NCERT SOLUTIONS

CLASS - 10th



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Class : 10th
Subject : Science
Chapter : 11
Chapter Name : The Human Eye And The Colourful World

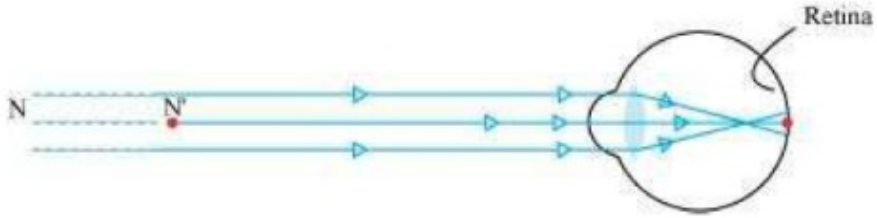
Q1 What is meant by power of accommodation of the eye?

Answer. When the ciliary muscles are relaxed, the eye lens becomes thin, the focal length increases, and the distant objects are clearly visible to the eyes. To see the nearby objects clearly, the ciliary muscles contract making the eye lens thicker. Thus, the focal length of the eye lens decreases and the nearby objects become visible to the eyes. Hence, the human eye lens is able to adjust its focal length to view both distant and nearby objects on the retina. This ability is called the power of accommodation of the eyes.

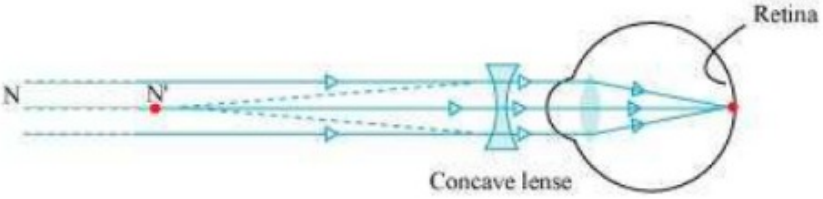
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Q2 A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?

Answer. The person is able to see nearby objects clearly, but he is unable to see objects beyond 1.2 m. This happens because the image of an object beyond 1.2 m is formed in front of the retina and not at the retina, as shown in the given figure.



To correct this defect of vision, he must use a concave lens. The concave lens will bring the image back to the retina as shown in the given figure.



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Q3 What is the far point and near point of the human eye with normal vision?

Answer. The near point of the eye is the minimum distance of the object from the eye, which can be seen distinctly without strain. For a normal human eye, this distance is 25 cm. The far point of the eye is the maximum distance to which the eye can see the objects clearly. The far point of the normal human eye is infinity.

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Q4 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?

Answer. A student has difficulty in reading the blackboard while sitting in the last row. It shows that he is unable to see distant objects clearly. He is suffering from myopia. This defect can be corrected by using a concave lens.

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Q1 The human eye can focus on objects at different distances by adjusting the focal length of the eye lens. This is due to
(a) presbyopia.
(b) accommodation.
(c) nearsightedness.
(d) farsightedness.

Answer. (b) Human eye can change the focal length of the eye lens to see the objects situated at various distances from the eye. This is possible due to the power of accommodation of the eye lens.

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Q2 The human eye forms the image of an object at its
(a) cornea.
(b) iris.
(c) pupil.
(d) retina.

Answer. (d) The human eye forms the image of an object at its retina.

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Q3 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) The least distance of distinct vision is the minimum distance of an object to see clear and distinct image. It is 25 cm for a young adult with normal visions.

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Q4 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) The relaxation or contraction of ciliary muscles changes the curvature of the eye lens. The change in curvature of the eye lens changes the focal length of the eyes. Hence, the change in focal length of an eye lens is caused by the action of ciliary muscles.

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Q5 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. For distant vision = -0.181 m, for near vision = 0.667 m
The power P of a lens of focal length f is given by the relation
$\mathrm{P}=\frac{1}{f(\text{ in metres })}$
$\text{(i) Power of the lens used for correcting distant vision} = -5.5\mathrm{D}$
$\text{Focal length of the required lens, } f=\frac{1}{P}$
$f=\frac{1}{-5.5}=-0.181\mathrm{m}$
$\text{(ii) Power of the lens used for correcting near vision} = +1.5\mathrm{D}$
$\text{Focal length of the required lens, } f=\frac{1}{\mathrm{P}}$
$f=\frac{1}{1.5}=+0.667\mathrm{m}$
$\text{The focal length of the lens for correcting near vision is } 0.667\mathrm{m}.$

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Q6 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 person is suffering from an eye defect called myopia. In this defect, the image is formed in front of the retina. Hence, 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,

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

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

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

$$f=-80\text{cm}=-0.8\text{m}$$

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

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

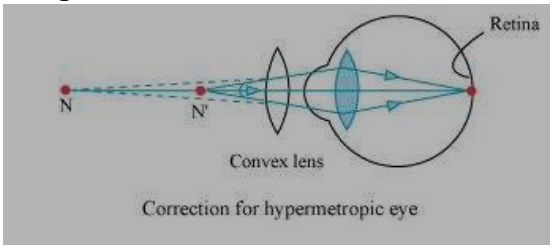
$$P=\frac{1}{-0.8}=-1.25\text{D}$$

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

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Q7 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.

Answer. A person suffering from hypermetropia can see distinct objects clearly but faces difficulty in seeing nearby objects clearly. It happens because the eye lens focuses the incoming divergent rays beyond the retina. This defect of vision is corrected by using a convex lens. A convex lens of suitable power converges the incoming light in such a way that the image is formed on the retina, as shown in the following figure.



Correction for hypermetropic eye

The convex lens actually creates a virtual image of a nearby object (N' in the figure) at the near

point of vision (N) of the person suffering from hypermetropia. The given person will be able to
clearly see the object kept at 25 cm (near point of the normal eye), if the image of the object is formed at his near point, which is given as 1 m.
Object distance, u = -25 cm
Image distance, v = —1 m = -100 m
Focal length, f
Using the lens formula,

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

$\frac{1}{-100}-\frac{1}{-25}=\frac{1}{f}$

$\frac{1}{f}=\frac{1}{25}-\frac{1}{100}$

$\frac{1}{f}=\frac{4-1}{100}$

$f=\frac{100}{3}=33.3\mathrm{cm}=0.33\mathrm{m}$

$\text{Power, } P=\frac{1}{f(\text{ in metres })}=\frac{1}{0.33\mathrm{m}}=+3.0\mathrm{D}$

$\text{A convex lens of power } +3.0\mathrm{D} \text{ is required to correct the defect.}$

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Q8 Why is a normal eye not able to see clearly the objects placed closer than 25 cm?

Answer. Because the focal length of Normal eye is 25cm.
When any object placed closer than 25 cm then the image is FORMED behind the retina. Then object seem blurred.

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Q9 What happens to the image distance in the eye when we increase the distance of an object from the eye?

Answer. Since the size of eyes cannot increase or decrease, the image distance remains constant. When we increase the distance of an object from the eye, the image distance in the eye does not change. The increase in the object distance is compensated by the change in the focal length of the eye lens. The focal length of the eyes changes in such a way that the image is always formed at the retina of the eye.

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Q10 Why do stars twinkle?

Answer. Stars emit their own light and they twinkle due to the atmospheric refraction of light. Stars are very far away from the earth. Hence, they are considered as point sources of light. When the light coming from stars enters the earth's atmosphere, it gets refracted at different levels because of the variation in the air density at different levels of the atmosphere. When the star light refracted by the atmosphere comes more towards us, it appears brighter than when it comes less towards us. Therefore, it appears as if the stars are twinkling at night.

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Q11 Explain why the planets do not twinkle?

Answer. Planets do not twinkle because they appear larger in size than the stars as they are relatively closer to earth. Planets can be considered as a collection of a large number of point-size sources of light. The different parts of these planets produce either brighter or dimmer effect in such a way that the average of brighter and dimmer effect is zero. Hence, the twinkling effects of the planets are nullified and they do not twinkle.

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Q12 Why does the Sun appear reddish early in the morning?

Answer. During sunrise, the light rays coming from the Sun have to travel a greater distance in the earth's atmosphere before reaching our eyes. In this journey, the shorter wavelengths of lights are scattered out and only longer wavelengths are able to reach our eyes. Since blue colour has a shorter wavelength and red colour has a longer wavelength, the red colour is able to reach our eyes after the atmospheric scattering of light. Therefore, the Sun appears reddish early in the morning.

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Q13 Why does the sky appear dark instead of blue to an astronaut?

Answer. The sky appears dark instead of blue 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 reach the eyes of the astronauts and the sky appears black to them.

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