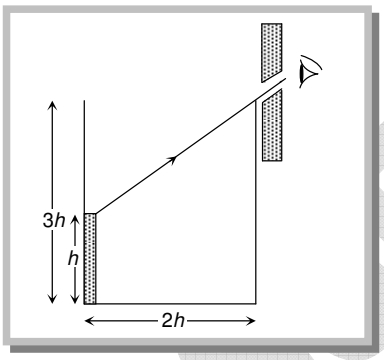
Refraction of Light Assignment

1. The optical path of a monochromatic light is same if it goes through 4.0 *cm* of glass or 4.5 *cm* of water. If the refractive index of glass is 1.53, the refractive index of the water is

(a) 1.30 (b) 1.36 (c) 1.42 (d) 1.46

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



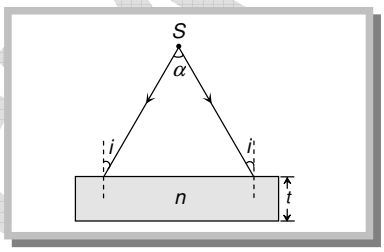
(a) $\frac{5}{2}$

(b) $\sqrt{\left(\frac{5}{2}\right)}$

(c) $\sqrt{\left(\frac{3}{2}\right)}$

(d) $\frac{3}{2}$

3. A diverging beam of light from a point source *S* having divergence angle α, falls symmetrically on a glass slab as shown. The angles of incidence of the two extreme rays are equal. If the thickness of the glass slab is *t* and the refractive index *n*, then the divergence angle of the emergent beam is



(a) Zero

(b) α

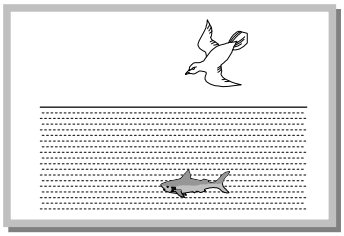
(c) $\sin^{-1}(1/n)$

(d) $2\sin^{-1}(1/n)$

4. How much water should be filled in a container 21 *cm* in height, so that it appears half filled when viewed from the top of the container (given that ${}_a\mu_w = 4/3$)

(a) 8.0 *cm* (b) 10.5 *cm* (c) 12.0 *cm* (d) None of these

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



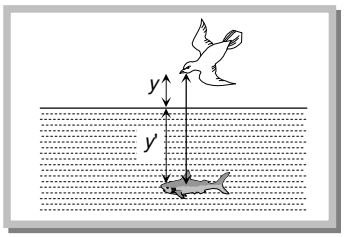
(a) Moving faster than its real speed and also away from the real distance

(b) Moving slower than its real speed and also nearer than its real distance

(c) Moving faster than its real speed and nearer than its real distance

(d) Moving slower than its real speed and away from the real distance

6. A fish rising vertically up towards the surface of water with speed 3 ms^{-1} observes a bird diving vertically down towards it with speed 9 ms^{-1}. The actual velocity of bird is



(a) 4.5 ms^{-1}

(b) 5. ms^{-1}

(c) 3.0 ms^{-1}

(d) 3.4 ms^{-1}

7. A stationary swimmer S_1 inside a liquid of refractive index μ_1, is at a distance *d* from a fixed point *P* inside the liquid. A rectangular block of width *t* and refractive index μ_2 ($\mu_2 < \mu_1$) is now placed between *S* and *P*, *S* will observe *P* to be at a distance

(a) $d-t\left(\frac{\mu_1}{\mu_2}-1\right)$ (b) $d-t\left(1-\frac{\mu_2}{\mu_1}\right)$ (c) $d+t\left(1-\frac{\mu_2}{\mu_1}\right)$ (d) $d+t\left(\frac{\mu_1}{\mu_2}-1\right)$

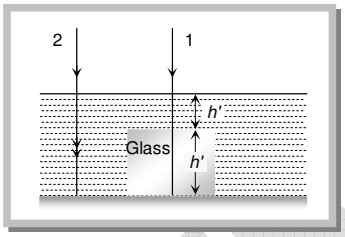
8. Two beams of light are incident normally on water (μ = 4/3). If the beam 1 passes through a glass (μ = 3/2) slab of height *h* as shown in the figure, the time difference for both the beams for reaching the bottom is

(a) Zero

(b) $\frac{h'}{6C}$

(c) $\frac{6h}{C}$

(d) $\frac{h}{6C}$



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

(a) $\frac{d-b}{d-c-b+a}$ (b) $\frac{b-d}{d-c-b+a}$ (c) $\frac{d-c-b+a}{d-b}$ (d) $\frac{d-b}{a+b-c-d}$

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

(a) $\left(\frac{\pi}{2}-C\right)$ (b) $2C$ (c) $\pi-2C$ (d) $\pi-C$

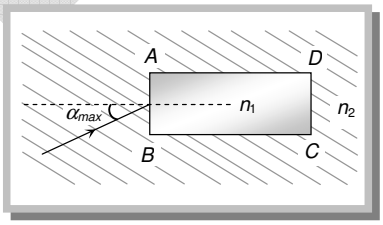
11. A rectangular glass slab *ABCD*, of refractive index n_1, is immersed in water of refractive index n_2 ($n_1>n_2$). A ray of light in incident at the surface *AB* of the slab as shown. The maximum value of the angle of incidence α_{max}, such that the ray comes out only from the other surface *CD* is given by

(a) $\sin^{-1}\left[\frac{n_1}{n_2}\cos\left(\sin^{-1}\frac{n_2}{n_1}\right)\right]$

(b) $\sin^{-1}\left[n_1\cos\left(\sin^{-1}\frac{1}{n_2}\right)\right]$

(c) $\sin^{-1}\left(\frac{n_1}{n_2}\right)$

(d) $\sin^{-1}\left(\frac{n_2}{n_1}\right)$



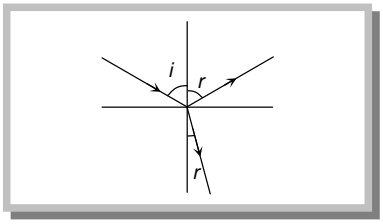
12. A ray of light is incident at an angle *i* from denser to rare medium. The reflected and the refracted rays are mutually perpendicular. The angle of reflection and the angle of refraction are respectively *r* and *r'*, then the critical angle will be

(a) $\sin^{-1}(\sin r)$

(b) $\sin^{-1}(\tan r')$

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

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



13. A ray of light travelling in a transparent medium falls on a surface separating the medium from air at an angle of incidence of 45^o. The ray undergoes total internal reflection. If *n* is the refractive index of the medium with respect to air, select the possible value (*s*) of *n* from the following

(a) 1.3 (b) 1.4 (c) 1.5 (d) 1.6

14. Light enters at an angle of incidence in a transparent rod of refractive index *n*. For what value of the refractive index of the material of the rod the light once entered into it will not leave it through its lateral face whatsoever be the value of angle of incidence

(a) $n>\sqrt{2}$ (b) $n=1$ (c) $n=1.1$ (d) $n=1.3$

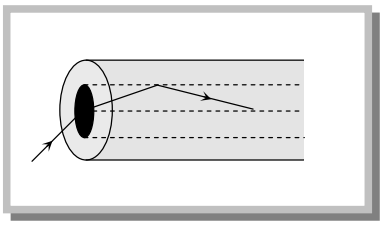
15. An optical fibre consists of core of μ_1 surrounded by a cladding of $\mu_2 < \mu_1$. A beam of light enters from air at an angle α with axis of fibre. The highest α for which ray can be travelled through fibre is

(a) $\cos^{-1}\sqrt{\mu_2^2-\mu_1^2}$

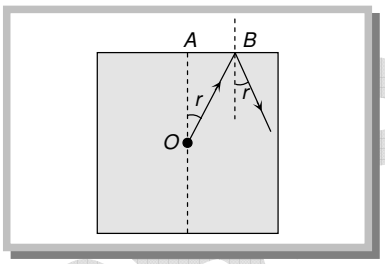
(b) $\sin^{-1}\sqrt{\mu_2^2-\mu_1^2}$

(c) $\tan^{-1}\sqrt{\mu_1^2-\mu_2^2}$

(d) $\sec^{-1}\sqrt{\mu_1^2-\mu_2^2}$



16. A 2.5 *cm* cube is constructed of a material whose refractive index is 1.65. Calculate the least radius of an opaque circular disc, which must be placed centrally over each face of the cube, so that a small air bubble at its centre shall be invisible from an external point



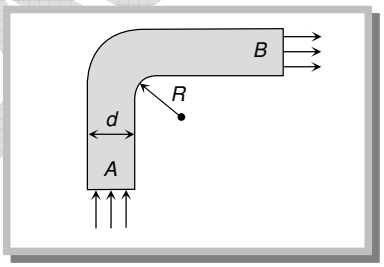
(a) 0.95 *cm*

(b) 0.59 *cm*

(c) 1.25 *cm*

(d) 0.75 *cm*

17. A rod of glass (μ = 1.5) and of square cross section is bent into the shape shown in the figure. A parallel beam of light falls on the plane flat surface *A* as shown in the figure. If *d* is the width of a side and *R* is the radius of circular arc then for what maximum value of $\frac{d}{R}$ light entering the glass slab through surface *A* emerges from the glass through *B*



(a) 1.5

(b) 0.5

(c) 1.3

(d) None of these

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

(a) 0.4 *m* (b) 0.2 *m* (c) 0.1 *m* (d) 0.75 *m*

19. The size of the image of an object, which is at infinity, as formed by a convex lens of focal length 30 *cm* is 2 *cm*. If a concave lens of focal length 20 *cm* is placed between the convex lens and the image at a distance of 26 *cm* from the convex lens, calculate the new size of the image

(a) 1.25 *cm* (b) 2.5 *cm* (c) 1.05 *cm* (d) 2 *cm*

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

(a) Air and placed in air (b) Air and immersed in L_1 (c) L_1 and immersed in L_2 (d) L_2 and immersed in L_1

21. Two lenses, one convex and the other concave of same power are placed such that their principal axes coincide. If the separation between the lenses is *x*, then

(a) Real image is formed for *x* = 0 only (b) Real image is formed for all values of *x*

(c) Virtual image is formed for all value of *x* other than zero (d) System will behave like a glass plate for *x* = 0

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

(a) > 3/2 (b) < (3/2) and > 1 (c) < 3/2 (d) All of these

23. A point object *O* is placed on the principal axis of a convex lens of focal length 20 *cm* at a distance of 40 *cm* to the left of it. The diameter of the lens is 10 *cm*. If the eye is placed 60 *cm* to the right of the lens at a distance *h* below the principal axis, then the maximum value of *h* to see the image will be

(a) 0 (b) 5 *cm* (c) 2.5 *cm* (d) 10 *cm*

24. A concave lens of glass, refractive index 1.5, has both surfaces of same radius of curvature *R*. On immersion in a medium of refractive index 1.75 it will behave as a

(a) Convergent lens of focal length 3.5 *R* (b) Convergent lens of focal length 3.0 *R*

(c) Divergent lens of focal length 3.5 *R* (d) Divergent lens of focal length 3.0 *R*

25. A plano-convex lens when silvered in the plane side behaves like a concave mirror of focal length 30 *cm*. However, when silvered on the convex side it behaves like concave mirror of focal length 10 *cm*. Then the refractive index of its material will be

(a) 3.0 (b) 2.0 (c) 2.5 (d) 1.5

26. A glass hemisphere of radius 0.04 *m* and *R.I.* of the material 1.6 is placed centrally over a cross mark on a paper (i) with the flat face (ii) with the curved face in contact with the paper. In each case the cross mark is viewed directly from above. The position of the images will be

(a) (i) 0.04 *m* from the flat face; (ii) 0.025 *m* from the flat face

(b) (i) At the same position of the cross mark; (ii) 0.025 *m* below the flat face

(c) (i) 0.025 *m* from the flat face; (ii) 0.04 *m* from the flat face

(d) For both (i) and (ii) 0.025 *m* from the highest point of the hemisphere

27. Diameter of a plano-convex lens is 6 *cm* and thickness at the centre is 3 *mm*. If the speed of light in the material of the lens is $2\times10^{8}\,m/\sec$ the focal length of the lens is

(a) 15 *cm* (b) 20 *cm* (c) 30 *cm* (d) 10 *cm*

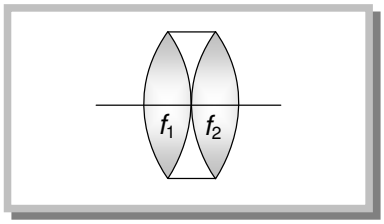
28. The angle subtended at the eye by the sun is $\frac{1^{o}}{2}$. The diameter of image of the sun formed by a convex lens of focal length 25 *cm* is

(a) 12.5 *cm* (b) 12.5 *mm* (c) $\frac{25}{36}mm$ (d) $\frac{25\pi}{36}mm$

29. A glass sphere of radius $r=5\times10^{-2}m$ has a small bubble $2\times10^{-2}m$ from its centre. The bubble is viewed along a diameter of the sphere from the side on which it lies. Refractive index of glass is 1.5. Distance from surface at which the bubble will appear is

(a) 2.5 *cm* (b) 5.2 *cm* (c) – 5.2 *cm* (d) – 2.5 *cm*

30. Two thin equi-convex lenses of focal lengths 10 *cm* and 20 *cm* are placed inside a thin-walled glass box with curved sides, side by side, such that these are tightly fitted inside. The glass is then filled with water and used as a lens. Determine the position of an object so that an image twice the size of the object is formed due to this lens combination. $\mu_{glass}=3/2$ and $\mu_{water}=4/3$



(a) 10 *cm*. 15 *cm*

(b) 12 *cm*, 4 *cm*

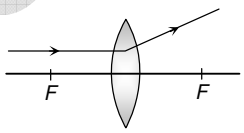
(c) 15 *cm*, 5 *cm*

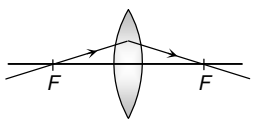
(d) 8 *cm*, 3 *cm*

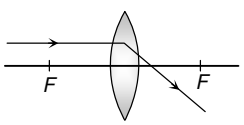
31. A thin lens of focal length *f* has aperture *a*. It forms an image of intensity *I*. Inner part of a lens upto diameter *d*/3 is painted black, the intensity of image will be

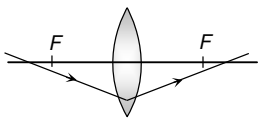
(a) *I* / 3 (b) *I* / 9 (c) 8*I* / 9 (d) *I*

32. In figure if points *F* represent the principal foci, which diagram illustrates the passage of a ray of light through a converging lens

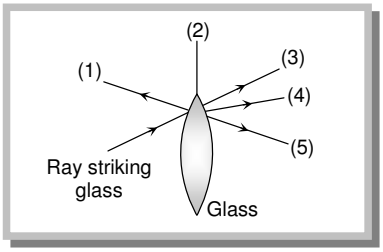
(a) 

(b) 

(c) 

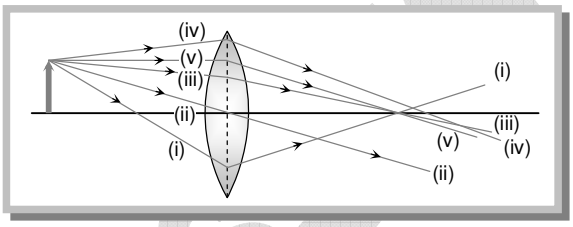
(d) 

33. A ray of light strikes a piece of glass shaped as shown in figure. Along which path does the ray continue



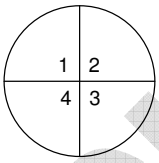
(a) 1
(b) 3
(c) 4
(d) 5

34. From shows five rays from an object passing through a converging lens. There of these rays are correctly drawn. The two rays, not drawn correctly, are

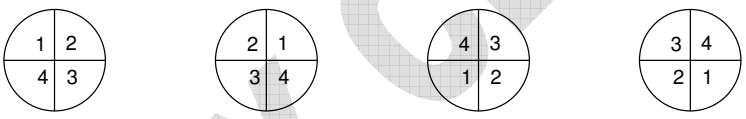


(a) (ii) and (iv)
(b) (I) and (iii)
(c) (iii) and (iv)
(d) (i) and (iv)

35. A convex lens is used a real image of the object shown in the following figure

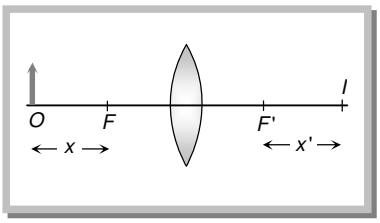


Then the real inverted images is as shown in the following figure



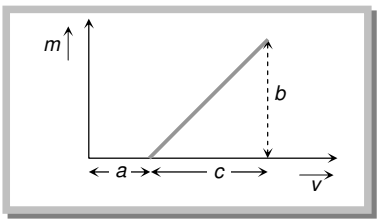
(a) a (b) b (c) c (d) d

36. An object is placed at a point distant *x* from the focus of a convex lens and its image is formed at *I* as shown in the figure. The distances *x*, *x'* satisfy the relation



(a) $\frac{x+x'}{2}=f$
(b) $f=xx'$
(c) $x+x'\le 2f$
(d) $x+x'\ge 2f$

37. The graph shows how the magnification *m* produced by a convex thin lens varies with image distance *v*. What was the focal length of the used



(a) $\frac{b}{c}$
(b) $\frac{b}{ca}$
(c) $\frac{bc}{a}$
(d) $\frac{c}{b}$

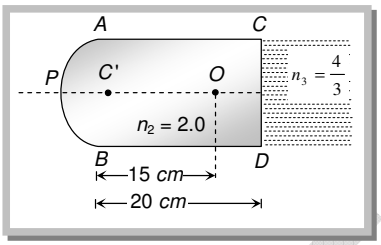
38. The distance between object and the screen is *D*. Real images of an object are formed on the screen for two positions of a lens separated by a distance *d*. The ratio between the sizes of two images will be

(a) *D/d* (b) D^2/d^2 (c) $(D-d)^2/(D+d)^2$ (d) $\sqrt{(D/d)}$

39. A convex lens of focal length *f* is placed some where in between an object and a screen. The distance between the object and the screen is *x*. If the numerical value of the magnification produced by the lens is m_1 the focal of the lens is

(a) $\frac{mx}{(m+1)^2}$ (b) $\frac{mx}{(m-1)^2}$ (c) $\frac{(m+1)^2}{m}x$ (d) $\frac{(m-1)^2}{m}x$

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



(a) 20 *cm*
(b) 30 *cm*
(c) 40 *cm*
(d) 50 *cm*

41. An object is kept at a distance of 16 *cm* from a thin and the image formed is real. If the object is kept at a distance of 6 *cm* from the same lens the image formed is virtual. If the size of the images formed are equal, the focal length of the lens will be
(a) 15 *cm* (b) 17 *cm* (c) 21 *cm* (d) 11 *cm*

42. A concave lens forms the image of an object such that the distance between the object and image is 10 *cm* and the magnification produced is 1/4. The focal length of the lens will be
(a) 8.6 *cm* (b) 6.2 *cm* (c) 10 *cm* (d) 4.4 *cm*

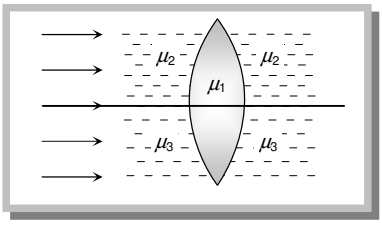
43. A plano convex lens fits exactly into a plano concave lens. Their plane surface are parallel to each other. If the lenses are made of different materials of refractive indices μ_1 and μ_2 and *R* is the radius of curvature of the curved surface of the lenses, then focal length of the combination is
(a) $\frac{R}{\mu_1 - \mu_2}$ (b) $\frac{2R}{\mu_1 - \mu_2}$ (c) $\frac{R}{2(\mu_1 - \mu_2)}$ (d) $\frac{R}{2-(\mu_1 + \mu_2)}$

44. Optic axis of a thin equiconvex lens is the *x*-axis. The co-ordinates of a point object and its image are (– 40 *cm*, 1*cm*) and (50 *cm*, – 2 *cm*) respectively. Lens is located at
(a) $x = +20\ cm$ (b) $x = -30\ cm$ (c) $x = -10\ cm$ (d) Origin

45. Focal length of a thin convex lens is 30 *cm*. At a distance of 10 *cm* from the lens there is a plane refracting surface of refractive index 3/2. Where will the parallel rays incident on lens converge
(a) At a distance of 27.5 *cm* from the lens (b) At a distance of 25 *cm* from the lens
(c) At a distance of 45 *cm* from the lens (d) At a distance of 40 *cm* from the lens

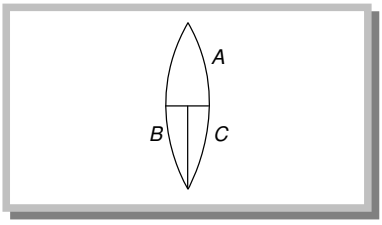
46. A ray incident at an angle of incidence 60° enters a glass sphere of refractive index $\mu = \sqrt{3}$. This ray is reflected and refracted at the further surface of the sphere. The angle between reflected and refracted rays at this surface is
(a) 90° (b) 60° (c) 70° (d) 40°

47. A double convex lens, lens made of a material of refractive index μ_1, is placed inside two liquids or refractive indices μ_2 and μ_3, as shown. $\mu_2 > \mu_1 > \mu_3$. A wide, parallel beam of light is incident on the lens from the left. The lens will give rise to



(a) A single convergent beam
(b) Two different convergent beams
(c) Two different divergent beams
(d) A convergent and a divergent beam

48. A thin, symmetric double-convex lens of power *P* is cut into three parts *A*, *B* and *C* as shown. The power of



(a) *A* is *P*
(b) *A* is 2*P*
(c) *B* is $\frac{P}{2}$
(d) *B* is $\frac{P}{4}$

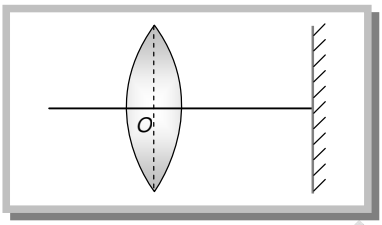
49. The distance between a convex lens and a plane mirror is 10 *cm*. The parallel rays incident on the convex lens after refraction from the mirror form image at the optical centre of the lens. Focal length of lens will be

(a) 10 *cm*

(b) 20 *cm*

(c) 30 *cm*

(d) Cannot be determined



50. One cannot see through fog because

(a) Fog absorbs light

(b) Light is scattered by the droplets in fog

(c) Light suffers total reflection at the droplets in fog

(d) The refractive index of fog is infinity