

1) The greatest thickness of a planoconvex glass lens appears to be 2cm when observed normally through the plane surface, and when observed through the curved surface, the greatest thickness is $\frac{80}{9}$ cm. If the real thickness is 3cm, then the radius of curvature of the spherical surface is :

- (a) 80cm (b) 10cm (c) 5cm (d) 2.5cm

2) A person wants a real image of his own, 3 times enlarged where should he stand in front of a concave mirror of radius of curvature 30cm?

- (a) 30cm (b) 80cm (c) 10cm (d) 90cm

3) The size of the image of an object which is at infinity as formed by a convex lens of focal length 30cm is 2cm. If a concave lens of focal length 20cm is placed between the convex lens and the image at a distance of 26cm from convex lens, find new size of image.

- (a) 0.5cm (b) 1cm (c) 2cm (d) 2.5cm

4) The image of point P when viewed from top of the slabs will be

- (a) 2cm above P

- (b) 1.5cm above P

- (c) 2cm below P

- (d) 1cm above P

$$u=1.5 \quad \begin{matrix} \uparrow \\ 1.5cm \end{matrix}$$

$$u=1.5 \quad \begin{matrix} \uparrow \\ 1.5cm \end{matrix}$$

$$\downarrow 2cm$$

$$\bullet P$$

5) The refractive index of a prism for a monochromatic wave is $\sqrt{2}$. Its refracting angle is 60° . For minimum deviation, the angle of incidence will be

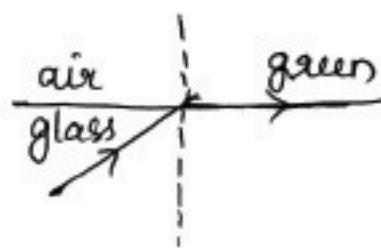
- (a) 30° (b) ~~45°~~ (c) 60° (d) 75°

6) A rod of length 10cm lies along the principal axis of a concave mirror of focal length 10cm in such a way that the end closer to the pole is 20cm away from it. The length of the image is

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

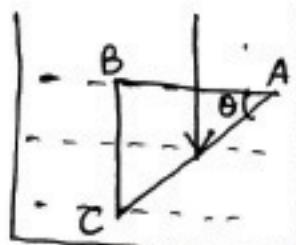
7) When light is incident on the interface of glass and air as shown in the figure. If green light is just totally internally reflected then the emerging ray in air contains

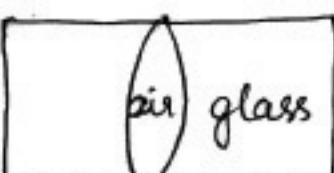
- (a) ~~yellow, orange, red~~
(b) violet, indigo, blue
(c) all colours
(d) all colours except green



8) A glass prism of RI 1.5 is immersed in water ($\mu = \frac{4}{3}$). Refer figure. A light beam incident normally on the face AB is totally reflected to reach the face BC if

- (a) $\frac{2}{3} < \sin \theta < \frac{8}{9}$
(b) $\sin \theta \leq 2/3$
(c) $\cos \theta \geq 8/9$
(d) ~~$\sin \theta > 8/9$~~



- 9) A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will
 (a) become zero (b) ~~become infinite~~ (c) become small, but non-zero (d) remain unchanged.
- 10) A container is filled with water ($\mu = 1.33$) upto height of 33.3 cm. A concave mirror is placed 15 cm above the water level. Image of an object placed at the bottom is formed 25 cm below the water level. The focal length of the mirror is
 (a) 10 cm (b) 15 cm (c) ~~20 cm~~ (d) 2 cm.
- 11) A fish looking up through the water sees the outer world contained in a circular horizon. If the refractive index of water is $\frac{4}{3}$ and fish is 18 cm below the surface. The radius of the circle in cm is
 (a) $36\sqrt{7}$ (b) ~~$\frac{36}{\sqrt{3}}$~~ (c) $\frac{36}{\sqrt{5}}$ (d) $\frac{4}{\sqrt{5}}$
- 12) In the figure, an air lens of radius of curvature 10 cm ($R_1 = R_2 = 10 \text{ cm}$) is cut in a cylinder of glass ($\mu = 1.5$). The focal length and the nature of the lens is
- 
- (a) 15 cm, concave (b) 15 cm, convex (c) ∞ , neither concave nor convex (d) 0, concave.

15) A point object O is placed at a distance of 15 cm in front of a glass rod having spherical end of radius of curvature 30 cm. The image would be formed at ($\mu_g = 1.5$)

- (a) ~~30 cm left~~ (b) infinity (c) 1 cm to the right
(d) 18 cm to the left.

Key Answers

Qno:	Answer
1	b
2	b
3	d
4	d
5	b
6	c
7	a
8	d
9	b
10	c
11	b
12	a
13	a

Synopsis

Ray optics mainly deals with reflection & refraction of light.

Reflection of light :-

1) Law of reflection :- $\text{Li} = \text{Lr}$

2) Concepts of mirrors :- (plane mirrors) :-

(a) When a ray of light is incident on a plane mirror it is completely reflected back and its angle of deviation is given by

$$d = (180 - 2i) \text{ where } i \text{ is the angle of incidence.}$$

(b) When two plane mirrors are inclined by an angle θ ; the deviation is given by; irrespective of any value of i , d remains same.

$$d = (360 - 2\theta) \text{ where } \theta \text{ is the angle between 2 plane mirrors. } d \text{ is independent of } i.$$

(c) When an object is placed in front of a plane mirror which is at rest, an image is obtained behind the mirror. When the object starts moving towards the plane mirror with a speed u , it is observed that the image also starts moving towards the plane mirror with the same speed u .

(d) In another case when the object is kept stationary and the plane mirror is moved towards the object with a speed u it is observed the image also starts moving towards but with a speed twice that of the plane mirror ie $2u$.

(e) If a person standing in front of a plane mirror would like to view his complete image the height of the plane mirror should be $h/2$ where h is the

height of the person.

- (d) In another case when a person standing in front of a plane mirror would like to view the complete image of the wall behind him the plane mirror is at a height of $\frac{h}{3}$ where in this case h is the height of the wall.

3) Concept of curved mirrors:-

- (a) In your theory classes, you would have studied about the relation between focal length and radius of curvature which is given by $f = \frac{R}{2}$.

- (b) There is an important relation between f, u, v which is given by the mirror formula that is

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}.$$

(c) Linear magnification (m) :-

It is defined as the ratio of size of the image to the size of the object.

$$m = \frac{h_i}{h_o} = -\frac{v}{u} = \frac{b}{f+u} = \frac{b+v}{f}$$

- (d) In case of a convex mirror the magnification is both always positive since it forms a virtual image.

- (e) In case of a concave mirror the magnification is both positive and negative depending on the nature of the image i.e;

m is +ve for a virtual image

m is -ve for a real image.

Refraction of light :-

1) There are three concepts to be learnt i.e

(i) refraction through a plane surface

(ii) refraction at a prism

(iii) refraction through a spherical surface.

2) Snell's law :-

$$n = \frac{\sin i}{\sin r} = \text{constant.}$$

3) Refraction through a glass slab :-

(i) Lateral shift :- It is defined as the perpendicular distance between the emergent ray and the incident ray.

4) Normal Shift :- It is defined as the apparent shift in the position of the object when viewed normally from the other medium.

5) Total internal reflection :-

(i) Conditions for TIR :-

a) The ray of light should travel from denser medium to a rarer medium.

b) The angle of incidence should be greater than critical angle.

(ii) Applications of TIR :- field of vision of a fish :-

When a fish is placed at the bottom of a water surface at a depth ~~'h'~~ 'h' it sees the outer world in the form of a circular frame due to TIR. The radius (α) of the circular frame can be calculated

using the formula:

$$a = \frac{b}{\sqrt{n^2 - 1}} ; \quad \epsilon = \sin^{-1}\left(\frac{1}{n}\right)$$

In the case of normal shift there are two cases to be explained:-

(i) When the object is placed in a denser medium and the observer is in the rarer medium, for the observer the image is more closer to the observer.

$$n = \frac{RD}{AD}$$

(ii) When the object is placed in a rarer medium and the observer is in the denser medium, the image is far away.

$$n = \frac{AD}{RD}$$

Refraction through a prism:-

(i) $A = a_1 + a_2 ; d = i_1 + i_2 - A$.

(ii) For minimum deviation $n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

(iii) The angle of prism should lie between a value of C and 2C.

i.e., when the ray of light should not emerge out the condition is $A = C$ and when $A = 2C$, TIR takes place.

Refraction through a spherical surface :-

$$\frac{-n_1}{r} + \frac{n_2}{r} = n_2 - n_1$$

Lens :-

- 1) You would have learnt about the ray diagrams for the formation of images at different position of objects.
- 2) A very important concept is related to lens maker's formula which is given by;

$$\frac{1}{f} = \left(\frac{n_2 - 1}{n_1} \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right); \text{ where } R_1 \text{ and } R_2 \text{ are}$$

the radii of curvature of
the 2 surfaces of lens.

- 3) Power of a lens is defined as the reciprocal of focal length ie $P = \frac{1}{f}$.
Its SI unit is dioptre (D).
- 4) In case of a biconvex lens of equal radii of curvature the focal length is given by;

$$f = \frac{R}{2(\mu-1)}$$

- 5) In case of a planoconvex lens, where one surface is plane (ie $R_1 = \infty$), the focal length is given by;

$$f = \frac{R}{(\mu-1)}$$

- 6) If a lens of focal length f is immersed in water of RI $4/3$ then the focal length of the lens in water is 4 times the focal length of the lens in air ie;

$$f_w = 4f_a$$

- 7) Silvering of a lens :- When one surface of a lens is silvered it behaves like a mirror.

The focal length is given by;

$$\frac{1}{b} = \frac{2}{b_1} + \frac{1}{b_m}$$

where b_1 is the focal length of the lens through which refraction takes place

b_m is the focal length of the mirror through which reflection takes place.

- 5) When two thin lenses are in contact, the effective focal length is given by;

$$\frac{1}{b} = \frac{1}{b_1} + \frac{1}{b_2}$$