19 - RAY OPTICS

(Answers at the end of all questions)

1) A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is 4 / 3 and the fish is 12 cm below the surface, the radius of this circle in cm is

(a) $36/\sqrt{7}$ (b) $36\sqrt{7}$ (c) $4\sqrt{5}$ (d) $36/\sqrt{5}$ [AIEEE 2005]

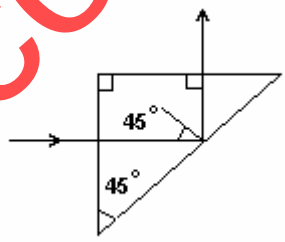
2) A thin glass (refractive index 1.5) lens has optical power - 5 D in air. Its optical power in a liquid medium with refractive index 1.6 will be

(a) - 1 D (b) 1 D (c) - 25 D (d) 25 D [AIEEE 2005]

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) $n < 1/\sqrt{2}$ (b) $n > \sqrt{2}$

(c) $n > 1/\sqrt{2}$ (d) $n < \sqrt{2}$ [AIEEE 2004]



4) 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 ?

(a) 20 cm (b) 30 cm (c) 60 cm (d) 80 cm [AIEEE 2004]

5) To get three images of a single object, one should have two plane mirrors at an angle of

(a) 30° (b) 60° (c) 90° (d) 120° [AIEEE 2003]

6) The image formed by an objective of a compound microscope is

(a) real and enlarged (b) virtual and enlarged

(c) real and diminished (d) virtual and diminished [AIEEE 2003]

7) A candle placed 23 cm from a lens, forms an image on a screen placed 75 cm on the other end of the lens. The focal length and type of the lens should be

(a) + 18.75 cm and convex lens (b) - 18.75 cm and concave lens

(c) + 20.25 cm and convex lens (d) - 20.25 cm and concave lens [AIEEE 2003]

8) A person having the nearest distance of distinct vision of 32 cm uses a reading lens of 8 cm focal length. The magnification of his reading lens is

(a) 5 (b) 4 (c) 3 (d) 2 [AIEEE 2002]

9) Consider telecommunication through optical fibres. Which of the following statements is not true ?

(a) Optical fibres can be of graded refractive index.

(b) Optical fibres have extremely low transmission loss.

(c) Optical fibres are subject to electromagnetic interference from outside.

(d) Optical fibres may have homogeneous core with a suitable cladding.

[AIEEE 2002]

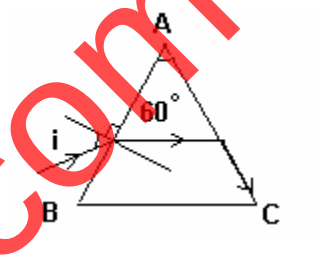
10) A ray of light passing through a prism having $\mu = \sqrt{2}$ suffers minimum deviation. If angle of incidence is double the angle of refraction within prism, the angle of prism is

(a) 30° (b) 45° (c) 60° (d) 90° [AIEEE 2002]

(Answers at the end of all questions)

11) The combined power of two lenses in contact is + 10 D. When they are separated by 20 cm, their power becomes + 6.25 D. The powers of these lenses are
(a) - 3.5 D, + 6.5 D (b) - 7.5 D, + 2.5 D
(c) + 7.5 D, + 2.5 D (d) + 9.0 D, + 1.0 D [AIEEE 2002]

12) A ray of light is incident on the face AB of a prism of refracting angle 60° as shown in the figure. The angle of incidence at which the ray of light just suffers total internal reflection on the face AC is (μ = 1.5)
(a) 19.6° (b) 23.6° (c) 27.6° (d) 35.6°
[AIEEE 2002]

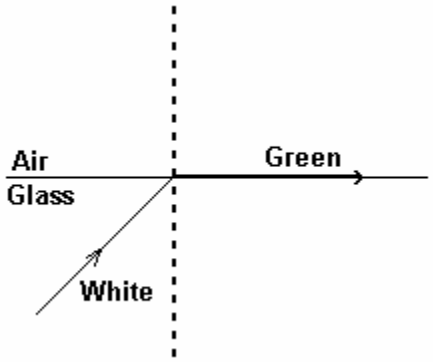


13) A double convex lens of refractive index μ_2 is immersed in a liquid of refractive index μ_1. This lens will act as converging lens, if
(a) $\mu_1 > \mu_2$ (b) $\mu_2 > \mu_1$ (c) $\mu_1 = \mu_2$ (d) $\mu_1 = \mu_2 = 0$ [AIEEE 2002]

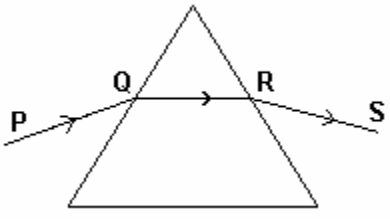
14) A convex lens is in contact with concave lens. The magnitude of the ratio of their focal lengths is 2 / 3. Their equivalent focal length is 30 cm. Their individual focal lengths are
(a) - 75, 50 (b) - 10, 15 (c) 75, 50 (d) - 15, 10 [IIT 2005]

15) A container is filled with water (m = 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
(a) 10 cm (b) 15 cm (c) 20 cm (d) 25 cm [IIT 2005]

16) 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
(a) yellow, orange, red
(b) violet, indigo, blue
(c) all colours
(d) all colours except green
[IIT 2004]



17) A ray of light is incident on an equilateral glass prism placed on a horizontal table. Which of the following is true for maximum deviation ?
(a) PQ is horizontal
(b) QR is horizontal
(c) RS is horizontal
(d) either PQ or RS is horizontal
[IIT 2004]



18) 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 [IIT 2004]

(Answers at the end of all questions)

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 length of focal length 20 cm is placed between the convex lens and the image at a distance of 26 cm from the convex lens, the size of the new image will be

(a) 1.25 cm (b) 2.5 cm (c) 1.05 cm (d) 2 cm [IIT 2003]

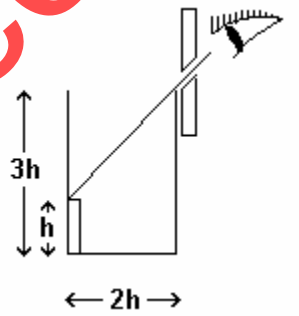
20) A ray of light is incident at the glass-water interface at an angle i. If it emerges finally parallel to the surface of water, then the value of μ_g would be

(a) (4 / 3) sin i (b) 1 / sin i (c) 4 / 3 (d) 1 [IIT 2003]

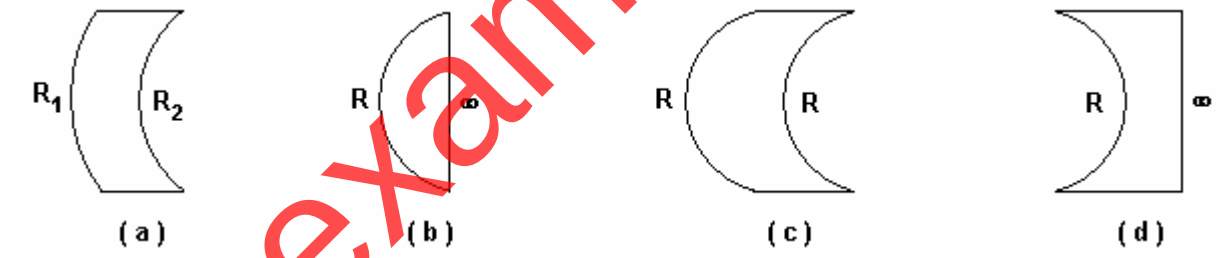
21) An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius is h. When the beaker is filled with a liquid upto a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is

(a) $\frac{5}{2}$ (b) $\sqrt{\frac{5}{2}}$ (c) $\sqrt{\frac{3}{2}}$ (d) $\frac{3}{2}$

[IIT 2002]

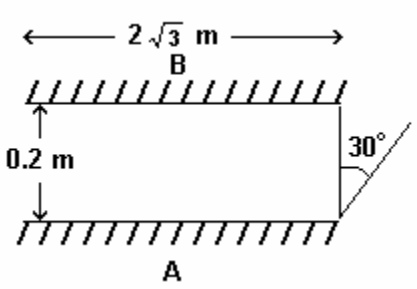


22) Which one of the following spherical lenses does not exhibit dispersion ? The radii of curvature of the surfaces of the lenses are given in the diagrams. [IIT 2002]



23) Two plane mirrors A and B are aligned parallel to each other as sown 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

(a) 28 (b) 30 (c) 32 (d) 34 [IIT 2002]

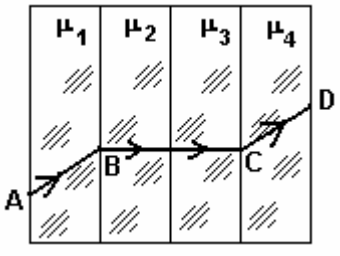


24) A ray of light passes through four transparent media with refractive indices μ_1, μ_2, μ_3 and μ_4 as shown in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have

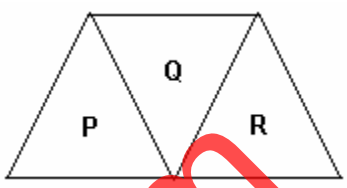
(a) $\mu_1 = \mu_2$ (b) $\mu_2 = \mu_3$

(c) $\mu_3 = \mu_4$ (d) $\mu_4 = \mu_1$

[IIT 2001]

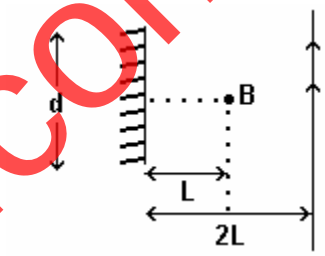


25) A given ray of light suffers minimum deviation in an equilateral prism P. Additional prisms Q and R of identical shape and of the same material as P are now added as shown in the figure. The ray will suffer



(a) greater deviation (b) same deviation as before
(c) no deviation (d) total internal reflection
[IIT 2001]

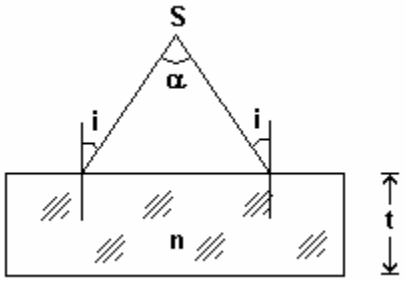
26) A point source of light B, placed at a distance L in front of the centre of a mirror of width d, hangs vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance 2L from it as shown. The greatest distance over which he can see the image of the light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



(a) d / 2 (b) d (c) 2d (d) 3d
[IIT 2000]

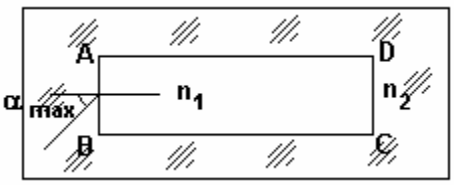
27) In a compound microscope, the intermediate image is
(a) virtual, erect and magnified (b) real, erect and magnified
(c) real, inverted and magnified (d) virtual, erect and reduced [IIT 2000]

28) A diverging beam of light from a point source S having divergence angle α is incident 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 its refractive index is n, then the divergent angle of the emergent beam is



(a) zero (b) α
(c) $\sin^{-1}(1/n)$ (d) $2\sin^{-1}(1/n)$
[IIT 2000]

29) 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 is 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) $\sin^{-1}\left(\frac{n_1}{n_2}\right)\cos\left(\sin^{-1}\frac{n_2}{n_1}\right)$ (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) $\sin^{-1}\left(\frac{n_2}{n_1}\right)$ [IIT 2000]

30) 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 or 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 its 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 [IIT 2000]

(Answers at the end of all questions)

31) 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 [IIT 1999]

32) A real image of a distant object is formed by a planoconvex lens on its principal axis. Spherical aberration
(a) is absent
(b) is smaller if the curved surface of the lens faces the object
(c) is smaller if the plane surface of the lens faces the object
(d) is the same whichever side of the lens faces the object [IIT 1998]

33) A ray of light traveling in a transparent medium is incident on a surface separating the medium from air at an angle of incidence 45°. The ray undergoes total internal reflection. If n is the refractive index f 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 [IIT 1998]

34) 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 1998]

35) 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) 5R (b) 3R (c) 2R (d) 1.5R [IIT 1998]

36) Which of the following form (s) a virtual and erect image for all positions of the object ?
(a) convex lens (b) concave lens
(c) convex mirror (d) concave mirror [IIT 1996]

37) Spherical aberration in a thin lens can be reduced by
(a) using a monochromatic light (b) using a doublet combination
(c) using a circular annular mask over the lens
(d) increasing the size of the lens [IIT 1994]

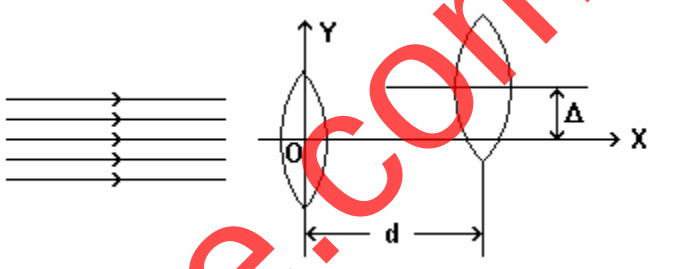
38) A planet is observed by an astronomical refracting telescope having an objective of focal length 16 m and an eyepiece of focal length 2 cm. Which of the following statements are true ?
(a) The distance between the objective and the eyepiece is 16.02 m.
(b) The angular magnification of the planet is - 800.
(c) The image of the planet is inverted.
(d) The objective is larger than the eyepiece. [IIT 1992]

(Answers at the end of all questions)

39) A thin prism P_1 with angle 4° and made of glass having refractive index 1.54 is combined with another thin prism P_2 made of glass having refractive index 1.72 to produce dispersion without deviation. The angle of the prism P_2 is

(a) 5.33° (b) 4° (c) 3° (d) 2.6° [IIT 1990]

40) Two thin convex lenses of focal lengths f_1 and f_2 are separated by a horizontal distance d (where $d < f_1$ and $d < f_2$), and their centres are displaced by a vertical separation Δ as shown in the figure. Taking the origin of coordinates, O, at the centre of the first lens, the x and y coordinates of the focal point of the lens system, for a parallel beam of rays coming from the left, are given by

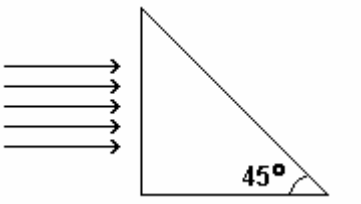


(a) $x = \frac{f_1 f_2}{f_1 + f_2}$, $y = \Delta$ (b) $x = \frac{f_1 (f_2 + d)}{f_1 + f_2 - d}$, $y = \frac{\Delta^2}{f_1 + f_2}$

(c) $x = \frac{f_1 f_2 + d(f_1 - d)}{f_1 + f_2 - d}$, $y = \frac{\Delta (f_1 - d)}{f_1 + f_2 - d}$

(d) $x = \frac{f_1 f_2 + d(f_1 - d)}{f_1 + f_2 - d}$ $y = 0$ [IIT 1993]

41) A beam of light consisting of red green and blue colours is incident on a right-angled prism as shown in the figure. The refractive indices of the material of the prism for the red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The prism will



(a) separate part of the red colour from the green and blue colours
(b) separate part of the blue colour from the red and green colours
(c) separate all the three colours from one another
(d) not separate even partially any colour from the other two colours [IIT 1989]

42) An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and the eye-piece is 36 cm and the final image is formed at infinity. The focal length f_0 of the objective and f_e of the eye-piece are

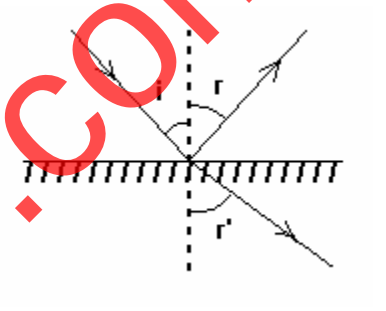
(a) 45 cm and - 9 cm (b) 50 cm and 10 cm
(c) 7.2 cm and 5 cm (d) 30 cm and 6 cm [IIT 1989]

43) A short linear object of length b 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

(a) $b\left(\frac{u - f}{f}\right)^{\frac{1}{2}}$ (b) $b\left(\frac{f}{u - f}\right)^{\frac{1}{2}}$ (c) $b\left(\frac{u - f}{f}\right)$ (d) $b\left(\frac{f}{u - f}\right)^2$ [IIT 1988]

44) A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen
(a) half the image will disappear (b) complete image will be formed
(c) intensity of the image will increase (d) intensity of the image will decrease
[IIT 1986]

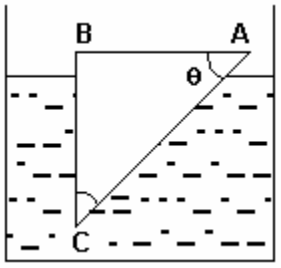
45) A ray of light from a denser medium strikes a rarer medium at an angle of incidence i (see figure). The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are r and r'. The critical angle is



(a) $\sin^{-1}(\tan r)$ (b) $\sin^{-1}(\tan r')$
(c) $\sin^{-1}(\tan i)$ (d) $\tan^{-1}(\sin i)$ [IIT 1983]

46) A convex lens of focal length 40 cm is in contact with a concave lens of focal length 25 cm. The power of the combination in diopters is
(a) - 1.5 (b) - 6.5 (c) + 6.5 (d) + 6.67 [IIT 1982]

47) A glass prism of refractive index 1.5 is immersed in water (refractive index 4 / 3). A light beam incident normally on the face AB (see figure) is totally reflected to reach the face BC, if



(a) $\sin\theta \geq \frac{8}{9}$ (b) $\frac{2}{3} < \sin\theta < \frac{8}{9}$ (c) $\sin\theta \leq \frac{2}{3}$
[IIT 1981]

48) When a ray of light enters a glass slab from air
(a) its wavelength increases (b) neither its wavelength nor its frequency changes
(c) its frequency increases (d) its wavelength decreases [IIT 1980]

49) An electric bulb illuminates a plane surface. The intensity of illumination on the surface at a point 2 m away from the bulb is 5×10^{-4} phot (lumens per sq. cm.). The line joining the bulb to the point makes an angle of 60° with the normal to the surface. The intensity of the bulb in candela (candle power) is
(a) $40\sqrt{3}$ (b) 40 (c) 20 (d) 40×10^{-4} [IIT 1980]

50) Two plane mirrors are inclined to each other at an angle θ. If a ray of light incident on the first mirror is parallel to the second mirror and that reflected from the second mirror is parallel to the second mirror, then the angle θ is
(a) 30° (b) 45° (c) 60° (d) 75°

51) A lens made of a material of refractive index μ_2 is immersed in a medium of refractive index μ_1. If the radii of curvature of the lens surfaces are R_1 and R_2, then the focal length f of the lens is given by

(a) $\frac{1}{f} = (\mu_2 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ (b) $\frac{1}{f} = \left(\frac{\mu_2}{\mu 1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

(c) $\frac{1}{f} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ (d) $\frac{1}{f} = \left(\frac{\mu_1}{\mu_2} - 1\right)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

Answers

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	b	b	a	c	a	a	a	c	d	c	c	b	d	a	c	b	c	b	b

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
b	c	b	d	b	d	c	b	a	d	a	b	c,d	d	a	b,c	c	a,c,d	c	c,d

41	42	43	44	45	46	47	48	49	50	51
c	d	d	b,d	a,c	a	a	d	b	c	b