NCERT CBSE Solutions for Class 10 Science Chapter 11

Human Eye and the Colorful World

In Chapter Questions: (Page:190)

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

Solution:

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

A normal eye can visualize the distant object as well as a nearby object. This is achieved with the help of the ciliary muscles, which changes the thickness of the lens and hence the focal length of the eye lens. It results in the alteration of the converging power of our eyes. This ability of the eye to focus the distant objects as well as the nearby objects on the Retina by changing the focal length or the converging power of its lens is called Accommodation.

2. A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?

Solution:

The shortsightedness (myopia) can be corrected by placing a concave lens (diverging lens) of suitable focal length before the eye lens. In this case, the distance of far point is 1.2 m. For viewing distant objects, we need to use a lens which can form the image of the object at infinity to at distance 1.2 m or at far point of the person.

Hence, focal length of corrective lens, $f = -1.2$ m

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

Solution:

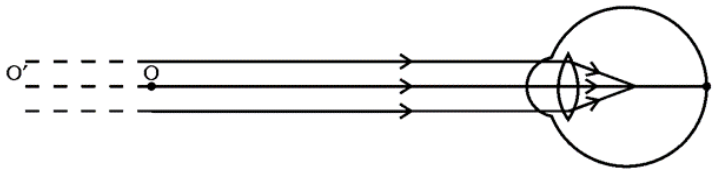
The minimum distance at which objects can be seen distinctly is called the near point of the eye. It is 25 cm for a normal human eye. The farthest point up to which the eye can see objects clearly is called the far point of the eye. It is infinity for a normal eye.

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?

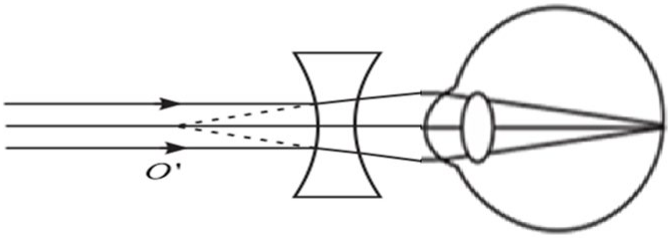
Solution:

The child is suffering from a defect known as Myopia or Short-sightedness. Myopia is commonly occurring defect of the eye which makes it not able to see clearly the distant objects, though it can see nearby objects. This defect develops due to the high converging power of the eye lens because of the insufficient relaxation of the

ciliary muscles. As a result, the image of a distant object is formed in front of the Retina. A person with this defect has a far point nearer than infinity.



The defect can be removed by using spectacles having Concave lenses. This diverges the incident light rays coming from the distant object and it helps the eye lens to focus the image on the right spot of the Retina and so that the eyes can see objects clearly.



NCERT Back of the Book Questions:

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.

Solution: (B)

The human eye can focus objects at different distances by adjusting the focal length of the eye lens. The ability of the eye lens to adjust its focal length is called accommodation.

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

(A) cornea

(B) iris

(C) pupil

(D) retina

Solution: (D)

The human eye forms the image of an object 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.

Solution: (C)

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

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.

Solution: (C)

The ciliary muscles change the thickness of the lens and hence the focal length of the eye lens.

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

Solution:

(i) Given: Power of lens $P = -5.5$ D

$$f = \frac{1}{\text{P}} = \frac{1}{-5.5} = -0.1818 \text{ m}$$

$$\Rightarrow f = -18.2 \text{ cm}$$

(ii) Given: Power of lens $P = +1.5$ D

$$f = \frac{1}{\text{P}} = \frac{1}{1.5} = 0.6667 \text{ m}$$

$$\Rightarrow f = +66.67 \text{ cm}$$

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?

Solution:

Distance of far point, $x = 80$ cm

For viewing distant objects, focal length of corrective lens,

$$f = -x = -80 \text{ cm}$$

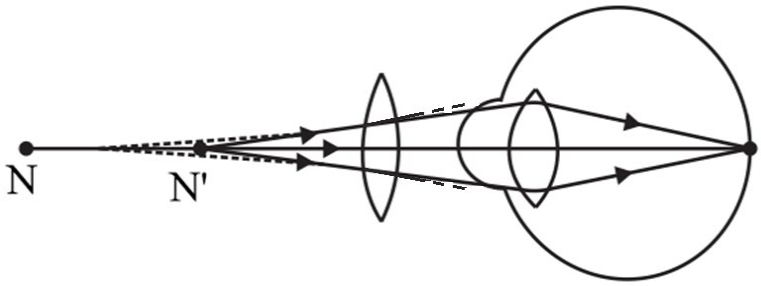
$$\Rightarrow P = \frac{1}{f} = \frac{1}{-0.8} = -1.25 \text{ D}$$

The lens is concave.

7. 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 the near point of the normal eye is 25 cm.

Solution:

Diagram explaining how hypermetropia is corrected.



Given: Near point of a hypermetropic eye $x' = 1 \text{ m} = 100 \text{ cm}$,

Near point of the normal eye $d = 25$ cm

From lens formula,

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

$$\Rightarrow \frac{1}{f} = \frac{100-25}{100\times25} = 33.33 \text{ cm}$$

Now, power of lens, $\text{P} = \frac{100}{f \text{ (in cm)}} = \frac{100}{33.33} = 3 \text{ D}$

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

Solution:

This is because the focal length of eye lens cannot be decreased below a certain minimum limit and as a result, the sharp image of the object is not formed on the retina but behind the retina of the lens.

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

Solution:

The image distance in the eye, is fixed and cannot be changed. The ability of the eye lens to adjust its focal length is called accommodation.

10. Why do stars twinkle?

Solution:

The twinkling of a star is due to atmospheric refraction of starlight. The starlight, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth.

11. Explain why the planets do not twinkle.

Solution:

The planets are much closer to the earth and are thus seen as extended sources. If we consider a planet as a collection of a large number of point-sized sources of light, the total variation in the amount of light entering our eye from all the individual point-sized sources will average out to zero, thereby nullifying the twinkling effect.

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

Solution:

At the time of sunrise, the light has to travel more distance in the atmosphere. Since scattering of blue light is more than the scattering of red light and because of this, blue light gets scattered away and red light reaches our eyes more than any other colour. Hence sunrise appears red.

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

Solution:

The sky appears dark to an astronaut because there is no atmosphere in the outer space that can scatter the sunlight. As the sunlight is not scattered, no scattered light reaches the eyes of the astronauts and the sky appears black to them.

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