OPTICS

1. 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 approx. equal to:

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

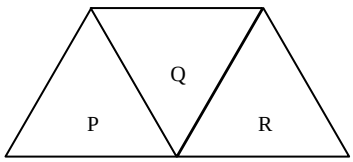
(c) $b\left(\frac{u-f}{f}\right)$ (d) $b\left(\frac{f}{u-f}\right)$

2. Two transparent media A and B are in contact. Velocity of light in A is 2×10^8 ms^{-1} and in B is 2.5×10^8 ms^{-1}. The critical angle for which ray of light going from A to B is totally internally reflected is

(a) $\sin^{-1}(4/7)$ (b) $\sin^{-1}(4/5)$

(c) $\sin^{-1}(2/5)$ (d) $\sin^{-1}(1/2)$

3. 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 figure. The ray will now suffer



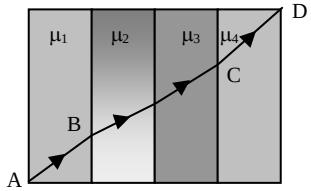
(a) greater deviation

(b) no deviation

(c) same deviation as before

(d) total internal reflection

4. A ray of light through four transparent media with refractive indices μ_1, μ_2, μ_3 and μ_4 is shown in 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) $\mu_4 = \mu_1$

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

(a) 0.5 m (b) 5 m

(c) 50 m (d) 500 m

6. The refractive index of the material of a prism is $\sqrt{2}$, and its refracting angle is 30^o. One of the refracting surface of the prism is made a mirror inwards. A beam of monochromatic light entering the prism from the other face retraces its path, after reflection from mirrored surface, if its angle of incidence on prism is

(a) 0^o (b) 30^o

(c) 45^o (d) 60^o

7. A telescope has an objective lens of 10 cm diameter and is situated at a distance of 1 km from two objects. The minimum distance between these two objects, which can be

resolved by the telescope, when the mean wavelength of lights is 5000 Å is of the order of

(a) 5 mm (b) 5 cm

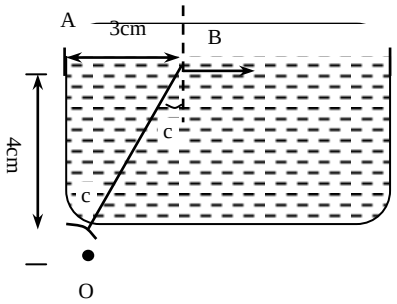
(c) 2.5 m (d) 5 m

8. If polarizing angle of a piece of glass for green light is 54-74^o then the angle of minimum deviation for an equilateral prism made of same glass is (tan 54-74^o = 1.414)

(a) 45^o (b) 54-74^o

(c) 30^o (d) 90^o

9. A small coin is resting on the bottom of a beaker filled with a liquid. A ray of right from the coin travels upto the surface of the liquid and moves along the surface, figure. How fast is light travelling in the liquid?



(a) 2.4×10^8 m/s (b) 3.0×10^8 m/s

(c) 1.2×10^8 m/s (d) 1.8×10^8 m/s

10. A boy is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length 10 cm. The diameter of the sun is 1.39×10^9 m and its mean distance from the earth is 1.5×10^{11} m. What is the diameter of the sun's image on the paper?

(a) 9.2×10^{-4} m (b) 6.5×10^{-4} m

(c) 6.5×10^{-5} m (d) 12.4×10^{-4} m

11. Mixture of light consisting of wavelength 590 nm and an unknown wavelength illuminates young's double slit and gives rise of two overlapping interference pattern on the screen. The central maximum of both lights coincide. Further, it is observed that the third bright fringe of known light coincides with the 4th bright fringe of unknown light. From this data, the wave length of unknown light is

(a) 885.0 nm (b) 442.5 nm

(c) 776.8 nm (d) 393.4 nm

12. Monochromatic light of wavelength 589 nm is incident from air on a water surface. The refractive index of water is 1.33. The wavelength of refracted light is

(a) 589 nm (b) 443 nm

(c) 333 nm (d) 221 nm

13. As the beam enters the medium, it will

(a) converge

(b) diverge near the axis and converge near the periphery

(c) travel as a cylindrical beam

(d) diverge

14. The speed of light in the medium is

(a) the same everywhere in the beam

(b) directly proportional to the internsity I

(c) maximum on the axis of the beam

(d) minimum on the axis of the beam

15. The initial shape of the wave front of the beam is

(a) concave

(b) convex near the axis and concave near the periphery

(c) planar

(d) convex

16. A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45^o. For which of the following value of μ the ray can undergo total internal refection?

(a) $\mu = 1.33$ (b) $\mu = 1.40$

(c) $\mu = 1.50$ (d) $\mu = 1.25$

17. A lens having focal length f and aperture of diameter d forms an image of intensity I. Aperture of diameter d/2 in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively

(a) f and $\frac{1}{4}$ (b) $\frac{3f}{4}$ and $\frac{1}{2}$

(c) f and $\frac{3I}{4}$ (d) $\frac{f}{2}$ and $\frac{1}{2}$

18. The speed of light in media M_1 and M_2 are 1.5×10^8 m/s and 2.0×10^8 m/s respectively. A ray of light enters from medium M_1 and M_2 at an incidence angle i. If the ray suffers total internal reflection, the value of i is

(a) equal to $\sin^{-1}\left(\frac{2}{3}\right)$

(b) equal to or less than $\sin^{-1}\left(\frac{3}{5}\right)$

(c) equal to or greater than $\sin^{-1}\left(\frac{3}{4}\right)$

(d) less than $\sin^{-1}\left(\frac{2}{3}\right)$

19. A ray of light is incident on a 60^o prism at the minimum deviation position. The angle of refraction at the first face (i.e., incident face) of the prism is

(a) zero (b) 30^o

(c) 45^o (d) 60^o

20. When a lens of refractive index n_1 is placed in a liquid of refractive index n_2, the lends looks to have disappeared only if

(a) $n_1 = n_2/2$ (b) $n_1 = 3\ n_2/4$

(c) $n_1 = n_2$ (d) $n_1 = 5\ n_2/4$

21. The angle subtended by a circular disc of diameter 3 cm at a distance of 1000 cm from your eye is

(a) 0.2^o (b) 0.002^o

(c) 0.11^o (d) 0.22^o

22. The focal length of a thin biconvex lens is 20 cm. When an object is moved from a distance of 25 cm in front of it to 50 cm, the magnification of its image changes from m_{25} to m_{50}. The ratio $\frac{m_{25}}{m_{50}}$ is:

(a) 4 (b) 6

(c) 11 (d) 3

23. Two point source S_1 and S_2 are 24 cm apart. Where should a convex lens of focal length 9 cm be placed in between them so that the images of both sources are formed at the same place?

(a) 5 cm from S_1 (b) 15 cm from S_1

(c) 10 cm from S_1 (d) 12 cm from S_1

24. The focal length of a thin biconvex lens is 20 cm. When an object is moved from a distance of 25 cm in front of it to 50 cm, the magnification of its image change from m_{25} to m_{50}. The ratio $\frac{m_{25}}{m_{50}}$ is

(a) 4 (b) 6

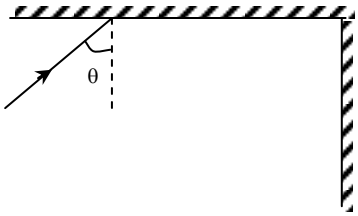
(c) 1 (d) 3

25. In an optic experiment, with the position of the object fixed, a student varies the position of a convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance u and image distance v from the lens, is plotted using the same scale for the two axes. A straight line passing through origin and making an angle of 42^o with the x-axis meets the experimental curve at P. The coordinate of P will be

(a) $\left(\frac{f}{2}, \frac{f}{2}\right)$ (b) (f, f)

(c) (4f, 4f) (d) (–2f, 2f)

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



(a) 60^o (b) 30^o

(c) 45^o (d) all of these

27. Two parallel rays are travelling in a medium of refractive index $\mu_1 = 4/3$. One of the rays passes through a parallel glass slab of thickness t and refractive index $\mu_2 = 3/2$. The path difference between the two rays due to the glass slab will be

(a) 4t/3 (b) 3t/2

(c) t/8 (d) t/6

28. Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$)

(a) less than θ_2 (b) between θ_1 and θ_2

(c) greater than θ_2 (d) less than θ_1

29. A hollow convex lens of glass will behave like a

(a) convex lens (b) concave lens

(c) glass plate (d) mirror

30. A plane mirror is made of glass slab ($\mu_g = 1.5$) 2.5 cm thick and silvered on back. A point object is placed 5 cm in front of the unsilvered face of the mirror. What will be the position of final image?

(a) 12 cm from unsilvered face

(b) 14.6 cm from unsilvered face

(c) 5.67 cm from unsilvered face

(d) 8.33 cm from unsilvered face

31. The refractive index of a prism is 2. This prism can have a maximum refracting angle of

(a) 90^o (b) 60^o

(c) 45^o (d) 30^o

32. A ray of light undergoes deviation of 30^o when jumping on an equilateral prism of refractive index $\sqrt{2}$. The angle made by the ray inside the prism with the base of the prism is

(a) 15^o (b) 0^o

(c) 45^o (d) 30^o

33. One of the refracting surfaces of a prism of angle 30^o is silvered. A ray of light incident at an angle of 60^o retraces its path. The refractive index of the material of prism is

(a) $\sqrt{2}$ (b) $\sqrt{3}$

(c) 3/2 (d) 2

34. Angle of minimum deviation is equal to the angle of prism A of an equilateral glass prism. The angle of incidence at which minimum deviation will be obtained is

(a) 60^o (b) 30^o

(c) 45^o (d) $\sin^{-1}(2/3)$

35. Two identical glass (μ_g = 3/2) equiconvex lenses of focal length f are kept in contact. The space between the two lenses is filled with water (μ_w = 4/3). The focal length of the combination is

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

(c) $\frac{4f}{3}$ (d) $\frac{3f}{4}$

36. The magnification of an object placed in front of a convex lens of focal 20 cm is +2. To obtain a magnification of –2, the object will have to be moved a distance equal to

(a) 10 cm (b) 20 cm

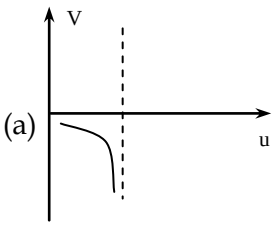
(c) 30 cm (d) 40 cm

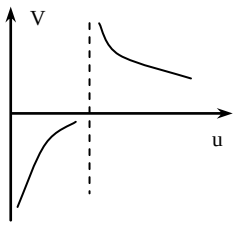
37. A plane mirror is placed or origin parallel of y-axis, facing the positive x-axis. An object starts from (2m, 0, 0) with a velocity of $(2\hat{i}+2\hat{j})$ m/s. The relative velocity of image with respect to object is along

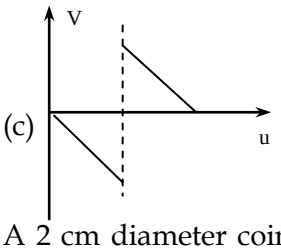
(a) positive x-axis (b) negative x-axis

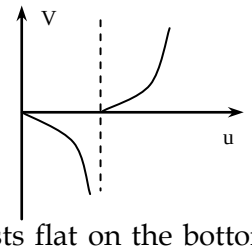
(c) positive y-axis (d) negative y-axis

38. As the position of an object (u) reflected from a concave mirror is varied, the position of the image (v) also varies. By letting the u changes form 0 to +∞ the graph between versus u will be

(a) 

(b) 

(c) 

(d) 

39. A 2 cm diameter coin rests flat on the bottom of a bowl in which the water is 20 cm deep (μ_w = 4/3). If the coin is viewed directly from above, what is its apparent diameter?

(a) 2 cm (b) 1.5 cm

(c) 2.67 cm (d) 1.67 cm

40. Refraction takes place at a convex spherical boundary separating air-glass medium. For the image to be real, the object distance (μ_g = 3/2)

(a) should be greater than three times the radius of curvature of the refracting surface

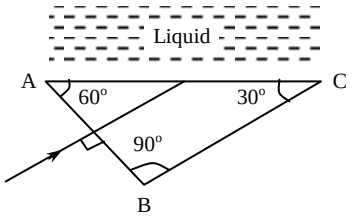
(b) should be greater than two times the radius of curvature of the refracting surface

(c) should be greater than the radius of curvature of the refracting surface

(d) is independent of the radius of curvature of the refracting surface

41. Light is incident normally on face AB of a prism as shown in figure. A liquid of refractive index μ is placed on face AC of the prism. The prism is made of glass of refractive index 3/2.

The limits of μ for which total internal reflection takes place on face AC is



(a) $\mu > \frac{\sqrt{3}}{2}$ (b) $\mu < \frac{3\sqrt{3}}{4}$

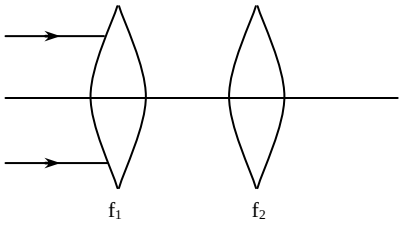
(c) $\mu > \sqrt{3}$ (d) $\mu < \frac{\sqrt{3}}{2}$

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 ¼. The focal length of the lens will be

(a) 8.6 cm (b) 6.2 cm

(c) 10 cm (d) 4.4 cm

43. Parallel beam of length is incident on the system of two convex lenses of focal lengths f_1 = 20 cm and f_2 = 10 cm. What should be the distance between the two lenses so that rays after refraction from both the lenses pass undeviated



(a) 60 cm (b) 30 cm

(c) 90 cm (d) 40 m

44. A point object is placed at a distance of 25 cm from a convex lens of focal length 20 cm. If a glass slab of thickness t and refractive index 1.5 is inserted between the lens and the object the image is formed at infinity. The thickness t is

(a) 10 cm (b) 5 cm

(c) 20 cm (d) 15 cm

45. Light waves travel in vacuum along the y-axis. Which of the following may represent the wavefront?

(a) x = constant (b) y = constant

(c) z = constant (d) x + y + z = constant

46. A plate of thickness t made of a material of refractive index μ is placed in front of one of the slits in a double slit experiment. What should be the minimum thickness t which will make the intensity at the centre of the fringe pattern zero?

(a) $(\mu - 1)\frac{\lambda}{2}$ (b) $(\mu - 1)\lambda$

(c) $\frac{\lambda}{2(\mu-1)}$ (d) $\frac{\lambda}{(\mu-1)}$

47. In Young's double slit experiment how many maximas can be obtained on a screen (including the central maximum) on both sides of the central fringe if λ = 2000 Å and d = 7000 Å

(a) 12 (b) 7

(c) 18 (d0 4

48. In Young's double slit experiment $\frac{d}{D} = 10^{-4}$ (d = distance between slits, D = distance of screen from the slits). At a point P on the screen resulting intensity is equal to the intensity due to individual slit I_0. Then the distance of point

P from the central maximum is (λ = 6000 Å)

(a) 2 mm (b) 1 mm

(c) 0.5 mm (d) 4 mm

49. Young's double slit experiment is made in a liquid. Th 10th bright fringe is liquid lies where 6th dark fringe lies in vacuum. The refractive index of the liquid is approximately

(a) 1.8 (b) 1.54

(c) 1.67 (d) 1.2

50. An infinitely long rod lies along the axis of a concave mirror of focal length f. The near end of the rod is at a distance n > 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) $\frac{f^2}{u-f}$

ANSWER KEY

1	D	**11**	B	**21**	C	**31**	B	**41**	B
2	B	**12**	B	**22**	B	**32**	B	**42**	D
3	C	**13**	A	**23**	D	**33**	B	**43**	B
4	D	**14**	D	**24**	B	**34**	A	**44**	D
5	C	**15**	C	**25**	D	**35**	D	**45**	B
6	C	**16**	C	**26**	D	**36**	B	**46**	C
7	A	**17**	C	**27**	C	**37**	B	**47**	B
8	C	**18**	C	**28**	C	**38**	A	**48**	A
9	D	**19**	B	**29**	C	**39**	A	**49**	A
10	A	**20**	C	**30**	D	**40**	A	**50**	D