The Human Eye and Colourful World

1. What is meant by the power of accommodation of the eye?

Ans: When the ciliary muscles are relaxed, the eye lens becomes thin. This results in the increase of the focal length, and distant objects are clearly visible to the eyes.

To see the nearby objects clearly, the ciliary muscles contract which makes the eye lens thicker. This results in reduction of focal length of the eye lens, and the nearby objects become visible to the eyes.

Therefore, the focal length can be adjusted by the human eye lens to view both distant and nearby objects on the retina. This ability of the eye refers to the power of accommodation of the eye.

2. A person with a myopic eye cannot see objects beyond

1.21.2

m distinctly. What should be the type of corrective lens used to restore proper vision?

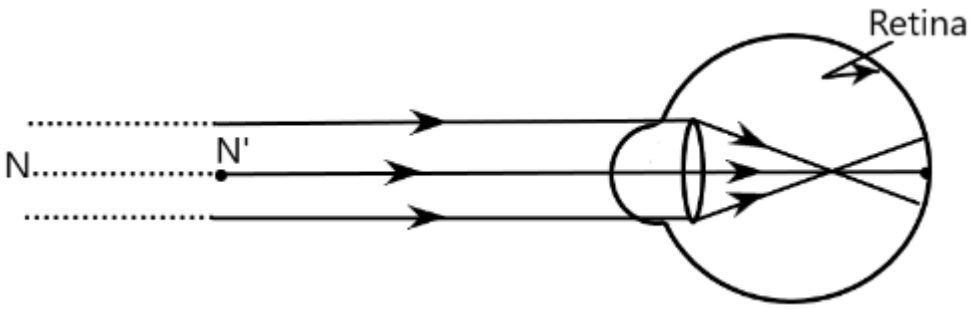
Ans: The person can clearly see the objects which are near, but he cannot see the objects beyond

1.2m1.2m

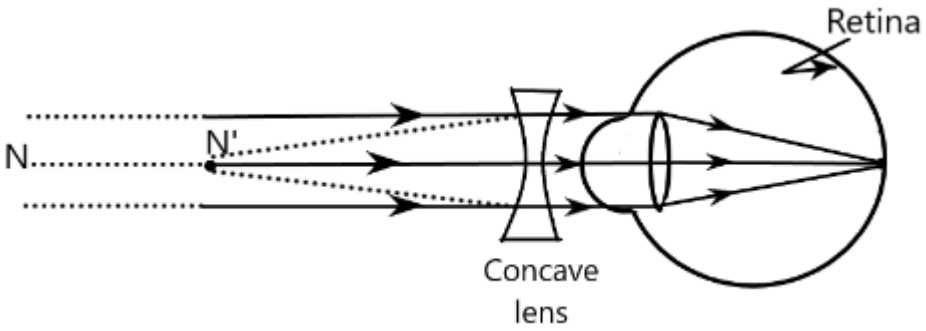
. This arises as the image of an object beyond

1.2m1.2m

is obtained in front of the retina and not at the retina, as displayed in the figure given below.



To correct this defect of vision, a concave lens should be used. The image will be brought back to the retina by the concave lens as shown in the given figure.



3. What is the far point and near point of the human eye with normal vision?

Ans: The near point of the eye refers to the minimum distance of the object from the eye that can be seen clearly without any strain to the eye. This distance is

$$\frac{25}{25}$$

cm, for a normal human eye.

The far point of the eye refers to the maximum distance to which the eye can clearly see the objects, without getting any strain to the eye. The far point of the normal human eye is at an infinite distance.

4. A student has difficulty reading the blackboard while sitting in the last row. What could be the defect the child is suffering from? How can it be corrected?

Ans: A student has difficulty in reading the blackboard while sitting in the last row. It means that he is unable to see distant objects clearly.

The student is suffering from myopia. This defect can be corrected using a concave lens.

MCQs

1. The human eye can focus objects at different distances by adjusting the focal length of the eye lens. This is due to

a) Presbyopia

b) Accommodation

c) Near-sightedness

d) Far-sightedness

Ans: The correct answer is (b) accommodation,

The focal length of the eye lens is changed by the human eye to see objects situated at various distances from the eye. This is possible due to the power of accommodation of the eye lens.

2. The human eye forms the image of an object at its

a) Cornea

b) Iris

c) Pupil

d) Retina

Ans: (d) The image of an object is formed by the human eye at its retina.

3. The least distance of distinct vision for a young adult with normal vision is about

(a) 25 m

(b) 2.5 cm

(c) 25 cm

(d) 2.5 m

Answer –

(c) 25 cm

25 cm is the least distance of distinct vision for a young adult with normal vision.

4. The change in focal length of an eye lens is caused by the action of the

(a) pupil

(b) retina

(c) ciliary muscles

(d) iris

Answer-

(c) ciliary muscles

The action of the ciliary muscles changes the focal length of an eye lens

5. A person needs a lens of power -5.5 dioptres for correcting his distant vision. For correcting his near vision he needs a lens of power +1.5 dioptre. What is the focal length of the lens required for correcting (i) distant vision, and (ii) near vision?

Answer-

The power (*P)* of a lens of focal length f is given by the relation

Power (P) = 1/*f*

(i) Power of the lens (used for correcting distant vision) = – 5.5 D

Focal length of the lens (*f)* = 1/*P*

f = 1/-5.5

f = -0.181 m

The focal length of the lens (for correcting distant vision) is – 0.181 m.

(ii) Power of the lens (used for correcting near vision) = +1.5 D

Focal length of the required lens (*f)* = 1/*P*

f = 1/1.5 = +0.667 m

The focal length of the lens (for correcting near vision) is 0.667 m.

6. The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Answer-

The individual is suffering from myopia. In this defect, the image is formed in front of the retina. Therefore, a concave lens is used to correct this defect of vision.

Object distance (u) = infinity = ∞

Image distance (v) = – 80 cm

Focal length = f

According to the lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$-\frac{1}{80} - \frac{1}{\infty} = \frac{1}{f}$$

$$\frac{1}{f} = -\frac{1}{80}$$

$$f = -80cm = -0.8\ m$$

$We\ know,$

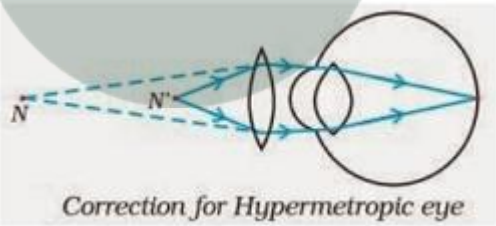
$$Power, P = \frac{1}{f(in\ metres)}$$

$$P = \frac{1}{-0.8} = -1.25D$$

A concave lens of power – 1.25 D is required by the individual to correct his defect.

11. Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is 1 m. What is the power of the lens required to correct this defect? Assume that near point of the normal eye is 25 cm.

Solution : Diagram representing the correction of hypermetropia is a follows:



Correction for Hypermetropic eye

Near point of defective eye is 1 m and that of normal eye is 25 cm.

Here, u = -25 cm, v = -1m = 100 cm.

Using lens formula

1/f = 1/v – 1/u

1/f = 1/-100 + 1/25 = 3/100

f = 100/3 cm = 1/3m.

P = 1/f(m) = 1/0.33 = +3.0 D.

12. Why is a normal eye not able to see clearly the objects placed closer than 25 cm?

Solution : Due to limit of power of accommodation, the focal length of the eye lens cannot be decreased below certain minimum limit. So, a normal eye cannot see clearly the objects placed closer than minimum distance, called near point of the eye.

13. What happen to the image distance in the eye when we increase the distance of an object from the eye?

Solution : The image is formed on the retina even on increasing the distance of an object from the eye. In fact, the eye lens becomes thinner and its focal length increases as the object is moved away from the eye and consequently image is formed on the retina.

14. Why do stars twinkle?

Solution : Stars twinkle due to atmospheric refraction of starlight. As the stars are very away they behave as almost point sources of light. As on account of atmospheric refraction, the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of light entering the eye flickers, so sometimes the star appear brighter and at some other time, fainter. Thus the stars twinkle.

11. Explain why the planets do not twinkle?

Ans: Planets do not twinkle because they appear larger in size than the stars as they are comparatively closer to earth. Planets are a collection of many point-sized sources of light. The various regions of these planets produce either brighter or dimmer effect in such a way that the resultant of brighter and dimmer effect is zero.

Clearly, the twinkling effects of the planets are nullified and that is why they do not twinkle.

12. Why does the Sun appear reddish early in the morning?

Ans: During sunrise, the light rays from the sun travel a greater distance in the earth's atmosphere before reaching our eyes. In this journey, the shorter wavelengths of lights are spread out and only the longer wavelengths reach our eyes.

Since blue colour has a short wavelength and red colour has a long wavelength, red colour can reach our eyes after the atmospheric scattering of light. Thus, the sun appears to be reddish early in the morning.

13. Why does the sky appear dark instead of blue to an astronaut?

Ans: Since there is no atmosphere in outer space that can scatter the sunlight, the sky appears dark instead of blue to an astronaut.

Since the sunlight is not scattered in space, no scattered light reaches the astronaut's eyes and the sky appears black to them instead of blue