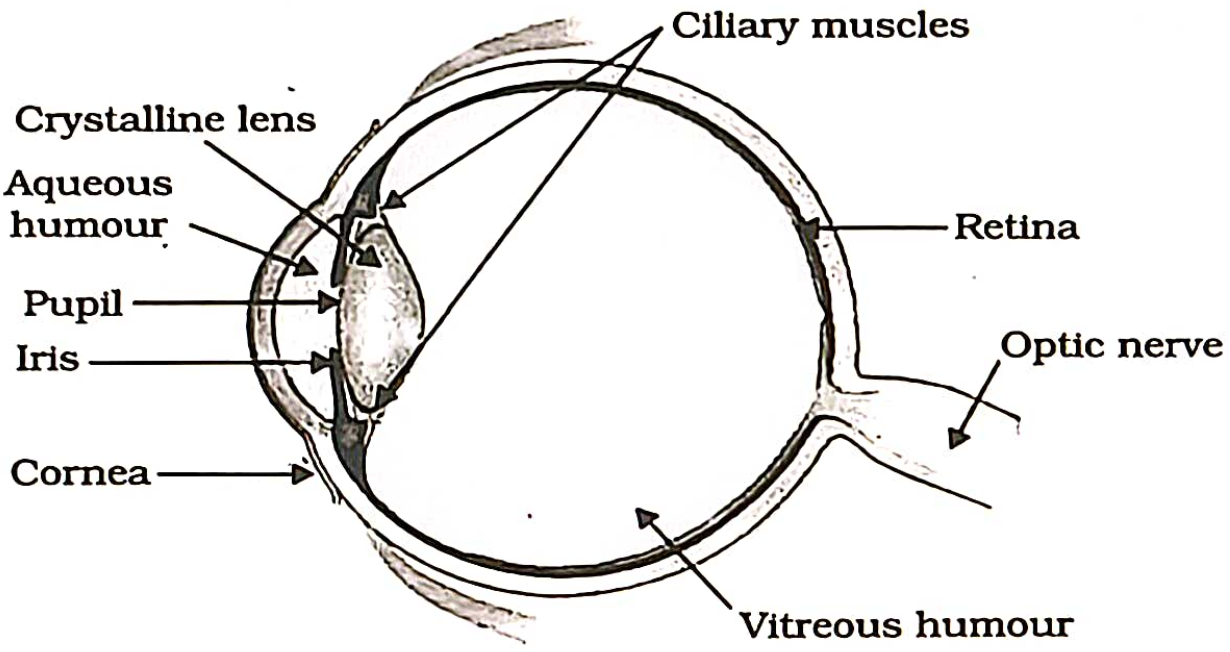
UNIT - 5
Human Eye and Colourful World

Human Eye :- The essential parts of human eye can see through diagram.



- Eye ball is spherical in shape and having 2.3 cm diameter
- The front transparent past of eye is called Cornea, behave as a window.
- Behind the Cornea is a Cirular diaphragm called Iris with a hole in its centre. The hole is called pupil of the eye. The Iris has muscles and coloured pigments whis is responsible for the colour of the eye.

The function of Iris is to control and regulate the amount of light entering the eye by adjusting the Size of the pupil.

Pupil contracts and expands upon intensity of outside light.

- Behind the pupil is a double convex lens, called the eye lens.
- The focal length and hence converging power of eye lens is not fixed. It is adjustable, because its curvature can be modified to some extent by the ciliary muscles.
- Behind the eye lens and at the back part of the eye ball there is a screen called Retina on which image of the object is formed. It contains enormous no. of light sensitive cells in the forms of rods and cones.
- The rod type cells responds to intensity of light and cone type cells respond to the colour of light.
- The space between cornea and eye lens is filled with a viscuas liquid, called aqueous humour, and the space between eye lens and Retina contains a transparent jelly called vitreous humour.
- The eye lid in front of human eye act like a shutter in a camera.

Persistence of Vision :-

The image of any object seen persists on the retina for 1/16 sec, even after the removel of the object.

This continuance of sensation of eye for some time even after the removal of the object is called persistance of vision.

If another object is seen before the impression of the first objects fades away completely, the eye is not able to separate the two impressions, and a sense of continuity develops.

Viewing different Colours :-

- The Rod shaped cells responds to brightness or intensity of light and cone shaped cells responds to colour of light.
- Cone shaped cells enable us to distinguish between different colours.

Colour blindness :-

Colour blindness is said to occur when a person cannot distinguished between different colours. though his vision may otherwise be normal.

Power of accommodation of human eye :-

The accommodation of eye is due to the action of ciliary muscless holding the eye lens.

For observing distinct objects, eye is in relaxed state, it is said to be unaccommodated.

For observing nearby objects, the eye is in a state of tension, it is said to be accommodated

OR

Power of accommodation of eye is the ability of the eye to observe distinetly the objects situated at widely different distance from the eye, on account of change in focal length of eye lens by the action of cilary muscles holding the lens. The maximum power of accomodation of the eye for a person having normal vision is.

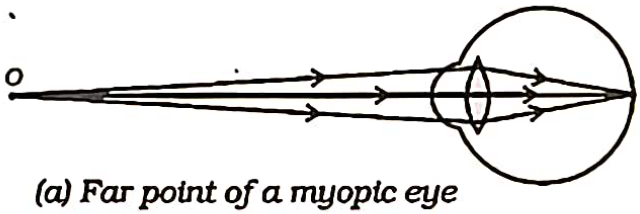
The maximum power of accommodation of the eye for a person having normal vision is

$$P = \frac{100}{f} = \frac{100}{d} = \frac{100}{25} = 4 \text{ dioptre.}$$

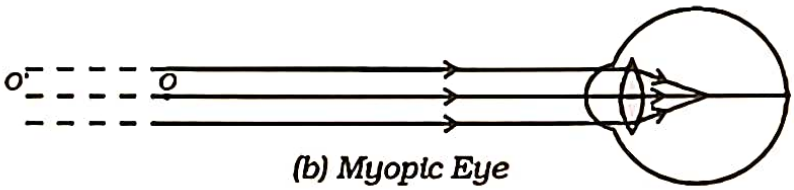
DEFECTS OF VISION

(1) MYOPIA OR SHORT-SIGHTEDNESS :-

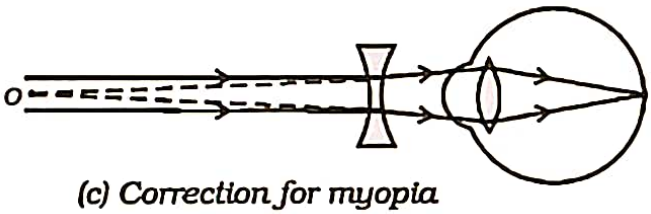
Myopia or short-sightedness is that defect of human eye by virtue of which it can see clearly the object lying at short distance from it But the far off objects cannot be seen clearly by the myopic eye.



(a) Far point of a myopic eye



(b) Myopic Eye



(c) Correction for myopia

Defects Causes :-

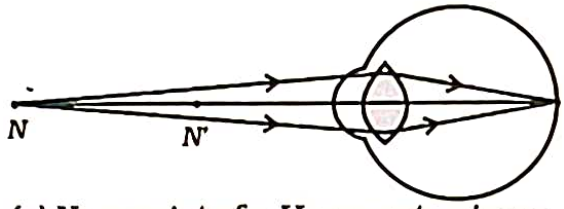
(i) Increase in the length of the eye ball.

(ii) Decrease in focal length of the eye lens when the eye is fully Relaxed.

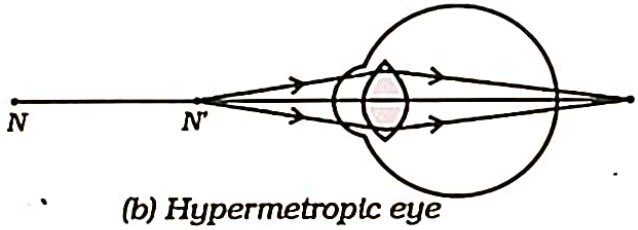
To correct a myopic eye, the person has to wear spectacle with a concave lens of suitable focal length or power.

(2) Hypermetropia or Long Sightedness :-

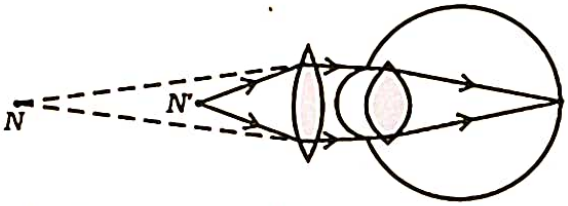
It is that effect of human eye, by virtue of which it can see clearly the object lying at large distance from it. But the nearly object can not be seen clearly by the hypermetropia eye



(a) Near point of a Hypermetropic eye



(b) Hypermetropic eye



(c) Correction for Hypermetropic eye

Defect Causes :-

(i) Decrease in length of the eye ball.

(ii) Increase in focal length of the eye lens, when the eye is fully relaxed.

To correcta hypermetropia eye, the person has to wear spectacles with a convex lens of suitable focal length or power.

(3) Presbyopia (old sight) :-

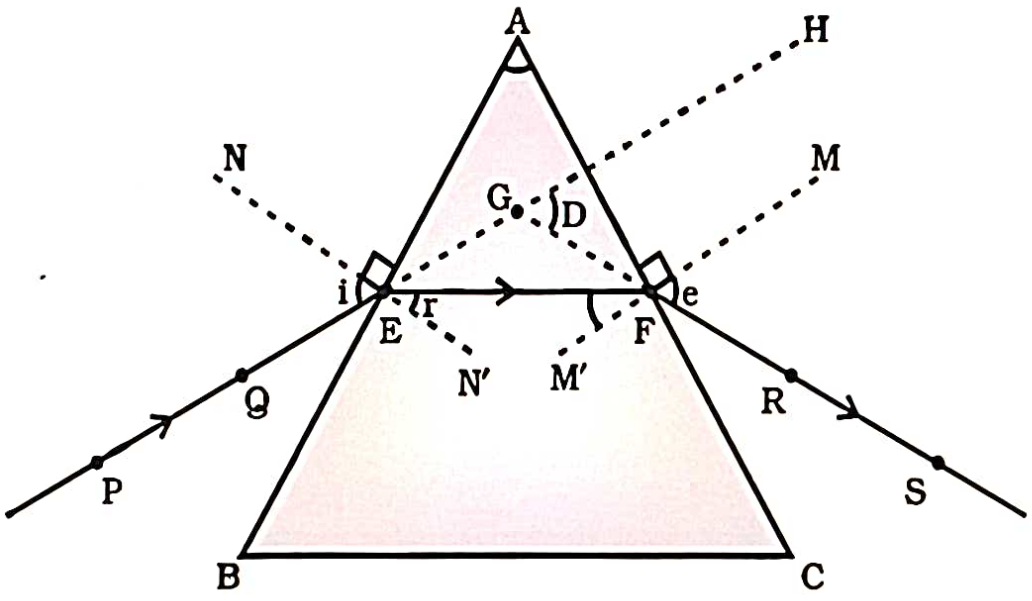
Presbyopia is that defect of human eye, due to which an old person cannot read and write comfortably. that is why presbyopia is also called old sight.

- The cause of hypermetropia is decrease in length of eye ball or increase in focal length of eye lens. But the cause of presbyopia is only increas in focal length of eye lens. The eye ball, in presbyopia has normal length.

- To correct presbyopia, an old person has to use sepectacles with a convex lens of suitable focal length or power as explained already.

- When a person suffers from both, the myopia as well as hypermetropia, his spectacles for correction have bifocal lenses. The upper half is a concave lens for distant vision and lower half is a convex lens for reading.

Refraction of light through a prism :-



- A triangular glass prism has two triangular bases and three rectangular bases surfaces.

- PE is incident Ray EF is Refracted Ray
  FS is emergent Ray ∠A Angle of prism

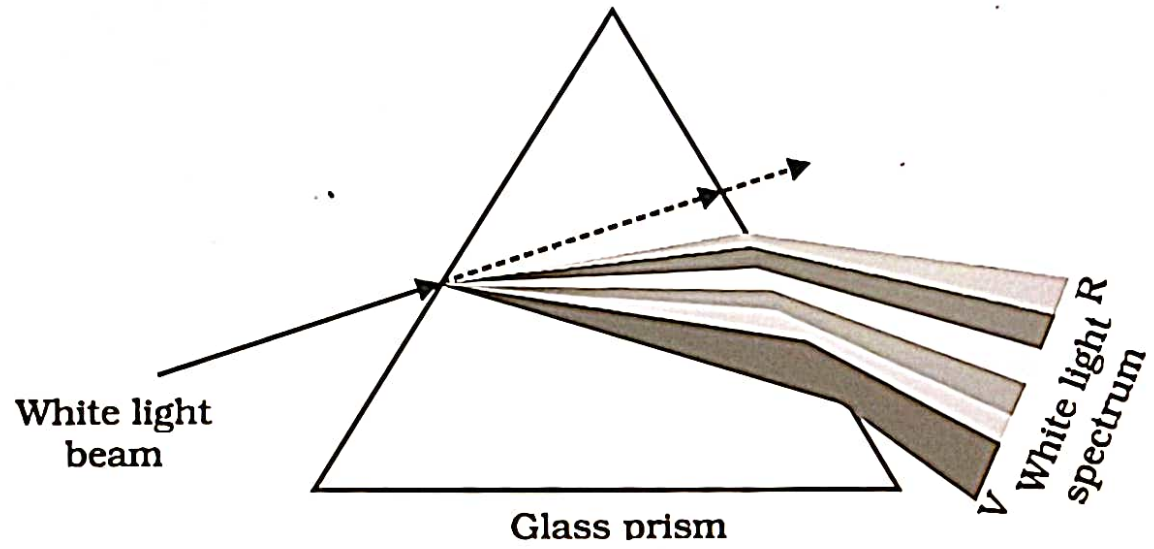
$\angle i$ angle of incidence $\angle r$ Angle of Refraction

$\angle e$ angle of emergence $\angle D$ Angle of Deviation

$$\angle A + \angle D = \angle i + \angle e$$

Dispersion of White light by a glass prism :-

The phenomenon of splitting of white light into its constituent seven colour on passing through a glass prism is called dispersion of light.



Red colour bends the least and Violet colour bends maximum passing through the prism.

Composition of white light :-

White light is a mixture of seven colours

S.No.	Colour	Wavelength (λ)	Frequency $\nu = \frac{c}{\lambda}$
1	Violet (V)	4000 A°	7.50×10^{14} Hz
2	Indigo (I)	4500 A°	6.67×10^{14} Hz
3	Blue (B)	4800 A°	6.25×10^{14} Hz
4	Green (G)	5400 A°	5.56×10^{14} Hz
5	Yellow (Y)	5800 A°	5.17×10^{14} Hz
6	Orange (O)	6000 A°	5.00×10^{14} Hz
7	Red (R)	7900 A°	3.80×10^{14} Hz

If light consist of one colour or single wavelength is called monochromatic light and if it consist more than one called polychromatic like mercury lamp.

VISIBLE SPECTRUM :-

The band of seven colours obtained on a screen on passing white light through a prism is called a spectrum. As all the colours in this spectrum. As all the colours in this spectrum are visible to our eyes, it is rightly called a visible spectrum.

A spectrum in which different colours occupy their own distinct positions without any overlapping, is called a pure spectrum.

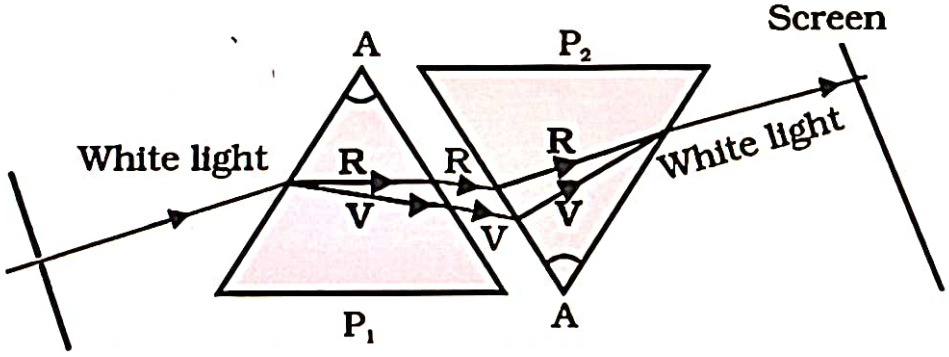
A spectrum in which different colours of light overlap one another, is called an Impure spectrum.

Cause of Dispersion :-

The cause of dispersion is that different colours of white having different wavelength deviate through different angles on passing through a glass prism. that is why they split on coming out from the prism. that different directions.

Recombination of spectrum colours :-

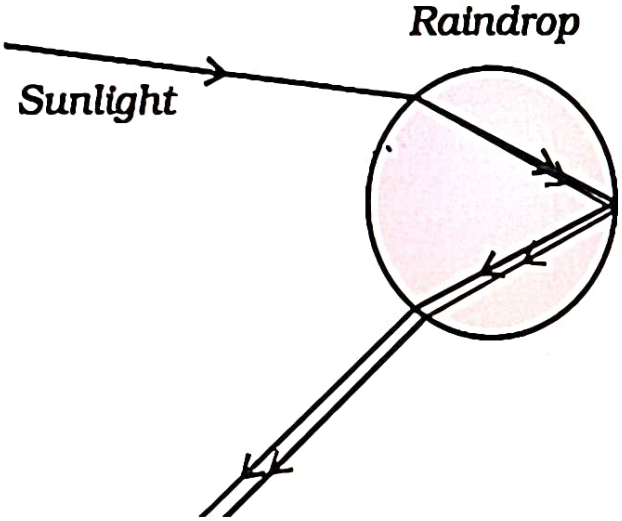
Here we can see that first prism disperses white light into seven colours. the second prism receives these seven colours and recombine them into the orginal white light.

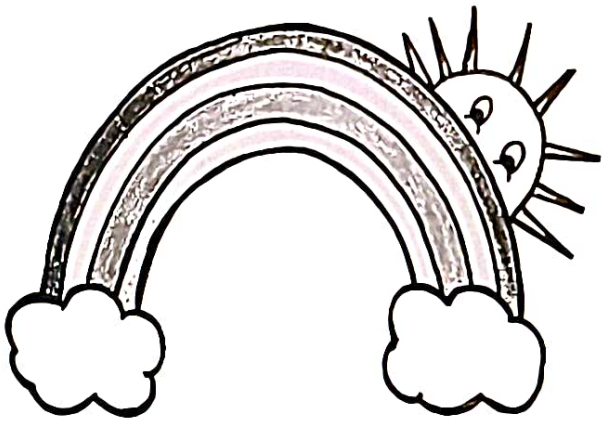


Rainbow :-

The essential condition for observing a rainbow is that observer must stand with his back towards the sun.

During or after a shower, a large no. of tiny water droplets remain suspended in air. they act like small prism. the sunlight falling on droplets is refracted and dispersed on passing through them. It then suffers total internal reflection and is finally refracted by the droplet to reach the observer's eye.



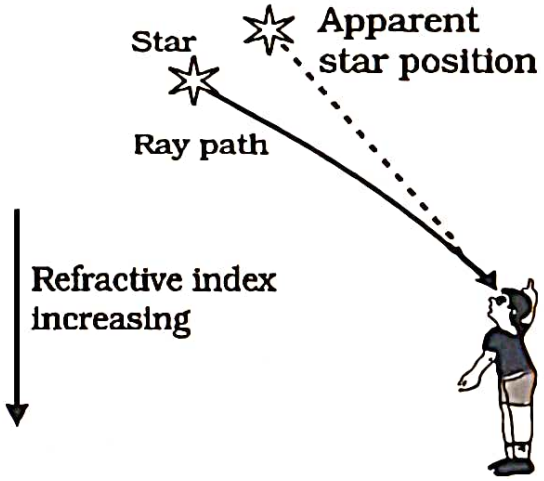


Atmospheric Refraction :-

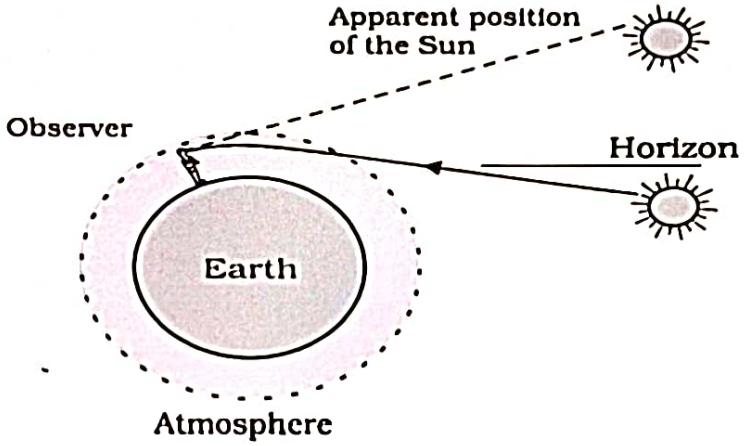
Atmospheric refraction is the phenomenon of bending of light on passing through earth's atmosphere

Examples:-

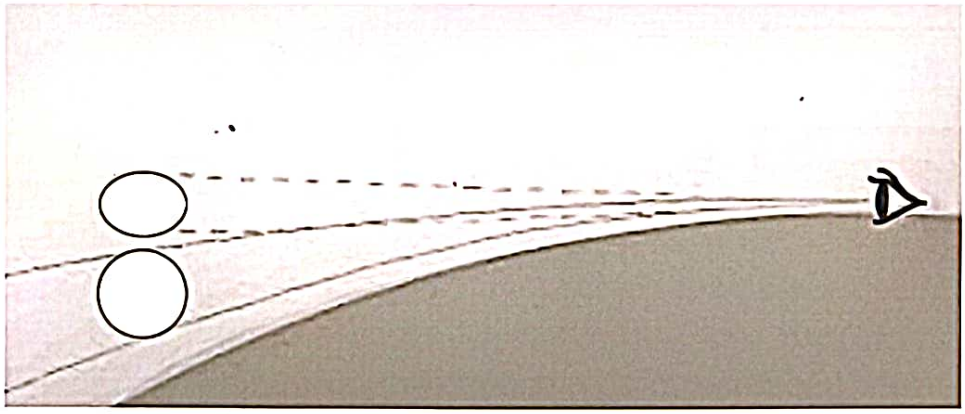
(i) Stars seems higher than they actuall are.



(ii) Advanced sunrise and delayed sunset.



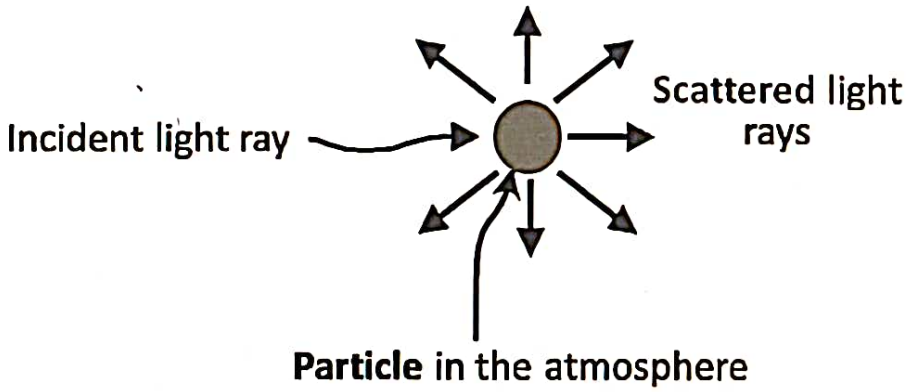
(iii) The sun appears flattened at sunrise and sunset, but appears circular at noon.



(iv) Stars twinkle, planets donot.

Scattering of light

Scattering of light is the phenomenon of change in the direction of light on striking on obstacle like an atom.



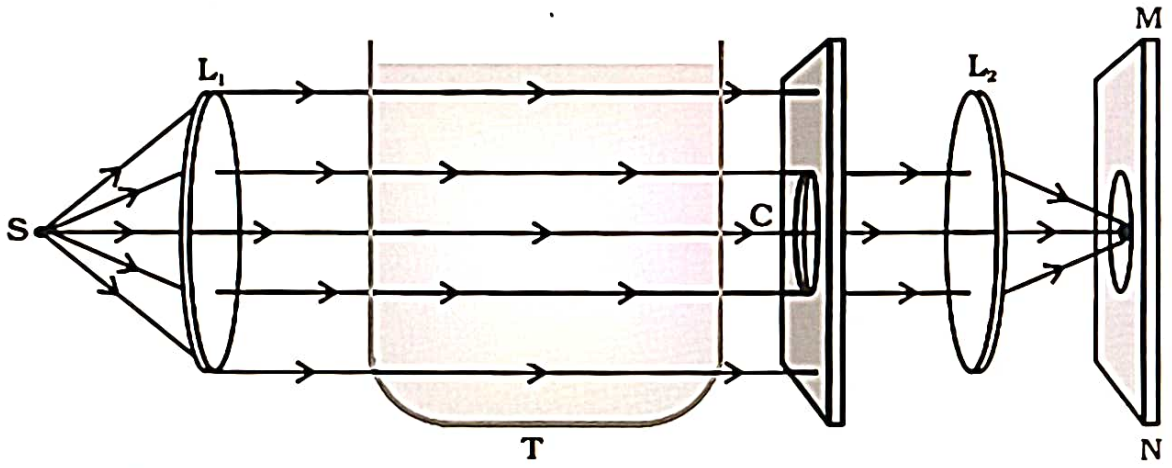
- Intensity of scattered light (I_s) varies Inversely as the fourth power of the wavelength of incident light.

$$I_s \propto \frac{1}{\lambda^4}$$

- Another Important factor in scattering of light is relative size of scatteres (x) compared to wavelength of light (λ).

For $x << \lambda$ when size of scatterer is much less than the wavelength of light, Rayleigh scattering is Valid. When $x >> \lambda$ Rayleigh scattering is not Valid.

Tyndall Effect



By help of diagram we can see that S is source of light. When light which is emitted by S passed through Convex lens it provides a parallel beam of light. this beam is passed through a transparent glass tank (T) containing clar water and 100 gm hypo (Sodium thiosuphate). now the beam emerging from the tank passes through a narrow hole and Convex lens L_2.

We find that :-

(i) Fine microscopic sulphur particle precipitate in water in a couple of minutes.

(ii) Light gets scattered from the minute colloidal sulphur particles and we observe blue colour to start with from the three sides of glass tank.

(iii) When we observe the colour of transmitted light from the fourth side of the tank facing the circulare hole, we find first the organe colour one the screen Y.

Some examples of scattering :-

(i) Blue colour of clear sky
(ii) White colour of cloudes.
(iii) Danger signal are Red
(iv) Sun looks Raddish at the time of sunrise and sunset.