LASER RAY OPTICS KIT

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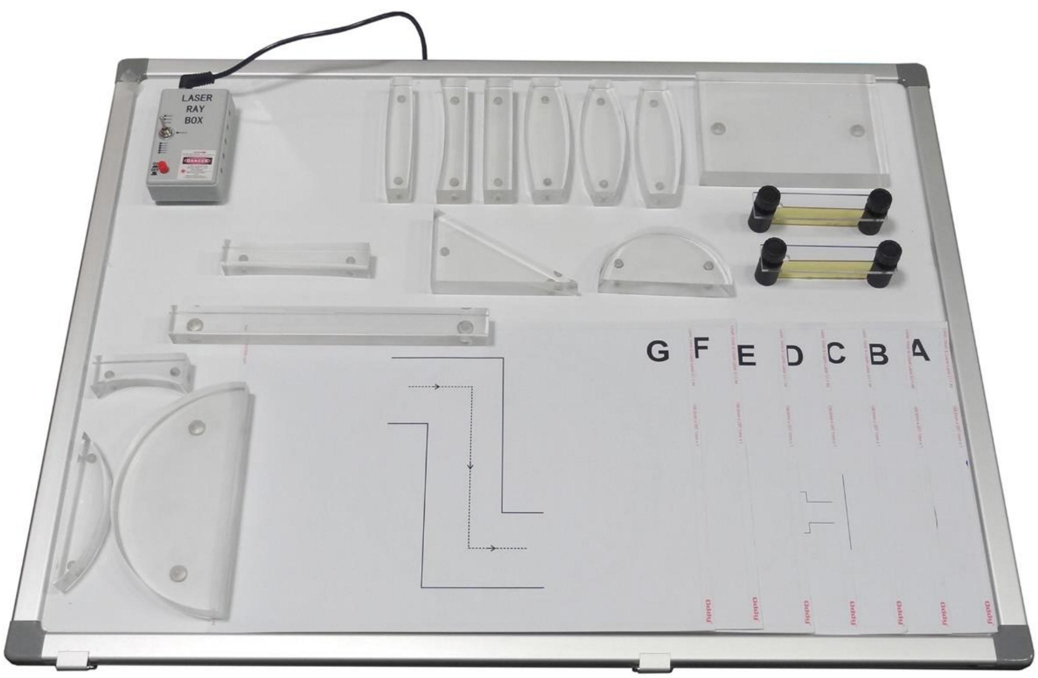


1. Ray Optics Demonstration Set

a) Plane mirror
b) Plane convex lens R=75mm
c) Concave mirror
d) Convex mirror
e) Biconvex lens no. 1
f) Biconvex lens no. 2
g) Biconvex lens no. 3
h) Biconvex lens no. 4
i) Biconcave mirror lens no 5.
j) Optical fiber
k) Plane convex lens R=45mm
l) Rectangular plane
m) Plane concave lens
n) Prism

2. Laser Ray Box

This light source is with a power 5x1mW and wavelength 635nm.

3. Working Sheets

This kit is demonstrated properly if all the objects are located on correct positions on the sheet.

a) Galileo and Kepler telescope
b) Photo Camera
c) Human Eye model
d) Hartley's circle for refraction and reflection.
e) Effect of spherical aberration of a lens and its correction
f) Magnetic board

For choosing the right location before demonstration the size of the board enables easy transportation.

EXPERIMENTS:

1. Principle of Kepler telescope.
2. Principle of photographic camera.
3. Principle of Spherical aberration.
4. Principle of Galileo telescope & periscope.

5. Working of human eye (Normal eyes, far sighted eye, near sighted eye).
6. Principle of Hartley's circle for refraction and reflection.

INTRODUCTION

1. This laser box consists of five independent laser modules.
2. This manual can be used for setting up and operating this device with safety.

LASER SAFETY INSTRUCTION

Lasers are used in measurements, and sensing applications, for industrial processing and in medical field. Laser describes the process by which a laser beam is generated. It may cause blindness if they radiate into the eyes directly or indirectly.

SAFETY RULES

1. Operate this very carefully because laser produces a very intense beam of light. We are using class 2^{nd} laser have output less than 1mw. It will not affect the skin.
2. Don't use it while playing or never point this at anyone's eye. Don't try to adjust the laser's internal components. It may cause electric shock.
3. Don't leave the laser ON when you are far away from it.
4. Don't use magnifies to look into the beam, it directly affects you because as the beam travels.
5. Don't look the laser aperture directly when the laser is turned ON.

LASER RAY BOX

1. Laser ray box consists of five independent laser modules with peak wavelength 635nm. When these light tracers are collimated by a cylindrical lens then 5 visible parallel lines tracer can be seen. It is very effective in the demonstration of light trace.
2. The low power laser cannot be used to burn, cut or drill. It should be used only for purpose that was originally produced for.

OPERATION

Use the laser box with power supply properly. From the ray optics demonstration set the bottom of the ray box is magnetic which enables to use it together with magnetic board, worksheet and optical components.

1. In a grounded circuit plug the power adaptor.
2. Connect the power adaptor cable to the laser ray box.

TECHNICAL SPECIFICATIONS

Distance between beams	18mm
Peak wavelength	635nm
Laser Product	Class II
Operating Voltage	5V DC
Laser type	Diode
Operating current	250mA
Wavelength	635nm
Optical power(per beam)	0.4-0.8mW
Storage temperature	-10 - 50ºC
Dimension(LxWxH)	100x75x42mm
Operating Temperature	0 - 40ºC

ELECTRICAL SAFETY INSTRUCTION

Do not open the housing of the power adapter. It is operated on low current or wattage levels, so it’s much safer to use. You need to take safety precautions.

USING SHADE WITH LASER RAY BOX

This box produces five parallel beams. While using of the shade, selection of beam (single, three outer or three inner) can be made with central beam during experiment.

LASER RAY OPTICS KIT

This kit describes students to understand the basic principle of ray optics- refraction, reflection and transmission. This kit allows understanding the following principles and optical effects:

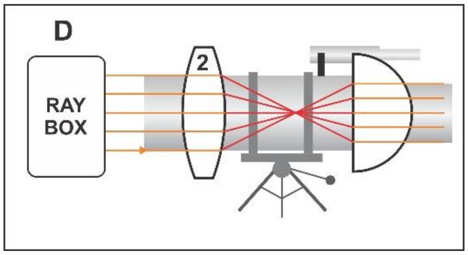
1. Reflection of the light.
2. Refractive index value.
3. Transmission of the light through the concave and convex lens.
4. Optical prism transmission effect.
5. Describe the functioning the photo camera, Galileo and Kepler telescopes.

EXPERIMENT-1

PRINCIPLE OF KEPLER TELESCOPE

MATERIALS REQUIRED:

1. Biconvex lens no. 2 – 1 No
2. Working sheet D – 1 No
3. Magnetic board – 1 No
4. Laser light source – 1 No
5. Plane convex lens no. 14 – 1 No



Model of Kepler telescope (working sheet D)

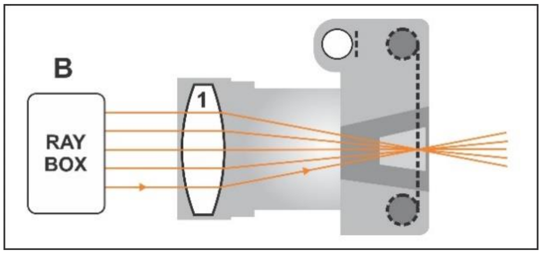
This telescope is reversed and can be verified by blocking a marginal ray lens no. 2. If top ray blocked, in the output ray the bottom ray disappears lens no. 14. It's magnified and unreal.

EXPERIMENT-2

PRINCIPLE OF PHOTOGRAPHIC CAMERA

MATERIALS REQUIRED:

1. Biconvex lens no. 1 – 1 No
2. Working sheet B – 1 No
3. Magnetic board – 1 No
4. Laser light source – 1 No



Model of photo camera (working sheet B)

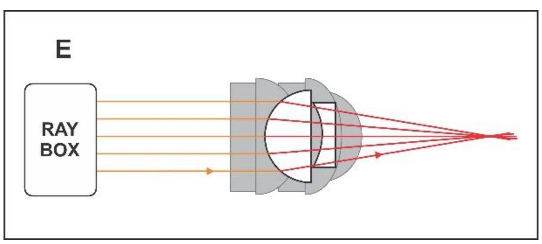
Image which displayed on the nearest part of the camera is real and reversed. The lens of the camera is convergent optical system.

EXPERIMENT-3

PRINCIPLE OF SPHERICAL ABERRATION

MATERIALS REQUIRED:

1. Plane concave lens no. 13 – 1 No
2. Working sheet E – 1 No
3. Magnetic board – 1 No
4. Laser light source – 1 No
5. Plane convex lens no. 14 – 1 No



Model of spherical aberration (working sheet E)

By a convenient combination of these two types of lenses the aberration can be corrected. The aberration Df = f'-f'',

Where,

f' = Focal length of marginal rays

f''= Focal length of paraxial rays

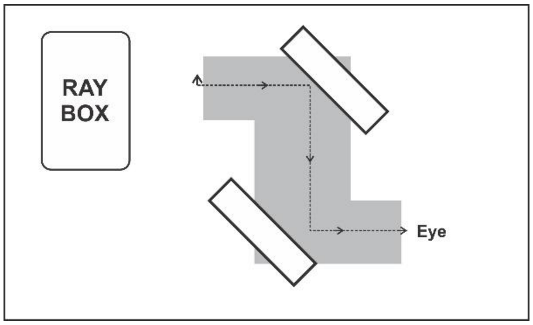
EXPERIMENT-4

PRINCIPLE OF GALILEO TELESCOPE & PERISCOPE

MATERIALS REQUIRED:

1. Plane concave lens no. 13 – 1 No
2. Working sheets C & G – 1 No
3. Magnetic board – 1 No

4. Laser light source – 1 No
5. Plane convex lens no. 14 – 1 No
6. Concave mirror – 1 No
7. Plane mirror – 1 No



Model of Galileo telescope & periscope (working sheets C and G)

The incident angle can be changed by lens no. 1.

The image is displayed by parallel rays by lens no 13.

If the ray of incident beam is blocked, the top ray of the output beam disappears.

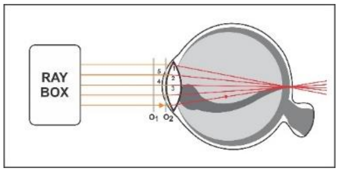
EXPERIMENT-5

WORKING OF HUMAN EYE (NORMAL EYES, FAR SIGHTED EYE, NEAR SIGHTED EYE)

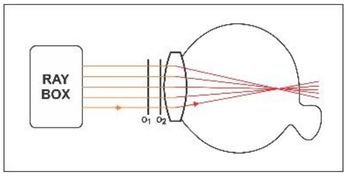
MATERIALS REQUIRED:

1. Working sheet A – 1 No
2. Laser light source – 1 No
3. Magnetic board – 1 No
4. Biconvex lens no. 1 – 1 No
5. Biconvex lens no. 2 – 1 No
6. Biconvex lens no. 3 – 1 No
7. Biconvex lens no. 4 – 1 No

Model of Human Eye (working sheet A) Normal eye:

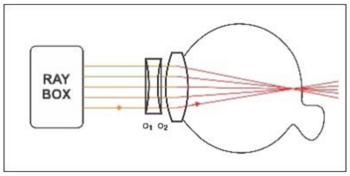


1. Behind the line O2 place the eyes lens 1 directly.
2. If parallel rays to the optical axis intersect after passing through uncorrected eye lens at one point of the retina.



Far sighted eye:

Place the correction lens no. 4 between the line O1 and O2 and eye lens no 3 directly the line O2.

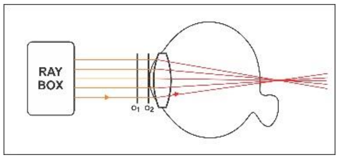


f'= (f1'f2'/ (f1'+f2'))

Where,

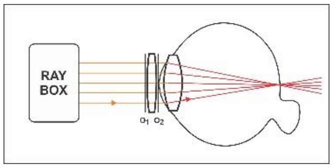
f'= Focal length of the system of eye lens and the correction lens

f1'= Focal length of the eye lens and f2' is the focal length of the correction lens.



Near Sighted eye:

Place the correction lens no. 4 between the line O1 and O2 and eye lens no 3 directly the line O2. Before the retina display rays parallel to the optical axis intersect after passing through uncorrected eye lens at one point of the optical axis.



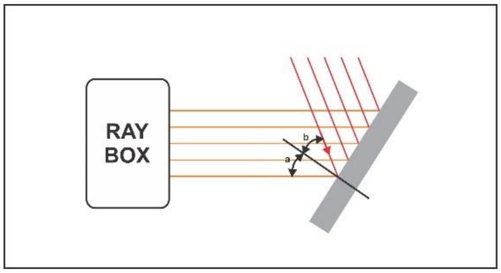
EXPERIMENT-6

PRINCIPLE OF HARTLEY'S CIRCLE FOR REFRACTION & REFLECTION

MATERIALS REQUIRED:

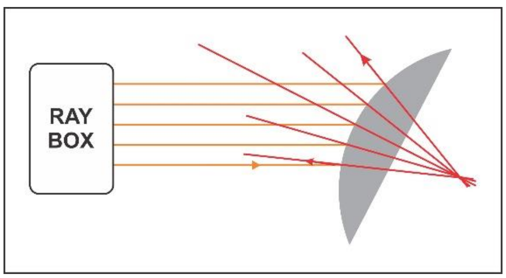
1. Laser light source – 1 No
2. Plane mirror No. 6 – 1 No
3. Convex No. 6 – 1 No
4. Concave mirror No. 7 – 1 No
5. Biconvex lens No. 1 – 1 No
6. Biconcave lens No. 5 – 1 No
7. Plane convex lens No. 9 – 1 No
8. Rectangular plane No. 11 – 1 No

9. Prism No. 10 – 1 No
10. Optical fiber No. 12 – 1 No
11. Working sheet F – 1 No
12. Magnetic board – 1 No



REFLECTIONS ON PLANE MIRROR:

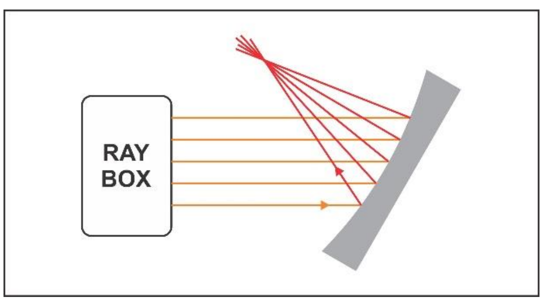
When a light ray hits a plane mirror, the angle of reflection is equal to the angle of incidence, and this is measured with respect to a line perpendicular to mirror plane.



REFLECTION ON CONVEX MIRROR:

When a ray hits the convex mirror parallel to the optical axis, the ray gets reflected from a point behind the convex mirror. This point is called the "focus" & the distance from that point to the mirror's center point is the "focal length (f)".

Radius of curvature, r = 2f

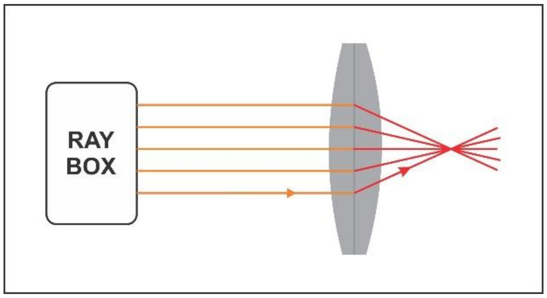


REFLECTIONS ON CONCAVE MIRROR:

When a ray hits the concave mirror parallel to the optical axis, the reflected rays meet at a point on the same side of the mirror. This point is called the "focus" & the distance from that point to the mirror's center point is the "focal length (f)".

Radius of curvature, r = 2f

REFRACTION BY CONVEX LENS:



When a ray hits the convex parallel to the principal axis, the ray after refraction meets at a point on the other side of the convex lens. This point is called the “second principal focus” & the distance from that point to the lens’s center point is the “focal length (f)”.

1/f = (n-1) (1/R1 – 1/R2)

Where, n = Refractive index

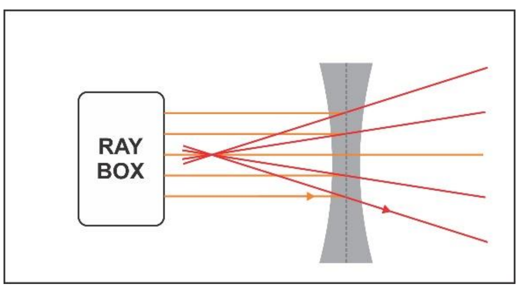
R = Radius of curvature

When the lens used is thick,

1/f = (n-1) (1/R1 – 1/R2) + (n-1) (CT/nR1R2)

Where, CT = Central thickness

REFRACTION BY CONCAVE LENS:



When a ray hits the concave parallel to the principal axis, the ray gets refracted from a point on the same side of the concave lens. This point is called the “first principal focus” & the distance from that point to the lens’s center point is the “focal length (f)”.

1/f = (n-1) (1/R1 – 1/R2)

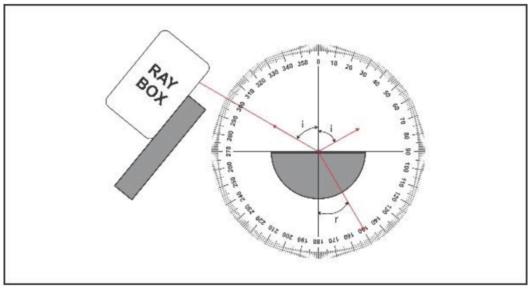
Where, n = Refractive index

R = Radius of curvature

When the lens used is thick,

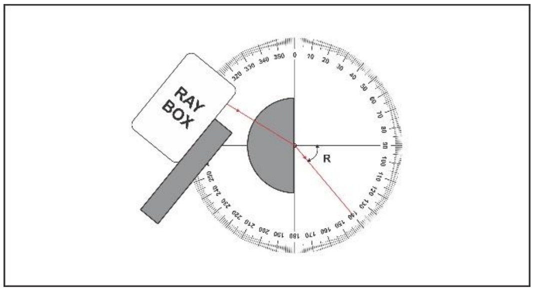
1/f = (n-1) (1/R1 – 1/R2) + (n-1) (CT/nR1R2)

Where, CT = Central thickness



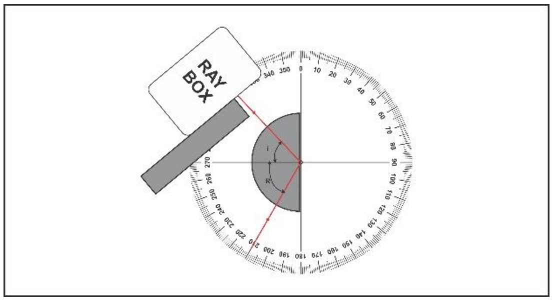
REFRACTION BY PLANE CONVEX LENS:

Take a convex lens, r = 75 mm & place it on Hartley disk. A single beam is taken and is incident at an angle i. a part of beam gets reflected back into the same medium and rest enter to the same medium. The law of reflection and refraction can be found out by measuring the angle of incidence, angle of reflection & angle of refraction.



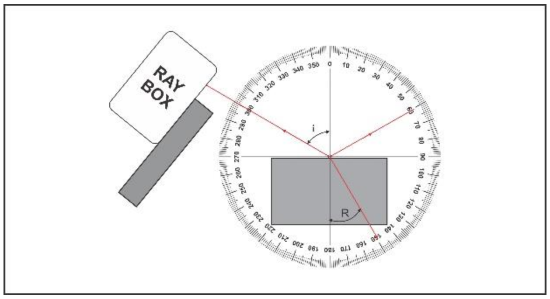
LIMITED ANGLE:

The limited angle can be found out by changing the spherical surface along the side of incident ray and varying the angle of incidence.



ABSOLUTE REFLECTION:

At a particular angle of incidence, the light ray gets reflected back into the same medium and this is known as absolute reflection.

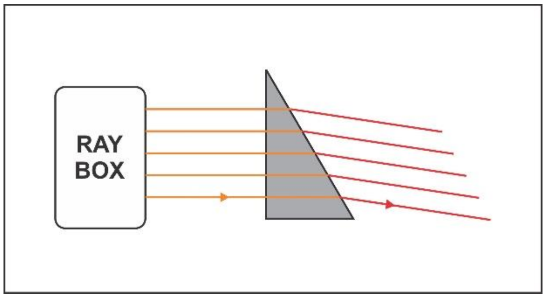


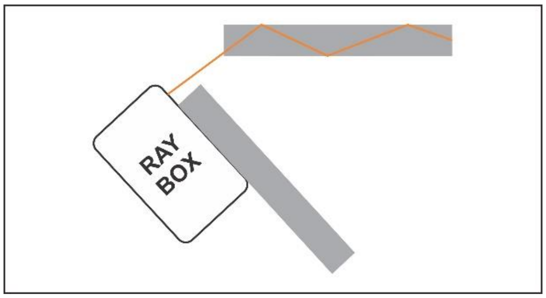
REFRACTION BY RECTANGULAR PLANE:

When a beam of light hits a transparent medium, a part of it gets reflected back to first medium & rest enters the other. The direction of propagation of incident ray of light that enters the other medium, changes at the interface of the two media. This is refraction. The Snell's law is given by,

sin i / sin r = n

Where, i = Incident angle





r = Refracted angle

n = Refractive index of medium

TRANSMISSION EFFECT OF AN OPTICAL PRISM:

The prism No. 10 is used here as it bends the light by 90 or by 180 degrees and uses total internal reflection. The working of this prism & the changes in characteristics at different angles of incident beam can be observed.

ABSOLUTE REFLECTION IN THE OPTICAL FIBER (TOTAL INTERNAL REFLECTION):

The pipes No. 12 are used for transmitting the long-distance signals. This design uses the principle of total internal reflection.