CLASS 10 NOTES

SCIENCE

Human Eye

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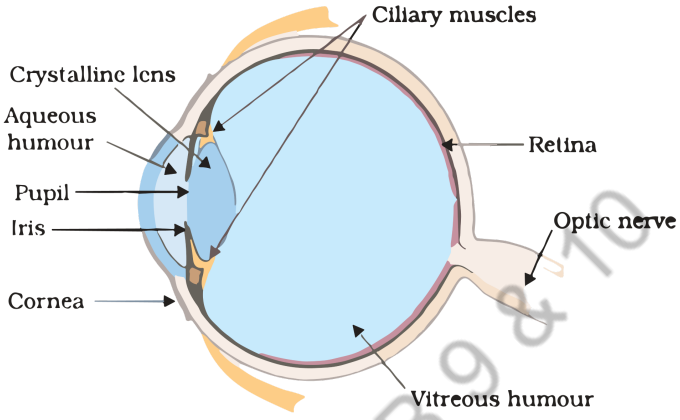
THE HUMAN EYE

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.



Parts of the Human Eye:

Exam me aayega

- **Cornea:->** The transparent, curved outermost layer of the eye that helps to focus incoming light.
- **Pupil:->** The small, adjustable opening in the center of the eye that regulates the amount of light entering the eye.
- **Iris:->** The colored part of the eye that surrounds the pupil and controls the size of the pupil.
- **Retina:->** The innermost layer of the eye that contains photoreceptor cells (rods and cones) that convert light into electrical signals, initiating the visual process.
- **Aqueous and Vitreous Humors:->** Clear fluids that fill the front and back chambers of the eye, providing nourishment and maintaining the shape of the eye.

- **Optic Nerve:->** The bundle of nerve fibers that transmits the electrical signals generated in the retina to the brain for processing.

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: E.M.A

MYOPIA:

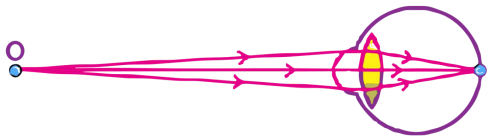
Myopia, or nearsightedness, is a vision condition where distant objects appear blurry due to the eye's inability to focus properly on them.

Cause of Myopia:

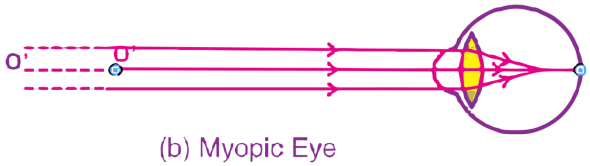
1. Excessive Curvature of the eye lens.
2. Elongation of the eyeball

Correction of Myopia:

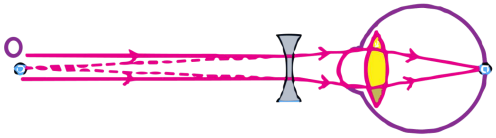
Myopia can be corrected by using a concave (diverging) lens of appropriate focal length (or Power)



(a) Far point of a myopic eye



(b) Myopic Eye



(b) Correction for Myopic Eye

Hypermetropia:

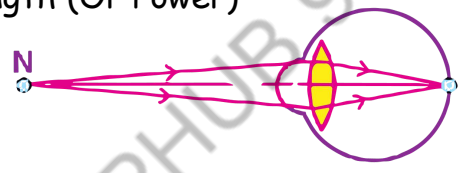
Hypermetropia, also known as farsightedness, is a vision condition where distant objects are clearer than close-up objects due to the eye's inability to focus on nearby objects properly.

Cause of Hypermetropia:

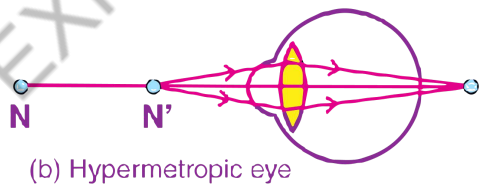
1. Large focal length of the eye lens.
2. Shortening of the eyeball.

Correction of Hypermetropia:

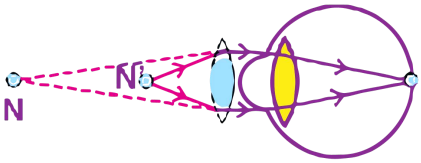
Hypermetropia can be corrected by using a convex (converging) lens of appropriate focal length (Or Power)



(a) Near point of a Hypermetropic eye



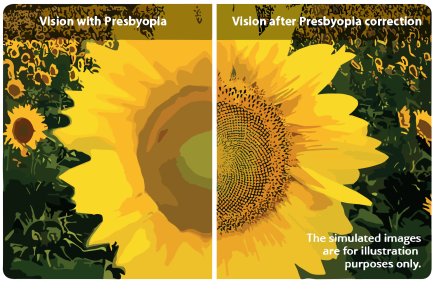
(b) Hypermetropic eye



(b) Correction for Hypermetropic eye

Presbyopia:

Presbyopia is an age-related vision condition where it becomes difficult to focus on close-up



objects, usually requiring reading glasses for correction.

Cause of Presbyopia:

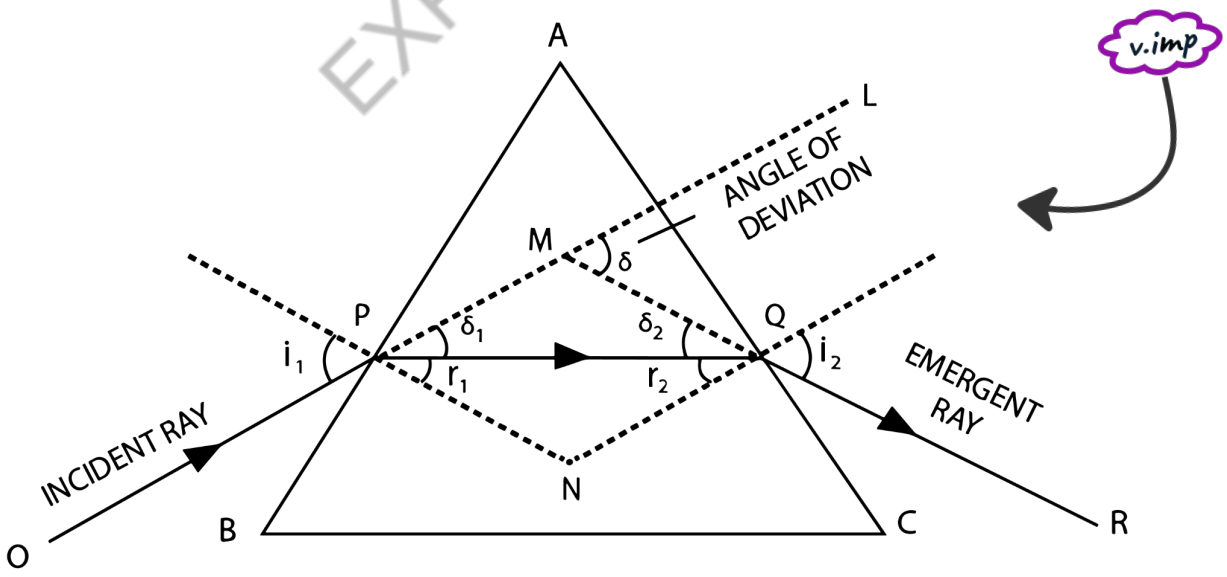
1. Gradual weakening of the ciliary muscles with age.
2. Decreasing flexibility of the crystalline lens.

Correction of Presbyopia:

For a person suffering from both myopia and hypermetropia, bi-focal lenses are required in which the upper part is a concave lens and lower part is a convex lens.

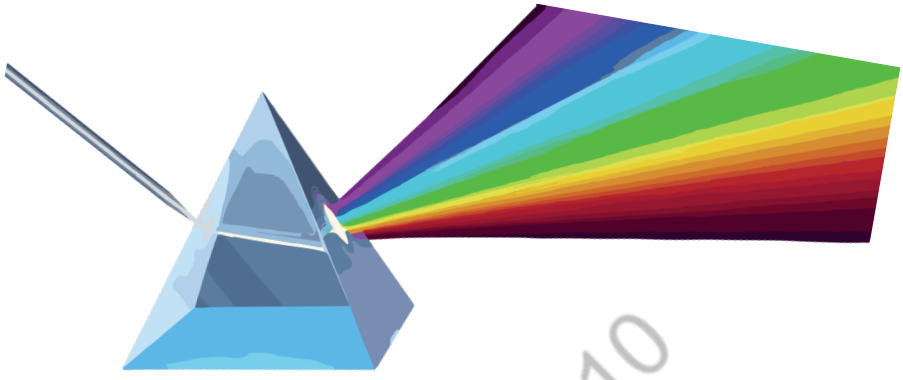
PRISM

A prism is an optically transparent material with a minimum of two angled surfaces, causing the refraction or bending of light as it passes through due to the surface inclination.



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.

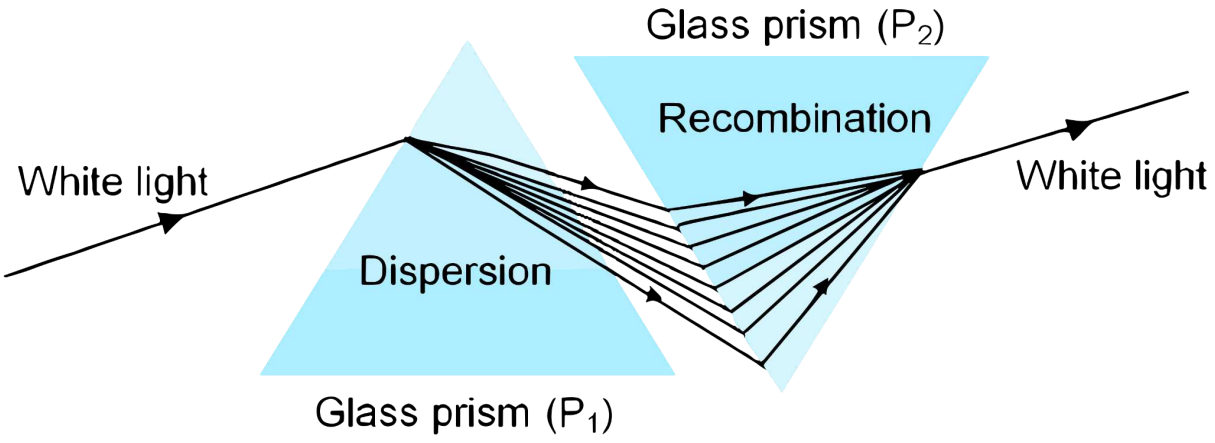


*What is the cause of dispersion?

Dispersion occurs due to the varying refractive indices of different colors or wavelengths of light when passing through a transparent medium like a prism, causing them to spread out.

Recombination 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.

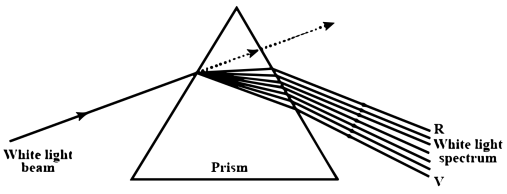


#Secret Questions

1) **State the cause of dispersion, when white light enters a glass prism. Explain with a diagram.(All India 2014)**

Solution:

When white light passes through a prism it splits into its constituent colors, because each colored light has a different speed in a prism. Prism has different refractive index for these light rays and so deviates through different angles when emerge from the prism. Deviation for violet colour (shortest wavelength) is the most and for red colour (largest wavelength) deviation is the least.



2) (a) Calculate maximum power of accommodation of a person having normal vision.

(b) A person needs to use glasses for reading newspaper. Identify the defect in her vision and the type of lens she would need to correct it.

c) Sometimes when we enter into a dark room from bright sunlight we are unable to see objects clearly. Why? [CBSE 2014]

Solution:

(a) Least distance of distinct vision for a normal eye D = 25 cm.

$$P = \frac{1}{f} = \frac{100}{25} = 4D$$

For a person having normal vision, the power of accommodation is 4 D.

(b) Hypermetropia, to correct hypermetropia convex lens is needed

(c) In bright light the pupil contract its size becomes small to control the light, but when we enter into a dark room it take sometime for the pupil to expand to allow more light in dark room.

3) State one function each of iris, pupil, and cornea. [CBSE 2014]

Solution:

a. Iris: It controls the amount of light entering the eye by changing the size of pupil.

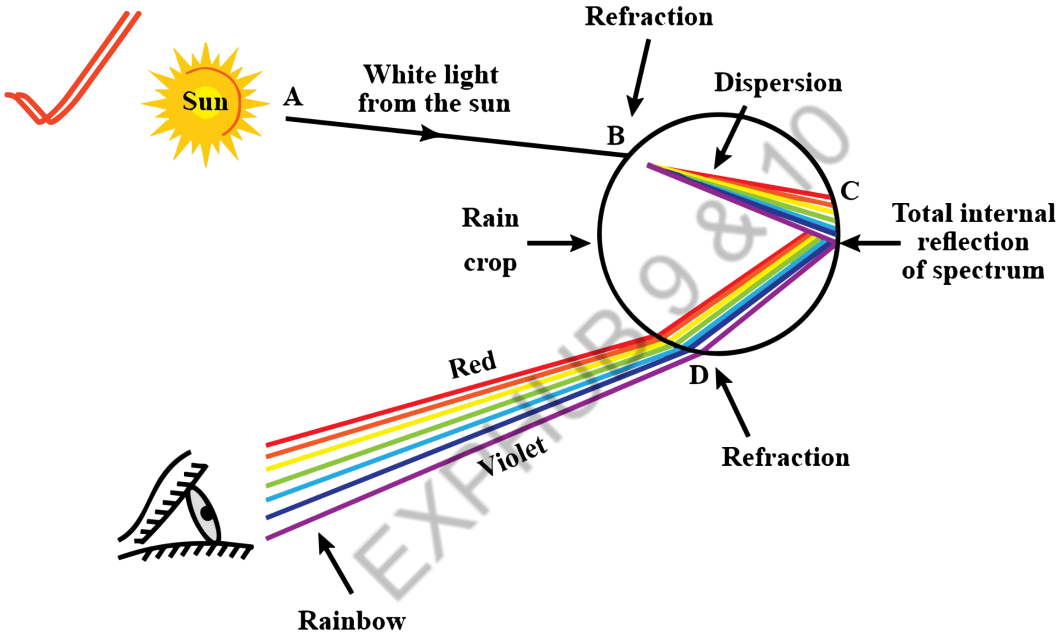
b. Pupil: Pupil is a part of the eye through which light enters in the eye.

c. Cornea: It is a thin membrane which covers the eye ball. Light enters the eye through cornea where it is refracted most.

Rainbow:

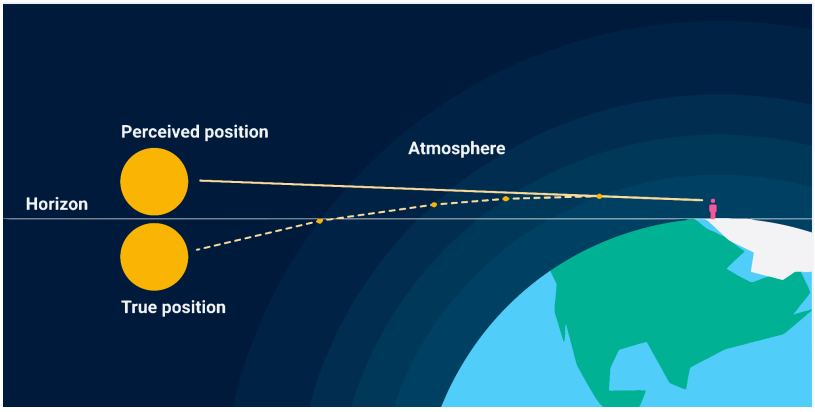
A rainbow is a colorful, circular arc of light in the sky that appears after rain, caused by the bending of sunlight in water droplets, resulting in the colors red, orange, yellow, green, blue, indigo, and violet in that order.

- Water droplets act as miniature prisms.
- Water droplets refract and disperse incoming sunlight, then internally refract it, and ultimately refract it once more upon exiting the raindrop.



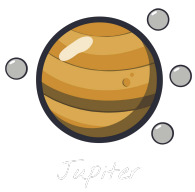
Atmospheric Refraction:

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



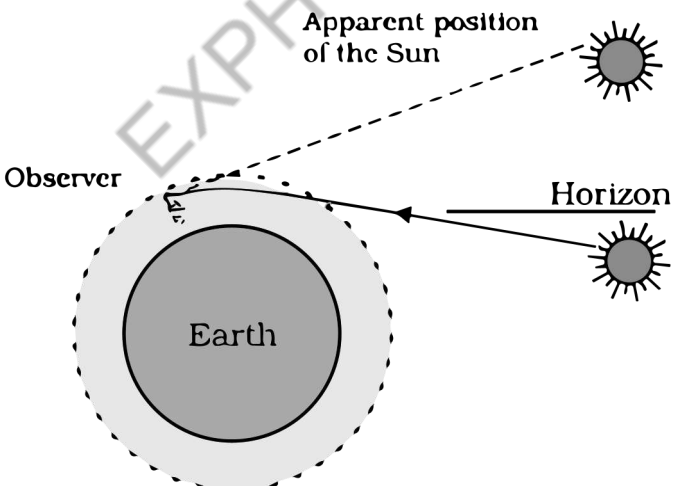
Consequences of Atmospheric Refraction:

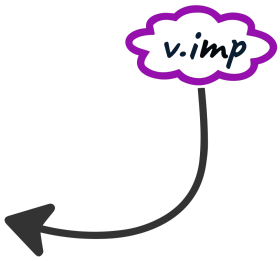
Twinkling of stars: Twinkling of stars is caused by the bending of starlight as it passes through Earth's atmosphere, resulting from variations in the atmosphere's refractive index. These variations lead to rapid fluctuations in a star's apparent position and brightness, creating the twinkling effect when observed from Earth.



Planets do not Twinkle: Planets do not twinkle because they appear as small disks and reflect the Sun's light, resulting in a more stable and constant source of illumination when viewed from Earth, unlike distant stars, which are point sources of light.

Advance sunrise and Delayed sunset: We can see the sun approximately two minutes before it officially rises and about two minutes after it technically sets. This phenomenon is a result of atmospheric refraction.

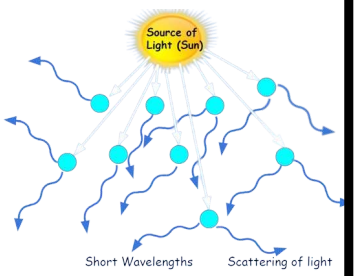




Scattering of light:

The dispersion of light in all directions when it interacts with an object is known as the scattering of light. This phenomenon is influenced by the type of particles involved.

Extremely fine particles predominantly scatter light in the blue color spectrum. Conversely, larger particles scatter light with longer wavelengths. The shorter the wavelength, the more pronounced the scattering.



Consequences of Light Scattering:

Tyndall Effect:

The Tyndall Effect is observed when Earth's atmosphere, composed of tiny particles like smoke, minuscule water droplets, and airborne dust, becomes visible because of the scattering of light.

Colour of Sky is blue:

The blue color of the sky is a result of a phenomenon known as Rayleigh scattering. In Earth's atmosphere, the small molecules of air and fine particles effectively scatter shorter-wavelength light, especially at the blue end of the spectrum, more than longer-wavelength light at the red end. As sunlight travels through the atmosphere, these tiny particles scatter blue light more prominently than red. This scattered blue light enters our eyes, giving the sky its characteristic blue color.

Colour of Sun at Sunrise and Sunset:

At sunrise and sunset, the Sun appears red or orange due to the longer path of sunlight through Earth's atmosphere, which scatters shorter wavelengths and lets red and orange colors dominate.

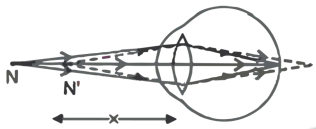
#TOP 7 QUESTIONS

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 and b. after using a corrective lens

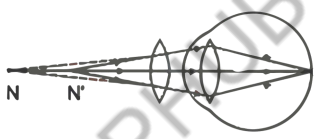
Solution:

a. Either the hypermetropic eyeball is too short or

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.

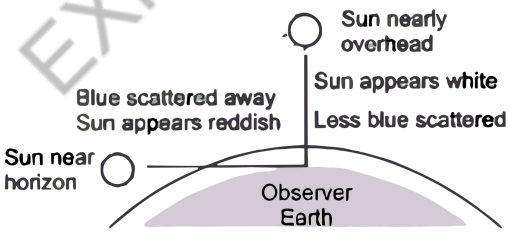
3) a) Explain why colour of the sky appears blue during the day with the help of a diagram.

(b) Explain why the Sun looks reddish at the time of sunrise and sunset.

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:

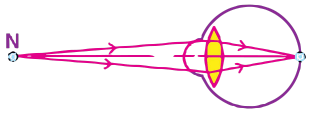
Light coming from stars when enters the Earth's atmosphere suffers refraction from the atmospheric layers. Since the densities of atmospheric gases change frequently. Since the stars are point-sized and at a far distance sometimes stars appear brighter and sometimes dimmer which gives the impression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

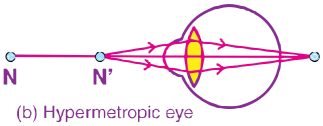
Solution:

(a) For a normal human eye, the least distance of distinct vision is 25 cm.

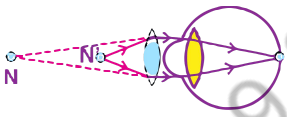
(b) Least distance of distinct vision increases for long-sighted eyes. A hypermetropic eye can see up to an infinite distance, which is more than 25 cm.



(a) Near point of a Hypermetropic eye



(b) Hypermetropic eye

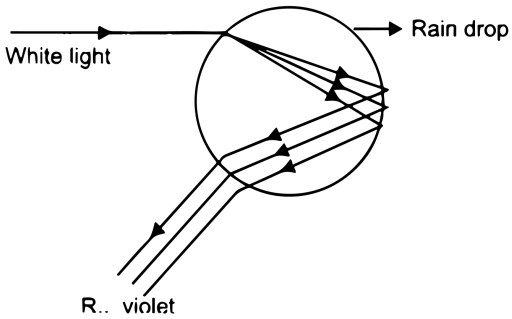


(b) Correction for Hypermetropic eye

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.



6) 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

$$v = -1.5 \text{ m or } -150 \text{ cm}, \quad u = -30 \text{ cm}$$

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

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

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

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

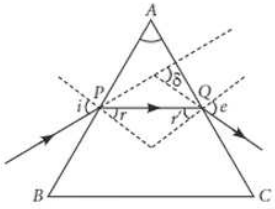
A convex lens of focal length 37.5 cm is required

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

Competency-based Question-Answer:

1. A prism is a transparent refracting medium bounded by two plane surfaces inclined to each other at a certain angle. The refraction of light through a prism follows the laws of refraction. In the prism, refraction takes place on its refracting surface it means when the light enters the prism and when the light leaves the prism. The refraction through a prism is shown. Here, A is the angle of prism, i is the angle of incidence of the face AB and Ze is the angle of emergence at other face AC.

The incident ray suffers a deviation or bending through an angle 8 due to the refraction through prism. This angle is called angle of deviation as shown in figure.



(i) The angle between the two refracting surfaces of a prism is called
(a) angle of prism (b) angle of incidence
(c) angle of deviation (d) angle of emergence

(ii) The angle between the incident ray and the emergent ray is called
(a) angle of emergence (b) angle of deviation
(c) angle of incidence (d) none of these

(iii) When a ray is refracted through a prism, then
(a) $\angle i = \angle \delta$ (b) $\angle i = \angle e + \angle \delta$
(c) $\angle \delta = \angle e$ (d) $\angle i > \angle r$

(iv) The angle of deviation depends on
(a) refractive index of prism (b) angle of incidence
(c) both (a) and (b) (d) none of these

(v) The rectangular surfaces of a prism are known as
(a) reflecting surfaces (b) dispersing surfaces
(c) refracting surfaces (d) none of these.

2. The spreading of light by the air molecules is called scattering of light. The light having least wavelength scatters more. The sun appears red at sunrise and sunset, appearance of blue sky it is due to the scattering of light. The colour of the scattered light depends on the size of particles. The smaller the molecules in the atmosphere scatter smaller wavelengths of light. The amount of scattering of light depends on the wavelength of light. When light from sun enters the earth's atmosphere, it gets scattered by the dust particles and air molecules present in the atmosphere. The path of sunlight entering in the dark room through a fine hole is seen because of scattering of the sun light by the dust particles present in its path inside the room.

(i) To an astronaut in a spaceship, the colour of earth appears
(a) red (b) blue (c) white (d) black

(ii) At the time of sunrise and sunset, the light from sun has to travel.
(a) longest distance of atmosphere (b) shortest distance of atmosphere
(c) both (a) and (b) (d) can't say

(iii) The colour of sky appears blue, it is due to the
(a) refraction of light through the atmosphere (b) dispersion of light by air molecules
(c) scattering of light by air molecules (d) all of these.

(iv) At the time of sunrise and sunset
(a) Blue colour scattered and red colour reaches our eye
(b) Red colour scattered and blue colour reaches our eye
(c) Green and blue scattered and orange reaches our eye
(d) None of these

(v) The danger signs made red in colour, because
(a) the red light can be seen from farthest distance (b) the scattering of red light is least
(c) both (a) and (b) (d) none of these