Enlightism

Spreading Inspiration

O level Physics

Light

Contributed by Mam Sheherbano


LIGHT
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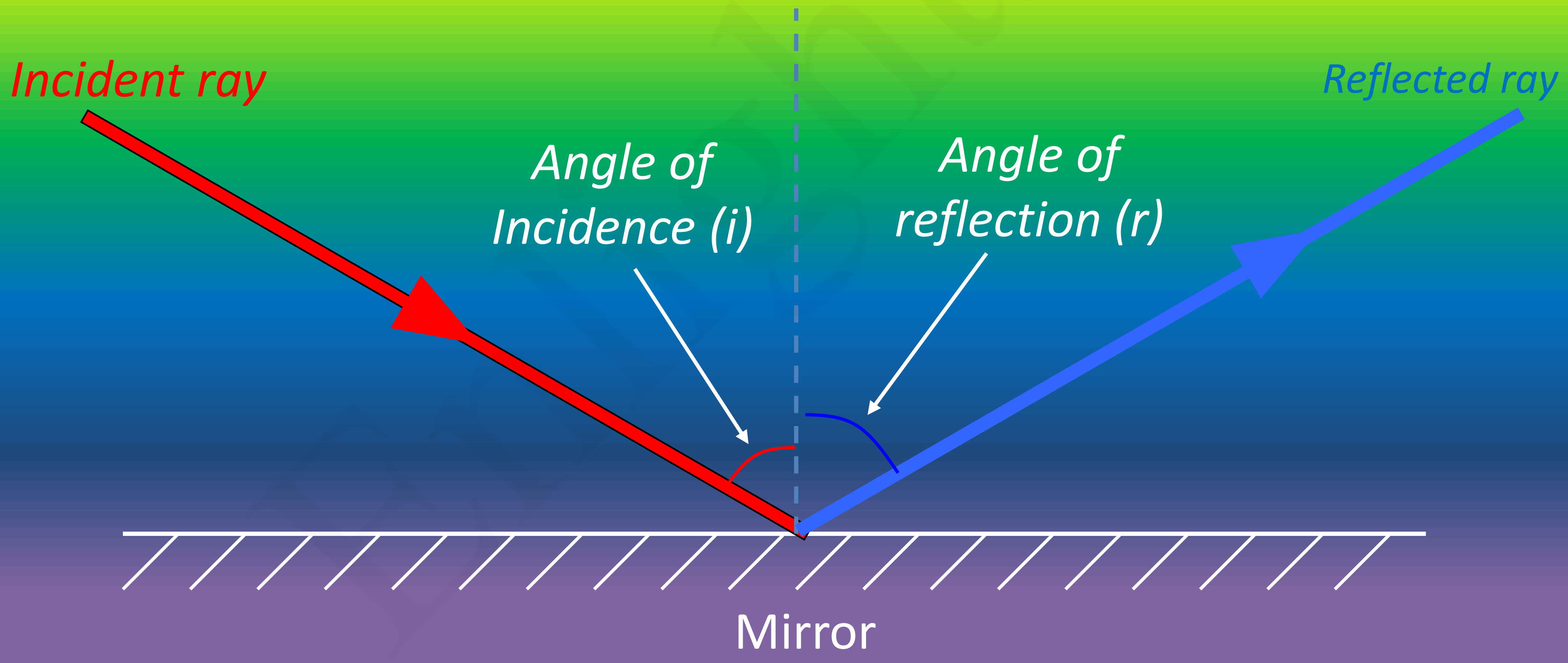
REFLECTION OF LIGHT

The change in direction of a ray of light when it strikes a surface without passing through it is known as **reflection of light**.



Incident ray

A ray of light striking a surface

Reflected ray

A ray of light that has been reflected after striking a surface

Angle of incidence

The angle between a incident ray and the normal to the surface at point where it reflects from a surface

Angle of reflection

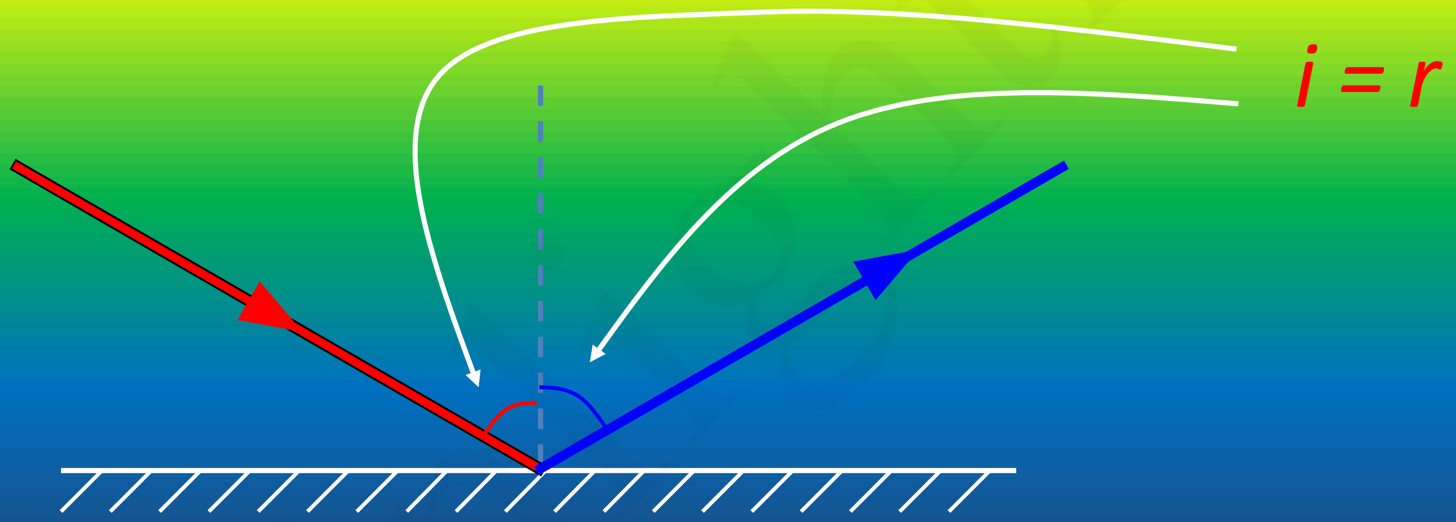
The angle between a reflected ray and the normal to the surface at point where it meets a surface

Normal

The line drawn at right angle to a surface at the point where a ray strikes the surface

Law of reflection

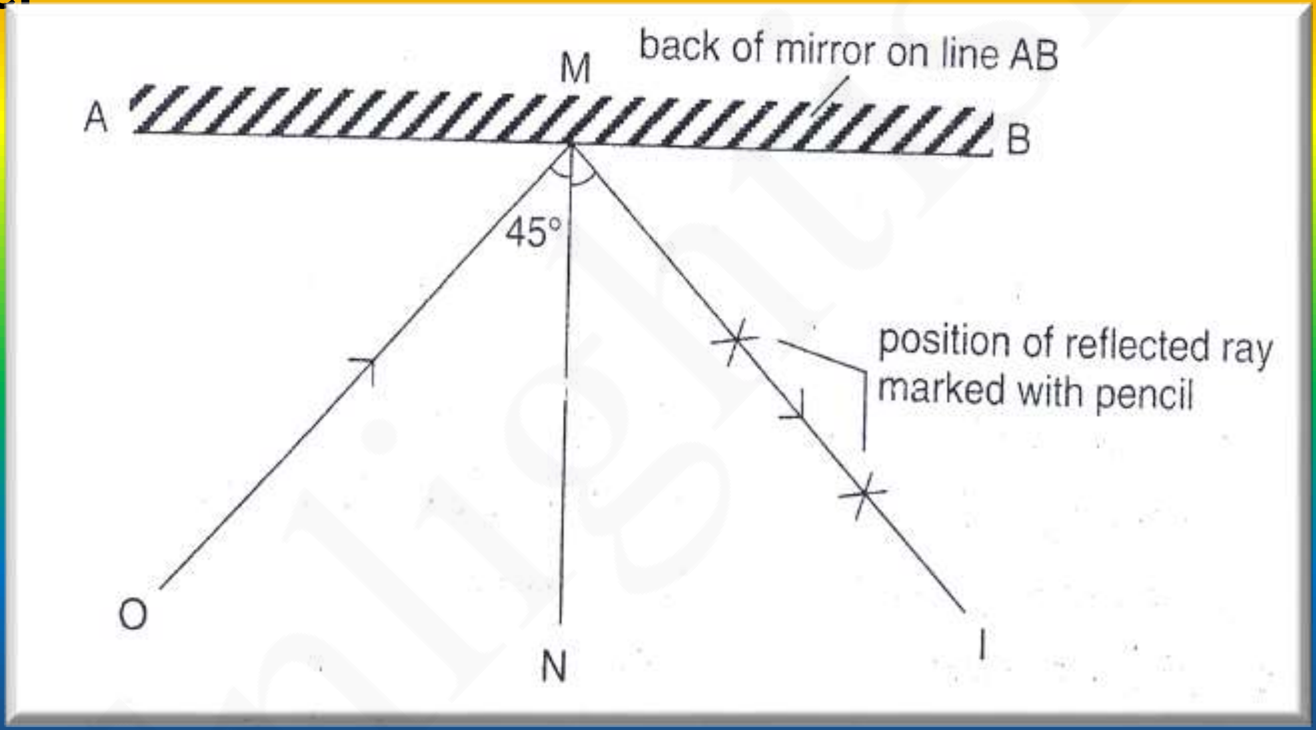
The angle of incidence is equals to angle of reflection (i = r)



Experiment to illustrate the law of reflection

Equipments:, A4 paper, ruler, plane mirror, pencil and ray box.

Procedure:



- Draw a line *AB* on a piece of paper.
- Mark *M* the midpoint of *AB.*
- Draw *MN* the line perpendicular to *AB* at *M.*

- Draw *OM* the line making an angle of 45° with *MN.*
- Place the mirror on the line *AB.*
- Position the ray box so that the ray is directed along the line *OM.*
- Mark the position of the reflected ray, *IM.*
- Remove the mirror and measure the angle between *MN* and *IM.*
- Repeat the experiment for different angles of *OMN.*

Observation & Conclusion

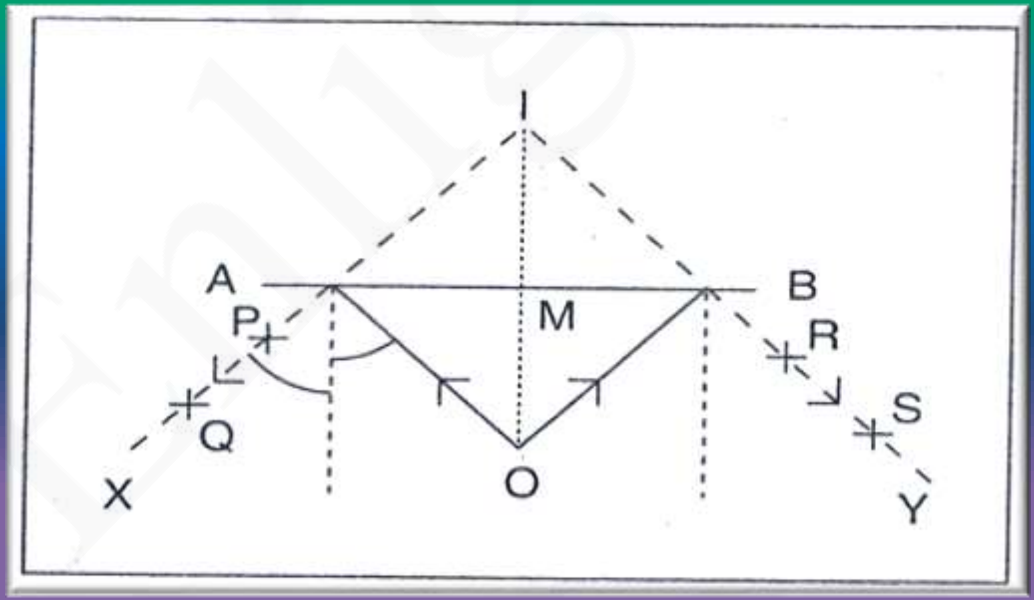
It is found that angle OMN is equal to angle IMN, i.e. the angle of incidence is equal to the angle of reflection.

Experiment to find the position and characteristics of an optical image formed by a plane mirror.

Equipments: optic pins, A4 paper, ruler, plane mirror, pencil.

Procedure

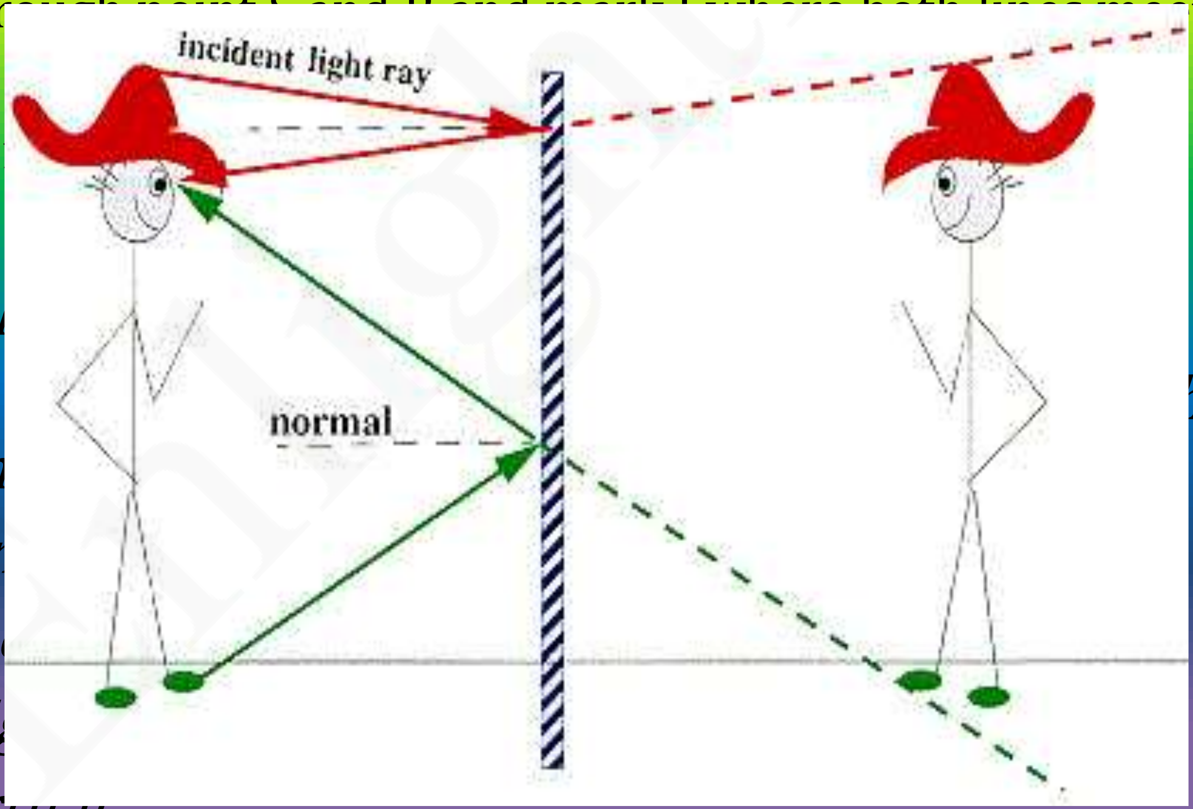
- Draw a line *AB* on a piece of paper and place a mirror vertically on *AB.*
- Stick a pin O in front of the plane mirror.
- View the image of O from position X



- Place pin P so that it covers the image of O.
- Place another pin Q so that it is in line with pin P and the image of O.
- Repeat the same procedure from position Y.
- Place a pin *R* to cover the image of O.
- Place another pin S in line with both R and the image of O.
- Remove the mirror and mark the position of the pins.
- Draw line from X which pass through point P and Q, also draw line from Y which pass thr t.
- Join O and *I* to
- Measure the d

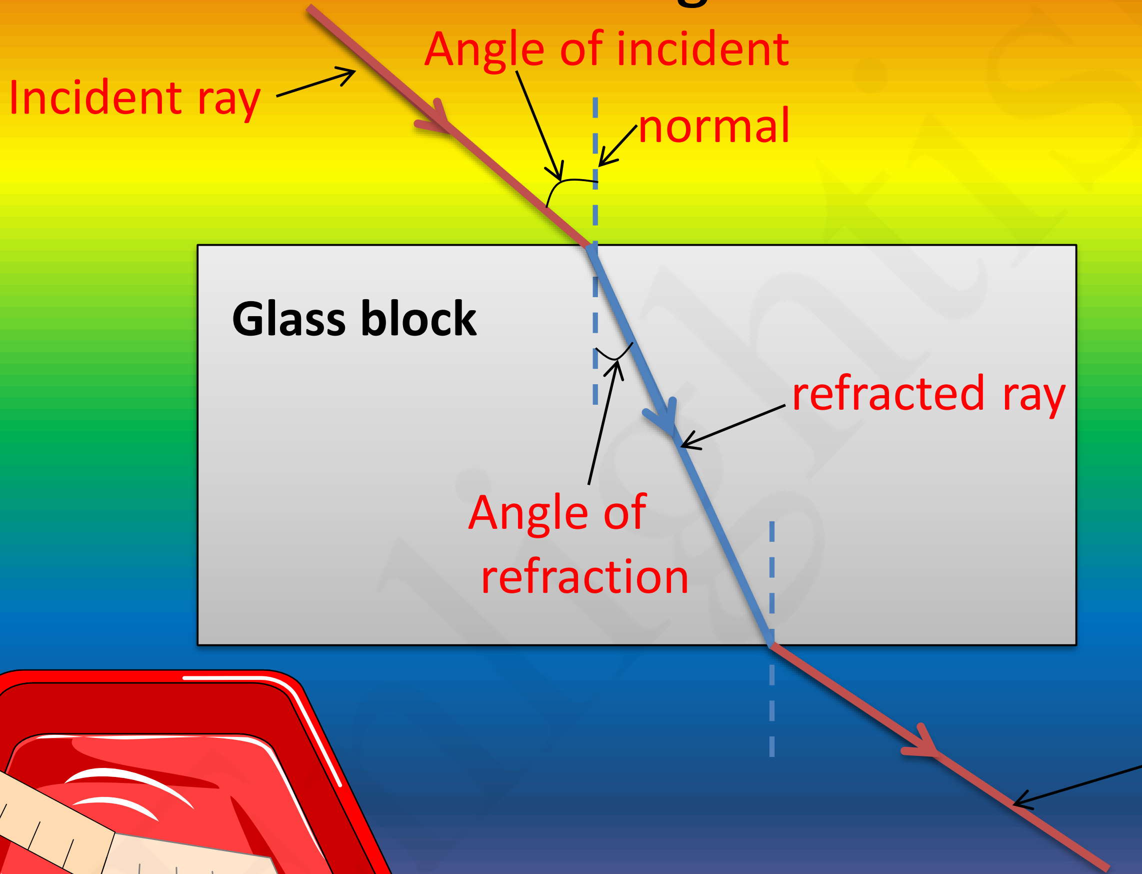
Observation &

- *It is found t*
- *This shows he mirror as th*
- *Image is sa*
- *Image form*
- *Erect (up ri*
- *Image is virtual*



REFRACTION OF LIGHT

The bending of a ray of light on passing from one medium to another is called **refraction of light**.



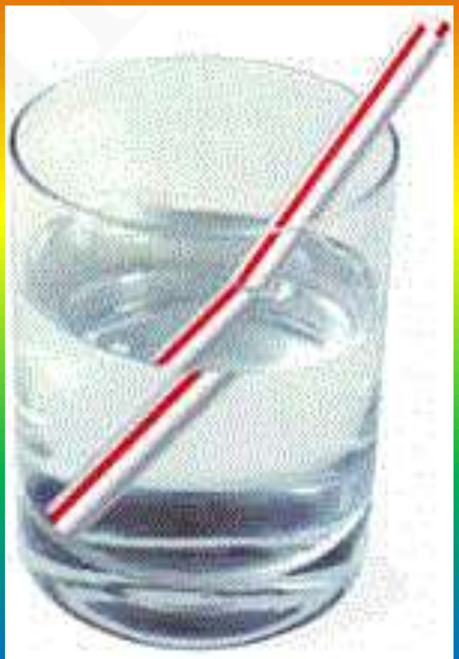


Figure 3

- When the light is travelling from optically less dense medium to denser medium the light ray bend towards the normal, because the speed of the light decreases.

- When the light travelling from optically dense medium to less dense medium the light ray bend away from the normal, because the speed of the light increases.

Angle of refraction

The angle between a refracted ray and the normal to the surface at point where it passes from one material to another.

Refractive index

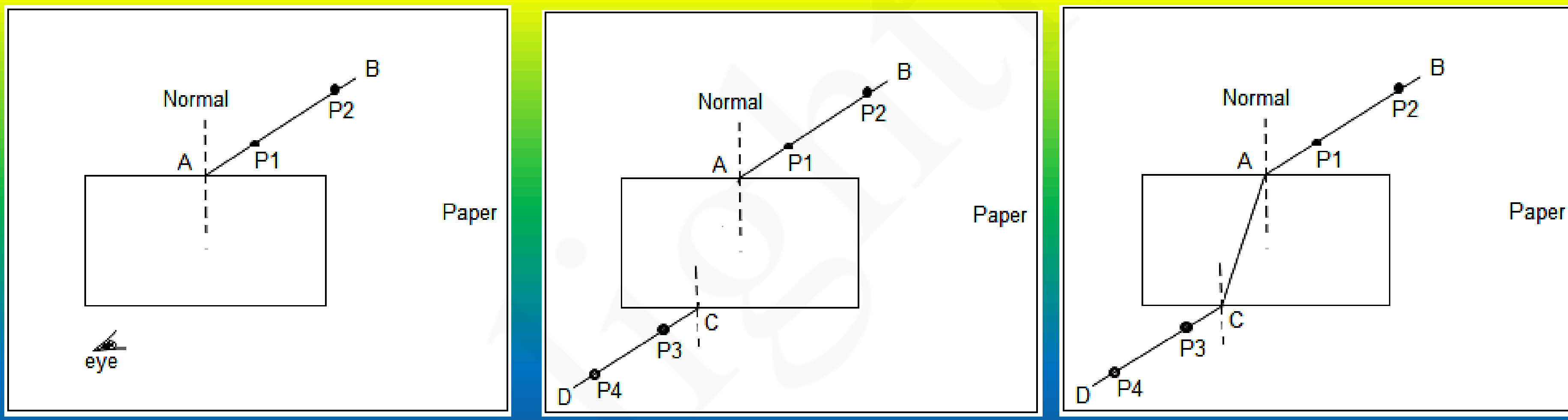
The property of material that determines that extent to which it causes ray of light to be refracted.

$$\text{Refractive index} = \frac{\sin i}{\sin r} \qquad \eta = \frac{\sin i}{\sin r}$$

Experiments to show refraction of light through glass blocks

Equipments : A glass block, ruler, protractor, pencil, A4 paper and 4 optic pins.

Diagrams:



Procedure:

- Keep the glass block in the middle of the paper and mark its outline with the pencil.
- Select point A as shown in the margin and draw a normal line to the point using the protractor.

- Draw a line AB making an angle of 45^o with the normal.
- Along that line fix two optic pins P1 and P2 as shown.
- Replace the glass block accurately along its outline.
- Move your eye to the position shown (eye) as shown diagram 1 and fix the other two pins P3 and P4 so as to make a straight line with the images seen in the glass bock.
- Remove the glass block and the pins, draw the line in such a way that the line passes through points of pins P3 and P4 and mark line as CD as shown in diagram 2.
- Draw a line to connect the line AB and CD as shown in diagram 3.
- Measure the angle of refraction and write the reading on the table given below.
- Calculate the values for sin i / sin r in the table given below.
- Repeat the same with angle of incidences 30^o, and 60^o.

Results:

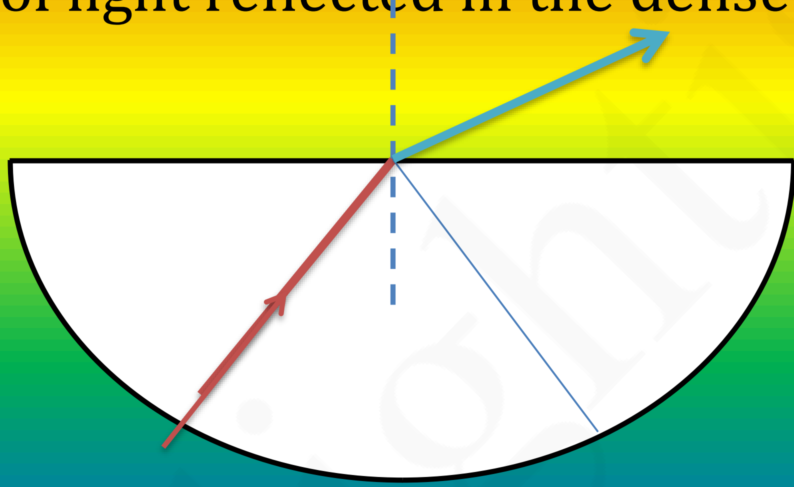
Angle of incidence	Angle of refraction	Sin i	Sin r	Sin i/Sin r
45°				
30°				
60°				

Conclusion:

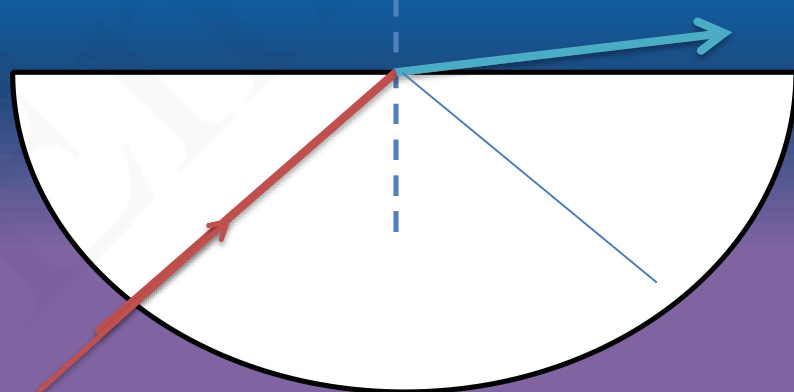
The value of sin i / sin r is ……………………………… for light travelling from given medium to another.

TOTAL INTERNAL REFLECTION

When the light is travelling from optically dense medium to low dense medium the refracted ray bend away from the normal and also some ray of light reflected in the dense medium as shown below.

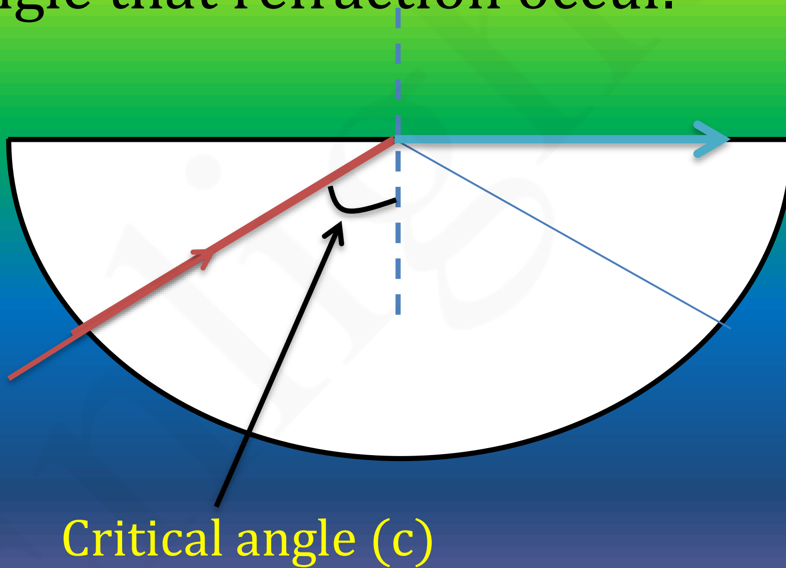


If the angle of incident is increased, more light is reflected inside the block. The refracted bends even further away from the normal

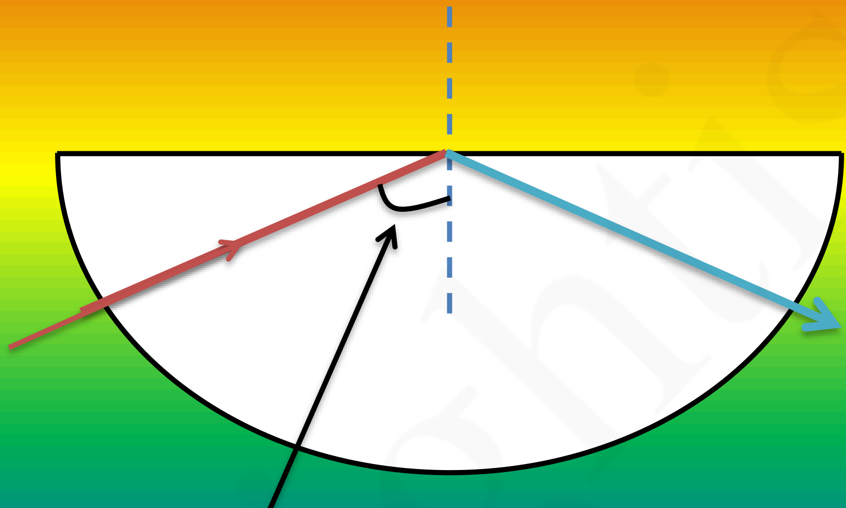


Eventually at one particular angle, the refracted ray emerges along and parallel to the surface of the block and perpendicular to the normal as shown below.

When the refracted ray is perpendicular to the normal, the angle between incident ray and normal in the dense medium is called ***critical angle***.
Or the largest angle that refraction occur.



If the light ray incident on the block is greater than the critical angle, the light is entirely reflected inside the glass block. This phenomenon is known as **total internal reflection** .



Angle of incidence is greater than critical angle (c)

*When the light is travelling from optically dense medium to optically less dense medium and if the angle of incidence is greater than the critical angle , all the light is reflected back into denser medium. This is known as **total internal reflection**.*

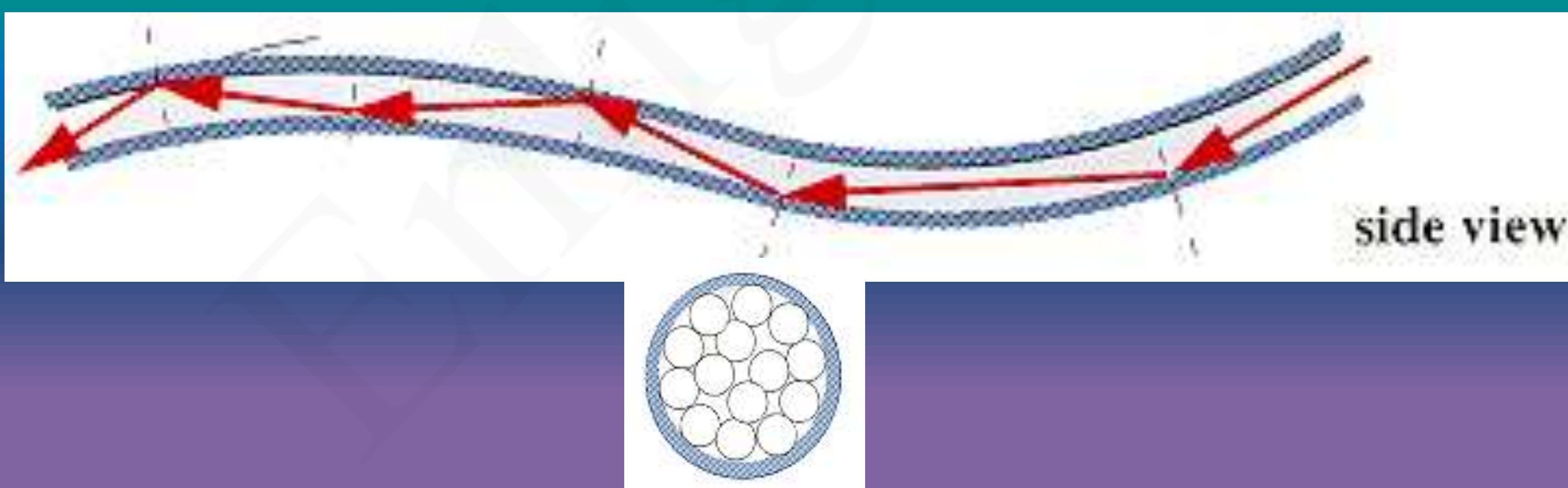
Optical fibre

Optical fibres are thin and flexible. When light enters it , is totally reflected many times until it comes from the other end. Telephone or computer messages can be transmitted by light along optical fibres.

There are some advantages of using optical fibre rather than copper wire:

Each of these fibres is capable of carrying thousands of telephone calls simultaneously.

The speed of signal is also faster.

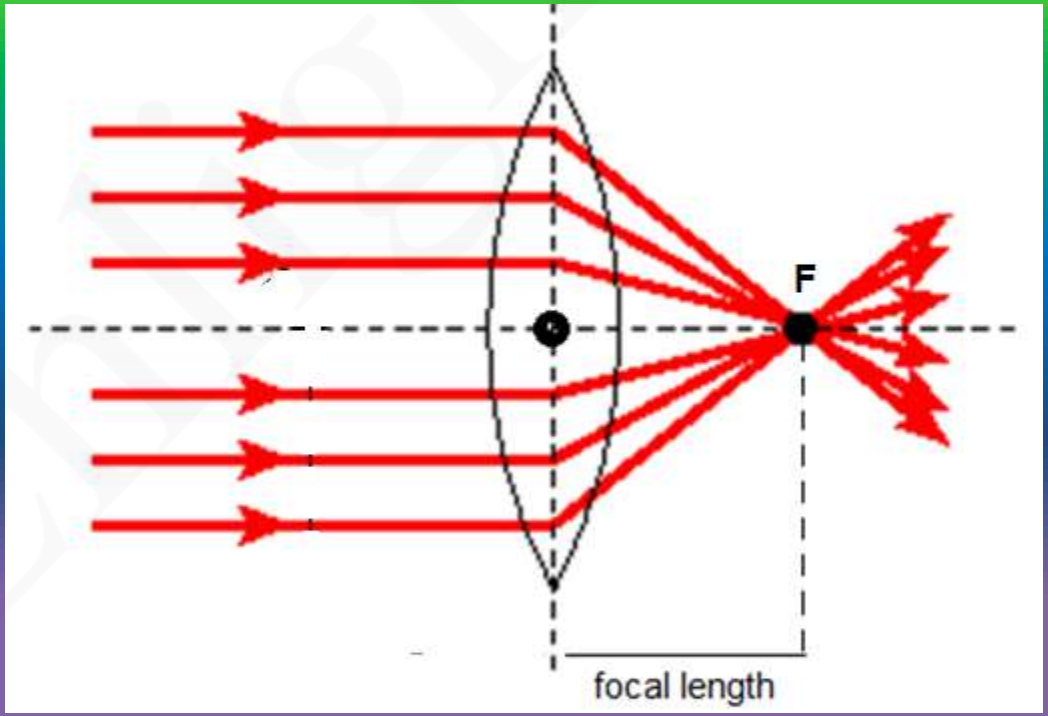


LENSES

Convex (converging) lens

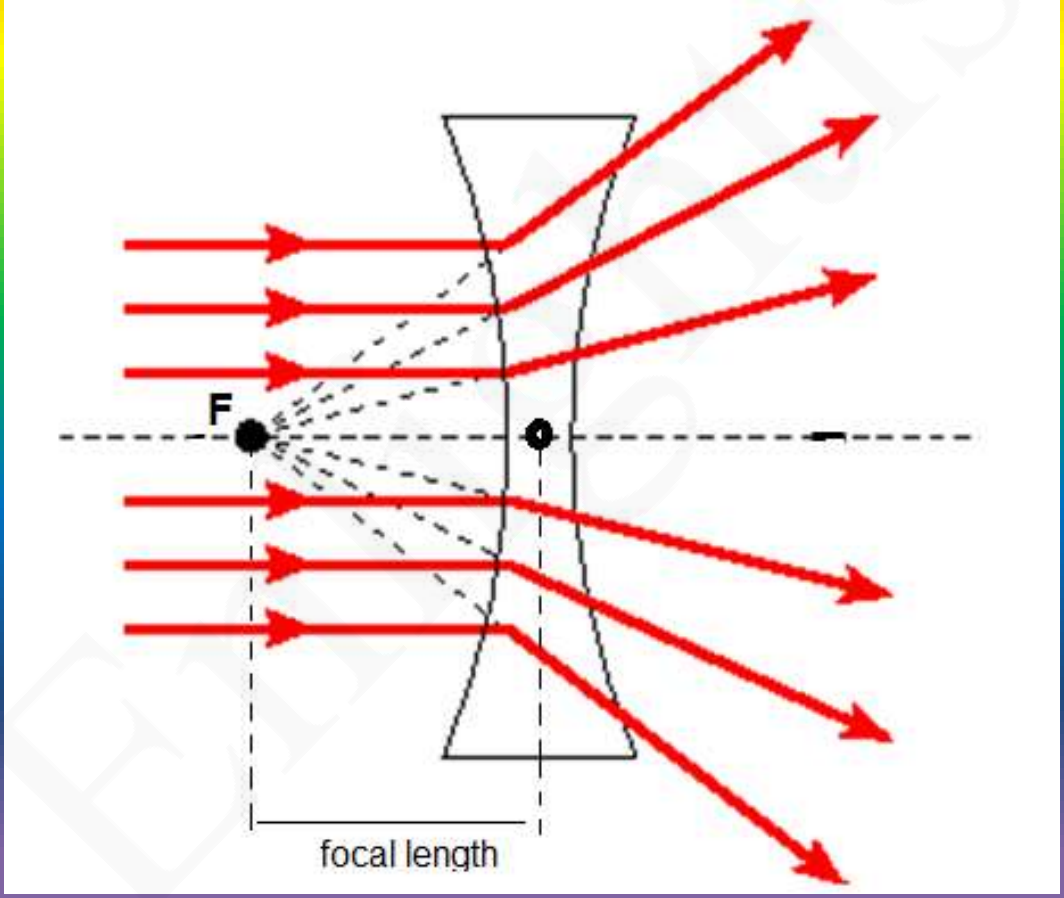
Convex lenses are thicker in the middle and thin round the edge. When parallel light rays pass through a convex lens , they are bent inwards. The point F were they converge(meet) is called the **principal focus (f)** or **focus point**.

The distance from centre of the lens to the principal focus is called the **focal length**.



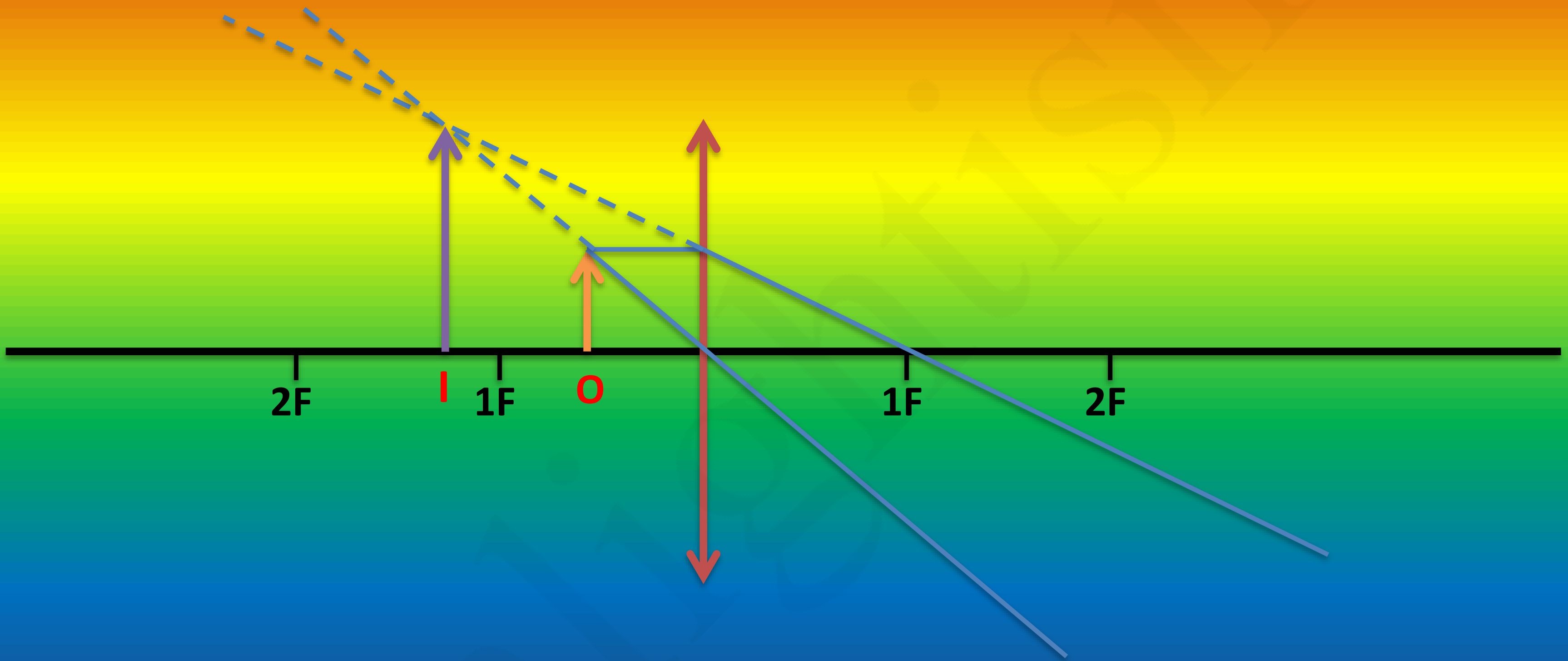
Concave (diverging) lens

Concave lenses are thin in the middle and thickest round the edge. When parallel light rays pass through a concave lens , they are bent outwards. The principal focus is the point from which the rays appear to diverge (spread out). A concave lens is a diverging lens.



Images Formed by convex(converging) lens

Object between center of the lens and pricipal focus



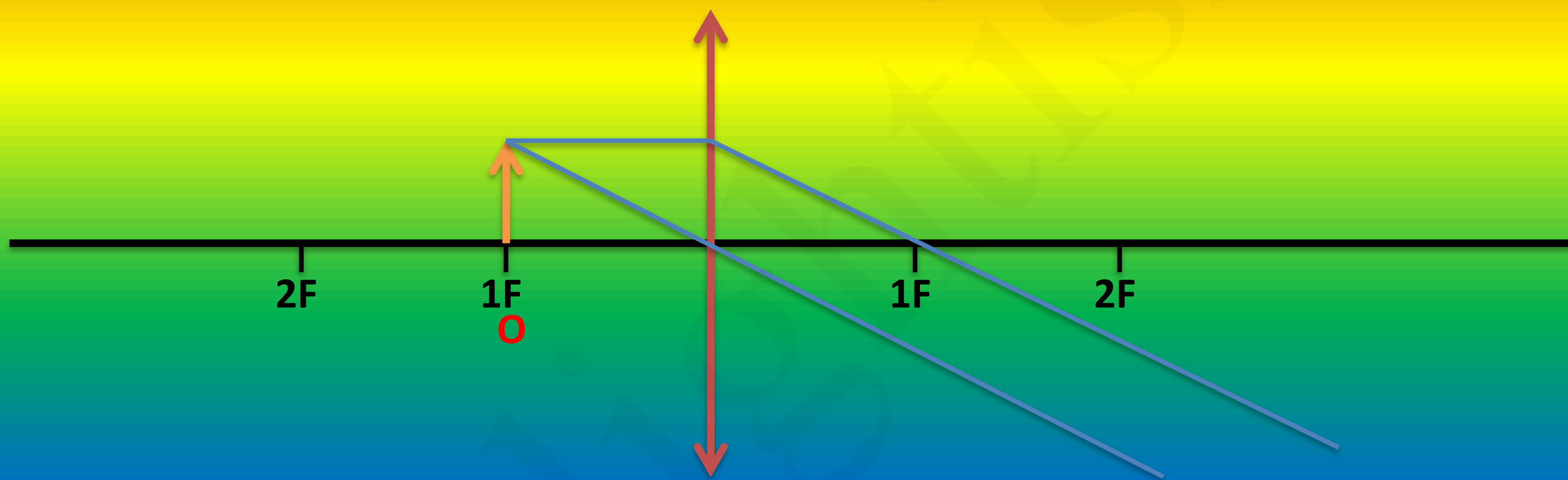
Characteristics of image formed:

Image is virtual, magnified (enlarged), upright

This type of image is formed in magnifying glass

Images of by convex(converging) lens

Object at principal focus F

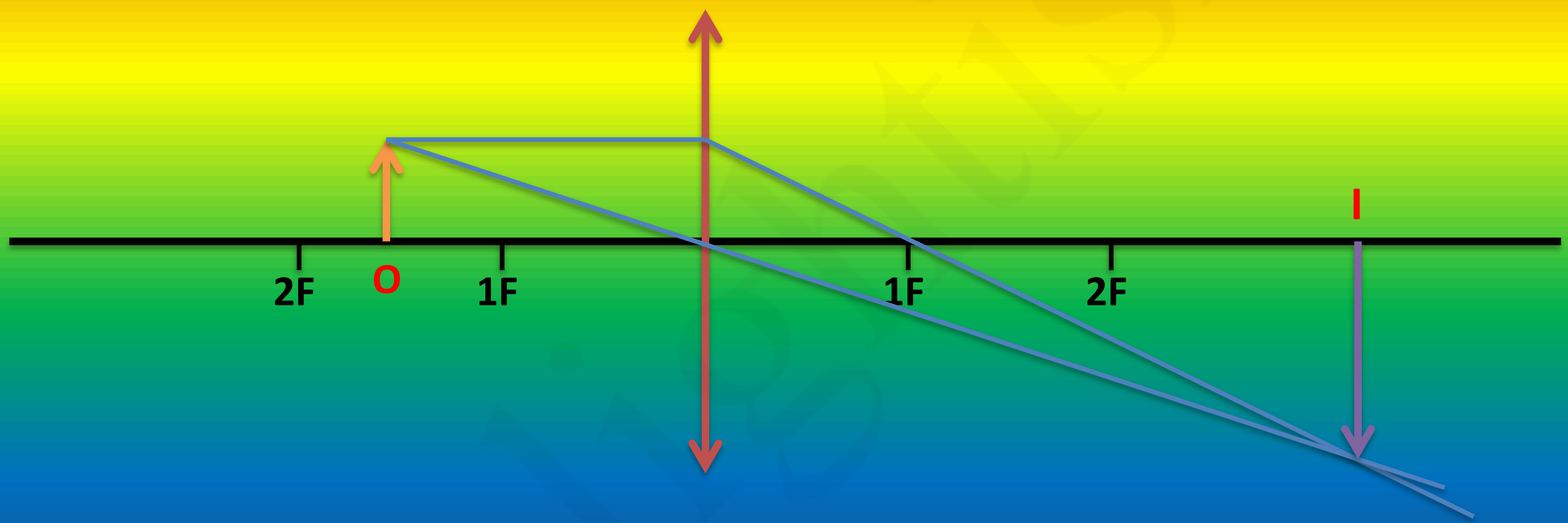


Characteristics of image formed:

At infinity

Images of by convex(converging) lens

Object between 1F and 2F



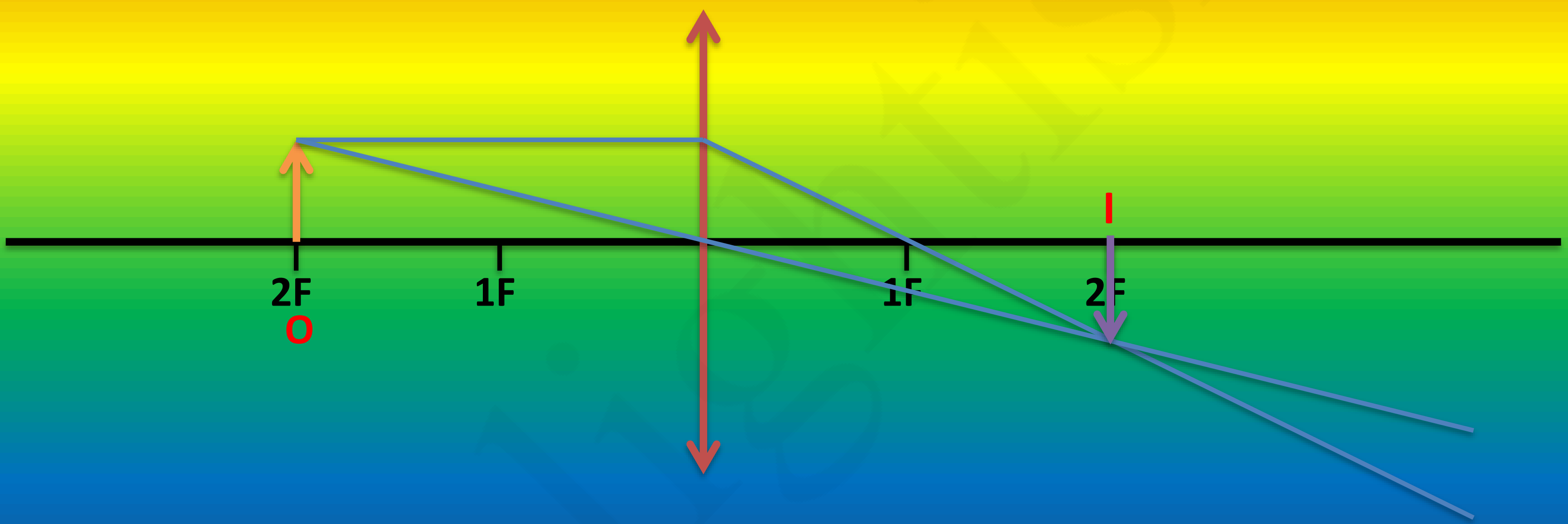
Characteristics of image formed:

Image is real, magnified (enlarged), upside down (inverted)

This type of image formed in projectors and photographic enlarger

Images of by convex(converging) lens

Object at 2F

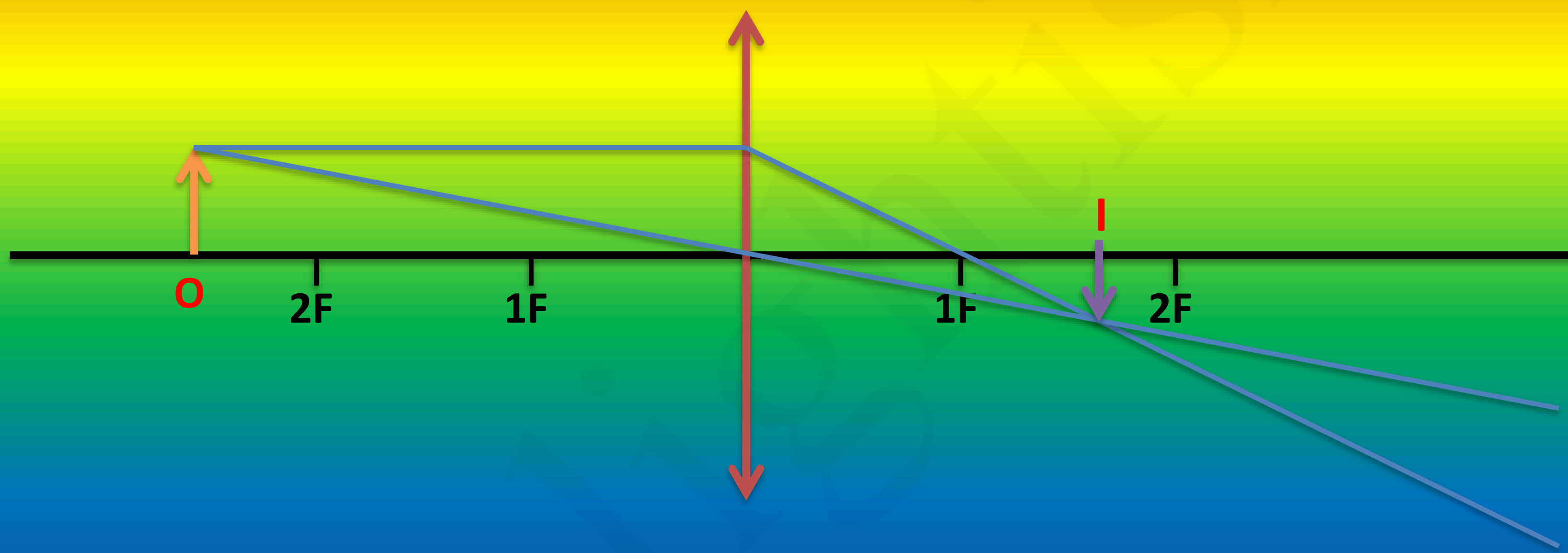


Characteristics of image formed:

Image is real, same size as object, upside down (inverted)

Images of by convex(converging) lens

Object beyond 2F

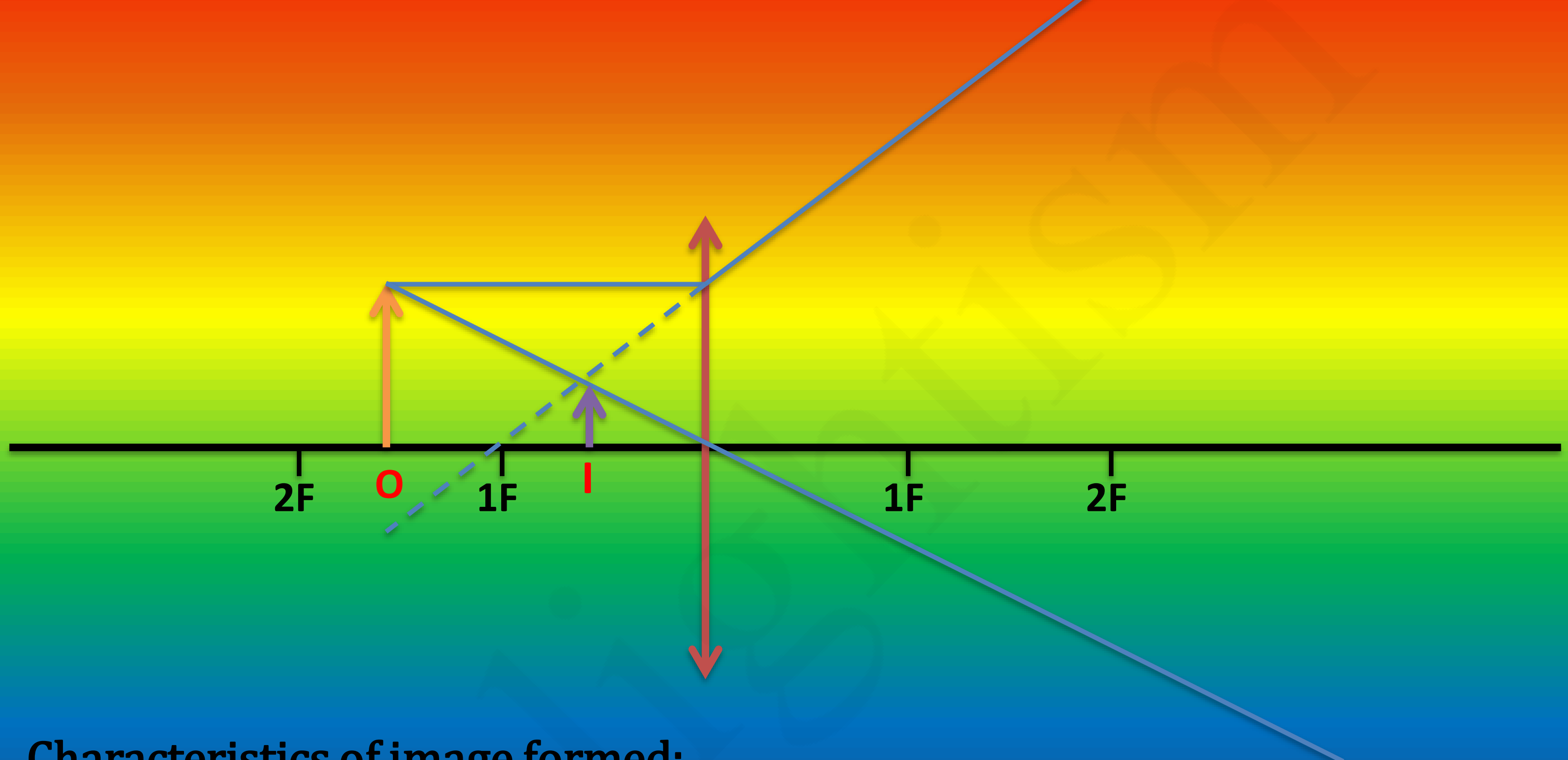


Characteristics of image formed:

Image is real, smaller than object (**diminished**), upside down (inverted)

This type of image formed in camera

Images Formed by concave(diverging) lens



Characteristics of image formed:

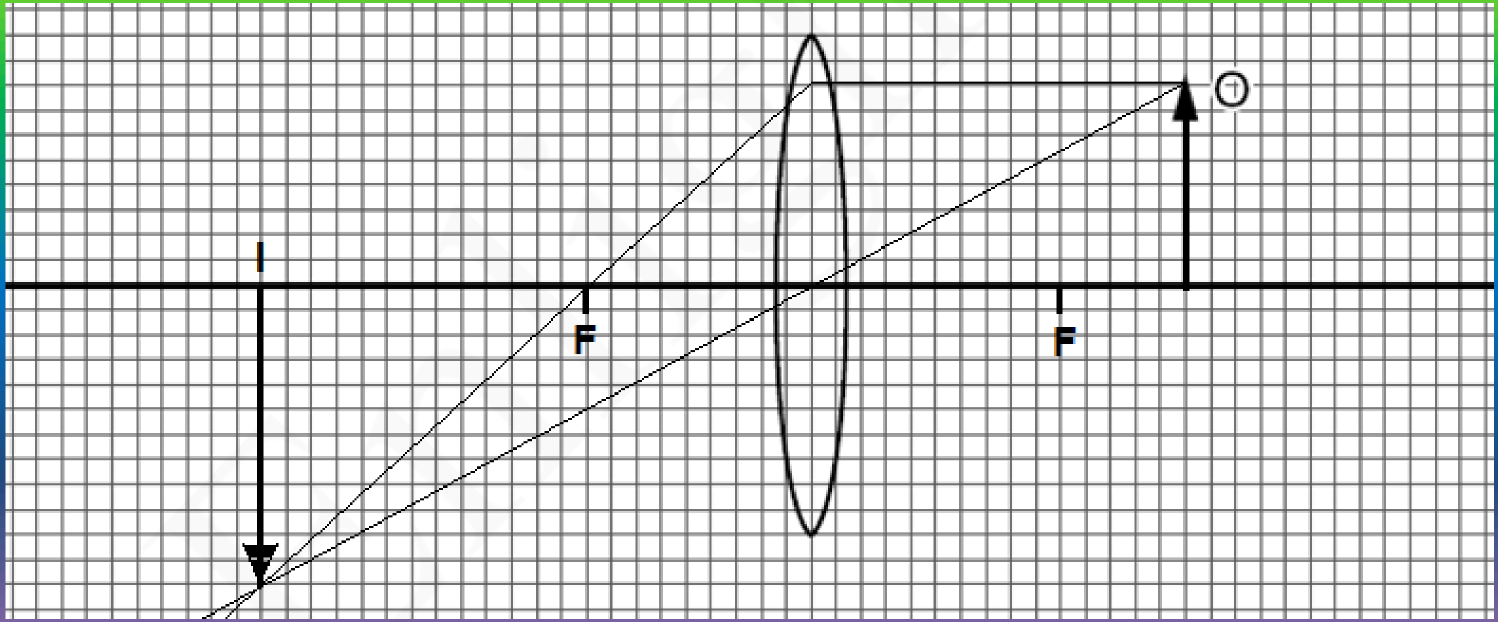
For concave lens the image formed has same characters, when the object is at any position. That is **virtual, upright and image is smaller than object (diminished).**

Linear magnification

An image can be MAGNIFIED so that it appears larger than the object (i.e. the magnification is greater than 1) or DIMINISHED so that it appears smaller than the object (i.e. the magnification is less than 1)

$$\text{Linear magnification} = \frac{hieght\ of\ image}{hieght\ of\ object} = \frac{image\ distance}{object\ distance}$$

Example:

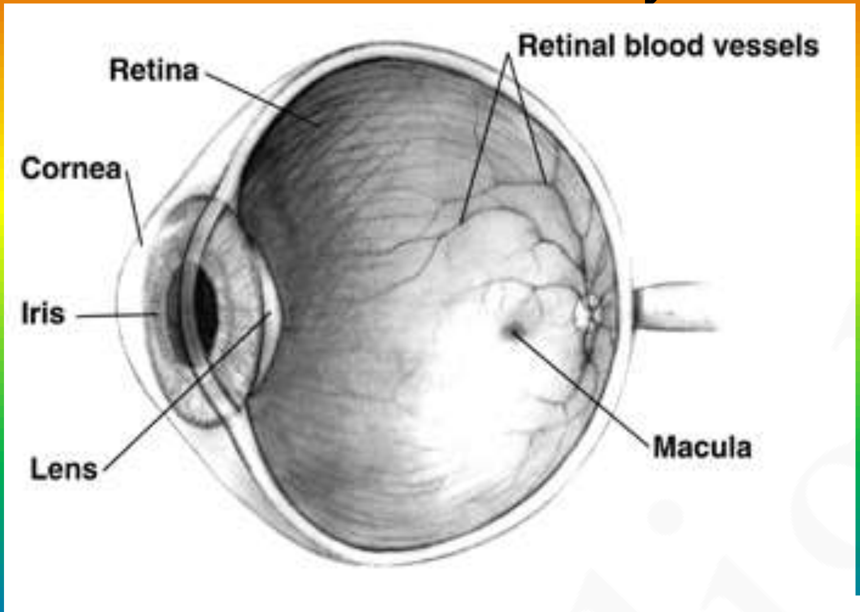


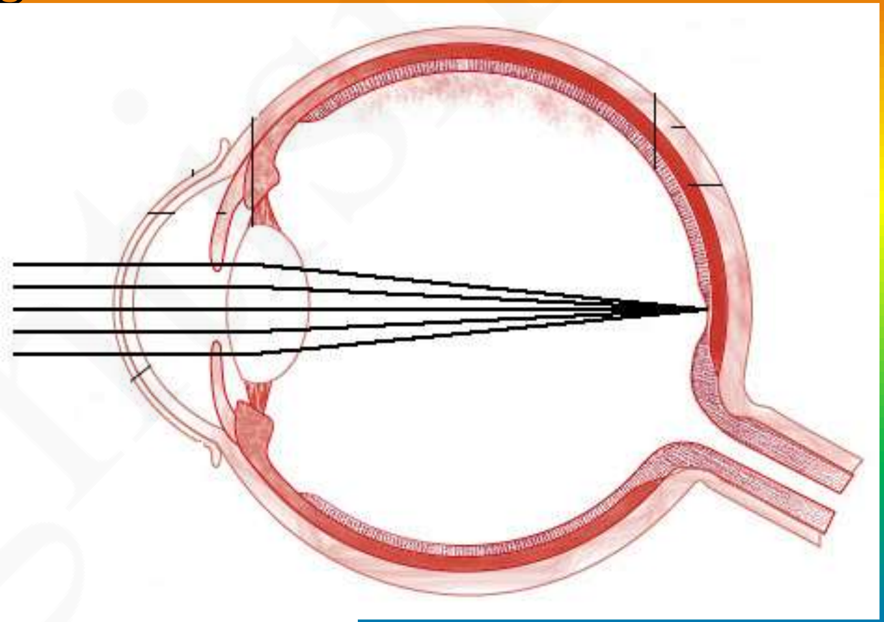
$$\text{Linear magnification} = \frac{hieght\ of\ image}{hieght\ of\ object} = \frac{2.4}{1.6} = 1.5$$

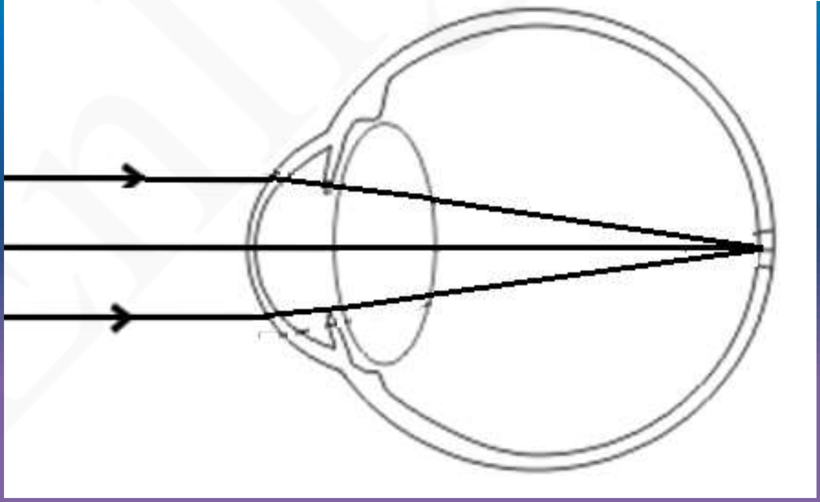
Image form in human eye

Normal eye

In the human normal eye the image is formed in retina.

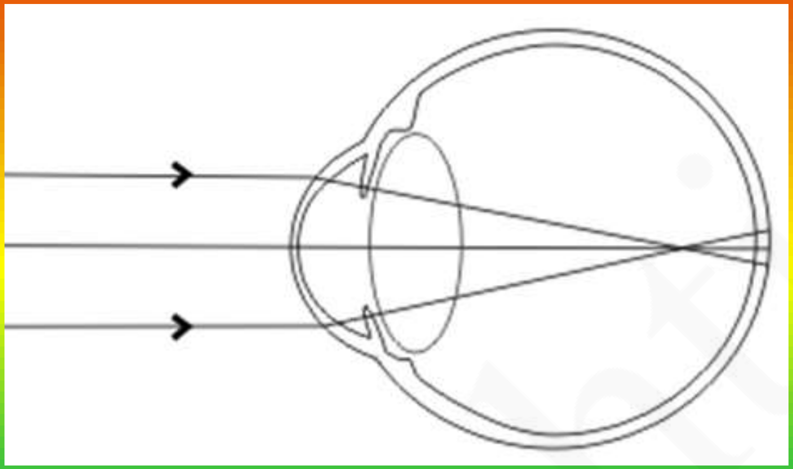






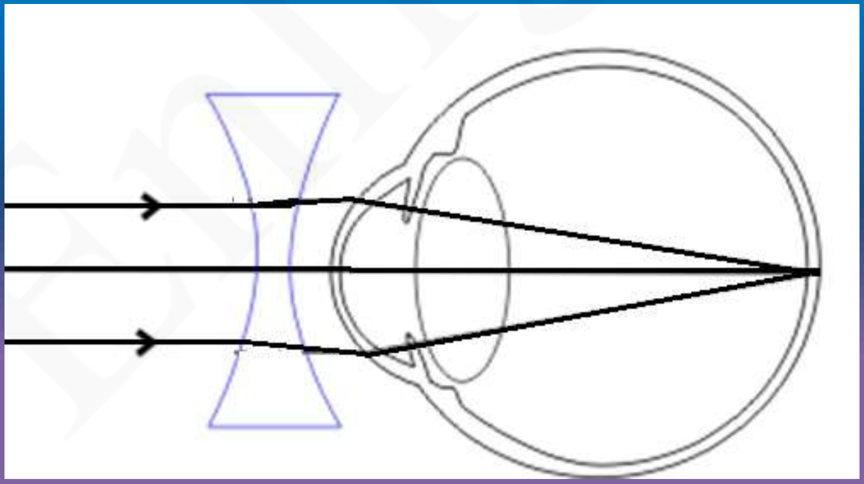
Short sight eye

In the short sight eye the image is formed infront of the retina.



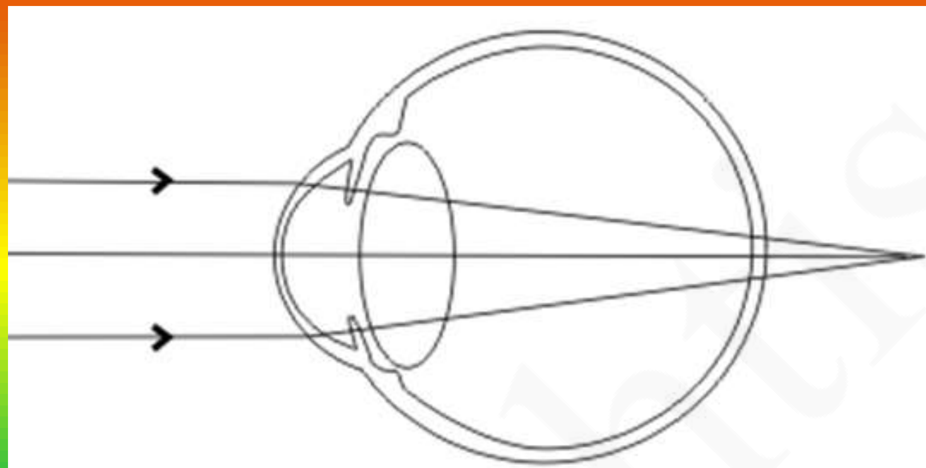
Correcting short sight

Short sight can be corrected by using concave lens infront of the eye.



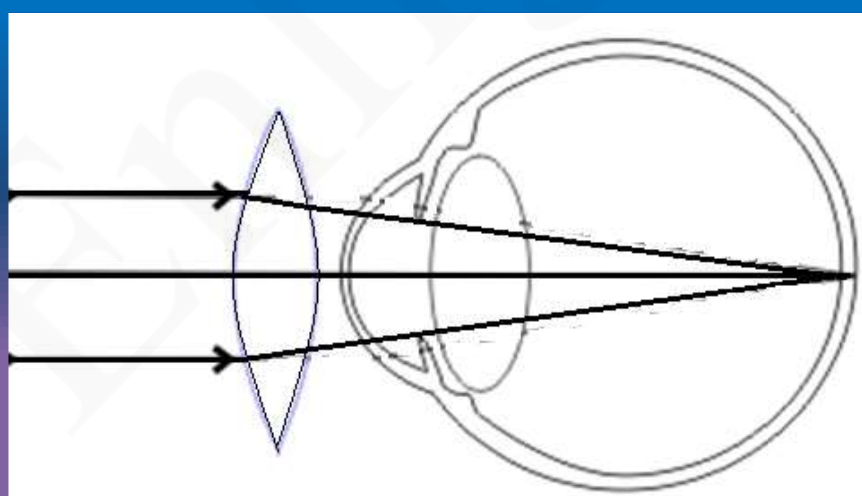
Long sight eye

In the long sight eye the image is formed beyond the retina.



Correcting long sight

long sight can be corrected by using convex lens infront of the eye.



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