QUESTION BANK

EXERCISE - 1

Q.1 A person is in a room whose ceiling and two adjacent walls are mirrors. (a) How many images are formed? (b) How many images of himself can he see ? (c) Are all the images virtual and erect ?

Q.2 A high flying bird does not cast shadow on the ground. Why?

Q.3 What is the difference between the images formed by a large and a small mirror ?

Q.4 What will happen to the image formed by a mirror if half of it is covered with a black paper ?

Q.5 Can a virtual image be photographed by a camera or projected on a screen ?

Q.6 For a plane mirror what is the focal length and the magnification ?

Q.7 The level of clear water in a clear colourless glass can be seen easily, but that of liquid helium cannot be. Why?

Q.8 Why is convex mirror preferred as rear - view mirror in cars?

Q.9 Prove the mirror formula for reflection of light from a concave mirror.

Q.10 Will the reflected rays converge at a point when a parallel beam of light lis incident on a concave mirror of large aperture ?

Q.11 If you want to see an enlarged image of your face, state whether you will use a concave mirror or a convex mirror.

Q.12 What do you mean by a normal to the reflecting surface ?

Q.13 In case of a spherical mirror, do both the sides act as reflecting surfaces ?

Q.14 For driving a car, what type of mirror would you prefer to see the traffic at your back ?

Q.15 A ray of light passes through the optical centre of a lens. Does it suffer any deviation ?

Q.16 What do you mean by a focal plane ?

Q.17 Will the focal length of the lens change when it is put in water?

Q.18 Define the principal focus of a concave mirror.

Q.19 A concave mirror produces three times magnified (enlarged) real image of an object placed at 10cm in front of it. Where is the image located ?

Q.20 Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass ? The speed of light in vacuum is 3×10^8 ms^{-1}.

Q.21 The refractive index of diamond is 2.42. What is the meaning of this statement.

Q.22 Find the power of a concave lens of focal length 2m.

Q.23 An object 5.0 cm in length is placed at a distance of 20 cm. in front of a convex mirror of radius of curvature 30cm. Find the position of the image, its nature and size.

Q.24 Find the focal length of a lens of power –2.0 D. What type of lens is this ?

Q.25 What is a ray ?

Q.26 What is the radius of a plane mirror ?

Q.27 In what way is the word AMBULANCE printed infront of the hospital vans ? Why is it printed this way ?

Q.28 Why does a convex mirror has a virtual principal focus ?

Q.29 A truck uses a convex mirror as view finder whose radius of curvature is 2.0 m. A maruti car is coming behind the truck at a distance of 10m. What will be the position of the image of the car and size of the image of the car when observed by the driver of the truck through the convex mirror ?

Q.30 An object is placed 90 cm away from a concave mirror of focal length 30 cm. Find the position and the nature of the image formed.

Q.31 An object is placed at a distance of 15 cm. from a convex mirror of focal length 30 cm. Find the position and the nature of the image.

Q.32 A monochromatic ray of light strikes the surface of a transparent medium at an angle of incidence 60° and gets refracted into the medium at an angle of refraction 45°. What is the refractive index of the medium ?
[sin 60° = 0.866, sin 45° = 0.707]

Q.33 An object 3 cm in height is placed 20cm from convex lens of focal length 12 cm. Find the nature, position and height of the image.

Q.34 A real image, 4/5 size of the object is formed 18 cm from a lens. Calculate the focal length of the lens.

Q.35 A convex lens is of focal length 10 cm. what is its power ?

Q.36 A concave lens has focal length of 15 cm. At what distance should the object from the lens be placed so that it forms an image at 10 cm from the lens ? Also, find the magnification produced by the lens.

Q.37 What is the nature of light ?

Q.38 What is spherical mirror ?

Q.39 For what position of an object, a concave mirror forms a virtual and magnified image ?

Q.40 A man standing in front of a spherical mirror, finds his image having a very small head, a fat body and legs of normal size. What types of mirrors are used in the small parts ?

Q.41 What type of mirror is formed when a mercury drop falls on the earth ?

Q.42 Define refraction.

Q.43 What is a rarer medium ?

Q.44 What is a lens ?

Q.45 Define one dioptre.

Q.46 Write down the magnification formula for a lens in terms of object distance and image distance. How does it differ from the corresponding formula for a mirror ?

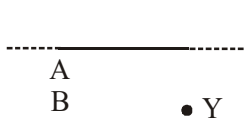
Q.47 Differentiate between virtual image of a concave mirror and of a convex mirror.

Q.48 A glass block 3.0m thick is placed over a stamp. Calculate the height through which image of stamp is raised. Refractive index of glass is 1.54.

Q.49 A postage stamp placed under a glass, appears raised by 8mm. If refractive index of glass is 1.5, calculate the actual thickness of glass slab.

Q.50 A 5 cm. tall object is placed on the principal axis of diverging lens of focal length 15 cm. and at a distance of 10 cm. from it. Find the nature, position and size of image.

Q.51 An image Y is formed of a point object X by a lens whose optic axis is AB as shown in figure. Draw a ray diagram to locate the lens and its focus. If the image Y of the object X is formed by a concave mirror (having the same optic axis AB) instead of lens, draw another ray diagram to locate the mirror and its focus . Write down the steps of construction of the ray diagrams.



Q.52 You read a newspaper because of the light that it reflects. Then why do you not see even a faint image of yourself in the newspaper ?

Q.53 The wall of a room is covered with a perfect plane mirror. Two movie films are made, one recording the movement of a man and the other of his image. From viewing the films later, can an outsider tell which is which?

Q.54 Under what condition will a concave mirror produce an erect image ? A virtual image ? An image smaller than the object ? An image larger than the object ?

Q.55 A concave spherical mirror has a radius of curvature of 40 cm. Draw ray diagrams to locate the image (if one is formed) for an object at a distance of (a) 100 cm, (b) 40cm, (c) 20 cm and (d) 10 cm. from the mirror. For each case, state whether the image is real or virtual, erect or inverted, and enlarged, reduced, or the same size as the object.

Q.56 In previous question instead of concave if convex mirror (same radius of curvature) is used what will be the answer.

Q.57 A beam of light converges to a point P. A lens is placed in the path of the convergent beam 12 cm. from P. At what point does the beam converge if the lens is (a) a convex lens of focal length 20 cm, and
(b) a concave lens of focal length 16 cm. ?

Q.58 (a) Determine the 'effective focal length' of the combination of a convex lens of focal length 30 cm. and a concave lens of focal length 20 cm. if they are placed 8 cm. apart with their principal axes coincident. Does the answer depend on which side a beam of parallel light is incident ? Is the notion of the effective focal length of this system useful at all ?

(b) An object 1.5 cm. in size is placed on the side of the convex lens in the above arrangement. The distance between the object and the convex lens is 40 cm. Determine the magnification produced by the two-lens system, and the size of the image.

Q.59 Two thin converging lenses of focal lengths 0.15m and 0.30m are held in contact with each other. Calculate power and focal length of combination.

Q.60 What is the focal length of a convex lens of focal length 30 cm. in contact with a concave lens of focal length 20 cm ? Is the system a converging or diverging lens ? Ignore thickness of the lenses.

Q.61 Two thin lenses of focal lengths + 10 cm. and – 5cm. are kept in contact. What is the focal length and power of the combination?

PASSAGE BASED QUESTIONS

Inside a substance such as glass or water, light travels more slowly than it does in a vacuum. If c denotes the speed of light in a vacuum and v denotes its speed through some other substance, then $v = c/n$
where n is a constant called the index of refraction.

To good approximation, a substance's index of refraction does not depend on the wavelength of light. For instance, when red and blue light waves enter water, they both slow down by about the same amount. More precise measurements, however, reveal that n varies with wavelength. Table presents some indices of refraction of Custon glass, for different wavelengths of visible light. A nanometer (nm) is 10^{-9} meters. In a vacuum, light travels as $c = 3.0 \times 10^8$ m/s

Table : Indices of refraction of Custon glass

Approximately colour	Wavelength in	
	vacuum (nm)	n
yellow	580	1.500
yellow orange	600	1.498
orange	620	1.496
orange red	640	1.494

Q.62 Inside Custon glass –
(A) Orange light travels faster than yellow light (B) Yellow light travels faster than orange light
(C) Orange and Yellow light travels equally fast (D) We cannot determine which color of light travels faster

Q.63 For blue-green of wavelength 520 nm, the index of refraction of Custon glass is probably closest to –
(A) 1.49 (B) 1.50 (C) 1.51 (D) 1.52

Q.64 Which of the following phenomena happens because n varies with wavelength –
(A) A lens focuses light (B) A prism breaks sunlight into different colors
(C) Total internal reflections ensures that light travels down a fiber optic cable
(D) Light rays entering a pond change direction at the pond's surface

EXERCISE - 2

Fill in the Blanks :

Q.1 The power of a convex lens is ..... and that of a concave lens is .....

Q.2 Light seems to travel in .....

Q.3 A light ray travelling obliquely from a denser medium to a rarer medium bends ..... the normal. A light ray bends ..... the normal when it travels obliquely from a rarer to a denser medium.

Q.4 In case of a rectangular glass slab, the refraction takes place at both ..... interface and ..... interface. The emergent ray is ..... to the direction of incident ray.

Q.5 Power of a lens is the reciprocal of its .....
Q.6 The SI unit of power of a lens is .....
Q.7 The angle of incidence is ..... to the angle of reflection.
Q.8 The reflecting surface of a spherical mirror may be curved ..... or .....
Q.9 the surface of the spoon can be approximated to a ..... mirror.
Q.10 The centre of the reflecting surface of a spherical mirror is a point called the .....
Q.11 The centre of curvature of a concave mirror lies in ..... of it.
Q.12 Line passing through the pole and the centre of curvature of a spherical mirror is called the .....
Q.13 A ray parallel to the principal axis, after reflection, will pass through the .....
Q.14 The dentists use ..... mirrors to see large images of the teeth of patients.
Q.15 A transparent material bound by two surfaces, of which one or both surfaces are spherical, forms a .....
Q.16 The degree of ..... of light rays achieved by a lens is expressed in terms of its power.
Q.17 An object is placed in front of a spherical mirror. The image is found to be virtual for all positions of the object. The spherical mirror is .....
Q.18 Two immiscible transparent liquids A and B have 1.2 and 1.5 as their refractive indices (with respect to air). The refractive index of B with respect to A is .....

True-false Statements –

Q.19 The reflecting surfaces, of all types, obey the laws of reflection.
Q.20 The magnification produced by a spherical mirror is the ratio of the height of the image to the height of the object.
Q.21 Light travels in vacuum with an enormous speed of 3×10^8 ms^{-1}.
Q.22 The speed of light is different in different media.
Q.23 The refractive index of a transparent medium is the ratio of the speed of light in vacuum to that in the medium.
Q.24 The incident ray, the normal to the mirror at the point of incidence and the reflected ray, all lie in the same plane.
Q.25 Centre of curvature is not a part of the mirror.
Q.26 Image formed by a plane mirror is always virtual and erect.
Q.27 The principal focus of a spherical mirror lies midway between the pole and centre of curvature.
Q.28 convex mirrors enable the driver to view much larger area than would be possible with a plane mirror.
Q.29 A concave lens will always give a virtual, erect and diminished image.
Q.30 A ray of light passing through the optical centre of a lens will emerge without any deviation.
Q.31 A plane mirror can form virtual images.
Q.32 An object is placed in front of a mirror and an image of it is formed at the object itself. The mirror mentioned in question is a convex mirror.
Q.33 A concave mirror can produce both real and virtual images.
Q.34 Light travels faster in glass than in air.

EXERCISE - 3

Q.1 Which one of the following materials cannot be used to make a lens?
(A) Water (B) Glass (C) Plastic (D) Clay

Q.2 The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of the object –
(A) Between the principal focus and the centre of curvature (B) At the centre of curvature
(C) Beyond the centre of curvature (D) Between the pole of the mirror and its principal focus.

Q.3 Where should an object be placed in front of a convex lens to get a real image of the size of the object?
(A) At the principal focus of the lens (B) At twice the focal length (C) At infinity
(D) Between the optical centre of the lens and its principal focus.

Q.4 A spherical mirror and a thin spherical lens have each a focal length of –15 cm. The mirror and the lens are likely to be – (A) both concave. (B) both convex.
(C) the mirror is concave and the lens is convex (D) the mirror is convex, but the lens is concave

Q.5 No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be
(A) plane. (B) concave. (C) convex. (D) either plane or convex.

Q.6 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 convex lens of focal length 5 cm. (D) A concave lens of focal length 5 cm.

Q.7 One light wave is incident upon a plate of refracting index μ. Incident angle i, for which refractive & reflective waves are mutually perpendicular will be
(A) $i = 45^o$ (B) $i = \sin^{-1}(\mu)$ (C) $i = \text{cosec}^{-1}(\mu)$ (D) $i = \tan^{-1}(\mu)$

Q.8 An object is situated at a distance of f/2 from a convex lens of focal length f. Distance of image will be –
(A) + (f/2) (B) + (f/3) (C) + (f/4) (D) – f

Q.9 An object is placed 60 cm in front of a concave mirror. The real image formed by the mirror is located 30 cm in front of the mirror. What is the object's magnification?
(A) + 2 (B) –2 (C) + 0.5 (D) –0.5

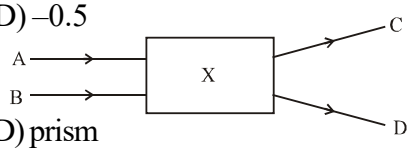
Q.10 Two plane mirrors are set at right angle and a flower is placed in between the mirrors. The number of images of the flower which will be seen is –
(A) One (B) Two (C) Three (D) Four

Q.11 A lens behaves as a converging lens in air and diverging lens in water. The refractive index of the material of the lens is –
(A) 1 (B) between 1 and 1.33(C) 1.33 (D) greater than 1.33

Q.12 A man is 6.0 ft tall. What is the smallest size plane mirror he can use to see his entire image –
(A) 3.0 ft (B) 6.0 ft (C) 12 ft (D) 24 ft

Q.13 An object is placed 60 cm in front of a convex mirror. The virtual image formed by the mirror is located 30 cm behind the mirror. What is the object's magnification –
(A) + 2 (B) –2 (C) + 0.5 (D) –0.5

Q.14 Light rays A and B fall on optical component X and come out as C and D. The optical component is a –



(A) concave lens (B) convex lens (C) convex mirror (D) prism

Q.15 An object is placed 20.0 cm in front of a concave mirror whose focal length is 25.0 cm. What is the magnification of the object?
(A) + 5.0 (B) – 5.0 (C) + 0.20 (D) – 0.20

Q.16 On passing through a glass slab , red light suffers a change of –
(A) wavelength (B) frequency (C) amplitude (D) both frequency and wavelength

Q.17 The focal length of a concave mirror depends upon –
(A) The radius of curvature of the mirror (B) The object distance from the mirror
(C) The image distance from the mirror (D) Both image and object distance

Q.18 An object is placed at the radius of curvature of a concave spherical mirror. The image formed by the mirror is
(A) located at the focal point of the mirror.
(B) located between the focal point and the radius of curvature of the mirror.
(C) located at the center of curvature of the mirror. (D) located out beyond the center of curvature of the mirror.

Q.19 The radius of curvature of a plane mirror is -
(A) zero (B) infinite (C) negative (D) finite

Q.20 If the refractive indices for water and diamond relative to air are 1.33 and 2.4 respectively, then the refractive index of diamond relative to water is –
(A) .55 (B) 1.80 (C) 3.19 (D) None of these

Q.21 There is an equiconvex lens of focal length of 20cm. If the lens is cut into two equal parts perpendicular to the principle axis, the focal lengths of each part will be –
(A) 20 cm. (B) 10 cm. (C) 40 cm. (D) 15 cm.

Q.22 Tick out the only wrong statements in the following –
(A) Light travels with a speed greater than that of sound (B) Light cannot travel through vacuum
(C) Light travels in a straight line (D) Light has no weight

Q.23 An object is placed 20.0 cm in front of a concave mirror whose focal length is 25.0 cm. Where is the image located?
(A) 1.0×10^2 cm in front of the mirror (B) 1.0×10^2 cm behind the mirror
(C) 5.0×10^1 cm in front of the mirror (D) 5.0×10^1 cm behind the mirror

Q.24 When viewed vertically a fish appears to be 4 meter below the surface of the lake. If the index of refraction of water is 1.33, then the true depth of the fish is –
(A) 5.32 metres (B) 3.32 metres (C) 4.32 metres (D) 6.32 metres

Q.25 Convex spherical mirrors produce images which –
(A) are always larger than the actual object (B) are always smaller than the actual object
(C) are always the same size as the actual object (D) are sometimes larger, sometimes smaller.

Q.26 Light waves –
(A) Require air or another gas to travel through (B) Require an electric field to travel through
(C) Require a magnetic field to travel through (D) Can travel through perfect vacuum

Q.27 An object is placed 40.0 cm in front of a convex mirror. The image appears 15 cm behind the mirror. What is the focal length of the mirror?
(A) + 24 cm (B) + 11 cm (C) – 11 cm (D) – 24 cm

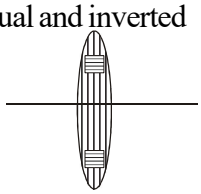
Q.28 Morning sun is not so hot as the mid day sun because –
(A) Sun is cooler in the morning (B) Heat rays travel slowly is the morning
(C) It is God gift
(D) The sun's rays travel a longer distance through atmosphere in the morning

Q.29 The image formed by a convex spherical mirror is –
(A) sometimes real, sometimes virtual (B) sometimes erect, sometimes inverted
(C) always real and inverted (D) always virtual and upright.

Q.30 When light passes from into glass it experiences a change of –
(A) Speed only (B) Wavelength and speed
(C) Frequency only (D) frequency and speed

Q.31 If a real object is placed inside the focal point of a concave mirror, the image is –
(A) real and upright (B) real and inverted (C) virtual and upright (D) virtual and inverted

Q.32 The layered lens shown below is made of two different transparent materials.
A point object is placed on its axis. The object will form –
(A) one image (B) infinite images
(C) no image (D) two images



Q.33 An object is placed in front of a concave mirror of focal length 50.0 cm and a real image is formed 75 cm in front of the mirror. How far is the object from the mirror –
(A) 25 cm (B) 30 cm (C) 150 cm (D) –150 cm

Q.34 A person standing infront of a mirror finds his image smaller than himself and erect. This implies the mirror is –
(A) plane (B) concave (C) convex (D) None of the above

Q.35 A number of images of a candle flame can be seen in a thick mirror. The brightest image is –
(A) Fourth (B) Second (C) Last (D) First

Q.36 The term refraction of light is –
(A) The bending of light rays when they enter from one medium to another medium
(B) Splitting of white light into seven colours when it passes through the prism
(C) Bending of light round corners of obstacles and apertures
(D) Coming back of light from a bright smooth surface

Q.37 A ray from air enters water, then through a thick layer of glass placed below water. After passing through glass, it again comes out in air medium. Then final emergent ray will –
(A) Bend towards the normal (B) Bend away from the normal (C) Suffer lateral displacement
(D) Have the same path as if it had not passed through glass and water.

Q.38 A concave spherical mirror has a radius of curvature of 100 cm. What is its focal length –
(A) 50 cm (B) 100 cm (C) 200 cm (D) 300 cm

Q.39 Light is incident on an air-water interface at an angle of 25° to the normal.. What angle does the refracted ray make with the normal –
(A) 19° (B) 34° (C) 25° (D) 90°

Q.40 Light reflected from a boundary between an unknown substance and air is seen to become 100% polarized when the angle of incidence is 62.0°. What is the index of refraction of the unknown substance?
(A) 1.88 (B) 1.13 (C) 2.14 (D) 0.532

Q.41 A converging lens has a focal length of 15 cm. An object is placed 9.0 cm from the lens. Describe the image formed
(A) real, upright, enlarged (B) real, inverted, reduced in size
(C) virtual, inverted, reduced in size (D) virtual, upright, enlarged

Q.42 An object is placed 10.0 cm from a diverging lens which forms an image 6.5 cm from the lens. What is the focal length of the lens? Include the sign.
(A) + 3.9 cm (B) – 16.5 cm (C) – 21.2 cm (D) – 18.6 cm

Q.43 Under what conditions does a diverging lens form a virtual image of a real object –
(A) Only if u > f. (B) Only if u < f. (C) Only if u = f
(D) A diverging lens always forms a virtual image of a real object.

Q.44 A convex lens of focal length 25 cm receives light from the sun. A diverging lens of focal length – 12 cm is placed 37 cm to the right of the converging lens. Where is the final image located relative to the diverging lens?
(A) 6 cm to the left (B) 25 cm to the left (C) At infinity (D) 12 cm to the right

Q.45 A lens produces a enlarged, virtual image. What kind of lens is it?
(A) converging (B) diverging
(C) It could be either diverging or converging. (D) None

Q.46 A camera lens focuses light from a 12.0 m tall building located 35.0 m away on film 50.0 mm behind the lens. How tall is the image of the building on the film?
(A) 17.1 mm (B) 7.00 mm (C) 2.50 cm (D) 1.25 mm

Q.47 Four students reported the following observation tables for the experiment, to trace the path of a ray of light passing through a glass slab for different angles of incidence. The observations, likely to be correct are those of student.

i	r	e
30°	40°	30°
40°	50°	40°
50°	50°	50°

I

i	r	e
30°	20°	30°
40°	30°	40°
50°	40°	50°

II

i	r	e
30°	20°	40°
40°	30°	50°
50°	40°	60°

III

i	r	e
30°	20°	20°
40°	30°	30°
50°	40°	40°

IV

(A) I (B) II (C) III (D) IV

Q.48 In an experiment to determine the focal length of a concave lens, a student obtained the image of a distant window on the screen. To determine the focal length of the lens, she/he should measure the distance between the
(A) lens and the screen only (B) lens and the window only
(C) screen and the window only
(D) screen and the lens and also between the screen and the window

Q.49 On the basis of experiment 'to trace the path of a ray of light passing through a rectangular glass slab' four students arrived at the following interpretations :
I. Angle of incidence is greater than the angle of emergence.
II. Angle of emergence is less than the angle of refraction.
III. Emergent ray is parallel to the incident ray. IV. Emergent ray is parallel to the refracted ray.
The correct interpretation is that of the student.
(A) I (B) II (C) III (D) IV

Q.50 Light waves
(A) are mechanical waves (B) are electromagnetic waves
(C) travel with the same velocity in all media (D) requires a material medium for their propagation

Q.51 Virtual images of object of the same size are formed by –
(A) a concave mirror (B) a convex mirror (C) a plane mirror (D) all the above

Q.52 Two plane inclined mirrors form 5 images by multiple reflection. The angle of inclination is –
(A) 90° (B) 60° (C) 45° (D) 30°

Q.53 A bright × (cross) mark is made on a sheet of white paper. Over the white paper a rectangular glass-slab of thickness 3 cm is placed. On looking through, the image of the mark appears above the mark. It is below the upper surface of the slab by –
(A) 2.5 cm (B) 1.5 cm (C) 2 cm (D) 1.75 cm.

Q.54 The critical angle of a transparent medium denser than air
(A) increases with its refractive index (B) decreases with its refractive index
(C) is independent of its refractive index (D) None of these

Q.55 Orange, blue and yellow are 3 of the colours formed by a prism. Their order according to increasing deviation is–
(A) blue, orange, yellow (B) yellow, blue, orange
(C) blue, yellow, orange (D) orange, yellow, blue

Q.56 Images formed by an object placed between two plane mirrors whose reflecting surfaces make an angle of 90° with one another lie on a –
(A) Straight line (B) Zig-zag curve (C) Circle (D) Ellipse

Q.57 A diver in a swimming pool wants to signal his distress to a person lying on the edge of the pool by flashing his water-proof torch –
(A) He must direct the beam of light vertically upwards
(B) He must direct the beam horizontally
(C) He must direct the beam at an angle to the vertical which is slightly lesser than the critical angle
(D) He must direct the beam at an angle to the vertical which is slightly greater than the critical angle

Q.58 The absolute refractive index of a medium depends on –
(A) nature of the medium only (B) wavelength of light only
(C) temperature of the medium only (D) all of the above

Q.59 Mark the wrong statement –
(A) Refractive index decreases with increase in temperature
(B) Refractive index depends on the angle of incidence
(C) Foucault demonstrated experimentally that the speed of light in air is more than that in water
(D) Polarization of light was discovered by Malus

Q.60 Two plane mirrors are inclined at an angle θ. A ray of light is incident on one mirror and is then reflected from the other mirror. Then the angle between the first ray and the final ray will be –
(A) θ (B) 2θ (C) between θ and 2θ (D) $> 2\theta$

Q.61 In comparison to the case when a ray of light travels from glass to air, the critical angle for total internal reflection of light when a ray of light travels from glass to water is –
(A) greater (B) smaller (C) same (D) nothing can be predicted

Q.62 A glass slab is placed in the path of a beam of convergent light, then the point of convergence of light –
(A) moves towards the glass slab (B) moves away from the glass slab
(C) remains at the same point (D) undergoes a lateral shift

Q.63 Mark the wrong statement about a virtual image –
(A) A virtual image can be photographed (B) A virtual image can be seen
(C) A virtual image can be photographed by exposing a film at the location of the image
(D) A virtual image may be diminished or enlarged in size in comparison to an object.

Q.64 A real image is formed by a convex mirror when the object is placed at –
(A) infinite (B) between center of curvature and focus
(C) between focus and pole (D) none of the above

Q.65 A virtual image is formed by a concave mirror when the object is placed between –
(A) infinity and center of curvature (B) center of curvature and focus
(C) focus and the pole (D) All of the above

Q.66 Which of the following are used in a Kaleidoscope –
(A) Plane mirrors (B) concave (C) convex mirrors (D) all of the above

Q.67 When a spherical convex lens made up of glass is immersed in water, its focal length –
(A) decreases (B) does not change (C) increases (D) none of the above

Q.68 Out of the following –
(a) pole (b) focus (c) radius of curvature (d) principal axis
for a spherical mirror, the quantities that do not depend on whether the rays are paraxial or not, are –
(A) a, b, c and d (B) only a, b and c (C) only a, c and d (D) only a and d

Q.69 A person standing at some distance from a mirror finds his image erect, virtual and of the same size. Then the mirror is possibly–
(A) plane mirror (B) concave mirror
(C) plane or concave mirror (D) plane or concave or convex mirror

Q.70 Concave mirrors are used –
(A) as reflectors in lamps (B) as objectives in reflecting type of astronomical telescope
(C) in Opthalmoscope (D) in all of the above

Q.71 Mark the wrong statement –
(A) A convex mirror produces an erect image
(B) A convex mirror always produces an erect image of an erect object
(C) A convex mirror always produces a diminished in size image
(D) A convex mirror is used as a shaving mirror

Q.72 When a clock is viewed in a mirror, the needles exhibit a time which appears to be 8.20. Then the actual time will be–
(A) 4.40 (B) 3.40 (C) 8.20 (D) 3.20

Q.73 When a light ray enters a refracting medium it is found that the magnitude of the angle of refraction is equal to half the angle of reflection. If μ is the refractive index of the medium, then the angle of incidence is –
(A) $2\sin^{-1}(\mu/2)$ (B) $2\cos^{-1}(\mu/2)$ (C) $\cos^{-1}(\mu/2)$ (D) $\sin^{-1}(\mu/2)$

Q.74 A container of depth H is filled with two immiscible transparent liquids of refractive index μ_1 and μ_2 respectively. The depth of each liquid is H/2. When viewed from above, the apparent depth of the vessel is –

(A) $\frac{H}{2\mu_1}+\frac{H}{2\mu_2}$ (B) $\frac{H}{2\mu_1}-\frac{H}{2\mu_2}$ (C) $\frac{H}{2\mu_1}+\frac{H\mu_1}{2\mu_2}$ (D) $\frac{H}{2\mu_1}-\frac{H\mu_1}{2\mu_2}$

Q.75 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. Then the size of the image is approximately equal to –

(A) $L\left(\frac{u-f}{f}\right)^{1/2}$ (B) $L\left(\frac{f}{u-f}\right)^{1/2}$ (C) $L\left(\frac{u-f}{f}\right)$ (D) $L\left(\frac{f}{u-f}\right)^{2}$

Q.76 For a concave mirror of focal length 20 cm. if the object is at a distance of 30 cm. from the pole, then the nature of the image and magnification will be –
(A) real and –2 (B) virtual and –2 (C) real and +2 (D) virtual and +2

Q.77 An object is placed xf to the right of the focus of a concave spherical mirror of focal length f. Then the image will be formed at a distance of –
(A) xf to the right of the focus (B) xf to the left of the focus
(C) f/x to the right of the focus (D) f/x to the left of the focus

Q.78 A lens forms a real image of an object on a screen placed at a distance of 100 cm. from the object. If the lens is moved by 20 cm. towards the screen, another image of the object is formed on the screen. Then the focal length of the lens is –
(A) 12 cm. (B) 24 cm. (C) 50/3 cm. (D) 48 cm.

Q.79 A parallel beam of light falls normally on the plane surface of a planoconvex lens of refractive index 1.5. If the radius of the curved surface of the lens is 20 cm, the beam will be focused at a distance from the lens given by –
(A) 10 cm. (B) 15 cm. (C) 25 cm. (D) 40 cm.

Q.80 In order to obtain a real image of magnification 2 using a converging lens of focal length 20 cm, where should an object be placed–
(A) – 30 cm. (B) 30 cm. (C) – 50cm. (D) 50 cm.

Q.81 An object placed 10 cm in front of a lens has an image 20 cm. behind the lens. What is the power of the lens (in dioptre) ?
(A) 1.5 (B) 3.0 (C) –5.0 (D) +15.0

Q.82 In vacuum the speed of light does not depend on –
(A) Wavelength (B) Frequency (C) Intensity (D) Speed of observer

Q.83 When light passes from air to water which of the following changes –
(A) Wavelength (B) Velocity (C) Frequency (D) Colour

Q.84 In case of reflection by a plane-mirror, which of the following statements are not correct –
(A) It can never give real image (B) It can never give inverted image
(C) It changes left into right (D) It changes front into back

Q.85 If two mirrors are inclined to each other at 90°, the image seen may be –
(A) One (B) Two (C) Three (D) Four

Q.86 In case of three plane-mirrors meeting at a point to form a corner of a cube, if incident light suffers one reflection on each mirror–
(A) The emergent ray is antiparallel to incident one
(B) The emergent ray is perpendicular to incident one
(C) The emergent ray is in phase with incident one
(D) The emergent ray is in opposite phase with incident one

Q.87 A plane mirror, reflecting a ray of incident light, is rotated through an angle θ about an axis through the point of incidence in the plane of the mirror perpendicular to the plane of incidence, then –
(A) the reflected ray does not rotate (B) the reflected ray rotates an angle θ
(C) the reflected ray rotates an angle 2θ (D) the incident ray is fixed

Q.88 A beaker containing liquid is placed on the 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 of 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 liquid is –

(A) $\frac{d-b}{d-c-b+a}$ (B) $\frac{d-c-b+a}{d-b}$ (C) $\frac{b-d}{d-c-b+a}$ (D) $\frac{d-c-b+a}{b-d}$

Q.89 Five images are formed, if two plane-mirrors are inclined to each other at an angle of –
(A) 60° (B) 70° (C) 72° (D) 90°

Q.90 Out of the following which statements are correct –
(A) Two plane mirrors are inclined to each other at an angle of 60°. If a ray of light incident on the first mirror is parallel to the second mirror, it is reflected from the second mirror parallel to the first mirror.
(B) A bird flying high up in the air does not cast a shadow on the ground because layers of atmosphere are dense.
(C) If a ray reflected successively from two plane mirrors inclined at a certain angle undergoes a deviation of 300°, then the number of images observable is 11.
(D) A clock indicates a time of 3.25. On seeing it in a plane mirror, the time appears as 8.35.

Q.91 When a plane mirror is placed horizontally on level ground at a distance of 60 m from the foot of a tower, the top of the tower and its image in the mirror subtend an angle of 90° at the eye. The height of the tower is –
(A) 30 m (B) 60 m (C) 90 m (D) 120 m

Q.92 Which of the following letters do not suffer lateral inversion
(A) HGA (B) HOX (C) VET (D) YUL

Q.93 N plane mirrors are arranged parallel to one another each moving with a speed v. The linear velocity of the Nth image of a point object placed in front of the first mirror is–
(A) Nv (B) Nv^2 (C) Nv^3 (D) 2Nv

Q.94 In case of concave mirror, the minimum distance between a real object and its real image is –
(A) f (B) 2f (C) 4f (D) zero

Q.95 The image formed by a convex mirror of a real object is larger than the object –
(A) when $u < 2f$ (B) when $u > 2f$ (C) for all values of u (D) for no value of u

Q.96 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 & O (D) real, and located at a point between C and O

Q.97 In case of a curved mirror if the distance of object (u) and image (v) are measured from the pole and a graph is plotted between (1/u) and (1/v), the graph is a –
(A) Straight and passing through the origin (B) Straight line making an intercept with both u and v axes
(C) Parabola (D) Hyperbola

Q.98 A concave mirror of focal length f produces an image n times the size of the object. If the image is real then the distance of the object from the mirror is –
(A) $(n-1)f$ (B) $\frac{(n-1)}{n}f$ (C) $\frac{(n+1)}{n}f$ (D) $(n+1)f$

Q.99 In a concave mirror if x_1 and x_2 are the distances of object and its image respectively from the focus, then the focal length of the mirror is –
(A) x_1x_2 (B) $\sqrt{x_1x_2}$ (C) $(x_1+x_2)/2$ (D) $x_1x_2/(x_1+x_2)$

Q.100 The index of refraction of diamond is 2.0, velocity of light in diamond in cm/second is approximately –
(A) 6×10^{10} (B) 3.0×10^{10} (C) 2×10^{10} (D) 1.5×10^{10}

Q.101 Light travels through a glass plate of thickness t and having refractive index n. If c is the velocity of light in vacuum, the time taken by the light to travel this thickness of glass is –
(A) t/nc (B) tnc (C) nt/c (D) tc/n

Q.102 Light takes 8 min 20 sec. to reach from sun on the earth. If the whole atmosphere is filled with water, the light will take the time ($_a\mu_w = 4/3$)
(A) 8 min 10 sec. (B) 8 min. (C) 6 min. 11 sec. (D) 11 min. 6 sec.

Q.103 The length of the optical path of two media in contact of length d_1 and d_2 of refractive indices μ_1 and μ_2 respectively, is –
(A) $\mu_1d_1 + \mu_2d_2$ (B) $\mu_1d_2 + \mu_2d_1$ (C) $\frac{d_1d_2}{\mu_1\mu_2}$ (D) $\frac{d_1+d_2}{\mu_1\mu_2}$

Q.104 An under water swimmer is at a depth of 12 m below the surface of water. A bird is at a height of 18m from the surface of water, directly above his eyes. For the swimmer the bird appears to be at a distance from the surface of water equal to (Refractive index of water is 4/3)
(A) 24m (B) 12m (C) 18m (D) 9m

Q.105 A ray of light is incident on a transparent glass slab of refractive index 1.62. The reflected and the refracted rays are mutually perpendicular. The angle of incidence is –
(A) 58.3° (B) 50° (C) 35° (D) 30°

Q.106 A microscope is focussed on a coin lying at the bottom of a beaker. The microscope is now raised up by 1cm. To what depth sound the water be poured into the beaker so that coin is again in focus ?
(Refractive index of water is 4/3)
(A) 1 cm. (B) 4/3 cm. (C) 3 cm. (D) 4 cm.

Q.107 Refractive index of air is 1.0003. The correct thickness of air column which will have one more wavelength of yellow light (6000 Å) than in the same thickness in vacuum is –
(A) 2 mm. (B) 2 cm. (C) 2 m. (D) 2 km.

Q.108 A glass slab of thickness 3cm. and refractive index 3/2 is placed on ink mark on a piece of paper. For a person looking at the mark at a distance 5.0 cm. above it, the distance of the mark will appear to be –
(A) 3.0 cm. (B) 4.0 cm. (C) 4.5 cm. (D) 5.0 cm.

Q.109 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)

Q.110 For image magnification one needs at least –
(A) two convex lens (B) one concave and one convex lens
(C) one concave lens (D) one convex lens

Q.111 An object is located at 10 cm. in front of a convex lens of focal length 12 cm. The image is located at –
(A) 60 cm. at the back of the lens (B) 60 cm. in front of the lens
(C) 5.45 cm. at the back of the lens (D) 5.45 cm. in front of the lens

Q.112 The sun subtends an angle of (1/2)° at the surface of the earth. A converging lens of focal length 100 cm. is used to obtain an image of the sun on a screen. The diameter of the image formed is about –
(A) 1 mm (B) 9 mm. (C) 18 mm. (D) 50 mm.

EXERCISE - 4

Match the column–

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**.

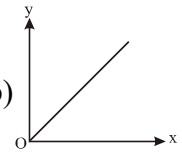
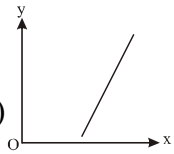
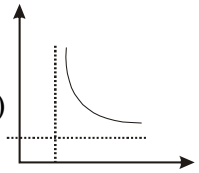
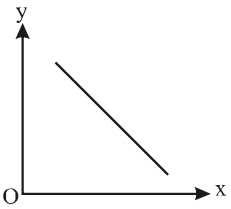
Q.1 Match the following :

Column I	**Column II**
(A) Power of convex mirror	(p) Positive power
(B) Power of concave mirror	(q) Negative power
(C) Power of plane mirror	(r) Zero power
(D) Power of convex lens	(s) Infinite power

Q.2 A convex lens (f) forms an image on a screen Considering the object to be at the zero mark in a scale, match the following.

Column I	**Column II**
(A) Image	(p) Moves the image of infinite object further away
(B) Additional lens in contact	(q) Not unique as lens is moved between object and source.
(C) Reduction in refractive index	(r) Virtual for screen position at a distance <4f from the object.
(D)Slicing the lens to have one plane and another convex surface	(s) Object at d forms real image further nearer plano-convex lens.

Q.3 The graphs given apply to convex lens of focal length f, producing a real image at a distance v from the optical centre when self luminous object is at distance u from the optical centre. The magnitude of magnification is m. Identify the following graphs with the first named quantity being plotted along y-axis.

Column I	**Column II**
(A) v against u	(p) 
(B) $\frac{1}{v}$ against $\frac{1}{u}$	(q) 
(C) m against v	(r) 
(D) (m + 1) against $\frac{v}{f}$	(s) 

ASSERTION & REASON TYPE

Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 5 choices (A), (B), (C), (D) and (E) out of which ONLY ONE is correct.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement -1 is True, Statement-2 is False.
(D) Statement -1 is False, Statement-2 is True.
(E) Statement -1 is False, Statement-2 is False.

Q.4 **Statement 1 :** A point object is placed at a distance of 26 cm. from a convex mirror of focal length 26cm. The image will form at infinity.

Statement 2 : For above given system the equation $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ gives $v=\infty$.

Q.5 **Statement 1 :** When a concave mirror is held under water, its focal length will increase.
Statement 2 : The focal length of a concave mirror is independent of the medium in which it is placed.

Q.6 **Statement 1 :** A convex mirror is used as a driver's mirror.
Statement 2 : Because convex mirror's field of view is large and images formed are virtual, erect and diminshed.

Q.7 **Statement 1 :** In visible light $\mu_r < \mu_v$

Statement 2 : This follows from cauchy's formula $\mu = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4}$

Q.8 **Statement 1 :** Keeping a point object fixed, if a plane mirror is moved, the image will also move.
Statement 2 : In case of a plane mirror, distance of object and Its image is equal from any point on the mirror.

Q.9 **Statement 1 :** When the object moves with a velocity $\vec{v}$, its image in the plane mirror moves with a velocity of $-2\vec{v}$.
Statement 2 : The minimum height of the mirror to be required to see the full image of man of height h is h/2.

Q.10 **Statement 1 :** If both plane mirror and object are moved through a distance x, then the image moves through a distance 3x.
Statement 2 : When the object is fixed and plane mirror is moved through a distance x. Then the image is also moves through the distance 2x.

Q.11 **Statement 1 :** As the temperature of a medium increases the refractive index decreases.
Statement 2 : When a ray travels from vacuum to a medium, then μ is known as absolute refractive index of the medium. ($\mu_{vacuum} = 1$)

Q.12 **Statement 1 :** If a spherical mirror is dipped in water, its focal length remains unchanged.
Statement 2 : A laser light is focused by a converging lens. There will be a significant chromatic aberration.

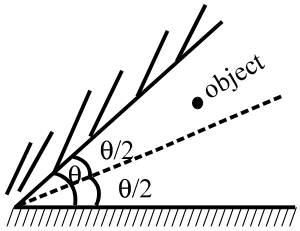
Q.13 **Statement 1 :** A virtual image cannot be photographed.
Statement 2 : Only real objects are photographed

Q.14 **Statement 1 :** The small object, to be seen in a microscope, is kept within the focus of its objective.
Statement 2 : In this case, the image formed by the objective is nearer to the eyepiece.

Q.15 **Statement 1 :** A point source of light is placed at a distance of 2f from a converging lens of focal length f. The intensity of the other side of the lens is maximum at distance 2f.
Statement 2 : In chromatic aberration the rays of different colours fail to converge at a point after going through a converging lens.

Q.16 **Statement 1 :** Light rays retrace their path when their direction is reversed (Law of reversibility of light rays)
Statement 2 : For the refraction light, water is denser than air, but for the refraction of sound, water is rarer than air.

Q.17 **Statement 1 :** If the angle between the two plane mirror is 72° and the object is asymmetrically placed between the two mirrors, then 5 images of the object will be formed.



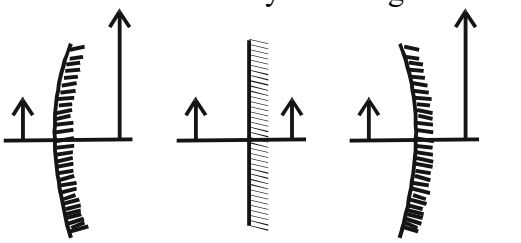
Statement 2 : For given system of mirror the total number of images formed due to successive reflection is equal to either $\frac{360°}{\theta}$ or $\frac{360°}{\theta} - 1$ accordingly as $\frac{360°}{\theta}$ is odd or even respectively.

Q.18 **Statement 1 :** Red light travels faster in glass than green light.
Statement 2 : The refractive index of glass is less for red light than for green light.

Q.19 **Statement 1 :** Speed of light in glass of $\mu = 1.5$ is 2×10^8 m/sec
Statement 2 : According to dual theory, light has particle nature and wave nature simultaneously.

Q.20 **Statement 1 :** As light travels from one medium to another, the frequency of light does not change.
Statement 2 : Because frequency is the characteristic of source.

Q.21 **Statement 1 :** We can decide the nature of a mirror by observing the size of erect image in the mirror (see figure)



Statement 2 : The minimum distance between a real object and its real image in a concave mirror is zero.

EXERCISE - 5

PREVIOUS YEARS COMPETITION PROBLEMS

Q.1 A beam of monochromatic light is refracted from vacuum into a medium of refractive index 1.5. The wavelength of refracted will be–
(A) dependent on intensity of refracted light (B) same
(C) smaller (D) larger

Q.2 Time taken by the sunlight to pass through a window of thickness 4 mm. whose refractive index is 1.5 is
(A) 2×10^{-8} second (B) 2×10^{8} second (C) 2×10^{-11} second (D) 2×10^{11} second

Q.3 Ray optics is valid, when characteristic dimensions are –
(A) of the same order as the wavelength of light (B) much smaller than the wavelength of light
(C) of the order of one millimeter (D) much larger than the wavelength of light

Q.4 The focal length of the convex lens depends upon –
(A) frequency of the light ray (B) wavelength of the light ray
(C) both (A) and (B) (D) None of these

Q.5 Focal length of a convex lens will be maximum for –
(A) blue light (B) yellow light (C) green light (D) red light

Q.6 If a convex lens of focal length 80 cm. and a concave lens of focal length 50 cm. are combined together, what will be their resulting power –
(A) + 6.5 D (B) – 6.55 D (C) + 7.5 D (D) – 0.75 D

Q.7 The refractive index of water is 1.33. What will be the speed of light in water ?
(A) 3×10^{8} m/s (B) 2.25×10^{8} m/s (C) 4×10^{8} m/s (D) 1.33×10^{8} m/s

Q.8 Light travels through a glass plate of thickness t and having a refractive index μ. If c is the velocity of light in vacuum, the time taken by light to travel this thickness of glass is –
(A) $t\mu c$ (B) tc/μ (C) $t/\mu c$ (D) $\mu t/c$

Q.9 Power of a lens is – 4D and for second lens, power is +2D, the total power for the couple is –
(A) –2D (B) 6D (C) –6D (D) –8D

Q.10 A ray of light from air is incident in water then which property of light will not change in water –
(A) velocity (B) frequency (C) amplitude (D) colour

Q.11 When a mirror is rotated through an angle θ, the reflected ray from it turns through an angle of –
(A) θ (B) $\theta/2$ (C) 2θ (D) 0

Q.12 The index of refraction of diamond is 2.0. The velocity of light in diamond in cm/s is –
(A) 6×10^{10} (B) 2×10^{10} (C) 3×10^{10} (D) 1.5×10^{10}

Q.13 Two thin lenses of focal length f_1 and f_2 are placed coaxially in contact. The combination acts as a single lens of focal length is –

(A) $\frac{f_1 f_2}{(f_1 + f_2)}$ (B) $\sqrt{f_1 f_2}$ (C) $\frac{(f_1 + f_2)}{f_1 f_2}$ (D) $\frac{f_1 + f_2}{2}$

Q.14 A convex lens of focal length 0.5 m and concave lens of focal length 1m are combined. The power of resulting lens will be

(A) 1 D (B) –1 D (C) 0.5 D (D) –0.5 D

Q.15 A concave lens and a convex lens have same focal length of 20 cm. and both put in contact this combination is used to view an object 5 cm. long kept at 20 cm. from the lens combination. As compared to object the image will be –

(A) Magnified and inverted (B) Reduced and erect

(C) Of the same size and erect (D) Of the same size and inverted

Q.16 The focal length of convex lens is 30 cm. and the size of image is quarter of the object, then the object distance is –

(A) 150 cm. (B) 60 cm. (C) 30 cm. (D) 40 cm.

Q.17 Radius of curvature of convex mirror is 40 cm. and the size of object is twice as that of image, then the image distance is –

(A) 10 cm. (B) 20 cm. (C) 40 cm. (D) 30 cm.

Q.18 A ray of light is incident on the surface of separation of a medium with the velocity of light at an angle 45° and is refracted in the medium at an angle 30°. What will be the velocity of light in the medium –

(A) 1.96×10^8 m/s (B) 2.12×10^8 m/s (C) 3.18×10^8 m/s (D) 3.33×10^8 m/s

Q.19 The speed of a wave in a medium is 760 m/s. If 3600 waves are passing through a point, in the medium in 2 minutes, then its wavelength is –

(A) 13.8 m (B) 25.3 m (C) 41.5 m (D) 57.2 m

Q.20 The combined power of two lenses is contact is +10D. When they are separated by 20 cm, their power becomes +6.25 D. The powers of these lenses are –

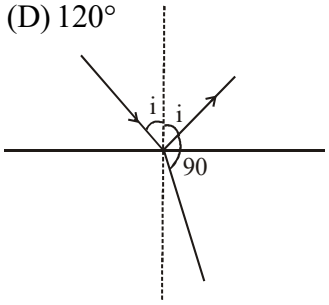
(A) –3.5 D, +6.5 D (B) –7.5 D, +2.5 D (C) +7.5 D, +2.5 D (D) +9.0 D, +1.0 D

Q.21 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°

Q.22 A ray of light strikes a transparent surface from air at an angle θ. If the angle between the reflected and refracted ray is a right angle, the refractive index of the other surface is given by –

(A) $\mu = 1/\tan\theta$ (B) $\mu = \tan^2\theta$ (C) $\mu = \sin\theta$ (D) $\mu = \tan\theta$

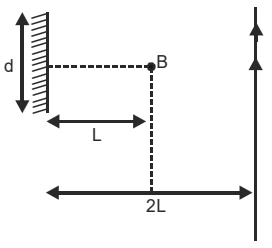


Q.23 A tall man of height 6 feet, want to see his full image. Then required minimum length of the mirror will be-

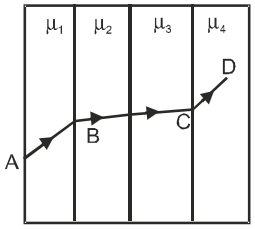
(A) 12 feet (B) 3 feet (C) 16 feet (D) Any length

Q.24 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



Q.25 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:

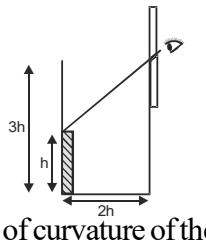


(A) $\mu_1 = \mu_2$ (B) $\mu_2 = \mu_3$ (C) $\mu_3 = \mu_4$ (D) $\mu_4 = \mu_1$

Q.26 In order to obtain image on wall of a bulb at a distance d from the wall a convex lens is placed between bulb and wall. Focal length of lens will be -

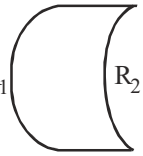
(A) d/2 (B) Between d/2 & d/4 (C) More then d/2 (D) Less than d/4

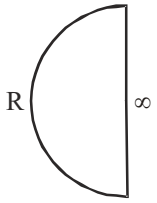
Q.27 An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is–

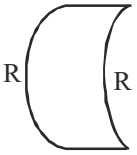


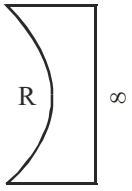
(A) 5/2 (B) $\sqrt{5/2}$ (C) $\sqrt{3/2}$ (D) 3/2

Q.28 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.

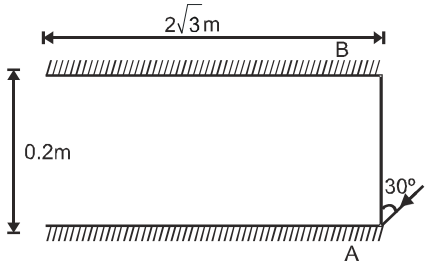
(A) 

(B) 

(C) 

(D) 

Q.29 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 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) 30 (B) 31 (C) 32 (D) 34

Q.30 An object is placed 12 cm to the left of a converging lens of focal length 8 cm. Another converging lens of 6 cm focal length is placed at a distance of 30 cm to the right of the first lens. The second lens will produce–

(A) a virtual enlarged image (B) no image
(C) a real inverted image (D) a real enlarged image

Q.31 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:

(A) (4/3) sin i (B) 1/sin i (C) 4/3 (D) i

Q.32 If two mirrors are kept at 60° to each other, then the number of images formed by them is

(A) 5 (B) 6 (C) 7 (D) 8

Q.33 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 –

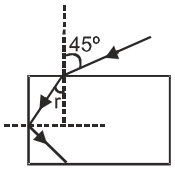
(A) $36\sqrt{5}$ (B) $4\sqrt{5}$ (C) $36\sqrt{7}$ (D) $36/\sqrt{7}$

Q.34 A cut diamond sparkles because of its –

(A) Hardness (B) High refractive index
(C) Emission of light by the diamond (D) Absorption of light by the diamond

Q.35 Consider telecommunication through optical fibres. Which of the following statement 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

Q.36 What will be refractive index of glass for total internal reflection –

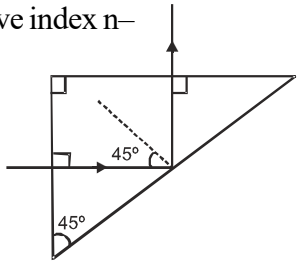


(1) $\frac{\sqrt{3}+1}{2}$ (2) $\frac{\sqrt{5}+1}{2}$

(3) $\frac{\sqrt{2}+1}{2}$ (4) $\sqrt{\frac{3}{2}}$

Q.37 Which of the following is used in optical fibres ?
(1) total internal reflection (2) scattering (3) diffraction (4) refraction

Q.38 A light ray is incident perpendicularly to one face to a 90º prism and is totally internally reflected at the glass-air interface. If the angle of reflection is 45º, we conclude that the refractive index n–



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

(3) $n > \frac{1}{\sqrt{2}}$ (4) $n < \sqrt{2}$

EXERCISE - 6

PREVIOUS YEARS BOARD QUESTIONS

Q.1 How does the frequency of a beam of ultra violet light change when it goes from air into glass ?
Q.2 What is the focal length of a plane mirror ?
Q.3 When light undergoes refraction at the surface of separation of two media, what happens to its wavelength ?
Q.4 How does a focal length of convex lens change if monochromatic red light is used instead of monochromatic blue light ?
Q.5 A concave mirror is placed in water. Will there be any change in focal length ? Give reason.
Q.6 The image of an object formed by a lens on the screen is not in sharp focus. Suggest a method to get clear focussing of the image on the screen without disturbing the position of the object, the lens or the screen.
Q.7 Refractive index of glass for light of yellow, green and red colours are μ_y, μ_g and μ_r respectively. Rearrange these symbols in the increasing order of values.
Q.8 Give the ratio of velocities of light rays of wavelengths 4000 Å and 8000 Å.
Q.9 An object is placed at a distance of 12 cm in front of a concave mirror. It forms a real image four times larger than the object. Calculate the distance of the image from the mirror.
Q.10 With respect to air, the refractive index of ice is 1.31 arid that of rock salt is 1.54. Calculate the refractive index of rock salt with respect to ice.
Q.11 Light enters from air into glass plate which has a refractive index of 1.50. Calculate the speed of light in glass. The speed of light in air is 3×10^8 ms^{-1}.
Q.12 A concave mirror and a convex lens are held separately in water. What changes, if any, do you expect in the focal length of either?
Q.13 If the wavelength of incident light on a (i) concave mirror and (ii) convex lens is increased, how will the focal length of each of these change ?
Q.14 Use the mirror formula to show that for an object lying between the pole and focus of a concave mirror, the image formed is always virtual in nature.

Q.15 A concave lens has focal length of 20 cm. At what distance from the lens a 5 cm tall object be placed so that it forms an image at 15 cm from the lens ? Also calculate the size of the image formed.

Q.16 An object 50 cm tall is placed on the principal axis of a convex lens. Its 20 cm tall image is formed on the screen placed at a distance of 10 cm from the lens. Calculate the focal length of the lens.

Q.17 An object 20 cm tall is placed on the principal axis of a convex lens. Its 30 cm tall image is formed on the screen placed at a distance of 10 cm from the lens. Calculate the focal length of the lens.

Q.18 An object 30 cm tall is placed on the principal axis of a convex lens. Its 10 cm tall inverted image is formed on the screen placed at a distance of 15 cm from the lens. Calculate the focal length of the lens.

Q.19 A 5.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 30 cm. By calculation determine (i) the position and (ii) the size of the image formed.

Q.20 An object 3.0 cm high is placed perpendicular to the principal axis of a concave lens of focal length 15.0 cm. The image is formed at a distance of 10.0 cm from the lens. Calculate
(i) distance at which the object is placed and (ii) size and nature of the image formed.

Q.21 An object 2.0 cm in size is placed 20.0 cm in front of a concave mirror of focal length 10.0 cm. Find the distance from the mirror at which a screen should be placed in order to obtain sharp image. What will be the size and nature of the image formed ?

Q.22 A convex lens has a focal length of 25 cm. Calculate the distance of the object from the lens if the image is to be formed on the opposite side of the lens at a distance of 75 cm from the lens. What will be the nature of the image ?

Q.23 A convex lens has a focal length of 30 cm. Calculate at what distance should the object be placed from the lens so that in forms an image at 60 cm on the other side of the lens. Find the magnification produced by the lens in this case.

Q.24 An object 3 cm high is placed at a distance of 9 cm in front of a concave mirror of focal length 18 cm. Find the position, nature and size of the image formed.

Q.25 An object 4 cm high is placed at a distance of 20 cm in front of a convex lens of focal length 12 cm. Find the position, nature and size of the image formed.

Q.26 Find the position, nature and size of the image of an object 3 cm high placed at a distance 6 cm from a concave mirror of focal length 12 cm.

Q.27 Where should an object be placed from a converging lens of focal length 20 cm, so as to obtain a real image of magnification 2?

Q.28 Find the position of the object which when placed in front of a convex mirror produces a virtual image, which is half the size of the object.

Q.29 Find the position of an object which when placed in front of a concave mirror of focal length 20 cm produces a virtual image, which is twice the size of the object.

Q.30 An object is kept in front of a concave mirror of focal length 15 cm. The image formed is three times the size of object. Calculate two possible distances of the object from the mirror.

Q.31 Monochromatic light of wavelength 589 nm is incident from air on a water surface. What are the wavelength, frequency and speed of (a) reflected (b) refracted light ? (n of water = 1.33)

Q.32 An object 10 cm long is placed at 15 cm away from a convex lens of focal length 10 cm. Find the position and size of image.

Q.33 (a) State the relation between object distance, image distance and focal length of a spherical mirror.
(b) A concave mirror of focal length 15 cm form an image of an object kept at a distance of 10 cm from the mirror. Find the position nature and size of the image formed by it. (c) Draw a ray diagram to show the image formed by a concave mirror when an object is placed between pole and focus of the mirror.

Q.34 What is meant by 'critical angle' for a ray of light going from a denser to a rarer medium ?
What will be the consequence, if the angle of incidence, at the interface is greater than the critical angle ?

ANSWER KEY

EXERCISE - 1

(11) Concave mirror **(19)** – 30 cm. **(20)** 2×10^8 ms^{-1}. **(22)** –0.5D
(23) 2.15cm. **(24)** – 0.50 m **(29)** 1/11 times smaller **(30)** – 45 cm.
(31) v = + 10 cm. **(32)** 1.22.
(33) The image is 30 cm. from the convex lens, located on the other side of the object. It is real inverted and 4.5 cm. high. **(34)** 10 cm. **(35)** P = + 10 dioptre (or + 10 D)
(36) +0.33 **(48)** 1.06 cm. **(49)** 24 mm
(50) 6 cm., Nature : Image is virtual, erect and diminished.
(54) The image will be virtual and erect is s < F, the image will be smaller is s > 2F and larger if s < 2F.
(55) (a) real inverted reduced (b) real, inverted, same size (c) no image is formed (d) virtual, erect, enlarged
(56) (a) virtual, erect, reduced (b) virtual, erect, reduced (c) virtual, erect, reduced (d) virtual, erect, reduced
(57) (a) 7.5 cm. (b) 48 cm. **(58)** (a) (i) +30 cm, –22 cm, (ii) –20 cm, –42 cm, (b) 0.98 cm.
(59) 10D, 0.1 **(60)** 60 cm. **(61)** –10 cm., –10 D **(62)** (A) **(63)** (C) **(64)** (B)

EXERCISE - 2

(1) positive, negative. **(2)** straight lines. **(3)** away from, towards **(4)** air-glass, glass-air, parallel
(5) focal length **(6)** dioptre **(7)** equal **(8)** inwards , outwards. **(9)** concave
(10) pole **(11)** front **(12)** principal axis **(13)** principal focus **(14)** concave
(15) lens. **(16)** convergence or divergence **(17)** convex **(18)** 5/4
(19) True **(20)** True **(21)** True **(22)** True **(23)** True
(24) True **(25)** True **(26)** False. **(27)** True **(28)** True
(29) True **(30)** True **(31)** True **(32)** False **(33)** True **(34)** False

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11
A	D	D	B	A	D	C	D	D	D	C	B
Q	12	13	14	15	16	17	18	19	20	21	22
A	A	C	A	A	A	A	C	B	B	C	B
Q	23	24	25	26	27	28	29	30	31	32	33
A	B	A	B	D	D	D	D	B	C	D	D
Q	34	35	36	37	38	39	40	41	42	43	44
A	C	B	A	C	A	A	A	D	D	D	A
Q	45	46	47	48	49	50	51	52	53	54	55
A	A	A	B	A	C	B	C	B	C	B	D
Q	56	57	58	59	60	61	62	63	64	65	66
A	C	C	D	B	B	A	B	C	D	C	A
Q	67	68	69	70	71	72	73	74	75	76	77
A	C	C	A	D	D	B	B	A	D	A	C
Q	78	79	80	81	82	83	84	85	86	87	88
A	B	D	A	D	A,B,C	A,B	A,B,C	A,B,C	A,D	C,D	A
Q	89	90	91	92	93	94	95	96	97	98	99
A	A,B,C	A,C,D	B	B	D	D	D	D	B	C	B
Q	100	101	102	103	104	105	106	107	108	109	110
A	D	C	D	A	A	A	D	B	B	B	D
Q	111	112									
A	B	B									

EXERCISE - 4

(1) (A) → q, (B) → p, (C) → r, (D) → p **(2)** (A) → q, r (B) → s (C) → p (D) → p, r

(3) (A) → r, (B) → s, (C) → q, (D) → p **(4)** (E) **(5)** (D) **(6)** (A)

(7) (A) **(8)** (D) **(9)** (B) **(10)** (E) **(11)** (B)

(12) (C) **(13) (E).** An image is a plane mirror is virtual and it can be photographed.

(14) (E). Object is placed between F and 2F of objective lens.

(15) (B) **(16)** (B) **(17)** (A) **(18)** (A)

(19) (C) **(20)** (A) **(21)** (B)

EXERCISE - 5											
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
A	C	C	D	B	D	D	B	D	A	B	C
Q	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
A	D	A	A	C	A	A	B	B	C	C	D
Q	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
A	B	D	D	D	B	C	B	C	B	A	D
Q	**34**	**35**	**36**	**37**	**38**						
A	B	C	D	A	B						

EXERCISE - 6

(7) $\mu_r < \mu_g < \mu_y$. **(8)** 1 : 1 **(9)** 48 cm on the same side of object. **(10)** 1.18.

(11) 2×10^8 ms^{-1}. **(15)** 5/4, Image is enlarged and virtual. **(16)** 7.14 cm.

(17) + 4 cm. **(18)** 11.25 cm.

(19) (i) + 60 cm. Image is real and inverted. (ii) – 10 cm. Size of image is twice the size of object.

(20) (i) u = – 30 cm. (ii) + 1.0. Image is virtual, erect and of same size.

(21) Nature of image : Real, inverted, same size (h' = h). **(22)** – 37.5 cm

(26) 12 cm. Nature : virtual, erect, enlarged, Size of image : Twice the size of object.

(27) – 30 cm. **(28)** Object has to be at a distance equal to focal length. **(29)** u = – 10 cm.

(30) 10 cm and 20 cm in front of concave mirror. **(31)** (a) 5.09×10^{14} Hz (b) 442 nm.

(32) – 20.