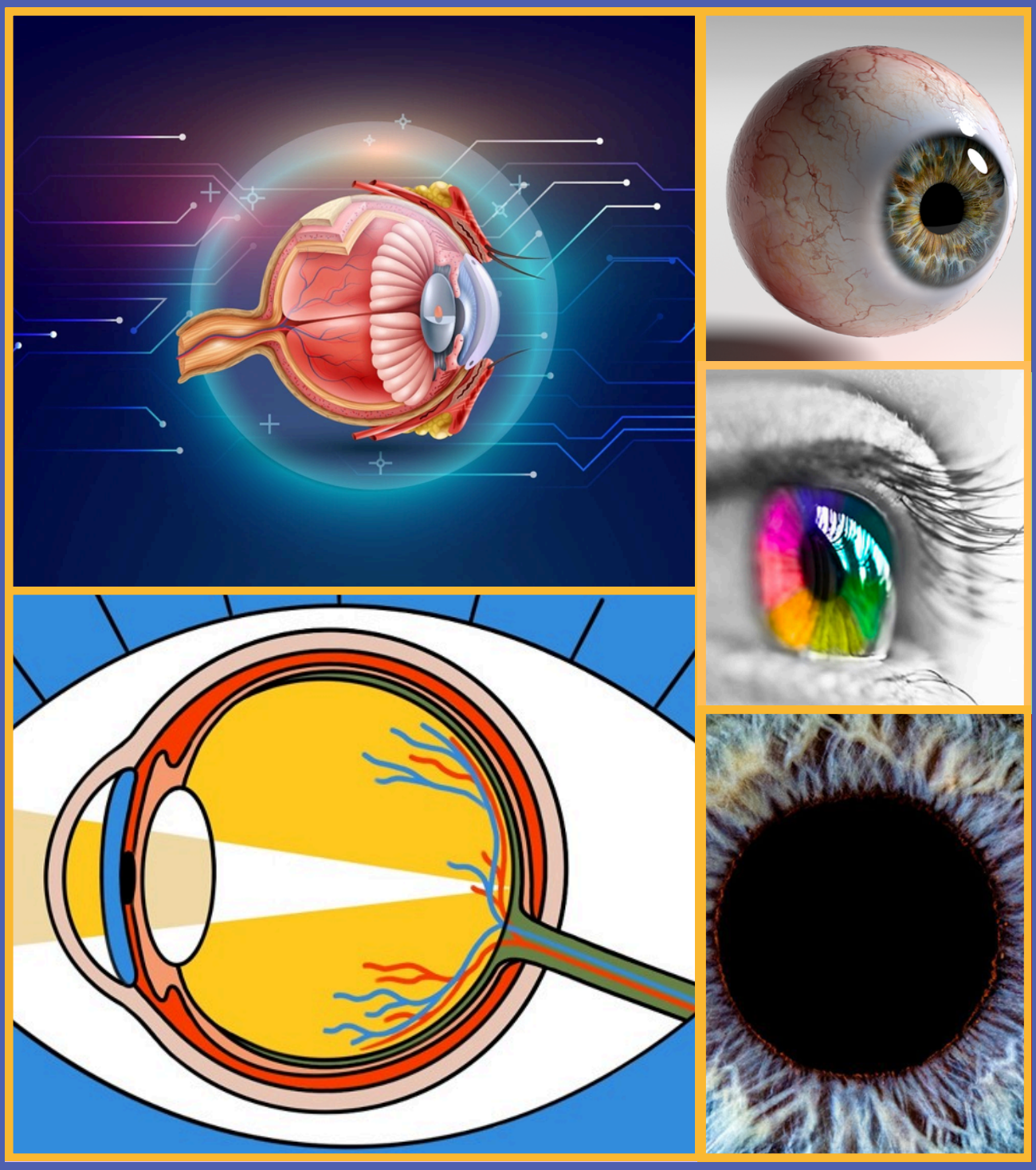


CLASS 10 NOTES

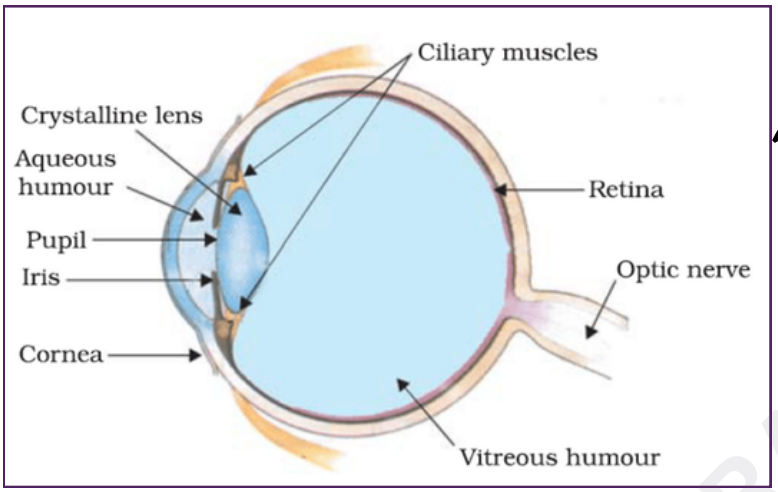
SCIENCE

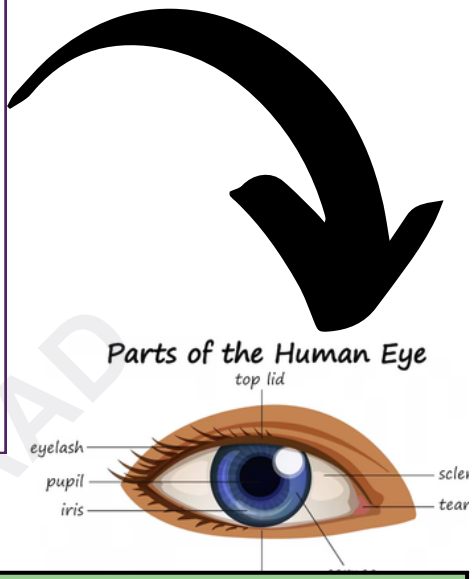
Human eye and the colourful world

PRASHANT KIRAD

The Human Eye

The human eye is a complex and highly specialized sensory organ responsible for the sense of vision. It is one of the primary components of the visual system in humans and plays a crucial role in perceiving the world around us.





Different parts of the human eye :

Part	Function/Definition
Cornea	The transparent, dome-shaped surface that covers the front of the eye and helps to focus incoming light.
Iris	The colored part of the eye that controls the size of the pupil, regulating the amount of light entering.
Pupil	The opening in the center of the iris that allows light to pass through.
Lens	A transparent structure behind the pupil that focuses light onto the retina by changing shape.
Retina	The inner layer at the back of the eye containing light-sensitive cells (rods and cones); converts light into electrical signals.
Aqueous and Vitreous Humors	Clear fluids filling the front and back chambers of the eye, providing nourishment and maintaining the eye's shape.
Optic Nerve	The nerve that carries visual information from the retina to the brain for processing.

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The light coming from an object enters the eye through the cornea and the pupil.

↓

The lens focuses the light rays to form a real, inverted and highly diminished image on the retina.

↓

The sensory cells (rods and cones) of the retina get activated and generate electric signals.

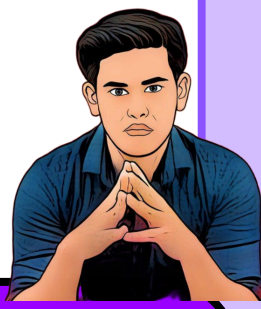
↓

Optic nerves send electric signals to the brain.

↓

The brain interprets these signals and renders the erect image of the object.

Flow mantra



"Defects Of Vision dhyaan mei rakhna diagram ke saath" - Prashant Bhaiya

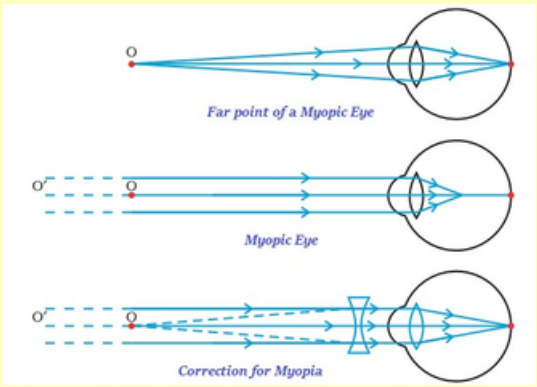
Power of accommodation :

The power of accommodation is the eye's ability to adjust and focus on objects at different distances by changing the shape of the lens, allowing us to see clearly at various ranges.

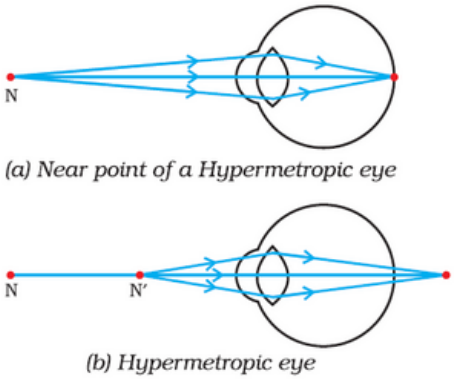
Defects of vision and their connections :

Defects of vision, also known as refractive errors, occur when the eye is unable to focus light correctly on the retina, leading to blurred or impaired vision. The most common types of vision defects are:

1. **Myopia (Nearsightedness):** Myopia, or nearsightedness, is a vision condition where distant objects appear blurry due to the eye's inability to focus properly on them.
   - Causes of myopia: The eyeball is too long, or the cornea is too curved, causing light rays to focus in front of the retina instead of directly on it.
   - Correction: Myopia is usually corrected with concave (diverging) lenses, which spread out the light rays before they enter the eye, allowing them to focus on the retina.



2. **Hypermetropia (Farsightedness):** It is also known as farsightedness, is a vision condition where distant objects are clearer than close-up objects due to the eye's inability to focus on nearby objects properly.
   - Causes of Hypermetropia: The eyeball is too short, or the cornea is not curved enough, causing light rays to focus behind the retina.



(a) Near point of a Hypermetropic eye

(b) Hypermetropic eye

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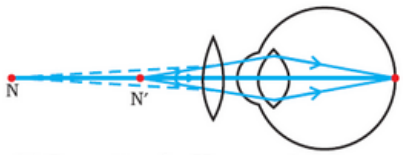
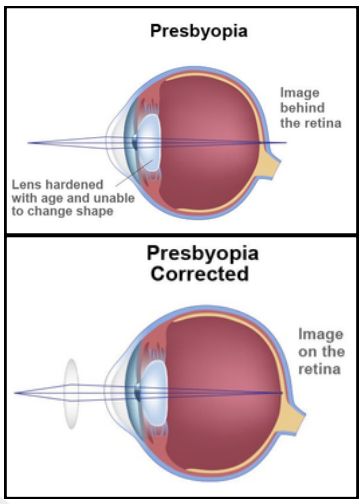
- Correction: Hypermetropia is corrected with convex (converging) lenses, which bend the light rays inward before they enter the eye, allowing them to focus on the retina.



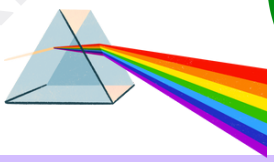
(c) Correction for Hypermetropic eye

3. **Presbyopia:** Presbyopia is an age-related vision condition where it becomes difficult to focus on close-up objects, usually requiring reading glasses for correction.



- Causes of Presbyopia: The lens of the eye loses its flexibility with age, making it harder to change its shape for focusing on near objects (loss of power of accomodation).
- Correction: Presbyopia is often corrected with reading glasses, bifocal lenses, or progressive lenses.

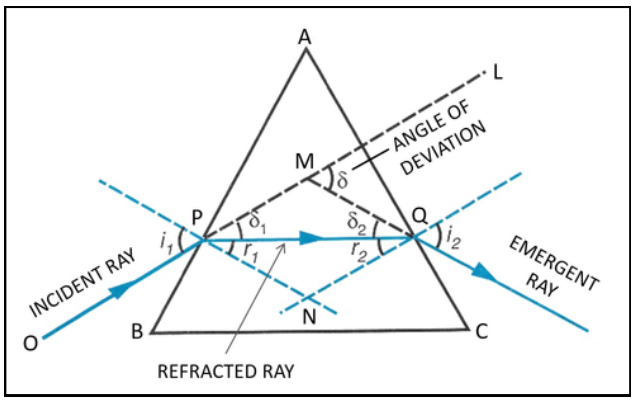
Prism

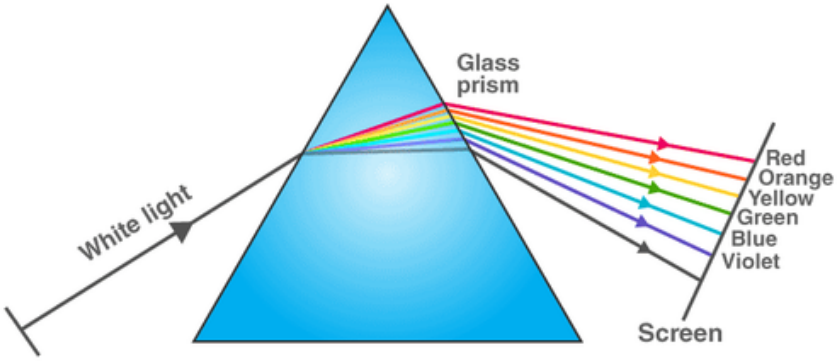


A transparent refracting medium bounded by at least two lateral surfaces inclined to each other at a certain angle.

Dispersion of white light by a glass prism

A glass prism disperses white light, splitting it into its constituent colors, and creating a rainbow-like spectrum due to the varying refraction of different wavelengths of light.



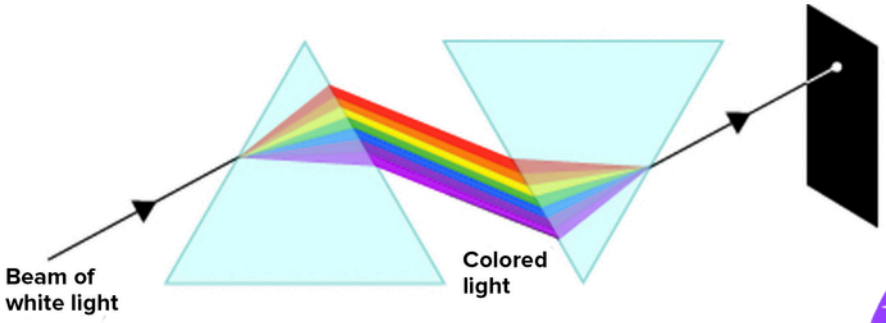


Why dispersion occur?

Dispersion of light occurs when white light passes through a prism because different colors (wavelengths) of light are refracted, or bent, by different amounts.

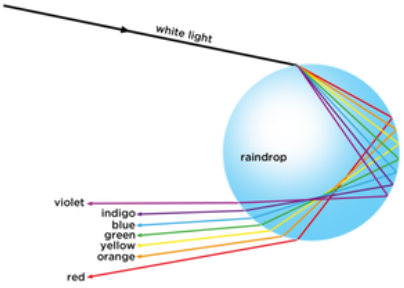
Recombination of the spectrum of white light:

Recombination of white light involves merging the separated colors (spectrum) created by a prism or similar device, resulting in the restoration of white light.



Rainbow

A rainbow is a natural optical phenomenon that occurs when sunlight is dispersed, refracted, and reflected by water droplets in the atmosphere, creating a spectrum of light in the form of a circular arc.



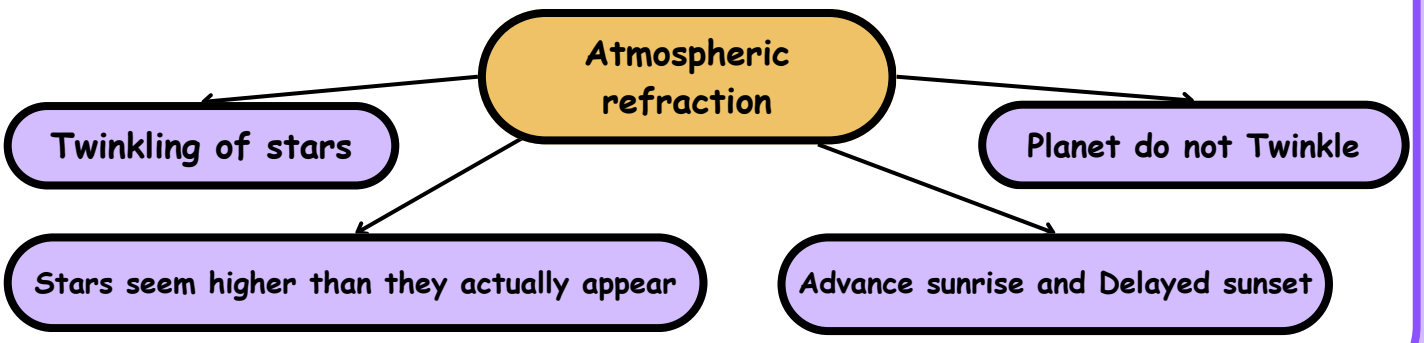
Rainbow formation:

- After rain, there are many tiny droplets of water still in the air
- When sunlight falls on these droplets
- These droplets act as tiny prisms
- When sunrays fall on these droplets, the rays get first refracted, then internally reflected and then refracted again
- Due to this different colors of sunlight are bent at different angles and we are able to see a spectrum in the form of a rainbow

Atmospheric refraction:

When refraction occurs between two mediums, and one of these mediums is Earth's atmosphere, this phenomenon is referred to as atmospheric refraction.

Consequences of Atmospheric Refraction:



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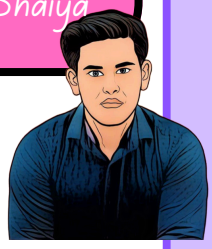
Concept	Explanation
Twinkling of Stars	Twinkling is caused by the bending of starlight as it passes through Earth's atmosphere, due to variations in the atmosphere's refractive index. This leads to rapid fluctuations in a star's apparent position and brightness.
Stars Seem Higher than They Appear	Light from stars undergoes refraction as it enters Earth's atmosphere, bending towards the normal with each layer. This atmospheric refraction causes the apparent position of a star to be slightly higher than its actual position, especially when viewed near the horizon.
Planets Do Not Twinkle	Planets appear as small disks and reflect the Sun's light, providing a more stable and constant source of illumination. This prevents the twinkling effect, unlike distant stars, which are point sources of light.
Advance Sunrise and Delayed Sunset	The Sun can be seen approximately two minutes before it officially rises and about two minutes after it technically sets. This is due to atmospheric refraction, which bends the Sun's light, allowing it to be visible even when it is below the horizon.

"Bahut Jaroori Table" - Prashant Bhaiya



Scattering of light:

Scattering of light is the process by which light rays are redirected in different directions as they pass through particles in the atmosphere or another medium. This phenomenon occurs because light interacts with small particles or molecules, causing the light to spread out in various directions.

Scattering of light depends on the type of particles:

- Very fine particles scatter mainly in blue colour.
- Large sized particle scatter light of longer wavelength
- Shorter wavelength greater will be the scattering

Consequences of scattering of light:

VIP (very important portion)

Scattering of light

Tyndall Effect

The scattering of light by tiny particles in Earth's atmosphere, such as smoke, water droplets, and dust, making these particles visible.

Colour of sun During sunrise and sunset

Light travels a longer path through the atmosphere, scattering shorter wavelengths like blue, and allowing the red and orange colors to dominate..

Blue Sky

Air molecules and tiny particles in the atmosphere scatter shorter-wavelength blue light more effectively than longer-wavelength red light, making the scattered blue light reach our eyes.

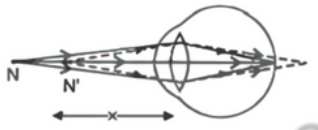
PRASHANT KIRAD

#TOP 7 IMPORTANT QUESTIONS

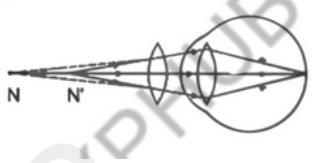
1) "A person cannot read a book at distances less than 50 cm. Name the defect of vision he is suffering from. How can it be corrected? Draw ray diagrams to show the image formation:
a. by defective eye
b. after using a corrective lens

Solution:

a. Either the hypermetropic eyeball is too short or corea is too curved.
b. The ciliary muscle is unable to change the shape of the lens enough to properly focus the image i.e., the focal length of the eye lens is too long. This defect is called hypermetropia.



It can be corrected with the help of a convex lens as shown.



2) (a) If a person wears a lens of power - 6D for distant vision and for correcting his near vision he needs a lens of +2D. Determine the focal length of the lenses in both cases. [CBSE 2016]
(b) Give a reason for the following natural phenomenon:
(i) Stars twinkle
(ii) Planets do not twinkle
(iii) Stars appear raised in the sky.

Solution:

(a) (i) $P_1 = -6D$ as $f_1 = \frac{1}{P_1} = -\frac{1}{6}$ m

$f_1 = -\frac{100}{6}$ cm $= -16.66$ cm

(ii) $P_2 = +2D$ as $f_2 = \frac{1}{P_2} = +\frac{1}{2}$ m

$f_2 = 50$ cm

(b) (i) Due to continuous changes in the densities of the atmospheric layers the apparent position of the star also changes; which makes the light coming from the distant point-sized star brighter and dimmer. The light coming from the stars therefore gives a shaking appearance, which gives the impression of the twinkling of a star.
(ii) Since the planets are closer to us. Due to this they appear a combination of large point-size source of light, and change in the path of light coming from the planets is not significant. So planets do not appear twinkling.
(iii) Due to atmospheric refraction, a star appears to be slightly higher than its actual position in the sky.

3) a) Explain why colour of the sky appears blue during the day with the help of a diagram.
(b) Explain why the Sun looks reddish at the time of sunrise and sunset.

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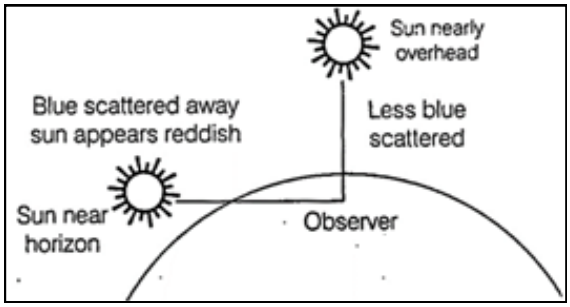
Solution: (a) Due to the scattering of blue colours by the dust particles present in the atmosphere.

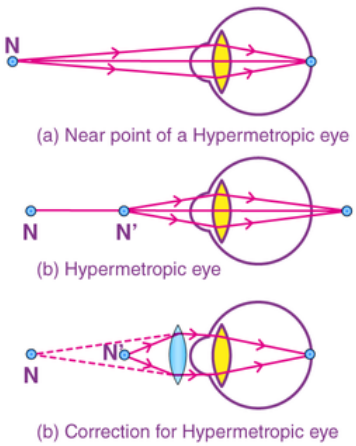


(b) During the Sunrise or Sunset, Sun is at the horizon, and sunlight travels a longer distance in the atmosphere. Due to this, all colours get scattered except red which reaches the eye of the observer to whom sun appears reddish in the morning or evening.

4) Why do stars twinkle? Explain.

Solution: Light coming from stars when enters the Earth's atmosphere suffers refraction from the atmospheric layers. Since the densities of atmospheric gases change frequently. Since the stars are point-sized and at a far distance sometimes stars appear brighter and sometimes dimmer which gives the impression as the stars twinkling.

5) (a) What is the least distance of distinct vision for the normal eye?
(b) Does the above distance increase or decrease for long sighted eye? Give a reason for your answer with a diagram.



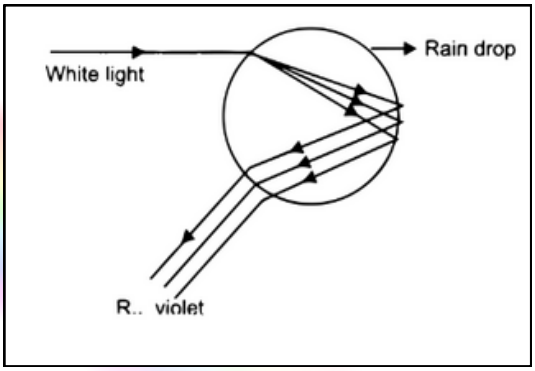
Solution:

(a) For a normal human eye, the least distance of distinct vision is 25 cm.
(b) Least distance of distinct vision increases for long-sighted eyes. A hypermetropic eye can see up to an infinite distance, which is more than 25 cm.

6) With the help of a diagram, Explain the formation of a rainbow in the sky.

Solution:

The water droplets in the atmosphere act like small prisms. These droplets refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the distortion of sunlight and internal reflection, different colours reach the observer.



7. A person with a defective eye-vision is unable to see objects nearer than 1.5 m. He wants to read books at a distance of 30 cm. Find the nature, focal length, and power of the lens he needs in his spectacles. (CBSE 2016)

Solution:

Defect is hypermetropia

$v = -1.5$ m or -150 cm, $u = -30$ cm

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

$$\frac{1}{f} = \frac{1}{-150} - \frac{1}{-30}$$

$$= -\frac{1}{150} + \frac{1}{30} = \frac{-1+5}{150}$$

$$f = +\frac{150}{4} = +37.5 \text{ cm}$$

A convex lens of focal length 37.5 cm is required

$$\text{Power} = \frac{100}{f(\text{cm})} = \frac{100}{37.5} = +2.67 \text{ D}$$

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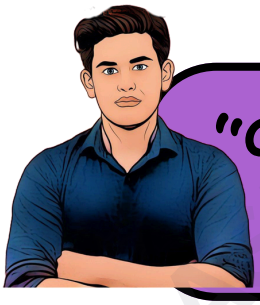

"Class 10th Phodenge"
- Prashant Bhaiya