



Refraction of light

Multiple Choice Questions

- 1. Incident angle of a ray of light is 30°. The angle between the incident ray and the reflected ray
 - (a) 30° (b) 60° (c) 90° $(d)15^{\circ}$
- 2. A letter L written on a white paper is placed in front of a plane mirror. The image of this letter in the plane mirror will appear as (a) L (b) Γ (d) 7 (c) **J**
- To form an image twice the size of the object, 3. using a convex lens of focal length 20 cm, the object distance must be

(a) $< 20 \, cm$

- (b) $> 20 \, cm$
- (c) < 20 cm and between 20 cm and 40 cm (d) cannot say
- 4. The refractive index of dense flint glass is 1.65 and for alcohol, it is 1.36 with respect to air, then the refractive index of the dense flint glass with respect to alcohol is

(a) 1.31	(b) 1.21
(c) 1.11	(d) 1.01

5. Light travels from air into glass of refractive index 1.2. The time taken by the light to travel through a piece of glass of 50 cm thickness is (b) $2.25 \times 10^{-7} s$ (a) 2.25s ⁻⁹ s

(c)
$$2.5 \times 10^{-8} s$$
 (d) $2.5 \times 10^{-8} s$

The even figure shows a ray of light as it 6. travels from medium A to medium B. Refractive index of the medium B relative to medium A is



7. Refractive index of glass with respect to air is and refractive index of water with respect to

air i	$s \frac{4}{3}$.	What	will	be	the	refra	active	index	of
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glass with respect to water?

(a) 1	(b) 1.5
(c) 1.125	(d) 1.4

- 8. Refractive index of diamond with respect to glass is 1.6 and the absolute refractive index of glass is 1.5, then the absolute refractive index of diamond is
 - (a) 1.4 (b) 2.4 (d) 4.4 (c) 3.4
- Power of a convex lens of focal length 50 cm 9. is
 - (a) 2 D (b) - 0.5 D (c) + 2 D (d) + 0.5 D
- 10. The sign of the power of a convex lens is (a) negative (b) positive (c) positive if focal length is small (d) positive or negative depending on the focal length of the lens
- 11. In the case of refraction of light from a rectangular glass slab, if i be the angle of incidence and e be the angle of emergence, then
 - (a) e = i(b) e < i
 - (c) e > i(d) $i \neq e$
- 12. The refractive index of diamond is (a) 1.5 (b) 1.33 (c) 2.42 (d) 1.8
- 13. In case of erect object having inverted image, sign of the linear magnification is (a) positive (b) negative (c) zero (d) no definite sign
- 14. Two thin lenses of power, + 3.5 D and - 2.5 D are placed in contact, then the power and focal length of the lens combination is (a)+1 D, +100 cm (b) + 2 D, + 150 cm
- (c)+1 D, + 200 cm (d) + 2 D, + 100 cm 15. When an object moves towards a convex lens, the size of the image
 - (a) decreases
 - (b) first decreases then increases
 - (c) increases
 - (d) remains the same
- A ray of light travelling from air enters a liquid 16. at an angle of 45° with the normal. If the corresponding angle of refraction is 30°, then the refractive index of the liquid with respect to air is

(a) 1.44	(b) 1.41
(c) 1.21	(d) 1.45

- **17.** Which of the following lenses, would you prefer to use while reading small letters found in a dictionary?
 - (a) A convex lens of focal length 50 cm
 - (b) A concave lens of focal length 50 cm
 - (c) A concave lens of focal length 5 cm
 - (d) A convex lens of focal length 5 cm
- **18.** Which of the following shows the bending of light from rarer (R) into denser (D) medium?



19. How will the image formed by a convex lens be affected if the upper half of the lens is wrapped with a black paper?



(a) The size of the image is reduced to one-half.

(b) The upper half of the image will be absent.

- (c) The brightness of the image is reduced.
- (d) There will be no effect.
- **20.** Which of the following correctly represents the graphical variation between very small angles of incidence (i) and refraction(r) ?



21. If *f* is focal length of the lens, then the power a lens is equal to



22. Which of the following diagram correctly represents the ray of light passing through the optical centre?



A convex lens of focal length 24 cm is placed 12 cm in front of a convex mirror. It is found that when a pin is placed 36 cm in front of the lens, it coincides with its own inverted image formed by, the lens and the mirror. Then the focal length of the mirror is

(a) 45 cm
(b) 60 cm

(c) 15cm (d) 30cm

24. A concave mirror of radius of curvature 60 cm is placed at the bottom of tank containing water up to a height of 20 cm. The mirror faces upwards with its axis vertical. Sun light falls normally on the surface of water and the

image of the sun is formed. If ${}^{a}n_{w}$ is $\frac{4}{3}$ then

with the observer in air, the distance of the image from the surface of water is

(a) 7.5 cm below (b) 7.5 cm above (c) 10 cm (d) 30 cm

25. A ray of light travelling inside a rectangular glass block of refractive index $\sqrt{2}$ is incident on the glass-air surface at an angle of incidence of 45°. The refractive index of air is one. Under these conditions the ray

(a) will emerge into the air without any deviation

(b) will be reflected back into the glass

(c) will be absorbed

(d) will emerge into the air with an angle of refraction equal to 90°

26. 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 in air contains



- (a) yellow, orange, red (b) violet, indigo, blue (c) all colours
- (d) all colours except green

27. A ray of light from a denser medium strikes a rare medium at angle of incidence i as shown in 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



28. A glass of thickness 4 cm contains the same number of waves as 5 cm of water when both Are traversed by the same monochromatic light. If the refractive index of water is 4/3, what is that of glass?

(a) 5/3	(b) 5/4
(c) 16/15	(d) 1.5

- 29. A point source of light is placed 4 m below the surface of water of refractive index 5/3. The minimum diameter of a disc, which should placed over the source, on the surface of water to cut off all light coming out of water is (a) 1m
 (b) 4 m
- (c) 3m (d) 6 m
 30. 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 of The ratio between the size of
 - 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) $\sqrt{(D/d)}$

31. A concave lens of focal length forms an image which is *n* times the size of the object. The distance of the object from the lens is

(a)
$$(1-n)f$$

(b) $(1+n)f$
(c) $\left(\frac{1+n}{n}\right)f$
(d) $\left(\frac{1-n}{n}\right)f$

- **32.** A lens behaves as a converging lens in air and a diverging lens in water. The refractive index of the material is
 - (a) equal to unity
 - (b) equal to 1.33
 - (c) between unity and 1.33
 - (d) greater than 1.33

33. A thin convex lens of focal length 10 cm and a thin concave lens of focal length 26.2 cm are in contact. The combination acts as
(a) concave lens of focal length 16.4 cm
(b) convex lens of focal length 16.2 cm
(c) concave or convex lens depends upon the material of lenses

(d) none of the above

34. A thin equiconvex lens has focal length 10 cm, refractive index 1.5. One of its faces is now silvered and for an object placed at a distance. *u* in front of it, the image coincides with the object. The value of M is

(a) 10 cm (b) 5 cm (c) 20 cm (d) 15 cm

35. A convex lens of focal length 20 cm is cut into two equal parts so as to obtain two Planoconvex lenses as shown in figure. The two parts are then put in contact as shown in figure. What is the focal length of

- **36.** 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 a distance *d* between them. If a parallel beam of light falling on A leaves B as a parallel beam, then the distance *d* in cm will be
 - (a) 25 (b) 15
 - (c) 30 (d) 50
- 37. Bending of ray of light, when it enters obliquely from one medium to other is called (a) dispersion (b) interference (c) reflection (d) refraction
- **38.** For light going from air to water ${}^{a}n_{w} = 4/3$.
 - Then ${}^{w}n_{a}$ has value (a) 1 (b) 3/4
 - (c) 16/9 (d) 3/2
- **39.** A ray of light passes undedicated through a point on the principal axis. The point is(a) optical center

(b) no where

- (c) focus
- (d) centre of curvature
- **40.** For studying refraction through a lens, we keep the lens with its refracting surface towards

up	(b) down
(c) right	(d) left
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41. We put a glass piece on a printed page. Image of prints on the page has same size. The piece is a

(a) concave lens	(b) prism
(c) glass slab	(d) convex lens

- 42. The power of a glass slab is
 (a) zero
 (b) infinite.
 (c) less
 (d) more
- 43. In a lens combination of thin lenses in contact, for obtaining the power of the combination power of individual lens are algebraically
 (a) multiplied
 (b) divided
 (c) added
 (d) subtracted
- **44.** A thin lens has focal length f, and its aperture has diameter d. It forms an image of intensity I. Now, the central part of the aperture up to diameter d/2 is blocked by an opaque paper. The focal length and image intensity will change to

(a) f/2 and I/2 (b) f and I/4(c) 3f/4 and I/2 (d) f and 3I/4

45. A convergent beam is incident on a concave lens as shown in figure. Which of the following statements is not correct?



- (a) The image formed is real
- (b) The image formed is virtual
- (c) The image formed is erect
- (d) The image formed is magnified
- **46.** A layered lens is mad of two types of transparent materials indicated by different shades. A point object is placed on its axis the object will form



(a) 1 image (b) 2 images

(c) 3 images (d) 9 images

- 47. A convex lens is made of two transparent materials A and B. A ray of light is incident on the lens from a point object. We will see

 (a) four images
 (b) two images
 (c) six images
 (d) none of these
- **48.** When white light passes through a dispersive medium, it breaks up into various colours. Which of the following is true?

(a) Velocity of light for violet is greater than the velocity of light for red colours.

(b) Velocity of light for violet is less than the velocity of light for red.

(c) Velocity of light is the same for all colours,(d) Velocity of light is different for different colours.

- 49. Focal length of a lens for red colour is
 (a) same as that for violet
 (b) greater than that for violet
 (c) lesser than that for violet
 (d) none of the above
- **50.** Even in absolutely clear water, a diver cannot see very clearly

(a) because rays of light get diffused

(b) because velocity of light is reduced in water

(c) because of ray of light passing through the water makes it turbid

(d) because the focal length of the eye lens in water gets changed and the image is no longer focused sharply on the retina

51. Due to refraction of light in atmosphere
(a) stars appear to twinkle
(b) the sun appears to be oval in morning and evening
(a) the maximum of visibility of the sum is

(c) the period of visibility of the sun is increased

(d) all of these

- **52.** For prism of refractive index 1.732, the angle of minimum deviation is equal to the angle of the prism. The angle of the prism is
 - (a) 80° (b) 70°
- (c) 60° (d) 50°
 53. When white light enters a prism, it get split into its constituent colours. This is due to

(a) high density of prism material

- (b) value of H is different for different λ
- (c) diffraction of light

(d) velocity changes for different frequencies

54. Which of the following correctly represents graphical relation between sine of angle of incidence (i) and sine of angle of refraction (r)?



55. An object *AB* is placed in front of a convex lens at its principal focus as shown in figure below.



Which of the ray diagram below correctly depicts the detraction through the lens L

56. An object is placed at a distance of 4 cm from a concave lens of focal length 12 cm. The nature of image is

(a) 0.75	(b) 0.65
(c) 0.55	(d) 0.45
	-

57. With regard to refraction which of the following statement is false,

(a)It is a change in direction of light when it passes from one transparent medium into another of different optical density

(b) Light is deviated away from the normal when it enters an optically dense medium from a less dense medium.

(c) the velocity of light is changed during refraction

(d) the wavelength of the light is changed during refraction

58. The following are true about the refractive index of a material

(a) the absolute refractive index of a material is always greater than its refractive index .

(b) the refractive index of a material is usually measured with ultraviolet light

(c) the refractive index of a medium differs for light of different wavelengths

(d) the deviation of light increases with the increase in refractive index of the material that it enters

59. A thick piano convex lens made of crown glass (refractive index 1.5) has a thickness of 3 cm at its centre. The radius of curvature of its curved face is 5 cm. An ink mark made at the centre of its plane face, when viewed normally through the curved face, appears to be at a distance x from the curved face. Then, *x* is equal to



60. An object is placed in front of a screen and a convex lens is placed at a position such that the size of the image formed is 9 cm. When the lens is shifted through a distance of 20 cm, the size of the image becomes 1 cm. The focal length of the lens and the size of the object are respectively,

(a) 7.5 cm and 3.5 cm (b) 7.5 cm and 4 cm (c) 6 cm and 3 cm (d) 7.5 cm and 3 cm

61. The focal length of an equi-convex lens in air is equal to either of its radii of curvature. The refractive index of the material of the lens is (a) 4/3 (b) 2.5

(c) 0.8 (d) 1.5

- 62. 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 3.5R
 - (b) convergent lens of focal length 3.02?
 - (c) divergent lens of focal length 3.5R
 - (d) divergent lens of focal length 3.0R
- 63. A convergent lens made of crown glass (refractive index 1.5) has focal length 20 cm in air. If it is immersed in a liquid of refractive index 1 .60, its focal length will be
 (a) 160cm
 (b) 100cm
 (c) -80 cm
 (d) -160 cm
- 64. The plane face of a plano-convex lens of focal length 20 cm is silvered. The lens will then behave as a concave mirror of focal length (a) 5 cm (b) 10 cm
 - (c) 20 cm (d) 40 cm
- **65.** 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 dioptre is
 - (a) 6.5 (b) -1.5 (c) +1.5 (d) +6.5
- **66.** Concave and convex lenses are placed touching each other. The ratio of magnitudes of their powers is 2:3. The focal length of the system is 30 cm. Then the focal lengths of individual lenses are

(a) -75 cm, 50 cm	(b) -15 cm, 10 cm	
(c) 75 cm, 50 cm	(d) 75 cm, -50 cm	
The principal axis i	c also called of t	۰h

67. The principal axis is also called _____ of the lens.

(a) optical axis	(b) x-axis
(c) y-axis	(d) none of these
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68. A ray of light travelling in air is incident on the plane of a transparent medium. The angle CT

incident is 45° and that of refraction is 30°. Fine the refractive index of the medium.

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

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

69. The minimum distance between an object and its real image formed by a convex lens is

(a)
$$\frac{2}{3}f$$
 (b) $2f$
(c) $\frac{5}{2}f$ (d) $4f$

- 70. A beam of white light passing through a prism is spilt up into its constituent colours. The light which undergoes least deviation is
 (a) violet
 (b) yellow
 (c) red
 (d) green
- 71. Under minimum deviation condition in a prism, if a ray is incident at an angle 30°, the angle between the emergent ray and the second refracting surface of the prism is

 (a) 0°
 (b) 30°
 (c) 45°
 (d) 60°

FILL IN THE BLANKS

- 1. To construct a ray diagram, you need at least..... whose path (s) after refraction through the lens are known.
- 2. The principal axis is also called..... of the lens.
- **3.** The power of a lens whose focal length is one metre is dioptre.
- **4.** The scattering of light depends inversely upon the fourth power of theof light.
- 5. The power of a convex lens is and that of a concave lens is
- **6.** The relationship $\frac{1}{f} = \frac{1}{v} \frac{1}{u}$ is called

the..... formula

- 7. No refraction occurs when light is incident..... on a boundary of two medium.
- 8. Light emerges from rectangular glass slab in a direction...... to that in which it entered the glass slab.
- **9.** Oval shape of sun at sunrise and sunset is due to...... of light.
- **10.** The largest value of refractive index is 2.42 for.....

- **11.** A convex lens of smaller focal length has..... power.
- **12.** A tank appears to be 3 m deep only then the actual depth of tank is.....
- **13.** The effective width of a lens from which refraction takes place is called its.....
- **14.** M. A lens having one curved surface bulged outwards and the other a plane surface is called...... lens.
- **15.** Air is optically..... than water or glass.
- **16.** The refractive index of vacuum is taken as.....
- **17.** The instrument that can directly measure the power of a lens is called.....
- **18.** A medium with higher refractive index is said to be.....
- **19.** The critical angle for a material of refractive index $\sqrt{2}$ is.....
- **20.**of a lens is defined as the ability of the lens to converge a beam of light falling on the lens.
- **21.** The power of piano convex lens, is...... when radius of curved surface is 15 cm and *n* is 1.5.

TRUE OR FALSE

- **1.** A ray parallel to the principal axis, after reflection, will pass through the principal focus.
- 2. Light travels faster in glass than in air.
- **3.** The degree of convergence or divergence of light rays achieved by a lens is expressed in terms of its power.
- **4.** Concave lenses are used mainly in spectacles for the correction of short sightedness.
- 5. A ray of light passing through the optical center of a lens does not suffer any deviation.
- 6. The lateral displacement during refraction does not depend on wavelength of the light.
- 7. Air has the highest optical density.
- 8. An opaque material cannot be used to make a lens.
- 9. One dioptre is equal to one metre.
- **10.** Focal length of convex lens is always positive.
- **11.** When light travels from air in to water, its speed increases.
- **12.** Regular reflection is also called total internal reflection.
- **13.** A real image is formed by a concave lens when the object is placed at infinity.

- **14.** Concave lens are used as reflectors in lamps.
- **15.** For image magnification one needs at least two convex lens.
- **16.** If two mirrors are inclined to each other at 90°, the image seen may be four.
- **17.** A ray passing through optical center proceeds undedicated through the lens.
- **18.** According to new sign convention, all distances are measured from poles.
- **19.** The power of a lens can be measured in watt.
- **20.** In optical instruments, the lenses are used to form images by dispersion.
- **21.** The unit of refractive index is deportee.

Matrix Match Type

This section contains 5 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column - I have to be matched with statements (p, q, r, s) in Column - II

1.	Column I	Column II
	(A) Lens formula	(p) $n\sin\theta = \text{constant}$
	(B) <i>n</i> _{gw}	(q) $\frac{\upsilon}{u}$
	(C) Magnification by a	(r) $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$
	lens	
	(D) Snell's law	(s) $n_{ga} imes n_{aw}$
2.	Column I	Column II
	(A)Negative magnification	(p) Diminished image
	(B) Magnification less than1	(q) Inverted image
	(D) Magnification equal to 1	(s) Erect image
3.	Column I	Column I
	(A) Concave lens	(p) Principal axis
	(B) Line passing through	n (q) Virtual image
	optical centre	
	(C) Convex lens	(r) Can be taken on a
		screen
	(D) Real image	(s) Converging lens
4.	Column I	Column II
	(A) 1 Angstrom unit	(p) Minimum deviation
	(B) Red	(q) $10^{-10} m$
	(C) Violet	(r) $\frac{1}{f(\text{in metre})}$
	(D) Power of lens (s)	Maximum deviation
5.	The graphs given apply	to convex lens of focal

The graphs given apply to convex lens of focal length *f*, producing a real image at a distance *v* from the optical center when self-luminous

object is at distance *u* from the optical center. The magnitude of magnification is *m*. Identify the following graphs with the first named quantity being plotted along y-axis. Column I Column II



ASSERTION & REASON QUESTIONS

Directions: In each of the following questions, statement of Assertion (A) is given followed by a responding statement of Reason (R) just below of the statements, mark the correct answer as

(a) If both assertion and reason are true and reason is the correct explanation of assertion

(b) *If both assertion and reason are true but reason is not the correct explanation of assertion.*

- (c) If assertion is true but reason is false.
- (d) If assertion is false but reason is true.
- Assertion: If a plane glass slab is placed on the letters of different colours all the letters appear to be raised up to the same height.
 Reason: Different colours have different wavelengths.
- Assertion: An air bubble in a jar of water shines brightly due to phenomenon of refraction.

Reason: Refraction of light is the phenomenon of change in the path of light, when it goes from one medium to another.

- Assertion: The diamond shines due to multiple total internal reflections.
 Reason: The critical angle for diamond is 24.4°.
- 4. Assertion: Higher is the refractive index of a medium or denser the medium, lesser is the velocity of light in that medium.

Reason: Refractive index is inversely proportional to velocity.

Assertion: Convergent lens property of converging does not remain same in all mediums.

Reason: Property of lens whether the ray is diverging or converging is independent of the surrounding medium.

- Assertion: Although the surfaces of a goggle lens are curved, it does not have any power.
 Reason: In case of goggles, both the curved surfaces have equal radii of curvature.
- Assertion: There is no dispersion of light refracted through a rectangular glass slab.
 Reason: Dispersion of light is the phenomenon of splitting of a beam of white light into its constituent colours.
- 8. Assertion: A ray of white light shows no dispersion on emerging from a glass slab although there occurs dispersion inside the glass slab.

Reason: The velocity of light inside the glass slab is same for all different colours.

- Assertion: A single lens produces a coloured image of an object illuminated by white light.
 Reason: The refractive index of material of lens is different for different wavelength of light.
- Assertion: The twinkling of star is due to reflection of light.
 Reason: The velocity of light changes while going from one medium to the other.

Assertion: The luminance of an image produced by a convex lens is greater in the middle and less towards the edges.
 Reason: The middle part of image is formed by unelected rays while outer part by inclined rays.

12. Assertion: The minimum distance between an object and its real image formed by a convex lens is If.

Reason: The distance between an object and its real image is minimum when its magnification is one.

- 13. Assertion: A secondary rainbow have inverted colours than the primary rainbow.Reason: The secondary rainbow is formed by single total internal reflection.
- 14. Assertion: The focal length of lens does not change when red light is replaced by blue light.Reason: The focal length of lens does not

Reason: The focal length of lens does not depend on colour of light used.

- Assertion: The frequencies of incident, reflected and refracted beam of monochromatic light incident from one medium to another are same.
 Reason: The incident, reflected and refracted rays are coplanar.
- Assertion: The Sun looks bigger in size at sunrise and sunset than during day.
 Reason: The phenomenon of diffraction bends light rays.
- **Assertion:** A convex lens is made of two different materials. A point object is placed on the principal axis. The number of images formed by the lens will be two.
 Reason: The image formed by convex lens is always virtual.
- **18.** Assertion: Speed of light in glass of n = 1.5 is $2 \times 10^8 m s^{-1}$.

Reason: According to dual theory, light has particle nature and wave nature simultaneously.

Assertion: The images formed by total internal reflections are much brighter than those formed by mirrors or lenses.
 Reason: There is no loss of intensity in total internal reflection.