HUMAN EYE AND THE COLOURFUL WORLD

Gist of the Lesson:

1. **Human Eye:** It is most important and sensitive sense organ. The essential parts of a human eye are sclerotic, cornea, choroid, iris, pupil, crystalline lens, ciliary muscle, aqueous humour, vitreous humour and retina.
2. **Iris:** It is an opaque circular diaphragm that controls the size of the pupil.
3. **Eye Lens:** It is a converging lens situated behind the iris. It is made of fibrous, jelly- like material.
4. **Accommodation:** It is the ability of the eye lens due to which it can change its focal length so that images of objects at various distances can be formed on the same retina.
5. **Range of Normal Vision:** The distance between infinity and 25 cm point the range of normal vision.
6. **Near Point:** The nearest point from the eye, at which an object can be seen clearly by the eye, is called its near point. The near point a normal eye is at a distance of 25 cm.
7. **Far Point:** The farthest point from the eye at which an object can be seen clearly by the eye is called the far point of the eye. For a normal eye, the far point is at infinity.
8. **Rods:** These are rod-shaped cells of the retina that are sensitive to the intensity of light.
9. **Cones:** These are cone-shaped cells of the retina that are sensitive to the colours of light.
10. **Cataract:** It is due to the development of hazy or opaque membrane over the eye lens which results in the decrease or loss of vision. It can be cured by surgery.
11. **Common Defects of Vision:** There are mainly four common defects of vision which can be corrected by the use of suitable eye glasses. These are

    (i) Myopia or near sightedness

    (ii) Hypermetropia or far-sightedness

    (iii) Presbyopia

    (iv) Pstigmatism.

12. **Presbyopia:** In this defect, a person in old age cannot read correctly due to the stiffening of the ciliary muscles and the decrease in flexibility of the eye lens.

13. **Astigmatism:** It is a defect of vision in which a person cannot simultaneously see both the horizontal and vertical views of an object with the same clarity. It is due to the irregular curvature of the cornea. It can be corrected by using a cylindrical lens.

14. **Rainbow:** It is a beautiful spectrum of light produced by refraction, dispersion and /internal reflection of sunlight by spherical raindrops. It is observed when the sun shines on raindrops after a rain shower. An observer standing with his back towards the sun observes it in the form of concentric circular arcs of different colours in the horizon.

15. **Advance Sunrise and Delayed Sunset:** Due to atmospheric refraction, the sun is visible to us about two minutes before the actual sunrise and two minutes after the actual sunset.

16. **Blue Colour of the Sky:** The atmospheric molecules scatter blue light of shorter wavelength more strongly than the red light of longer wavelength. When this scattered light reaches our eyes, it contains blue light in larger proportion. That is why the sky appears blue.

One Mark Questions (One word or one sentence)

1. Name the part of the eye which controls the amount of light entering the eye?

A. Pupil

2. Mention the function of retina in a human eye?

A. It acts like a screen on which the image is formed.

3. Name the parts of human eye which:

(i) Regulates and controls the amount of light entering into the eye.

(ii) Provides light sensitive screen on which image is formed.

A. (i) Pupil. (ii)Retina.

4. Explain giving reason the type of lens used to correct the myopia vision defect?

A. Concave lens of appropriate power is used to correct myopia as it will bring the image back on to the retina.

Two Marks Questions (30 words)

1. Explain how does image of an object is communicated to the brain?

A. (1) The eye lens forms an inverted and real image of the object on the retina.

(2) The retina is a delicate membrane having enormous number of light sensitive cells.

(3) The light sensitive cells get activated up on illumination and generate electrical signals.

(4) These signals are sent to the brain via the optic nerves.

2. What is meant by the power of accommodation of the eye? State the role of ciliary muscles in achieving it?

A. The ability of the eye lens to adjust its focal length is called power of accommodation.

Role of Ciliary Muscles: Ciliary muscles help in changing the focal length of the eye lens.

3. Name the defect of visions in a person whose:

(a) Near point is more than 25 cm away.

(b) Far point is less than infinity.

State the nature of corrective lens used in each case.

A. • (a) Hypermetropia. (b) Myopia.

• Corrective lens: Convex lens for hypermetropia and concave lens for myopia.

4. An old person is unable to see clearly nearby object as well as distant objects?

(i) What defect of vision is he suffering from?

(ii) What kind of lens will be required to see clearly the nearby as well as distant objects? Give reasons. How is this lens made?

A. (i) Presbyopia.

(ii) He will have to use both kinds of lenses — convex lens for far-sightedness and concave lens for near-sightedness.

5. Person having presbyopia uses a bifocal lens to restore proper vision. Which part of this lens is convex and which part is concave?

A. Upper part is concave lens while lower part is convex lens.

Three Marks Questions (50 words)

1. Explain Power of Accommodation. Explain in brief the near and the far point of an eye and give their values?

A. **Power of Accommodation:** It is the ability of the eye lens to adjust its focal length.

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

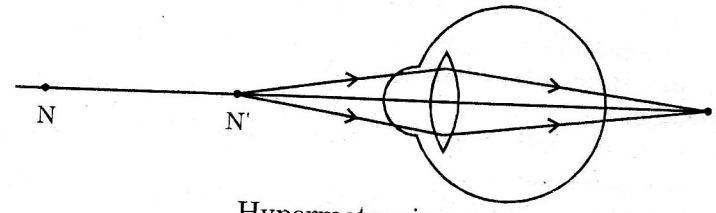
Far Point: The farthest point from the eye which can be seen clearly is known as the far point of the eye. Far point of a normal human eye is infinity.

2. A person is advised to wear spectacles with convex lenses of appropriate power. Name the defect of vision. Show on a figure how convex lens corrects this defect. State any two causes of this eye defect?

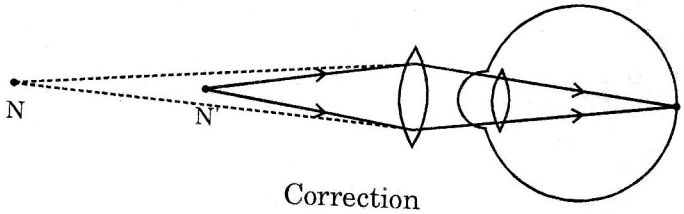
A. Hypermetropia eye

Causes: (1) The focal length of the eye lens is too long.

(2) The eyeball has become too small.



Hypermetropic eye



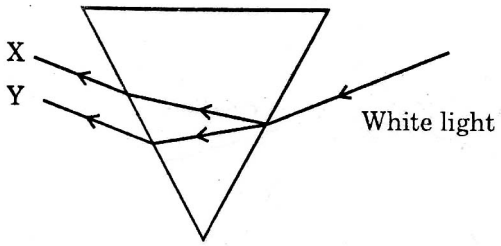
Correction

3. What is a prism? Explain the term dispersion of light illustrate with a diagram the phenomenon of dispersion through it.

A prism is a device which is used in the laboratory to show splitting of white light into seven colours?

A. • The process of splitting up white light into its constituent colour as it passes through a refracting medium is known as dispersion of light.

• It bends towards the base of prism after passing through it.



4. (a) Name the device which is used in laboratory to show splitting of white light into seven colours?

(b) Name the colours of light for which angle of deviation is:

(i) Maximum (ii) Minimum

(c) Why is angle of deviation different for different colours? Name the scientist who first showed that white light is composed of seven colours?

A. (a) Glass prism

(b) (i) Maximum — Violet (ii) Minimum — Red

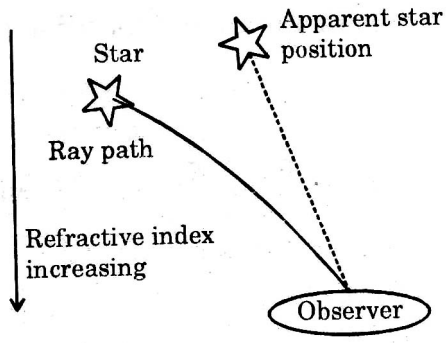
(c) Because different colours of light bend through different angles with respect to Incident Ray as they pass through the Prism.

The name of the scientist is Isaac Newton.

5. Explain why planets do not twinkle while stars twinkle? (Or)

Explain with the help of a labelled diagram, the cause of twinkling of stars?

A. As the stars are very distant, they approximate point-sized source of light. Path of ray of light coming from the stars goes on varying slightly. The apparent position of the star fluctuates and the amount of starlight entering the eye flickers sometimes appears brighter and at times fainter which is t]winkling effect. However, the planets are much closer and appear bigger to us so they cannot be considered as a source point, hence no twinkling occurs.



6. Give the factors on which the colour of scattered white light depends. Give any two examp1es where we observe scattering of light?

A. The colour of the scattered light depends on the size of the particles of the medium through which is passing.

Examples are: (1) Blue colour of the sky (2) Colour of water in the deep sea.

7. (a) Which component of white light is least scattered by fog or smoke?

(b) Why are danger signals red in colour?

(c) What would have been the colour of sky if the earth had no atmosphere? Give reason for your answer?

A. (a) Red.

(b) Because red colour has longer wavelength hence it scatters the least.

(c) If the earth had no atmosphere there would be no particles to scatter light. Hence sky will appear black.

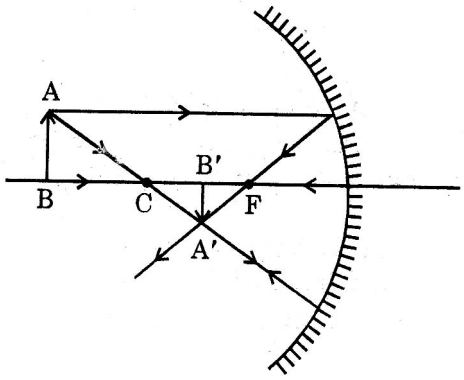
Five Marks Questions (70 words)

1 . (a) Draw a ray diagram for the image formed by a concave mirror when the object is placed beyond its centre of curvature?

(b) Write the characteristics of the image formed?

(c) List the uses of concave mirrors?

A. (a) Object is placed beyond centre of curvature.

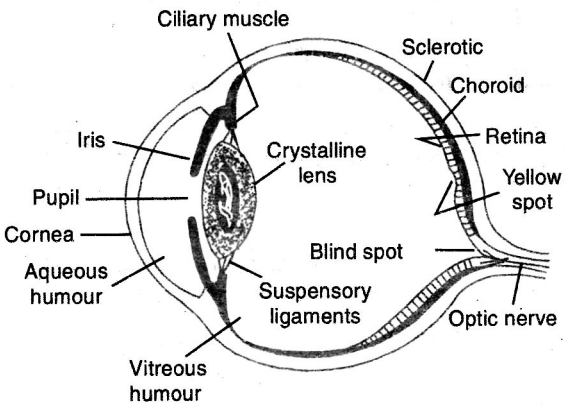


(b) Image formed is: • real and inverted • diminished in size • situated between focus and centre of curvature.

(c) It is used as shaving mirror, in solar furnaces and also used by doctors.

2. Describe the main parts of human eye. Explain its focusing action?

A. **Human Eye:** It is the most valuable and sensitive sense organ. It is a remarkable optical instrument.



Structure of the Eye: As shown in Fig. the main parts of the human eye are as follows:

(i) Sclerotic: The eyeball is nearly spherical in shape with a diameter of about 2.3 cm. It has a tough and opaque white covering, called sclerotic which protects and holds the eye.

(ii) Cornea: Light enters the eye through a thin membrane called cornea which covers the transparent bulge on the front portion of the eyeball.

(iii)Choroid: It is a black membrane below the sclerotic. It absorbs stray light and avoids any blurring of image due to multiple reflections in the eyeball.

(iv) Iris: Behind the cornea, there is an opaque circular diaphragm called iris. The colour of the iris determines the colour of the eyes of a person. The iris has a central hole called the pupil. Due to its muscular action, the iris controls the size of the pupil and hence regulates the amount of light entering the eye. In bright light, the pupil becomes small. In dim light, the pupil opens up completely through the relaxation of the iris.

(v) Eye Lens: It is a double convex lens situated behind the iris. It is composed of a fibrous, jelly like material. The lens is held in position by suspensory ligaments and connected to the sclerotic by the ciliary muscles. By contracting or relaxing, the ciliary muscles can change the shape or curvature of the eye lens and hence change its focal length. This ability of the eye lens to change its focal length is called accommodation. This enables the eye lens to focus the images of objects at different distances on the retina of the eye.

(vi) Retina: It is a delicate inner membrane on the back wall of the eyeball. It contains light sensitive cells called rods and cones. Rods are sensitive to intensity of light while cones are sensitive to colours. These cells change light energy into electrical signals which send message to the brain via the optic nerves.

(vii)Blind Spot and Yellow Spot: In the region where the optic nerve enters the eyeball, there are no rods and cones. This region is totally insensitive to light and is called blind spot. Yellow spot has maximum concentration of light sensitive cells. It is situated in the centre of the retina.

(viii)Aqueous humour and vitreous Humour: Aqueous humour is a salty fluid (n = 1.337) that fills the space between the cornea and the eye lens. Vitreous humour is a jelly like fluid (n = 1.437) that fills the space between the retina and the eye lens.

Focusing action of the eye: The transparent structures like cornea, aqueous humour, eye lens and vitreous humous together constitute a single converging lens. As the rays from an object enter the eye, they suffer refractions on passing successively through these structures and get converged. A real and inverted image is formed on the retina. The light sensitive cells of retina get activated and

generate electrical signals that are sent to the brain through the optic nerves. Our brain translates the inverted image into an erect image.

3. (a)What is myopia? State two reasons due to which this effect is caused. (b) Draw a diagram to show the formation of image of a distant object by a myopic eye. How can such an eye defect be remedied? (Or)
State two main causes of a person developing near sightedness. With the help of a ray diagram, suggest how he can be helped to overcome this disability?

A. **Myopia or short-sightedness:** It is a vision defect in which a person can see nearby objects clearly but cannot see the distant objects clearly beyond a certain point. This defect is common among children.

Cause of Myopia: This defect arises due to either of the following two reasons:

(i) The eyeball gets elongated along its axis so that the distance between the eye lens and the retina becomes larger.

(ii) The focal length of the eye lens becomes too short due to the excessive curvature of cornea.

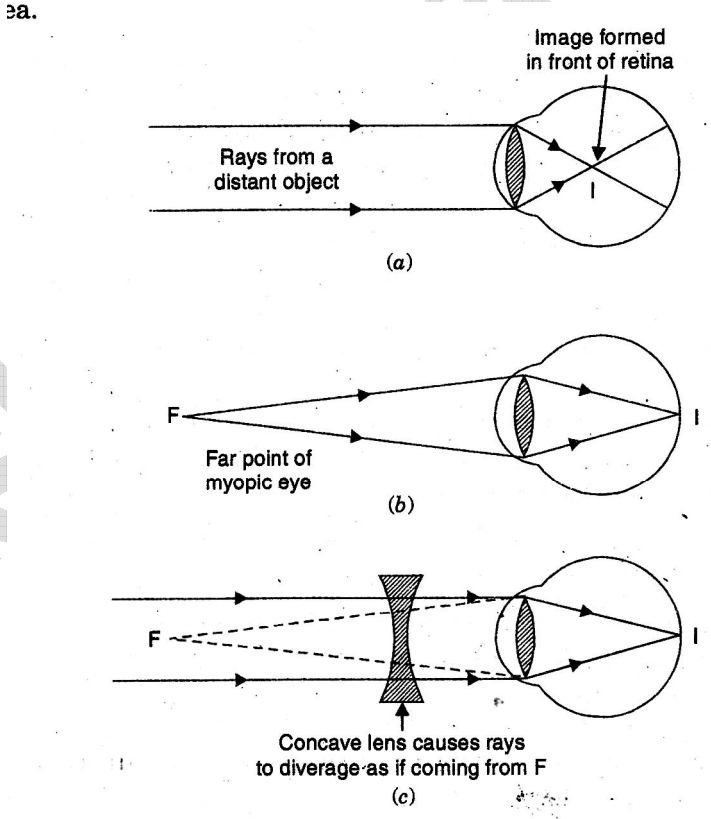


Fig. 11.4. *Myopic and its correction*

As a result of the above causes, the parallel rays coming from a distant object do not meet at the retina but at a point in front of the retina, as shown in Fig. 11.4 (a) and the distant object is not seen clearly. The object has to be moved closer to the eye to a point F to focus it on the retina, as shown in Fig. 11.4

(b) Thus, the far point of a myopic eye is not at infinity but only a few metres from the eye.

Correction of Myopia: A myopic eye is corrected by using a concave lens of focal length equal to the distance of the far point F from the eye. This lens diverges the parallel rays from distant object as if they are coming from the far point F. Finally, the eye lens forms a clear image at the retina.

4. (a) What is hypermetropia?

(b) What are the two causes of this defect of vision?

(c) How can this defect of the eye be corrected? Illustrate your answer by drawing ray d gram to show the formation of image by

(i) A hypermetropia eye,

(ii) A hypermetropia eye corrected with a suitable lens.

A. **Hypermetropia or long-sightedness:** It is a vision defect in which a person ca-. See the distant objects clearly but cannot see the nearby objects clearly.

Cause of Hypermetropia: This defect arises due to either of the following two reasons

(i) The eyeball becomes too small along its axis so that the distance between the eye lens and the retina is reduced.

(ii) The focal length of the eye lens becomes too large resulting in the low converging power of the eye lens.

As a result of the above causes, the rays coming from an object placed at 25 cm (Normal Near Point) from the eye meet at a point behind the retina, as shown in Fig. (a) So the object is not seen clearly.

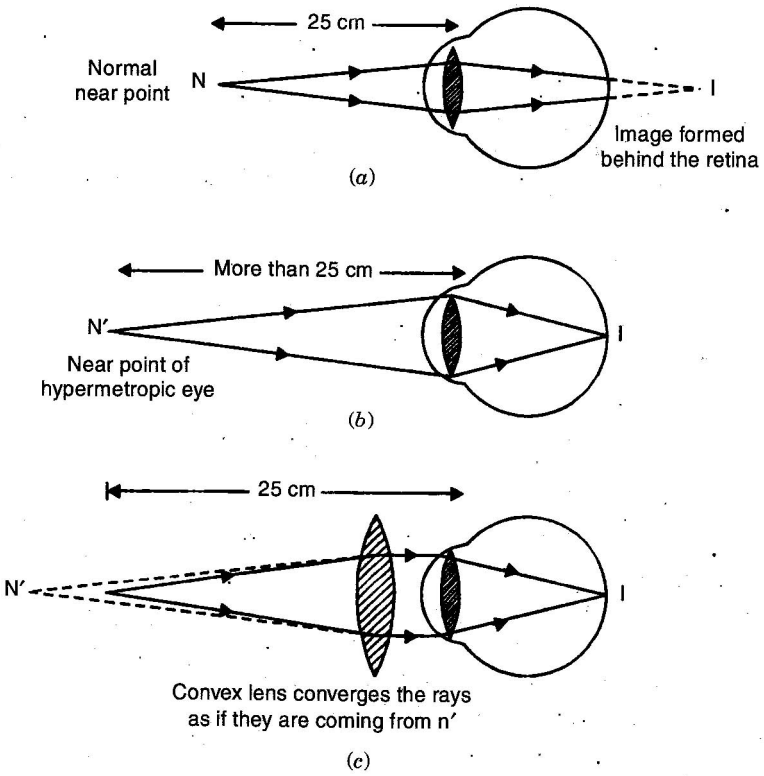


Fig. 11.5. *Hypermetropia and its correction*

To focus the rays again on the retina, the object has to be moved away from the eyes to a distance greater than 25 cm, as shown in Fig.(b) Thus, the near point of the eye is not at 25 cm but it has shifted to N' at a distance greater than 25 cm from the eyes.

Correction of Hypermetropia: A hypermetropia eye is corrected by using a convex lens of suitable focal length. This lens diverges the rays such that the rays coming from normal near point N appear to come after refraction, from near point N' of the defected eye. That is a virtual image of the object placed at N is formed at N'. Then the eye lens forms a clear image at the retina, as shown in Fig. (c).

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