INDIAN SCHOOL AL WADI AL KABIR		
Class: X	**DEPARTMENT OF SCIENCE -2023-24** **SUBJECT: PHYSICS**	**DATE OF SUBMISSION: 20.08.2023**
HANDOUTS	**TOPIC:** **THE HUMAN EYE AND THE COLOURFUL WORLD**	**A4 FILE FORMAT** **(PORTFOLIO)**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

Human eye: The human eye is one of the most valuable and sensitive sense organs. It enables us to see the wonderful world and the colours around us.

Crystalline lens: The human eye is like a camera. Its lens system forms an image on a light-sensitive screen called the retina. The crystalline lens merely provides the finer adjustment of focal length required to focus objects at different distances on the retina.

Cornea: Light enters the eye through a thin membrane called the cornea. Most of the refraction for the light rays entering the eye occurs at the outer surface of the cornea.

Eyeball: It forms the transparent bulge on the front surface of the eyeball. The eyeball is approximately spherical in shape with a diameter of about 2.3 cm.

Iris: We find a structure called iris behind the cornea. Iris is a dark muscular diaphragm that controls the size of the pupil.

Pupil: The pupil regulates and controls the amount of light entering the eye.

Working of an human eye: When the light rays enter the eye,

- The eye lens forms an inverted real image of the object on the retina.
- The retina is a delicate membrane having enormous number of light-sensitive cells.
- The light-sensitive cells get activated upon illumination and generate electrical signals.
- These signals are sent to the brain via the optic nerves.
- The brain interprets these signals, and finally, processes the information so that we perceive objects as they are.

Power of the accommodation: The ability of the eye lens to adjust its focal length is called accommodation.

How is it possible to see the distant objects clearly?

- The eye lens is composed of a fibrous, jelly-like material.
- Its curvature can be modified to some extent by the ciliary muscles.
- The change in the curvature of the eye lens can thus change its focal length.
- When the muscles are relaxed, the lens becomes thin.
- Thus, its focal length increases. This enables us to see distant objects clearly.

How is it possible to see nearby objects clearly?

- When you are looking at objects closer to the eye, the ciliary muscles contract.
- This increases the curvature of the eye lens. The eye lens then becomes thicker.
  - Consequently, the focal length of the eye lens decreases. This enables us to see nearby objects clearly.

Near point of the eye: The minimum distance, at which objects can be seen most distinctly without strain, is called **the least distance of distinct vision**. It is also called the near point of the eye. For a young adult with normal vision, the near point is about 25 cm.

Far point of the eye: The farthest point up to which the eye can see an object clearly is called the far point of the eye. It is infinity for a normal eye.

What is the power of accommodation of a normal eye?

A normal eye can see objects clearly that are between 25 cm and infinity.

Cataract: Sometimes, the crystalline lens of people at old age becomes milky and cloudy. This condition is called cataract. This causes partial or complete loss of vision. It is possible to restore vision through a cataract surgery.

What are refractive defects?

- Sometimes, the eye may gradually lose its power of accommodation. In such conditions, the person cannot see the objects distinctly and comfortably.
- The vision becomes blurred due to the refractive defects of the eye.

What are the three types of refractive defects? How are they generally corrected ?

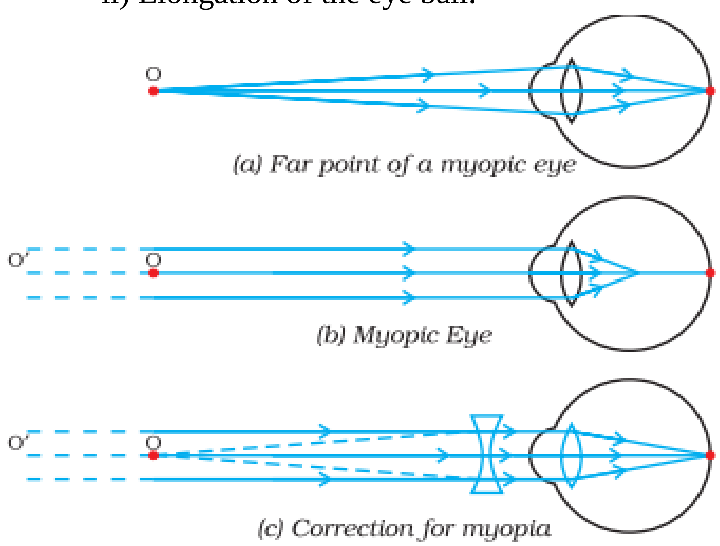
(i) Myopia or near-sightedness (ii) Hypermetropia or far -sightedness, and (iii) Presbyopia. These defects can be corrected by the use of **suitable spherical lenses**.

Write four differences between myopia and hypermetropia?

MYOPIA	HYPERMERTROPIA
near-sightedness	far -sightedness.
can see nearby objects clearly but cannot see distant objects distinctly	can see distant objects clearly but cannot see nearby objects distinctly.
A person with this defect has the far point nearer than infinity	The near point, for the person, is farther away from the normal near point (25 cm).
A concave lens or diverging lens is used for correction	A convex lens or converging lens is used for correction.

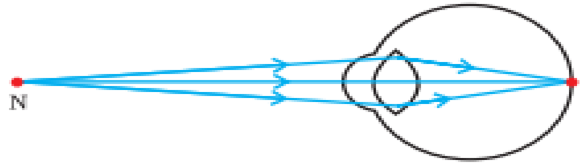
A student has difficulty in reading the blackboard while sitting in the last row. What could be the defect the child is suffering from? What are the causes? Make a diagram to show how the defect is corrected.

- The student is suffering from **Myopia. (<u>Myopia</u>** is the defect of vision due to which the person cannot see distant objects distinctly but can see the nearby objects clearly.)
- **Causes** – i) Excessive curvature of the eye lens.
  ii) Elongation of the eye ball.

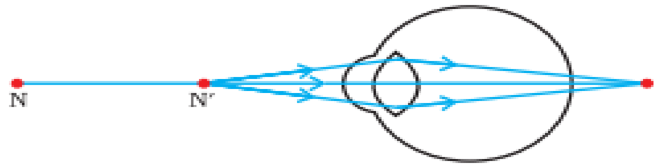


What is hypermetropia? State its two causes. With the help of ray diagram show how the defect is corrected.

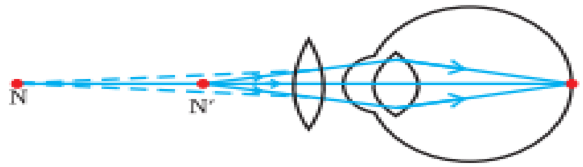
- **<u>Hypermetropia</u>** is the defect of vision due to which the person cannot see nearby objects clearly but can see distant objects distinctly.
- **Causes**-i) Focal length of eye lens is too long
  ii) The eyeball has become too small



(a) Near point of a Hypermetropic eye



(b) Hypermetropic eye



(c) Correction for Hypermetropic eye

Presbyopia: The power of accommodation of the eye usually decreases with ageing. For most people, the near point gradually recedes away. They find it difficult to see nearby objects comfortably and distinctly without corrective eye-glasses. This defect is called Presbyopia.

Causes:

(i) gradual weakening of the ciliary muscles (ii) diminishing flexibility of the eye lens.

(iii) suffers from both myopia and hypermetropia.

Corrective measures:

(i) A common type of **bi-focal lenses** consists of both concave and convex lens.

The upper part – concave lens – facilitates distant vision.

The lower part – convex lens – facilitates near vision.

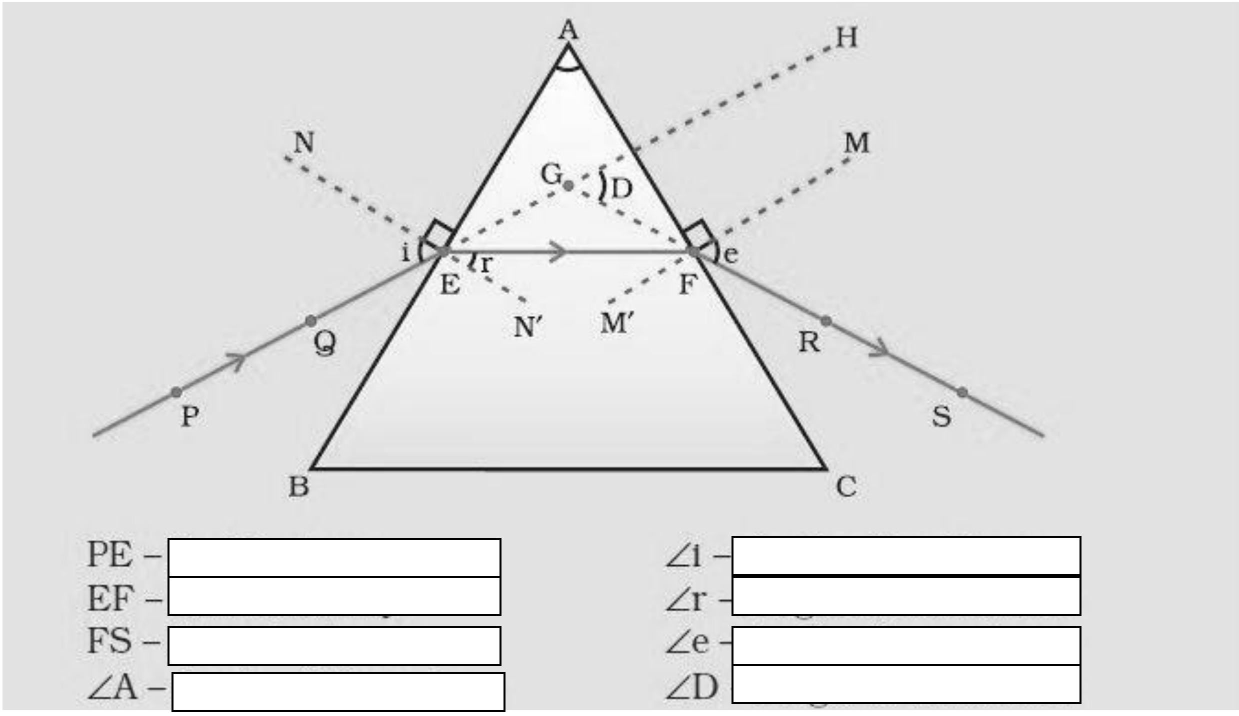
(ii) Use of contact lens or surgical interventions.

Refraction in a glass prism:

Triangular glass prism: It has two triangular bases and three rectangular lateral surfaces. These surfaces are inclined to each other.

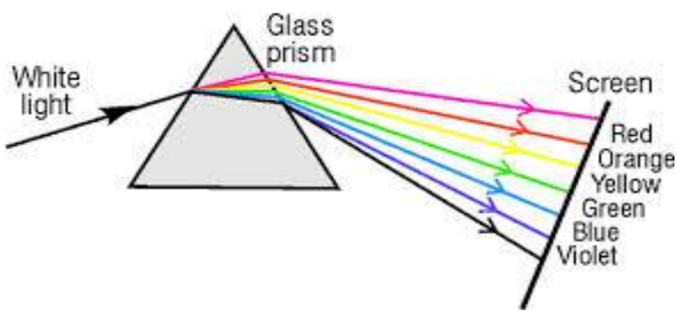
Angle of the prism: The angle between its two lateral faces is called the angle of the prism.

Identify the following terms:



Angle of deviation : The peculiar shape of the prism makes the emergent ray bend at an angle to the direction of the incident ray. This angle is called the angle of deviation. In this fig. ∠D is the angle of deviation.

Dispersion: The splitting of white light into its component colours is called dispersion.



What is VIBGYOR? The seven colours are Violet, Indigo, Blue, Green, Yellow, Orange and Red.

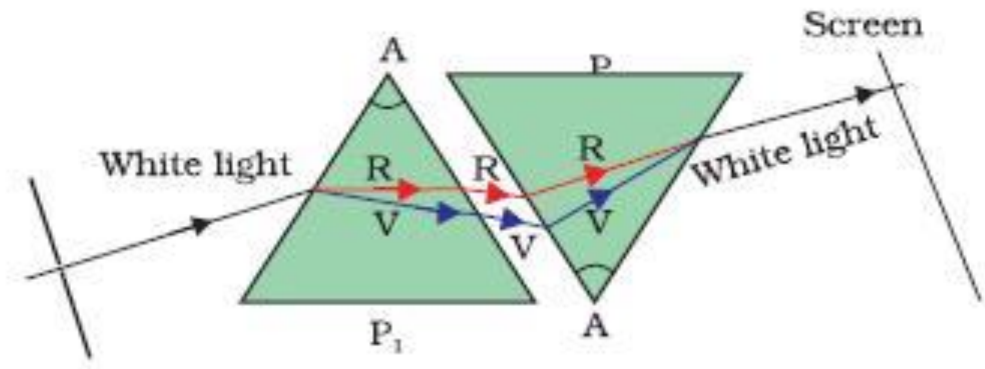
Spectrum: The band of the coloured components of a light beam is called its spectrum.

Why do we get these colours? Different colours of light bend through different angles with respect to the incident ray, as they pass through a prism. **The red light bends the least while the violet the most.** Thus the rays of each colour emerge along different paths and thus become distinct.

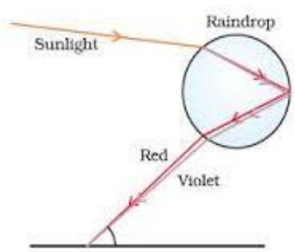
How did Newton prove that the sunlight is made of seven colours?

- Isaac Newton was the first to use a glass prism to obtain the spectrum of sunlight.
- He tried to split the colours of the spectrum of white light further by using another similar prism.
- However, he could not get any more colours.

- He then placed a second identical prism in an inverted position with respect to the first prism
- This allowed all the colours of the spectrum to pass through the second prism.
- He found a beam of white light emerging from the other side of the second prism.



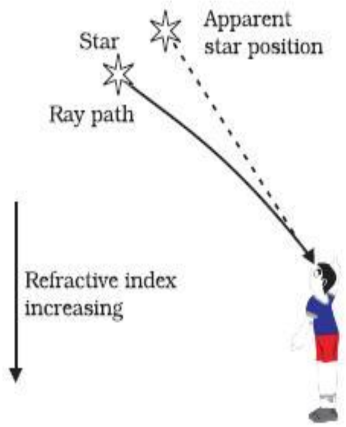
Formation of a rainbow:



- A rainbow is a natural spectrum appearing in the sky after a rain shower. It is caused by dispersion of sunlight by tiny water droplets, present in the atmosphere.
- A rainbow is always formed in a direction opposite to that of the Sun.
- The water droplets act like small prisms.
- They 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 dispersion of light and internal reflection, different colours reach the observer's eye.

ATMOSPHERIC REFRACTION:

- The apparent random wavering or flickering of objects seen through a turbulent stream of hot air rising above a fire or a radiator.
- The air just above the fire becomes hotter than the air further up.
- The hotter air is lighter (less dense) than the cooler air above it, and has a refractive index slightly less than that of the cooler air.
- Since the physical conditions of the refracting medium (air) are not stationary, the apparent position of the object, as seen through the hot air, fluctuates. This wavering is thus an effect of atmospheric refraction (refraction of light by the earth's atmosphere) on a small scale in our local environment.
- **<u>The twinkling of stars is a similar phenomenon on a much larger scale</u>.**



- The starlight, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth.
- The atmospheric refraction occurs in a medium of gradually changing refractive index.
- Since the atmosphere bends starlight towards the normal, the apparent position of the star is slightly different from its actual position.
- **This is the reason why the star appears slightly higher (above) than its actual position when viewed near the horizon**

Why do the stars twinkle?

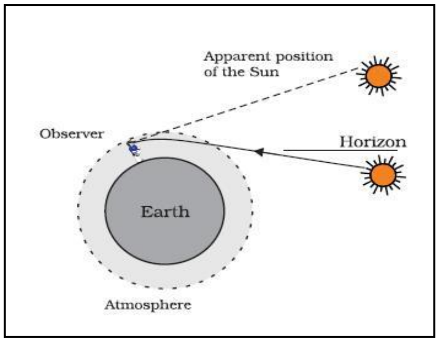
- **The twinkling of a star** is due to atmospheric refraction of starlight.
- This apparent position of the star is not stationary, but keeps on changing slightly, since the physical conditions of the earth's atmosphere are not stationary.
- Since the stars are very distant, they approximate point-sized sources of light.
- As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers – the star sometimes appears brighter, and at some other time, fainter, **which is the twinkling effect.**

Why don't the planets twinkle?

- The planets are much closer to the earth, and are thus seen as extended sources.
- If we consider a planet as a collection of a large number of point-sized sources of light, the totalvariation in the amount of light entering our eye from all the individual point-sized sources will average out to zero, thereby nullifying the twinkling effect.

Advance sunrise and 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.
- The time difference between actual sunset and the apparent sunset is about 2 minutes.
- The apparent flattening of the Sun's disc at sunrise and sunset is also due to **atmospheric refraction.**



Tyndall effect:

- 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.
- The phenomenon of scattering of light by the colloidal particles gives rise to Tyndall effect

Examples of Tyndall effect:

- When sunlight passes through a canopy of a dense forest, it scatters light.
- Tiny water droplets in the mist scatter light.
- When sunlight passes through suspended particles of dust and molecules of air, Tyndall effect occurs.

Explain how the scattering of light results in different colours.

- The colour of the scattered light depends on the size of the scattering particles.
- Very fine particles scatter mainly blue light while particles of larger size scatter light of longer wavelengths.
- If the size of the scattering particles is large enough, then, the scattered light may even appear white.

Why is the colour of the clear Sky Blue?

- The molecules of air and other fine particles in the atmosphere have size smaller than the wavelength of visible light.
- When sunlight passes through the atmosphere, the fine particles in air scatter the blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes. Hence the sky appears blue.

Give four differences between blue and red light.

BLUE LIGHT	RED LIGHT
1. Shorter wavelength	**1. Longer wavelength – about 1.8 times greater than blue light**
2. More deviated light	**2. Least deviated light**
3. Air particles are more effective in scattering blue light	**3. Air particles are less effective in scattering red light**
4. Cannot be used for danger signals	**4. Can be used for danger signals**

When does the sky appear dark?

If the earth had no atmosphere, there would not have been any scattering. Then, the sky would have looked dark. The sky appears dark to passengers flying at very high altitudes, as scattering is not prominent at such heights.

Which light is used for danger signal?

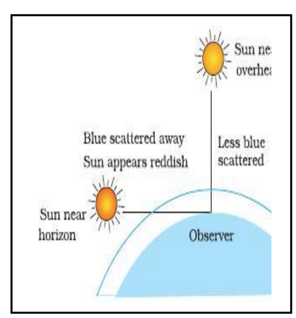
Red light is used for danger signals because the red is least scattered by fog or smoke. Therefore, it can be seen in the same colour at a distance.

Explain the colour of the Sun at Sunrise and Sunset.

Scattering of the light causes the blue colour of the sky and the reddening of the Sun at the sunrise and the sunset. This phenomenon can be demonstrated with the help of an activity.

1. Allow a source of white light to fall on the colloidal Sulphur particles.

The three sides of the glass tank will appear blue, indicating the scattering of the short wavelengths by the Sulphur particles.



2. The colour of the transmitted light from the fourth side of the tank appears orange red.

What are the colour changes occur based on the position of the Sun with respect to the observer?

- **When the Sun is overhead with respect to the observer:** At noon, the Sun appears white as very little blue and violet colours are scattered due to short distance.
- **When the Sun is at the horizon with respect to the observer:** At sunrise and sunset, the Sun appears orange red as most of the blue light is scattered by the air particles and only the red light reaches our eyes which is of longer wavelength. Therefore, this gives rise to the reddish appearance of the Sun.

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