CLASS X - SCIENCE

HUMAN EYE & COLORFUL WORLD

PRASHANT KIRAD

अभय

PK HITS🔥

- Human Eye (Diagram)
- Defects (Myopia and Hypermetropia)
- Prism (Diagram + Concept)

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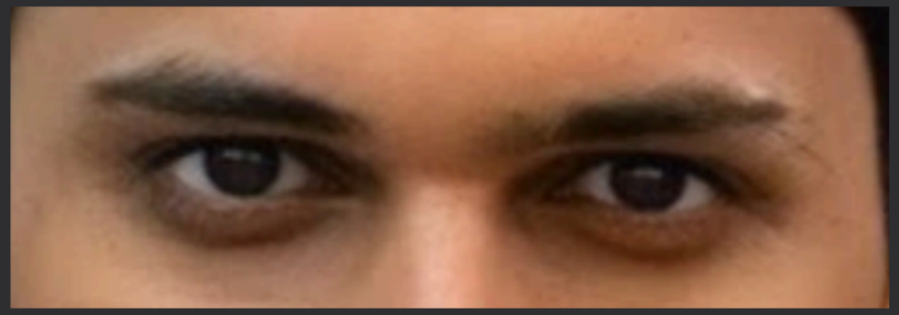
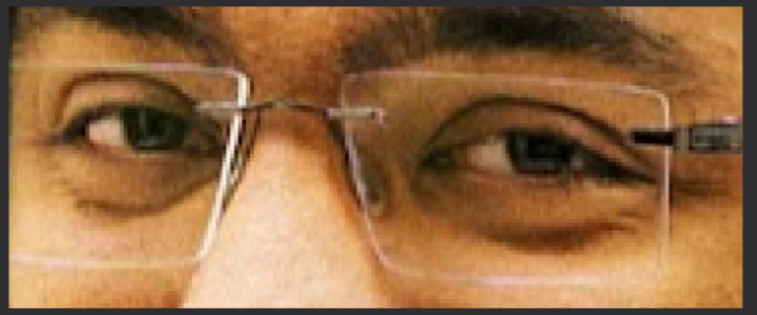
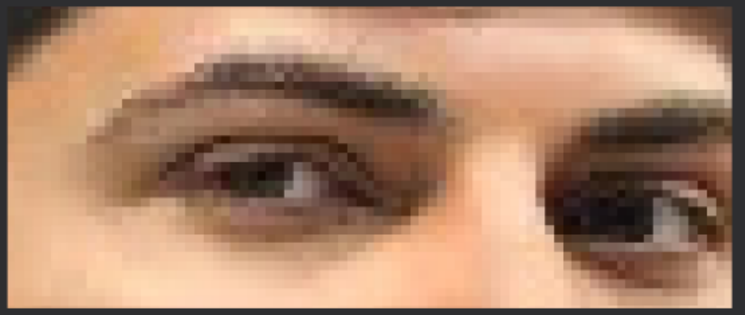
Pehchano?







STRUCTURE OF HUMAN EYE

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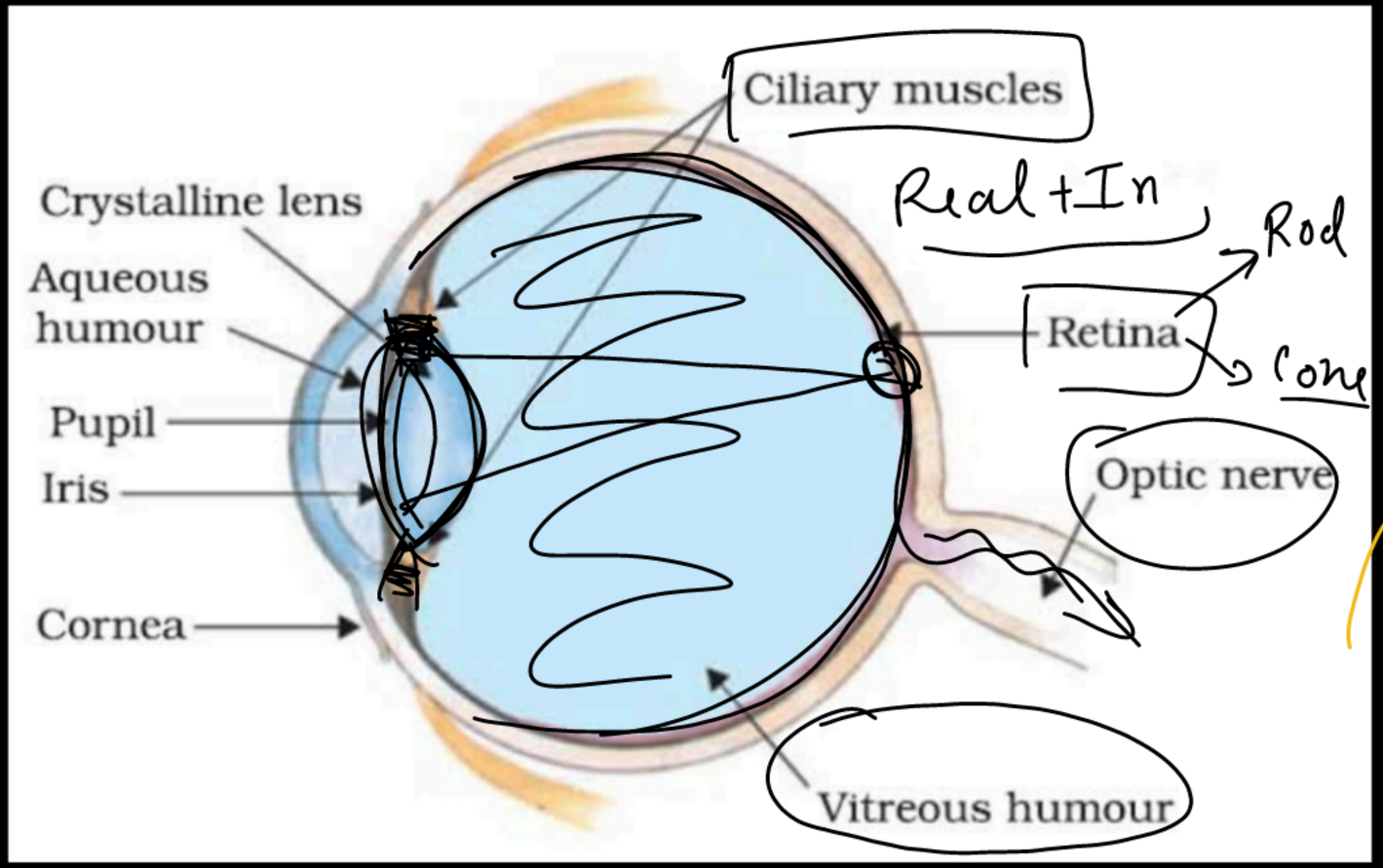
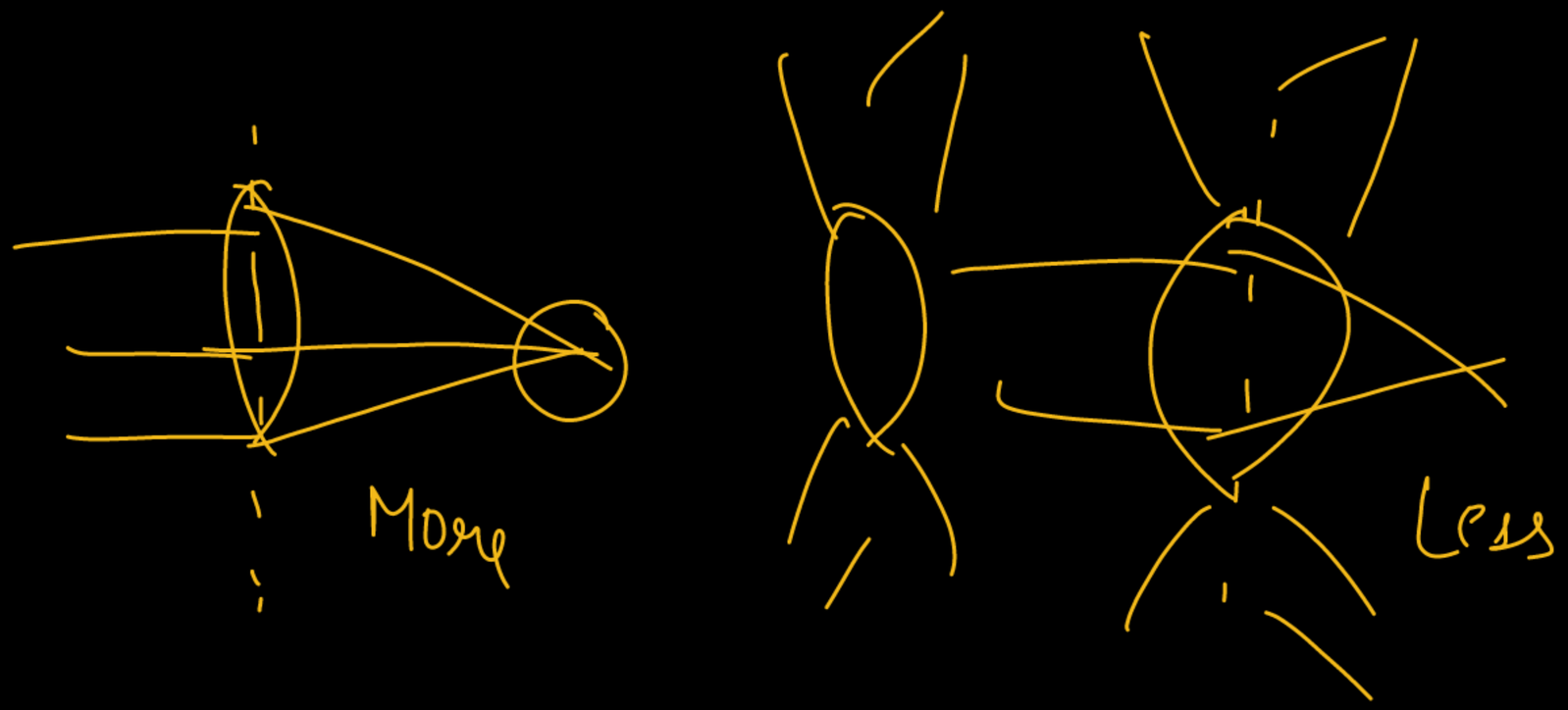


Real + In

Rod

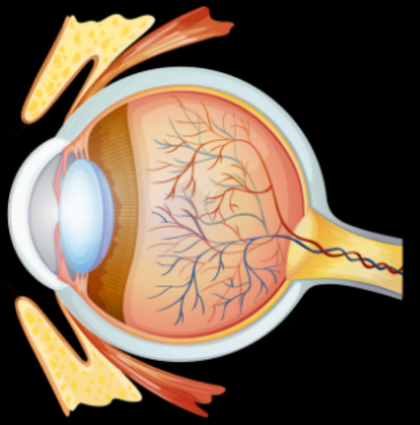
Cone


More
Less

PARTS OF HUMAN EYE

Part of the Eye	Description
Cornea	Transparent front part; allows light to enter and contributes to refraction.
Iris	Colored part; controls the pupil size and regulates light entry.
Pupil	Opening in the iris; adjusts to control light entering the eye.
Lens	Biconvex, transparent structure; focuses light on the retina.
Retina	Inner light-sensitive layer with rods and cones; converts light to signals.
Rods	Detect dim light; responsible for black-and-white vision.
Cones	Detect bright light; responsible for color vision.
Sclera	Tough, white outer covering; protects and maintains the eye's shape.

Part of the Eye	Description
Optic Nerve	Carries signals from the retina to the brain for image formation.
Ciliary Muscles	Control the lens's shape to adjust focal length for near or distant vision.
Aqueous Humor	Clear fluid between cornea and lens; maintains pressure and refracts light.
Vitreous Humor	Transparent gel between lens and retina; provides shape and supports the retina.
Blind Spot	Area where the optic nerve exits; no photoreceptor cells, so no vision here.



POWER OF ACCOMMODATION

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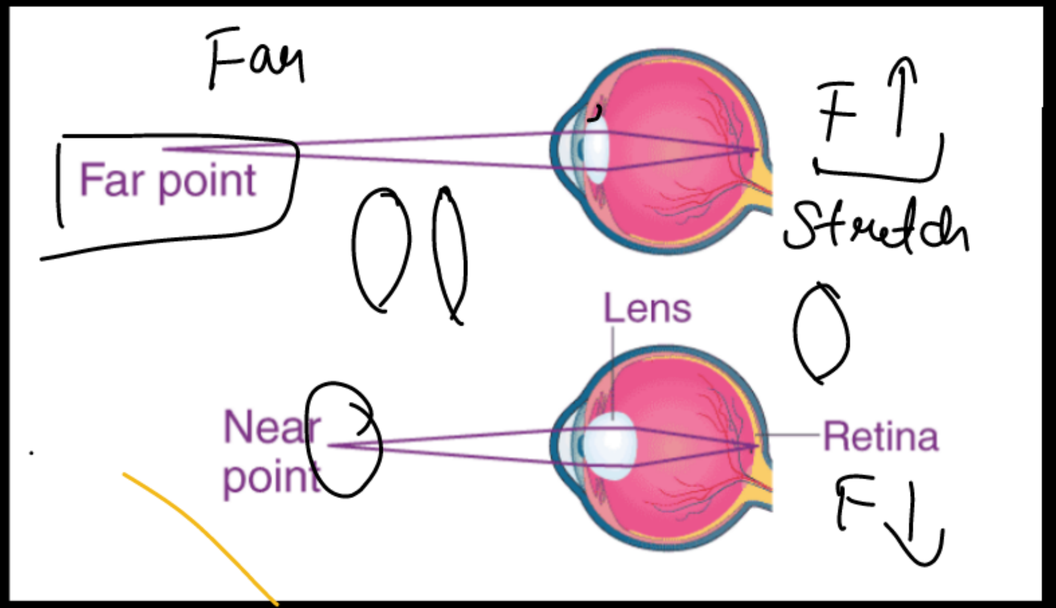
"The power of accommodation of the eye refers to its ability to adjust the lens curvature to focus on near and distant objects. This ability declines with age."

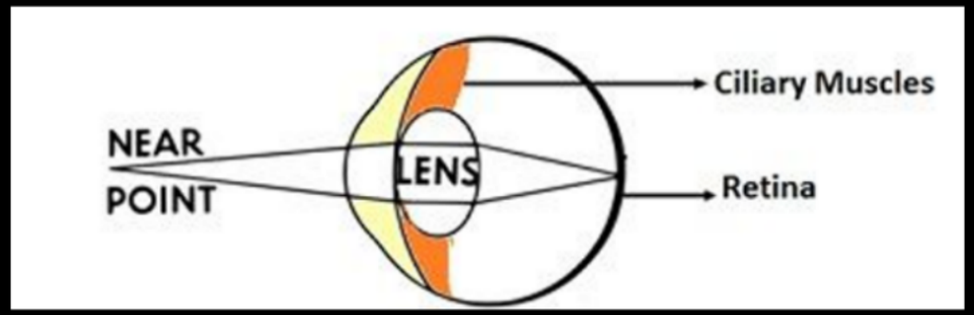
Change focal length



NEAR POINT

The minimum distance at which objects can be seen most distinctly without strain is called near point of the eye.

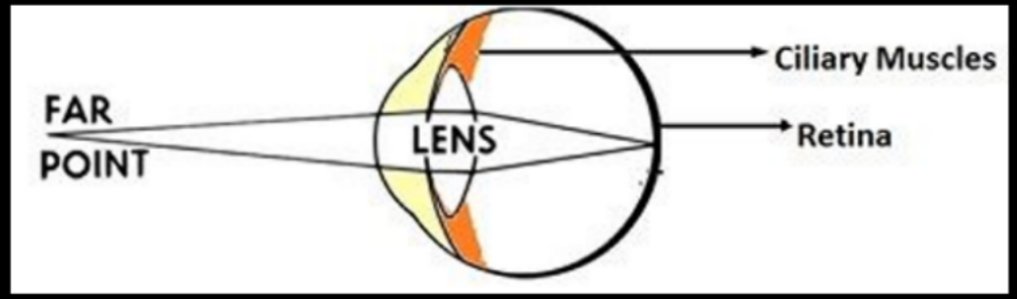
It is at 25 cm for a normal human eye.



FAR POINT → ∞

The farthest point up to which the eye can see object clearly is called the far point of the eye.

It is at infinity for a normal eye .



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Why do we have two eyes for vision and not just one?

Humans have a horizontal field of view of about 150° with one eye and 180° with both eyes, giving a wider view. Two eyes enhance the ability to detect faint objects and perceive depth. Since each eye sees slightly different images, the brain combines them to provide a sense of distance and a 3D perspective.

DEFECTS OF VISION AND THEIR CORRECTION

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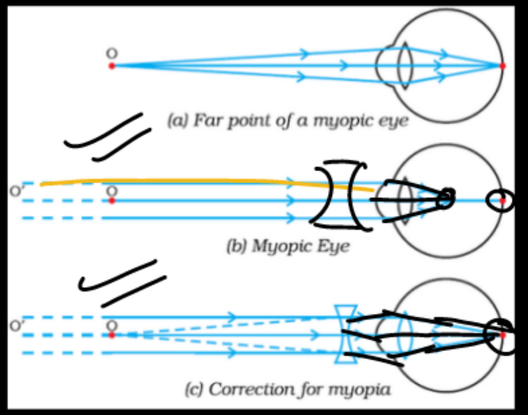
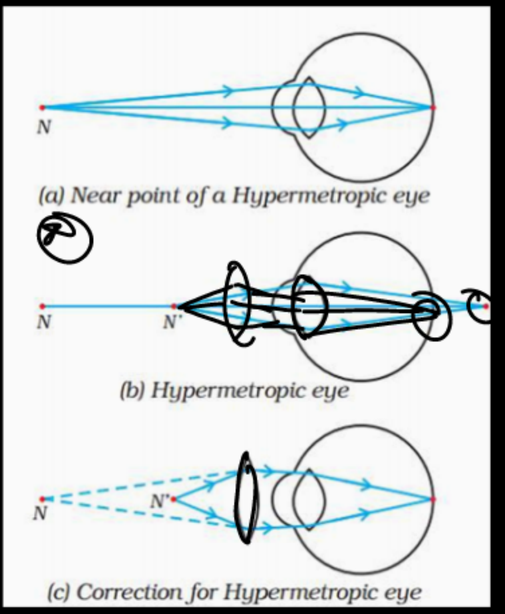
Condition	Description	Cause	Correction
Myopia	Near-sightedness: Can see nearby objects clearly but distant objects appear blurry.	Elongation of the eyeball or excessive curvature of the lens.	Use of a concave lens.
Hypermetropia	Far-sightedness: Can see distant objects clearly but nearby objects appear blurry.	Shortening of the eyeball or insufficient curvature of the lens.	Use of a convex lens.





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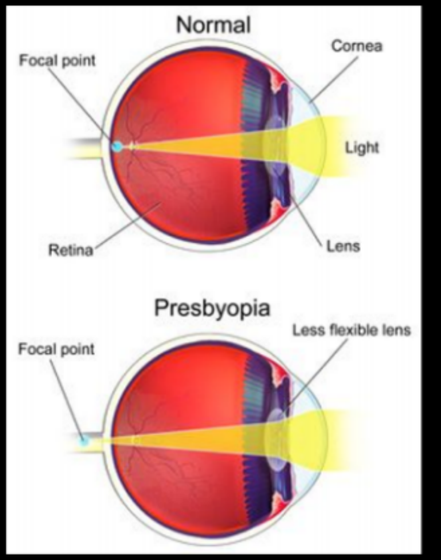
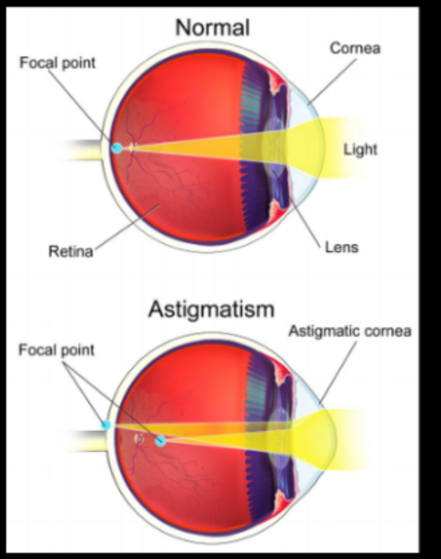
Condition	Description	Cause	Correction
Presbyopia	Difficulty in seeing nearby objects due to aging; often accompanied by hypermetropia.	Gradual weakening of the ciliary muscles and reduced flexibility of the lens with age.	Use of bifocal lenses or progressive lenses.
Astigmatism	Blurred or distorted vision at all distances due to an irregularly curved cornea or lens.	Uneven curvature of the cornea or lens surface.	Use of cylindrical lenses.

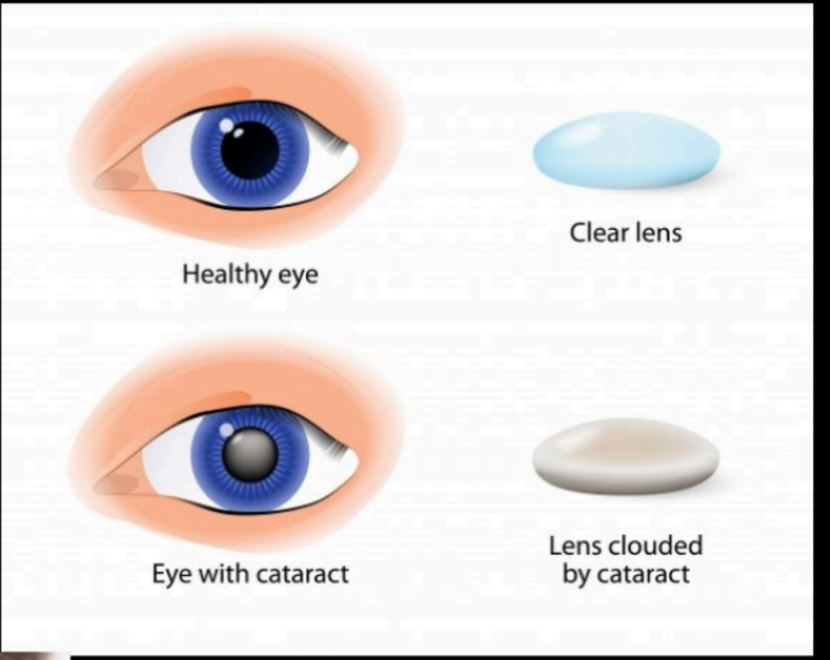




CATARACT

- *A condition in which crystalline lens of eye becomes milky and cloudy due to growth of membrane over it.*

- It generally occurs in older adults.
- This causes partial or complete loss of vision.
- Vision can be restored through cataract surgery.



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Q. An old aged person can read the newspaper by keeping it at 80 cm in front of his eye. What is the nature and power of the lens required to correct the problem?

Hy → Convex

[25 cm] $P = \frac{1}{f}$ $\left[\frac{1}{f} = \frac{1}{v} - \frac{1}{u}\right]$

Trick → add ⊖ sign

u = (Heathy)

v = (given)

$P = \frac{100}{400/11}$

$= \frac{11}{4} = 2.75\,D$

$u = -25\,cm$

$v = -80\,cm$

$\left[\frac{1}{f} = -\frac{1}{80} + \frac{1}{25}\right] \rightarrow \frac{400}{11}$

अभय

Q. A person cannot clearly see objects at a distance more than 40 cm. He is advised to use a lens of power.

40 cm $\longrightarrow \infty$

$$P = \frac{1}{f} = \left[\frac{1}{v} - \frac{1}{u}\right]$$

↳ Myopia

↳ Concave) C

$$P = \frac{1}{f} = \frac{100}{-40} = \frac{-10}{4} = -2.5\ D$$

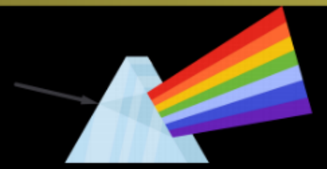
$u = -\infty$

$v = -40\ cm$

$$-\frac{1}{40} + \frac{1}{\infty}$$

$$\frac{1}{f} = -\frac{1}{40} \rightarrow f = -40\ cm$$

PRISM



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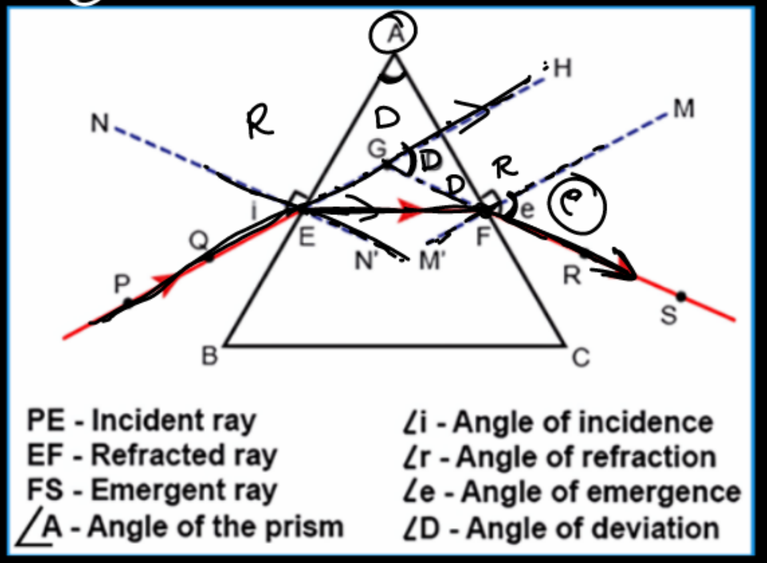
Prism is a ***transparent refracting medium*** bounded by at least two lateral surfaces, inclined at each other at a certain angle.
It consists of two triangular bases and three rectangular lateral surfaces.

REFLECTION OF LIGHT THROUGH PRISM

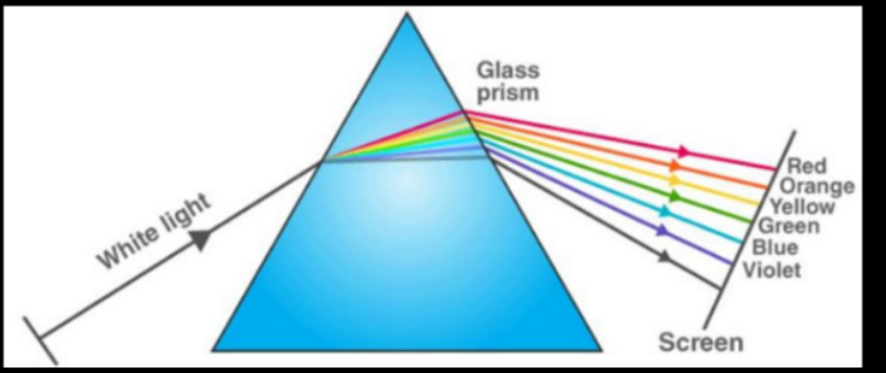
- The angle between the two lateral faces of the prism is known as the angle of the prism.

- The **angle of deviation** is the *angle between the direction of the incident ray and the direction of the emergent ray after light passes through a prism.*

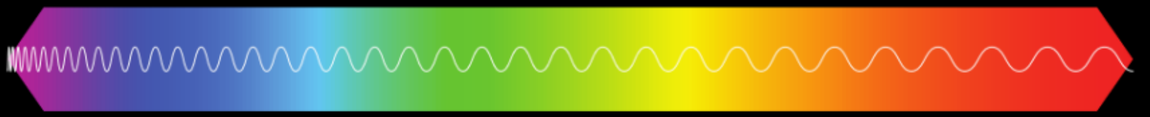


DISPERSION OF WHITE LIGHT BY PRISM

The phenomenon of splitting of white light into its constituent colours when it passes through a prism is called ***dispersion***.



This band of seven colors so obtained the **VIBGYOR**(violet, indigo, blue, green, yellow, orange, red) is called a **spectrum**.



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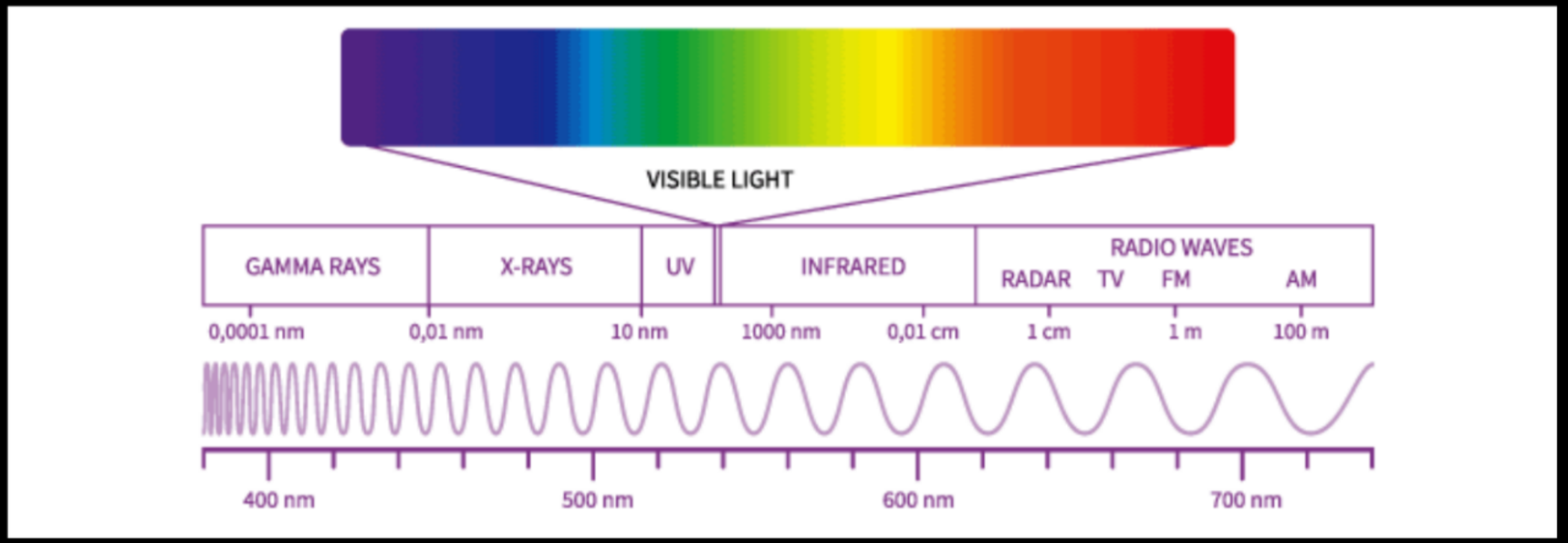
ELECTROMAGNETIC SPECTRUM

The visible light range is from 400 nm to 700 nm in wavelength.

Violet: 400 nm (shortest wavelength)

Red: 700 nm (longest wavelength)



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CAUSE OF DISPERSION

In a vacuum and air, light rays of all colors travel at the same speed.

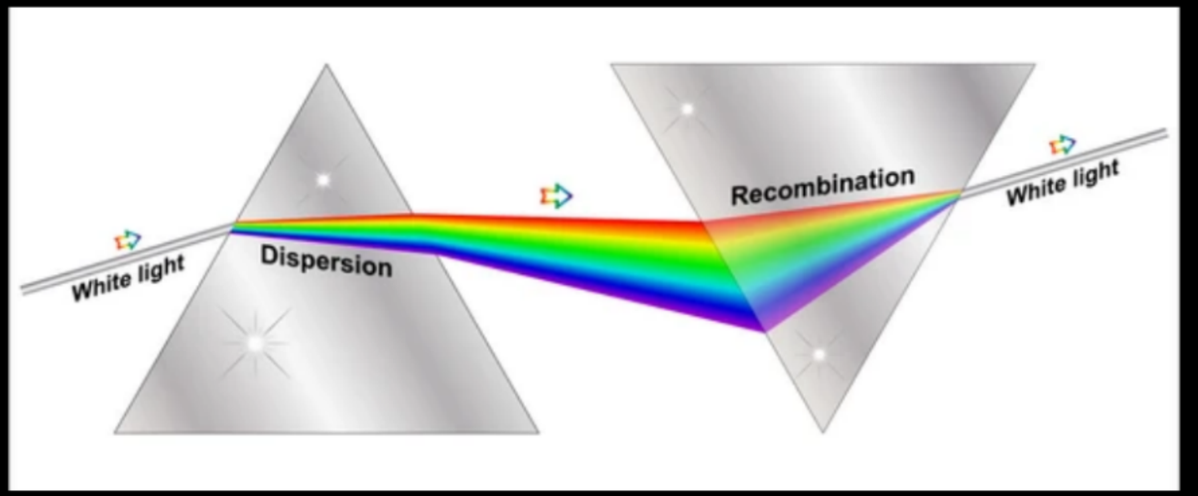
However, in other mediums, they travel at different speeds and bend at different angles, causing light to disperse into its constituent colors.

Red light has the maximum wavelength, and violet light has the minimum wavelength.
Thus, in any medium, **red light** travels the fastest and deviates the least, while **violet light** travels the slowest and deviates the most, i.e.,

Wavelength ∝ Velocity ∝ 1/Deviation

RECOMBINATION OF WHITE LIGHT

Seven coloured lights of the spectrum." can be recombined to give back white light by passing two prism one by upside down.



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RAINBOW FORMATION

- A rainbow is a natural spectrum that appears in the sky after a rain shower, caused by the dispersion and reflection of sunlight by water droplets.
- ***Water droplets act like small prisms**, refracting, dispersing, and internally reflecting sunlight.*
- A rainbow always forms in the direction opposite to the Sun.

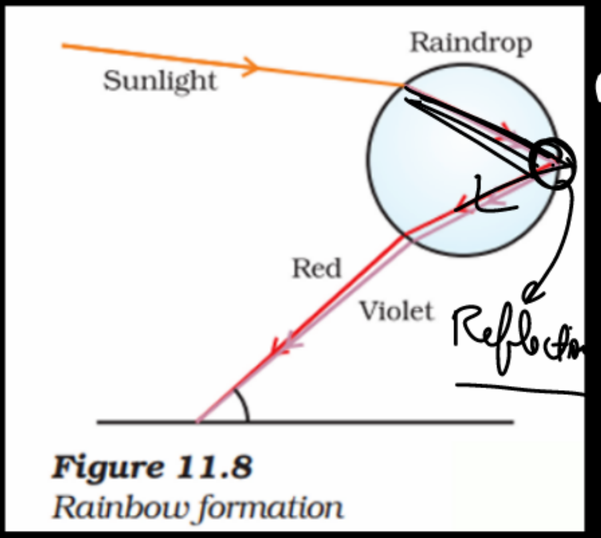
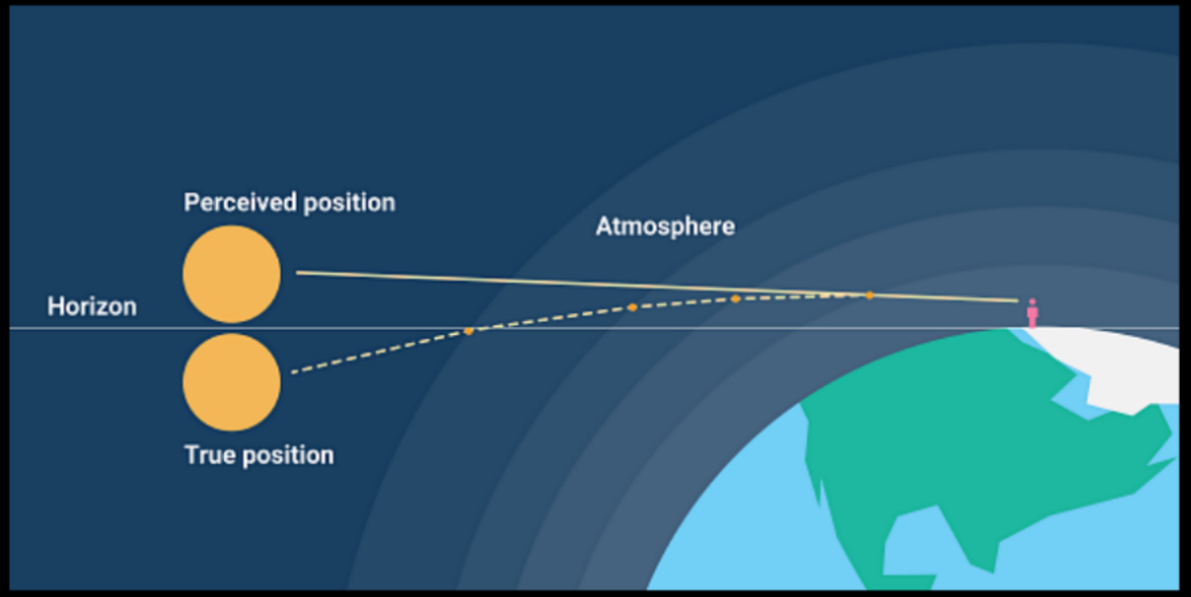
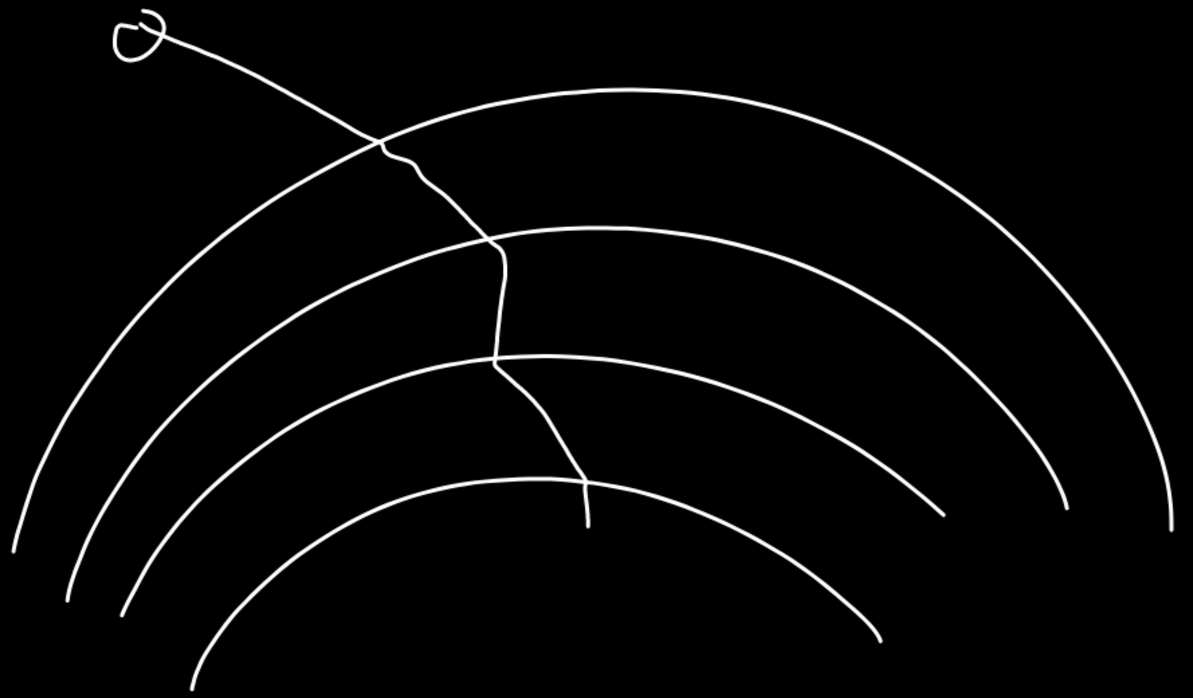


Figure 11.8
Rainbow formation

ATMOSPHERIC REFRACTION



- It is the bending of light or ~~other electromagnetic waves~~ as they pass through the Earth's atmosphere.
- It occurs because the atmosphere's layers have different optical densities, which is due to variations in air density with height.



EFFECTS OF ATMOSPHERIC REFRACTION

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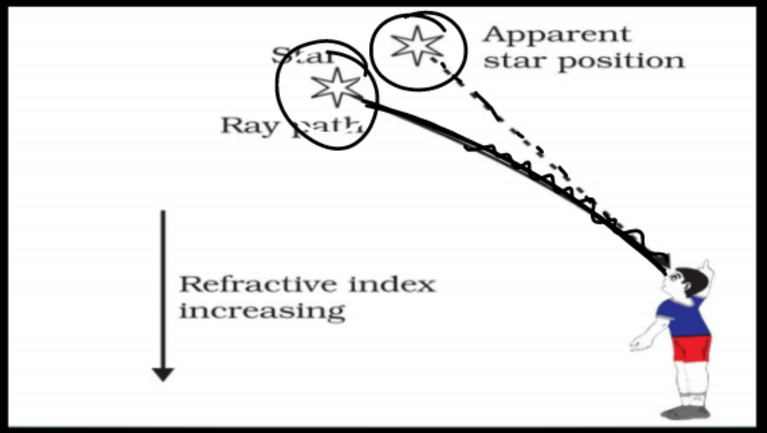
TWINKLING OF STARS

- It is **due to atmospheric refraction.**
- Distant stars act like a point sources of light.
- As the beam of starlight keeps deviating from its path, the apparent position of star keeps on changing because physical condition of earth's atmosphere is not stationary.
- Hence, the amount of light entering our eyes fluctuates, sometimes bright and sometime dim.
- This is known as the 'twinkling effect of stars.'"



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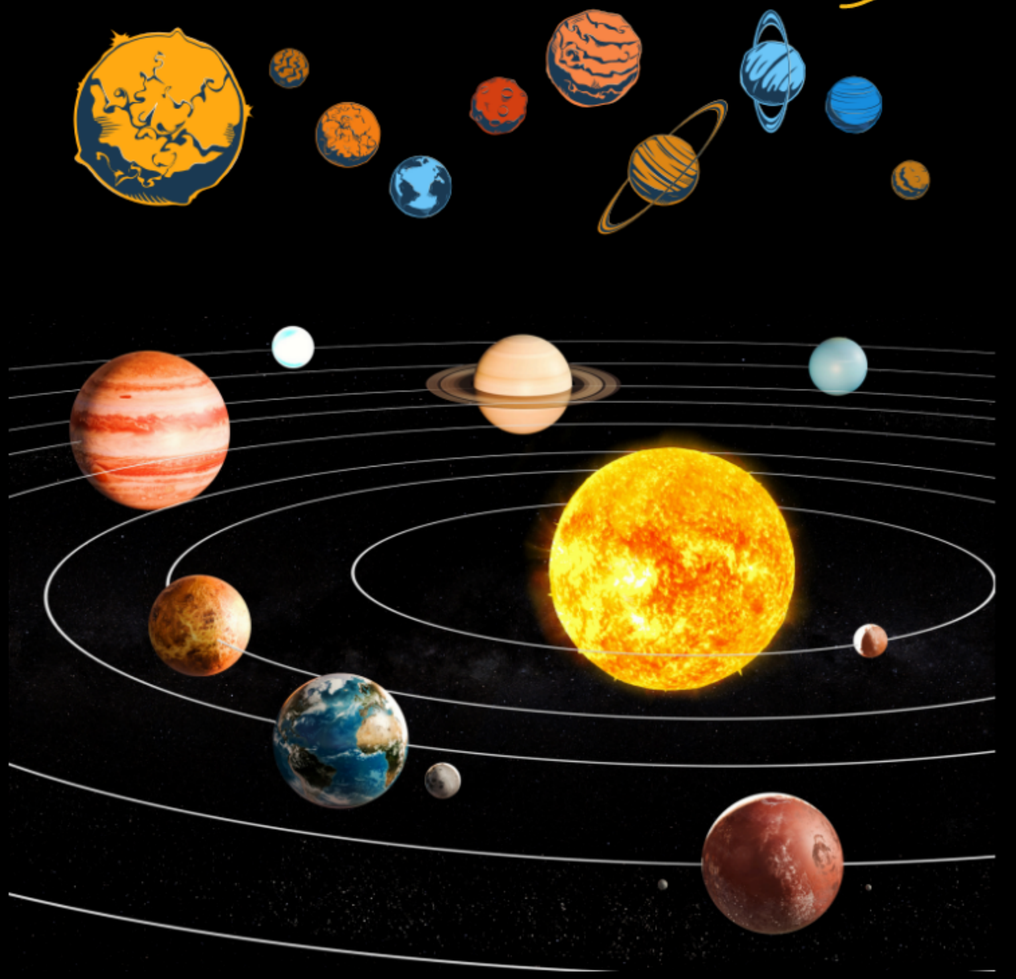
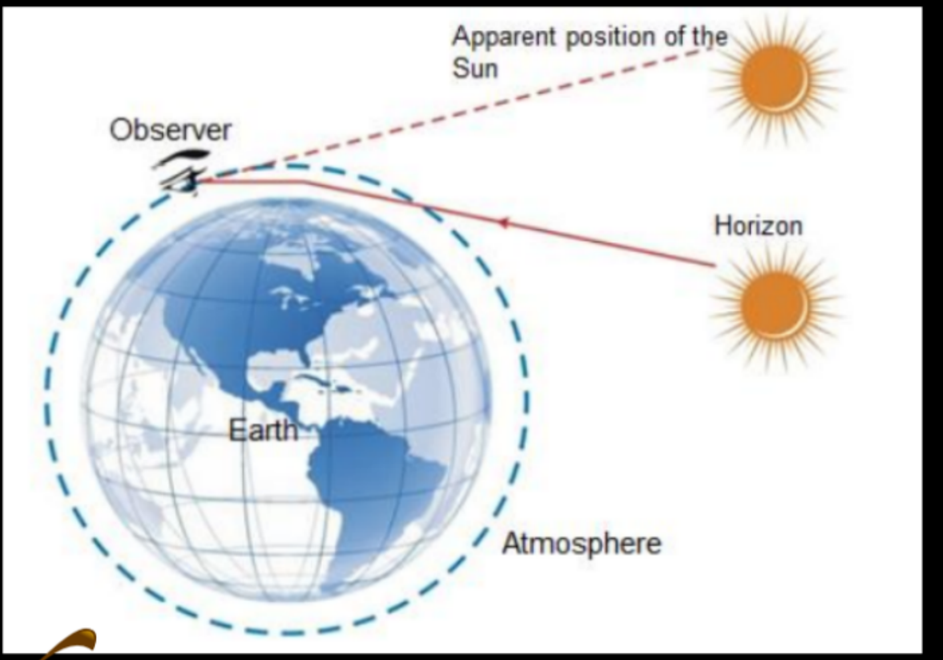
BUT WHY DO PLANETS NOT TWINKLE?

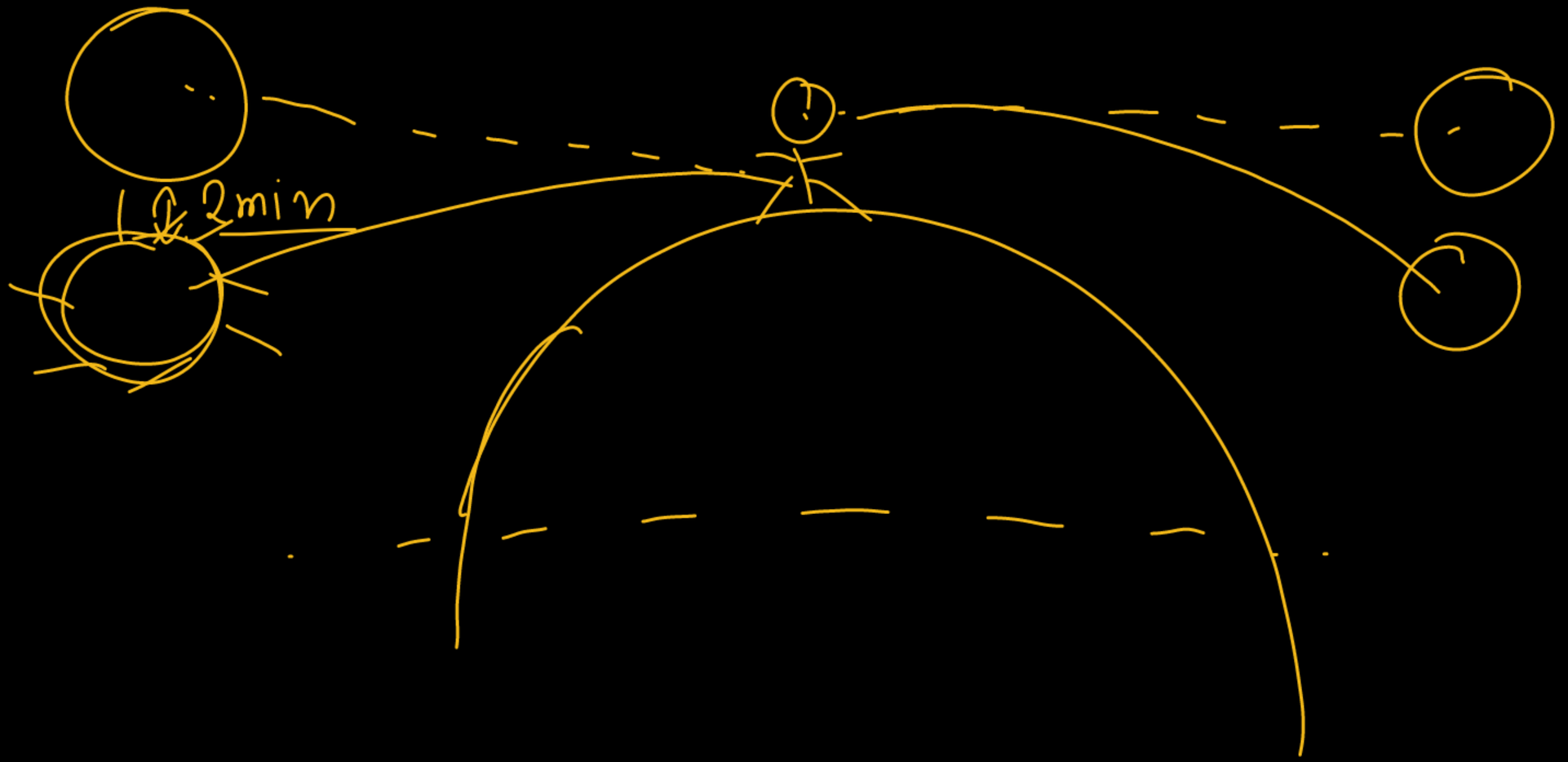
The **planets are much closer to the earth** and are considered a collection of a large number of sized sources of light, the total amount of light entering from all the individual point sized sources will average out to zero thereby nullifying the twinkling effect.



ADVANCED SUNRISE & DELAYED SUNSET

- The Sun is visible to us about 2 minutes before the actual sunrise, and about 2 minutes after the actual sunset because of atmospheric refraction.
- *By 'actual sunrise,' we mean the actual crossing of the horizon by the Sun.*




2min

SCATTERING OF LIGHT

The reflection of light from an object in all directions is called scattering of light. It depends on type of particle.

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

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SCATTERING OF LIGHT

Tyndall effect

- The Earth's atmosphere is a heterogeneous mixture containing smoke, tiny water droplets, dust, and air particles.
- *When a beam of light strikes such fine particles, the path of the beam becomes visible.*
- The light reaches us, after being reflected diffusely by these particles.
- It can also be observed when sunlight passes through a canopy of a dense forest.

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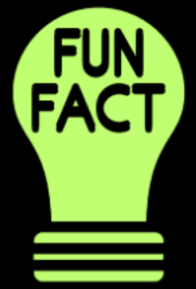
SCATTERING OF LIGHT

Blue Sky

- Sunlight gets scattered by small air molecules and other fine particles in the atmosphere during its passage.
- **Scattering is inversely proportional to wavelength**, i.e. **Blue** with the shortest wavelength will scatter more compared to the **red**.
- This greater scattering of **blue** light by air molecules makes the sky appear blue on a clear day.



- Without Earth's atmosphere, **no scattering of light would occur, and the sky would appear dark**, similar to what passengers observe at high altitudes.

- **Why red is used for danger signals:** *Red light scatters the least due to its longest wavelength,* allowing it to remain visible over long distances through fog or smoke.

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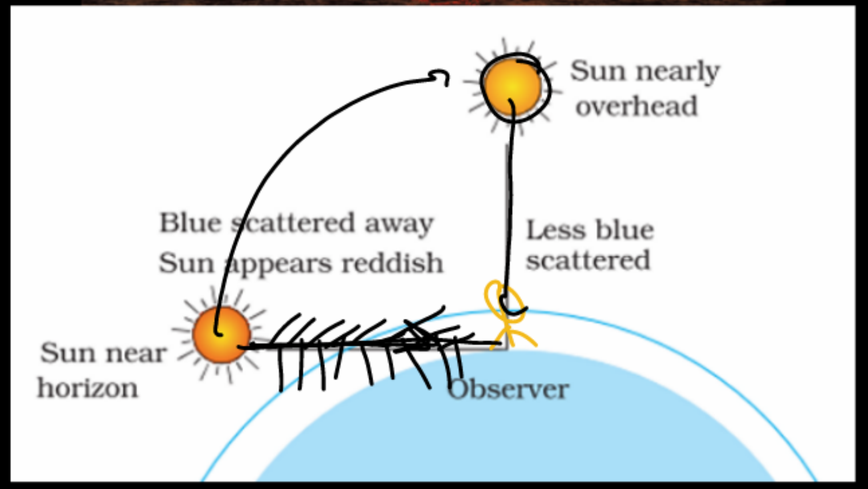
SCATTERING OF LIGHT

Color of Sun at Sunrise and sunset

- The Sun appears red during sunrise and sunset because its light travels a longer distance through the Earth's atmosphere
- *Shorter wavelengths (blue and violet) are scattered away, while longer wavelengths (red and orange) dominate*, giving the Sun a red appearance.



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(2022)

Q1.The danger signals installed at the top of tall buildings are red in colour. These can be easily seen from a distance because, among all other colours, the red light

(a) is scattered the most by smoke or fog

(b) is scattered the least by smoke or fog

(c) is absorbed the most by smoke or fog

(d) moves fastest in the air

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Q2.Which part of the human eye controls the amount of light entering it?

a) Retina

b) Cornea

c) Iris

d) Lens

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(2023)

Q3.Near and far points of a young person normal eye respectively are

(a) 0 and infinity

(b) 0 and 25 cm

(c) 25 cm and infinity

(d) 25 cm and 150 cm.

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Q4.Having two eyes gives a person:

(a) deeper field of view

(b) colored field of view

(c) rear field of view

(d) wider field of view

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(2021)

Q5.A person gets out in the sunlight from a dark room. How does his pupil regulate and control the light entering the eye?

(a) The size of the pupil will decrease, and less light will enter the eye

(b) The size of the pupil will decrease, and more light will enter the eye

(c) The size of the pupil will remain the same, but more light will enter the eye

(d) The size of the pupil will remain the same, but less light will enter the eye

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Q6.The blue color of the sky is due to:

(a) refraction of light

(b) dispersion of light

(c) diffraction of light

(d) scattering of light

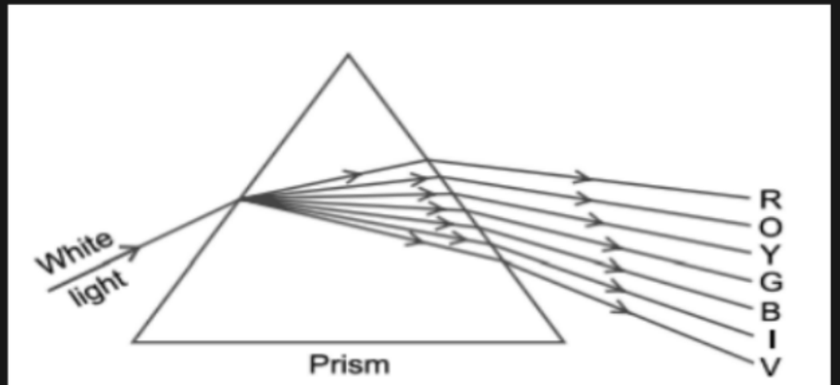
(2021)

Q. What is dispersion of white light? State its cause. Draw a diagram to show dispersion of a beam of white light by a glass prism.

Answer:

• Dispersion of white light: The splitting of white light into its constituent colors when it passes through a prism.

• Cause: Different colors of light travel at different speeds in the prism, causing them to refract by different amounts.



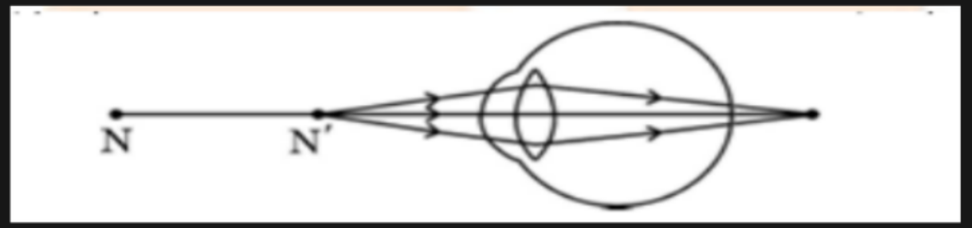
Dispersion of white light

(2022)

Q. (a) Study the diagram given below and answer the questions that follow:

(i) Name the defect of vision depicted in this diagram stating the part of the eye responsible for this condition.

(ii) List two causes of this defect.



Answer:

(i)• Defect of vision: Myopia (Nearsightedness)

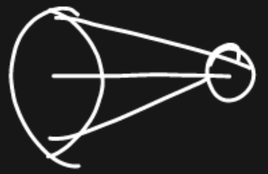
• Part of the eye responsible: The eyeball is too long, or the cornea is too curved.

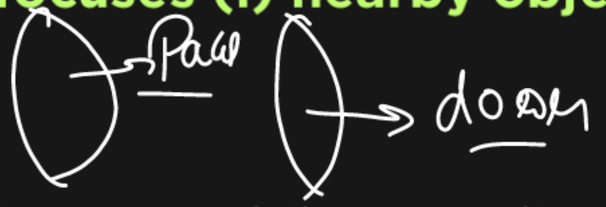
(ii) 1. Elongation of the eyeball

2. Excessive curvature of the cornea

(2024)

Q.(a) Define the term power of accommodation of human eye. Write the name of the part of the eye which plays a major role in the process of accommodation and explain what happens when human eye focuses (i) nearby objects and (ii) distant objects.





Answer:

The power of accommodation refers to the eye's ability to adjust its focal length to clearly see objects at different distances. The lens plays a major role in this process.

(i) When focusing on nearby objects, the ciliary muscles contract, causing the lens to become thicker and increase its refractive power.

(ii) When focusing on distant objects, the ciliary muscles relax, causing the lens to become thinner and decrease its refractive power.

(2023)

Q. (a) State one important function of the following parts of the human eye:

(i) Retina

(ii) Pupil

(b) State the role of ciliary muscles in focusing objects at varying distances from the eye

Answer:

(a) (i) Retina: Converts light into electrical signals which are sent to the brain.

(ii) Pupil: Regulates the amount of light entering the eye by changing its size.

(b)Ciliary muscles adjust the curvature of the lens, allowing the eye to focus on objects at different distances. They contract to thicken the lens for near objects and relax to flatten the lens for distant objects

(2024)

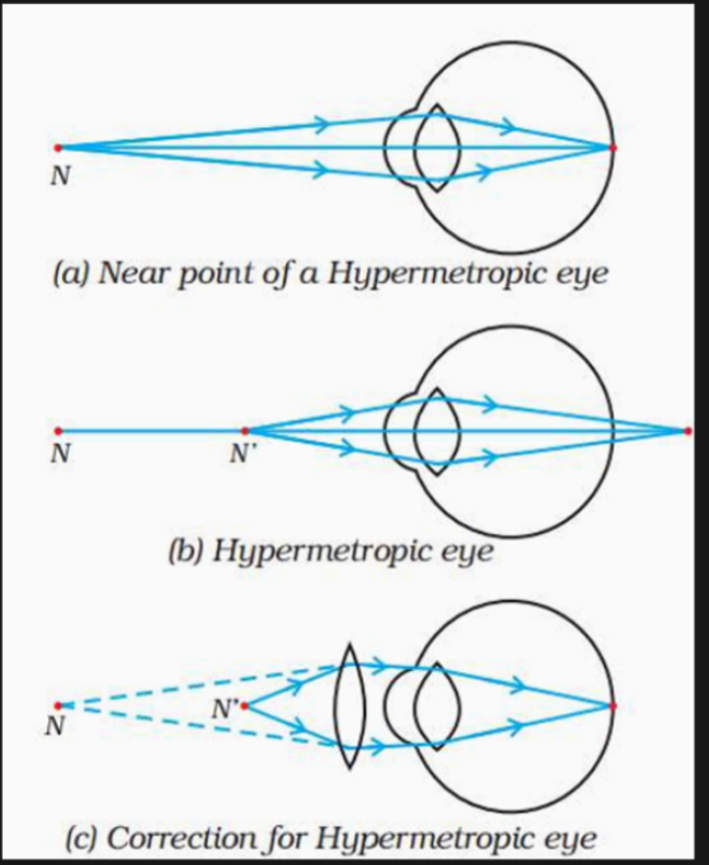
Q.(a) List two causes of hypermetropia.

(b) Draw ray diagrams showing (i) a hypermetropic eye and (ii) its correction using suitable optical device.

a) Hypermetropia is caused due to following reasons:

Hypermetropia is due to

- Decrease in the power of eye lens i.e., increase in focal length of eye lens.
- Shortening of eyeball



(2020)

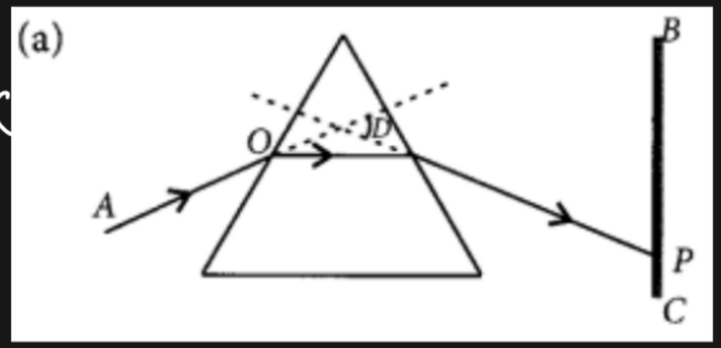
Q. (a) With the help of labelled ray diagram show the path followed by a narrow beam of monochromatic light when it passes through a glass prism.

(b) What would happen if this beam is replaced by a narrow beam of white light?

Monochromatic

Single

White



Here, in the figure, ∠D is the angle of deviation of the given monochromatic light by the glass prism.

(b) If AO were a ray of white light, then on screen BC, a spectrum will be observed, consisting of seven colours arranged from bottom to top as follows. Violet, Indigo, Blue, Green, Yellow, Orange, Red (VIBGYOR)

Chapter ka gyaan

"Even your blind spot has a job—reminding you that no one is perfect, not even your amazing eyes."

- embrace your flaws