EXERCISE - O

SINGLE CORRECT TYPE QUESTIONS

Plane Mirror

1. A plane mirror makes an angle of 30° with horizontal. If a vertical ray strikes the mirror, find the angle between mirror and reflected

(A) 30° (B) 45° (C) 60° (D) 90°

PGO106

2. A plane mirror reflects a beam of light to form a real image. The incident beam is :-

(A) parallel (B) convergent (C) divergent (D) any one of the above

PGO107

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

(A) 50° (B) 45° (C) 30° (D) 55°

PGO108

4. Plane mirrors *A* and *B* are kept at an angle with respect to each other. Light falls on *A*, is reflected, then falls on *B* and is reflected. The emergent ray is opposite to the incident direction. Then the angle is equal to

(A) 30° (B) 45° (C) 60° (D) 90°

PGO109

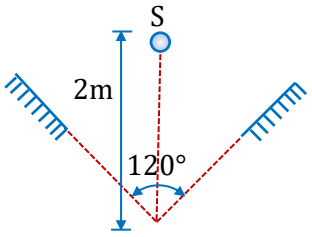
5. Two plane mirrors are placed perpendicular to each other. A ray strikes at 45° to one mirror and after reflection from the second mirror will be :-

(A) perpendicular to the original ray (B) parallel to the original ray

(C) at 45° to the original ray (D) can be at any angle to the original ray

PGO110

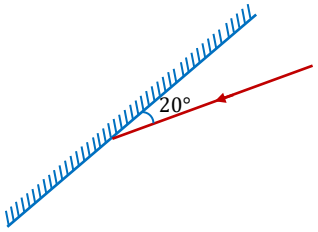
6. Area of triangle formed by *S* and its two images is :-



(A) $3\sqrt{3}\ m^2$ (B) $\frac{3\sqrt{3}}{4}\ m^2$ (C) $\frac{4}{3\sqrt{3}}\ m^2$ (D) Can't be determined

PGO111

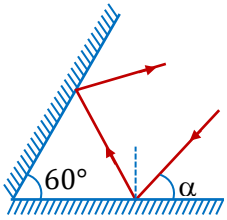
7. In the shown figure what is the value of deviation?



(A) 40° (B) 140° (C) 80° (D) None of these

PGO112

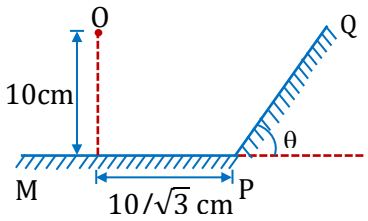
8. What is the value of α for which there are maximum 2 reflections only ?



(A) 35° (B) 45° (C) 55° (D) 65°

PGO113

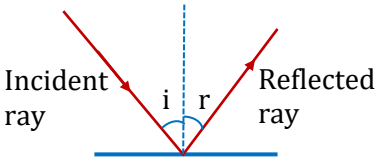
9. Two plane mirror *MN* and *PQ* inclined at an angle θ as shown in figure. *O* is a point source 10 *cm* above the mirror *MN*. For light rays striking on the mirror *MN* directly from *O* not to strike the mirror *PQ*, the maximum value of θ is :-



(A) 30° (B) 45° (C) 60° (D) 75°

PGO114

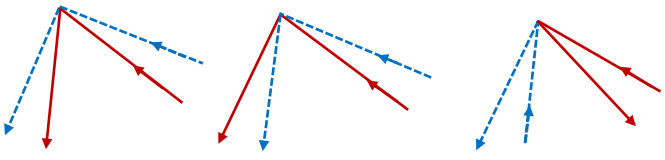
10. Law of reflection states that when a light ray is incident on a reflecting surface then angle of incidence (i) = Angle of reflection (r). If incident ray is given by $\left[\frac{\hat{i}}{2}+\frac{\sqrt{3}}{2}\hat{j}\right]$ and reflected ray is given by $\left[\frac{\hat{i}}{2}-\frac{\sqrt{3}}{2}\hat{j}\right]$, then angle of incidence is :-



(A) 30° (B) 45° (C) 60° (D) 120°

PGO115

11. Each of these diagrams is supposed to show two different rays being reflected from the same point on the same mirror. Which option is correct :-

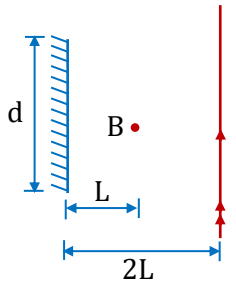


(I) (II) (III)

(A) Only I (B) Only II (C) Only III (D) All

PGO116

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



(A) $d/2$ (B) d

(C) $2d$ (D) $3d$

PGO117

13. A person is in a room whose ceiling and two adjacent walls are mirrors. How many images are formed

(A) 5 (B) 6 (C) 7 (D) 8

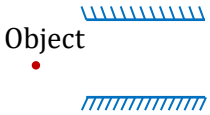
PGO119

14. An object is placed between two parallel mirrors. The number of images formed is

(A) 2 (B) 4 (C) 8 (D) infinite

PGO120

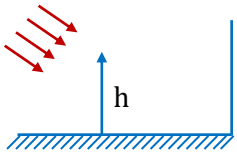
15. Consider two very small plane mirrors. If the object is at a large distance from mirrors then number of images formed by the mirror system will be



(A) 1 (B) 2 (C) ∞ (D) none of these

PGO121

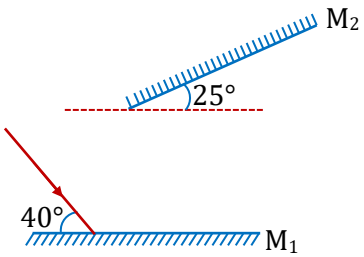
16. Sun rays are reflected from a horizontal mirror and fall on a vertical screen. An object is placed perpendicular to mirror at large distance from the screen. If object is of length 'h' then length of the shadow on the screen of image will be



(A) h (B) $2h$ (C) $3h$ (D) ∞

PGO122

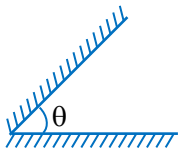
17. By what angle should M_2 be rotated, so that the light ray after reflection from both mirrors become horizontal?



(A) 5° clockwise (B) 85° clockwise (C) 5° anticlockwise (D) 15° anticlockwise

PGO123

18. Two mirrors are inclined at an angle θ as shown in the figure. Light ray is incident parallel to one of the mirrors. The ray will start retracing its path after third reflection if :-



(A) θ = 45° (B) θ = 30° (C) θ = 60° (D) all three

PGO124

19. A man, whose height is 1.75*m* is standing at a distance 6*m* from a vertical pillar of height *h* = 7*m*. At what distance from the man should we put a small flat mirror on the ground horizontally to see in it the image of the top of the pillar ?

(A) 4.8 *m* (B) 1.2 *m* (C) 5.2 *m* (D) 4.2 *m*

PGO125

20. If two mirrors are kept at 60° to each other, then the number of images formed by them is :-

(A) 5 (B) 6 (C) 7 (D) 8

PGO127

21. A point object approaches a plane mirror with a speed of 10 ms^{-1}, while the image recedes away from the mirror with a speed of 6 ms^{-1} (as seen by stationary observer). The direction and magnitude of the velocity of mirror is :-

(A) towards the object, 8 ms^{-1} (B) towards the image, 6 ms^{-1}

(C) away from the object, 8 ms^{-1} (D) away from the object, 2 ms^{-1}

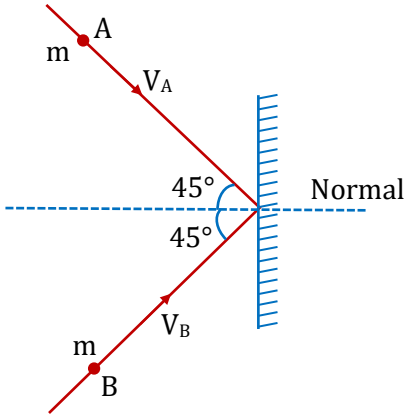
PGO128

22. An object is moving with a velocity of $2\hat{i}+3\hat{j}+6\hat{k}$. A plane mirror whose reflecting surface is parallel to *y*-*z* plane is moving with a velocity of $\hat{i}+\hat{j}+\hat{k}$. What is the velocity of image as seen by a stationary observer?

(A) $\hat{j}+4\hat{k}$ (B) $3\hat{j}+6\hat{k}$ (C) $-\hat{j}-4\hat{k}$ (D) $-\hat{i}+3\hat{j}+6\hat{k}$

PGO130

23. Two bodies *A* and *B* are moving towards a plane mirror with speeds v_A and v_B respectively as shown in the figure. The speed of image of *A* with respect to the body *B* is :-



(A) $v_A + v_B$ (B) $|\vec{v}_A+\vec{v}_B|$ (C) $\sqrt{v_A^2+v_B^2}$ (D) $\sqrt{v_A^2-v_B^2}$

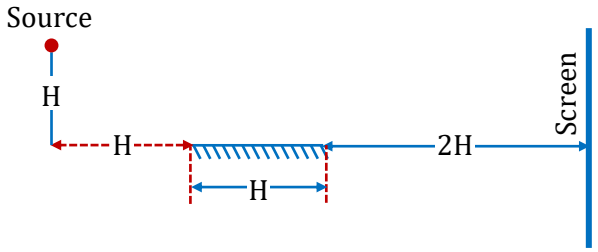
PGO131

24. A boy of *TOA*3 batch is 1.8*m* tall and can see his image in a plane mirror fixed on a wall. His eyes are 1.6*m* from the floor level. The minimum length of the mirror to see his full image is :-

(A) 0.9 *m* (B) 0.85 *m* (C) 0.8 *m* (D) Can't be determined

PGO133

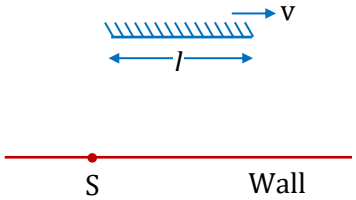
25. A point source has been placed as shown in the figure. What is the length on the screen that will receive reflected light from the mirror ?



(A) 2*H* (B) 3*H* (C) *H* (D) None

PGO134

26. A point source *S* is located on a wall. A plane mirror *M* having length *l* is moving parallel to the wall with constant velocity *v*. The bright patch formed on the wall by reflected light will



(A) move with uniform velocity *v* and will have a length 2*l*.

(B) move with uniform velocity 2*v* and will have a length *l*.

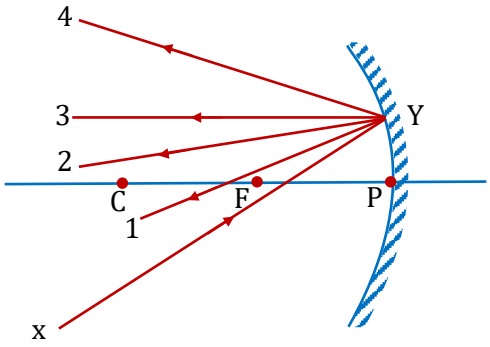
(C) move with uniform velocity 2*v* and will have a length 2*l*.

(D) move with uniform velocity but will have a changing length.

PGO135

Spherical Mirror

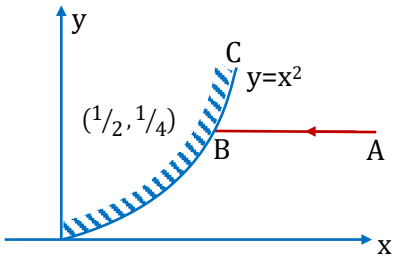
27. Figure shows a small concave mirror with *CP* as its principal axis. A ray *XY* is incident on the mirror. Which of the four rays can be the reflected ray.



(A) 1 (B) 2 (C) 3 (D) 4

PGO136

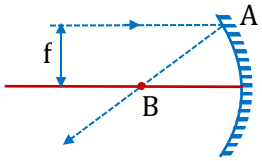
28. In the given figure, incident ray *AB* is parallel to *x*-axis. The angle of reflection is :-



(A) 30° (B) 60° (C) 45° (D) None of these

PGO137

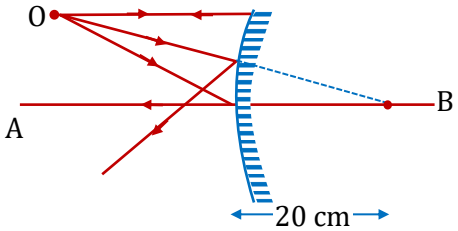
29. A ray of light is incident on a concave mirror. It is parallel to the principal axis and its height from principal axis is equal to the focal length of the mirror. The ratio of the distance of point *B* to the distance of the focus from the centre of curvature is (*AB* is the reflected ray) :-



(A) $\frac{2}{\sqrt{3}}$ (B) $\frac{\sqrt{3}}{2}$ (C) $\frac{2}{3}$ (D) $\frac{1}{2}$

PGO138

30. In the figure, a convex mirror of radius of curvature 20 *cm* is shown. An object *O* is placed in front of this mirror. Its ray diagram is shown. How many mistakes are there in the diagram?
(*AB* is its principal axis)



(A) 3 (B) 2 (C) 1 (D) 0

PGO141

31. An object is placed in front of a spherical mirror whose 2 times magnified image is formed on screen. Then choose **CORRECT** option :-

(A) Mirror is concave $m = +2$ (B) Mirror is concave $m = -2$

(C) Mirror is convex $m = +2$ (D) Mirror is convex $m = -2$

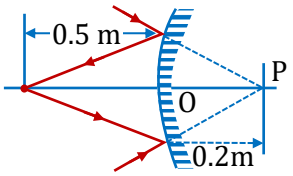
PGO142

32. An object of height $h = 5cm$ is located at a distance $a = 12$ *cm* from a concave mirror with focal length 10 *cm*. Find the height of the image :-

(A) 10 *cm* (B) 15 *cm* (C) 20 *cm* (D) 25 *cm*

PGO143

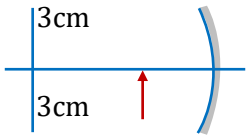
33. A beam of convergent light converges to a point 0.5 *m* in front of the mirror after reflection at a convex mirror but in the absence of the mirror the beam converges to a point 0.2 *m* behind the mirror. The radius of curvature of the mirror is :-

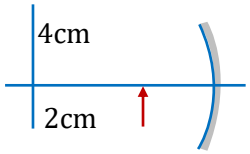


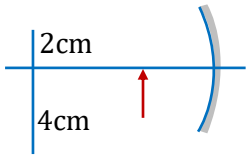
(A) 20 *cm* (B) 50 *cm* (C) 66.67 *cm* (D) 28.57 *cm*

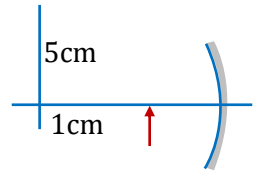
PGO144

34. A candle of length 2 *cm* is placed perpendicular to principal axis of a concave mirror of radius of curvature 40 *cm* at a distance of 30 *cm* from the mirror. A white screen is placed perpendicular to principal axis to obtain the image. If the screen is a square sheet of side 6 *cm*, then in which of the set of given arrangements the image can be totally obtained?

(i)


(ii)


(iii)


(iv)


(A) (i) and (iii) (B) (ii) and (iv) (C) (i), (ii) and (iv) (D) None of these

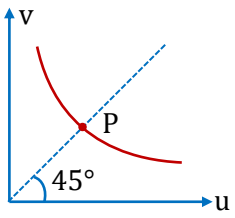
PGO145

35. A convex mirror has a radius of curvature of 20 *cm*. An object is placed in front at such a distance from the mirror that the size of the image is exactly half that of the object. The object distance must be :

(A) 20 *cm* (B) 30 *cm* (C) 10 *cm* (D) 40 *cm*

PGO146

36. The graph shows the variation of *v* with change in *u* for a mirror. Points plotted above the point *P* on the curve are for values of *v*



(A) smaller than *f* (B) smaller than 2*f* (C) larger than 2*f* (D) larger than *f*

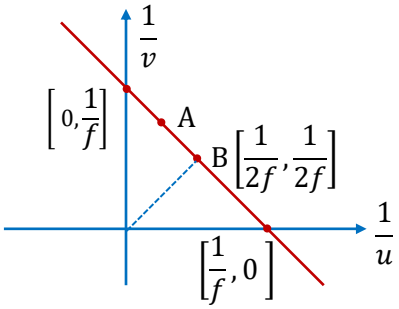
PGO147

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

(A) $\frac{uf}{u-f}$ (B) $\frac{uf}{u+f}$ (C) $\frac{f^2}{u+f}$ (D) $\frac{f^2}{u-f}$

PGO148

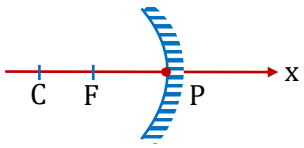
38. Figure shows $\frac{1}{v}$ vs $\frac{1}{u}$ curve for convex mirror. Nature of image at point A is :-



(A) Real, erect, magnified (B) Virtual, inverted, magnified
(C) Virtual, inverted, diminished (D) Virtual, erect, diminished

PGO149

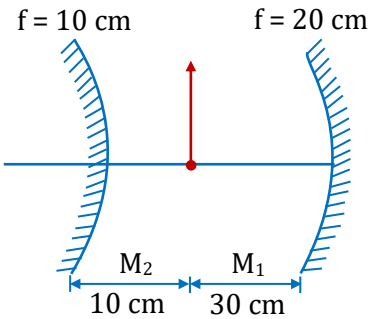
39. A concave mirror is kept as shown in figure. Its principal axis coincides with the x–axis. A real object is moving towards the pole of the mirror starting from the $-\infty$. In which region image will never form :–



(A) Between $-\infty$ and C (B) Between C and F
(C) Between F and P (D) Between P and $+\infty$

PGO150

40. In figure, find the total magnification after two successive reflections first on M_1 and then on M_2 :-

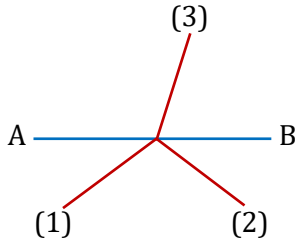


(A) +1 (B) –2 (C) +2 (D) –1

PGO155

Refraction from Plane Surface

41. *AB* is a boundary separating two media of different refractive indices. A ray is incident on the boundary is partially reflected and partially transmitted. Choose the **CORRECT** statement.



(A) 3 is incident ray and 1 is refracted ray

(B) 2 is incident ray and 1 is partially reflected ray

(C) 1 is incident ray and 3 is refracted ray

(D) 3 is incident ray and 2 is partially reflected ray

PGO158

42. **Statement-1:** You see a geostationary satellite above the horizon. You desire to communicate with the satellite by sending a beam of laser light. You should aim your laser slightly higher than the line of sight of the satellite.

Statement-2: Light bends away from the normal while moving from denser to rarer medium.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

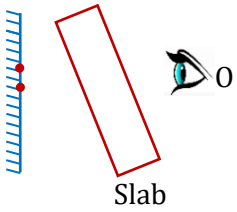
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

PGO159

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



(A) shifted upward

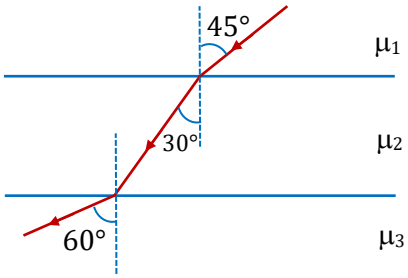
(B) shifted downward

(C) spaced farther apart

(D) spaced closer together

PGO161

44. For shown situation the value of $\frac{\mu_3}{\mu_1}$ is equal to



(A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{\frac{2}{3}}$ (C) $\sqrt{\frac{3}{2}}$ (D) $\frac{2}{\sqrt{3}}$

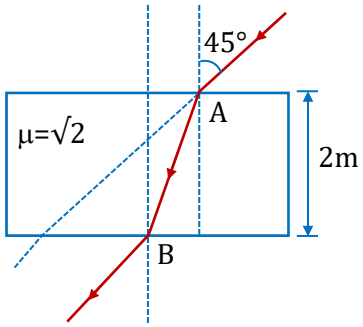
PGO162

45. A light ray is travelling from air to a liquid of refractive index $\sqrt{3}$. If the incident beam is rotated at a rate of 3 rad/sec then the angular speed of refracted beam when angle of incidence is 60° is :-

(A) 3 rad/sec (B) $\sqrt{3}$ rad/sec (C) 1 rad/sec (D) rad/sec

PGO164

46. Find the time taken by a monochromatic light to cross a transparent slab of width $2m$ and *R.I.* = $\sqrt{2}$ as shown in figure :-

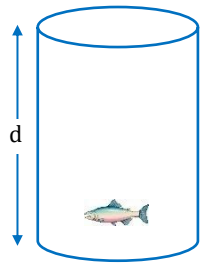


(A) $\frac{2\sqrt{2}}{3}\times10^{-8}s$ (B) $\frac{4\sqrt{2}}{3}\times10^{-8}s$

(C) $\frac{4}{3\sqrt{3}}\times10^{-8}s$ (D) $\frac{4\sqrt{2}}{3\sqrt{3}}\times10^{-8}s$

PGO165

47. A fish floats in liquid with its eye at the centre of an opaque walled full tank of liquid of circular cross section. When the fish look upwards, it can see a fish-eye view of the surrounding scene i.e. it is able to view the entire space above the liquid surface. The diameter of the tank is 30 *cm*, and the critical angle for liquid is 37°. At what maximum depth below the surface of the liquid, *d*, must the fish be floating? $\left(\sin 37^\circ = \frac{3}{5}\right)$



(A) 16 *cm* (B) 20 *cm*

(C) 11.25 *cm* (D) 25 *cm*

PGO171

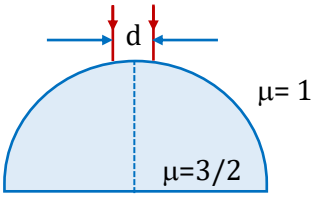
Refraction through Curved Surface

48. A light ray is incident on a transparent sphere of index =$\sqrt{2}$, at an angle of incidence = 45°. What is the deviation of a tiny fraction of the ray, which enters the sphere, undergoes two internal reflections and then refracts out into air ?

(A) 270° (B) 240° (C) 120° (D) 180°

PGO174

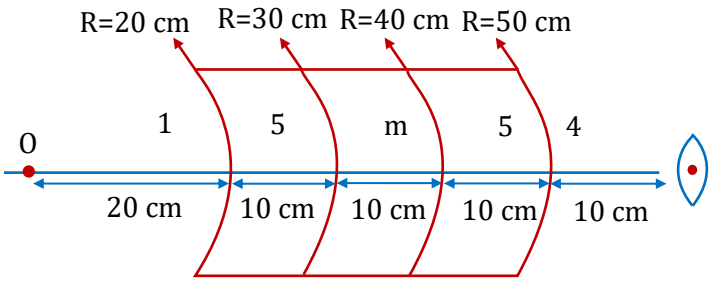
49. A beam of diameter '*d*' is incident on a glass hemisphere as shown. If the radius of curvature of the hemisphere is very large in comparison to *d*, then the diameter of the beam at the base of the hemisphere will be :-



(A) $\frac{3}{4}d$ (B) d (C) $\frac{d}{3}$ (D) $\frac{2}{3}d$

PGO189

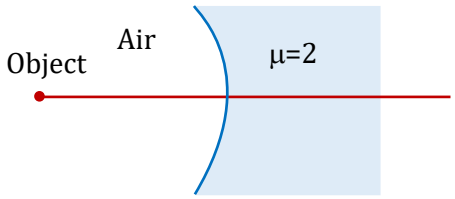
50. In the arrangement shown, separation between observer and object as seen by observer is



(A) 60 *cm* (B) more than 60 *cm* (C) less than 60 *cm* (D) depends on μ

PGO192

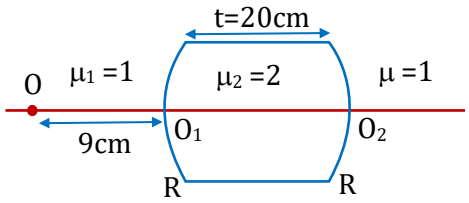
51. A concave spherical surface with radius *R* separates a medium with index of refraction 2 from air. If an object is moved toward the surface from far away along the central axis, its image :



(A) Changes from virtual to real when it is $R/2$ from the surface
(B) Changes from virtual to real when it is $2R$ from the surface
(C) Changes from real to virtual when it is $R/2$ from the surface
(D) Remains virtual

PGO193

52. In the given figure, if object is placed at a distance 9 *cm* from O_1 then find the image distance (in *cm*) from O_2. (R = 9 *cm* for both surface)



(A) 9 *cm* (B) 20 *cm* (C) 18 *cm* (D) infinity

PGO196

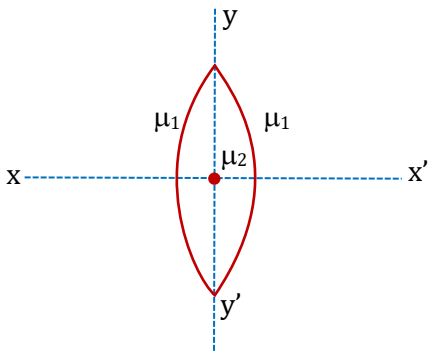
Lens

53. A convergent (biconvex) lens is placed inside a jar filled with a liquid. The lens has focal length 20*cm*, when in air and its material has a refractive index of 1.5. If the liquid has a refractive index of 1.6, the focal length of the lens while in the jar, is :-

(A) –110 *cm* (B) –130 *cm* (C) –160 *cm* (D) –180 *cm*

PGO191

54. An equi-convex lens of refractive index μ_2 and focal length f (in air) is kept in medium of refractive index μ_1.



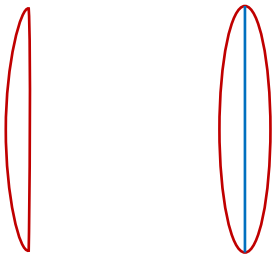
	Column-A		**Column-B**
(P)	If lens is cut in two equal parts by a plane yy'. ($\mu_1 = 1$)	(1)	Lens will act as a glass slab
(Q)	If lens is cut in two equal parts by a plane xx'. ($\mu_1 = 1$)	(2)	Lens will be converging and focal length will change.
(R)	If $\mu_1 = \mu_2$.	(3)	Lens will be converging and focal length will remain same
(S)	If $\mu_1 > \mu_2$.	(4)	Lens will be diverging and focal length will change.

Codes :

	P	**Q**	**R**	**S**
(A)	2	4	1	3
(B)	2	3	1	4
(C)	3	4	2	1
(D)	1	2	3	4

PGO200

55. You are given two thin identical plano-convex lenses, one of which is shown in the figure. When you place an object 20 *cm* to the left of a single plano-convex lens, the image appears 40 *cm* to the right of the lens. You then arrange the two plano-convex lenses back to back to form a double convex lens. If the object is at 20 *cm* to the left of this new lens, what is the approximate location of the image?

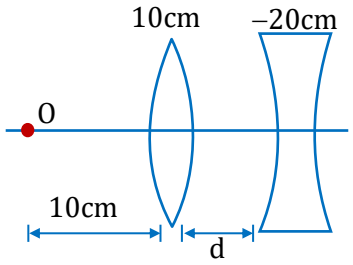


Plano-convex **Double convex**

(A) 6.7 *cm* to the right of the lens.
(B) 10 *cm* to the right of the lens.
(C) 20 *cm* to the right of the lens.
(D) 80 *cm* to the right of the lens.

PGO206

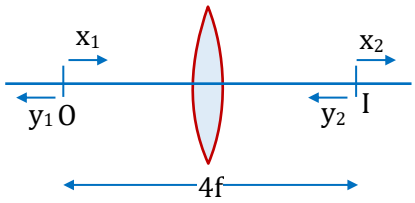
56. What should be the value of distance d so that final image is formed on the object itself ? (Focal lengths of the lenses are written on the lenses).



(A) 10 *cm* (B) 20 *cm* (C) 5 *cm* (D) none of these

PGO207

57. In a converging lens of focal length f and the distance between real object and its real image is $4f$. If the object moves x_1 distance towards lens its image moves x_2 distance away from the lens and when object moves y_1 distance away from the lens its image moves y_2 distance towards the lens, then choose the correct option :-



(A) $x_1 > x_2$ and $y_1 > y_2$ (B) $x_1 < x_2$ and $y_1 < y_2$
(C) $x_1 < x_2$ and $y_1 > y_2$ (D) $x_1 > x_2$ and $y_2 > y_1$

PGO209

58. In the displacement method, a convex lens is placed in between an object and a screen. If the magnification in the two positions are m_1 and $m_2, (m_1 > m_2)$, the distance between the two positions of the lens is x, the focal length of the lens is

(A) $\frac{x}{m_1 + m_2}$ (B) $\frac{x}{m_1 - m_2}$ (C) $\frac{x}{(m_1 + m_2)^2}$ (D) $\frac{x}{(m_1 - m_2)^2}$

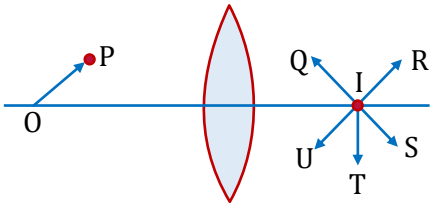
PGO213

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

(A) f / x (B) x / f (C) $\frac{f + x}{f}$ (D) $\frac{f}{f + x}$

PGO214

60. A point object O moves from the principal axis of a converging lens in a direction OP. I the image of O, will move initially in the direction :



(A) *IQ* (B) *IR* (C) *IS* (D) *IU*

PGO215

61. When the object is at distances u_1 and u_2 the images formed by the same lens are real and virtual respectively and of the same size. Then focal length of the lens is :

(A) $\frac{1}{2}\sqrt{u_1u_2}$ (B) $\frac{u_1+u_2}{2}$ (C) $\sqrt{u_1u_2}$ (D) $\sqrt{(u_1+u_2)}$

PGO216

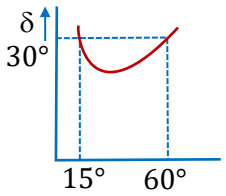
Prism

62. A ray of light is incident at 60° on a prism of refracting angle 30°. The emerging ray is at an angle 30° with the incident ray. The value of refractive index of the prism is :-

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

PGO178

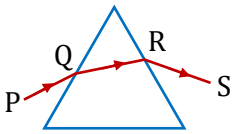
63. Figure shows graph of deviation δ versus angle of incidence for a light ray striking a prism. Angle of prism is :-



(A) 30° (B) 45° (C) 60° (D) 75°

PGO179

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



(A) *PQ* is horizontal (B) *QR* is horizontal
(C) *RS* is horizontal (D) Either *PQ* or *RS* is horizontal

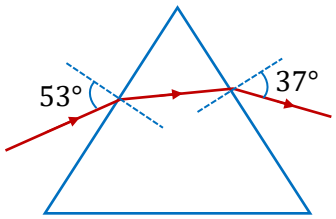
PGO180

65. An isosceles glass prism having refractive index μ has one of its faces coated with silver. A ray of light is incident normally on the other face (which is equal to the silvered face). The ray of light is reflected twice on the same sized faces and then emerges through the base of the prism perpendicularly. The angles of prism are :-

(A) 40°, 70°, 70° (B) 50°, 65°, 65° (C) 36°, 72°, 72° (D) data insufficient

PGO181

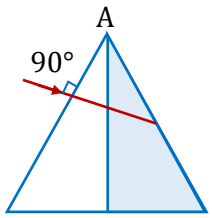
66. A ray incident at an angle 53° on a prism emerges at an angle 37° as shown. If the angle of incidence is made 50°, which of the following is a possible value of the angle of emergence?



(A) 35° (B) 42° (C) 40° (D) 38°

PGO182

67. A ray of light is incident normally on the first refracting face of the prism of refracting angle A. The ray of light comes out at grazing emergence. If one half of the prism (shaded position) is knocked off, the same ray will :–



(A) Emerge at an angle of emergence $\sin^{-1}\left(\frac{1}{2}\sec A/2\right)$

(B) Not emerge out of the prism

(C) Emerge at an angle of emergence $\sin^{-1}\left(\frac{1}{2}\sec A/4\right)$

(D) None of these

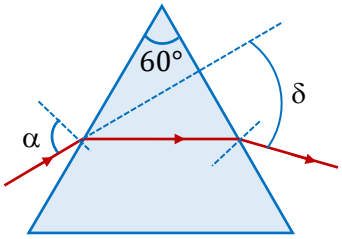
PGO183

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

(A) 0° (B) 12.5° (C) 15° (D) 22.5°

PGO184

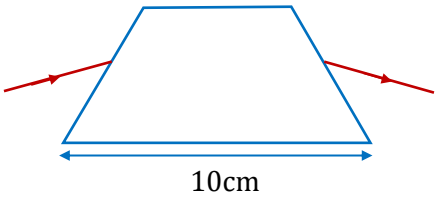
69. A light ray is incident on a triangular prism of refracting angle 60° at an angle of incidence 37° as shown in figure. The refractive index of prism material is 1.5 and surrounding medium is having refractive index 1. The angle δ through which the light ray deviates from its path is :
[(sin 37° = 0.6, sin (23.6°) = 0.4, sin (36.4°) = 0.59, $\sin^{-1}$ (0.885) = 62.3°]



(A) 39.3° (B) 52° (C) 42.4° (D) None of these

PGO185

70. Consider an isosceles trapezoid of material of refractive index $\sqrt{2}$ and dimensions of sides being 5 *cm*, 5 *cm*, 10 *cm* and 5 *cm*. The angle of minimum deviation by this arrangement when light is incident from air and emerges in air is



(A) 22.5° (B) 30° (C) 45° (D) 60°

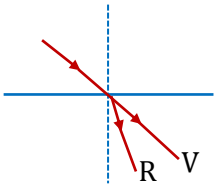
PGO186

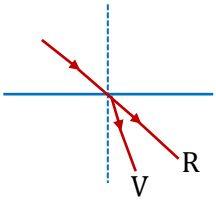
71. When white light passes through a glass prism, one gets spectrum on the other side of the prism. In the emergent beam, the ray which is deviating least is or deviation by a prism is lowest for

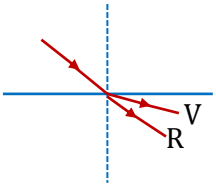
(A) Violet ray (B) Green ray (C) Red ray (D) Yellow ray

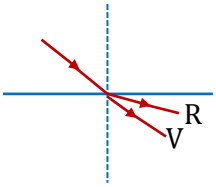
PGO218

72. A ray of light is coming from air to water. Which of the following figure shows correct dispersion of light ?

(A) 

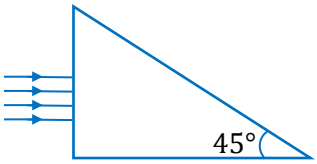
(B) 

(C) 

(D) 

PGO219

73. A beam of light consisting of red, green and blue and is incident on a right-angle prism. The refractive index of the material of the prism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The prism will



(A) separate part of the red color from the green and blue colors

(B) separate part of the blue color from the red and green colors

(C) separate all the three colors from the other two colors

(D) not separate even partially, any colors from the other two colors

PGO220

74. Chromatic aberration will be absent if for two thin lenses in contact :-

(A) $(\omega_1/F_1) + (\omega_2/F_2) = 0$ (B) $(\omega_1/F_2) + (\omega_2/F_1) = 0$

(C) $(F_1/\omega_2) + (F_2/\omega_1) = 0$ (D) $(\omega_1/\omega_2) + (F_1 + F_2) = 0$

PGO221

75. The dispersive powers of the materials of the two lenses are in the ratio 4 : 3. If the achromatic combination of these two lenses in contact is a convex lens of focal length 60 *cm* then the focal lengths of the component lenses are

(A) – 20 *cm* and 25 *cm* (B) 20 *cm* and – 25 *cm*

(C) – 15 *cm* and 40 *cm* (D) 15 *cm* and – 20 *cm*

PGO222

76. An achromatic convergent doublet of two lenses in contact has a power of + 2*D*. The convex lens has a power + 5*D*. What is the ratio of the dispersive powers of the convergent and divergent lenses

(A) 2 : 5 (B) 3 : 5 (C) 5 : 2 (D) 5 : 3

PGO224

77. It is desired to make an achromatic combination of two lenses (L_1 and L_2) made of materials having dispersive powers ω_1 and ω_2 ($<\omega_1$). If the combination of lenses is converging then

(A) L_1 is converging

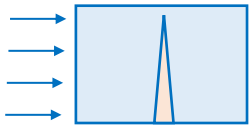
(B) L_2 is converging

(C) Power of L_1 is greater than the power of L_2

(D) None of these

PGO225

78. A thin isosceles prism with angle 4° and refractive index 5/4 is placed inside a transparent tube with liquid (refractive index = 1.5) as shown. The deviation of light due to prism will be :-



(A) 0.8° upward (B) 0.8° downward (C) 0.67° upward (D) 0.67° downward

PGO226

Defects of Eye and Optical Instruments

79. A long-sighted person has a minimum distance of distinct vision of 50 *cm*. He wants to reduce it to 25 *cm*. He should use a

(A) Concave lens of focal length 50 *cm* (B) Convex lens of focal length 25 *cm*

(C) Convex lens of focal length 50 *cm* (D) Concave lens of focal length 25 *cm*

PGO227

80. A normal eye is not able to see objects closer than 25 *cm* because

(A) the focal length of the eye is 25 *cm*

(B) the distance of the retina from the eye-lens is 25 *cm*

(C) the eye is not able to decrease the distance between the eye-lens and the retina beyond a limit

(D) the eye is not able to decrease the focal length beyond a limit.

PGO229

81. To increase the angular magnification of a simple microscope, one should increase

(A) the focal length of the lens (B) the power of the lens

(C) the aperture of the lens (D) the object size.

PGO230

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

(A) $L < u$ (B) $L > u$ (C) $f_o < L < 2f_o$ (D) $L > 2f_o$

PGO231

83. A compound microscope has a magnification of 30. The focal length of the eyepiece is 5 *cm*. If the final image is formed at the least distance of vision (25 *cm*), the magnification produced by the objective is

(A) 5 (B) 7.5 (C) 10 (D) 15

PGO232

84. A person can see objects only at a distance greater than 40 *cm*. He is advised to use lens of power

(A) + 2.5 *D* (B) + 1.5 *D* (C) – 2.5 *D* (D) – 6.25 *D*

PGO233

85. A person cannot see clearly objects at a distance less than 100 *cm*. The power of the spectacles required to see clearly objects at 25 *cm* is

(A) + 1 *D* (B) + 3 *D* (C) + 4 *D* (D) + 2 *D*

PGO234

86. Astigmatism for a human eye can be removed by using

(A) concave lens (B) convex lens (C) cylindrical lens (D) prismatic lens

PGO235

87. In the case of hypermetropia

(A) the image of a near object is formed behind the retina

(B) the image of a distant object is formed on front of the retina

(C) a concave lens should be used for correction

(D) a convex lens should not be used for correction

PGO236

88. When the length of an astronomical telescope tube increases its magnifying power

(A) Decreases (B) Increases

(C) Does not change (D) May increase or decrease

PGO237

89. An astronomical telescope has magnifying power 6 for distant objects. The separation between objective and the eye piece is 42 *cm* and the final image is formed at infinity. The focal length f_0 of objective and focal length f_e of eye-piece are (in *cm*) :-

(A) $f_0 = 36, f_e = 6$ (B) $f_0 = 50, f_e = 8$ (C) $f_0 = 20, f_e = 10$ (D) $f_0 = 40, f_e = 8$

PGO242

90. An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and the eyepiece is 36 *cm* and the final image is formed at infinity. The focal length of the objective and of the eyepiece are

(A) $f_o = 45cm$ and $f_e = -9cm$ (B) $f_o = 50cm$ and $f_e = 10cm$

(C) $f_o = 7.2cm$ and $f_e = 5cm$ (D) $f_o = 30cm$ and $f_e = 6cm$

PGO243

91. An astronomical telescope has an eyepiece of focal length 5 *cm*. If the angular magnification in normal adjustment is 10, the distance between the objective and the eye piece is

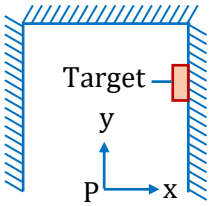
(A) 45 *cm* (B) 50 *cm* (C) 55 *cm* (D) 110 *cm*

PGO244

MULTIPLE CORRECT TYPE QUESTIONS

Plane Mirror

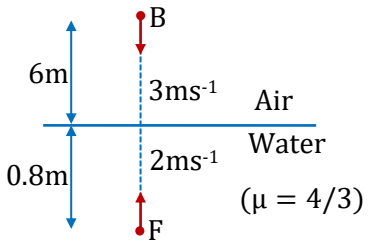
92. The drawing shows a top view of a square room. One wall is missing and the other three are each mirrors. From point *P* in the center of the open side, a laser is fired, with the intent of hitting a small target located at the center of one wall. Identify vector in whose direction the laser can be fired and score a hit, assuming that the light does not strike any mirror more than one.



(A) $\frac{\hat{i}}{3} + \hat{j}$ (B) $\hat{i} + \hat{j}$ (C) $-\hat{i} + \hat{j}$ (D) $-\hat{i} + \frac{\hat{j}}{3}$

PGO118

93. A fish, *F* in the pond, is at a depth of 0.8 *m* from water surface and is moving vertically upwards with velocity 2 ms^{-1}. At the same instant, a bird *B* is at a height of 6 *m* from water surface and is moving downwards with velocity 3 ms^{-1}. At this instant both are on the same vertical lines as shown in the figure. Which of the following statement(s) is(are) correct?



(A) Height of *B*, observed by *F* (from itself) is equal to 8.00 *m*.

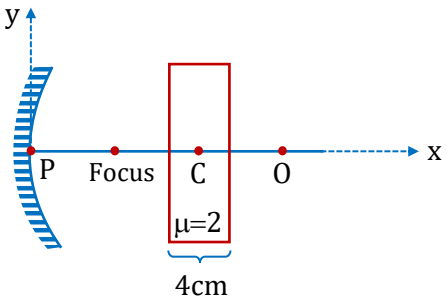
(B) Depth of *F*, observed by *B* (from itself) is equal to 6.60 *m*.

(C) Velocity of *B*, observed by *F* (relative to itself) is equal to 5.00 ms^{-1}.

(D) Velocity of *F*, observed by *B* (relative to itself) if equal to 4.50 ms^{-1}.

PGO160

94. A concave mirror of focal length 50 *cm* is placed at origin as shown in diagram. A point sized object is placed at *O* (x = 152 *cm*). A glass slab of thickness 4 *cm*, μ = 2, is placed symmetrically around *C*. Light can not reach from object to mirror without passing through slab. Choose the **CORRECT** option(s) :



(A) Image made by concave mirror will be at *x* = 75 *cm*

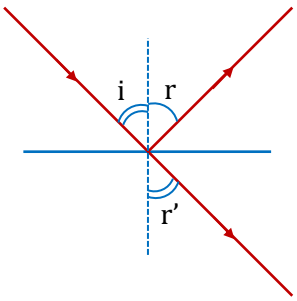
(B) Final image made by entire optical system will be at *x* = 77 *cm*.

(C) Final image of the system will be real.

(D) Final image of the system will be virtual.

PGO168

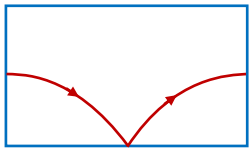
95. A ray of light from a denser medium strikes a rarer medium at an angle of incidence *i*. The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are *i* and *r*. The critical angle is :-

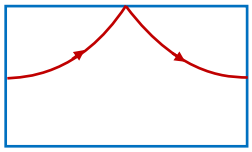


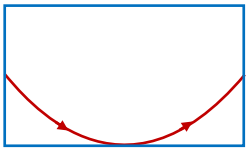
(A) $\sin^{-1}(\tan r)$ (B) $\sin^{-1}(\tan i)$ (C) $\sin^{-1}(\tan r')$ (D) $\tan^{-1}(\sin i)$

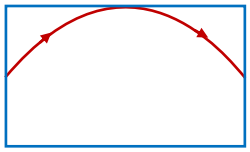
PGO169

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

(A) 

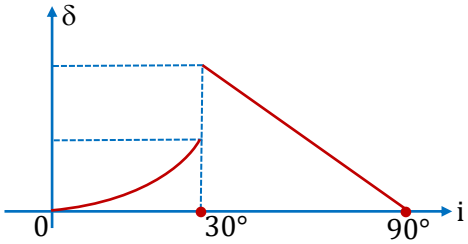
(B) 

(C) 

(D) 

PGO172

97. Figure shows graph of angle of deviation v/s angle of incidence for a light ray. Incident ray goes from medium 1 (μ_1) to medium 2 (μ_2). Mark the **correct** option(s).



(A) $\frac{\mu_1}{\mu_2} = \frac{1}{2}$

(B) Critical angle is 30°

(C) $\mu_1 > \mu_2$

(D) Maximum deviation is 120°

PGO173

98. In the figure (a) light is incident at an angle θ which is slightly greater than the critical angle. Now, keeping the incident fixed a slab of refractive index n_3 ($n_3 < n_2$) is placed on surface AB in fig. (b). Which of the following statements are correct :

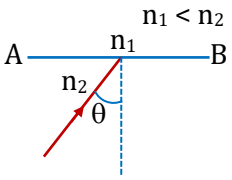


Fig. (a)

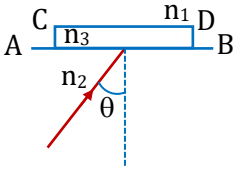


Fig. (b)

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

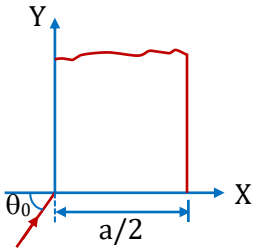
(B) total internal reflection occurs at AB for $n_3 > n_1$

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

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

PGO176

99. A glass slab is of thickness $d = a/2$ is shown in figure. The refractive index of the slab varies according to relation $\mu = \frac{a}{a-x}$ where a is positive constant. A ray of light enters the slab at origin at an angle $\theta_0 \to \pi/2$, then choose the **CORRECT** statement (s):-



(A) The path of the light ray inside medium is a circle given by $(x - a)^2 + y^2 = a^2$

(B) The path of the light ray inside medium is a parabola given by $(x - a)^2 = y$

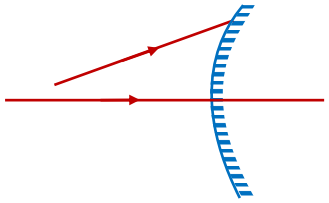
(C) The deviation of ray from its initial direction is $\delta = \pi/3$

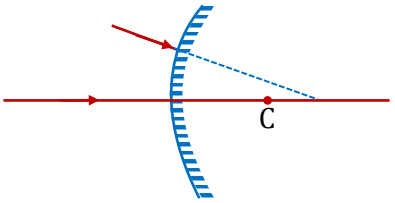
(D) Ray emerges grazing at the surface.

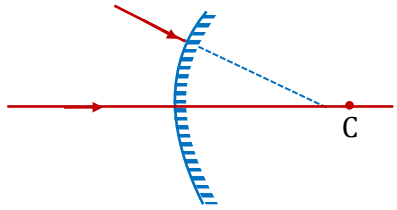
PGO177

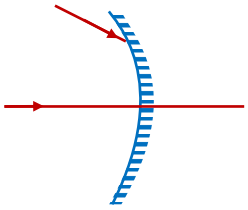
Spherical Mirror

100. In which of the following diagrams the image formed is virtual and inverted ?

(A) 

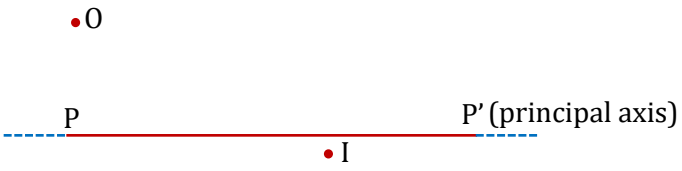
(B) 

(C) 

(D) 

PGO140

101. The location *I* of image for object location *O* can be obtained by placing



(A) Concave mirror left of *O* facing towards *O*.

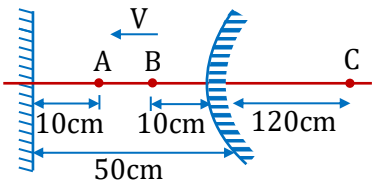
(B) Concave mirror right of *I* facing towards *I*.

(C) Convex mirror between *O* and I facing towards *O*.

(D) Convex mirror right of *I* facing away from *I*.

PGO151

102. In the figure 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 $1/5^{th}$ magnification w.r.t *AB*

(B) the second image is virtual and erect with magnification $1/5$ w.r.t *AB*

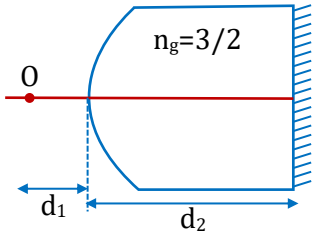
(C) the second image moves towards the convex mirror

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

PGO156

Refraction through Curved Surface

103. In the figure shown a point object *O* is placed in air on the principal axis. The radius of curvature of the spherical surface is 60 *cm*. I_f is the final image formed after all the refractions and reflections.



(A) If d_1 = 120 *cm*, then the 'I_f' is formed on '*O*' for any value of d_2.

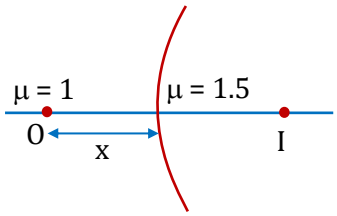
(B) If d_1 = 240 *cm*, then the 'I_f' is formed on '*O*' only if d_2 = 360 *cm*.

(C) If d_1 = 240 *cm*, then the 'I_f' is formed on '*O*' for all values of d_2.

(D) If d_1 = 240 *cm*, then the 'I_f' cannot be formed on '*O*'.

PGO194

104. A convex spherical surface of radius 10 *cm* is used to form the image of a point object as shown. What should be the object distance *x* so that the distance between object and the image is 1 *m* ?



(A) 40 *cm* (B) 50 *cm* (C) 60 *cm* (D) 70 *cm*

PGO197

Lens

105. A lens is formed by a material having refracting index $\frac{3}{2}$ and radii of curvature 20*cm* and 10 *cm*. Then choose the correct option(s) :-

(A) If lens is concavo-convex and light is falling on the surface having radius of curvature 20 *cm*, then focal length is 40 *cm*

(B) If lens is concavo-convex and light is falling on the surface having radius of curvature 10 *cm*, then focal length is –40 *cm*

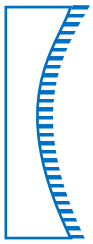
(C) If lens is convexo-concave and light is falling on the surface having radius of curvature 20 *cm*, then focal length is 40 *cm*

(D) If lens is convexo-concave and light is falling on the surface having radius of curvature 10 *cm*, then focal length is –40 *cm*

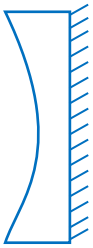
PGO190

106. Which of the following silvered lenses kept in air may form real image of a real object.

(A) 

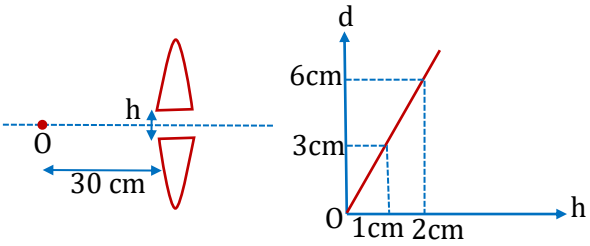
(B) 

(C) 

(D) 

PGO199

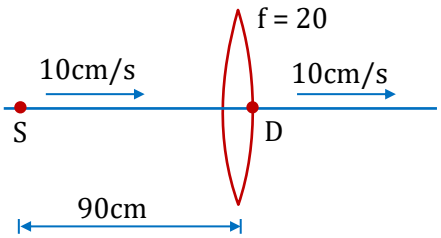
107. Figure shows a convex lens cut symmetrically into two equal halves and separated laterally by a distance *h*. A point object *O* placed symmetrically at a distance 30 *cm*, from the lens halves, forms two images separated by a distance *d*. A plot of *d* versus *h* is shown in figure. The focal length of the lens is :-



(A) 22.5 *cm* (B) 40 *cm* (C) 45 *cm* (D) 20 *cm*

PGO201

108. The figure shows initial positions of a source of light *S* and a light detector *D*. Both *S* and *D* move with velocity 10 *cm/s*, as shown. The converging lens of focal length 20 *cm* is fixed. Time instant(s) when the detector detects maximum intensity of light is/are :-



(A) 3 sec (B) 4.5 sec
(C) 6 sec (D) equal intensity at all time

PGO208

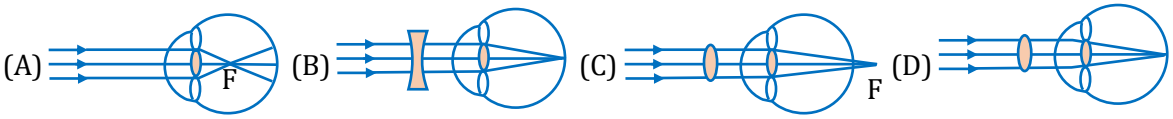
109. In displacement method, the distance between object and screen is 96 *cm*. The ratio of length of two images formed by a convex lens placed between them is 4.84 :-

(A) Ratio of the length of object to the length of shorter image is 11/5.
(B) Distance between the two positions of the lens is 36 *cm*.
(C) Focal length of the lens is 20.625 *cm*.
(D) Distance of the lens from the shorter image is 30 *cm*.

PGO217

Defects of Eye and Optical Instruments

110. Identify the wrong description of the given figures :-



(A) *A* represents far-sightedness (B) *B* correction for short-sightedness
(C) *C* represents far-sightedness (D) *D* correction for far-sightedness

PGO228

COMPREHENSION TYPE QUESTIONS

Lens

PARAGRAPH FOR QUESTION NO. 111 TO 113

A turnip sits before a thin converging lens, outside the focal point of the lens. The lens is filled with a transparent gel so that it is flexible; by squeezing its ends toward its center [as indicated in figure(a)], you can change the curvature of its front and rear sides.

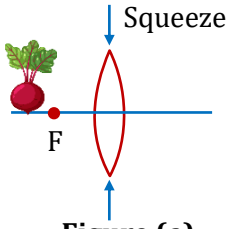


Figure (a)

111. When you squeeze the lens, the image.

(A) moves towards the lens (B) moves away from the lens

(C) shifts up (D) remains as it is

PGO210

112. When you squeeze the lens, the lateral height of image.

(A) increases (B) decreases (C) remains same (D) data insufficient

PGO211

113. Suppose that a sharp image must be formed on a card which is at a certain distance behind the lens [figure(b)], while you move the turnip away from the lens, then you should

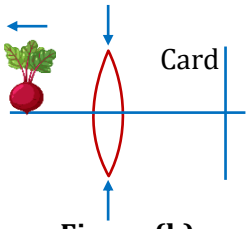


Figure (b)

(A) decrease the squeeze of the lens (B) increase the squeeze of the lens

(C) keep the card and lens as it is. (D) move the card away from the lens

PGO212

Defects of Eye and Optical Instruments

PARAGRAPH FOR QUESTION NO. 114 TO 117

114. If an astronomical telescope has objective and eye-pieces of focal lengths 200 *cm* and 4 *cm* respectively, then the magnifying power of the telescope for the normal vision is

(A) 42 (B) 50 (C) 58 (D) 204

PGO238

115. In the above question the length of the telescope for normal vision, is

(A) 204 *cm* (B) 200 *cm* (C) 196 *cm* (D) 203.45 *cm*

PGO239

116. In the above question magnifying power of the telescope for distinct vision is

(A) 42 (B) 50 (C) 58 (D) 204

PGO240

117. In the above question the length of the telescope for distinct vision is

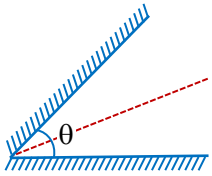
(A) 204 *cm* (B) 200 *cm* (C) 196 *cm* (D) 203.45 *cm*

PGO241

MATRIX MATCH TYPE QUESTION

Plane Mirror

118. Angle between two mirrors 'θ' and location of object is given in column *I* and some possible number of images are given in column *II*.



Column–I	Column–II
(A) θ = 30° and object is on bisector	(P) 9
(B) θ = 36° and object is on bisector	(Q) 11
(C) θ = 22.5° and object is on bisector	(R) 8
(D) θ = 50° and object is on bisector	(S) 15

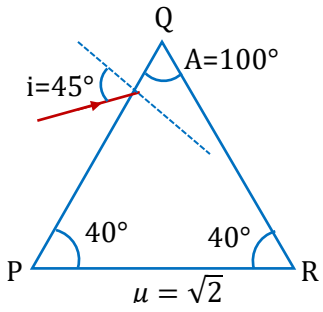
PGO129

Prism

119. Light is incident at surface *PQ* of prism as shown in column-I then match the column-I with column-II (surrounding medium is air in all cases)

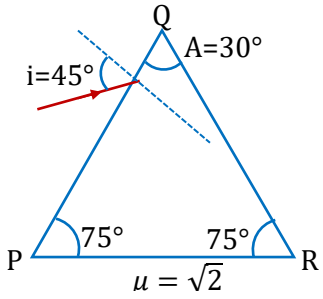
Column-I **Column-II**

(A)

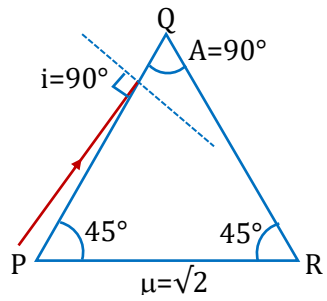
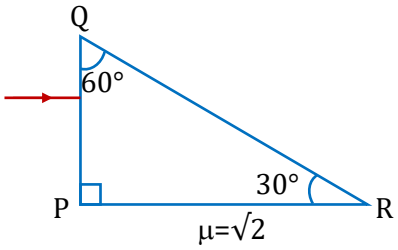


(P) Total internal reflection takes place at surface *QR*

(B)



(Q) Light emerges normally from the surface *QR*

Column-I	Column-II
(C)  Grazing incidence	(R) Light emerges parallel to surface *QR*
(D)  Normal incidence	(S) The light ray emerges from face perpendicularly
	(T) When light ray passes through the prism it is parallel to the base *PR*.

PGO187

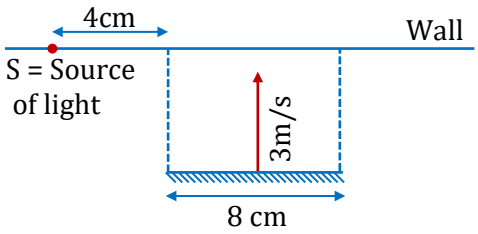
EXERCISE - S

Plane Mirror

1. There is a point object and a plane mirror. If the mirror is moved by 2 *cm* away from the object find the distance (in *cm*) which the image will move.

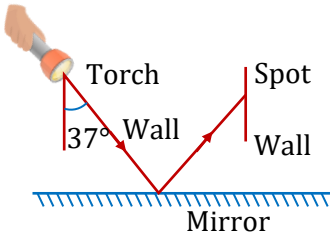
PGO126

2. A plane mirror of length 8 *cm* is moving with speed 3 *m/s* towards a wall in situation as shown in figure. Size of spot formed on the wall is $32/x$ *cm*. Find the value of x.



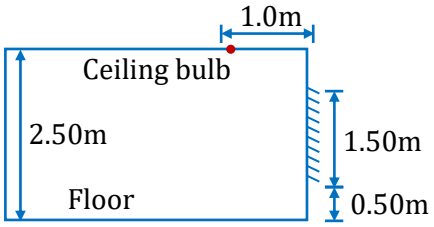
PGO132

3. As shown in the figure a torch is used to send a beam of light on a mirror which forms a spot on a vertical wall. If the wall is moved 6 *cm* towards left, keeping the direction of beam fixed, the vertical shift of spot on the wall is x *cm*, then fill value of $\frac{x}{16}$.



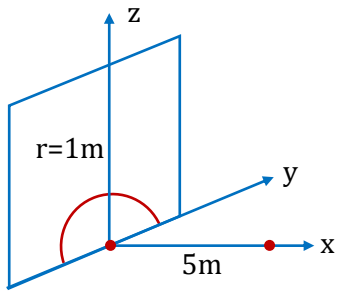
PGO245

4. A plane mirror of length 1.50 *m* hangs on a 2.50 *m* tall wall inside a room. The bottom of mirror is 0.50 *m* above the floor. A small bulb is situated at the ceiling of room at a distance of 1.0 *m* from the wall of plane mirror as shown in the figure. Find the length (in *m*) of patch of light on the floor due to reflection from mirror (assume floor size is sufficient)



PGO246

5. A plane mirror of semicircular shape (radius = 1m) is placed in y-z plane with its diameter along y-axis and centre at origin. A point object in the form of light source is placed on the axis of mirror at point (5, 0, 0). At a distance of 10 m from plane mirror there is a wall also parallel to y-z plane. The ratio of area of spot of light on wall to that of mirror is

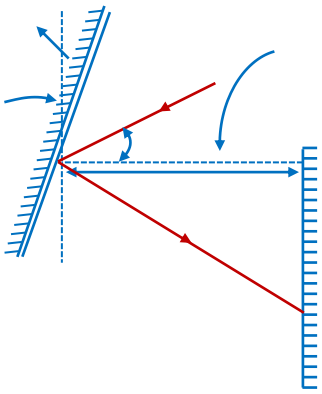


PGO247

6. A point object is moving with velocity $6\hat{i}+\hat{j}+2\hat{k}$ (m/s) in front of a plane mirror whose reflecting side is xz-plane. If the mirror also moves with a velocity $\hat{i}-\hat{j}$ (m/s), what is the speed of the image in m/s rounded off to nearest integer ?

PGO248

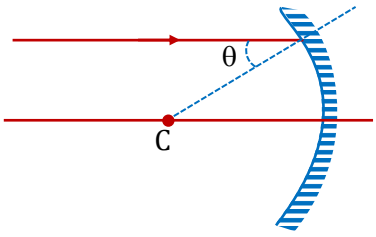
7. The view in the figure is from above a plane mirror suspended by a thread connected to the centre of the mirror at point A. A scale is located 0.75 m (the distance from point A to point P) to the right of the centre of the mirror. Initially, the plane of the mirror is parallel to the side of the scale; and the angle of incidence of a light ray which is directed at the centre of the mirror is 30°. A small torque applied to the thread causes the mirror to turn 11.5° away from its initial position. The reflected ray then intersects the scale at point Q. The distance (in m) from point P to point Q on the scale is :-



PGO249

Spherical Mirror

8. A ray incident parallel to principal axis on a concave mirror at an angle θ after two reflection, reflected ray becomes parallel to incident ray. If $\theta=\frac{\pi}{N}$ (in radian) then find the value of N.

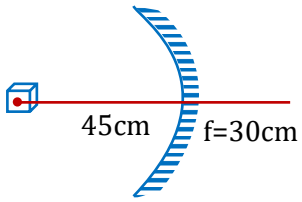


PGO139

9. An experimentalist devises a method for finding the radius of curvature of a convex mirror. He uses a plane mirror strip between the object and the convex mirror and adjusts it till the two virtual images formed by reflection at both the mirrors coincide without parallax. In his observations, the object distance from the convex mirror is 0.5 *m* while it is 0.30 *m* in front of the plane mirror. Find the radius of curvature (in *cm*) of the convex mirror.

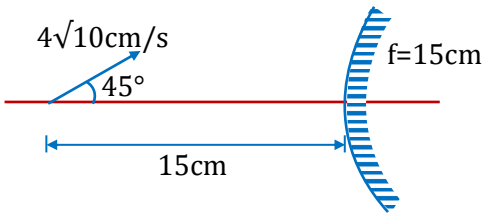
PGO152

10. A cube of side length 1*mm* is placed on the axis of a concave mirror at a distance of 45 *cm* from the pole as shown in the figure. One edge of the cube is parallel to the axis. The focal length of the mirror is 30 *cm*. Find approximate volume of the image.



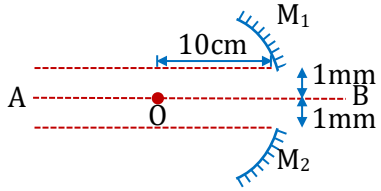
PGO153

11. In the figure shown, the speed *cm/s* of image with respect to mirror is :



PGO154

12. 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*. If an object is placed of a distance of 10 *cm* from the mirror on the line *AB* then, find the distance between the images formed by the two parts?



PGO157

Refraction from Plane Surface

13. A cylindrical bucket of depth 60 *cm* is partly filled with a liquid of refractive index 1.5 and with oil (on top of liquid) of refractive index 2. It appears that the volume of air, volume of liquid and volume of oil are equal, to an observer who views from top of the bucket. The apparent depth of the bucket as seen by the observer is given as α *cm*. Fill $\left(\frac{\alpha}{5}\right)$ in OMR sheet.

PGO163

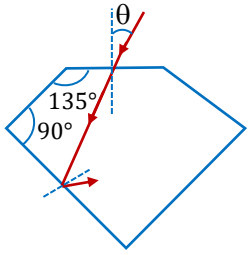
14. At what angle with the normal (in degree) should a light beam fall on the surface from air to material of -refractive index n = 1.732, if the angle of refraction was half the angle of incidence? Assume that the beam is not incident normally.

PGO166

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

PGO167

16. A ray of light enters a diamond (n = 2) from air and is being internally reflected near the bottom as shown in the figure. Find maximum value of angle θ possible ?



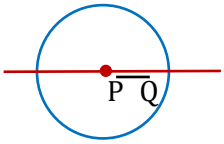
PGO170

17. A room contains air in which the speed of sound is 340 m/s. The walls of the room are made of concrete, in which the speed of sound is 1700 m/s. (a) Find the critical angle for total internal reflection of sound at the concrete–air boundary. (b) In which medium must the sound be traveling to undergo total internal reflection? (Assume sound waves follow snell's law)

PGO175

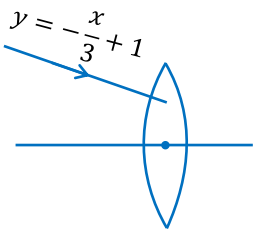
Refraction through Curved Surface

18. A small object of length 1 mm lies along the principal axis of a spherical glass of radius R = 10 cm and refractive index is 3/2. The object is seen from air along the principal axis from left. The distance of object from the centre is 5 cm. Find the size of the image. Is real, inverted ?



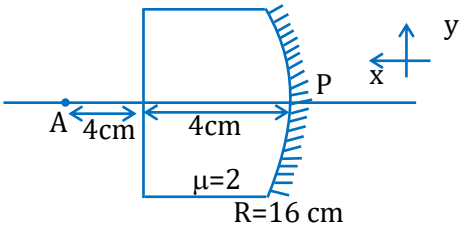
PGO195

19. A convex lens of focal length 15 cm is placed at the origin with its optical axis coinciding with the x-axis. A ray of light given by $y = -\frac{x}{3}+1$ is incident on the lens. The equation of refracted ray is $y = -0.1mx + c$. (x and y are in cm). Find the value of m.



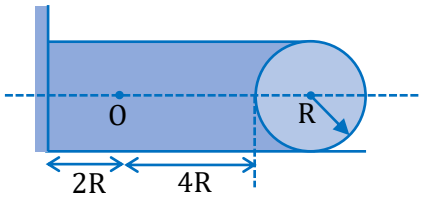
PGO250

20. A curved thick glass surface is silvered at curved face & not silvered on plane surface. Object is placed at A as shown in figure. Considering *P* (pole of the silvered surface) as origin. If *x* – co–ordinate of final image is '*n*' *cm* then find *n*.



PGO251

21. The figure shows a very long circular cylinder of radius $R = 2m$ made of glass $\mu_g = \frac{3}{2}$ fixed to the horizontal surface. The space between the cylinder and a vertical wall (plane mirror) is filled with water of refractive index $\mu_w = 4/3$, as shown in figure. Find the positions of the final image formed of an object *O* placed on the horizontal axis passing through the centre of mass *C* of the cylinder as shown in figure. Express your answer with respect to centre *C* of the cylinder. Consider only paraxial rays lying in the vertical plane containing the point *O* and *C*.



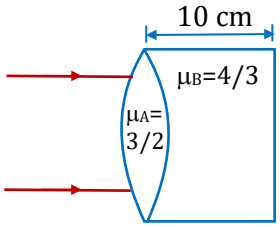
PGO252

Lens

22. A plano convex lens (μ = 1.5) has a maximum thickness of 1 *mm*. If diameter of its aperture is 4 *cm*. Find (i) Radius of curvature of curved surface; (ii) its focal length in air.

PGO188

23. A parallel paraxial beam of light is incident on the arrangement as shown $\mu_A = 3/2$, $\mu_B = 4/3$, the two spherical surfaces are very close and each has radius of curvature 10 *cm*. Find the point where the rays are focussed. (w.r.t. point of entry)



PGO198

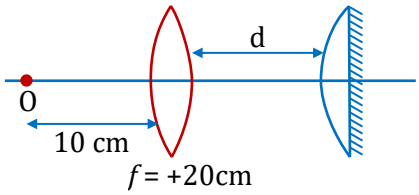
24. A converging beam of rays is incident on a diverging lens. Having passed through the lens the rays intersect at a point 15 *cm* from the lens. If the lens is removed, the point where the rays meet will move 5 *cm* closer to the mounting that holds. Find the focal length (in *cm*) of the lens without sign.

PGO202

25. A point source of light is kept at a distance of 150 *cm* from a converging lens, on its optical axis. The focal length of the lens is 100 *cm* and its diameter is 3 *cm*. A screen is placed on the other side of the lens, perpendicular to the axis of lens, at a distance 200 *cm* from it. Then find the area of the illuminated part of the screen? (Assume all rays incident on lens as paraxial)

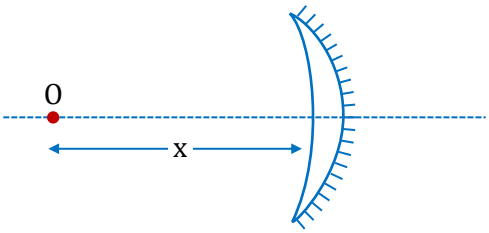
PGO203

26. A convex lens of focal length 20 *cm* and another plano convex lens of focal length 40 *cm* are placed co-axially (see fig.). The plano convex lens is silvered on plane surface. What should be the 5*d* (in *m*) so that final image of the object '*O*' is formed on *O* itself.



PGO204

27. Radii of curvature of a concavo-convex lens (refractive index = 1.5) are 40 *cm* and 20 *cm* as shown. The convex side is silvered. The distance *x* (in *cm*) on the principal axis where an object is placed so that its image is created on the object itself, is given as 4β. Find the value of β.



PGO205

Prism

28. A flint glass convex lens of focal length 16 *cm* is placed in contact with crown glass lens. The refractive indices of crown glass for violet and red colour are $\mu_v = 1.525$, $\mu_r = 1.515$ and for flint glass $\mu_{v'} = 1.655$ and $\mu_{r'} = 1.645$.

(a) Find the nature and focal length of the crown glass lens which will form an achromatic combination with the flint glass lens.

(b) What is the focal length of the combination?

PGO223

Defects of Eye and Optical Instruments

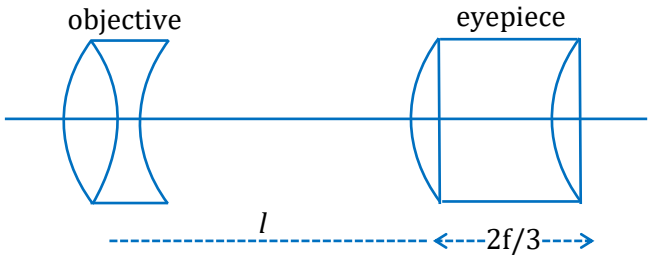
29. A simple telescope consisting of an objective of focal length 60 *cm* and a single eye lens of focal length 5 *cm* is focussed on a distant object in such a way that parallel rays emerge from the eye lens. If the object subtend an angle of 2° at the objective then find the angular width of the image (in degree).

PGO253

30. You are trying to construct a compound microscope given two lenses with focal lengths f_1 = 1.0 *cm* and f_2 = 4.0 *cm.* How far apart (in *cm*) should you place the lenses in order to obtain an angular magnification of 60 ? (Assume normal adjustment of microscope)

PGO254

31. The objective of an astronomicaltelescope consists of two thin lenses in contact, of focal lengths +20 *cm* and -25 *cm* respectively. Eyepiece of the same telescope consists of two plano convex lenses each of focal length f separated by 2/3 *f* as shown in the figure. Find the value of *l* for which final image will be formed at infinity with its angular magnification 100/3. Also find *f*.



PGO255

32. An object viewed from a near point distance of 25 *cm*, using a microscopic lens with magnification '6', gives an unresolved image. A resolved image is observed at infinite distance with a total magnification double the earlier using an eyepiece along with the given lens and a tube of length 0.6 *m*. The focal length of the eyepiece is equal to _____*cm*.

PGO256

EXERCISE - JEE (Main) PYQ

1. A thin convex lens made from crown glass $\left(\mu = \frac{3}{2}\right)$ has focal length f. When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal length f_1 and f_2 respectively. The correct relation between the focal lengths is : **[JEE (Main) 2014]**

(1) $f_2 > f$ and f_1 becomes negative (2) f_1 and f_2 both become negative

(3) $f_1 = f_2 < f$ (4) $f_1 > f$ and f_2 become negative

PGO031

2. A green light is incident from the water to the air - water interface at the critical angle (θ). Select the **correct** statement. **[JEE (Main) 2014]**

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

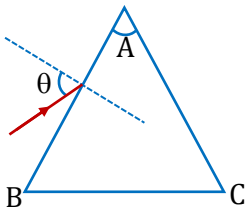
(2) The entire spectrum of visible light will come out of the water at various angles to the normal

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

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

PGO032

3. Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ, a ray, incident at an angle θ, on the face AB would get transmitted through the face AC of the prism provided : **[JEE (Main) 2015]**



(1) $\theta > \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$ (2) $\theta < \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(3) $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$ (4) $\theta < \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

PGO033

4. An observer looks at a distant tree of height 10 m with a telescope of magnifying power of 20. To the observer the tree appears : **[JEE (Main) 2016]**

(1) 20 times nearer (2) 10 times taller (3) 10 times nearer (4) 20 times taller

PGO034

5. In an experiment for determination of refractive index of glass of a prism by $i - \delta$, plot, it was found that a ray incident at angle 35°, suffers a deviation of 40° and that it emerges at angle 79°. In that case which of the following is closest to the maximum possible value of the refractive index? **[JEE (Main) 2016]**

(1) 1.8 (2) 1.5 (3) 1.6 (4) 1.7

PGO035

6. A diverging lens with magnitude of focal length 25 *cm* is placed at a distance of 15 *cm* from a converging lens of magnitude of focal length 20 *cm*. A beam of parallel light falls on the diverging lens. The final image formed is : **[JEE (Main) 2017]**

(1) real and at a distance of 40 *cm* from the divergent lens

(2) real and at a distance of 6 *cm* from the convergent lens

(3) real and at a distance of 40 *cm* from convergent lens

(4) virtual and at a distance of 40 *cm* from convergent lens.

PGO036

7. The eye can be regarded as a single refracting surface. The radius of curvature of this surface is equal to that of cornea (7.8 *mm*). This surface separates two media of refractive indices 1 and 1.34. Calculate the distance from the refracting surface at which a parallel beam of light will come to focus. **[JEE (Main) 2019]**

(1) 2 *cm* (2) 1 *cm* (3) 3.1 *cm* (4) 4.0 *cm*

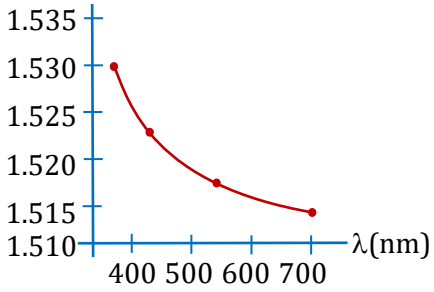
PGO037

8. A plano convex lens of refractive index μ_1 and focal length f_1 is kept in contact with another plano concave lens of refractive index μ_2 and focal length f_2. If the radius of curvature of their spherical faces is R each and $f_1 = 2f_2$, then μ_1 and μ_2 are related as : **[JEE (Main) 2019]**

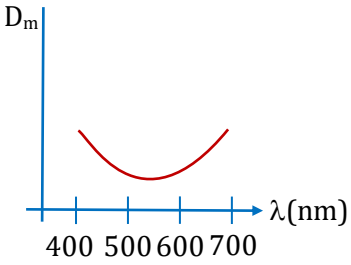
(1) $\mu_1 + \mu_2 = 3$ (2) $2\mu_1 - \mu_2 = 1$ (3) $2\mu_2 - \mu_1 = 1$ (4) $3\mu_2 - 2\mu_1 = 1$

PGO038

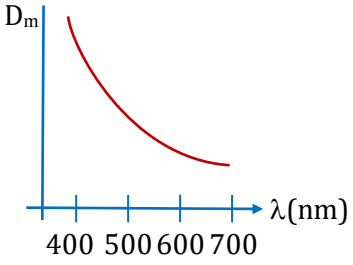
9. The variation of refractive index of a crown glass thin prism with wavelength of the incident light is shown. Which of the following graphs is the correct one, if D_m is the angle of minimum deviation? **[JEE (Main) 2019]**



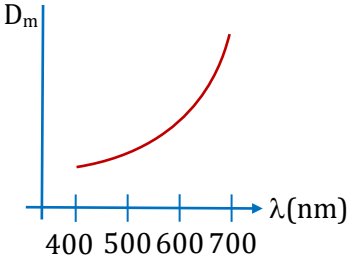
(1)



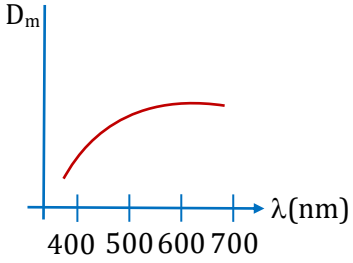
(2)



(3)

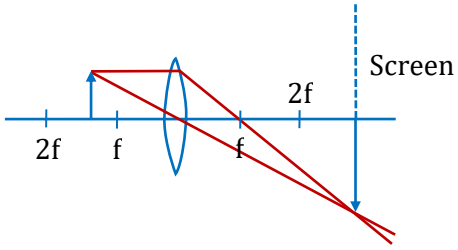


(4)



PGO039

10. Formation of real image using a biconvex lens is shown below : **[JEE (Main) 2019]**



If the whole set up is immersed in water without disturbing the object and the screen position, what will one observe on the screen ?

(1) Image disappears (2) No change

(3) Erect real image (4) Magnified image

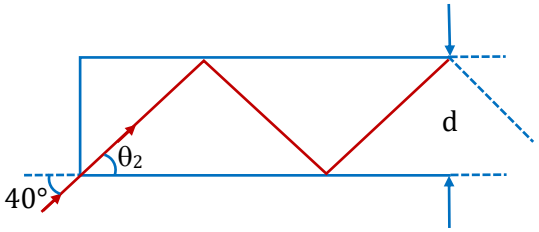
PGO040

11. A convex lens (of focal length 20 *cm*) and a concave mirror, having their principal axes along the same lines, are kept 80 *cm* apart from each other. The concave mirror is to the right of the convex lens. When an object is kept at a distance of 30 *cm* to the left of the convex lens, its image remains at the same position even if the concave mirror is removed. The maximum distance of the object for which this concave mirror, by itself would produce a virtual image would be: **[JEE (Main) 2019]**

(1) 20 *cm* (2) 10 *cm* (3) 25 *cm* (4) 30 *cm*

PGO041

12. In figure, the optical fiber is $\ell = 2m$ long and has a diameter of $d = 20\ \mu m$. If a ray of light is incident on one end of the fiber at angle $\theta_1 = 40°$, the number of reflection it makes before emerging from the other end is close to: (Refractive index of fibre is 1.31 and sin 40° = 0.64) **[JEE (Main) 2019]**

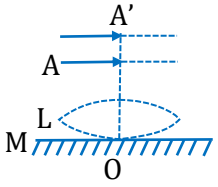


(1) 55000 (2) 57000 (3) 66000 (4) 45000

PGO042

13. A thin convex lens *L* (refractive index = 1.5) is placed on a plane mirror *M*. When a pin is placed at *A*, such that *OA* = 18 *cm*, its real inverted image is formed at *A* itself, as shown in figure. When a liquid of refractive index μ_1 is put between the lens and the mirror. The pin has to be moved to *A*', such that *OA*' = 27 *cm*, to get its inverted real image at *A*' itself. The value of μ_1 will be :-

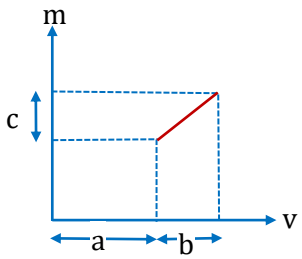
[JEE (Main) 2019]



(1) $\sqrt{2}$ (2) $\frac{4}{3}$ (3) $\sqrt{3}$ (4) $\frac{3}{2}$

PGO043

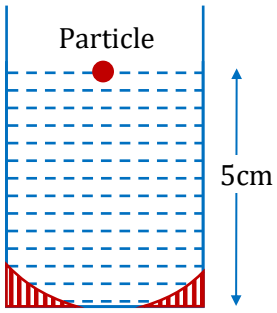
14. The graph shows how the magnification m produced by a thin lens varies with image distance v. What is the focal length of the lens used ? **[JEE (Main) 2019]**



(1) $\frac{b^2c}{a}$ (2) $\frac{b^2}{ac}$ (3) $\frac{a}{c}$ (4) $\frac{b}{c}$

PGO044

15. A concave mirror has radius of curvature of 40 *cm*. It is at the bottom of a glass that has water filled up to 5 *cm* (see figure). If a small particle is floating on the surface of water, its image as seen, from directly above the glass, is at a distance d from the surface of water. The value of d is close to : (Refractive index of water = 1.33) **[JEE (Main) 2019]**



(1) 8.8 *cm* (2) 11.7 *cm* (3) 6.7 *cm* (4) 13.4 *cm*

PGO045

16. An object is at a distance of 20 *m* from a convex lens of focal length 0.3 *m*. The lens forms an image of the object. If the object moves away from the lens at a speed of 5 *m/s*, the speed and direction of the image will be : **[JEE (Main) 2019]**

(1) 0.92×10^{-3} *m/s* away from the lens (2) 2.26×10^{-3} *m/s* away from the lens

(3) 1.16×10^{-3} *m/s* towards the lens (4) 3.22×10^{-3} *m/s* towards the lens

PGO046

17. In a compound microscope, the magnified virtual image is formed at a distance of 25 *cm* from the eye-piece. The focal length of its objective lens is 1 *cm*. If the magnification is 100 and the tube length of the microscope is 20 *cm*, then the focal length of the eye-piece lens (in *cm*) is _____.

[JEE (Main) 2020]

PGO047

18. The distance between an object and a screen is 100 *cm*. A lens can produce real image of the object on the screen for two different positions between the screen and the object. The distance between these two positions is 40 *cm*. If the power of the lens is close to $\left(\frac{N}{100}\right)D$ where N is an integer, the value of N is _____.

[JEE (Main) 2020]

PGO048

19. If we need a magnification of 375 from a compound microscope of tube length 150 *mm* and an objective of focal length 5 *mm*, the focal length of the eye-piece, should be close to :

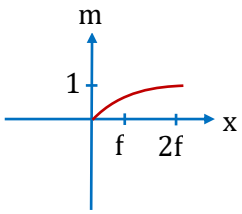
[JEE (Main) 2020]

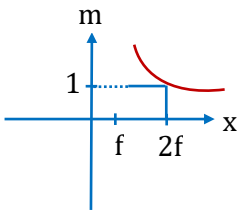
(1) 22 *mm* (2) 12 *mm* (3) 33 *mm* (4) 2 *mm*

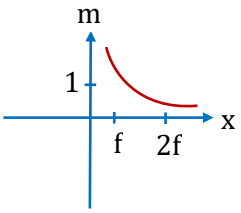
PGO049

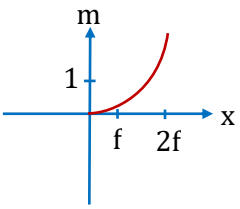
20. An object is gradually moving away from the focal point of a concave mirror along the axis of the mirror. The graphical representation of the magnitude of linear magnification (m) versus distance of the object from the mirror (x) is correctly given by :

(Graphs are drawn schematically and are not to scale) **[JEE (Main) 2020]**

(1) 

(2) 

(3) 

(4) 

PGO050

21. There is a small source of light at some depth below the surface of water (refractive index = $\frac{4}{3}$) in a tank of large cross sectional surface area. Neglecting any reflection from the bottom and absorption by water, percentage of light that emerges out of surface is (nearly) :

[Use the fact that surface area of a spherical cap of height h and radius of curvature r is $2\pi rh$]

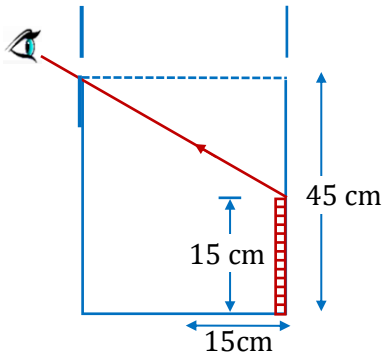
[JEE (Main) 2020]

(1) 17% (2) 21% (3) 34% (4) 50%

PGO051

22. An observer can see through a small hole on the side of a jar (radius 15 *cm*) at a point at height of 15 *cm* from the bottom (see figure). The hole is at a height of 45 *cm*. When the jar is filled with a liquid up to a height of 30 *cm* the same observer can see the edge at the bottom of the jar. If the refractive index of the liquid $N/100$, where N is an integer, the value of N is_____.

[JEE (Main) 2020]



PGO052

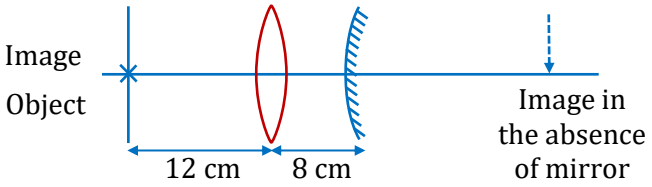
23. A thin lens made of glass (refractive index = 1.5) of focal length $f = 16\ cm$ is immersed in a liquid of refractive index 1.42. If its focal length in liquid is f_l, then the ratio f_l/f is closest to the integer :

[JEE (Main) 2020]

(1) 1 (2) 5 (3) 9 (4) 17

PGO053

24. An object is placed at a distance of 12 *cm* from a convex lens. A convex mirror of focal length 15 *cm* is placed on other side of lens at 8 *cm* as shown in the figure. Image of object coincides with the object.



When the convex mirror is removed, a real and inverted image is formed at a position. The distance of the image from the object will be .....(*cm*)

[JEE (Main) 2021]

PGO054

25. Car *B* overtakes another car *A* at a relative speed of 40 ms^{-1}. How fast will the image of car *B* appear to move in the mirror of focal length 10 *cm* fitted in car *A*, when the car *B* is 1.9 *m* away from the car *A*?

[JEE (Main) 2021]

(1) 4 ms^{-1} (2) 0.2 ms^{-1} (3) 40 ms^{-1} (4) 0.1 ms^{-1}

PGO055

26. A ray of light is incident at an angle of incidence 60° on the glass slab of refractive index $\sqrt{3}$. After refraction, the light ray emerges out from other parallel faces and lateral shift between incident ray and emergent ray is $4\sqrt{3}\ cm$. The thickness of the glass slab is _____ *cm*.

[JEE (Main) 2022]

PGO056

27. Two identical thin biconvex lenses of focal length 15 *cm* and refractive index 1.5 are in contact with each other. The space between the lenses is filled with a liquid of refractive index 1.25. The focal length of the combination is _____ *cm*.

[JEE (Main) 2022]

PGO057

28. Two objects *A* and *B* are placed at 15 *cm* and 25 *cm* from the pole in front of a concave mirror having radius of curvature 40 *cm*. The distance between images formed by the mirror is:

[JEE (Main) 2023]

(1) 40 *cm* (2) 60 *cm* (3) 160 *cm* (4) 100 *cm*

PGO258

29. A thin cylindrical rod of length 10 *cm* is placed horizontally on the principal axis of a concave mirror of focal length 20 *cm*. The rod is placed in a such a way that mid-point of the rod is at 40 *cm* from the pole of mirror. The length of the image formed by the mirror will be $\frac{x}{3}$ cm. The value of *x* is _____.

[JEE (Main) 2023]

PGO259

30. A monochromatic light wave with wavelength λ_1 and frequency v_1 in air enters another medium. If the angle of incidence and angle of refraction at the interface are 45° and 30° respectively, then the wavelength λ_2 and frequency v_2 of the refracted wave are : **[JEE (Main) 2023]**

(1) $\lambda_2 = \lambda_1, \nu_2 = \sqrt{2}\nu_1$

(2) $\lambda_2 = \frac{1}{\sqrt{2}}\lambda_1, \nu_2 = \nu_1$

(3) $\lambda_2 = \sqrt{2}\lambda_1, \nu_2 = \nu_1$

(4) $\lambda_2 = \lambda_1, \nu_2 = \frac{1}{\sqrt{2}}\nu_1$

PGO260

31. In a reflecting telescope, a secondary mirror is used to: **[JEE (Main) 2023]**

(1) reduce the problem of mechanical support

(2) remove spherical aberration

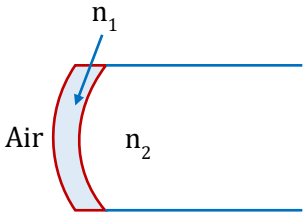
(3) make chromatic aberration zero

(4) move the eyepiece outside the telescopic tube

PGO261

EXERCISE - JEE (Advanced) PYQ

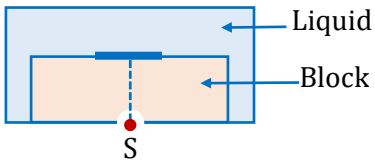
1. A transparent thin film of uniform thickness and refractive index $n_1 = 1.4$ is coated on the convex spherical surface of radius R at one end of a long solid glass cylinder of refractive index $n_2 = 1.5$, as shown in the figure. Rays of light parallel to the axis of the cylinder traversing through the film from air to glass get focused at distance f_1 from the film, while rays of light traversing from glass to air get focused at distance f_2 from the film. Then **[JEE (Advanced) 2014]**



(A) $|f_1| = 3R$ (B) $|f_1| = 2.8\ R$ (C) $|f_2| = 2R$ (D) $|f_2| = 1.4\ R$

PGO076

2. A point source S is placed at the bottom of a transparent block of height 10 *mm* and refractive index 2.72. It is immersed in a lower refractive index liquid as shown in the figure. It is found that the light emerging from the block to the liquid forms a circular bright spot of diameter 11.54 *mm* on the top of the block. The refractive index of the liquid is :- **[JEE (Advanced) 2014]**



(A) 1.21 (B) 1.30 (C) 1.36 (D) 1.42

PGO077

3. Four combinations of two thin lenses are given in List-I. The radius of curvature of all curved surfaces is r and the refractive index of all the lenses is 1.5. Match lens combinations in List-I with their focal length in List-II and select the correct answer using the code given below the lists.

[JEE (Advanced) 2014]

List–I		**List–II**	
(P)		(1)	$2r$
(Q)		(2)	$\frac{r}{2}$
(R)		(3)	$-r$
(S)		(4)	r

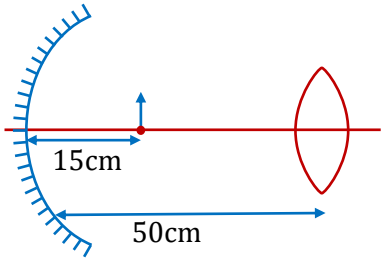
Code :

(A) P-1, Q-2, R-3, S-4 (B) P-2, Q-4, R-3, S-1

(C) P-4, Q-1, R-2, S-3 (D) P-2, Q-1, R-3, S-4

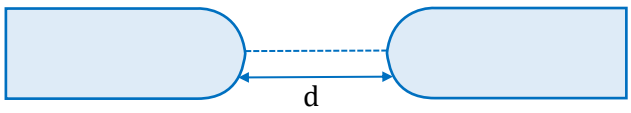
PGO078

4. Consider a concave mirror and a convex lens (refractive index = 1.5) of focal length 10 *cm* each, separated by a distance of 50 *cm* in air (refractive index = 1) as shown in the figure. An object is placed at a distance of 15 *cm* from the mirror. Its erect image formed by this combination has magnification M_1. When the set-up is kept in a medium of refractive index 7/6 the magnification becomes M_2. The magnitude $\left|\frac{M_2}{M_1}\right|$ is **[JEE (Advanced) 2015]**



PGO079

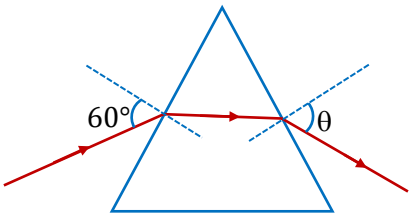
5. Two identical glass rods S_1 and S_2 (refractive index = 1.5) have one convex end of radius of curvature 10 cm. They are placed with the curved surfaces at a distance *d* as shown in the figure, with their axes (shown by the dashed line) aligned. When a point source of light *P* is placed inside rod S_1 on its axis at a distance of 50 cm from the curved face, the light rays emanating from it are found to be parallel to the axis inside S_2. The distance *d* is : **[JEE (Advanced) 2015]**



(A) 60 *cm* (B) 70 *cm* (C) 80 *cm* (D) 90 *cm*

PGO080

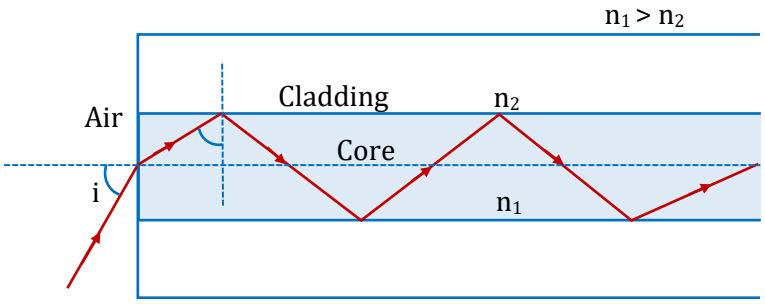
6. A monochromatic beam of light is incident at 60° on one face of an equilateral prism of refractive index *n* and emerges from the opposite face making an angle θ(*n*) with the normal (see the figure). For $n = \sqrt{3}$ the value of θ is 60° and $\frac{d\theta}{dn} = m$. The value of *m* is **[JEE (Advanced) 2015]**



PGO081

PARAGRAPH FOR QUESTION NO. 7 & 8

Light guidance in an optical fiber can be understood by considering a structure comprising of thin solid glass cylinder of refractive index n_1 surrounded by a medium of lower refractive index n_2. The light guidance in the structure takes place due to successive total internal reflections at the interface of the media n_1 and n_2 as shown in the figure. All rays with the angle of incidence i less than a particular value of i_m are confined in the medium of refractive index n_1. The numerical aperture (NA) of the structure is defined as sin i_m. **[JEE (Advanced) 2015]**



7. For two structures namely S_1 with $n_1 = \sqrt{45}/4$ and $n_2 = 3/2$, and S_2 with $n_1 = 8/5$ and $n_2 = 7/5$ and taking the refractive index of water to be $4/3$ and that of air to be 1, the correct option(s) is (are)

(A) NA of S_1 immersed in water is the same as that of S_2 immersed in liquid of refractive index $\frac{16}{3\sqrt{15}}$.

(B) NA of S_1 immersed in liquid of refractive index $\frac{6}{\sqrt{15}}$ is the same as that of S_2 immersed in water.

(C) NA of S_1 placed in air is the same as that of S_2 immersed in liquid of refractive index $\frac{4}{\sqrt{15}}$.

(D) NA of S_1 placed in air is the same as that of S_2 placed in water.

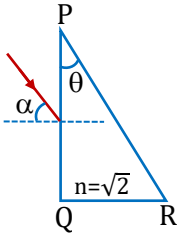
PGO082

8. If two structures of same cross-sectional area, but different numerical apertures NA_1 and NA_2 ($NA_2 < NA_1$) are joined longitudinally, the numerical aperture of the combined structure is

(A) $\frac{NA_1 NA_2}{NA_1 + NA_2}$ (B) $NA_1 + NA_2$ (C) NA_1 (D) NA_2

PGO083

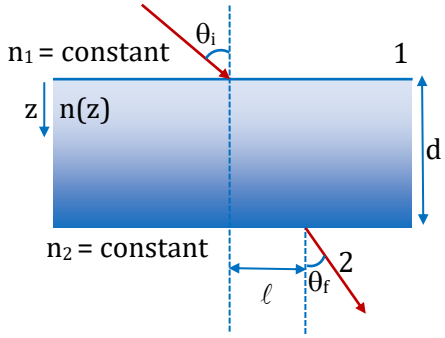
9. A parallel beam of light is incident from air at an angle α on the side PQ of a right angled triangular prism of refractive index $n = \sqrt{2}$. Light undergoes total internal reflection in the prism at the face PR when α has a minimum value of 45°. The angle θ of the prism is : **[JEE (Advanced) 2016]**



(A) 15° (B) 22.5° (C) 30° (D) 45°

PGO084

10. A transparent slab of thickness d has a refractive index $n(z)$ that increases with z. Here z is the vertical distance inside the slab, measured from the top. The slab is placed between two media with uniform refractive indices n_1 and n_2 ($> n_1$), as shown in the figure. A ray of light is incident with angle θ_i from medium 1 and emerges in medium 2 with refraction angle θ_f with a lateral displacement ℓ. Which of the following statement(s) is(are) true ? **[JEE (Advanced) 2016]**



(A) ℓ is independent of n_2

(B) ℓ is dependent on $n(z)$

(C) $n_1 \sin\theta_i = (n_2 - n_1)\sin\theta_f$

(D) $n_1 \sin\theta_i = n_2 \sin\theta_f$

PGO085

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

(A) The refractive index of the lens is 2.5 **[JEE (Advanced) 2016]**

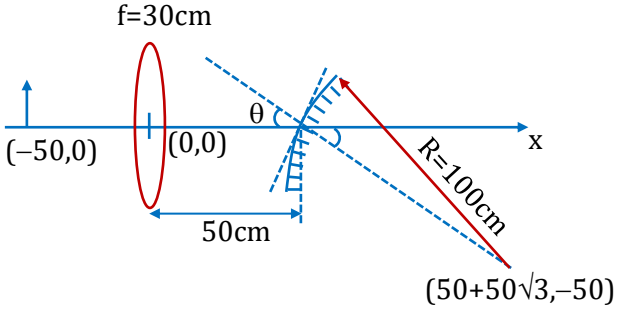
(B) The radius of curvature of the convex surface is 45 *cm*

(C) The faint image is erect and real

(D) The focal length of the lens is 20 *cm*.

PGO086

12. A small object is placed 50 *cm* to the left of thin convex lens of focal length 30 *cm*. A convex spherical mirror of radius of curvature 100 *cm* is placed to the right of the lens at a distance of 50 *cm*. The mirror is tilted such that the axis of the mirror is at an angle $\theta = 30°$ to the axis of the lens, as shown in the figure. If the origin of the coordinate system is taken to be at the centre of the lens, the coordinates (in *cm*) of the point (x, y) at which the image is formed are : **[JEE (Advanced) 2016]**



(A) $(25, 25\sqrt{3})$ (B) $\left(\frac{125}{3}, \frac{25}{\sqrt{3}}\right)$ (C) $(50-25\sqrt{3}, 25)$ (D) (0, 0)

PGO087

13. For an isosceles prism of angle A and refractive index μ, it is found that the angle of minimum deviation $\delta_m = A$. Which of the following options is/are correct ? **[JEE (Advanced) 2017]**

(A) At minimum deviation, the incident angle i_1 and the refracting angle r_1 at the first refracting surface are related by $r_1 = (i_1/2)$

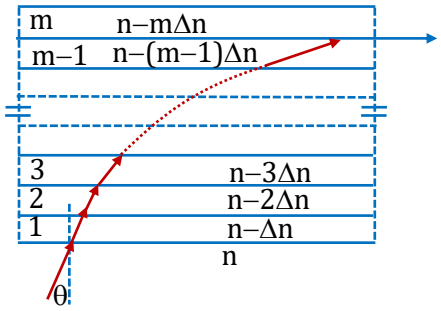
(B) For this prism, the refractive index μ and the angle of prism A are related as $A = \frac{1}{2}\cos^{-1}\left(\frac{\mu}{2}\right)$

(C) For this prism, the emergent ray at the second surface will be tangential to the surface when the angle of incidence at the first surface is $i_1 = \sin^{-1}\left[\sin A\sqrt{4\cos^2\frac{A}{2}-1}-\cos A\right]$

(D) For the angle of incidence $i_1 = A$, the ray inside the prism is parallel to the base of the prism.

PGO088

14. A monochromatic light is travelling in a medium of refractive index $n = 1.6$. It enters a stack of glass layers from the bottom side at an angle $\theta = 30°$. The interfaces of the glass layers are parallel to each other. The refractive indices of different glass layers are monotonically decreasing as $n_m = n - m\Delta n$, where n_m is the refractive index of the m^{th} slab and $\Delta n = 0.1$ (see the figure). The ray is refracted out parallel to the interface between the $(m-1)^{th}$ and m^{th} slabs from the right side of the stack. What is the value of m? **[JEE (Advanced) 2017]**

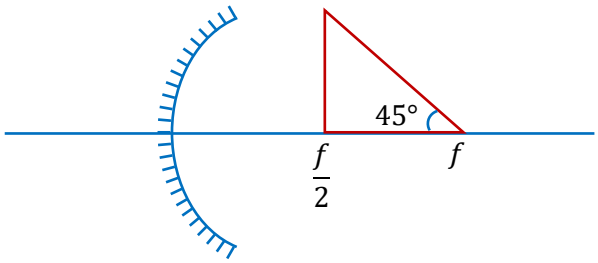


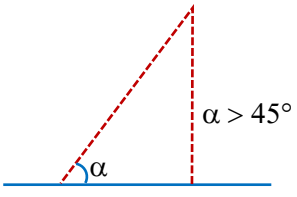
PGO089

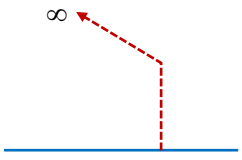
15. Sunlight of intensity 1.3 $kW\ m^{-2}$ is incident normally on a thin convex lens of focal length 20 cm. Ignore the energy loss of light due to the lens and assume that the lens aperture size is much smaller than its focal length. The average intensity of light, in $kW\ m^{-2}$, at a distance 22 cm from the lens on the other side is _____. **[JEE (Advanced) 2018]**

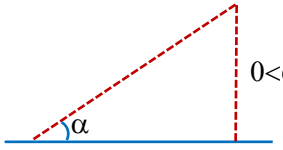
PGO090

16. A wire is bent in the shape of a right angled triangle and is placed in front of a concave mirror of focal length f, as shown in the figure. Which of the figures shown in the four options qualitatively represent(s) the shape of the image of the bent wire ? (These figures are not to scale.) **[JEE (Advanced) 2018]**



(A)


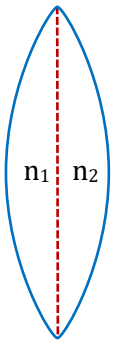
(B)


(C)


(D)


PGO091

17. A thin convex lens is made of two materials with refractive indices n_1 and n_2, as shown in figure. The radius of curvature of the left and right spherical surfaces are equal. f is the focal length of the lens when $n_1 = n_2 = n$. The focal length is $f + \Delta f$ when $n_1 = n$ and $n_2 = n + \Delta n$. Assuming $\Delta n << (n-1)$ and $1 < n < 2$, the correct statement(s) is/are : **[JEE (Advanced) 2019]**



(A) The relation between $\frac{\Delta f}{f}$ and $\frac{\Delta n}{n}$ remains unchanged if both the convex surfaces are replaced by concave surfaces of the same radius of curvature.

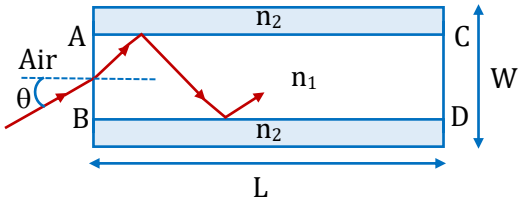
(B) $\left|\frac{\Delta f}{f}\right| < \left|\frac{\Delta n}{n}\right|$

(C) For $n = 1.5$, $\Delta n = 10^{-3}$ and $f = 20$ *cm*, the value of $|\Delta f|$ will be 0.02 *cm* (round off to 2nd decimal place)

(D) If $\frac{\Delta n}{n} < 0$ then $\frac{\Delta f}{f} > 0$

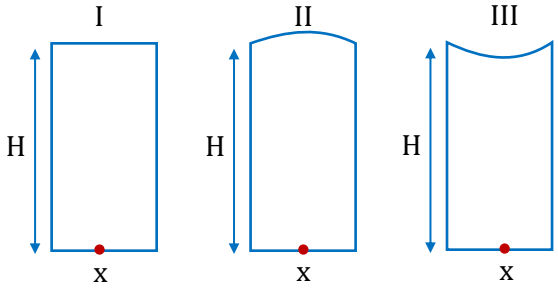
PGO092

18. A planar structure of length L and width W is made of two different optical media of refractive indices $n_1 = 1.5$ and $n_2 = 1.44$ as shown in figure. If $L >> W$, a ray entering from end AB will emerge from end CD only if the total internal reflection condition is met inside the structure. For $L = 9.6$ *m*, if the incident angle θ is varied, the maximum time taken by a ray to exit the plane CD is $t \times 10^{-9}$ *s*, where t is ___. [Speed of light $c = 3 \times 10^8$ *m/s*] **[JEE (Advanced) 2019]**



PGO093

19. Three glass cylinders of equal height H = 30 *cm* and same refractive index n = 1.5 are placed on a horizontal surfaces shown in figure. Cylinder *I* has a flat top, cylinder II has a convex top and cylinder III has a concave top. The radii of curvature of the two curved tops are same ($R = 3m$). If H_1, H_2 and H_3 are the apparent depths of a point *X* on the bottom of the three cylinders, respectively, the correct statement(s) is/are **[JEE (Advanced) 2019]**



(A) $H_3 > H_1$

(B) 0.8 cm < $(H_2 - H_1)$ < 0.9 cm

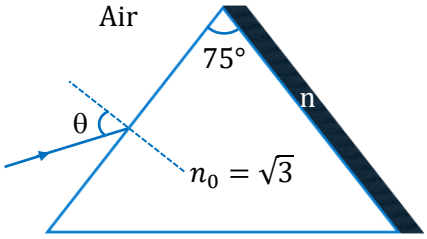
(C) $H_2 > H_3$

(D) $H_2 > H_1$

PGO094

20. A monochromatic light is incident from air on a refracting surface of a prism of angle 75° and refractive index $n_0 = \sqrt{3}$. The other refracting surface of the prism is coated by a thin film of material of refractive index n as shown in figure. The light suffers total internal reflection at the coated prism surface for an incidence angle of $\theta \le 60°$. The value of n^2 is_____.

[JEE (Advanced) 2019]



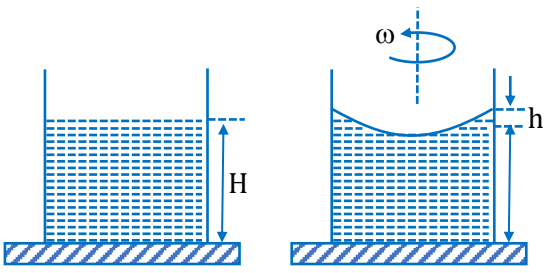
PGO095

21. A beaker of radius r is filled with water (refractive index $\frac{4}{3}$) up to a height H as shown in the figure on the left. The beaker is kept on a horizontal table rotating with angular speed ω. This makes the water surface curved so that the difference in the height of water level at the center and at the circumference of the beaker is h ($h << H$, $h << r$), as shown in the figure on the right. Take this surface to be approximately spherical with a radius of curvature R. Which of the following is/are correct? (g is the acceleration due to gravity) **[JEE (Advanced) 2020]**

(A) $R = \frac{h^2 + r^2}{2h}$

(B) $R = \frac{3r^2}{2h}$

(C) Apparent depth of the bottom of the beaker is close to $\frac{3H}{2}\left(1 + \frac{\omega^2 H}{2g}\right)^{-1}$

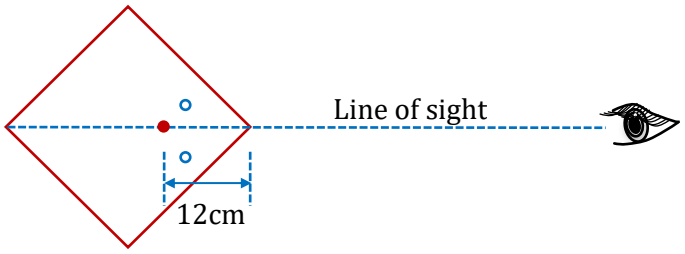


(D) Apparent depth of the bottom of the beaker is close to $\frac{3H}{4}\left(1 + \frac{\omega^2 H}{4g}\right)^{-1}$

PGO096

22. A large square container with thin transparent vertical walls and filled with water (refractive index $\frac{4}{3}$) is kept on a horizontal table. A student holds a thin straight wire vertically inside the water 12 *cm* from one of its corners, as shown schematically in the figure. Looking at the wire from this corner, another student sees two images of the wire, located symmetrically on each side of the line of sight as shown. The separation (in *cm*) between these images is _____.

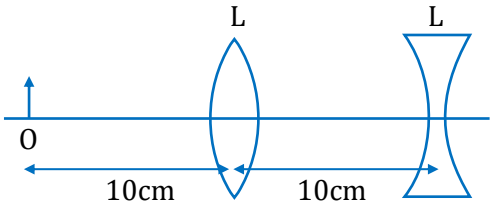
[JEE (Advanced) 2020]



PGO097

23. An extended object is placed at point O, 10 *cm* in front of a convex lens L_1 and a concave lens L_2 is placed 10 *cm* behind it, as shown in the figure. The radii of curvature of all the curved surfaces in both the lenses are 20 *cm*. The refractive index of both the lenses is 1.5. The total magnification of this lens system is

[JEE (Advanced) 2021]

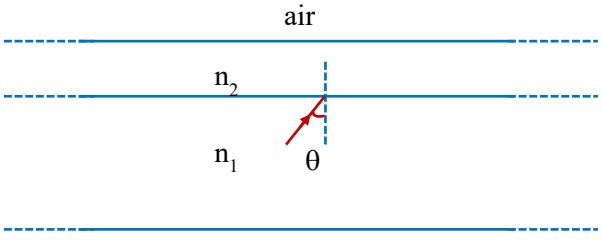


(A) 0.4 (B) 0.8 (C) 1.3 (D) 1.6

PGO098

24. A wide slab consisting of two media of refractive indices n_1 and n_2 is placed in air as shown in the figure. A ray of light is incident from medium n_1 to n_2 at an angle θ, where $\sin\theta$ is slightly larger than $1/n_1$. Take refractive index of air as 1. Which of the following statement(s) is(are) correct?

[JEE (Advanced) 2021]



(A) The light ray enters air if $n_2 = n_1$

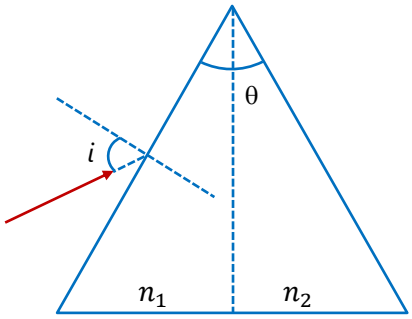
(B) The light ray is finally reflected back into the medium of refractive index n_1 if $n_2 < n_1$

(C) The light ray is finally reflected back into the medium of refractive index n_1 if $n_2 > n_1$

(D) The light ray is reflected back into the medium of refractive index n_1 if $n_2 = 1$

PGO099

25. For a prism of prism angle θ = 60°, the refractive indices of the left half and the right half are, respectively, n_1 and n_2 ($n_2 \geq n_1$) as shown in the figure. The angle of incidence *i* is chosen such that the incident light rays will have minimum deviation if $n_1 = n_2 = n$ = 1.5. For the case of unequal refractive indices, $n_1 = n$ and $n_2 = n + \Delta n$ (where $\Delta n << n$), the angle of emergence $e = i + \Delta e$. Which of the following statement(s) is (are) correct ? **[JEE (Advanced) 2021]**



(A) The value of Δe (in radians) is greater than that of Δn

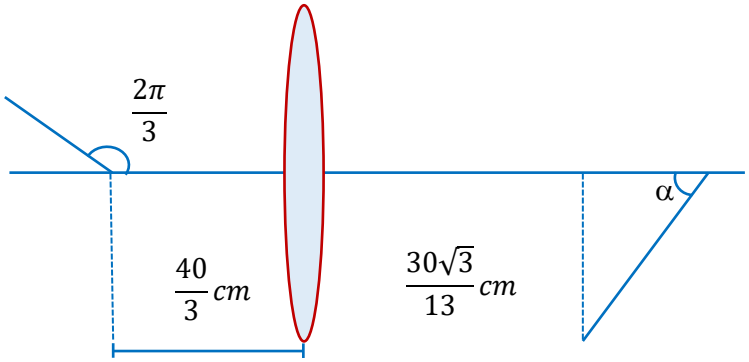
(B) Δe is proportional to Δn

(C) Δe lies between 2.0 and 3.0 milliradians, if $\Delta n = 2.8 \times 10^{-3}$

(D) Δe lies between 1.0 and 1.6 milliradians, if $\Delta n = 2.8 \times 10^{-3}$

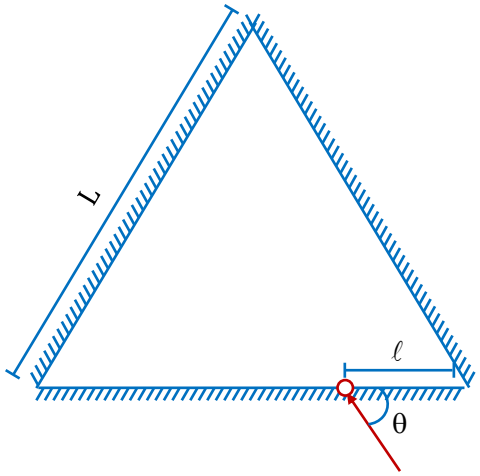
PGO100

26. A rod of length 2 *cm* makes an angle $\frac{2\pi}{3}$ rad with the principal axis of a thin convex lens. The lens has a focal length of 10 *cm* and is placed at a distance of $\frac{40}{3}$ *cm* from the object as shown in the figure. The height of the image is $\frac{30\sqrt{3}}{13}$ *cm* and the angle made by it with respect to the principal axis is α rad. The value of α is $\frac{\pi}{n}$ *rad*, where *n* is _____. **[JEE (Advanced) 2022]**



PGO101

27. Three plane mirrors form an equilateral triangle with each side of length L. There is a small hole at a distance $\ell > 0$ from one of the corners as shown in the figure. A ray of light is passed through the hole at an angle θ and can only come out through the same hole. The cross section of the mirror configuration and the ray of light lie on the same plane. **[JEE (Advanced) 2022]**



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

(A) The ray of light will come out for $\theta = 30°$, for $0 < \ell < L$.

(B) There is an angle for $\ell = \frac{L}{2}$ at which the ray of light will come out after two reflections.

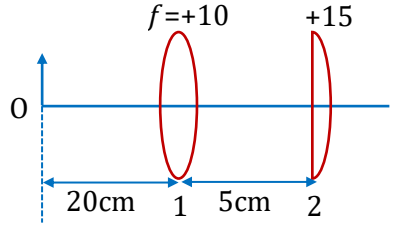
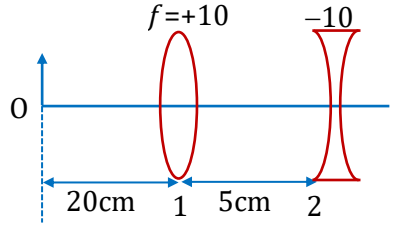
(C) The ray of light will **NEVER** come out for $\theta = 60°$, and $\ell = \frac{L}{3}$.

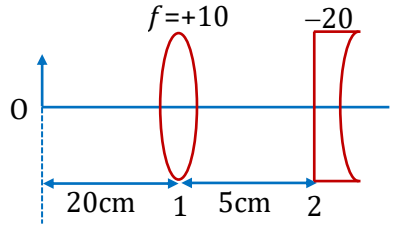
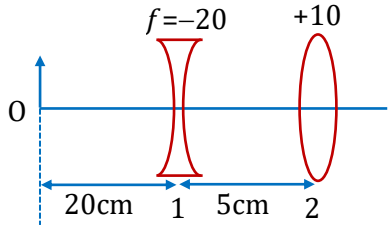
(D) The ray of light will come out for $\theta = 60°$, and $0 < \ell < \frac{L}{2}$ after six reflections.

PGO102

28. List *I* contains four combinations of two lenses (1 and 2) whose focal lengths (in *cm*) are indicated in the figures. In all cases, the object is placed 20 *cm* from the first lens on the left, and the distance between the two lenses is 5 *cm*. List II contains the positions of the final images.

[JEE (Advanced) 2022]

List-I		List-II	
(I)		**(P)**	Final image is farmed at 7.5 *cm* on the right side of lens 2.
(II)		**(Q)**	Final image is formed at 60.0 *cm* on the right side of lens 2.

List-I		List-II	
(III)		**(R)**	Final image is formed at 30.0 *cm* on the left side oflens 2.
(IV)		**(S)**	Final image is formed at 6.0 *cm* on the right side of lens 2.
		(T)	Final image is formed at 30.0 *cm* on the right side of lens 2.

Which one of the following options is correct ?

(A) I → P, II → R, III → Q, IV → T

(B) I → Q, II → P, III → T, IV → S

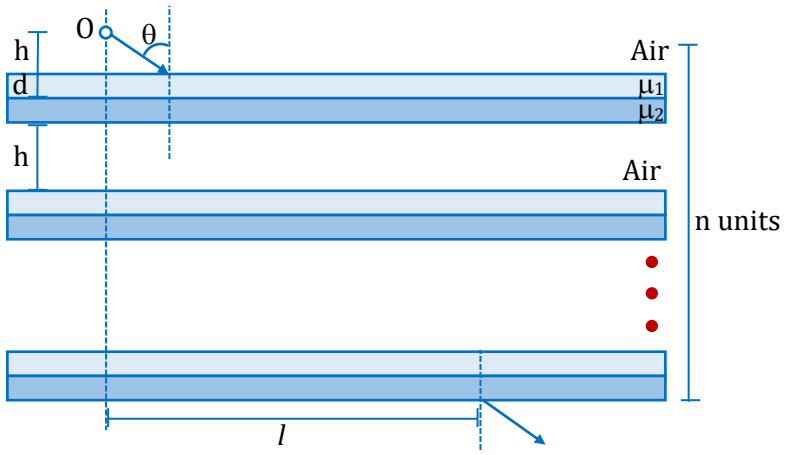
(C) I → P, II → T, III → R, IV → Q

(D) I → T, II → S, III → Q, IV → R

PGO103

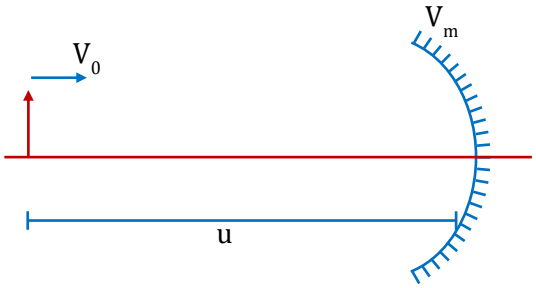
29. Consider a configuration of n identical units, each consisting of three layers. The first layer is a column of air of height $h = \frac{1}{3}\,cm$, and the second and third layers are of equal thickness $d = \frac{\sqrt{3}-1}{2}\,cm$, and refractive indices $\mu_1 = \sqrt{\frac{3}{2}}$ and $\mu_2 = \sqrt{3}$, respectively. A light source O is placed on the top of the first unit, as shown in the figure. A ray of light from O is incident on the second layer of the first unit at an angle of $\theta = 60°$ to the normal. For a specific value of n, the ray of light emerges from the bottom of the configuration at a distance $l = \frac{8}{\sqrt{3}}\,cm$, as shown in the figure. The value of n is _____.

[JEE (Advanced) 2022]



PGO104

30. An object and a concave mirror of focal length $f = 10$ *cm* both move along the principal axis of the mirror with constant speeds. The object moves with speed $V_0 = 15$ *cm* s^{-1} towards the mirror with respect to a laboratory frame. The distance between the object and the mirror at a given moment is denoted by u. When $u = 30$ *cm*, the speed of the mirror V_m is such that the image is instantaneously at rest with respect to the laboratory frame, and the object forms a real image. The magnitude of V_m is _____ *cm* s^{-1}.



[JEE (Advanced) 2022]

PGO105

31. A plane polarized blue light ray is incident on a prism such that there is no reflection from the surface of the prism. The angle of deviation of the emergent ray is $\delta = 60°$ (see Figure-1). The angle of minimum deviation for red light from the same prism is $\delta_{min} = 30°$ (see Figure–2). The refractive index of the prism material for blue light is $\sqrt{3}$. Which of the following statement(s) is(are) correct?

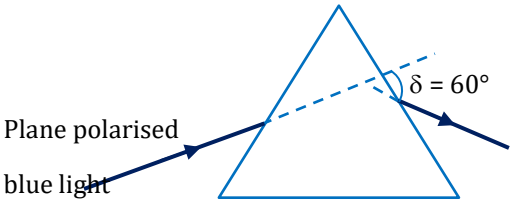


Figure-1

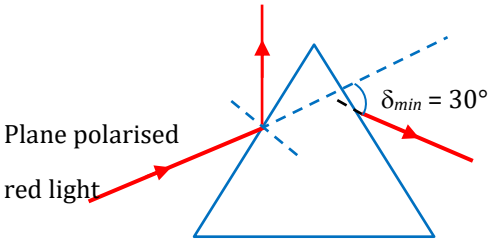


Figure-2

[JEE (Advanced) 2023]

(A) The blue light is polarized in the plane of incidence.

(B) The angle of the prism is 45°.

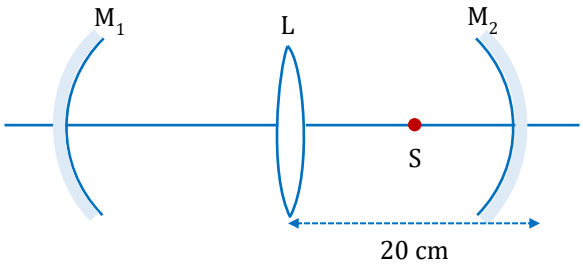
(C) The refractive index of the material of the prism for red light is $\sqrt{2}$.

(D) The angle of refraction for blue light in air at the exit plane of the prism is 60°.

PGO262

32. An optical arrangement consists of two concave mirrors M_1 and M_2, and a convex lens L with a common principal axis, as shown in the figure. The focal length of L is 10 *cm*. The radii of curvature of M_1 and M_2 are 20 *cm* and 24 *cm*, respectively. The distance between L and M_2 is 20 *cm*. A point object S is placed at the mid-point between L and M_2 on the axis. When the distance between L and M_1 is $n/7$ *cm*, one of the images coincides with S. The value of n is _____.

[JEE (Advanced) 2023]



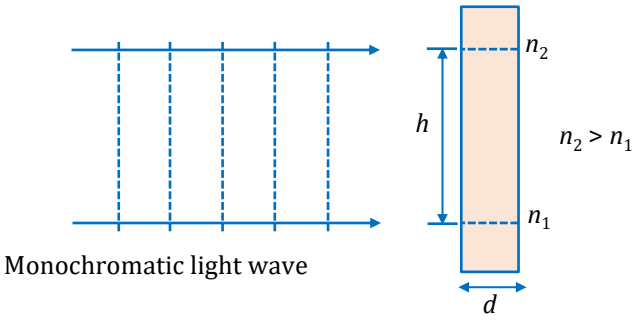
PGO263

33. In an experiment for determination of the focal length of a thin convex lens, the distance of the object from the lens is 10 ± 0.1 *cm* and the distance of its real image from the lens is 20 ± 0.2 *cm*. The error in the determination of focal length of the lens is *n* %. The value of *n* is _____.

[JEE (Advanced) 2023]

PGO264

34. A monochromatic light wave is incident normally on a glass slab of thickness *d*, as shown in the figure. The refractive index of the slab increases linearly from n_1 to n_2 over the height *h*. Which of the following statement(s) is (are) true about the light wave emerging out of the slab ?



(A) It will deflect up by an angle $tan^{-1}\left[\frac{(n_2^2-n_1^2)d}{2h}\right]$

(B) It will deflect up by an angle $tan^{-1}\left[\frac{(n_2-n_1)d}{h}\right]$

(C) It will not deflect.

(D) The deflection angle depends only on ($n_2 - n_1$) and not on the individual values of n_1 and n_2.

[JEE (Advanced) 2023]

PGO265

JEE (Main) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION–A

- This section contains **TWENTY** questions.
- Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

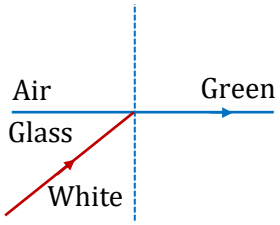
Full Marks : +4, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1 in all other cases.

---

1. When length of a compound microscope tube increase, its magnifying power
(1) decreases (2) increases
(3) does not change (4) may increase or decrease

PGO001

2. White light is incident on the interface of glass and air as shown in the figure. If green light is just totally internally reflected then the emerging ray in air contains



(1) yellow, orange, red (2) violet, indigo, blue
(3) all colours (4) all colours except green

PGO002

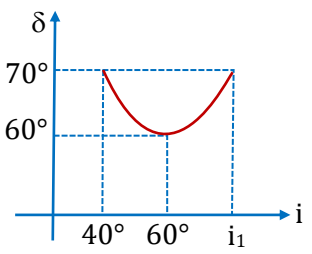
3. Two thin prisms of flint glass, with refracting angles of 6° and 8° respectively, possess dispersive powers in the ratio :
(1) 4 : 3 (2) 3 : 4 (3) 1 : 1 (4) 9 : 16

PGO003

4. The angle of prism is 5° and its refractive indices for red and violet colours are 1.5 and 1.6 respectively. The angular dispersion produced by the prism is :–
(1) 7.75° (2) 5° (3) 0.5° (4) 0.17°

PGO004

5. The curve of angle of incidence versus angle of deviation shown has been plotted for prism. The value of refractive index of the prism used is :



(1) $\sqrt{3}$ (2) $\sqrt{2}$
(3) $\frac{\sqrt{3}}{\sqrt{2}}$ (4) $\frac{2}{\sqrt{3}}$

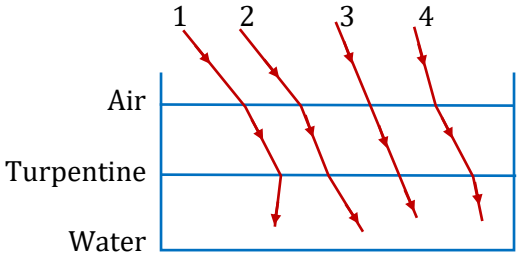
PGO005

6. The refracting angle of the prism is 60° and minimum deviation of 30°, then the angle of incidence is:-

(1) 30° (2) 45° (3) 25° (4) 60°

PGO006

7. The optical density of turpentine is higher than that of water while its mass density is lower. Figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in figure, the path shown is **CORRECT** ?



(1) 1 (2) 2 (3) 3 (4) 4

PGO007

8. When a ray of light of frequency 6×10^{14} Hz travels from water of refractive index 4/3 to the glass of refractive index 8/5, its :-

(1) frequency decreases to 5/6 of its initial value

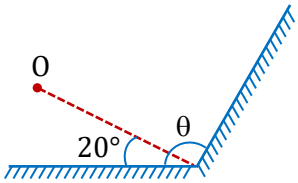
(2) speed decreases to 5/6 of its initial value

(3) wavelength decreases to 6/5 of its initial value

(4) speed increases to 6/5 of its initial value

PGO008

9. If $\theta = 110°$ then total number of images formed by the mirror system will be :-



(1) 2 (2) 3 (3) 4 (4) 5

PGO009

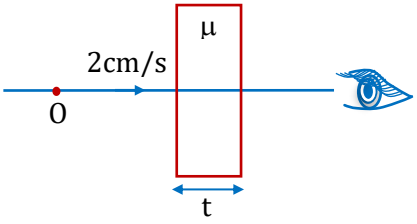
10. The distance of an object from a spherical mirror is equal to the focal length of the mirror. Then the image:

(1) must be at infinity (2) may be at infinity

(3) may be at the focus (4) none

PGO010

11. A glass slab of width '*t*', refractive index 'μ' is placed as shown in the figure. If the point object, moves with a speed 2 *cm/s* towards the slab the speed observed will be



(1) 2 *cm/s*

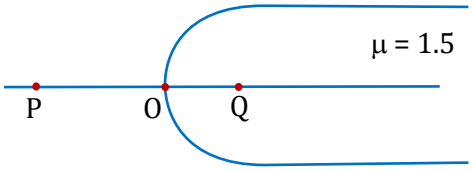
(2) less than 2 *cm/s*

(3) greater than 2 *cm/s*

(4) dependent on the refractive index of surrounding medium

PGO011

12. One end of a glass rod of refractive index $n = 1.5$ is a spherical surface of radius of curvature R. The centre of the spherical surface lies inside the glass. A point object placed in air on the axis of the rod at the point P has its real image inside glass at the point Q (see fig.). A line joining the points P and Q cuts the surface at O such that $OP = 2OQ$. The distance PO is :-



(1) 8 R (2) 7 R (3) 2 R (4) None of these

PGO012

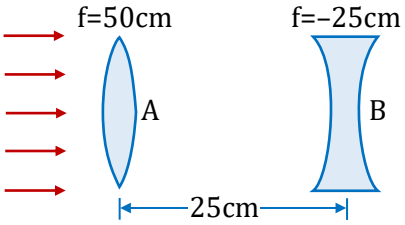
13. The two lenses shown are illuminated by a beam of parallel light from the left. Lens B is then moved slowly toward lens A. The beam emerging from lens B is :

(1) Initially parallel and then diverging

(2) Always diverging

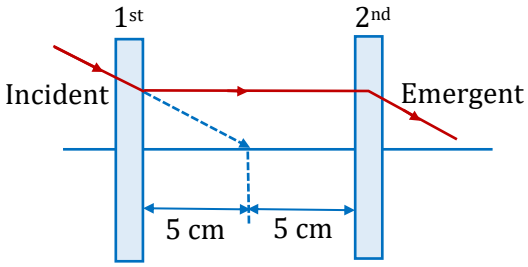
(3) Initially converging and finally parallel

(4) Always parallel



PGO013

14. Look at the ray diagram shown, what will be the focal length of the 1st and the 2nd lens, if the incident light ray passes without any deviation ?

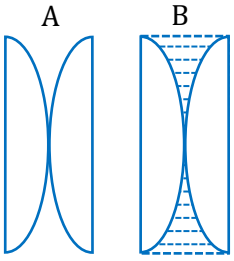


(1) –5 *cm* and +10 *cm* (2) +5*cm* and +10*cm*

(3) –5*cm* and +5*cm* (4) +5*cm* and – 5*cm*

PGO014

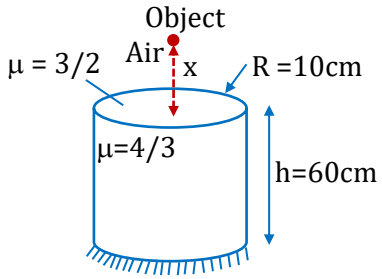
15. Figure A shows two identical plano-convex lenses in contact as shown. The combination has focal length 24 *cm*. Figure B shows the same with a liquid introduced between them. If refractive index of glass of the lenses is 1.50 and that of the liquid is 1.60, the focal length of the system in figure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



(1) –120 *cm* (2) 120 *cm* (3) –24 *cm* (4) 24 *cm*

PGO015

16. In the arrangement shown given that a biconvex lens of radius of curvature equal to 10 *cm* and concave mirror has focal length equal to 20 *cm*. Then find the distance '*x*' such that the final image formed by the system coincides with the object.



(1) 15 *cm* (2) 22.5 *cm*
(3) 20 *cm* (4) 17.5 *cm*

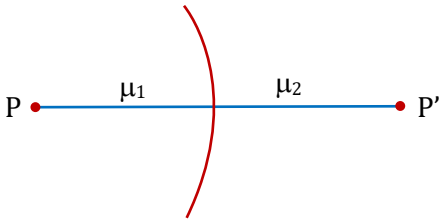
PGO016

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

(1) 20 *cm* (2) 30 *cm* (3) 60 *cm* (4) 80 *cm*

PGO017

18. Two refracting media are separated by a spherical interface as shown in the figure. *PP*' is the principal axis, μ_1 and μ_2 are the refractive indices of medium of incidence and medium of refraction respectively, then



(1) if $\mu_2 < \mu_1$, then there cannot be a real image of real object.
(2) if $\mu_2 > \mu_1$, then there cannot be a real image of virtual object.
(3) if $\mu_1 > \mu_2$, then there cannot be a virtual image of virtual object.
(4) if $\mu_1 > \mu_2$, then there cannot be a real image of real object.

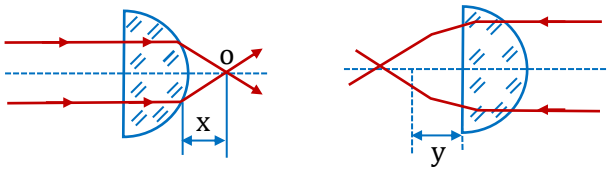
PGO018

19. The ratio of angle of minimum deviation produced by a thin prism $\left(\mu = \frac{3}{2}\right)$ in air to that in liquid of refractive index $\frac{9}{7}$ is :

(1) $\frac{1}{3}$ (2) 3 (3) $\frac{1}{4}$ (4) 4

PGO019

20. A narrow beam of light passing through the hemisphere of material with refractive index *n*, intersects at point *O*. Where does the beam converge (i.e. *y* in *cm*) if beam were to travel in the opposite direction as shown in figure(b)? The value of *x* is given to be 10 *cm*. Radius of the hemisphere is also 10 *cm* :-



(a) **(b)**

(1) 2 (2) 3 (3) 5 (4) 7

PGO020

SECTION–B

- This section will have **TEN questions**. Candidate can choose to attempt any 5 questions out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (Answer should be rounded off to the nearest integer).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4, if only correct answer is given.
Zero Marks	:	0, if no answer is given.
Negative Marks	:	–1 for incorrect answer.

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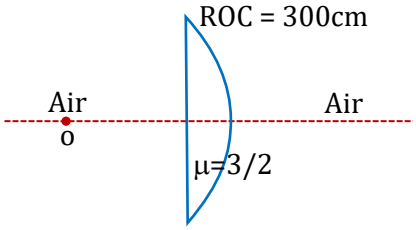
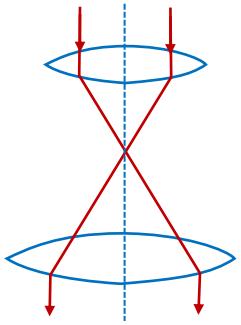
1. Plane surface of a thin planoconvex lens reflects 50% of light, while the curved surface is completely transparent, if final image of '*O*' after refraction through thin lens coincides with the image formed due to partial reflection from plane surface. If distance between *O* and lens is *x* (in *m*) then find the value of *x*/4.



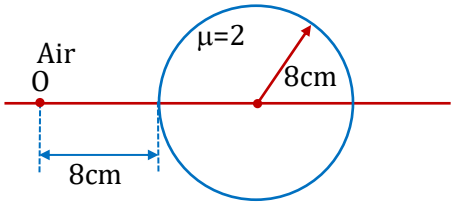
PGO021

2. Consider a 'beam expander' which consists of two converging lenses of focal lengths 40 *cm* and 100 *cm* having a common optical axis. A laser beam of diameter 2 *mm* is incident on the 40 *cm* focal length lens. Then what is the diameter (in *mm*) of the final beam (see figure)?



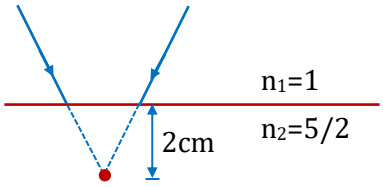
PGO022

3. On the axis of a transparent sphere of refractive index (n = 2) and radius 8 *cm*, an object is kept at the distance 8 *cm* from the surface of the sphere. Find the minimum distance of the image after all possible refraction from the surface of the sphere in *cm*.



PGO023

4. In the given figure rays incident on an interface would converge 2 *cm* below the interface if they continued to move in straight lines without bending. But due to refraction, the rays will bend and meet somewhere else. Find the distance of meeting point of refracted rays below the interface (in *cm*). (Assuming the rays to be making small angles with the normal to the interface)



PGO024

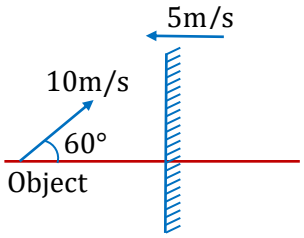
5. A point object is placed 33 *cm* from a convex mirror of curvature radius = 40 *cm*. A glass plate of thickness 6 *cm* and index 2.0 is placed between the object and mirror, close to the mirror. Find the distance (in *cm*) of final image from the object?

PGO025

6. A thin rod of length 10 *cm* is placed along the principal axis of a concave mirror of focal length = 30 *cm* such that its image, which is real and elongated, just touches the rod. Find the length (in cm) of the image?

PGO026

7. The angle between the velocity vector of object and image is $\frac{\pi}{\alpha}$. Velocity are shown in the figure. Then the value of α is.

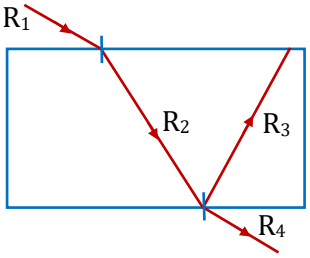


PGO027

8. A boy of height 1 *m* stands in front of a convex mirror. His distance from the mirror is equal to its focal length. The height of his image is (in *cm*):- (Assume paraxial ray approximation holds)

PGO028

9. A ray R_1 is incident on the plane surface of the glass slab (kept in air) of refractive index $\sqrt{2}$ at an angle of incidence equal to the critical angle for this air glass system. The refracted ray R_2 undergoes partial reflection and refraction at the other surface. The angle between reflected ray R_3 and the refracted ray R_4 at that surface is (in degree) :



PGO029

10. A thin prism P_1 with angle 4° and made from a glass of refractive index 1.54 is combined with another thin prism P_2 made from glass of refractive index 1.72 to produce dispersion without deviation. The angle (in degree) of the prism P_2 is :-

PGO030

JEE (Advanced) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION–I

- This section contains **TWELVE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3 if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 if none of the bubbles is darkened.
Negative Marks : –1 in all other cases.

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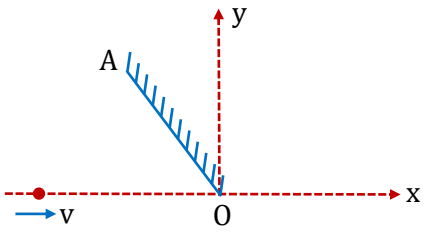
1. A plane mirror *OA* of length 2 *m* is kept along the line $y = -x$ as shown in the figure. An insect having velocity of $4\hat{\imath}$ *cm/s* is moving along the *x*-axis from far away. The time span for which the insect can see its image will be :-

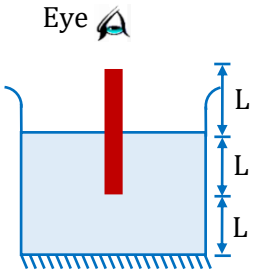


(A) 50 sec (B) 25 sec

(C) $25\sqrt{2}$ sec (D) $50\sqrt{2}$ sec

PGO058

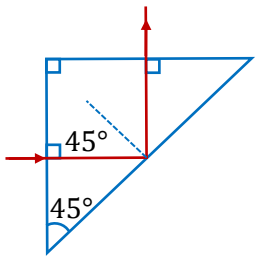
2. What is the length of the image of the rod in mirror, according to the observer in air? (Refractive index of the liquid is μ)



(A) $\mu L + L$ (B) $L + \frac{L}{\mu}$ (C) $L\mu + \frac{L}{\mu}$ (D) None of these

PGO059

3. A light ray is incident perpendicular to one face of a 90° prism and is totally internally reflected at the glass-air interface. If the angle of reflection is 45°, we conclude that the refractive index *n* :



(A) $n < \frac{1}{\sqrt{2}}$ (B) $n > \sqrt{2}$ (C) $n > \frac{1}{\sqrt{2}}$ (D) $n < \sqrt{2}$

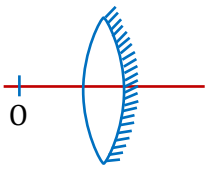
PGO060

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

(A) 2 *cm* (B) 4 *cm* (C) 6 *cm* (D) 12 *cm*

PGO061

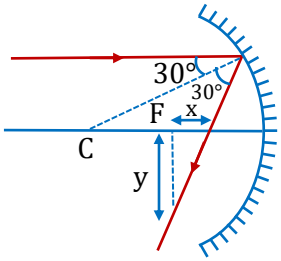
5. An equiconvex lens of refractive index μ and radius of curvature *R* has its one surface silvered. A point source *O* is placed before the silvered lens so that its image is coincident with it, the distance of the object from the lens is :-



(A) $\frac{R}{(\mu-1)}$ (B) $\frac{2R}{(\mu-1)}$ (C) $\frac{R}{(2\mu-1)}$ (D) $\frac{2R}{(2\mu-1)}$

PGO062

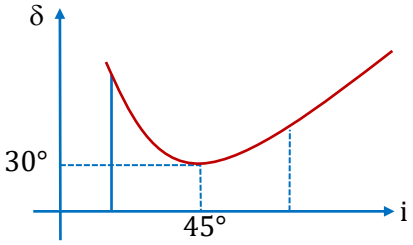
6. A marginal ray is falling on the concave mirror as shown in the figure. The ratio of *x* and *y* is



(A) $\sqrt{3}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{2}{\sqrt{3}}$ (D) Can't be determined

PGO063

7. Variation of angle of deviation δ versus angle of incidence *i* for a prism is given the figure. The value of refractive index of prism :-

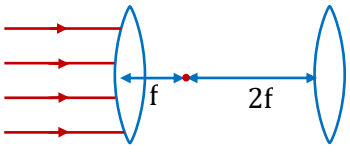


(A) $\sqrt{3}$ (B) $\sqrt{2}$ (C) $\sqrt{\frac{3}{2}}$ (D) $\frac{2}{\sqrt{3}}$

PGO064

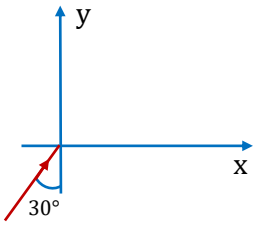
8. Two convex lenses of focal length *f* and 2*f* are arranged to have their foci at the same point as shown in the figure. A beam of parallel light of diameter 1 *cm* is incident into the first lens. The beam emerging from the second lens is

(A) diverging
(B) converging
(C) parallel, of diameter 0.5 *cm*
(D) parallel, of diameter 2 *cm*



PGO065

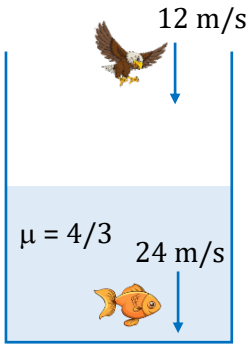
9. Refractive indices of a medium in x-y coordinate system as shown are $\mu = \frac{2}{1+y^2}$ for $y > 0$ and $\mu = \frac{4}{3}$ for $y < 0$. A ray incidents on medium as shown then maximum y-coordinate of ray is :-



(A) $y = \sqrt{2}$ (B) $y = 0$ (C) $y = \sqrt{\left(\sqrt{3}-1\right)}$ (D) None of these

PGO066

10. A fish and bird are moving as shown in figure. Find the velocity of bird as observed by fish.



(A) 8 *m/s* (B) 6 *m/s* (C) 10 *m/s* (D) 12 *m/s*

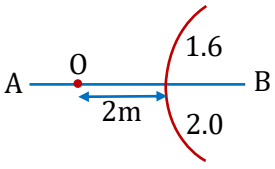
PGO067

11. A beam of monochromatic light is incident at $i = 50°$ on one face of an equilateral prism, the angle of emergence is 40°, then the angle of minimum deviation is :

(A) 30° (B) < 30° (C) ≤ 30° (D) ≥ 30°

PGO068

12. In the figure shown a point object *O* is placed in air. A spherical boundary of radius of curvature 1.0 *m* separates various media. *AB* is principal axis. The refractive index above *AB* is 1.6 and below *AB* is 2.0. The separation between the images formed due to refraction at spherical surface is:



(A) 12 *m* (B) 20 *m* (C) 14 *m* (D) 10 *m*

PGO069

SECTION-II

- This section contains **ONE** question.
- Each question has **FOUR** options for correct answer(*s*). **ONE OR MORE THAN ONE** of these four option(*s*) is (are) correct option(*s*).
- For each question, choose the correct option(*s*) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	: +4	if only (all) the correct option(*s*) is (are) chosen.
Partial Marks	: +3	if all the four options are correct but ONLY three options are chosen.
Partial Marks	: +2	if three or more options are correct but ONLY two options are chosen, both of which are correct options.
Partial Marks	: +1	if two or more options are correct but ONLY one option is chosen and it is a correct option.
Zero Marks	: 0	if none of the options is chosen (i.e. the question is unanswered).
Negative Marks	: –2	in all other cases.

For Example : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(*s*) (second option in this case), with or without selection of any correct option(*s*) will result in –2 marks.

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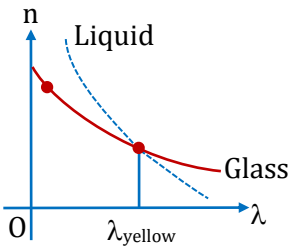
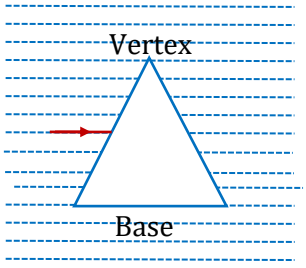
13. A glass prism is immersed in a hypothetical liquid. The curves showing the refractive index *n* as a function of wavelength λ for glass and liquid are as shown in the figure. When a ray of white light is incident on the prism parallel to the base :





(A) yellow ray travels without deviation
(B) blue ray is deviated towards the vertex
(C) red ray is deviated towards the base
(D) there is no dispersion

PGO070

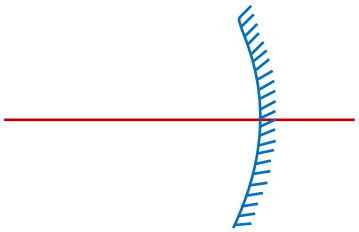
SECTION-III

- This section contains **ONE** paragraph.
- Based on each paragraph, there are **THREE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks	: +3	if only the bubble corresponding to the correct answer is darkened.
Zero Marks	: 0	in all other cases.

PARAGRAPH FOR QUESTION NO. 14 TO 16

In the given figure, an object is kept on the principal axis of a concave mirror in front of it. Magnification of image is found – 2/3 at this position. Now mirror is shifted towards the object keeping object fixed, by amount 10 *cm*. At this new position, distance of object from mirror becomes same as the distance of image from the mirror before displacing the mirror.



14. Distance of object from mirror before displacing the mirror is

(A) 10 *cm* (B) 20 *cm* (C) 30 *cm* (D) 40 *cm*

PGO071

15. Magnitude of focal length of the mirror is

(A) 6 *cm* (B) 8 *cm* (C) 10 *cm* (D) 12 *cm*

PGO072

16. Magnification at the new position of mirror is

(A) $-\frac{3}{2}$ (B) – 3 (C) – 2 (D) $-\frac{1}{3}$

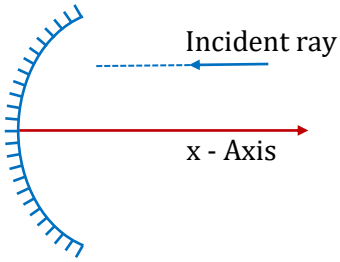
PGO073

SECTION–IV

- This section contains **TWO** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :

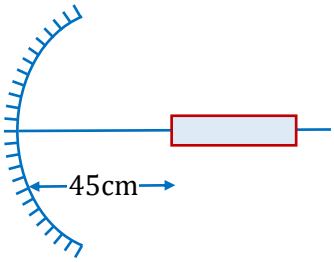
Full Marks : +3 if only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 in all other cases.

17. A parabolic reflecting surface given by $x = \frac{y^2}{2}$, is placed at origin, as shown. An incident ray moving along $y = 1$ is incident on it. The ray gets reflected by the surface twice. The deviation suffered by the ray is $\frac{\pi}{n}$ radians. Find n.



PGO074

18. An object of length 30 *cm* is placed on principal axis of a concave mirror of focal length 30 *cm*. Its one end at a distance of 45 *cm* as shown. If length of image is 10x (in *cm*) find the value of x.



PGO075

ANSWER KEY

EXERCISE - O

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	C	B	A	D	B	A	A	D	C	A
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	A	D	C	D	B	B	A	B	B	A
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	C	B	A	A	A	C	D	C	A	A
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	B	D	C	B	C	C	D	C	C	C
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	C	D	A	B	C	C	B	A	D	A
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	D	A	C	B	B	A	C	B	A	C
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	B	C	B	B	C	D	A	C	A	B
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	C	B	A	A	D	B	B	C	C	D
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	B	D	A	B	B	C	A	A	A	D
Que.	91	92	93	94	95	96	97	98	99	100
Ans.	C	ABCD	BD	ABD	AB	AD	BCD	AC	AC	BC
Que.	101	102	103	104	105	106	107	108	109	110
Ans.	BD	BC	AB	AB	AD	AC	BD	AC	ABCD	BD
Que.	111	112	113	114	115	116	117			
Ans.	A	B	A	B	A	C	D			
Que.	118					119				
Ans.	(A-Q), (B-P), (C-S), (D-R)					(A-P), (B-Q), (C-RT), (D-PT)				

EXERCISE - S

1. 4 **2.** 2 **3.** 0.50 **4.** 3.75

5. 9 **6.** 7.00 **7.** 1 **8.** 4

9. 25 **10.** 16 mm^3 **11.** 5 **12.** 2 mm

13. (8) **14.** (60) **15.** 4

16. $\theta < \sin^{-1}(2\sin 15°)$ **17.** A $\sin^{-1}\left(\frac{1}{5}\right)$ B air **18.** $\frac{8}{3}mm$ **19.** 4

20. 14.00 **21.** 7.50 **22.** (i) 0.2 m, (ii) 0.4 m

23. 17.5 cm **24.** 30 **25.** $(\pi/4)$ cm^2 **26.** 1

27. 4

28. (A) $f = -20$ cm, (B) + 80 cm, convergent achromatic lens

29. 24.00 **30.** 14.60 **31.** 101 **32.** 25

EXERCISE - JEE (Main) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	4	4	3	1	2	3	3	2	2	1
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	2	2	2	4	1	3	4.48	476	1	2
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	1	158	3	50	4	12	10	3	32	2
Que.	31									
Ans.	4									

EXERCISE - JEE (Advanced) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	AC	C	B	7	B	2	AC	D	A	ABD
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	AD	A	ACD	8	130	D	ACD	50	CD	1.50
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	AD	2	B	BCD	BC	6	AB	A	4	3
Que.	31	32	33	34						
Ans.	ACD	80 or 150 or 220	1	BD						

JEE (Main) Practice Paper

Section-A	Q.	1	2	3	4	5	6	7	8	9	10
	A.	1	1	3	3	1	2	2	2	2	2
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	1	1	1	3	1	2	1	3	2	3
Section-B	Q.	1	2	3	4	5	6	7	8	9	10
	A.	3	5	8	5	42	15	2	50	105	3

JEE (Advanced) Practice Paper

Section-I	Q.	1	2	3	4	5	6	7	8	9	10	11	12
	A.	D	B	B	C	C	B	B	D	A	A	B	A
Section-II	Q.	13											
	A.	ABC											
Section-III	Q.	14	15	16									
	A.	C	D	A									
Section-IV	Q.	17	18										
	A.	1	4										