Class X	**Topic Chapter – Human eye and the colourful world**
Subject- PHYSICS	**Prepared by-JITENDER V SKARIA**

Structure of human eye

The human eye is like a camera. The eye ball of the human eye is spherical in shape. Diameter of the eyeball is 2.3 cm. It consists of a tough fibrous membrane called sclera that protects the internal parts of the eye.

Cornea:

- Front part of eye is the Cornea.
- It is the transparent window that bulges outwards (having a convex shape).

- It is responsible for the maximum refraction (bending) of the light that enters the eye.
- Behind the cornea is a ring-shaped membrane called the iris.

Iris:

Iris is the coloured part of the eye. The iris has an adjustable circular opening that is located at the centre of the iris, called the pupil.

Pupil-

- The pupil regulates and controls the amount of light entering the eye.
- A clear watery fluid called the aqueous humor fill the space between the cornea and the iris.
- Aqueous humor nourishes the cornea and the lens and gives the eye it's shape
- Situated behind the iris and pupil is a colorless, transparent structure called the crystalline lens.

Crystalline lens:

It is made of a jelly type transparent material and is a biconvex structure. The eye lens forms an **i**nverted real image of the object on the retina.

Retina:

The screen of the eye is referred to as retina because the light rays come through the pupil and passes through the lens and converges on a screen called retina. The **retina** is a delicate membrane having a large number of light sensitive cells called rods and cones which respond to the intensity of light and colour of objects by generating electrical signal.

Suspensory ligament:

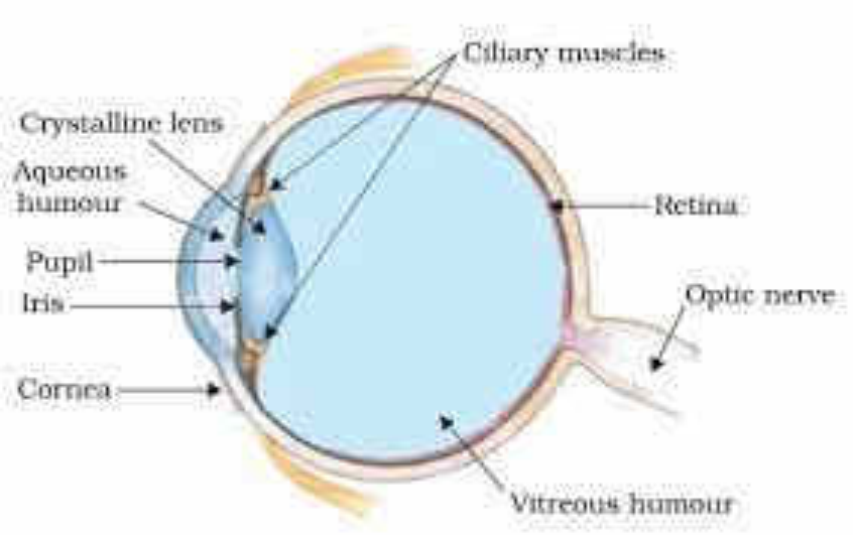
The ciliary muscle and lens are supported by the suspensory ligament. Suspensory ligaments are elastic-like structures present in the eye that helps to keep the lens in its position. The other end of the suspensory ligament is connected to the ciliary muscles.

Ciliary Muscles:

Ciliary muscles determine the shape of the lens. They help in adjusting the focal length of the lens by contraction or relaxing. Vitreous humor lies behind the lens and forms the bulk of the eye. It is a dense, clear, jelly like fluid which helps to maintain the shape of the eye and it also refracts light onto the retina.

Optic nerves:

There are some nerves that connect the retina with the brain and it is called the optic nerves. It is located at the back of the eye. Optic nerves are bundle of over one million nerves fibers that carry visual messages from the retina to the brain.



Working of eye:

- Basic Working of a human eye is similar to camera.
- Light reflects off from the objects and enters the eyeball through a transparent layer of tissue at the eye called cornea.
- The cornea bends the light rays through the pupil-the dark opening in the center of the coloured portion of the eye.
- The adjusted light passes through the eye's natural crystalline lens.
- Since the eye lens is convex in nature, the resulting image is real, small and inverted. This image is formed on retina.
- The retina converts these rays into electrical signals that is relayed to the brain via the optic nerve. The brain processes the information it receives, so that in turn, we can see.

Power of Accommodation

The eye lens is composed of a fibrous, jelly-like material. Its curvature can be modified to some extent by the ciliary muscles. The change in the curvature of the eye lens can thus change its focal length. When the muscles are relaxed, the lens

becomes thin. Thus, its focal length increases. This enables us to see distant objects clearly. When looking at objects closer to the eye, the ciliary muscles contract. This increases the curvature of the eye lens. The eye lens then becomes thicker. Consequently, the focal length of the eye lens decreases. This enables us to see nearby objects clearly.

The ability of the eye lens to adjust its focal length is called accommodation. However, the focal length of the eye lens cannot be decreased below a certain minimum limit.

The minimum distance, at which objects can be seen most distinctly without strain, is called the **least distance of distinct vision**. It is also called the **near point** of the eye. For a young adult with normal vision, the near point is about 25 cm.

The farthest point up to which the eye can see objects clearly is called the **far point** of the eye. It is infinity for a normal eye.

A normal eye can see objects clearly that are between 25 cm and infinity.

CATARACT

Sometimes, the crystalline lens of people at old age becomes milky and cloudy. This condition is called **cataract**. This causes partial or complete loss of vision. It is possible to restore vision through a cataract surgery

DEFECTS OF VISION

There are mainly three common refractive defects of vision. These are (i) myopia or near-sightedness, (ii) Hypermetropia or far - sightedness, and (iii) Presbyopia. These defects can be corrected by the use of suitable spherical lenses.

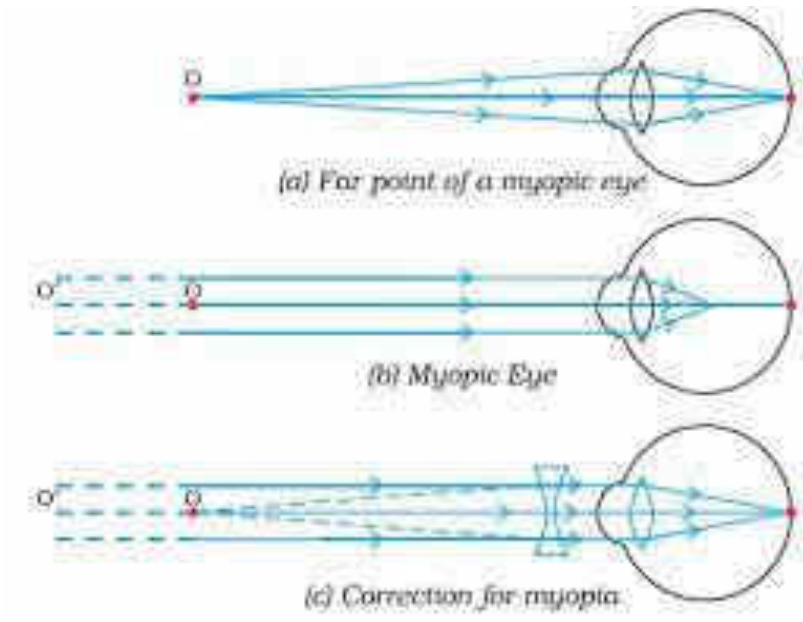
Myopia

Myopia is also known as near-sightedness. A person with myopia can see nearby objects clearly but cannot see distant objects distinctly. A person with this defect has the far point nearer than infinity. Such a person may see clearly up to a distance of a few metres. In a myopic eye, the image of a distant object is formed in front of the retina and not at the retina itself. This defect may arise due to

(i) excessive curvature of the eye lens, or

(ii) elongation of the eyeball. This defect can be corrected by using a concave lens of suitable power.

A concave lens of suitable power will bring the image back on to the retina and thus the defect is corrected.



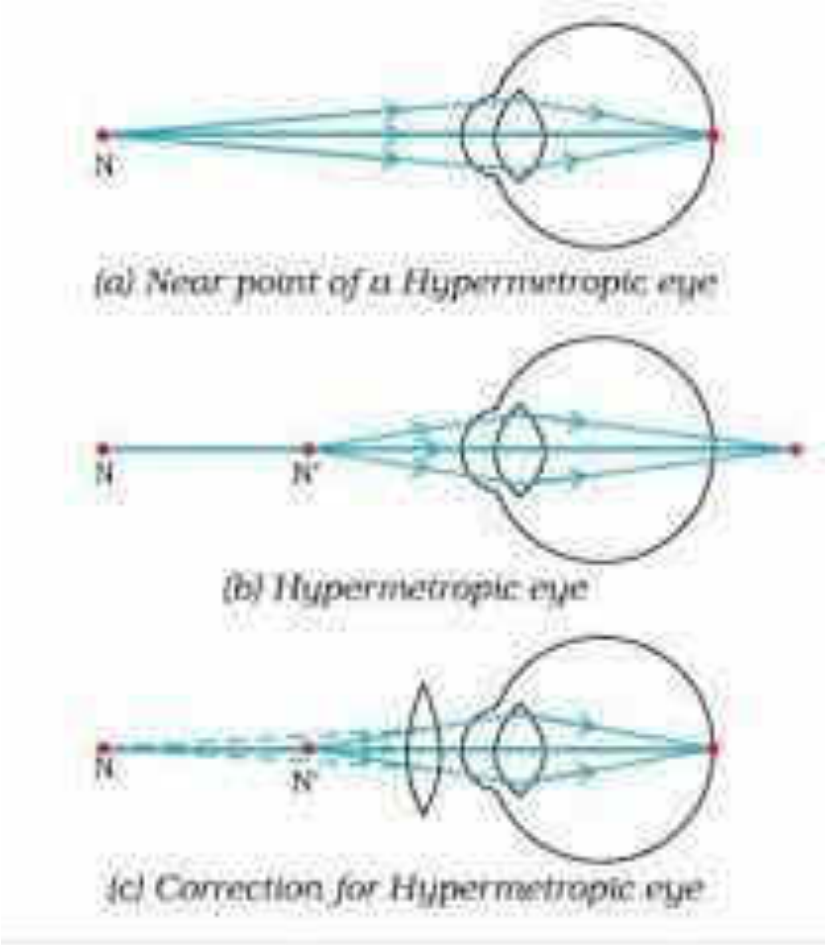
Hypermetropia

Hypermetropia is also known as far -sightedness. A person with hypermetropia can see distant objects clearly but cannot see nearby objects distinctly. The near point, for the person, is farther away from the normal near point (25 cm). Such a person has to keep a reading material much beyond 25 cm from the eye for comfortable reading. This is because the light rays from a close by object are focused at a point behind the retina. This defect arises either because

(i) the focal length of the eye lens is too long, or

(ii) the eyeball has become too small.

This defect can be corrected by using a convex lens of appropriate power.



Presbyopia

The power of accommodation of the eye usually decreases with ageing. For most people, the near point gradually recedes away. They find it difficult to see nearby objects comfortably and distinctly without corrective eye-glasses. This defect is called Presbyopia. It arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens. Sometimes, a person may suffer from both myopia and hypermetropia. Such people often require bifocal lenses. A common type of bi-focal 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. These days, it is possible to correct the refractive defects with contact lenses or through surgical interventions

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