CHAPTER 10

THE HUMAN EYE AND THE COLOURFUL WORLD

CLASS 10TH

NCERT EXERCISE AND SOLUTIONS - SCIENCE

Q. 1. 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) Near-sightedness
(d) Far-sightedness

ANSWER:-

(b) Accommodation

Solution: The human eye can adjust the focal length of the eye lens to see objects at different distances. This ability is known as the power of accommodation of the eye lens.

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

(a) Cornea
(b) Iris
(c) Pupil
(d) Retina

ANSWER:-

(d) Retina

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

Q. 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

Solution: 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.

Q. 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

Solution: The ciliary muscles relax or contract to change the curvature of the eye lens. This change in curvature alters the focal length of the eye, allowing the eye to focus on objects at different distances. Therefore, the ciliary muscles control the change in the focal length of the eye lens.

Q. 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 of a lens of focal length is given by the relation: $P = \frac{1}{f(\text{ in metres})}$

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

Focal length of the required lens, $f = 1/P$

$$f = \frac{1}{-5.5} = -0.181\text{m}$$

The focal length of the lens for correcting distant vision is -0.181 m.

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

Focal length of the required lens, $f = 1/P$

$$f = \frac{1}{1.5} = +0.667\text{m}$$

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

Q. 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:-

Object distance (u) = ∞, Image distance(v) = –80 cm,
Focal length (f) = ?
Need to find- nature and power of the lens
Using lens formula,

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

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

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

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

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

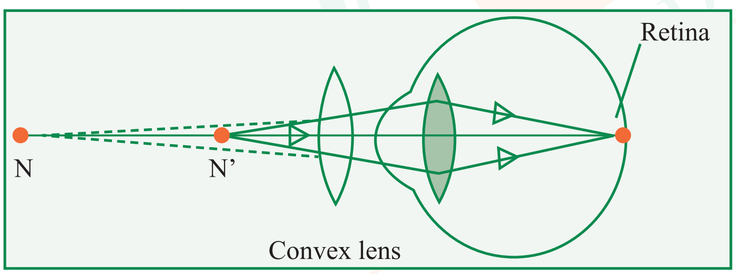
$$P=\frac{1}{-0.8}=-1.25\text{D}$$

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

Q.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.

ANSWER:-

A person suffering from hypermetropia can see distant objects clearly but has difficulty focusing on nearby objects. This happens because the eye lens focuses the incoming divergent rays beyond the retina. This vision defect can be corrected with a convex lens. A convex lens of appropriate power converges the incoming light so that the image is formed directly on the retina, as shown in the figure.



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.
Given - Object distance, $u=-25$ cm, Image distance, $v=-1$ m $=-100$ m Focal length, f
Using the lens formula,

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

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

$$\frac{1}{f} = \frac{1}{25} - \frac{1}{100}$$
$$\frac{1}{f} = \frac{4-1}{100}$$
$$f = \frac{100}{3} = 33.3\text{cm} = 0.33\text{m}$$
$$\text{Power, } P = \frac{1}{f(\text{ in metres})} = \frac{1}{0.33\text{m}} = +3.0\text{D}$$

A convex lens of power +3.0 D is required to correct the defect.

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

ANSWER:-

A normal eye cannot see objects clearly that are placed closer than 25 cm because this is the closest distance at which the eye can focus. This distance is known as the near point of the eye. When an object is placed closer than 25 cm, the eye's lens cannot adjust its focal length enough to bring the image into focus on the retina. This is due to the limited ability of the eye's accommodation (the adjustment of the lens's shape) at such close distances.

Q. 9. 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 the eye cannot change, the image distance remains constant. When the distance of an object from the eye increases, the image distance in the eye doesn't change. The eye compensates for the increased object distance by adjusting the focal length of the eye lens. The focal length changes in a way that ensures the image is always formed on the retina.

Q. 10. Why do stars twinkle?

Answer: Stars twinkle because of the Earth's atmosphere. As the light from a star passes through the layers of air in the atmosphere, it gets refracted (bent) due to changes in air density and temperature. These variations cause the star's light to shift in color and intensity, making it appear as if the star is twinkling. This effect is more noticeable for stars because they are so far away that their light appears as a small point, compared to closer, larger light sources like planets.

Q. 11. Explain why the planets do not twinkle.

ANSWER:-

Planets don't twinkle because they are closer to Earth and appear larger than stars. A planet can be thought of as made up of many tiny light sources. The light from different parts of the planet may be brighter or dimmer, but overall, these effects balance out. As a result, planets don't twinkle like stars do.

Q. 12. Why does the sky appear dark instead of blue to an astronaut?

ANSWER:-

The sky appears dark to an astronaut because there is no atmosphere in outer space to scatter the sunlight. Since the sunlight isn't scattered, no scattered light reaches the astronaut's eyes, making the sky look black.