UNIT 12

GEOMETRICAL OPTICS

After studying this unit, the students will be able to:

a. Describe the terms used in reflection and state laws of reflection. Including normal, angle of incidence, angle of
b. Solve problems of image location by spherical mirrors by using mirror formula.

c. Define the terminology for the angle of incidence i and angle of refraction r and describe the passage of light through parallel-sided transparent material.
d. Solve problems by using the equation sin i/ sin r= n (refractive index).
e. State the conditions for total internal reflection.
f. Describe the passage of light through a class prism.
g. Describe how total internal reflection is used in light propagation through optical fibres.
h. Describe how light is refracted through lenses.
i. Define power of a lens and its unit.
j. Solve problems of image location by lenses using lens formula.
k. Define the terms resolving power and magnifying power.
l. Draw ray diagram of simple microscope and mention its magnifying power.
m. Draw ray diagram of compound microscope and mention its magnifying power.
n. Draw ray diagram of a telescope and mention its magnifying power.
o. Dray ray diagrams to show the formation of images in the normal eye, a short-sighted eye and a long-sighted eye.
p. Describe the correction of short-sightedness and long-sightedness.

Q.1 What do you mean by reflection of light? Describe the laws and types of motion?

Answer

Reflection of light: (Definition)

When light travelling in a certain medium falls on the surface of another medium, a part of it turns back in the turns back in the same medium. This is called reflection of light.

shown in fig. (12.1).

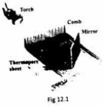

Torch
Comb
Mirror
Thermopore sheet

Fig 12.1

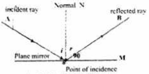

incident ray
A
Normal N
reflected ray
B
i
r
90
Plane mirror
M
Point of incidence

Fig. 12.2: Reflection of light

Activity

Spread a dark colored sheet of paper between the mirror and the comb as

Keep this apparatus in sunlight or send a beam of light from a torch through the comb.

The pattern formed in this activity gives us an idea of a process in which light gets deflected from a mirror. This' process is called reflection of light.

Laws of reflection

i) The incident ray, the normal and the reflected ray at the point of incidence, all lie in the same plane.

ii) The angle of incidence is equal to be angle of reflection i.e. i = r

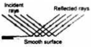

Incident rays
Reflected rays
Smooth surface

Fig. 12.3: Regular reflection

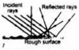

Incident rays
Reflected rays
Rough surface

Fig. 12.4: Irregular reflection

Types of reflection

a) Regular reflection

The reflection of light rays from the smooth surfaces (silver, mirror etc.) is called regular reflection.

b) Irregular reflection

Most of the objects in everyday world are not smooth on the microscopic level. The rough surfaces of these objects reflect the rays of light in many directions. Such a type of reflection is called irregular reflection.

Q.2. What are the spherical mirrors? Write its types and different terms related to spherical mirrors?

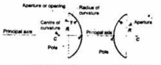
Answer

Spherical mirror

A mirror who's polished, reflecting surface is a part of a hollow sphere of glass or plastic is called a spherical mirror.

In a spherical mirror one of the two curved surfaces is called with a thin, layer of silver followed by a coating of red lead oxide paint. Thus, one side of the spherical mirror is opaque and the other side is a highly polished reflecting

Do you know?


Aperture or opening
Radius of curvature
Centre of curvature
R
Principal axis
C
Pole
F
Principal axis
Aperture
R
C
Pole

(a) Concave mirror (b) Convex mirror
Fig. 12.5: Types of spherical mirrors

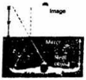


Image
Mirror
Small Object

The image you see in a flat mirror is at the same distance behind the mirror as you are in front of it.

surface. There are two types of spherical mirrors.

In this picture you can see clearly the image of a lion formed inside the pond water. Can you tell which phenomenon of physics is involved here ?

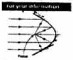
Concave mirror

"A spherical mirror whose inner curved surface is reflecting is called concave mirror."

1) In concave mirror the size of the image depends upon the position of the object.

2) Both virtual and real images can be formed by concave mirror.

For your information



Parabolic mirror used in head lights.

Convex mirror

"A spherical mirror whose outer curved Surface is reflecting is called convex mirror."

I) In convex mirror the size of the image is always smaller than the object.

2) Only virtual and erect image is formed by a convex mirror.

Different terms related to spherical mirrors

1) Pole

It is the midpoint of the curved surface of spherical mirror.

It is also called vertex.

2) Centre of curvature (c)

A spherical mirror is a part of a sphere. The centre of this sphere is called centre of curvature.

3) Radius of curvature (R)

It is the radius of the sphere of which spherical mirror is a part.

4) Principal axis

It is the line joining centre of curvature and pole of the spherical mirror.

5) The principal focus (F)

After reflection from a concave mirror, rays of light parallel to the principal Axis" converge to a point 'F'. This point is called 'the principal focus", of the mirror.

1) In case of convex mirror, parallel rays are converged at the principal focus.

2) In case of concave mirror, parallel rays appear to diverge from the principal focus.

6) Focal length (f)

It is the distance from the pole to the principal focus. The focal length is related to the radius of curvature by, f= R/2.

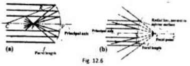
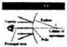

(a)
Principal axis
Focal length
(b)
Principal axis
Radial line, normal to mirror surface
Focal point
Focal length

Fig 12.6

Q.3. Describe the characteristics of focus of a concave and convex mirror.

How reflection of light takes place in spherical mirrors?

A well polished spoon acts as convex (right) and concave (left) mirrors


Viewer
Radius
Centre of sphere
Pole
Principal axis

For convex mirror focus and centre of curvature are behind the mirror

Answer

Characteristics of focus of spherical mirror

a) Convex mirror

1) The focus lies behind the mirror.

2) The focus is virtual as the rays of light after reflection appear to come from the focus.

b) Concave mirror

1) The focus is in front of the mirror.

2) The focus is real as the rays of light after reflection converge at the focus.

Reflection of light by spherical mirrors

Like plane surface spherical surfaces also reflect light following the two laws of reflection.

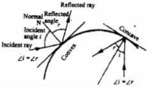

Reflected ray
Normal N
Reflected angle r
Incident angle i
Incident ray
∠i = ∠r
Convex
Concave
∠i = ∠r

Fig.12.7: Reflection of light by spherical mirror

Activity

Take a convex mirror or a well-polished spoon (using the outside of the spoon, with the convex surface bulging outward), and hold it in one hand, Hold a pencil with its tip in the upright position in the other hand. When we look at its image in the mirror, it seems to be erect, virtual and smaller.

Q.4. What is spherical mirror formula? How can we fine the location of an image by using sign conventions?

Answer

Spherical mirror formula

Mirror formula is the relationship between object distance 'p', image distance 'q' from the mirror and focal length 'F of the mirror.

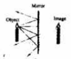
Thus we can write mirror formula as:

$1/f = 1/p \ 1/q$

> **For your information**
> The focal length of a spherical mirror is one-half of the radius of curvature i.e. $f = R/2$. However, we take the focal length of a convex mirror as negative. It is because the rays appear to come from the focal point behind the mirror. Therefore, for convex mirror $f = -R/2$.

The above equation is true for both concave and convex mirrors. However, following sign conventions should be followed to apply this equation for solving problems related to mirrors.

Ray diagram for the virtual image formation In a plane mirror


Mirror
Object
Image

Ray diagram for the virtual image formation in a plane mirror

Quantity	When positive (+)	When negative(-)
Object distance 'p'	Real object	Virtual object
Image distance 'q'	Real image	Virtual image
Facal length 'f'	Concave mirror	Convex mirror

Activity

Take a concave mirror or a well-polished spoon (using inside of the spoon with concave surface bulging inward). Hold it in hand towards a distant object, such as the sun, a building, a tree or a pole. Try to get a sharp, well focused image of the distant object on the wall or a screen. Measure the distance of the screen from the mirror using a meter scale. By applying the spherical mirror formula and by putting distance of object and distance of image from 'the mirror, we can find length of the concave mirror.

Q.5. Explain the phenomenon of refraction of light? What is the effect of medium on speed of light? Write the formula of refractive index?

Answer

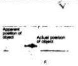
Refraction of light (definition)

The process of bending of light as it passes from air into glass and vice versa is called refraction of light.

Explanation

If we dip one end of a pencil or some other object into water at an angle to the surface, the submerged part looks bent as shown in fig. 12.8. Its image is 'displaced because the light

Point to ponder


Apparent position of object
Actual position of object

Why the position of [illegible] inside the water seems to be at [illegible] depth [illegible] actual position?

coming from the underwater portion of the object changes direction as it leaves the water. This bending of light as it passes from one transparent medium into another is called refraction.

Fig 12.8: Bending of pencil in water due to refraction

Refraction of light can be explained with the help of figure 12.9.

A ray of light I₀' travelling from air falls on the surface of a glass block.

At the air glass interference, the ray of light 'i₀' changes direction and bends towards the normal and travels along the path 'OR' inside the glass block.

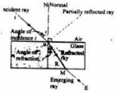
1) The rays 'i₀' and 'OR' are called the incident ray and the refracted ray respectively

2) The angle made by the incident ray with the normal is called angle of incidence.

3) The angle r made by the refracted ray with the normal is called angle of refraction.

Laws of refraction

1) The incident ray, the normal at the point of same plane.


ncident ray
N Normal
Partially reflected ray
i
Angle of incidence i
Air
Glass
O
Angle of refraction, r
Refracted ray
R
M
Emerging ray
E

2) The ratio of the sine of the angle of incidence I to the sine of angle of refraction r is always equal to the constant. i.e. sin i / sin r = constant.

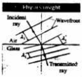
This constant is called the refractive index of the second medium, with respect to the first medium, so we have,

Refractive index 'n' of a medium is also the ratio of speed 'c' of light in a vacuum to the speed 'v' of light in the medium i.e..

Effect on speed of light in a medium

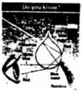
The speed of light in space is 3 x 10⁸' ms⁻¹, when it passes through glass (medium) its speed decreases, i.e. 2 x 10⁸ ms⁻¹. The speed of light in water i's approximately 2.3 x 10⁸ ms⁻¹.

Physics insight


Incident ray
Wavefront
Air
Glass
Transmitted ray

In refraction, the speed of light changes due to change in the wavelength. But, frequency and hence the colour of light does not change.

Do you know?


Red
Blue
Rainbow

Dispersion of light is due to the variation in refractive index with the colour. Dispersion in drops of water separates the colors of sunlight into a rainbow.

Q 4 What is total internal reflection? Define the critical angle?

Answer

Total internal reflection

When a wave enters from denser medium to rare medium it bends at some certain angle in the rare medium. But if the angle pf incidence in the denser medium is such that the wave instead of bending into the rare medium,

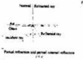

Normal
Refracted ray
Air
Glass
Incident ray
Reflected ray
Partial refraction and partial internal reflection

Fig. 12.10 (a)

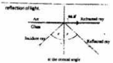

reflection of light.
90.0°
Air
Glass
Refracted ray
Incident ray
Reflected ray
at the critical angle

Fig. 12.10 (b): Condition for total internal reflection

bounces back (reflected) in the same 'denser medium, then this phenomenon is called total internal reflection."

Critical angle

"The angle of incidence in the denser medium by which the angle of refraction in the rare medium becomes 90° is called critical angle."

If the incident angle become greater than the critical angle, the wave (ray) will reflect back in the same denser medium showing total internal reflection.

Q.7 Write about the refraction through prism?

Answer

Prism in a transparent body (made of optical glass) with at least two polished plane faces inclined towards each other from which light is refracted.

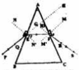

A
B
C
N
N'
M
M'
G
Q
E
F
P
S
R

Fig.12.11: Refraction through a triangular glass prism

Refraction through prism

In case of triangular prism, the emergent ray is net parallel to the incident ray. It is deviated from the prism from its original path.

The incident ray PE makes an angle of incidence i at point E and is refracted towards the normal 'N' as EF. According to the law of refraction.

When light passes through prism it deviates from its original path due to refraction

The refracted ray EF makes an angle r inside the prism and travels to the other end of the prism. This ray emerges out from prism at point F making an angle S '.

Hence the emerging ray FS is not parallel to the incident ray EF but is deviated by an angle D' which is called "angle of deviation".

Q8. What are lenses? Write their types and terminology used?

Answer

Lenses

"A lens is any transparent material having two surfaces of which at least one is curved."

Lenses refract light in such a way that an image of the objects is formed.

Lenses of many different types are used in optical devices cameras, eye glasses, microscopes, telescopes and projectors.

Types of lenses

1) Convex lens

The lens which causes incident parallel rays to converge (focus) at a point is known as "Convex of converging lens."

This lens is thick at the centre but thin at the edges.

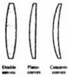

Double convex
Plano-convex
Concavo-convex

Fig.12.12: Convex lenses

2) Concave lens

The lens which causes diverge from a point is lens." incident parallel rays of light to known as concave or diverging

This lens is thin at the cent and thick at the edges.

Lens Terminology

1) Principal axi

Each of the two surfaces of a spherical lenses is a section of a sphere. The line passing through the two centres of curvature of the lens in called "principal axis."

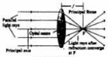

f
Principal focus
Parallel light rays
Optical centre
Principal axis
F
Light rays after refraction converge at F

Fig. 12.14: Convex lens

2) Optical centre (c)

A point on the principal axis at the centre of lens is called optical centre.

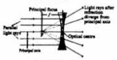

Principal focus
f
Parallel light rays
Principal axis
F
Light rays after refraction diverge from principal axis
Optical centre

Fig. 12.15: Concave lens

3) Principal focus (F)

The light rays travelling parallel to. The principal axis of a convex lens after refraction meet at a paint on the principal axis called principal focus, or focal point (F).

For concave lens, the parallel rays appear to come from a point behind the lens called principal focus (F).

4) Focal length (f)

This is the distance between the optical centre and the principal focus.

5) Power of a lens (P)

Power of a lens is defined as the reciprocal of its focal length in meters.

Thus:

Power of a lens = p = 1/focal length in meters.

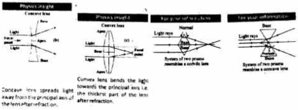
The unit of power of lens is "Diopter", denoted by symbol "D".

If P is expressed in meters so that 1 D = I m^{-1}

Thus, Diopter is the power of a lens whose focal length is 1 meter.

1) Power of convex lens is positive because its focal length is positive.

2) Power of concave lens is negative because its focal length is negative.


Physics insight
Concave lens
Light
Focal point
Apex
(b)
Light
Base
Physics insight
Convex lens
Apex
Light
Base
(a)
Focal point
Light
Apex
Normal
Light rays
Base
Base
System of two prisms resembles a convex lens
For your information
Base
Light rays
Base
System of two prisms resembles a concave lens

Concave lens spreads light away from the principal axis of the lens after refraction.

Convex lens bends the light towards the principal axis i.e. the thickest part of the lens after refraction.

Q.9. How images are formed in lenses through refraction? Explain with the help of ray diagrams of lenses?

Answer

Lenses form images through refraction. This is explained with the help of ray diagrams as follows:

Ray diagram of lenses

Image formation in convex lens can be explained with the help of three principal rays shown in fig. 12.17.

1) The rays parallel to the principal axis passes through the focal point after refraction by the lens.

2) The ray passing through the optical centre passes straight through the lens and passes underrated.

3) The ray passing through the focal point becomes parallel to the principal axis after refraction by the lens.

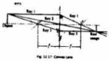

lens
Ray 1
Ray 2
Ray 3
Object
Real image
f
f

Fig. 12.17 Convex Lens

The ray diagram for concave lens is shown in Fig. 12.18.

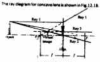
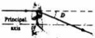

Ray 1
Ray 2
Ray 3
Object
Virtual image
f
f

Fig. 12.18 Concave Lens

Lens


Principal axis
D
Optical centre

The refraction of light by the convex lens causes the ray to deviate from its original pat like in prism

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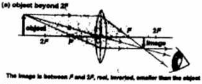
Image formation in convex lens

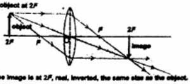
To explain image formation with ray diagrams for objects placed at different positions from a convex lens, we have the following figures.

(a) object beyond 2F


object
2F
F
F
2F
image

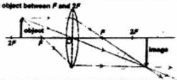
The image is between F and 2F, real, inverted, smaller than the object

(b) object at 2F


object
2F
F
F
2F
image

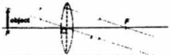
The image is at 2F, real, inverted, the same size as the object.

(c) object between F and 2F


object
2F
F
F
2F
image

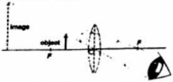
The image is beyond 2F, real, inverted larger than the object.

(d)object at F



No image is formed because the refracted rays are parallel and never meet.

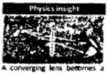
(e) object between lens and F


F
image
object
F
F

The image is behind the object, virtual, erect, larger than the object.

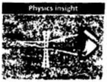
Fig. 12.19

Physics insight



A converging lens becomes a magnifying glass when an object is located inside the lens's focal length.

Physics insight



A diverging lens always has the same ray diagram, which forms a smaller image.

Mirror Application

Concentrated solar power (CSP) systems use lenses or mirrors to focus a large area of sunlight into a small beam. This solar power can be used to heat water that can run turbine to produce electricity.

For your information

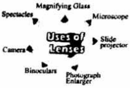
You can compare lenses simply by looking at them.

- A lens with a long focal length is thin; its surfaces are not very strongly curved.
- A lens with a short focal length is fatter; its surfaces are more strongly curved

Q.10. How can the location of an image be found by using lens equations?

Answer

In fig. 12.20, let an object 'OP' is placed in front of a convex lens at a distance 'P'. A ray 'PR' parallel to the principal axis after refraction passes through focus F'. Another ray 'PC' meets the first ray at point 'P' after passing through the optical centre 'C'. If this process is repeated for the other points of the object, a real and inverted image 'OP' is formed at a distance 'q' from the lens. Size of image formed in a lens for particular distance, nature of image, whether the image is real or imaginary, erect or inverted all these can be found by using lens formula lens.


Magnifying Glass
Spectacles
Microscope
Uses of Lenses
Camera
Slide projector
Binoculars
Photograph Enlarger

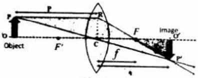

P
P
R
O
Object
F'
C
F
f
Image
O'
P'
q

Fig.12.20

Lens formula

The relationship between the object and, image distance from the lens in terms of the focal length of the lens is called lens formula and is given by:

1/f = 1/p 1/q

The above equation is valid for both concave and convex lenses.

Sign conventions for lenses

1) Focal lengths

a) 'f' is positive for a converging (convex) lens.

b) 'f' is negative for a diverging (concave) lens.

2) Object distance

a) 'P' is positive, if the object is towards the left side of the lens.

b) 'P' is negative, if the object is on the right side of the lens. It is called virtual object.

3) Image distance

a) 'q' is positive for a real image made on the right side of the lens by a real object.

b) 'q' is negative for a virtual image made on the left side of the lens by a real object.

Q.11 Write the use of lens in a camera and slide projector?

Answer

Camera

A simple camera consists of a light proof box with a converging lens in front and a light sensitive plate or film at the back.

The lens focuses images to be photographed onto the film. In simple lens camera, the distance between lens and film is fixed which is equal to the focal length of the lens. In camera, object is placed beyond '2F:

A real, inverted and diminished image iS formed in this way as shown in fig.

12.21.

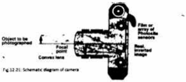

Object to be photographed
Focal point
Convex lens
Film or array of Photocells sensors
Real, inverted image

Fig.12.21: Schematic diagram of camera

Slide projector

Fig. 12.22 shows how a slide or movie projector works. The light source is placed at the centre of curvature of a concave mirror. The concave mirror is used to reflect light back in fairly parallel rays. The condenser is made up of 2 converging lenses, that refract light so all parts of the slide are illuminated with parallel rays.

The projection or converging lens provides a real, large and inverted image. It must be real to be projected on a screen. The slide (object) must be placed between Y and because 2F' of projection lens so as to produce the image is inverted, the slide must be a real, large, and inverted image, placed upside down and laterally inverted so we can see the image properly.

Q. How lenses are used in a photograph enlarger? What is reflecting?

Answer

Photograph Enlarger

In the case of photograph enlarges object is placed at distance more than 'F' but less than '2F': in this way we get a real, inverted and enlarged image as shown in fig.

12.23.

The working principal of photograph enlarger is basically the same as that of a slide projector. It uses a convex lens to produce a real, magnified and inverted image of the film on photographic paper.

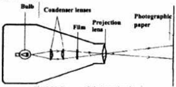

Bulb
Condenser lenses
Film
Projection lens
Photographic paper

Fig.12.23: Diagram of photograph enlarger

Totally reflecting prism

Many optical instruments use right angled prisms to reflect a beam of light through 90° or 180° (by total internal reflection) such as cameras, binoculars, periscope and telescope.

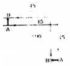

45
B
A
45
90
45
B
A

Fig. 12.24: Total internal reflection through right angled prism

One of the angles of a right-angled prism is 90°, when a ray of light strikes a face of prism perpendicularly, it enters the prism without deviation and strikes the hypotenuses at an angle of 45°. Since the angle of incidence 45° is greater than critical angle 45° the light is totally reflected by the prism through an angle of 90°.

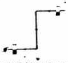


Fig. 12.25: Prism periscope

Two such prisms are used in periscope as shown in fig. 12.25. In fig. 12.26, the light is totally reflected by the prism by an angle of 180°. Two such prisms are used in binoculars.

Q13. Write in detail about optical fibres and its uses?

Answers

Optical fibres

Total internal reflection is used in fibre optics which has number of advantages in telecommunicate ion field.

Fibre optics consists of hair size threads of glass or plastic through which light can travel as shown in figure. 12.28

The inner part of the fibre optics is called core that carries the light and an outer concentric shell is called cladding. The core is made from glass or plastic of relatively large (high) index of refraction.

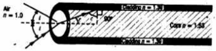

Air
n = 1.0
90°
Cladding
Core n = 1.53
Cladding

Fig.12.28: Passage of light through optical fibre

The cladding is made of glass or plastic of relatively low refractive index.' Light entering from one end of the core strikes the core/cladding boundary at an angle of incidence greater than critical angle and is reflected back into the core.

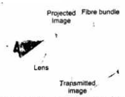
In this way, light travels many kilometers with small loss of energy.

In Pakistan, optical fibre is being used in telephone and advanced telecommunication systems. Now. We can listen thousands of phone calls without any disturbance.

Light pipe

Light pipe is a bundle of thousands of optical fibres bounded together. They are used to illuminate the inaccessible places by-the doctors or engineers.

For example, doctors view inside the human body. They can also be used to transmit images from one place to another.


Projected Image
Fibre bundle
Lens
Transmitted image

: .2 29: A lens and light pipe can be used together to produce a

Endoscope

An endoscope is a medical instrument used of exploratory diagnostics, and surgical purposes. An endoscope is used to explore the interior organs of the body. Due to its small size. It can be inserted through the mouth and thus eliminates the invasive surgery.

The endoscope to diagnose the stomach, bladder and throat are called "Gastroscope, cystoscope and Bronchoscope respectively.

An endoscope uses two fibre-optic tubes through a pipe. A medical procedure using any type of endoscope is called "endoscopy".

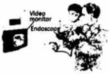

Video monitor
Endoscope

Fig. 12.30: Doctors are investigating a patient with endoscope.

The light shines on the organ of patient to be diagnosed entering through one of the fibre tubes of the endoscope. Then light is transmitted back to the physician's viewing lens through the other fibre tube by total internal reflection.

Flexible endoscopes have a tiny camera attached to the end. Doctor can see the view recorded by the camera is displayed on a computer screen.

Q14. Write the construction and working of simple microscope.

Answer

Simple microscope (construction)

A magnifying glass is a convex lens which is used to produce magnified images of small objects. Hence it is also called simple microscope.

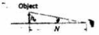


Fig. 12.31 (a)

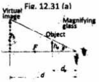

Virtual image
Magnifying glass
Object
F
h_o
d_o
d

Fig. 12.31 (b) Image formation in magnifying glass

The object is placed nearer to the lens then the principal focus such that an upright, virtual and magnified image is seen clearly at 25 cm from the normal eye.

Working

1. Magnifying power

Let '8' is the angle subtended at the eye by the object when it is placed at the near distance from eye as shown is fig. 12.31.

Let 'θ' is the angle subtended by the final image at the eye when the object is placed close to the eye at a distance less than 'F. The angular magnification (or magnifying power) M is the angular sixe 'θ' of the final image produced by the

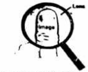
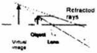


Image in a magnifying glass

Ray diagram


Refracted rays
Object
Virtual image
Lens

Magnifying glass is a lens that forms a virtual image that is larger than object and appears behind the lens.

$$M = \frac{\text{Angular size of final image produced by magnifying glass}}{\text{Angular size of object seen without magnifying glass}}$$

i.e., $M = \theta'/\theta$

magnifying glass divided by an angular size 'B' of the object seen without the magnifying glass.

Fig. 12.31 (b) indicates that the lens produces virtual image which is enlarged and upright with respect to the object. If 'd' is the near distance of the object from eye which is usually equal to 25 cm, then magnifying power becomes,

$$M = (\frac{d}{f} + 1)$$

2) Resolving Power

The resolving power of an instrument is its ability to distinguish between to closely spaced objects or point sources.

In order to see objects that are close together, we use an instrument of high resolving power.

For example, we use high resolving power microscope to see tiny organisms and telescope to view distant stars.

Q9. What is 'the construction of compound microscope? Write about its magnification and uses?

Answer

Compound microscope (construction)

Compound microscope has two converging sets of lenses, the objective and the eye-piece and is used to investigate structure of small objects as shown in the fig. 12.22.

Following are some features of compound microscope:

1) It gives greater magnification than a single lens.

2) The objective lens has a short focal length, $f_0 < 1$ cm.

3) The eye-piece has a focal length, f_0 of a few cm.

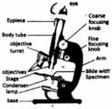

eye
Eypiece
Body tube
objective turret
objectives
Stage
Condenser
lamp
base
Coarse focusing knob
Fine focusing knob
Arm
Slide with Specimen

Fig.12.32. Compound microscope

Magnification of the compound microscope

Magnification can be determined through the ray diagram as shown in fig. 12.33. Objective forms a small image Ii ', inside the focal point of eye-piece.

This image acts as an object for the eye-piece and the final larger image I,', is from outside the focal point of the objective.

The magnification of compound microscope is given by:

$M = L/f_0$ (I + d/f,)

Where 'L' is the length of compound microscope which is equal to the distance between objective and eye-piece, d is near distance of object from eye, f_0 and f_e are the focal length of object and eye-piece respectively.

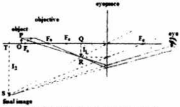

eyepiece
objective
object
P
F_o
F_e
Q
T
O
F_o
I_1
R
I_2
F_e
eye
S
final image

Fig. 12.33: Ray diagram for compound microscope

Uses of compound microscope

The compound microscope is used to study bacteria and other micro objects. It is also used for research in several fields of sciences like, Microbiology, Botany, Geology and

Genetics.

Q16 Write the construction and working Of telescope?

Answer

Telescope

Construction

Telescope is an optical instrument which is used to observe distant objects using lenses or mirrors. A telescope that uses two converging lenses is called "refracting telescope" as shown in figure 12.34. In refracting telescope an objective lens forms a real image of the distant object, while an eye piece forms a virtual image that is viewed by the eye.

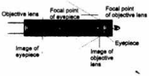

Objective lens
Focal point of eyepiece
Focal point of objective lens
Eyepiece
Image of eyepiece
Image of objective lens

Fig. 12.34: An astronomical refracting telescope creates a

Working of refracting telescope

The ray diagram of refracting telescope' is shown in fig. 12.35. When parallel rays from a point on a distant object pass through objective lens, a real image I', is formed at the focus Ft' of the objective lens. This image acts as an object for the

eye piece. A large virtual image I and I, is formed by the, eye piece at a large distance from the objective lens.

This virtual image makes an angle 'θ' at the eye-piece.

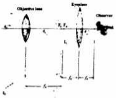

Objective lens
Eyepiece
Observer
F_o F_e
I_1
f_e
f_e
f_o

Fig 12.35: Ray diagram of refracting telescope

Magnification n of telescope

Magnification of a refracting telescope can figure 12.35 and is given by:

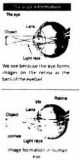
$M = f_O/f_e$

Q17. How image is formed in the' human eye? What is human eye accommodation?

Answer

The human eye

The image formation in human eye is shown in fig. 12.36. Human eye acts like a camera. In place of the film, the retina records the picture. The eye has a refracting system containing a converging lens. The lens forms an image on the retina which is a light sensitive layer at the back of the eye. In the camera. The distance of lens from films is adjusted for proper focus but in the eye, the lens changes focal length. Light enters the eye through a transparent membrane called the cornea.


The eye
Lens
Object
Light rays
We see because the eye forms images on the retina at the back of the eyeball
Retina
Iris
Lens
Object
cornea
Light rays
Image formation in human eye

This iris is the colored portion of the eye and controls the amount of light reaching the retina. It has an opening at its center called "pupil". The iris controls the size of the pupil.

In bright light, iris contracts the size of the pupil while in dim light pupil is enlarged. The lens of the eye is flexible and accommodates objects over a wide range of distance.

Accommodation

The camera focuses the image of an object at a given distance from it by moving the lens towards or away from the film.

The eye has different adjusting mechanism for focusing the image of an object onto the retina its ciliary muscles control the curvature and thus the focal length of the lens, and allow objects at various distances to be seen. If an object is far away from the eye. The deviation of light through the lens must be less. To do this, the ciliary muscles relax and decrease the curvature of the lens, thereby increasing the focal length. The rays are thus focused onto the retina producing a sharp image of the distant object. If an object is close to the eye, the cliary muscles increase curvature of the lens. Thereby shortening the local length.

The divergent rays Drum the nearer object are thus bent more so as to come to a focus on the retina as shown in fig. 12. 37 (b).

This variation of local length of eye lens is called accommodation.

It is large in young people while it goes on decreasing with age.

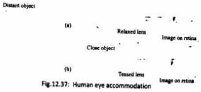

Distant object
(a)
Relaxed lens
Image on retina
Close object
(b)
Tensed lens
Image on retina

Fig.12.37: Human eye accommodation

Q18. Write about the defects of vision and their remedies?

Answer

Near point and far point

When we hold a book too close, the point is blurred because the lens cannot adjust enough to bring the book into focus. The near point of the eye is the minimum distance of an object from the eye at which it produces a sharp image on the retina as shown in the figure 12.38. This distance is also called "the least distance of distinct vision." An object closer to the eye than the near point appears blurred. For people in their early twenties with normal vision, the near point is located about 25 cm from the eye. It increases to about 50 cm at the age of 40 years and to roughly 300 cm at the age of 60 years.

The far point of the eye is the maximum distance of a distant object from the eye on which the fully relaxed eye can focus. A person with normal eye sight can see object very far away, such as the planets and stars, and thus has a far point located at infinity.

Majority of people do not have "normal eyes" in this sense.

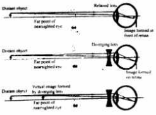

Distant object
Relaxed lens
Far point of nearsighted eye
Image formed at front of retina
Distant object
Diverging lens
Far point of nearsighted eye
Image formed on retina
Distant object
Virtual image formed by diverging lens
Far point of nearsighted eye

Fig. 12.39: Correction of near sightedness

Defects of vision

The inability of the eye to see the image of objects clearly is called defect of vision.

The defects of vision arise when the eye lens is unable to accommodate effectively.

The images formed are therefore blurred.

1) Near sightedness (myopia)

Some people cannot see distant objects clearly without the aid of spectacles. This defect of vision is called near-sightedness and it may due to the eye ball being too long.

Light rays from a distant object are focused in front of the retina and a blurred image is produced, as shown in the figure 12.39 (a).

The near sighted eye can be corrected with glass or contact lenses that use diverging lenses as shown in fig. 12.39 (b). Light rays from the distant object are now diverged by this lens before entering the eye.

To the observer, these light rays appear to come from far point and are therefore focused on the retina, thus forming a shape image as shown in fig. 12.39 (c).

Far sightedness (hypermetropia)

The disability of the eye to form distinct images of nearby objects on its retina is known as far sightedness. When a far sighted eye tries to focus on a book held closer than the near point, it shortens its focal length as much as it can.

However, even at its shortest, the focal length is longer than it should be. Therefore the light rays from the book would form a sharp image behind the retina as show in fig.12.40 (a).

The lens refracts the light rays and they converge to form an image on the retina.

To an observer, these rays appear to come from near point to form a sharp virtual image on the retina as shown in the figure 12.40 (c).

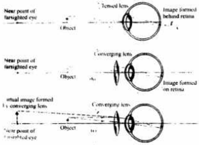

Near point of farsighted eye
Object
Tensed lens
Image formed behind retina
Near point of farsighted eye
Object
Converging lens
Image formed on retina
irtual image formed by converging lens
Converging lens
Object
Near point of farsighted eye

Fig. 12.40: Correction of farsightedness

MULTIPLE CHOICE QUESTIONS

Choose the correct answer from the following choices:

i)Which of the following g quantities is not changed during refraction of light?

a) its direction

b) its speed

c) its frequency

d) its wavelength

ii)A converging mirror with a radius of 20 cm creates a real image 30 cm from the mirror. What is the object distance?

a)5 0 cm

b)-7.5 cm

c)15 cm

d)20 cm

iii)An object is pieced at the center of curvature of a concave mirror. This image produced by the mirror is located:

a) beyond the center of curvature

b) at the center of curvature

c) between the center of curvature and the focal point

d) at the focal point

iv)An object is14 cm in front of a convex mirror. The image is 5.8 cm behind the mirror. What is the focal length of the mirror?

a)4.1 cm

b)8.2 cm

c)9.9cm

d)20 cm

v)The index of refraction depends upon:

a) the focal length

b) the speed of light

c) the image distance

d) the object distance

vi)Which type of image is formed by a concave lens on a screen?

a) inverted and real

b) inverted and virtual

c) upright and real

d) upright and virtual

vii)Which type of image is produced by the converging lens of human eye if it views a distant object?

A) real, erect, same size

c)Virtual. Erect, diminished

b) real, inverted, diminished

d) Virtual. in verted, magnified

viii) Image formed on a camera is:

a) real, inverted, and diminished

c) virtual. Upright and magnified

b) virtual, upright and diminished

d) real, inverted and magnified

ix)If a ray of light in glass is incident on an air surface at an angle greater than the critical angle, the ray will:

a) refract only

b) reflect only

c) partially refract and partially reflect

d)diffract only

x) If array of light in glass is incident on an air surface at an angle greater than the critical angle, the ray will:

a) be absorbed

b) totally reflected

c) partially reflected and partially transmitted

d) totally transmitted

ANSWERS

i)	C) its frequency
ii)	C) 15 cm
iii)	B) centre of curvature
iv)	C) 9.9 cm
v)	B) the speed of light
vi)	D) upright and virtual
vii)	B) real, inverted, diminished
viii)	A) real, inverted, diminished
ix)	B) reflect only
x)	B) totally reflected

REVIEW QUESTIONS

12.2 Describe the following terms used in reflection?

a) Normal b) angle of incidence c) angle of reflection

Answer:

i) Normal

An imaginary line perpendicular to the reflecting surface (on which the ray of light in incident) is called normal.

ii) Angle of incidence

The angle made by the incident ray of light with the normal is called angle of incidence.

iii) Angle of reflection

The angle of made by the reflected ray of light with the normal is called angle of reflection.

12.9 State the conditions for total internal reflection?

Answer

I) The ray of light should be incident Iron› denser medium› to rare medium.

2) The angle of incidence should be greater than the critical angle.

12.10 What is critical angle? Derive a relationship between the critical angle and the refractive index of a substance?

Answer

Critical angle

When a ray of light in the denser medium moves toward a rare medium then the angle of incidence at which light instead of refracting into rare medium comes across the media making an angle of refraction of 90° with the normal is called critical angle.

Relation between 'θ' and 'n'

According to snell's law, $n_1\sin\theta_1 = n_2\sin\theta_2$

If, $\theta_1 = \theta_c,\quad \theta_2 = 90^\circ$

$$n_1\sin\theta_1 = n_2 \qquad \therefore (\sin 90^\circ = 1)$$

$$\boxed{\sin\theta_1 = n_2/n_1}$$

12.16 A coin is placed at a focal point of a converging lens. Is an image formed? What its nature?

Answer

[redacted]

Yes, an image will be donned away from the focal point which will be real inverted and magnified.

12.17 What are the differences between real and virtual images?

Answer

Real image

The image formed on the screen at the other side of the lens is called real image. (I is obtained by joining the real rays of light.

Virtual image

The image formed on the same side where objected is placed is called virtual image. It is obtained by extending the real rays behind called imaginary rays. So virtual image is formed fry joining such imaginary lines.

12.20 i) Describe the passage of light through a glass prism?

ii) Measure the angle of deviation?

Answer

i) Please see the topic.

ii › for the measurement of angle of deviation, we apply the following formula.

$$n = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Where n is the refractive index of glass medium, 'A' is the angle of prism and 'Dm' is the angle of deviation.

Secondly, angle of deviation can also be measured graphically through diagram.

CONCEPTUAL QUESTIONS

12.1 A man raises hit left hand in a plane mirror, the image facing him is raising his right hand. Explain why.

Answer

In case of plane mirror, virtual & opposite image is formed due to which left hand of the man is seemed to be right hand in the mirror.

12.2 1n your own words, explain why light caves are refracted at a boundary between two materials.

Answer

When a ray of light enters from rare medium to denser medium its speed and wave length arc decreased while frequency remains the same. Due to this fact light bends while entering from one medium (rare) to another medium (denser).

12.3 Explain why a fish under water appears to be are different depth below the surface than it actually is. Does it appear deeper or shallower?

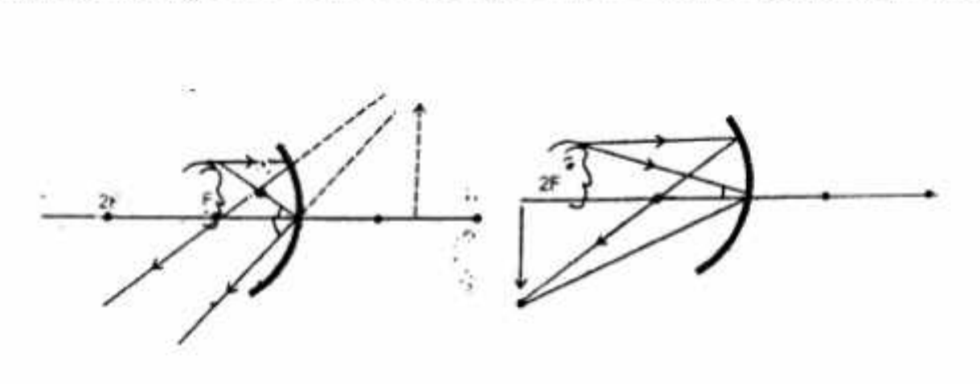
Answer

The is due to the refraction of the light by which apparent depth of the fish is seen at some angle outside the water. The fish appears shallower as compared to its actual position or location.

12.4 Why or why not concave mirrors are suitable for make up?

Answer

If the face of the person is in the range of focal length of concave mirror. its image formed is virtual, erect and magnified but as we move away from the focal point. The image becomes real but inverted and magnified as shown below.



12.5 Why is the driver's side mirror in many cars convex rather than plane or concave?

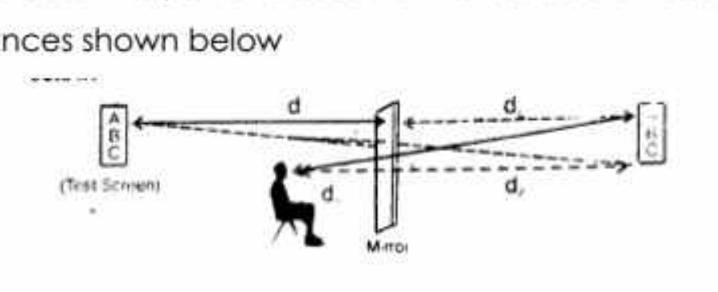
Answer

It is better to use concave mirrors to view properly the far sight cars coming behind. In this case the rays coming from those cars or objects diverge and make an erect and virtual image.

12.6 When an optician's testing road is small, he uses mirror to help him test the eye sight of his patients. Explain why.

Answer

In this case the patients observe the test screen double that of its actual distances shown below



So total distance of test screen as observed by the patient will be ....

12.7 How docs the thickness of lens effects its focal length?

Answer

Thick lens has short focal length while thin lens has large local length.

12.8 Under what conditions will a converging lens form a virtual image?

Answer

If the object lies within the range of focal length of converging lens then the .... Formed will be virtual. Erect and magnified.

12.9 Under what conditions s ill a converging lens form a real image that is the same size as the object?

Answer

When the object is placed at 2F from a converging lens then its real, inverted but same sized image is formed.

12.10 Why do we use refracting telescope with large objective lens of large focal length?

Answer

In case of telescope, large objective lens is used to collect maximum rays of light coming from far sight objects and the focal length of such objective lens is also kept large to focus all the rays received at a common focal point of objective lens and eye-piece. That is why a refracting telescope having large objective lens of large focal length is commonly used to view distant objects.

OBJECTIVE TYPE QUESTIONS & ANSWERS

Q.2 Give short Answers.

1. What is light?

Answer

Light is a form of energy, which enables us to see various objects and their colours. It is a kind of radiation to which our eyes are sensitive.

2. What 1st the nature of light?

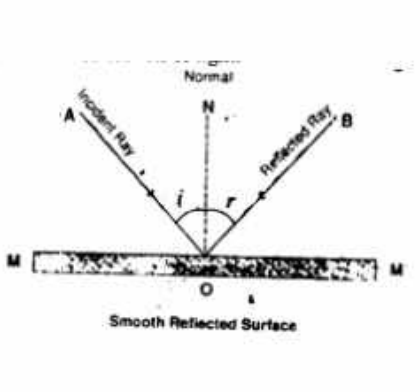
Answer

The light possesses dual nature. It means that, in some crises it behaves as particle, but in some cases as wave.

3. What is reflection of light?

Answer

When a beam of light travelling in a straight line in homogenous medium falls on the boundary of another medium, then a part of it bounces back from there, this bouncing back of the light is called the reflection of light.



4. On what factors the amount of light reflected from the surface of another medium depends?

Answer

The amount of light reflected from the surface of another medium depends upon:

- Nature of the medium
- Smoothness of the medium

5. State laws of reflection.

Answer

There are two laws (of reflection:

- Angle of incidence is equal to the angle of reflection i.e. < i < r.
- The incident ray, the normal at the point of incidence and reflected ray all lie in the same plane.

6. Differentiate between real and virtual image?

Answer

Real image	Virtual image
• Recall image is formed in front of the mirror when rays of light coming from a point on object converge after • Reflection from the mirror.	• Virtual image is formed behind the mirror when ray of light coming from a point on subject diverge after • Reflection from a mirror.
• It can be observed on the screen.	• It cannot be observed on the screen.
• It is always inverted.	• It is always erect.

7. What are spherical mirrors?

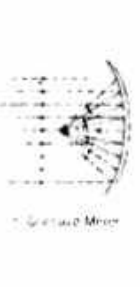
Answer

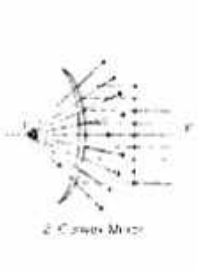
A part of spherical reflecting surface is called spherical mirror.

8. Distinguish between concave and convex mirror.

Answer

- If the inner surface of the spherical mirror is reflecting, then it is called a concave mirror.
- If the outer surface of a spherical mirror is reflecting, then it is called a convex mirror.


1. Concave Mirror


2. Convex Mirror

9. Explain how a convex lens is used a magnifier.

Answer

A convex lens of short focal length can be used as magnifier when object is placed very close to it when the object is in between the lens and its focus. The image is then formed is virtual, erect and magnified.

10. Differentiate between center of curvature and radius of curvature of a mirror.

Answer

The center of the hollow sphere of which mirror is a par is called its center of the curvature.

The radius of the hollow sphere which is mirror is a part called its radius of the curvature.

11. Define pole and aperture.

Answer

Pole

The central point of a mirror is called its pole

Aperture

The diameter of a circular outline c of a spherical edge or boundary of a spherical mirror is called aperture.

12. Define principal focus in terms of:

i) Concave mirror 2) Convex mirror

Answer

- The point where rays of light parallel to the principal axis converge after reflection from concave mirror is called its principal focus.

- The point from where rays of light seem to come after reflection if they are parallel to the principal axis initially is called its principal focus.

13. What is focal length of a mirror?

Answer

The distance between principal focus and pole of the mirror is called its local length.

- Focal length of concave e mirror is positive.
- Focal length of convex mirror is negative.

Focal length of a mirror is equal to the half of its radius of curvature.

f=1/2 R

14. What is principal axis?

Answer

The line joining the pole of the mirror and center of curvature is called principal axis of the mirror.

15. Write the characteristics of image formed by a convex mirror.

Answer

- 'the image formed by convex mirror is always virtual.
- Distance of virtual image is taken as negative
- In this case, the values of f arid q arc taken as negative.

16. what is linear magnification?

Answer

The ratio of the height of the image to that of the object is called as linear magnification.

Magnification = image height/ object height

17. Write some uses of concave mirrors.

Answer

- Concave mirrors are used as shaving mirrors.
- Concave mirrors are used as magnifiers
- Concave mirror are used to throw light on the slides of microscope to view it more clearly.
- These mirrors are used in searchlights and head lights.
- These mirrors are also used fry doctors in their instruments for the examination of eye, nose, ears and throat.
- Some developed countries use giant concave mirrors in their huge telescopes.
- They are used in some optical instruments as an alternate to lens.

18. Find the power of 0.5 m of focal length?

Answer

Power of lens =1/ focal length

P = 1/f

P = 1/05 =2D

19. What sign connections of mirror formula are used?

Answer

The relation for the mirror formula

1/f = 1/p + 1/q

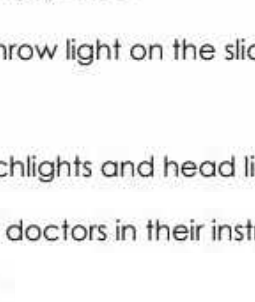
The following rules, known as sign of convection are used for this purpose.

- The distance of real objects and real images from the mirror are positive.
- The distance of virtual images from mirror are negative.
- Focal length of concave mirror is positive.
- Focal length of convex mirror is negative.

20. What is meant by refraction of light?

Answer

The bending of light when it enters from one medium to another is called refraction of light.



21. State the laws of refraction.

Answer

There are two laws of refraction of light.

- The incident ray, the refracted ray and the normal at the point of incidence all are in the same plane.

- The ratio of the sine of the angle of incidence to the sine of angle of retraction is constant for a given pair of media.

22. State Snell's law

Answer

The ration of the sine of the angle of incidence to the sine of angle of refraction is constant for a given pair of media. This is known as Snell's law and can be expressed as:

n= sin <I / sin <r

23. Define refractive index. Give its unit.

Answer

The ratio of the sine of the angle of incidence to the sine 'of angle 'of refraction is constant for a grin pair of media. This is known as Snell's law and can be expressed as:

n= sin <I / sin <r

Where n is a constant called the refractive index.

Since refractive index is a ratio, so it has no unit.

24. On what factors refractive index of the medium depends?

Answer

Refractive index is independent of the angle of incidence but depends upon the nature of the medium.

25. What is the relation between real and apparent depth?

Answer

The distance of object from the surface of water is real depth.

The distance of image from the surface of water is called apparent depth is

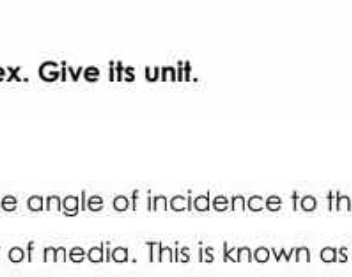
n=Real depth/ Apparent depth

where n is the reference index

26. What is meant by total internal reflection?

Answer

When a ray of light from denser medium enters a rare medium in such a way that the angle of incidence is greater than the critical angle, then the ray is reflected totally in side and does not emerge out from the dense medium. This phenomenon is called total internal refection.



27. What conditions are necessary for total internal reflection?

Answer

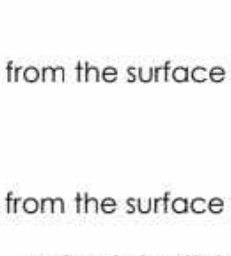
The following too conditions are necessary for the total internal reflection:

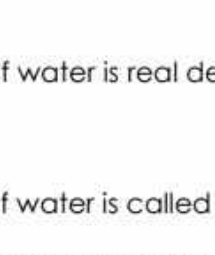
- The ray of light should travel from a denser to a rare medium.
- The angle of incidence should be greater than the critical angle.

28. Differentiate between convex and concave lens.

Answer

- The lens which is thicker in the middle and thinner at the edges, is called a convex lens.
- The lens which is thinner in the middle and thicker at the edges, is called a concave lens.


i. Convex lens


ii. Concave lens

29. Can power of lens be negative?

Answer

Yes, the power of the lens can be positive as well as negative

- It is positive for convex lens or converging lens.
- It is negative for the concave lens or diverging lens

30. What is critical angle?

Answer

When light enters from a denser medium to a rare medium then the angle of incidence whose angle of refraction becomes 900, is called critical angle.

31. Find the relation for the relation for the critical angle?

Answer

Let the refractive index of glass to air is n, as the light is entering from glass to air in this case. According to Snell's law,

$$\frac{1}{n} = \frac{\sin\angle i}{\sin\angle r}$$

$$n = \frac{\sin\angle i}{\sin\angle r}$$

in this case, $\angle r = 90^\circ$ and $\angle i = \angle C$, then we get

$$n = \frac{\sin 90^\circ}{\sin C}$$

$$n = \frac{1}{\sin C} \quad \text{or} \quad \sin C = \frac{1}{n}$$

32. On what factors does critical angle depend?

Answer

Critical angle depends upon the following two factors.

- Nature of two media
- Wavelength of light

33. Define the term lens and diopter.

Answer

Lens

A transparent refracting medium bounded by two surfaces, one of which is at least curved is called a lens.

Diopter

The unit of the power of lens is called 'diopter'. Power of a lens is said to be one diopter when local length of lens is one meter. It is expressed as

P=1/f

Where f is the focal length

34. Under what conditions does a convex lens act as a diverging lens'?

Answer

A convex lens acts as diverging lens under the following conditions:

- If the object lies between the focus and the optical center of convex lens.
- If the medium outside the lens is denser.

35. For glass-air boundary, find the value of critical angle?

Answer

When ray of light enters from the denser to rare medium, then

Refractive index of glass to air medium I.e. n=1.5

The relation for critical angle is

$$\sin \hat{C} = \frac{1}{n} = \frac{1}{1.5} = 0.66$$

$$\hat{C} = 41.8^\circ$$

Thus for glass-air boundary, the value of critical angle is 41.8^0

36. What is optical fibre?

Answer

An optical fibre is made of a highly transparent fine strand of glass or plastic coated with another type of glass whose refractive index is less than the inner tube. Usually the refractive index of inner tube is 1.52 and of outer coating is 1.48.

37. By what processes light propagates in an optical fibre should be totally confined within the fibre?

Answer

Light propagating in an optical fibre should be totally confined within the fibre. This can he made possible by:

- Total internal reflection
- Continuous refraction

38. Give some uses of optical fibre.

Answer

- Optical fibres are used to carry telephonic signals and modern communication systems using laser beams.
- Optical fibres are very light in weight more flexible and much cheaper than copper cables.
- The information capacity of light is thousands time greater than that of electricity or radio waves.

39. What is prism and angle of prism?

Answer

- Prism is transparent body having three rectangles and two triangular surfaces.
- Triangular surface opposite to its base is known as angle of prism.

40. What is angle of deviation?

Answer

The angle through which convergent ray has been deviated is called angle of deviation.

41. On what factors the value of angle of deviation depend?

Answer

The value of angle of deviation depends upon the following factors

- Angle of prism
- The refractive index of the material of prism
- The angle of incidence

42. What is minimum an angle of deviation?

Answer

When the angle of incidence is continuously increased from a small value. The angle of deviation first decreases reaches a minimum value and then starts increasing the minimum value of the angle of deviation is known as minimum angle of deviation.

43. What is dispersion of light?

Answer

The phenomenon of splitting of white light into its colours is called dispersion of light.

44. On what factor the refraction of light through prism depends.

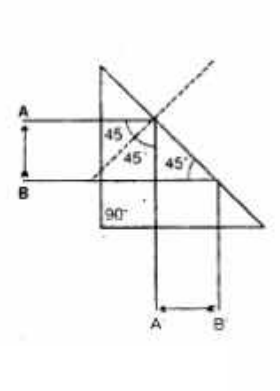
Answer

The refraction of light depends on the wavelength. Since the sunlight consists of different colours, the caves of different wavelengths are obtained.

Therefore, when light passes through a prism then the waves of' different wavelengths deviate on different paths due to dispersion of light.

45. What is totally reflecting prism?

Answer



A totally refraction prism is the one, which has one of its angles equal to 90° and each of the remaining two angles equal to 45'. In totally reflecting prism, the phenomenon of total internal reflection has been used.

46. Give some uses of totally reflecting prisms.

Answer

Totally reflecting prisms is used in:

- The periscope
- Binocular
- Projectors

47. What is endoscope?

Answer

Endoscope is an instrument, which is used for viewing and photographing internal organs of human body, by using light pipes.

48. Describe the types of endoscope.

Answer

Endoscope are of many types, which are based on the nature of work required.

- Gastro-scope is used to view stomach.
- Bronchoscope is used to view sore throat.
- Cystoscope is used to examine the working of liver.

49. What is rainbow?

Answer

An arc of spectral colors, which appears in the sky after the rainfall, is called rainbow.

OBJECTIVE TYPE QUESTIONS & ANSWERS

Q1. Each question is followed by four options encircle the correct option:

1) Focal length of the concave mirror is:
a. positive
b. negative
c. greater
d. smaller

2) Linear magnification:
a. is the ration of the distance of object to image distance from mirror.
b. is the ratio of the distance of object and image from the focal point
c. is the ratio of the distance of the image and object from the mirror
d. is the ratio of the distance of image Iron object and the distance of object from the mirror

3) Focal length of a concave lens is:
a. positive
b. negative
c. greater
d. smaller

4) If the image is virtual, then its distance from lens is taken:
a. positive
b. negative
c. double
d. half

5) The ratio or the height of the image to an object is called:
a. imagination
b. magnification
c. mirage
d. mirror

6) Diameter of a spherical mirror is called:
a. radius of curvature
b. center of curvature
c. aperture
d. focal length

7) The focal length of a spherical mirror is:
a. R
b. 2/R
c. 2R
d. √R/2

8) The principal focus of a concave mirror is rear because:
a. the reflected rays actually pass through it
b. the refracted rays actually pass through it
c. prisms has been placed before principal focus
d. the reflected rays do not pass through it.

9) The distance between principal focus of a convex mirror and its' pole is called:

a. radius
b. focal length
c. principal axis
d. virtual focus

10) If the outer cured surface of g mirror is reflecting, then it's called:
a. concave mirror
b, spherical mirror
c. plane mirror
d. convex

11) Select the 'strong statement:
a. image formed by convex mirror is always virtual
b. distance of virtual image is taken as negative
c. distance of virtual image is taken as positive
d. focal length of a convex mirror is taken as negative

12) Which of the equation for ... ramification is cor...ct?
a. q/p
b. p/q
c. 1/p
d. q/p

13) Which is the use of convex mirror?
a used by doctors for examination of eyes etc..
b. used for shaving and make up
c. used in search light
d. used in motor cycle or automobiles

14) Which is the refractive index of diamond?
a. 1000
b. 1.003
c. 1.33
d. 2.42

15) Which ... sems Snel1's law?
a. $n = \frac{\sin i}{\sin r}$
b. ni Sin r = n·
c. $n = \frac{1}{q}$
d. n = v x λ

16) Speed of light in glass is:
a. $3 \times 10^{8}\ ms^{-1}$
b. $2 \times 10^{8}\ ms^{-1}$
c. $3 \times 10^{8}\ ms^{-1}$
d. $4 \times 10^{8}\ ms^{-1}$

17) The angle of incidence in the denser medium for which the corresponding angle of refraction is 90^0 in the rare medium is called:
a. angle of deviation
b. critical angle
c. angle of reflection
d. angle of refraction

18) The critical angle for water is:
a. 40°
b. 49°

c. 59°
d. 51°

19) In the equation: $n = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$ n is called:
a. no. of moles of diamond
b. no. of atoms of diamonds
c. refractive index of diamond
d. angle of minimum deviation

20) In a totally reflecting prism one angle must be of:
a. 60°
b. 30°
C. 70°
d. 90°

21) Which of the following is used in modern telecommunication system?
a optical fibre
b. endoscopes
c. convex lenses
d. convex mirror

22) The instrument used to view the internal structure of the human body is called:
a. pc...copc
b. binocular
c. endoscope
d. prism

23) Power of lens is equal to:
a. f
b. 1/f
c. 2f
d. 3f

24, Select the wrong statement.
a. power of concave lese is negative
b. power convex lens is negative
c. focal length concave lens is negative
d. a normal eye can see clearly up to a distance of 25 cm from the eye

25) If the radius of curvature of spherical mirror is 26 cm, its focal length will be:
a. 26
b. 13
c . 52
d. 2.6

26) A person suffering from long sightedness cannot see the objects distinctly:
a. near objects
b. distant objects
c.. at near point
d. both (a) and (b)

27) Long sightedness is corrected by wearing glasses having:
a. concave lens
b. concave mirrors
c. convex lens
d. Plano-convex lens

28) The unit of power of lens is:
a. watt
b. diopter
c. degree
d. joules

29) 1f a person cannot sec thy distant objects distinctly then he is suffering from:
a. short sightedness
b. long sightedness
c. zero sightedness
d. none of these

30) Dioptre is the reciprocal of:
a. focal length in cm
b. focal length in m
c. diameter
d. aperture

31) A normal eye can see objects clearly whose distance from eye is about:
a.10 cm
b. 20 cm
c. 35 cm
d. 25 cm

32) Line magnification is equal to
a. size of image/size of object
b. size of object/size of image
c. q/p
d. both (a) and (c)

33) The S.I. unit of magnification is:
a meters
b. centimeters
c. no unit
d. dioptre

34) The image formed by a concave lens is:
a. virtual
b. real
c. virtual and erect
d. erect

35) the lens which is thick form edges and thin from center is called:
a. convex lens
b. concave lens
c. plain lens
d. all of above

36) The formula 1/f=1/p + 1/q
a. convex lens
b. concave lens
c. convex mirror
d. all of above

37) The rainbow which has red color on its outer edge and violet color on its inner edge is called:
a. primary
b. secondary
c. both (a) and (b)
d. all of the above

38) Violet, indigo, blue, green, yellow and red represents:

a. Primary rainbow
b. secondary rainbow
c. both (a) and (b)
d. all of the above

39) Gastroscope is an instrument to view the:
a. heart
b. lungs
c. stomach
d. liver

40) Optical fibres are used in the field of:
a. telecommunication
b. medical surgery
c. engineering
d. all of these

41) The optical fibre works on the principal of:
a. total internal reflection
b. reflection of light
c. interference
d. diffraction

42) The refraction of waves depends on their:
a. frequency
b. wavelength
c. amplitude
d. density

43) The angle of incidence for which corresponding angle of refraction is 90c is called:
a. total internal reflection
b. angle of prism
c. critical angle
d. refracted angle

44) In total internal reflection, light must be coming from:
a. rare medium
b. denser medium
c. denser to rare medium
d. rare to denser medium

45) The angle of prism <A is equal to:
a. 45°
b 30°
c. 90°
d. 60^0

46) Refraction of water is also given by:
a. apparent depth/actual depth
b. real depth/ apparent depth
c. real depth x apparent depth
d. none of these

47) The refractive index of water is:
a. 1.33
b. 1.5
c. 1.47
d. 2.42

48) When light enters from rare medium to denser medium, it bends:
a. move straights
b. away from the normal
c. towards the normal
d. at 30°

49) Concave mirrors are used for:
a. examination of ear, nose, throat etc.
b. shaving and makeup
c. as a rear view mirror in automobiles
d. all are correct

50) The real relation between focal length f and radius of curvature R is:
a. f = 2R
b. f / R
c. f =R/ 2
d. R =f/2

ANSWERS

No.	Ans	No.	Ans	No.	Ans	No.	Ans
1	a	2	c	3	b	4	b
25	b	26	a	27	c	28	b
29	a	30	b	31	d	32	d
33	c	34	c	35	b	36	d
37	a	38	b	39	c	40	d
41	a	42	b	43	c	44	c
45	d	46	b	47	a	48	c
49	d	50	c				