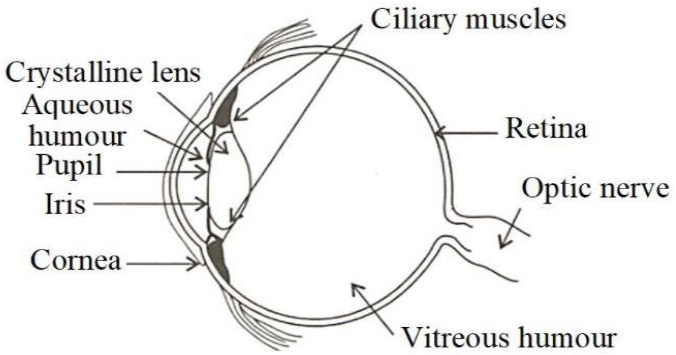
SHORT NOTES: CLASS 10

CHAPTER 10: HUMAN EYE AND COLOURFUL WORLD

THE HUMAN EYE

The Human eye is one of the most valuable and sensitive sense organs. It enables us to see the wonderful world and the colours around us.

MAIN PARTS OF THE HUMAN EYE:



i. Cornea: Front part of the eye is called Cornea. It is made up of transparent substa and is bulging outwards.

ii. Iris: It is a dark muscular assembly that controls the size of the pupil.

iii. Pupil: The amount of light entering the can be controlled by the pupil. When light very bright, the pupil becomes very small. However, in dim light, it opens up.

iv. **Eye lens/Convex lens:** The eye lens is composed of fibrous, jelly like material. The focal length of the eye lens can be changed by the action of ciliary muscles.

v. **Retina:** It is just like a screen on which the image is formed in the eye. It is behind the eye lens. Image formed on retina is real and inverted. The retina is a delicate membrane having a large number of light sensitive cells called rods and cones.
Rods: These are light sensitive cells which respond to intensity of light.
Cones: These are light sensitive cells present in the retina of eye which respond to colour of objects.

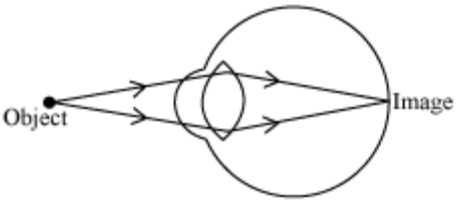
vi. **Aqueous Humour:** The space between the cornea and eye lens is filled with a viscous liquid called Aqueous Humour.

vii. **Vitreous Humour:** The space between Eye lens and retina of the eye is called Vitreous Humour.

viii. **Blind Spot:** A small region of retina, where the optic nerve enters the eye ball, is insensitive to light and it is called Blind Spot.

ix. **Optic Nerve:** The image formed on retina is conveyed to the brain by optic nerve and gives rise to sensation of vision.

WORKING OF THE EYE: The light rays coming from the object enter the pupil of the eye and fall on the eye lens which converges the light rays and produces a real and inverted image of the object on the retina. The image formed on the retina is conveyed to the brain by optic nerve. Our mind interprets the image as that of an erect image.

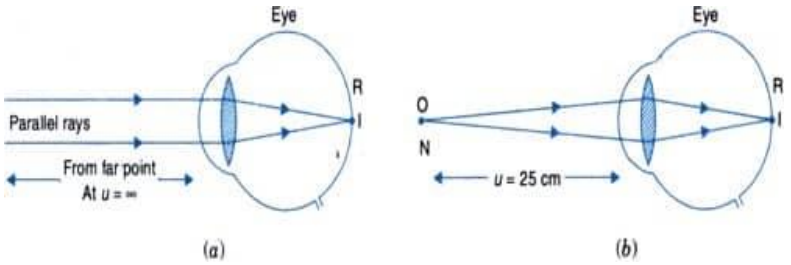


ACCOMMODATION: The ability or property of the eye lens to adjust its focal length is called Accommodation. A normal eye has a power of accommodation which enables objects as far as infinity and as close as 25 cm to be focused on the retina.

Far point: The farthest point from the eye which can be seen clearly is known as far point of the eye. The far point of the normal eye is at infinity.

Near Point: The nearest point up to which an eye can see objects clearly is called the near point of the eye. The near point of a normal human eye is at a distance of 25 cm from the eye.

Least distance of distinct vision: The minimum distance at which an object must be placed so that a normal eye may see it clearly, is called the least distance of distinct vision.



DEFECTS OF VISION AND THEIR CORRECTION: Sometimes, the eye may gradually lose its power of accommodation. In such conditions, the person cannot see the objects distinctly and comfortably. The vision becomes blurred due to refractive defects of the eye. These defects can be corrected by the use of suitable lenses.

There are four types of defects of vision:

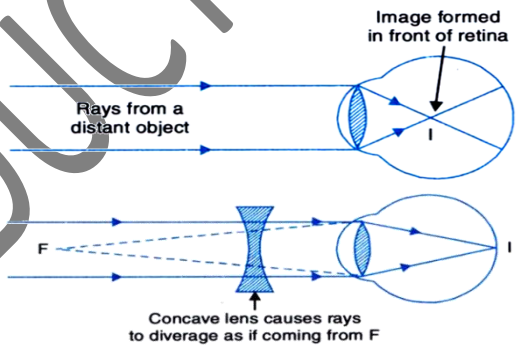
i. Myopia (short sightedness or near sightedness)
ii. Hypermetropia (long sightedness or far sightedness)
iii. Presbyopia
iv. Astigmatism

i. Myopia: It is a defect of eye due to which a person can see nearby objects clearly but can't see the distant objects distinctly.

Causes:

a. Due to excessive curvature of the eye lens.
b. Due to elongation of the eye ball.

Correction: The defect can be corrected by using concave lens.

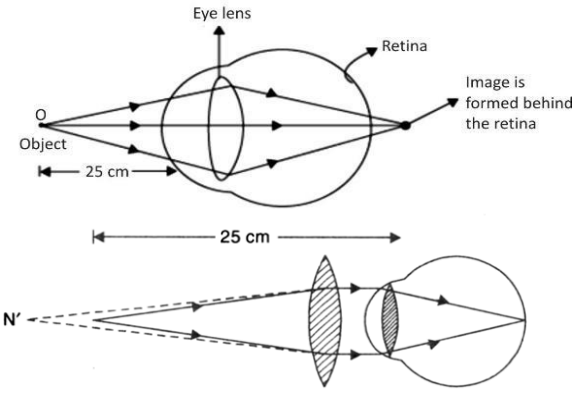


ii. Hypermetropia: It is a defect of eye due to which a person can see distant objects distinctly but can't see nearby objects so clearly.

Causes:

a. Due to low converging power of the eye lens i.e., focal length of the eye lens is too long.
b. Due to the eye ball being too small.

Correction: The defect can be corrected by using convex lens.



iii. Presbyopia: It is the defect of the eye due to which an old person can't read comfortably and clearly without spectacles. It arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye-lens.

Such people often require bifocal lenses. A common type of bifocal lenses consists of both concave and convex lenses. The upper portion consists of a concave lens, it facilitates distant vision. The lower part is a convex lens, it facilitates near vision.

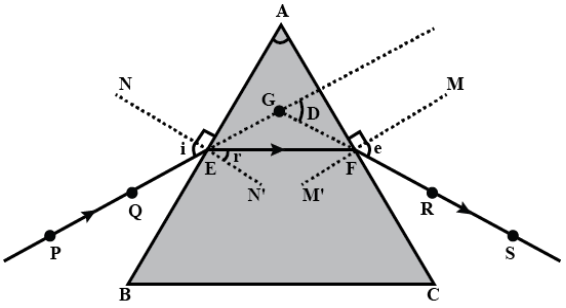
iv. Astigmatism: It is that defect of the eye due to which a person cannot focus on both horizontal and vertical lines simultaneously.

Cause: This defect arises due to irregularities on the surface of cornea. It is not perfectly spherical. It

has different curvatures in different directions. Astigmatism can be corrected by superimposing cylindrical lenses upon the spherical shape of spectacle lenses.

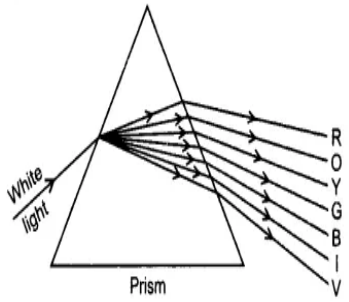
Cataract: Cataract develops when eye lens of a person becomes hazy due to the formation of membrane over it. It can even lead to total loss of vision of the eye.

REFRACTION OF LIGHT THROUGH A PRISM: A prism has two triangular bases and three rectangular lateral surfaces. These surfaces are inclined to each other. The angle between its two lateral surfaces is called the angle of the prism.



PE : Incident Ray
EF : Refracted Ray
FS : Emergent Ray
A : Angle of prism
i: Angle of Incidence
r: Angle of refraction
e : Angle of emergence
D : Angle of deviation

The peculiar shape of the prism makes the emergent ray bend at an angle to the direction of incident ray.



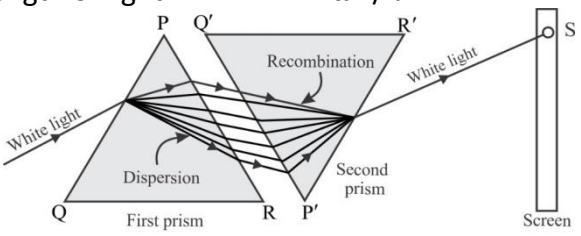
DISPERSION: The splitting of white light into seven colours on passing through a transparent medium is called dispersion of light. A glass prism splits white light into seven colours.

The dispersion of white light occurs because angle of refraction (angle of bending) of different colours is different when passing through a glass prism. Red colour is deviated the least. Violet colour is deviated the maximum.

- Frequency increases from red to violet.
- Wavelength decreases from red to violet.

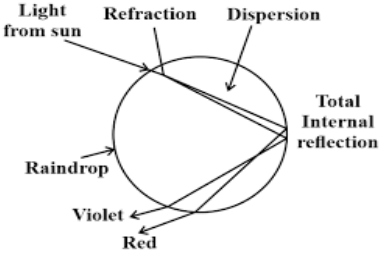
Frequency, $\nu = c/\lambda$ where c : velocity of light, λ : wavelength of light $\nu \propto 1/\lambda$

Recombination of spectrum colours: Issac Newton was the first to use a glass prism to obtain the spectrum of sunlight. He showed that spectrum of colours can be recombined to give back white light.



How rainbow is formed: A rainbow is a natural spectrum appearing in the sky after a rain shower. It is produced by dispersion of light (sunlight) by tiny rain drops in the air.

After the rain, there are a large number of small water drops (rain drops) in the atmosphere which act like many small prisms. As, the white light enters and leaves these water drops, the various coloured constituents of white light are refracted by different amounts and a band of seven colours is obtained.



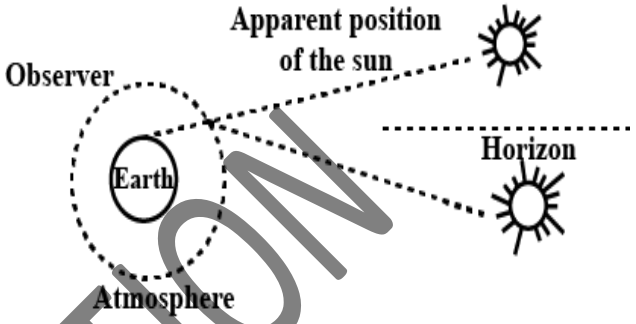
ATMOSPHERIC REFRACTION: The refraction of light caused by Earth's atmosphere is called Atmospheric refraction. E.g., twinkling of stars, Advance sunrise and delayed sunset, Mirage,

Looming, Stars appear higher than they actually are.

i. **Twinkling of stars:** The twinkling of a star is due to the atmospheric refraction of star's light. The continuously changing atmosphere refracts the light from the stars by different amounts. In this way, star light reaching our eyes increases and decrease continuously due to atmospheric refraction. And, the stars appear twinkle at night.

ii. **Advanced sunrise and delayed sunset:** The Sun is visible to us about 2 minutes before the sunrise and about 2 minutes after the actual sunset because of atmospheric refraction.

When the Sun is slightly below the horizon then the sun's light coming from less dense to more dense air, is refracted downwards as it passes through the atmosphere. Because of this atmospheric refraction, the Sun appears to be raised above the horizon.



SCATTERING OF LIGHT: Scattering of light causes blue colour of the sky and reddening of the Sun at sunrise and sunset. The interplay of light with objects around us gives rise to several spectacular phenomena in nature (scattering of light).

i. **Tyndall effect:** Colloidal particles scatter a beam of light passing through it. The particles present in colloidal solution have size big enough to scatter or disperse the lightrays present in the beam as they fall on them. As a result, these rays as well as colloidal particles become visible. The scattering of light by colloidal particles is known as Tyndall Effect.

Note: The colour of the scattered light depends on the size of the scattering particles. Very fine particles scatter mainly blue light (shorter wavelengths) while, particles of larger size scatter light of longer wavelengths. If the size of scattering particles is large enough then, the scattered light may even appear white.

ii. **Why is the colour of the clear sky blue?:** When sunlight passes through the atmosphere, the fine particles of air scatter the blue colour (shorter wavelengths) more strongly than the red. The scattered blue light enters our eyes.

- If the Earth had no atmosphere, there would not have been any scattering, then the sky would have looked dark.
- Sky appears dark to the passengers flying at high altitudes, as scattering is not prominent at such heights.
- Danger signal lights are red in colour because red is least scattered by fog or smoke. Therefore, it can be seen in the same colour at a distance.

iii. **Colour of the Sun at sunrise and sunset:** light form the sun near the horizon passes through thicker layer of air and larger distance in the Earth's atmosphere.

However, light from the sun overhead would travel relatively shorter distance. At noon, the sun appears white as only a little of blue and violet colours are scattered. Near the horizon, most of the blue light and shorter wavelengths are scattered away by the particles. Therefore, the light that reaches our eyes is of longer wavelengths. This gives rise to reddish appearance of the Sun.