. When an object is moved from a distance of 25cm in front of it to 50cm, the magnification of its image changes from m_{25} to m_{50}. The ration m_{25}/m_{50} is

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ADDITIONAL PRACTICE EXERCISE (LEVEL-I (MAIN) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A ray of light passes normally through a slab $(\mu = 1.5)$ of thickness t. If the speed of light in vacuum be C, then time taken by the ray to go across the slab will be

A. $\frac{t}{C}$

B. $\frac{3t}{2C}$

C. $\frac{2t}{3C}$

D. $\frac{4t}{9C}$

Answer: B

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2. A glass slab of thickness $4cm$ contains the same number of waves as $5cm$ of water, when both are traversed by the same monochromatic light. If the refractive index of water is $4/3$, then refractive index of glass is

A. $5/3$

B. $5/4$

C. $16/15$

D. $3/2$

Answer: A

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3. The wavelength of light in vacuum is 5000Å when it travels normally through diamond of thickness 1.0 mm find the number of waves of light in 1.0 mm of diamond. (Refractive index of diamond =2.417)

A. 4834 waves

B. 5834 waves

C. 4384 waves

D. 6834 waves

Answer: A

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4. A glass plate has a thicknes t and refractive index μ. The angle of incidence of a ray from air into the plate is equal to the critical angle for glass air intrerface. The lateral shift (perpendicular distance between incident ray and emergent ray) of ray is given by

A. $t\left(1-\frac{1}{\sqrt{\mu^2+1}}\right)$

B. $\mu\left(t-\frac{1}{\sqrt{\mu^2+1}}\right)$

C. $\frac{t}{\mu}\left(1-\frac{1}{\sqrt{\mu^2+1}}\right)$

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

Answer: C

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5. Wave length of light in denser mediumis 4000Å, it is grazing into a rarer medium. If critical angle for the pairof mediam is $\sin^{-1}\left(\frac{2}{3}\right)$ then

the wave length of light in rarer medium is

A. 4000Å

B. 2666Å

C. 8000Å

D. 6000Å

Answer: D

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6. A ray of light travels from an optically denser to rarer medium. The critical angle for the two media is C. The maximum possible deviation of the ray will be

A. $\pi - C$

B. $\frac{\pi}{2} + C$

C. 2C

D. $\pi - 2C$

Answer: B

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7. A point source of light is placed at the bottom of a water lake. If the area of the illuminated circle on the surface is equal to 3 times the square of the depth of the lake. The refractive index of water is

A. $\sqrt{\pi + 1}$

B. $\sqrt{\frac{\pi}{3} + 1}$

C. $\frac{\pi}{3} + 1$

D. $\frac{\pi}{4} + 1$

Answer: B

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8. The refractive index of the material of a double convex lens is 1.5 and its focal length is 5 cm. If the radii of curvature are equal, the value of the radius of curvature (in cms)is

A. 5

B. 6.5

C. 8

D. 9.5

Answer: A

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9. A double convex lens of refractive index 1.5 has radii of 20 cm. Incident rays of light parallel to the axis will come to converge at a distance from the lens is

A. 20cm

B. 10cm

C. 40cm

D. 30cm

Answer: A

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10. A diverging meniscus lens of radii of curvatures 25 cm and 50 cm has a refractive index 1.5. Its focal length is (in cm)

A. -50

B. -100

C. 100

D. 50

Answer: B

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11. A thin liquid convex lens is formed in glass. Refractive index of liquid is 4/3 and that of glass is 3/2. If f is the focal length of the liquid lens is air, its focal length and nature in the glass is

A. f, convex

B. f, concave

C. 2f, concave

D. 3f, concave

Answer: D

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12. The focal lengths of a lens are in the ratio 8:3 when it is immersed in two different liquids of refractive induces 1.6 and 1.2 respectively. The refractive index of the material of the lens is

A. 1.25

B. 1.5

C. 1.8

D. 2

Answer: D

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13. A double convex lens of focal length 30 cm is made of glass. When it is immersed in a liquid of refractive index 1.4, the focal length is found to be 126 cm. The critical angle between glass and the liquid is

A. $\sin^{-1}\left(\frac{3}{4}\right)$

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

C. $\sin^{-1}\left(\frac{7}{13}\right)$

D. $\sin^{-1}\left(\frac{7}{8}\right)$

Answer: D

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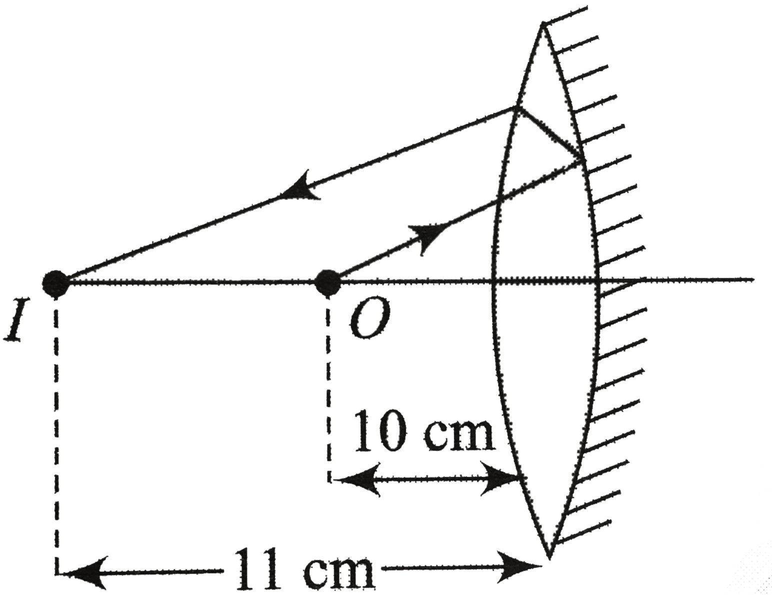
14. A pin is placed 10cm in front of a convex lens of focal length 20cm, made of a material having refractive index 1.5 . The surface of lens farther away from the pin is silvered and has a radius of curvature 22cm. Determine the position of the final image. Is the image real or virtual?



A. 10cm

B. 11cm

C. 12cm

D. 13cm

Answer: B

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15. A convex lens is in contact with a concave lens. The magnitude of the ration of their focal lengths is $2/3$. Their equivalent focal length is 30cm. What are their individual focal lengths?

A. -75 cm, 50 cm.

B. -10 cm, 15 cm

C. -50 cm, 75 cm

D. -15 cm, 10 cm

Answer: D

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16. A double convex lens is made of glass which has refractive inded 1.55 for voilet rays and 1.50 for red rays. If the focal length for violet rays is 20 cm, the focal length for red rays will be

A. 9cm

B. 28cm

C. 20cm

D. 22cm

Answer: D

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17. The refractive index of a lens material is 1.5 and focal length f. Due to some chemical changes in the material, its refractive index has increased by 2%. The percentage change in its focal length is

A. $+4.5\%$

B. -4.5%

C. $+5.67\%$

D. -5.67%

Answer: D

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18. A plano-convex lens of refractive index 1.5 and radius of curvature 30 cm is silvered at the curved surface. Now, the lens has been used to form the image of an object. What should be the distance of the object from the lense in order to have a real image of the size of the object?

A. 20cm

B. 30cm

C. 60cm

D. 10cm

Answer: A

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19. A ray of light is incident at 50° on the middle of one of two mirrors arranged at an angle of 60° between them. They ray then touches the second mirror, get reflected back to the first mirror, making an anlge of incidence of

A. 50°

B. 60°

C. 70°

D. 80°

Answer: C

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20. A 2.0 cm high object is placed on the principal axis of a concave mirror at a distance of 12 cm from the pole. Ilf the image is inverted, real and 5.0

cm high, find the location of the image the focal length of the mirror.

A. 30cm, 8.6cm

B. 8.6cm, 30cm

C. 30cm, 10cm

D. 10cm, 30cm

Answer: A

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

A. 36cm, 36cm

B. 36cm,16cm

C. 72cm,36cm

D. none of these

Answer: A

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

A. 12.5cm

B. 25cm

C. 50cm

D. 100cm

Answer: B

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ADDITIONAL PRACTICE EXERCISE (LEVEL-II LECTURE SHEET(ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A transparent cube of 15 cm edge contains a small air bubble. Its apparent depth when viewed through one face is 6 cm and when viewed through the opposite face is 4 cm. Then the refractive index of the material of the cube is

A. 2

B. 2.5

C. 1.6

D. 1.5

Answer: D

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2. 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. $\frac{7}{4}$

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

C. $\frac{7}{5}$

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

Answer: C

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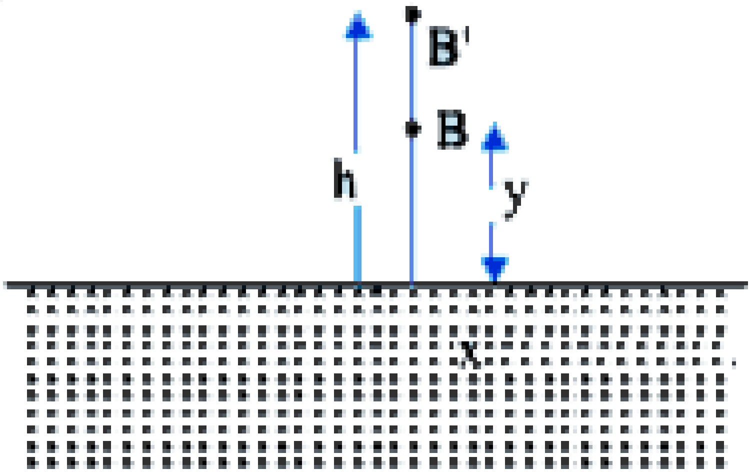
3. A fish rising vertically to the surface of water in a lake uniformly at the rate of3m/s observes a king fisher bird diving vertically towards water at the rate 9 m/s vertically above it. If the refractive index of water is $4/3$, find the actual velocity of the dive of the bird in $cm/\sec.$



A. 6

B. 4.5

C. 1.5

D. 2

Answer: B

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

A. 26°

B. 0°

C. 30°

D. 15°

Answer: D

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5. A man in an empty swimming pool has a telescope focussed at 4o'clock sun. When the swimming pool is filled with water, the man observes the setting sun through telescope. If sunrises and sets at 6 o'clock, then refractive index of water is

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

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

C. $\frac{4\sqrt{2}}{3}$

D. none

Answer: A

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6. A ray of light is incident on one face of a transparent slab of thickness 15 cm. The angle of incidence is 60°. If the lateral displacement of the ray on emerging from the parallel plane is $5\sqrt{3}$ cm, the refractive index of the material of the slab is

A. 1.414

B. 1.532

C. 1.732

D. none

Answer: C

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7. A person looking through a telescope focuses lens at a point on the edge of the bottom of an empty cylindrical vessel. Next he fills the entire vessel with a liquid oif refractive index μ, without disturbing the telescope. Now, he observes the mid point of the vessel. Determine the radius to depth ratio of the vessel

A. $\frac{1}{2}\sqrt{\frac{1-\mu^2}{\mu^2+1}}$

B. $\frac{1}{2}\sqrt{\frac{4-\mu^2}{\mu^2-1}}$

C. $\frac{1}{2}\sqrt{\frac{4+\mu^2}{\mu^2+1}}$

D. $\frac{1}{2}\sqrt{\frac{4+\mu}{\mu+1}}$

Answer: B

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8. 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 are then for what maximum value of $\frac{d}{R}$ light entering the glass slab through surface A emerges from the glass through B

A. 1.5

B. 0.5

C. 1.3

D. none of these

Answer: B

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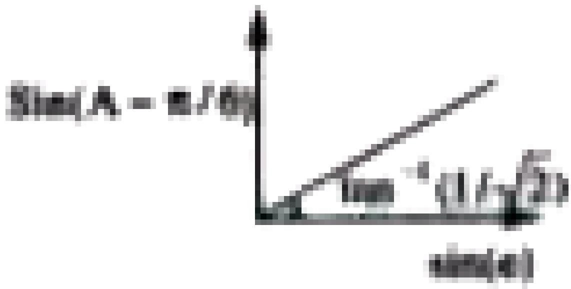
9. A light ray is incident at an angle of incedence $(\pi / 4)$. The graph of $\sin(A - \pi / 6)$ versus sin e is shown in fig. The minimum angle of devation corresponds to a prism with angle (e=angle of emergence)



A. 90°

B. 60°

C. 45°

D. 30°

Answer: B

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10. Light is incident from glass $(\mu = 1.50)$ to water $(\mu = 1.33)$ find the range of the angle of deviation for which there are two angles of incidence.

A. 0 to $\cos^{-1}(8/9)$

B. 0 to $\sin^{-1}(8/9)$

C. 0 to $\sin^{-1}(9/8)$

D. 0 to $\cos^{-1}(9/8)$

Answer: A

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11. A ray of light is incident at an angle of 75° into a medium having refractive index μ. The reflected and the refracted rays are found to suffer equal deviations in opposite direction. Then μ equals to

A. $\dfrac{\sqrt{3}+1}{\sqrt{3}-1}$

B. $\dfrac{\sqrt{3}+1}{2}$

C. $\dfrac{2\sqrt{2}}{\sqrt{3}+1}$

D. none of these

Answer: B

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12. A beam of parallel rays of width b cm propagates in glass at an angle θ to its plane face. What would the beam width b_1 be after it goes over to air thrugh this face? (The refractive index of the glass is μ)

A. $b\mu$

B. $b\mu\cos\theta$

C. $\dfrac{b\left(1-\mu^2\cos^2\theta\right)^{1/2}}{\sin\theta}$

D. $\dfrac{b\left(1-\mu^2\sin^2\theta\right)^{1/2}}{\cos\theta}$

Answer: C

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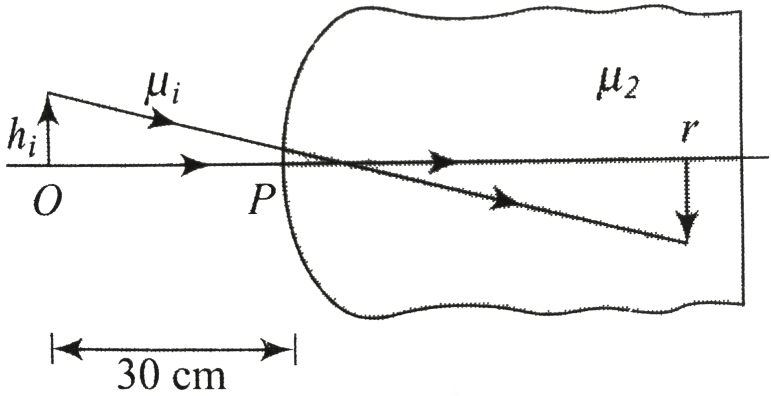
13. A small object of height 0.5 cm is placed in front of a convex surface of glass $(\mu - 1.5)$ of radius of curvature 10cm. Find the height of the image formed in glass.



A. 1 cm real, inverted, magnified, formed in the glass

B. 1 cm real, inverted magnified formed in the air c

C. 1 cm virtual erected magnified formed in the air

D. 1 cm virtual erected magnified formed in the glass

Answer: A

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14. 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.

A. $\dfrac{\mu R^2 \text{gt}}{\left[(\mu - 1)\left(h - \frac{1}{2}\text{gt}^2\right) - R\right]^2}$

B. $\left[\dfrac{\mu R^2 \text{gt}}{(\mu - 1)\left(h - \frac{1}{2}\text{gt}^2\right)}\right]$

C. $\dfrac{\mu R^2 \text{gt}}{\left(\mu - 1\left(h - \frac{1}{2}\text{gt}^2\right) - R\right)}$

D. $\dfrac{\mu R^2 \text{gt}}{\mu\left(h - \frac{1}{2}\text{gt}^2\right)}$

Answer: A

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

A. at 29 cm to the right of 2nd face, m = -0.44

B. at 10 cm to the right of 2nd face , m = -0.3

C. at 10 cm to the left of 2nd face, m = -0.3

D. at 29 cm to the left of 2nd face , m = -0.44

Answer: A

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16. The radii of curvature of two spherical surfaces of a concave convex lens $(\mu = 1.5)$ are 20 cm and 40 cm. (i) What is its focal length when it is in air? Also find its focal length when it is immersed in a liquid of refractive index (ii) $\mu = 1.2$ (iii) $\mu = 2$

A. (80 cm, 160 cm, -160 cm)

B. (80 cm, 80 cm, -80 cm)

C. (160 cm, 80 cm, 80 cm)

D. (80 cm, 160 cm, 160 cm)

Answer: A

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17. A light ray travelling parallel to the principal axis of a convex lens of focal length 12 cm strikes the lens at a height of 5 mm from the principal axis. What is the angle of deviation produced?

A. 4°

B. 5°

C. 1°

D. 2.4°

Answer: D

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18. Twot thin lenses when placed in contact, then the power of combination is +10D. If they are kept 0.25m apart, then the power reduceds to +6D. The focal lengths of the lenses (in m) will be

A. (5 cm, 50 cm)

B. (10 cm, 40 cm)

C. (20 cm, 30 cm)

D. (12.5 cm, 50 cm)

Answer: D

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19. A convex lens is placed some where between an object and a screen which are separated by 48 cm. If the numerical value of magnification produced by the lens is 3, what is the focal length of lens?

A. 6cm

B. 12cm

C. 24cm

D. 9cm

Answer: D

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20. A point object moves along the principal axis of a convex lens of focal length f such that its real image, also formed on the principal axis at a distance $\frac{4f}{3}$ (at t=0) moves away from the lens with uniform velocity α. Find the velocity of the point object as a function of time t.

A. $\left(\frac{f}{f+\alpha t}\right)^2 \alpha$

B. $\left(\frac{\alpha}{r+\alpha t}\right)^2$

C. $\left(\frac{r/3+\alpha t^2}{f}\right)^2 \alpha$

D. $\left(\frac{f}{\frac{f}{3}+\alpha t}\right)^2 \alpha$

Answer: D

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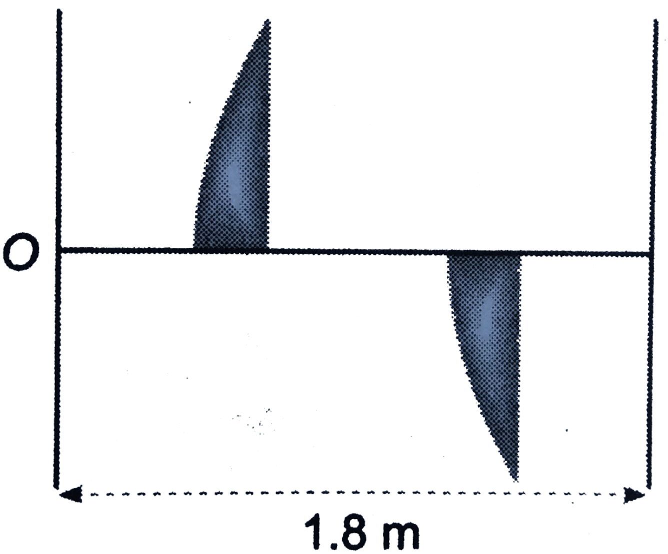
21. A thin plano-convex lens of focal length f is split into two halves. One of the halves is shifted along the optical axis as shown in figure. The sepration between object and image planes is $1.8m$. The magnification of the image formed by one of the half lens is 2. Find the focal length of the lens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



A. (0.3 m, 0.2 m)

B. (0.4 m, 0.6 m)

C. (0.1 m, 0.6 m)

D. (0.4 m, 0.2 m)

Answer: D

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22. A converging lens L_1 of focal length 20 cm is separated by 8 cm from a diverging lens L_2 of focal length 30cm. A parallel beam of light falls on L_1 after passing through L_2 is focussed at point P. Calculate V.

A. (40 cm, 30 cm)

B. (20 cm, 35.3 cm)

C. (20 cm, 42.2 cm)

D. (60 cm, 20 cm)

Answer: C

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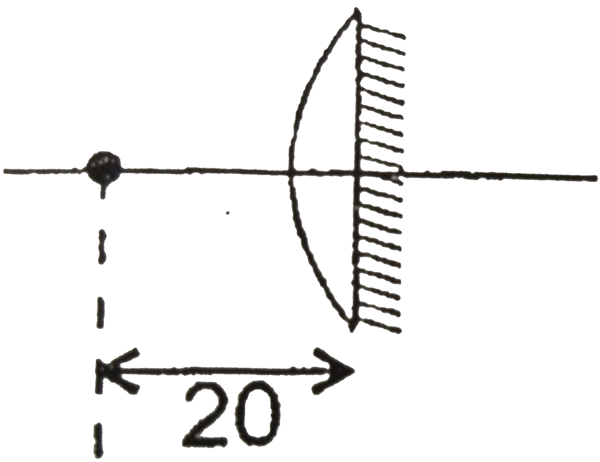
23. A point object is placed at a distance of $20 cm$ from a thin plano-concex lens of focal length $15 cm$. The plane surface of the lens is now silvered. The image created by the is at :



A. 12 cm to the left of lens system

B. 20 cm to the right of lens system

C. 12 cm to the right of lens system

D. 20 cm to the left of lens system

Answer: A

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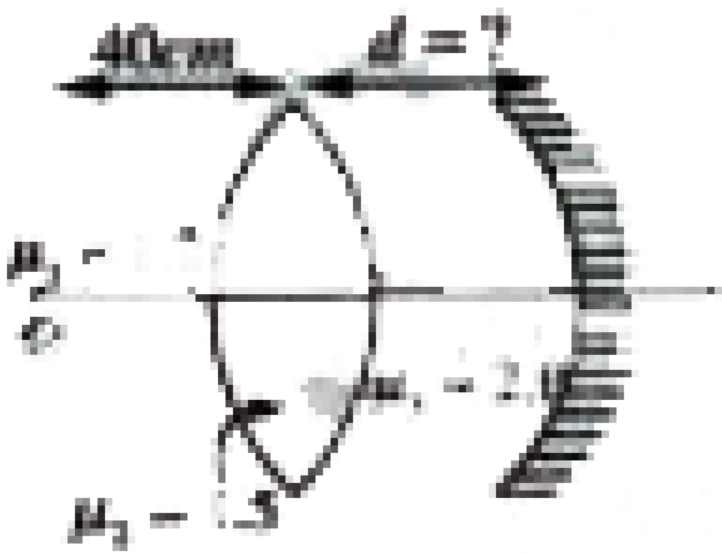
24. Figure shows an arrangement ofan equiconvex lens (f=20 cm in air) and a concave mirror (R=80cm). A point object O is placed on the principal axis at a distance 40 cm from the lens such that the final image is also formed at the position of object. Find d.



A. 20cm

B. 30cm

C. 40cm

D. 50cm

Answer: B

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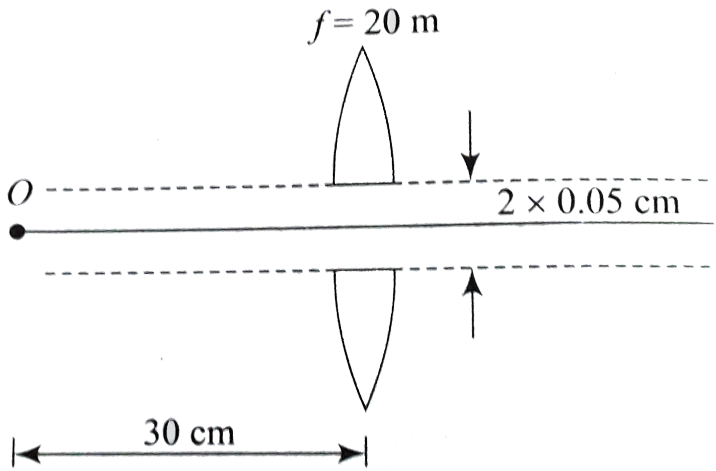
25. A point object O is placed at a distance of 0.3m from a convex lens (focal length 0.2m) cut into two halves each of which is displaced by 0.0005 m as shown in figure



Q. If this arrangement will generate more than one image, then what will be the total number of image?

A. 30 cm, 2 images, 0.5 cm

B. 40 cm, 2 images, 0.3 cm

C. 50 cm, 2 images, 0.4 cm

D. 60 cm, 2 images, 0.3 cm

Answer: D

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26. A small object stuck on the surface of a glass sphere $(n = 1.5)$ is viewed from the diametrically opposite position. Find transverse magnification.

A. $+2$

B. $+1$

C. $+3$

D. -2

Answer: C

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

A. 75cm

B. 60cm

C. 20cm

D. 100cm

Answer: A

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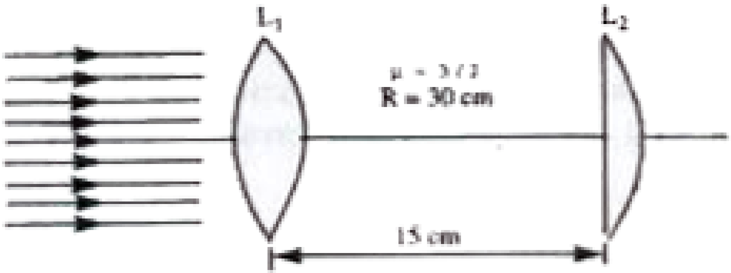
28. In the given diagram find the position where the equivalent lens can be placed for image formation by rays takes place at same place as in the given diagram. Assume that all the curved surfaces have same radii and same optical axis for both the lenses.



A. 2.5 cm from lens L_1

B. 3.0 cm from L_1

C. 7.5 cm from L_1

D. 10.0 cm from L_1

Answer: B

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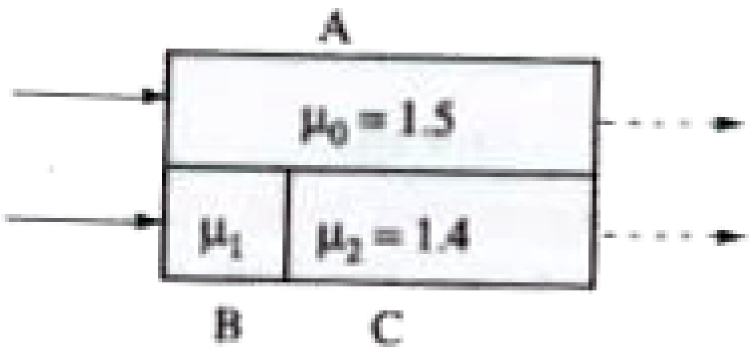
ADDITIONAL PRACTICE EXERCISE (LEVEL-II LECTURE SHEET(ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. A slab of transparent materials is made as shown in the figure. Monochromatic parallel beams of light are normally incident on the slabs. The thickness of C is twice the thickness of B. The number of waves is A= the number of waves in the combination of B and C. The refractive index of material A is $\mu_0 = 1.5$ and that of C is $\mu_2 = 1.4$



A. The refractive index of B is 1.6

B. The frequency of light in B is two times the frequency of light in C.

C. The refractive index of B is 1.7

D. The frequency of light in B is the same as the frequency of light in C.

Answer: C::D

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2. The first factor length f_1 for refraction at a spherical surface is defined as the value of u corresponding to $v = \infty$ (as shown) with refractive indices of two mediums, as n_1 and n_2. The second focal length f_2 is defined as value of v for $u = \infty$.

A. f_2 is equal to $\dfrac{n_2 R}{(n_2 - n_1)}$

B. f_1 is equal to $\dfrac{n_2 R}{(n_2 - n_1)}$

C. f_2 is equal to (-) $\dfrac{n_1 R}{(n_2 - n_1)}$

D. f_1 is equal to $\dfrac{n_1 R}{(n_2 - n_1)}$

Answer: A::D

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3. A biconvex thin lens is prepared from glass of refractive index $\mu_2 = \dfrac{3}{2}$. The two conducting surfaces have equal radii of 20 cm each. One of the

the surface is silvered from outside to make it reflecting. It is placed in a medium of refractive index $\mu_1 = \frac{5}{3}$. It acts as a

A. converting mirror

B. diverging mirror

C. concave mirror of focal length 12.5.cm

D. convex mirror of focal length 12.5 cm

Answer: A::C

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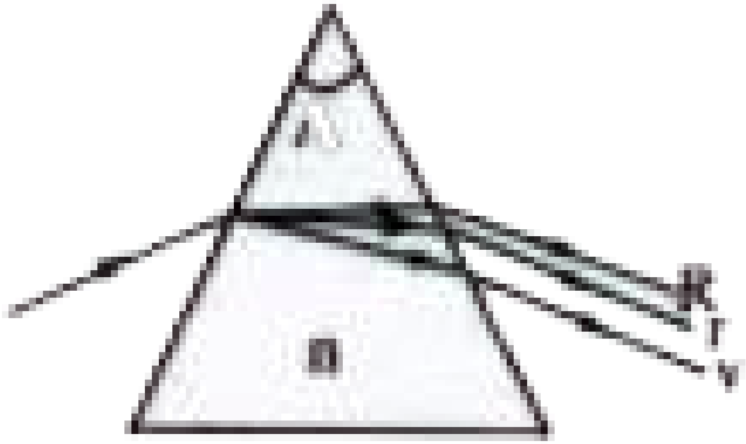
ADDITIONAL PRACTICE EXERCISE (LEVEL-II LECTURE SHEET(ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. When a ray of sun light passes through the prism, each colour of light has its own speed in the glass. The seven colours come out of the prism with different angles of deviation. Red deviates least and blue deviates maximum. Thus a prism can disperse a white light into seven colours which is called colour spectrum.



For a thin prism, the angle of deviation is given as $\delta=(n-1) A$. The angle of dispersion is given as $\phi=\delta_v-\delta_r$. The dispersive power of a prism is $\omega=\frac{\phi}{\delta_{\text{mean}}}=\frac{\phi}{\delta_y}$

Using the above ideas, give answer the following questions.

A prism has R.I. for violet and red $n_v=1.523, n_r=1.5145$. If the angle of prism is $A=2^{\circ}$ the dispersive power of the prism is :

A. 0.01639

B. 1.593

C. 0.1639

D. 0.18

Answer: A

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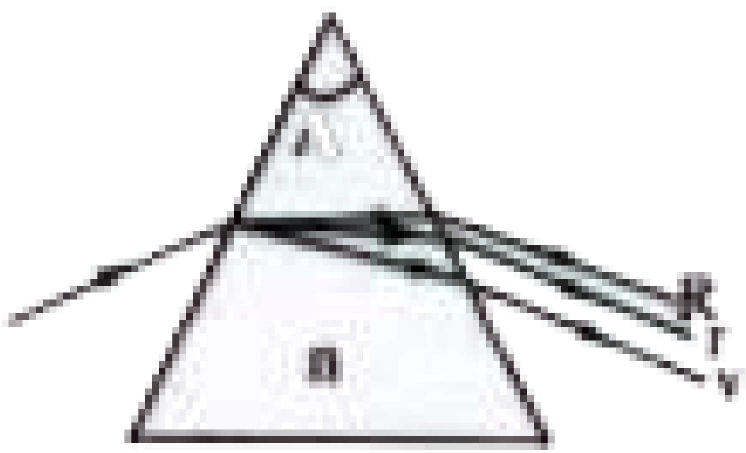
2. When a ray of sun light passes through the prism, each colour of light has its own speed in the glass. The seven colours come out of the prism with different angles of deviation. Red deviates least and blue deviates maximum. Thus a prism can disperse a white light into seven colours which is called colour spectrum.



For a thin prism, the angle of deviation is given as $\delta = (n-1)A$. The angle of dispersion is given as $\phi = \delta_v - \delta_r$. The dispersive power of a prism is $\omega = \dfrac{\phi}{\delta_{\text{mean}}} = \dfrac{\phi}{\delta_y}$

Using the above ideas, give answer the following questions.

A prism has R.I. for violet and red $n_v = 1.523$, $n_r = 1.5145$. If the angle of prism is $A = 2^\circ$ the dispersive power of the prism is :

A. $\dfrac{A'}{A}$

B. $\dfrac{A}{A'}$

C. $\dfrac{A - A'}{A + A'}$

D. $\sqrt{\dfrac{A'}{A}}$

Answer: A

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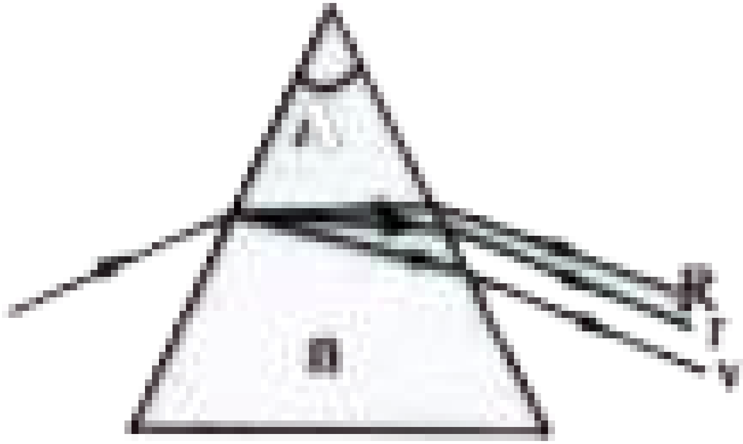
3. When a ray of sun light passes through the prism, each colour of light has its own speed in the glass. The seven colours come out of the prism with different angles of deviation. Red deviates least and blue deviates maximum. Thus a prism can disperse a white light into seven colours which is called colour spectrum.



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Using the above ideas, give answer the following questions.

A prism has R.I. for violet and red $n_v=1.523$, $n_r=1.5145$. If the angle of prism is $A=2^{\circ}$ the dispersive power of the prism is :

A. $\left(1-\frac{\omega_1}{\omega_2}\right)$

B. $\left(1-\frac{\omega_2}{\omega_1}\right)$

C. $\frac{\omega_2}{\omega_1}$

D. $\frac{\omega_1}{\omega_2}$

Answer: A

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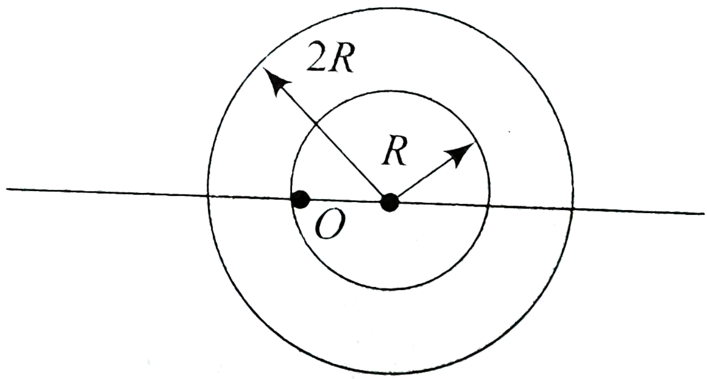
4. A glass sphere of radius 2R and refractive index n has a spherical cavity of radius R, concentric with it.



Q. When viewer is ono left side of the hollow sphere, what will be the shift in position of the object?

A. $\frac{(n+1)}{(n-1)}R$, right

B. $\frac{(n-1)}{(n+1)}$R, left

C. $\frac{(2n-1)}{(2n+1)}$R, left

D. $\frac{(2n-1)}{(n+1)}$R, left

Answer: B

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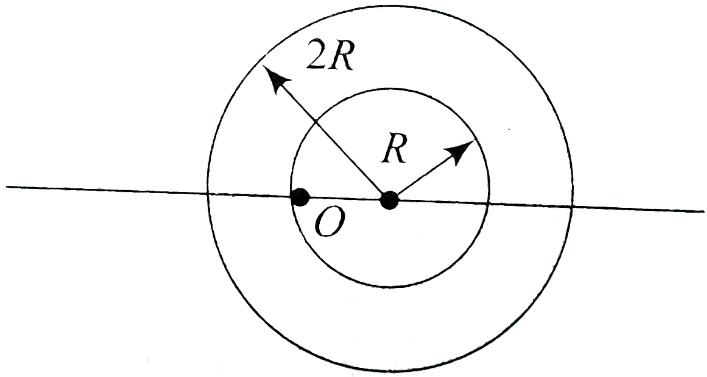
5. A glass sphere of radius 2R and refractive index n has a spherical cavity of radius R, concentric with it.



Q. When viewer is ono left side of the hollow sphere, what will be the shift in position of the object?

A. $\frac{(n-1)}{(3n+1)}R$, toward left

B. $\frac{(n+1)}{(3n-1)}R$, toward left

C. $\frac{(n+1)}{(3n+1)}R$, toward right

D. $\frac{(n-1)}{(3n-1)}R$, toward right

Answer: D

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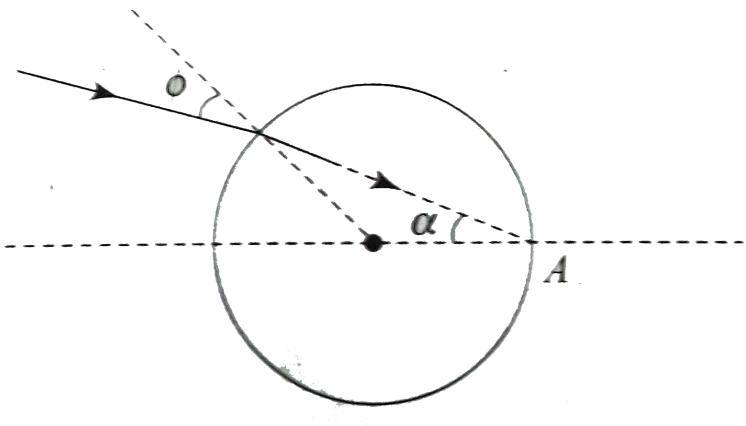
6. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. Select the correct statement:

A. Incident rays are partially reflected at point A

B. Incident rays are totally reflected at point A

C. Incident rays are totally transmitted through A

D. None of these

Answer: A

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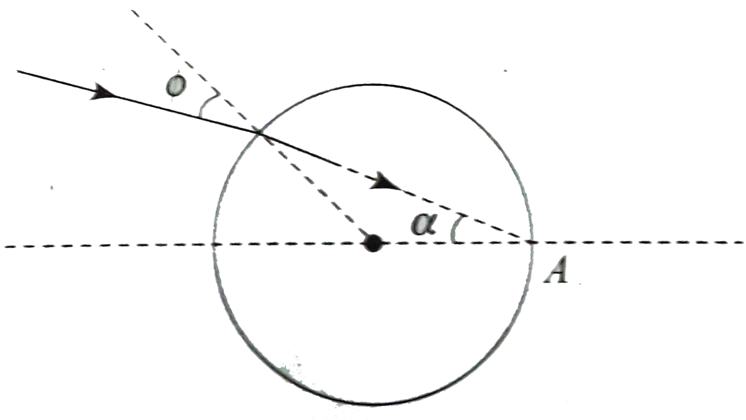
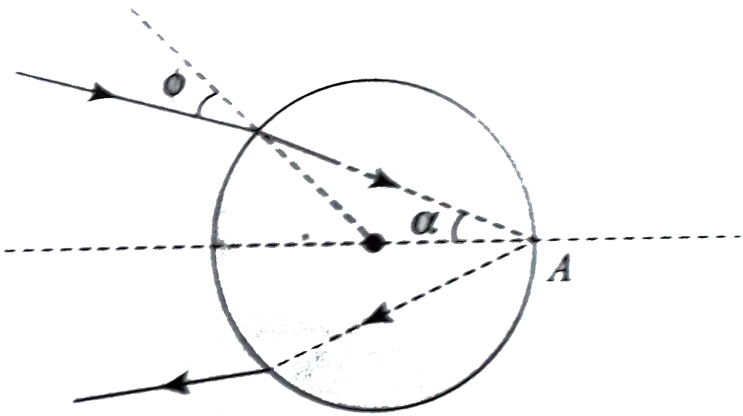
7. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. An expression of the angle between incident ray and emergent ray (angle of deviation) as shown in figure.



A. 0°

B. ϕ

C. $\alpha - \phi$

D. $\pi - 4\alpha + 2\phi$

Answer: D

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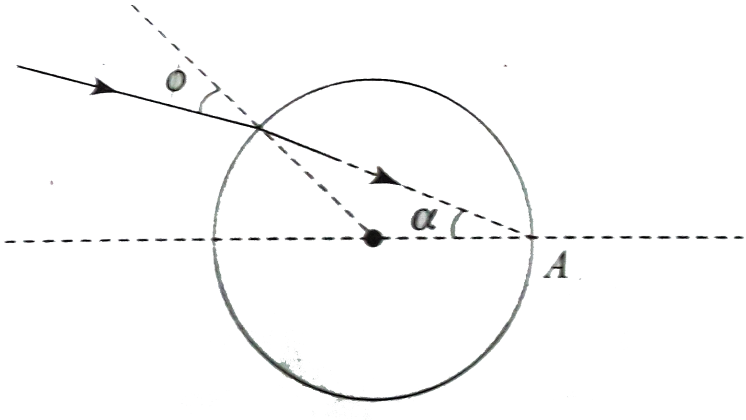
8. A ray of light enters a spherical drop of water of refractive index μ as shown in figure.



Q. Considert eh figure of question 60, the angle ϕ for which minimum deviation is produced will be given by

A. $\cos^2\phi = \frac{\mu^2+1}{3}$

B. $\cos^2\phi = \frac{\mu^2-1}{3}$

C. $\sin^2\phi = \frac{\mu^2+1}{3}$

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

Answer: B

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ADDITIONAL PRACTICE EXERCISE (LEVEL-II LECTURE SHEET(ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. Real and inverted image of an object is formed at a distance d=40 cm from the object. The size of the image is hall of that of object.

Column - I	Column - II
A) The nature of lens used should be	p) concave
B) focal length of the lens	q) convex
C) distance of object from the lens	r) 80/3 cm
D) If mirror were used, then nature of mirror should be	s) 80/9 cm

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ADDITIONAL PRACTICE EXERCISE (LEVEL-II LECTURE SHEET(ADVANCED) INTEGER TYPE QUESTIONS)

1. Light propogates x cm distance in a medium of refractive index μ in time t_0. In the same time t_0, light propogates a distance of $\frac{x}{6}$ cm in a medium of refractive index μ. If $\mu' = k\mu$ find the value of k.

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2. How much height of water in cm would be filled in a container of height 14 cm,so that it appears half filled to the observer when viewed from the top of the container $\left(\mu_{\omega} = \frac{4}{3}\right)$

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3. The magnification of an object placed in front of a convex lens is $+2$. The focal length of the lens is 2.0 metres. Find the distance by which object has to be moved to obtain a magnification of -2 (in metres).

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4. Where should a convex lens of focal length 9cm be placed (in cm) between two point sources S_1 and S_2 where are 24 cm apart, so that images of both the sources are formed at the same place. You have to find distance of lens from S_1 or S_2 whichever is lesser.

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ADDITIONAL PRACTICE EXERCISE (LEVEL-II PRACTICE SHEET (ADVANCED) STRAIGHT OBJECTIVE TYPE QUESTIONS)

1. A ray of light is incident at an anlgge of 60° on a $\sqrt{3}$ cm thick palte $(\mu = \sqrt{3})$. The shift in the path of the ray as it emerges out from the plate is (incm)

A. 1

B. 1.2

C. 0.5

D. 1.8

Answer: A

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2. A mark at the bottom of a liquid appears to rise by 0.1 m. The depth of the liquid is 1 m. The refractive index of the liquid is

A. 1.33

B. $\frac{9}{10}$

C. $\frac{10}{9}$

D. 1.5

Answer: C

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3. An under water swimmer is at a depth of 12 m below the surface of water. A bird is at a height of 18 m from the surface of water, directly above his eyes. For the swimmer the bird appears to be at a distance from the surface of water equal to (Refracting index of water is 4/3)

A. 24m

B. 12m

C. 36m

D. 18m

Answer: A

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4. A microscope is focussed on a coin lying at the bottom of a beaker. The microscope is now raised by 1 cm. To what depth should water be poured into the beaker so that the coin is again in focus?

(The refractive index of water is $\frac{4}{3}$)

A. 1cm

B. 4/3cm

C. 3cm

D. 4cm

Answer: D

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5. If a light ray incidents normally on one of the faces of the prism of refractive index 2 and the emergent ray just grazes the second face of the prism, then the angle of deviation is

A. 0°

B. 30°

C. 60°

D. 90°

Answer: C

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6. A parallel beam of white light falls on a convex lens. Images of blue, yellow and red light are formed on other side of the lens at a distance of 0.20 m, 0.205 m and 0.214 m respectively. The dispersive power of the material of the lens will be

A. $\frac{619}{1000}$

B. $\frac{9}{200}$

C. $\frac{14}{205}$

D. $\frac{5}{214}$

Answer: C

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7. A ray of light is incident on the face AB of a glass prism ABC having vertex anlge A equal to 30°. The face AC is silvered and a ray of light incident on the face AB retraces its path. If the refractive index of the material of prism is $\sqrt{3}$ find the angle of incidence on the face AB.

A. 60°

B. 30°

C. 45°

D. 25°

Answer: A

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8. The refracting angle of a prism is A, and refractive index of the material of the prism is $\cot\left(\frac{A}{2}\right)$. The angle of minimum deviation is

A. $\pi + 2A$

B. $\pi - 2A$

C. $\frac{\pi}{2} + A$

D. $\frac{\pi}{2} - A$

Answer: B

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9. A ray of light is incident on the hypotenuse of a right-angled prism after travelling parallel to the base inside the prism. If μ is the refractive index of the material of the prism, the maximum value of the base angle for which light is totally reflected from the hypotenuse is

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

B. $\tan^{-1}\left(\frac{1}{\mu}\right)$

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

D. $\cos^{-1}\left(\frac{1}{\mu}\right)$

Answer: D

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10. A plane mirror is fixed at the bottom of a tank containing water. A small object is kept at a height of 24 cm from the bottom and is viewed from a point vertically above it. The distance between the object and the image in the mirror as appears to the person is

A. 48cm

B. 64cm

C. 36cm

D. 54cm

Answer: C

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11. A ray of light travelling in glass having refractive index $_(a)\mu_g = 3/2$ is incident at a critical angle C on the glass air interface. If a thin layer of water is poured on glass air interface, then what will be the angle of emergence of this ray in air when it emerges from water air inteface?

A. 180°

B. 0°

C. 90°

D. 45°

Answer: C

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12. A light ray is normally incident onone face of equilateral glass prism of refractive index $\sqrt{2}$. The deviation of light ray is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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13. A equilateral glass prism has a refractive index $\sqrt{2}$. A light ray is incident at 45° on one face. Total deviation of ray is $n \times 15^\circ$ where n is

A. 75°

B. 95°

C. 100°

D. none

Answer: B

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

A. 50

B. 15

C. 5

D. 3

Answer: C

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15. A glass sphere of diameter 50 cm and $\mu = 1.5$ has a small air bubble. Looking from outside the diameter, the bubble appears to be at a distance 10 cm the surface. Find the apparent position of the bubble when it is viewed from the diametrically opposite position.

A. real image, at the pole of 2nd face

B. real image, at the pole of 1st face

C. virtual image, at the pole of 1st face

D. virtual image, at the centre of the sphere

Answer: C

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16. A parallel beam falls on solid glass sphere of radius R and refractive index μ. What is the distance of final image after refractioin from two surfaces of sphere? What is the condition for the image to be real?

A. $\dfrac{R(\mu-2)}{2(\mu-1)}$ from 2nd surface , $\mu > 2$

B. $\dfrac{R(2-\mu)}{2((\mu-1))}$ from 2nd surface , $\mu < 2$

C. $\dfrac{R(\mu-1)}{(2-\mu)}$ from 2nd surface , $\mu < 2$

D. $\dfrac{R}{2}\left(\dfrac{\mu+2}{\mu+1}\right)$ from 2nd surface , $\mu < 2$ for any value of μ

Answer: B

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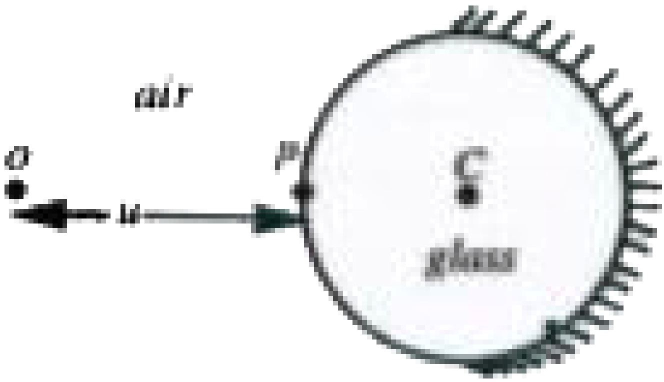
17. A transparent glass sphere of radius 10 cm and refractive index $\mu = 1.5$ has its one half silvered so that it acts like a concave mirror. Find the position of final image for an object O at (a) 30 cm to the left of the front surface of the ball.



A. 30 cm to the right of P, at the pole of mirrored surface

B. 20 cm to the left of P, at the center of sphere

C. 20.9 cm to the right of P , at the pole P.

D. 20.9 cm to the left of P, at the pole of mirrored surface

Answer: D

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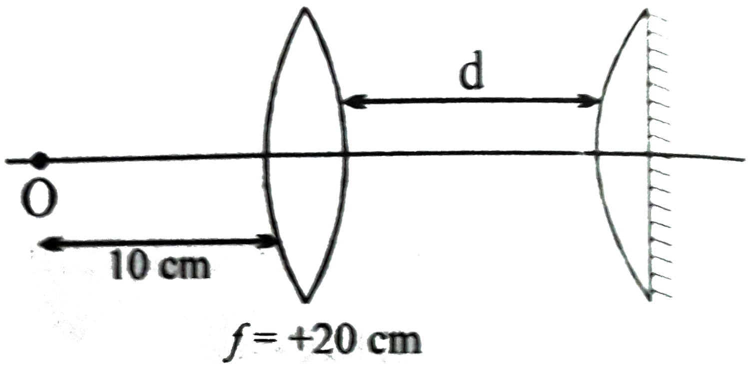
18. A convex lens of focal length 20cm and another plano convex lens of focal length 40cm are placed co-axially . The plano convex lens is silvered on plane surface. What should be the distance (in cm) so that final image of the object 'O' is formed on O itself.



A. 10

B. 15

C. 20

D. 25

Answer: C

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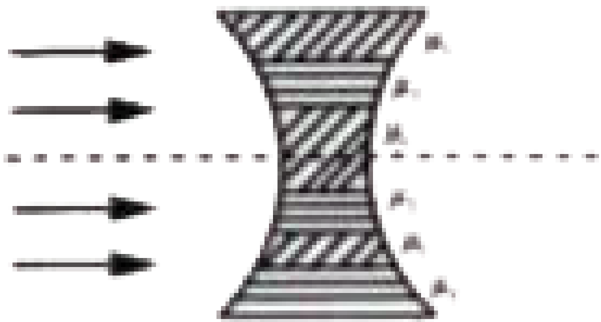
19. A symmetrical bioconcave lens having radius of curvature R is made up to two different materials as shown in figure. A parallel beam of light passing through the lens appear to diverge from two different points. Find the distance between them.



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

B. $\dfrac{R}{2}\dfrac{(\mu_2 - \mu_1)}{(\mu_1 - 1)(\mu_2 - 1)}$

C. $\dfrac{R}{2}\left(\dfrac{\mu_2 - 1}{\mu_1 - 1}\right)$

D. $\dfrac{R}{2}\left(\dfrac{\mu_1 - 1}{\mu_2 - 1}\right)$

Answer: B

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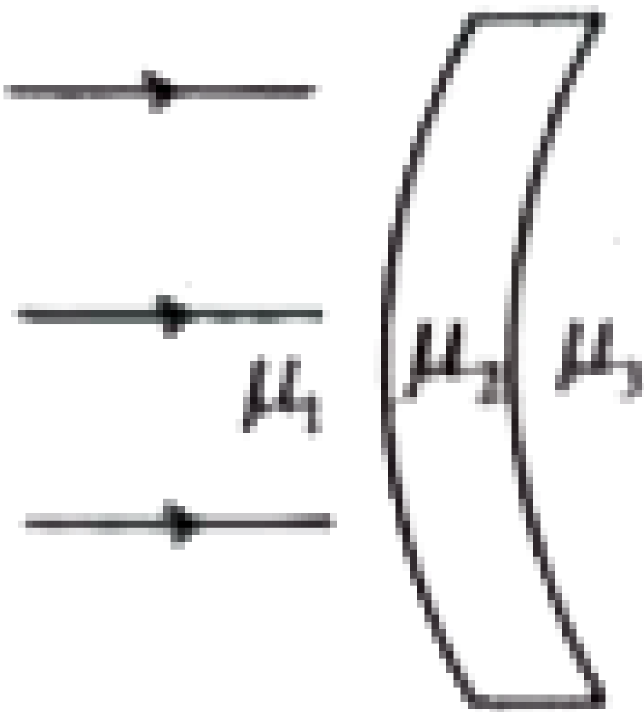
20. Light is incident on the thin lens as shown in figure. The refractive index of the material of the lens is μ_2. The radii of curvature of both the surfaces are R. The refractive index of the medium of left side is μ_1, while that of right side is μ_3. What is the focal length of the lens?



A. $\dfrac{\mu_2 R}{\mu_3 - \mu_1}$

B. $\dfrac{\mu_1 R}{\mu_3 - \mu_1}$

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

D. $\dfrac{\mu_3 R}{\mu_3 - \mu_1}$

Answer: D

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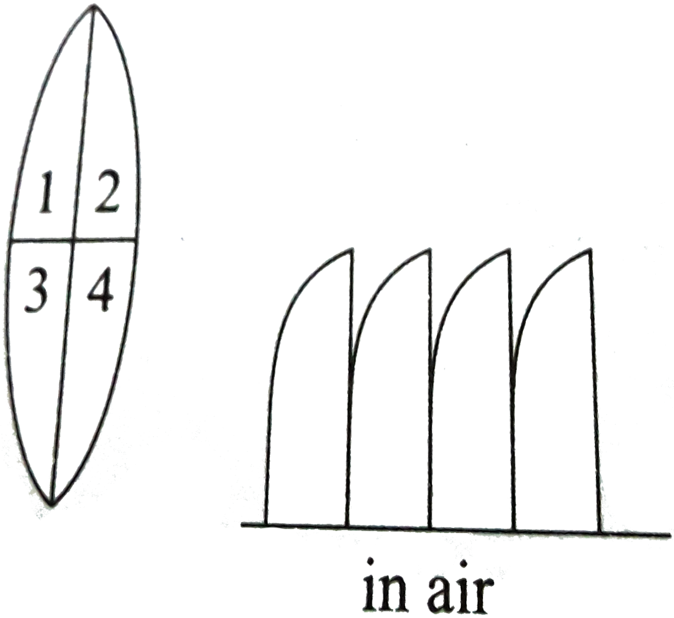
21. The given lens is broken into four parts rearranged as shown. If the initial focal length is f, then after rearrangement the equivalent focal length is



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

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

C. 8f

D. 2f

Answer: A

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22. A convex lens is placed between an object and a screen which are at a fixed distance apart for one position of the lens. The magnification of the image obtained on the screen is m_1. When the lens is moved by a distance d the magnification of the image obtained on the same screen m_2, Find the focal length of the lens.

A. 6cm

B. 9cm

C. 10cm

D. 4cm

Answer: A

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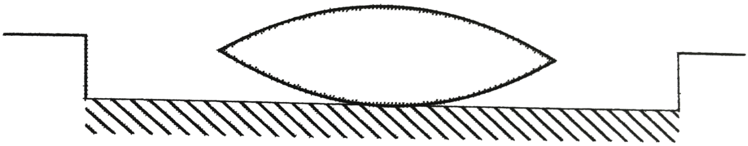
23. A thin biconvex lens of refractive index $3/2$ is placed on a horizontal plane mirror as shown in Figure . The space between the lens and the mirror is then fille with water or refractive index $4/3$. It is found that when a point object is placed 15 cm above the lens on its principal axis, the object coincides with its own image. On representing with another liquid, the object and the image again coincide at a distance 25 cm from the lens. Calculate the refractive index of the liquid.



A. 1.4

B. 1.5

C. 1.6

D. 1.7

Answer: C

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24. A convex lens is placed between an object and a screen which are at a fixed distance apart for one position of the lens. The magnification of the image obtained on the screen is m_1. When the lens is moved by a distance d the magnification of the image obtained on the same screen m_2, Find the focal length of the lens.

A. $\dfrac{d}{(m_1 - \mu_2)}$

B. $\dfrac{d}{(m_1 + m_2)}$

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

D. $d\dfrac{m_2}{m_1}$

Answer: A

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25. A point object is placed at a distance of 24 cm from a convex surface of a medium $(\mu = 1.5)$ and radius of curvature 24 cm in air. What is the distance of image position from the pole?

A. real image, 36 cm in air

B. virtual image, 72 cm in air

C. virtual image, 72 cm medium

D. real image 36 cm, in air

Answer: B

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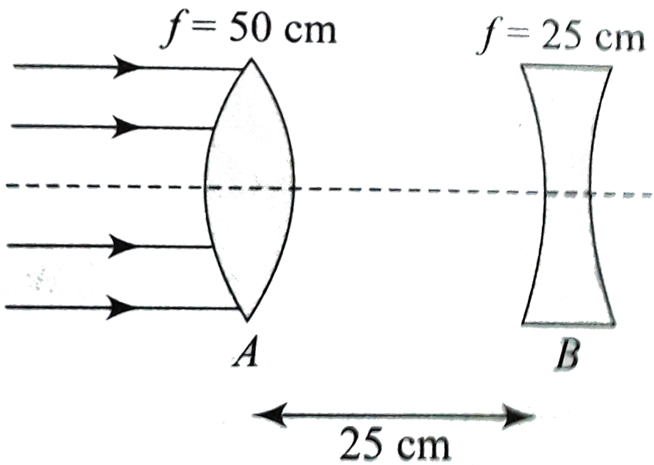
26. Two lenses shown in figure. Are illuminated by a beam of parallel light from the left. Lens B is then moved slowly toward lens A. the beam emerging from lens B is



A. always diverging

B. initially parallel and then diverging

C. always parallel

D. initially converging and then parallel

Answer: B

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27. A double convex lens forms a real image of an objectt on a screen which is fixed. Now lens is given a constant velocity v=1m/s along its axis and away from the screen for the purpose of forming image always on the screen the object is also required to be given appropriate velocity . Find the velocity (in m/s) of the object at the instant its size is doubled the size of the image.

A. 1m/s

B. 2m/s

C. 3m/s

D. 4m/s

Answer: C

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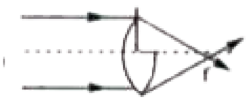
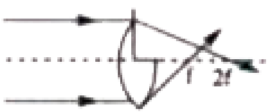
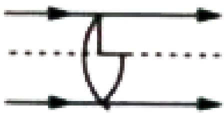
28. Choose the correct ray diagram of an equi convex lens which is cut as shown.

A. 

B. 

C. 

D. 

Answer: C

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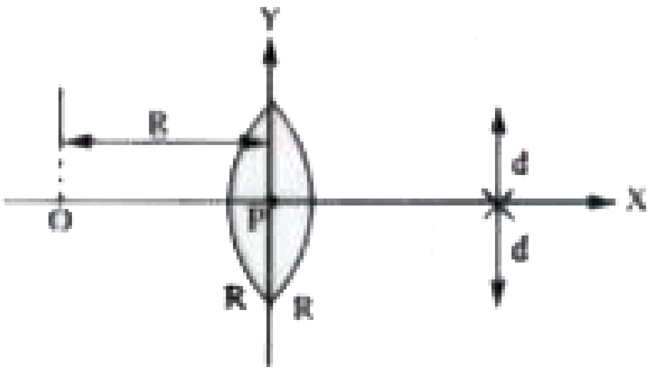
29. A biconvex thin lens of radius of curvature R is made up of variable refractive index $\mu = 2\left(1 + \frac{r}{d}\right)$. Assume $2d < < R$. There are infinite images of the point O, which is placed at a distance R on the principal axis from the lens as shown in the figure. The image is spread along the pricipal axis in a length of (r is the radial distance from P measured perpendicular to principal axis)



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

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

C. $\frac{3R}{5}$

D. $\frac{4R}{5}$

Answer: D

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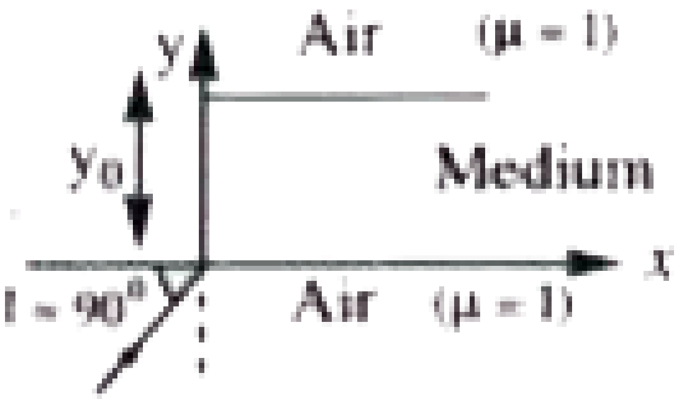
ADDITIONAL PRACTICE EXERCISE (LEVEL-II PRACTICE SHEET (ADVANCED) MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS)

1. A ray of light travelling in air is incident at angle of incidence $I \approx 90^\circ$ on a long rectangular slab of a transparent medium of thickness y_0. The medium has a variable refractive index of $\mu(x) = \sqrt{1 + ke^{2x/a}}, x \geq 0$

wher a is a positive constant



A. In the above situation if y_0 = a/2, the co-ordinates of the point where the ray intersects the upper surface of the slab-air boundary are $\left[a \ln 2, \frac{a}{2}\right]$

B. In the above situation if y_0 = a/2, the co-ordinates of the point where the ray intersects the upper surface of the slab-air boundary are $\left[\frac{a}{2} \ln 2, \frac{a}{2}\right]$

C. the angle made by light ray with +ve x-axis, at the upper surface of slab air boundary, inside the medium is $\pi / 3$

D. the angle made by light ray with +ve x-axis, at the upper surface of slab air boundary, inside the medium is $\tan^{-1}\left(\frac{1}{2}\right)$

Answer: A::D

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2. A right-angled prism is made up of a material of refractive index μ. It is desired that a light ray incident normally on PQ emerges parallel to the incident direction after suffering two total internal reflections . In which of the following conditions is this possible ?

A. $\mu = \sqrt{2}$

B. $\mu = 2/\sqrt{3}$

C. $\mu = 1.3$

D. never possible

Answer: A::B::C

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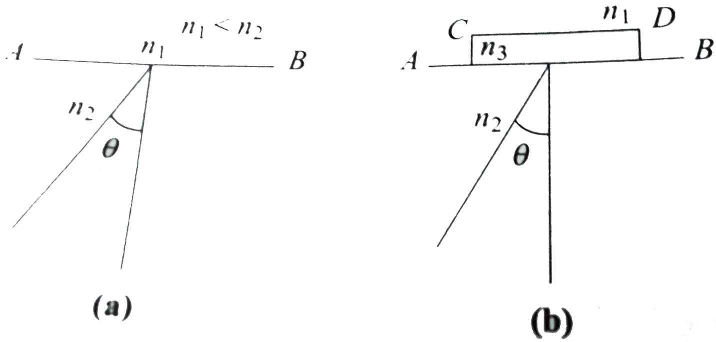
3. In Figure, light is incident at an angle θ which is slightly greater than the critical angle. Now, keeping the incident angle fixed a parallel slab or refractive index n_3 is placed on surface AB. Which of the following statements are correct?



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

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

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

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

Answer: A::C

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4. An image of a bright square is obtained on a screen with the aid of a convergent lens. The distance between the square and the lens is 40cm. The area of the image is nine times larger than that of the square. Select the correct statement(s):

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

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

C. focal length of the lens is 30 cm

D. focal length of the lens is 36 cm

Answer: A::C

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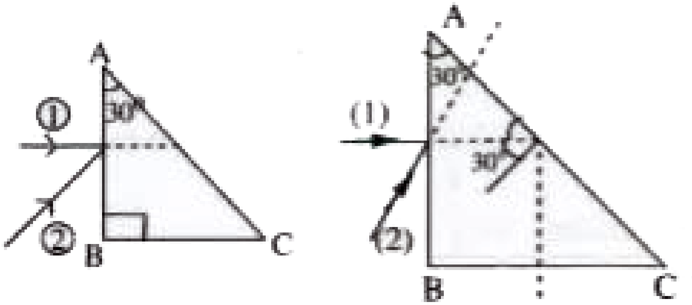
ADDITIONAL PRACTICE EXERCISE (LEVEL-II PRACTICE SHEET (ADVANCED) LINKED COMPREHENSION TYPE QUESTIONS)

1. ABC is right angled prism kept in air. A ray (1) is incident on the face AB along the normal. Another ray (2) is incident on the face AB such that it emerges normally form the face AC. Then



The minimum value of refractive index of the material of the prism for which the ray 1undergoes TIR on the face AC is

A. $\sqrt{2}$

B. 2

C. 1.5

D. 2.2

Answer: B

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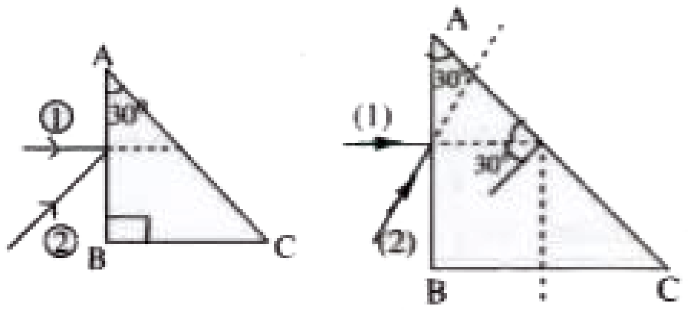
2. ABC is right angled prism kept in air. A ray (1) is incident on the face AB along the normal. Another ray (2) is incident on the face AB such that it emerges normally form the face AC. Then



The minimum value of refractive index of the material of the prism for which the ray 1undergoes TIR on the face AC is

A. 0°

B. 45°

C. 30°

D. 90°

Answer: D

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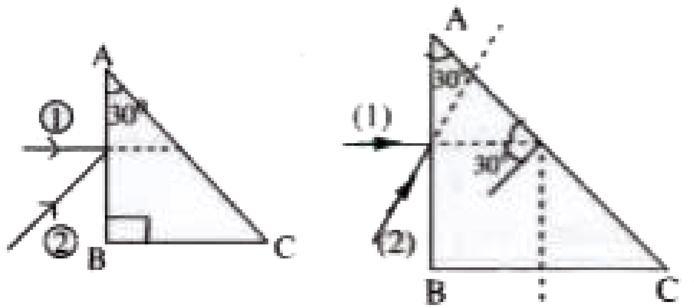
3. ABC is right angled prism kept in air. A ray (1) is incident on the face AB along the normal. Another ray (2) is incident on the face AB such that it emerges normally form the face AC. Then



The minimum value of refractive index of the material of the prism for which the ray 1undergoes TIR on the face AC is

A. 60°

B. 45°

C. 30°

D. 90°

Answer: A

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4. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

Find the linear magnification of the first image after refraction from the lens.

A. $+3$

B. -3

C. $+2$

D. -2

Answer: B

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5. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

Find the linear magnification of the second image after reflection from the mirror.

A. $+2$

B. -2

C. $+1/2$

D. $-1/2$

Answer: C

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6. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

If A'B' is the final image formed, A' corresponding to A and B' corresponding to B, find the distance of B' below optics axis of lens.

A. 0.3m

B. 0.5m

C. 0.6m

D. none of these

Answer: A

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7. A convex lens of focal length 15 cm and concave mirror of focal length 30 cm are kept their optical axes PQ and RS parallel but separated in vertical direction by 0.6 m, as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 m is placed on the optic axic PQ of the lens at a distance of 20 cm from the lens.

As in the lat problem, find the distance of A' below the optic axis of lens.

A. 1.5cm

B. 0.6cm

C. 1.8cm

D. 2.1cm

Answer: D

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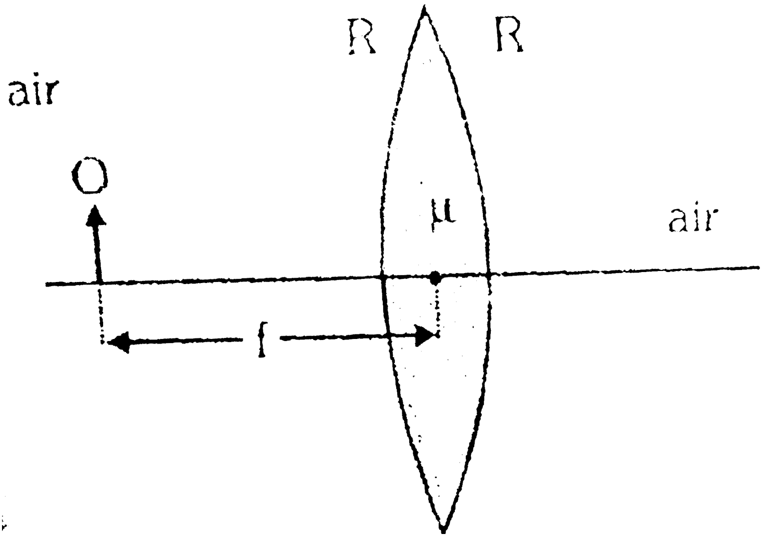
ADDITIONAL PRACTICE EXERCISE (LEVEL-II PRACTICE SHEET (ADVANCED) MATRIX MATCHING TYPE QUESTIONS)

1. An object O (real) is placed at focus of an equi-biconvex lens as shown in. figure-I . The refractive index of lens is $\mu = 1.5$ and the radius of curvature of either suface of lens is R . The lens is surronded by air . In each statement of column-I some changes are made to situation given above and information regarding final image formed as a result is given in column-II . The distance between lens and object is unchanged in all statements of column-I. match the statements in column-I with resulting image in column-II.

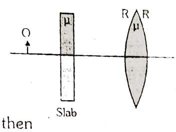


Column–I

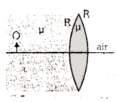
(A) If the refractive index of the lens is doubled (that is, made 2μ) then

(B) If the radius of curvature is doubled (that is, made $2R$) then

(C) If a glass slab of refractive index $\mu = 1.5$ is introduced between the object and lens as shown then



(D) If the left side of lens is filled with a medium of refractive index $\mu = 1.5$ as shown, then



Column–II

(p) final image is real

(q) final image is virtual

(r) final image becomes smaller in size in comparison to size of image before the change was made

(s) final image is of same size of object.

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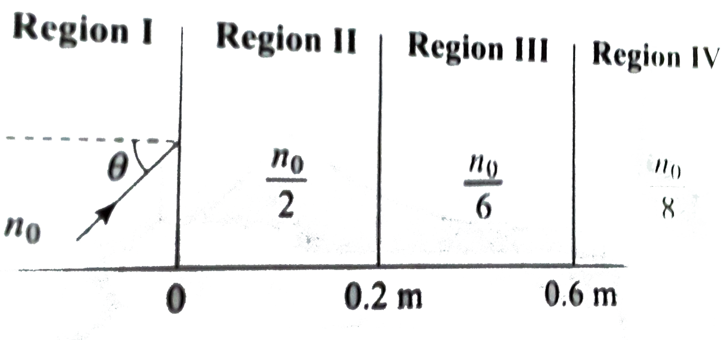
ADDITIONAL PRACTICE EXERCISE (LEVEL-II PRACTICE SHEET (ADVANCED) INTEGER TYPE QUESTIONS)

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



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2. A fish which is at a depth of 12 cm in water $\left(\mu = \frac{4}{3}\right)$ is viewed by an observer on the bank of a lake. Its apparent depth as observed by the observer is :

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3. A thin prism P_1 of angle 4° and refractive index $1.54^\circ C$ is combined with another thin prism P_2 of refractive index 1.72 to produce dispersion without deviation. The angle of P_2 is

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4. A ray of light undergoes deviation of 30° when incident on an equilateral prism of refractive index $\sqrt{2}$. The angle made by the ray inside the prism with the base of the prism is

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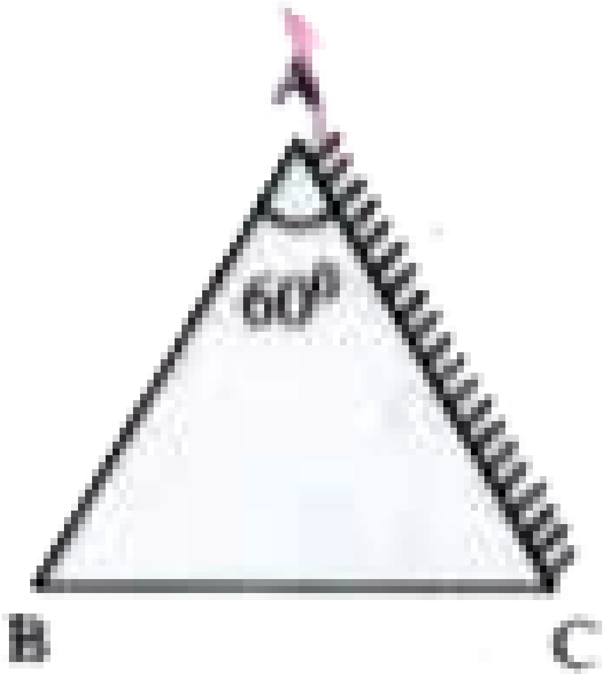
5. On face AC of an equilateraal prism ABC is silvered as shown in fig. The angle of incidence of a light ray inorder that it eventually leaves the prism in the opposite direction from base of prism is $n \times 15^\circ$ where n is

$(\mu = \sqrt{2})$



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6. A equilateral glass prism has a refractive index $\sqrt{2}$. A light ray is incident at 45° on one face. Total deviation of ray is $n \times 15^{\circ}$ where n is

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7. A ray of monochromatic light is incident on one refracting face of a prism of angle 75°. It passes thorugh the prism and is incident on the other face at the critical angle. If the refractive index of the material of the prism is $\sqrt{2}$, the angle of incidence on the first face of the prism is

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8. Light passes symmetrically through an equilateral prism. After emergence, it is incident on a plane mirror fixed to the base of the prism extending beyond it. Find the deviation produced (μ of the prism material is $\sqrt{2}$).

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9. An extended object of size 2mm is placed on the principal axis of a converging lens of focal length 10cm. It is found that when the object is placed perpendicular to the principal axis the image formed is 4mm in size. The size of image when it is placed along the principal axis is ____________ mm.

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10. A point object is placed at a distance 25cm from a convex lens of focal length 20cm. If a glass slab of thickness t annd refractive index 1.5 is inserted between the lens and object, image is formed at . Thickness t is found to be K times of 5cm. Fink K.

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