37. A point source of light moves in a straight line parallel to a plane table. Consider a small portion of the table directly below the line of movement of the source. The illuminance at this portion varies with its distance r from the source as

(a) $E \propto \frac{1}{r}$ (b) $E \propto \frac{1}{r^2}$

(c) $E \propto \frac{1}{r^3}$ (d) $E \propto \frac{1}{r^4}$

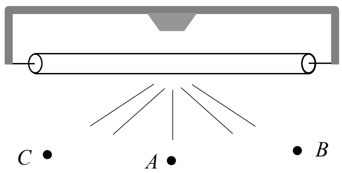
38. Figure shows a glowing mercury tube. The illuminances at point *A, B* and *C* are related as

(a) $B > C > A$

(b) $A > C > B$

(c) $B = C > A$

(d) $B = C < A$



39. The relative luminosity of wavelength 600 *nm* is 0.6. Find the radiant flux of 600 *nm* needed to produce the same brightness sensation as produced by 120 *W* of radiant flux at 555 *nm*

(a) 50*W* (b) 72*W*

(c) $120 \times (0.6)^2 W$ (d) 200*W*

40. Find the luminous intensity of the sun if it produces the same illuminance on the earth as produced by a bulb of 10000 *candela* at a distance 0.3 *m*. The distance between the sun and the earth is $1.5 \times 10^{11} m$

(a) $25 \times 10^{22} cd$ (b) $25 \times 10^{18} cd$

(c) $25 \times 10^{26} cd$ (d) $25 \times 10^{36} cd$

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

(a) 40 % (b) 64%

(c) 78% (d) 92%

CT Critical Thinking

Objective Questions

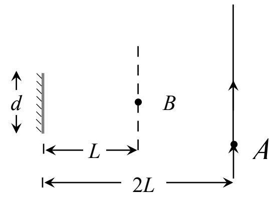
1. A point source of light *B* is placed at a distance *L* in front of the centre of a mirror of width *d* hung vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance 2*L* from it as shown. The greatest distance over which he can see the image of the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

(a) *d*/2

(b) *d*

(c) 2*d*

(d) 3*d*



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

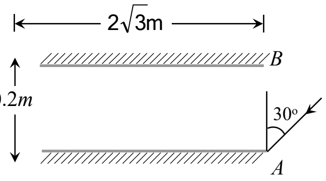
[IIT-JEE (Screening) 2002]

(a) 28

(b) 30

(c) 32

(d) 34



3. A concave mirror of focal length $100 cm$ is used to obtain the image of the sun which subtends an angle of $30°$. The diameter of the image of the sun will be

(a) $1.74 cm$ (b) $0.87 cm$

(c) $0.435 cm$ (d) $100 cm$

4. A square of side $3 cm$ is placed at a distance of $25 cm$ from a concave mirror of focal length $10 cm$ The centre of the square is at the axis of the mirror and the plane is normal to the axis. The area enclosed by the image of the square is

(a) $4 cm^2$ (b) $6 cm^2$

(c) $16 cm^2$ (d) $36 cm^2$

5. A short linear object of length l lies along the axis of a concave mirror of focal length f at a distance u from the pole of the mirror. The size of the image is approximately equal to **[IIT-JEE 1988; BHU**

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

(c) $\left(\frac{f}{u-f}\right)^{1/2}$ (d) $\left(\frac{f}{u-f}\right)^{2}$

6. A thin rod of length $f/3$ lies along the axis of a concave mirror of focal length f. One end of its magnified image touches an end of the rod. The length of the image is

[MP PET 1995]

(a) f (b) $\frac{1}{2}f$

(c) $2f$ (d) $\frac{1}{4}f$

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

[NCERT 1982]

(a) $(\alpha-\beta)$ (b) $2(\alpha-\beta)$

(c) $(\alpha-\beta)/2$ (d) $(\beta-\alpha)$

8. 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

[CBSE PMT 1998]

(a) $n>\sqrt{2}$ (b) $n=1$

(c) $n=1.1$ (d) $n=1.3$

9. 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

[ISM Dhanbad 1994]

(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

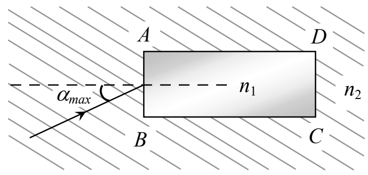
10. One face of a rectangular glass plate 6 *cm* thick is silvered. An object held 8 *cm* in front of the first face, forms an image 12 *cm* behind the silvered face. The refractive index of the glass is **[CPMT 1999]**

(a) 0.4 (b) 0.8

(c) 1.2 (d) 1.6

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

[IIT-JEE (Screening) 2000]



(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 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

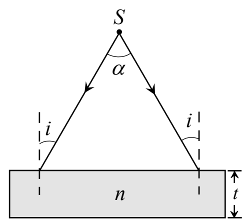
[IIT-JEE (Screening) 2000]

(a) Zero

(b) α

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

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



13. A concave mirror is placed at the bottom of an empty tank with face upwards and axis vertical. When sunlight falls normally on the mirror, it is focussed at distance of 32 *cm* from the mirror. If the tank filled with water $\left(\mu = \frac{4}{3}\right)$ upto a height of 20 *cm*, then the sunlight will now get focussed at

[UPSEAT 2002]

(a) 16 *cm* above water level

(b) 9 *cm* above water level

(c) 24 *cm* below water level

(d) 9 *cm* below water level

14. An air bubble in sphere having 4 *cm* diameter appears 1 *cm* from surface nearest to eye when looked along diameter. If ${}_a\mu_g = 1.5$, the distance of bubble from refracting surface is

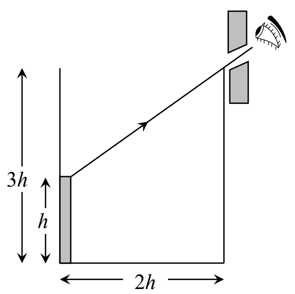
[CPMT 2002]

(a) 1.2 *cm* (b) 3.2 *cm*

(c) 2.8 *cm* (d) 1.6 *cm*

15. 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

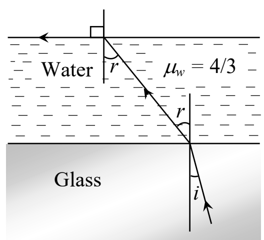
[IIT-JEE (Screening) 2002]



(a) 5/2 (b) $\sqrt{(5/2)}$

(c) $\sqrt{(3/2)}$ (d) 3/2

16. A ray of light is incident at the glass–water interface at an angle *i*, it emerges finally parallel to the surface of water, then the value of μ_g would be **[IIT-JEE (Screening) 2003]**



(a) (4/3) sin *i*

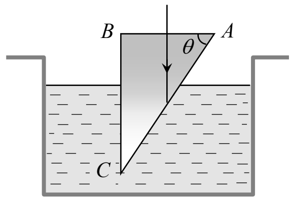
(b) 1/sin *i*

(c) 4/3

(d) 1

17. A glass prism (μ= 1.5) is dipped in water (μ= 4/3) as shown in figure. A light ray is incident normally on the surface *AB*. It reaches the surface BC after totally reflected, if

[IIT JEE 1981; MP PMT 1997]



(a) $\sin\theta \geq 8/9$

(b) $2/3 < \sin\theta < 8/9$

(c) $\sin\theta \leq 2/3$

(d) It is not possible

18. A convex lens *A* of focal length 20 *cm* and a concave lens *B* of focal length 5 *cm* are kept along the same axis with the distance *d* between them. If a parallel beam of light falling on *A* leaves *B* as a parallel beam, then distance *d* in *cm* will be

(a) 25 (b) 15

(c) 30 (d) 50

19. 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 2×10^8 *m/sec*, the focal length of the lens is

[CPMT 1989]

(a) 15 *cm* (b) 20 *cm*

(c) 30 *cm* (d) 10 *cm*

20. 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 **[MP PMT 1999]**

(a) 0 (b) 5 *cm*

(c) 2.5 *cm* (d) 10 *cm*

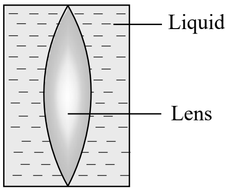
21. A luminous object is placed at a distance of 30 *cm* from the convex lens of focal length 20 *cm*. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature 10 *cm* be placed in order to have an upright image of the object coincident with it

[CBSE PMT 1998; JIPMER 2001, 02]

(a) 12 *cm* (b) 30 *cm*

(c) 50 *cm* (d) 60 *cm*

22. Shown in the figure here is a convergent lens placed inside a cell filled with a liquid. The lens has focal length + 20 *cm* when in air and its material has refractive index 1.50. If the liquid has refractive index 1.60, the focal length of the system is **[NSEP 1994; DPMT 2000]**



(a) + 80 *cm*

(b) – 80 *cm*

(c) – 24 *cm*

(d) –100 *cm*

23. 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

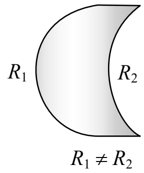
24. The object distance *u*, the image distance *v* and the magnification *m* in a lens follow certain linear relations. These are

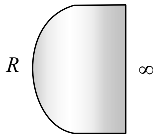
(a) $\frac{1}{u}$ versus $\frac{1}{v}$ (b) *m* versus *u*

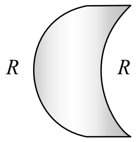
(c) *u* versus *v* (d) *m* versus *v*

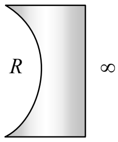
25. Which one of the following spherical lenses does not exhibit dispersion? The radii of curvature of the surfaces of the lenses are as given in the diagrams

[IIT-JEE (Screening) 2002]

(a) 

(b) 

(c) 

(d) 

26. 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

[IIT-JEE (Screening) 2003]

(a) 1.25 *cm* (b) 2.5 *cm*

(c) 1.05 *cm* (d) 2 *cm*

27. An achromatic prism is made by crown glass prism $(A_c = 19^o)$ and flint glass prism $(A_F = 6^o)$. If ${}^C\mu_v = 1.5$ and ${}^F\mu_v = 1.66$, then resultant deviation for red coloured ray will be

(a) 1.04° (b) 5°

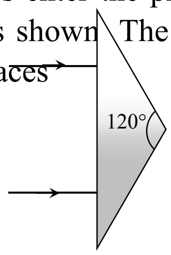
(c) 0.96° (d) 13.5°

28. The refracting angle of prism is *A* and refractive index of material of prism is $\cot\frac{A}{2}$. The angle of minimum deviation is **[IIT-JEE (Screening) 2000]**

(a) 180°– 3A (b) 180° + 2A

(c) 90° –A (d) 180° – 2A

29. An isosceles prism of angle 120° has a refractive index of 1.44. Two parallel monochromatic rays enter the prism parallel to each other in air as shown. The rays emerging from the opposite faces **[Roorkee 2000]** **[IIT-JEE 1995]**



(a) Are parallel to each other

(b) Are diverging

(c) Make an angle $2\sin^{-1}(0.72)$ with each other

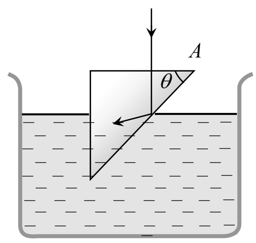
(d) Make an angle $2\{\sin^{-1}(0.72) - 30^o\}$ with each other

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

(a) $\sin^{-1}\left(\frac{1}{\mu}\right)$ (b) $\tan^{-1}\left(\frac{1}{\mu}\right)$

(c) $\sin^{-1}\left(\frac{\mu-1}{\mu}\right)$ (d) $\cos^{-1}\left(\frac{1}{\mu}\right)$

31. The refractive index of the material of the prism and liquid are 1.56 and 1.32 respectively. What will be the value of θ for the following refraction **[BHU 2003; CPMT 2004]**



(a) $\sin\theta \ge \frac{13}{11}$

(b) $\sin\theta \ge \frac{11}{13}$

(c) $\sin\theta \ge \frac{\sqrt{3}}{2}$

(d) $\sin\theta \ge \frac{1}{\sqrt{2}}$

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

(a) 5 *R* (b) 3 *R*

(c) 2 *R* (d) 1.5 *R*

33. 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 a concave mirror of focal length 10 *cm*. Then the refractive index of its material will be **[BHU 1997; UPSEAT 1995]**

(a) 3.0 (b) 2.0

(c) 2.5 (d) 1.5

34. 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 **[KCET (Engg./Med.) 2002]**

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

(c) $\pi - 2C$ (d) $\pi - C$

[EAMCET 2003]

35. An astronaut is looking down on earth's surface from a space shuttle at an altitude of $400\,km$. Assuming that the astronaut's pupil diameter is $5\,mm$ and the wavelength of visible light is $500\,nm$. The astronaut will be able to resolve linear object of the size of about

(a) 0.5 *m* (b) $5\,m$

(c) 50 *m* (d) 500 *m*

36. The average distance between the earth and moon is $38.6 \times 10^4\,km$. The minimum separation between the two points on the surface of the moon that can be resolved by a telescope whose objective lens has a diameter of 5 *m* with $\lambda = 6000\,Å$ is **[MP PMT 1993]**

(a) 5.65 *m* (b) 28.25 *m*

(c) 11.30 *m* (d) 56.51 *m*

37. The distance of the moon from earth is $3.8 \times 10^5\,km$. The eye is most sensitive to light of wavelength 5500 Å. The separation of two points on the moon that can be resolved by a 500 *cm* telescope will be **[IIT-JEE 1998; DPMT 2000]**

(a) 51 *m* (b) 60 *m*

(c) 70 *m* (d) All the above

38. A small source of light is to be suspended directly above the centre of a circular table of radius *R*. What should be the height of the light source above the table so that the intensity of light is maximum at the edges of the table compared to any other height of the source

(a) $\frac{R}{2}$ (b) $\frac{R}{\sqrt{2}}$

(c) R (d) $\sqrt{2}R$

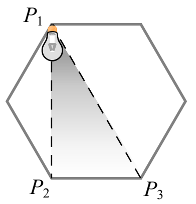
39. A light source is located at P_1 as shown in the figure. All sides of the polygon are equal. The intensity of illumination at P_2 is I_0. What will be the intensity of illumination at P_3

(a) $\frac{3\sqrt{3}}{8}I_0$

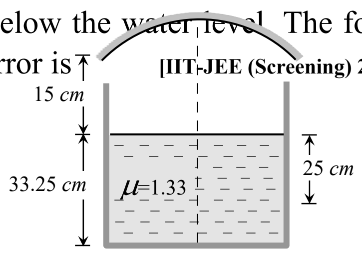
(b) $\frac{I_0}{8}$

(c) $\frac{3}{8}I_0$

(d) $\frac{\sqrt{3}}{8}I_0$



40. A container is filled with water (μ = 1.33) upto a height of 33.25 *cm*. A concave mirror is placed 15 *cm* above the water level and the image of an object placed at the bottom is formed 25 *cm* below the water level. The focal length of the mirror is **[IIT-JEE (Screening) 2005]**



(a) 10

(b) 15

(c) 20

(d) 25

41. A point object is moving on the principal axis of a concave mirror of focal length $24 cm$ towards the mirror. When it is at a distance of $60 cm$ from the mirror, its velocity is $9 cm/sec$ What is the velocity of the image at that instant **[MP PMT 1997]**

(a) $5 cm/sec$ towards the mirror

(b) $4 cm/sec$ towards the mirror

(c) $4 cm/sec$ away from the mirror

(d) $9 cm/sec$ away from the mirror

42. A concave mirror is placed on a horizontal table with its axis directed vertically upwards. Let O be the pole of the mirror and C its centre of curvature. A point object is placed at C. It has a real image, also located at C. If the mirror is now filled with water, the image will be

(a) Real, and will remain at C

(b) Real, and located at a point between C and ∞

(c) Virtual and located at a point between C and O

(d) Real, and located at a point between C and O

[IIT-JEE 1998]

43. The diameter of moon is $3.5 \times 10^3 \, km$ and its distance from the earth is $3.8 \times 10^5 \, km$. If it is seen through a telescope whose focal length for objective and eye lens are 4 *m* and 10 *cm* respectively, then the angle subtended by the moon on the eye will be approximately **[NCERT 1982; CPMT 1991]**

(a) 15° (b) 20°

(c) 30° (d) 35°

44. The focal length of an objective of a telescope is 3 *metre* and diameter 15 *cm*. Assuming for a normal eye, the diameter of the pupil is 3 *mm* for its complete use, the focal length of eye piece must be **[MP PET 1989]**

(a) 6 *cm* (b) 6.3 *cm*

(c) 20 *cm* (d) 60 *cm*

45. We wish to see inside an atom. Assuming the atom to have a diameter of 100 *pm*, this means that one must be able to resolved a width of say 10 *p.m.* If an electron microscope is used, the minimum electron energy required is about **[AIIMS 2004]**

(a) 1.5 *KeV* (b) 15 *KeV*

(c) 150 *KeV* (d) 1.5 *KeV*

46. A telescope has an objective lens of 10 *cm* diameter and is situated at a distance of one kilometre from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000 Å, is of the order of **[CBSE PMT 2004]**

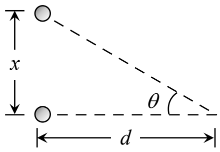
(a) 0.5 *m* (b) 5 *m*

(c) 5 *mm* (d) 5 *cm*

47. Two point white dots are 1*mm* apart on a black paper. They are viewed by eye of pupil diameter 3 *mm*. Approximately, what is the maximum distance at which dots can be resolved by the eye ? [Take wavelength of light = 500 *nm*]

[AIEEE 2005]

(a) 6 *m*
(b) 3 *m*
(c) 5 *m*
(d) 1 *m*



48. A convex lens of focal length 30 *cm* and a concave lens of 10 *cm* focal length are placed so as to have the same axis. If a parallel beam of light falling on convex lens leaves concave lens as a parallel beam, then the distance between two lenses will be

(a) 40 *cm* (b) 30 *cm*
(c) 20 *cm* (d) 10 *cm*

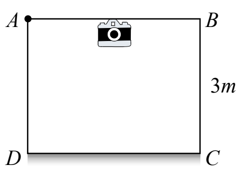
49. A small plane mirror placed at the centre of a spherical screen of radius *R*. A beam of light is falling on the mirror. If the mirror makes *n* revolution. per second, the speed of light on the screen after reflection from the mirror will be

(a) $4\pi nR$ (b) $2\pi nR$
(c) $\frac{nR}{2\pi}$ (d) $\frac{nR}{4\pi}$

50. A room (cubical) is made of mirrors. An insect is moving along the diagonal on the floor such that the velocity of image of insect on two adjacent wall mirrors is 10 cms^{-1}. The velocity of image of insect in ceiling mirror is

(a) 10 cms^{-1} (b) 20 cms^{-1}
(c) $\frac{10}{\sqrt{2}}$ cms^{-1} (d) $10\sqrt{2}$ cms^{-1}

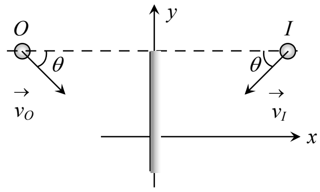
51. Figure shows a cubical room *ABCD* with the wall *CD* as a plane mirror. Each side of the room is 3*m*. We place a camera at the midpoint of the wall *AB*. At what distance should the camera be focussed to photograph an object placed at *A*



(a) 1.5 *m*
(b) 3 *m*
(c) 6 *m*
(d) More than 6 *m*

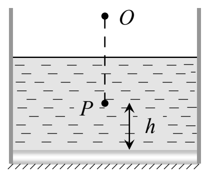
52. If an object moves towards a plane mirror with a speed *v* at an angle θ to the perpendicular to the plane of the mirror, find the relative velocity between the object and the image

(a) *v*
(b) 2*v*
(c) $2v\cos\theta$
(d) $2v\sin\theta$

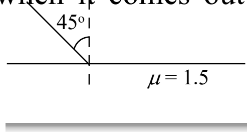


53. A plane mirror is placed at the bottom of the tank containing *a* liquid of refractive index μ. *P* is a small object at a height *h* above the mirror. An observer *O*-vertically above *P* outside the liquid see *P* and its image in the mirror. The apparent distance between these two will be

(a) $2\mu h$
(b) $\frac{2h}{\mu}$
(c) $\frac{2h}{\mu-1}$
(d) $h\left(1+\frac{1}{\mu}\right)$

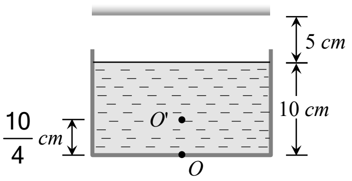


54. One side of a glass slab is silvered as shown. A ray of light is incident on the other side at angle of incidence $i = 45^o$. Refractive index of glass is given as 1.5. The deviation of the ray of light from its initial path when it comes out of the slab is



(a) 90°
(b) 180°
(c) 120°
(d) 45°

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

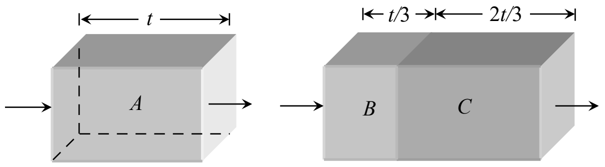


(a) 15 *cm*
(b) 12.5 *cm*
(c) 7.5 *cm*
(d) 10 *cm*

56. A person runs with a speed *u* towards a bicycle moving away from him with speed *v*. The person approaches his image in the mirror fixed at the rear of bicycle with a speed of

(a) $u - v$ (b) $u - 2v$
(c) $2u - v$ (d) $2(u - v)$

57. Two transparent slabs have the same thickness as shown. One is made of material *A* of refractive index 1.5. The other is made of two materials *B* and *C* with thickness in the ratio 1 : 2. The refractive index of *C* is 1.6. If a monochromatic parallel beam passing through the slabs has the same number of waves inside both, the refractive index of *B* is

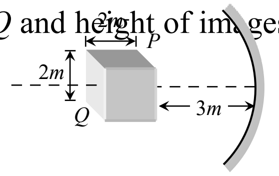


(a) 1.1 (b) 1.2
(c) 1.3 (d) 1.4

58. An object is placed infront of a convex mirror at a distance of 50 *cm*. A plane mirror is introduced covering the lower half of the convex mirror. If the distance between the object and plane mirror is 30 *cm,* it is found that there is no parallax between the images formed by two mirrors. Radius of curvature of mirror will be

(a) 12.5 *cm* (b) 25 *cm*
(c) $\frac{50}{3}$ *cm* (d) 18 *cm*

59. A cube of side 2 *m* is placed in front of a concave mirror focal length 1*m* with its face *P* at a distance of 3 *m* and face *Q* at a distance of 5 *m* from the mirror. The distance between the images of face *P* and *Q* and height of images of *P* and *Q* are

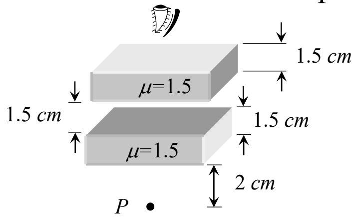


(a) 1 *m,* 0.5 *m,* 0.25 *m*
(b) 0.5 *m,* 1 *m,* 0.25 *m*
(c) 0.5 *m,* 0.25 *m,* 1*m*
(d) 0.25 *m,* 1*m,* 0.5 *m*

60. A small piece of wire bent into an *L* shape with upright and horizontal portions of equal lengths, is placed with the horizontal portion along the axis of the concave mirror whose radius of curvature is 10 *cm*. If the bend is 20 *cm* from the pole of the mirror, then the ratio of the lengths of the images of the upright and horizontal portions of the wire is

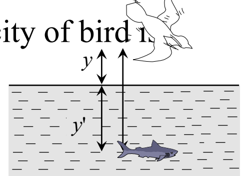
(a) 1 : 2 (b) 3 : 1
(c) 1 : 3 (d) 2 : 1

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



(a) 2.0 *cm* above *P*
(b) 1.5 *cm* above *P*
(c) 2.0 *cm* below *P*
(d) 1 *cm* above *P*

62. 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}

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

64. Two point light sources are 24 *cm* apart. Where should a convex lens of focal length 9 *cm* be put in between them from one source so that the images of both the sources are formed at the same place

(a) 6 *cm* (b) 9 *cm*

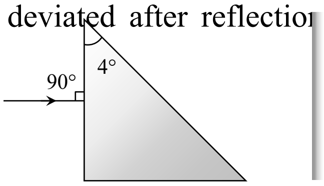
(c) 12 *cm* (d) 15 *cm*

65. There is an equiconvex glass lens with radius of each face as *R* and ${}_a\mu_g = 3/2$ and ${}_a\mu_w = 4/3$. If there is water in object space and air in image space, then the focal length is

(a) 2*R* (b) *R*

(c) 3 *R*/2 (d) R^2

66. A prism having an apex angle 4° and refraction index 1.5 is located in front of a vertical plane mirror as shown in figure. Through what total angle is the ray deviated after reflection from the mirror



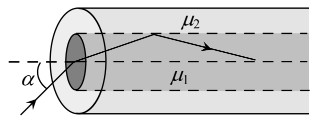
(a) 176°

(b) 4°

(c) 178°

(d) 2°

67. 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



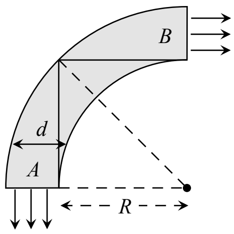
(a) $\cos^{-1}\sqrt{\mu_2^2-\mu_1^2}$

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

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

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

68. 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*



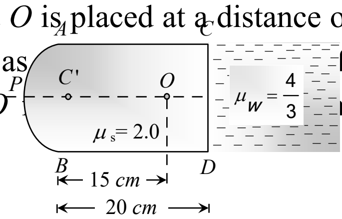
(a) 1.5

(b) 0.5

(c) 1.3

(d) None of these

69. 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



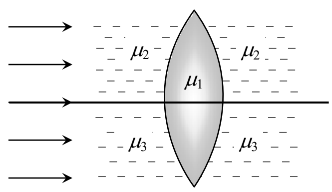
(a) 20 *cm*

(b) 30 *cm*

(c) 40 *cm*

(d) 50 *cm*

70. 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

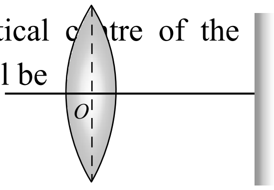
(a) A single convergent beam

(b) Two different convergent beams

(c) Two different divergent beams

(d) A convergent and a divergent beam

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



(a) 10 *cm*

(b) 20 *cm*

(c) 30 *cm*

(d) Cannot be determined

72. A compound microscope is used to enlarge an object kept at a distance 0.03*m* from it's objective which consists of several convex lenses in contact and has focal length 0.02*m*. If a lens of focal length 0.1*m* is removed from the objective, then by what distance the eye-piece of the microscope must be moved to refocus the image

(a) 2.5 *cm* (b) 6 *cm*

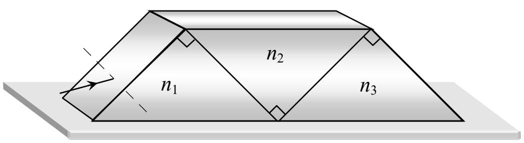
(c) 15 *cm* (d) 9 *cm*

73. If the focal length of the objective lens and the eye lens are 4 *mm* and 25 *mm* respectively in a compound microscope. The length of the tube is 16 *cm*. Find its magnifying power for relaxed eye position

(a) 32.75 (b) 327.5

(c) 0.3275 (d) None of the above

74. Three right angled prisms of refractive indices n_1, n_2 and n_3 are fixed together using an optical glue as shown in figure. If a ray passes through the prisms without suffering any deviation, then



(a) $n_1 = n_2 = n_3$ (b) $n_1 = n_2 \neq n_3$

(c) $1 + n_1 = n_2 + n_3$ (d) $1 + n_2^2 = n_1^2 + n_3^2$

75. In a compound microscope, the focal length of the objective and the eye lens are 2.5 *cm* and 5 *cm* respectively. An object is placed at 3.75 *cm* before the objective and image is formed at the least distance of distinct vision, then the distance between two lenses will be (*i.e.* length of the microscopic tube)

(a) 11.67 *cm* (b) 12.67 *cm*

(c) 13.00 *cm* (d) 12.00 *cm*

76. In a grease spot photometer light from a lamp with dirty chimney is exactly balanced by a point source distance 10 *cm* from the grease spot. On clearing the chimney, the point source is moved 2 *cm* to obtain balance again. The percentage of light absorbed by dirty chimney is nearly

(a) 56% (b) 44%

(c) 36% (d) 64%

77. The separation between the screen and a plane mirror is 2*r*. An isotropic point source of light is placed exactly midway between the mirror and the screen. Assume that mirror reflects 100% of incident light. Then the ratio of illuminances on the screen with and without the mirror is

(a) 10 : 1 (b) 2 : 1

(c) 10 : 9 (d) 9 : 1

78. The separation between the screen and a concave mirror is 2*r*. An isotropic point source of light is placed exactly midway between the mirror and the point source. Mirror has a radius of curvature *r* and reflects 100% of the incident light. Then the ratio of illuminances on the screen with and without the mirror is

(a) 10 : 1 (b) 2 : 1

(c) 10 : 9 (d) 9 : 1

79. The apparent depth of water in cylindrical water tank of diameter $2R$ *cm* is reducing at the rate of x *cm*/minute when water is being drained out at a constant rate. The amount of water drained in *c.c.* per minute is (n_1 = refractive index of air, n_2 = refractive index of water) **[AIIMS 2005]**

(a) $x\,\pi R^2\, n_1/n_2$ (b) $x\,\pi R^2\, n_2/n_1$

(c) $2\,\pi R\, n_1/n_2$ (d) $\pi R^2\, x$