Class – 10 Science

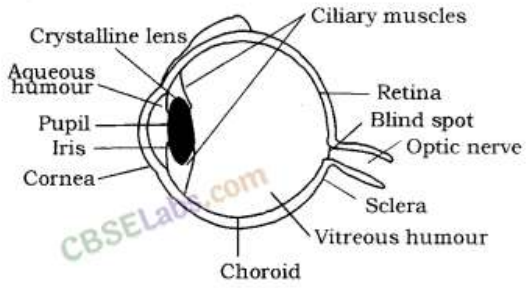
Notes

Chapter-11 Human Eye and Colourful World

Human Eye: working of human eye, Persistence of vision, Power of accommodation of human eye, Defects of vision.

The Human Eye: It is a natural optical instrument which is used to see the objects by human beings. It is like a camera which has a lens and screen system.

Structure of the Human Eye



The various parts of eye and their functions :

- Retina: It is a light sensitive screen inside the eye on which image is formed. It contains rods and cones.
- Cornea: It is a thin membrane which covers the eye trail. It acts like a lens which refracts the light entering the eye.
- Aqueous humour: It is fluid which fills the space between cornea and eye lens.
- Eye lens: It is a convex lens made of transparent and flexible jelly like material. Its curvature can be adjusted with the help of ciliary muscles.
- Pupil: It is a hole in the middle of iris through which light enters the eye. It appears black because light falling on it goes into the eye and does not come back.
- Ciliary muscles: These are the muscles which are attached to eye lens and can modify the shape of eye lens which leads to the variation in focal lengths.
- Iris: It controls the amount of light entering the eye by changing the size of the pupil.
- Optical nerve: These are the nerves which take the image to the brain in the form of electrical signals.

The human eye is roughly spherical in shape with a diameter of about 2.3 cm. It consists of a convex lens made up of living tissues. Hence, human lenses are living organs contrary to the simple optical lenses. The following table lists the main parts of the human eye and their respective functions.

S.No.	Human Eye Part	Functions
1.	Pupil	Opens and closes in order to regulate and control the amount of light.
2.	Iris	Controls light level similar to the aperture of a camera.
3.	Sclera	Protects the outer coat.
4.	Cornea	A thin membrane which provides 67% of the eye's focusing power.
5.	Crystalline lens	Helps to focus light into the retina.
6.	Conjunctive	Covers the outer surface (visible part) of the eye.
7.	Aqueous humour	Provides power to the cornea.
8.	Vitreous humour	Provides the eye with its form and shape.

9.	Retina	Captures the light rays focussed by the lens and sends impulses to the brain via the optic nerve.
10.	Optic nerve	Transmits electrical signals to the brain.
11.	Ciliary muscles	Contracts and extends in order to change the lens shape for focusing.

How Pupil Works?
For Example, You would have observed that when you come out of the cinema hall after watching the movie in the bright sunlight, your eyes get closed. And when you entered the hall from the bright light, you won't be able to see and after some time you would be able to see. Here, the pupil of an eye provides a variable aperture, whose size is controlled by iris.
(a) When the light is bright: Iris contracts the pupil, so that less light enters the eye.
(b) When the light is dim: Iris expands the pupil, so that more light enters the eye.
Pupil opens completely when iris is relaxed.

Persistence of Vision: It is the time for which the sensation of an object continues in the eye. It is about 1/16th of a second.

Power of Accommodation: The ability of the eye lens to adjust its focal length accordingly as the distances is called power of accommodation.

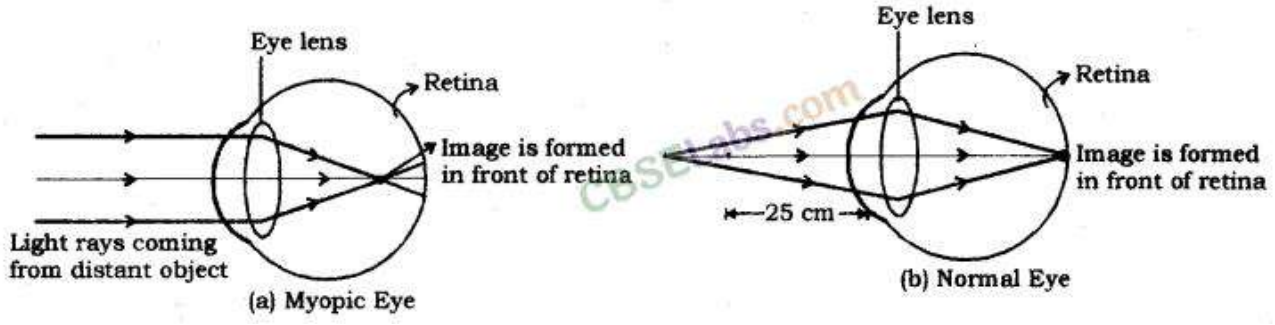
Ciliary muscles

Relaxed	Contract
1. Eye lens become thin.	1. Eye lens become thick.
2. Increases the focal length.	2. Decreases the focal length.
3. Enable us to see distant object clearly.	3. Enable us to see nearby object clearly.

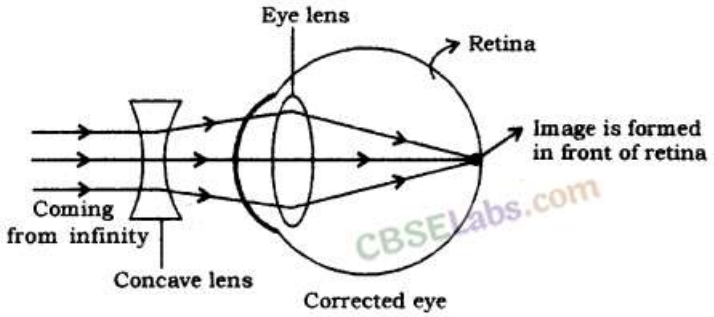
Near point of the Eye	Far point of the Eye
It is 25 cm for normal eye. The minimum distance at which object can be seen most distinctly without strain.	It is infinity for normal eye. It is the farthest point upto which the eye can see object clearly.

Colour Blindness: A person having defective cone cells is not able to distinguish between the different colours. This defect is known as Colour Blindness.

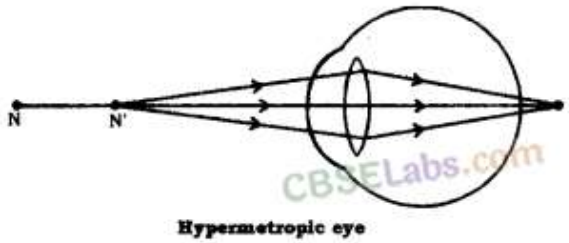
Defects of Vision and their Correction
Myopia (Short-sightedness): It is a kind of defect in the human eye due to which a person can see near objects clearly but he cannot see the distant objects clearly. Myopia is due to
(i) excessive curvature of the cornea.
(ii) elongation of eyeball.



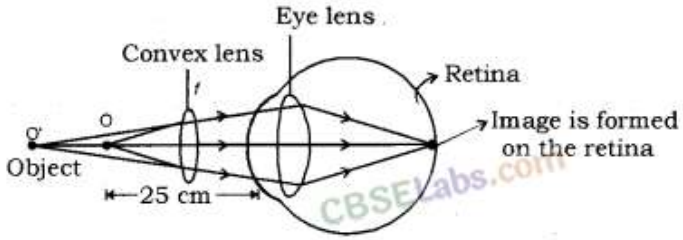
Correction: Since a concave lens has an ability to diverge incoming rays, it is used to correct this defect of vision. The image is allowed to format the retina by using a concave lens of suitable power as shown in the given figure.



Hypermetropia (Long-sightedness): It is a kind of defect in the human eye due to which, a person can see distant objects properly but cannot see the nearby objects clearly. It happens due to
(i) decrease in the power of eye lens i.e., increase in focal length of eye lens.
(ii) shortening of eyeball.



A hypermetropic eye has its least distance of distinct vision greater than 25 cm.
Correction: Since a convex lens has the ability to converge incoming rays, it can be used to correct this defect of vision, as you already have seen in the animation. The ray diagram for the corrective measure for a hypermetropic eye is shown in the given figure.



Power of the correcting convex lens:

The Lens formula, $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ can be used to calculate the focal length and hence, the power of the myopia correcting lens.
In this case,
Object distance, u = ∞
Image distance, v =
person's far point Focal length, f =?
Hence, lens formula becomes

$$\frac{1}{\text{far point}}-\frac{1}{\infty}=\frac{1}{\text{focal length}}$$

$$\frac{1}{\text{far point}}-0=\frac{1}{\text{focal length}}$$

In case of a concave lens, the image is formed in front of the lens i.e., on the same side of the object.
Focal length = -Far point
Now, power of the required lens (P) = $\frac{1}{f}(in m)$

Power of the correcting convex lens: Lens formula, $1v-1u=1f$ can be used to calculate focal length f and hence, power P of the correcting convex lens, where,
Object distance, u = -25 cm, normal near point
Image distance, v = defective near point
Hence, the lens formula is reduced to
$1v+125=1f$

Presbyopia: It is a kind of defect in human eye which occurs due to ageing. It happens due to the following reasons
(i) decrease in flexibility of eye lens.
(ii) gradual weakening of ciliary muscles.
In this, a person may suffer from both myopia and hypermetropia.

Correction: By using a bifocal lens with appropriate power. Bifocal lenses consist of both concave and convex lens, upper position consists of the concave lens and lower portion consists of a convex lens.

Astigmatism: It is a kind of defect in human eye due to which a person cannot see (focus) simultaneously horizontal and vertical lines both.

Correction: By using a cylindrical lens.

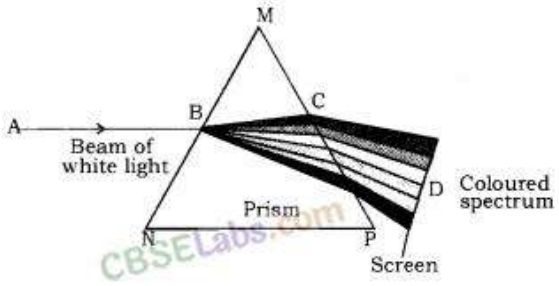
Cataract: Due to the membrane growth over eye lens, the eye lens becomes hazy or even opaque. This leads to a decrease or loss of vision. This problem is called a cataract. It can be corrected only by surgery.

Refraction of light through a prism, Dispersion of white light by a glass prism, Composition of white light, Recombination of spectrum colours, Rainbow.

Refraction of light through a prism: When a ray of light is incident on a rectangular glass slab, after refracting through the slab, it gets displaced laterally. As a result, the emergent ray comes out parallel to the incident ray.
Unlike a rectangular slab, the side of a glass prism are inclined at an angle called the angle of prism.

Prism: A prism has two triangular bases and three
Angle of Prism: Angle between two lateral faces is
Angle of Deviation: The angle between the incident deviation.

Dispersion of white light by a glass prism: The phenomenon of splitting of white light into its seven constituent colours when it passes through a glass prism is called dispersion of white light. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red. The sequence of colours remembers as VIBGYOR. The band of seven colours is called the spectrum. The different component colour of light bends at a different angle with respect to the incident angle. The violet light bends the least while the red bends most.



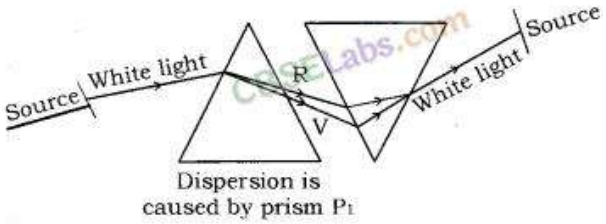
Composition of white light: White light consists of seven colours i.e., violet, indigo, blue, green, yellow, orange and red.

Monochromatic light: Light consisting of single colour or wavelength is called monochromatic light, example; sodium light.

Polychromatic light: Light consisting of more than two colours or wavelengths is called polychromatic light, example; white light.

Recombination of white light: Newton found that when an inverted prism is placed in the path of dispersed light then after passing through the prism, they recombine to form white light.

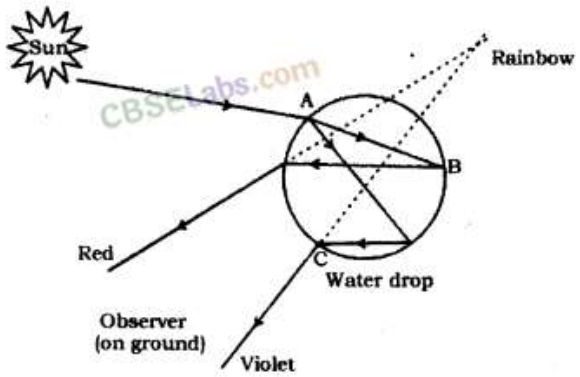
Issac Newton: He was the first, who obtained spectrum of sunlight by using glass prism. He tried to split the spectrum of white light more by using another similar prism, but he could not get any more colours.
He repeated the experiment using second prism in inverted position with respect to the first prism. It allowed all the colours of spectrum to pass through second prism. He found white light emerges on the other side of second prism.



He concluded that Sun is made up of seven visible colour VIBGYOR.

Rainbow: It is the spectrum of sunlight in nature. It is formed due to the dispersion of sunlight by the tiny water droplet, present in the atmosphere.

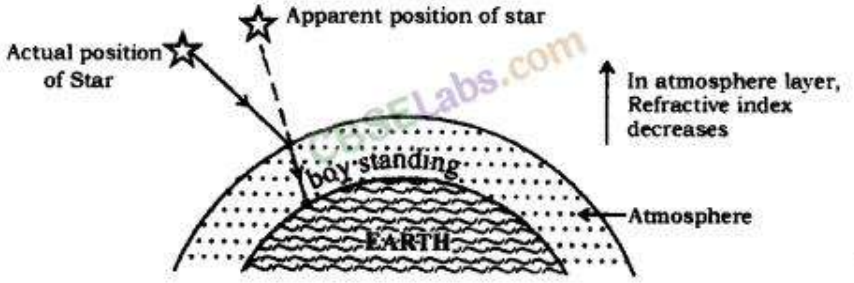
Formation of the rainbow: The water droplets act like small prism. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colours reach the observer's eye.
Red colour appears on top and violet at the bottom of rainbow.
A rainbow is always formed in a direction opposite to that of Sun.
At 'A' – Refraction and dispersion take place.
At 'B' – Internal reflection takes place.
At 'C' – Refraction and dispersion take place.



Atmospheric Refraction: The refraction of light caused by the Earth's atmosphere (having air layers of varying optical densities) is called Atmospheric Refraction.

Appearance of Star Position: It is due to atmospheric refraction of star light.
The temperature and density of different layer of atmosphere keeps varying. Hence, we have different medium.
Distant star act as point source of light. When the starlight enter the Earth's atmosphere, it undergoes refraction continuously, due to changing refractive index i.e. from Rarer to denser. It bends towards the normal.

Due to this, the apparent position of the star is different from actual position. The star appear higher than its actual position.

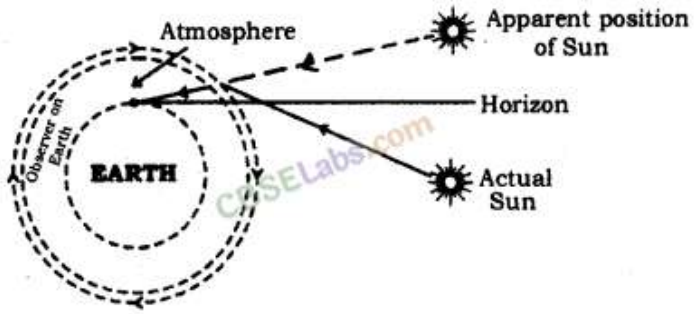


Twinkling of Star: It is also due to atmospheric refraction.
Distant star act like a point source of light. As the beam of starlight keeps deviating from its path, the apparent position of star keeps on changing because physical condition of earth's atmosphere is not stationary.
Hence, the amount of light enters our eyes fluctuate sometimes bright and sometime dim. This is the "Twinkling effect of star".

Why planets do not twinkle ?
Planets are closer to earth and are seen as extended source of light i.e. the collection of large number of point sized sources of light. Therefore the total amount of light entering our eyes from all individual point source will nullify the twinkling effect.

Why, the duration of day becomes approximately 4 minutes shorter if there is no atmosphere on earth: Actual sun rise happens when it is below the horizon in the morning. The rays of light from the sun below the horizon reach our eyes because of refraction of light. Similarly, the sun can be seen about few minutes after the actual sun set. Thus the duration of, day time will increase by 4 minutes. This is due to atmospheric refraction. Because of this sun is visible about 2 minutes earlier than actual sunrise and about 2 minutes after the actual sun set.

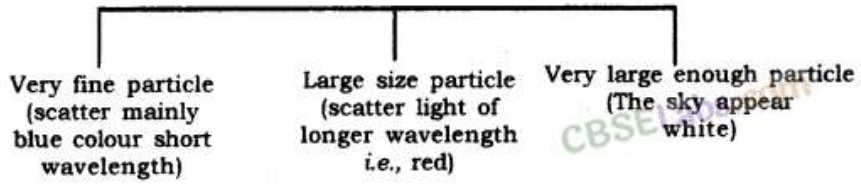
Apparent flattering of the Sun's disc at sunset and sunrise is due to atmospheric refraction.



Scattering of light: According to Rayleigh' Law of Scattering, the amount of scattered light $\propto 1\lambda_4$ (λ = wavelength)
Scattering of light decreases with increase in wavelength.

Tyndall Effect: When a beam of light strikes, the minute particle of earth's atmosphere, suspended particles of dust and molecule of air the path of beam become visible. The phenomenon of scattering of light by the colloidal particle gives rise to Tyndall Effect.
It can be observed when sunlight passes through a canopy of a dense forest.

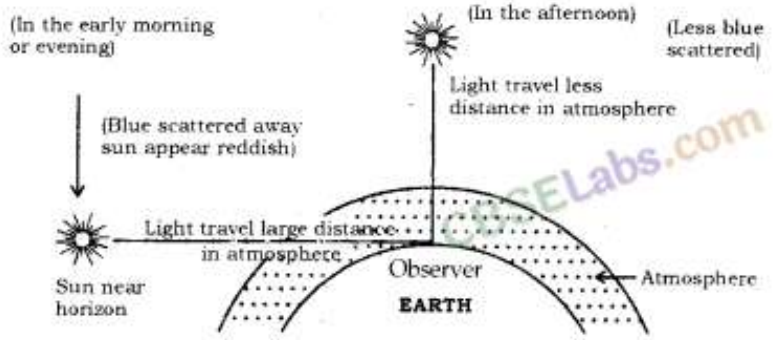
The colour of the scattered light depends on the size of the scattering particles.



Colour of Sunrise and Sunset: While sunset and sunrise, the colour of the sun and its surroundihg appear red. During sunset and sunrise, the sun is near to horizon, and therefore, the sunlight has to travel larger distance in atmosphere. Due to this, most of the blue light (shorter wavelength) is scattered away by the particles. The light of longer wavelength (red colour) reaches our eye. This is why sun appear red in colour.

Why the danger signal or sign is made of red colour?
Red colour scatteres the most when strikes the small particle of fog and smoke because it has the maximum wavelength (visible spectrum). Hence, from large distance also, we can see the red colour clearly.

At noon sun appears white: At noon, the sun is overhead and sunlight would travel shorter distance relatively through the atmosphere. Hence, at noon, the sun appear white as only little of the blue and violet colours are scattered.



Human Eye: It is a wonderful gift of nature to the human body. Human eye is nearly spherical in shape of diameter about 2.5 cm.

Parts of Human Eye:

- **Cornea:** It is the protective and front layer of the eye. It is made by a transparent membrane. Light enters the eye through the cornea.
- **Iris:** Dark and a colourful muscular diaphragm is called iris. It is responsible for colour of the eye.
- **Pupil:** Small circular hole in the centre of iris. It regulates the amount of light entering the eye by adjusting the size of the iris.
- **Ciliary Muscles:** It holds the eye lens at its proper position. It changes the size of eye lens.
- **Eye lens:** The eye lens is a convex lens made by the transparent jelly like material.
- **Retina:** It is the screen of the eye. A real and inverted image form on the retina.
- **Rods and Cones:** These are colour sensitive rods and cones shaped cells. Rods are responsible for the vision in dim light while cones are responsible for colour.
- **Optic Nerve:** It converts information of the image into a corresponding electric signal and passes it to the brain.
- **Blind Spot:** The junction of the optic nerve and retina, where no rods and cones cells are present is called the blind spot. It is insensitive to light.

Near Point: The nearest point from eye at which the eye can see clearly without strain is called near point. For normal eye it is 25 cm.

Far Point: The farthest point, upto which the eye can see the object clearly is called far point. For normal eye it is infinity.

The range of Vision: Distance between near point and far point of eye is called range of vision.

Power of Accommodation: The ability of the eye to see near as well as far objects clearly is called Power of Accommodation.

Myopia (Nearsightedness): In this defect, the eye is unable to see far off objects clearly but is able to see near objects clearly.
Reason.

- Due to increase in size of eye ball
- Due to excessive curvature of cornea
- Due to increase in power (or decrease in focal length) of eye lens.

Correction: It is corrected by using concave lens of suitable focal length.

Hypermetropia (Far sightedness): In this defect eye is unable to see nearby objects clearly but is able to see far objects clearly.
Reason.

- Due to decrease in size of eye ball
- Due to decrease in power (or increase in focal length) of eye lens.

Correction: It is corrected by using a convex lens of suitable focal length.

Dispersion of Light: Splitting of white light into seven colours is called dispersion. Example, the formation of Rainbow (VIBGYOR). Violet deviates the most but red deviates least.

1. 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.

2. The eyeball is approximately spherical in shape with a diameter of about 2.3 cm.

3. Most of the refraction for the light rays entering the eye occurs at the outer surface of the cornea. The crystalline lens merely provides the finer adjustment of focal length required to focus.

4. The human eye has the following parts :

- **Cornea :** The transparent spherical membrane covering the front of the eye.
- **Iris:** The coloured diaphragm between the cornea and lens.
- **Pupil:** The small hole in the iris.
- **Eye lens :** It is a transparent lens made of jelly like material.
- **Ciliary muscles:** These muscles hold the lens in position.
- **Retina:** The back surface of the eye.
- **Blind spot:** The point at which the optic nerve leaves the eye. An image formed at this point is not sent to the brain.
- **Aqueous humour:** A clear liquid region between the cornea and the lens.
- **Vitreous humour:** The space between eye lens and retina is filled with another liquid called vitreous humour.

5. In the eye, the image is formed on the retina by successive refractions at the cornea, the aqueous humour, the lens and the vitreous humour. Electrical signals then travel along the optic nerve to the brain to be interpreted. In good light, the yellow spot is most sensitive to detail and the image is automatically formed there.

6. Accommodation: The ability of the eye to focus both near and distant objects, by adjusting its focal length, is called the accommodation of the eye or the ability of the ciliary muscles to change the focal length of the eye lens is called accommodation.

7. Defects of the Eye : Although the eye is one of the most remarkable organs in the body, it may have several abnormalities, which can often be corrected with eyeglasses, contact lenses, or surgery. The various defects from which an eye can suffer are (i) Hypermetropia or long sightedness, (ii) Myopia or short sightedness and (iii) Astigmatism, (iv) Presbyopia.

8. Hypermetropia, hyperopia, or long sightedness : A person suffering from this defect can see distant objects I clearly but cannot see nearby objects clearly. In this defect, the near point lies farther away than 25 cm. Hypermetropia (far sightedness — the image of nearby objects is focussed beyond the retina) is corrected by using a convex lens of suitable power. The eye loses its power of accommodation at old age.

9. Hypermetropia is due to the following reasons :

- Either the hyperopic eyeball is too short or
- 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 increases.

10. Myopia or short sightedness or near sightedness: A person suffering from myopia or short sightedness can see nearby objects clearly but cannot see the far away objects clearly. Myopia (short sightedness — the image of distant objects is focussed before the retina) is corrected by using a concave lens of suitable power.

11. This defect is due to the following reasons :

- Either the eyeball is longer than normal or
- The maximum focal length (due to excessive curvature of the cornea) of the lens is insufficient to produce a clearly formed image on the retina.

12. A person may also have an eye defect known as astigmatism, in which light from a point-source produces a line image on the retina. A person suffering from this defect cannot see in all directions equally well i.e., he cannot see the vertical and horizontal lines simultaneously. This condition arises either when the cornea or the crystalline lens or both are not perfectly spherical. Astigmatism can be corrected with lenses having different curvatures in two mutually perpendicular directions i.e., cylindrical lens.

13. When a person suffers from both, the myopia as well as Hypermetropia, his spectacles for correction have bifocal lenses. The upper half is a concave lens for distant vision and lower half is a convex lens for reading.

14. Presbyopia is that defect of human eye, due to which an old person cannot read and write comfortably. That is why Presbyopia is also called old sight.

15. To correct Presbyopia, an old person has to use spectacles with a convex lens of suitable focal length, or power as explained already.

16. The cause of Hypermetropia is decrease in length of eyeball or increase In focal length of eye lens. But the cause of Presbyopia is only increase in focal length of eye lens. The eyeball, in Presbyopia, has normal length.
the vision of the eye decreases, leading sometimes to total loss of vision. The problem is overcome by cataract surgery i.e., removal of the eye lens, and its replacement by a lens of suitable focal length.

18. We need two eyes because a human being has a horizontal field of view of about 150° with one eye and of about 180° with two eyes. Thus, two eyes provide us wider horizontal field of view.
With one eye, the world looks flat, i.e., two dimensional only. With two eyes, the view is three dimensional, i.e., dimension of depth is added to our view.

19. As our two eyes are separated by a few centimetres, each eye observes a slightly different image. Our brain combines the two views into one and we get to know how close or far away the things seen are.

20. By donating our eyes after we die, one pair of our eyes can give vision to two corneal blind people. Eye donors may belong to any sex or any age group. People suffering from diabetes, hypertension, asthma or any other non- communicable diseases can donate eyes. People who have been using spectacles or those operated for cataract can also donate eyes.

21. The smallest distance, at which the eye can see objects clearly without strain, is called the near point of the eye or the least distance of distinct vision. For a young adult with normal vision, it is about 25 cm.

22. Persistence of vision of the eye: The image of an object persists on the retina for 1/16 second, even after the removal of the object. The sequence of still pictures taken by a movie camera is projected on a screen at a rate of about 24 images or more per second. The successive impressions of images on the screen appear to merge smoothly into one another to give us the feeling of moving images.

23. The large numbers of light sensitive cells contained in the retina of the eye are of two types: rod shaped cells which respond to brightness or intensity of light and cone shaped cells, which respond to colour of light. Thus/cone shaped cells enable us to distinguish between different colours.

24. When a person cannot distinguish between different colours, he is said to be colour blind though his vision may otherwise be normal. Colour blindness is a genetic disorder which occurs by inheritance. So far, there is no cure for colour blindness.

25. Far point: The farthest point upto which a short sighted eye can see clearly is called the far point of the eye. For a normal eye, the far point is infinity.

26. Near point : The nearest point upto which a long sighted eye can see clearly is called the near point of the eye. For a normal human eye, of an adult, the near point is about 25 cm from the eye.

27. Least distance of distinct vision: The minimum distance upto which an eye can see clearly is called the legist distance of distinct vision ; it is normally denoted by D. The least distance of distinct vision is equal to the distance between the eye and its near point. For a normal human eye, this distance is around 25 cm.

28. The distance between far point and near point of the eye is called range of vision of the eye.

29. When white light passes through a prism, the violet light bends most and the red light bends the least. Dispersion of light is the phenomenon of splitting of white light into its constituent seven colours on passing through a glass prism. The band of seven colours so obtained is called visible spectrum.

30. The seven colours of white light are violet, indigo, blue, green, yellow, orange and red. It is remembered by the acronym VIBGYOR.

31. Isaac Newton was the first to use a prism to obtain a spectrum of sunlight.

32. Spectrum is the band of distinct colours we obtain when white light is split by a prism.

33. Cause of dispersion : Every colour has its own characteristic wavelength/frequency. Different colours move with same speed in air/vacuum. But their speeds in refracting media like glass are different. Therefore, refractive index of the medium for different colours is different. As a result, different colours undergo different deviations on passing through the prism. Hence, different colours emerge from the prism along different directions.

34. The speed of light in vacuum is same for all wavelengths, but the speed in a material substance is different for different wavelengths.

35. In any medium other than air/vacuum red light travels the fastest and violet light travels the slowest.

36. The most familiar form of electromagnetic radiation may be defined as that part of the spectrum that the human eye can detect. Light is produced by the rearrangement of electrons in atoms and molecules. The various wavelengths of visible light are classified with colours ranging from violet ($\lambda = 4 \times 10^{-7}$ m) to red ($\lambda = 7 \times 10^{-7}$ m). The eye's sensitivity is a function of wavelength, the sensitivity being a maximum at a wavelength of about $\lambda = 5.6 \times 10^{-7}$ m (yellow-green).

37. When we pass white light through two identical prisms held side by side with their refracting edges in opposite directions; the first prism disperses white light into seven colours and the second prism recombines the seven colours into white light. Thus, light emerging from 2nd prism is white.

38. A rainbow is formed due to dispersion of light by tiny droplets of water which act as prisms.

39. Atmospheric refraction is the cause of twinkling of stars, advance sunrise and delayed sunset.

40. Scattering of light causes the blue colour of sky and the reddening of the Sun at sunrise and sunset.

Important Questions of Light Reflection and Refraction

Question 1. State one function of iris in human eye. (AI 2012)
Answer: Irish adark muscular diaphragm that controls the size of the pupil.

Question 2. State one function of the crystalline lens in the human eye. (Foreign 2012)
Answer: The crystalline lens of human eye focuses the light that enters the eye and form the image on the retina.

Question 3. Define the term power of accommodation. Write the modification in the curvature of the eye lens which enables us to see the nearby objects clearly? (Delhi 2019)
Answer: The ability of the eye lens to adjust its focal length is called power of accommodation. The ciliary muscles modifies the curvature to some extent. The change in the curvature of the eye lens can thus change its focal length. When the ciliary muscles contract, the lens becomes thick and its focal length decreases, thus enables us to see nearby objects clearly.

Question 4. Trace the sequence of events which occur when a bright light is focused on your eyes. (Delhi 2019)
Answer: When a bright light enters the eye then most of the refraction for the light rays entering the eye occurs at the outer surface of the cornea. Then, the crystalline lens merely provides the finer adjustment of focal length required to focus object at different distances on the retina. The pupil regulates and controls the amount of light entering the eye. At retina, the light-sensitive cells get activated upon illumination and generate electric 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.

Question 5. Write about power of accommodation of human eye. Explain why the image distance in the eye does not change when we change the distance of an object from the eye? (Delhi 2017)
Answer: The ability of the eye lens to adjust its focal length is called power of accommodation.
The ciliary musqles modifies the curvature to some extent. The change in the curvature of the eye lens can thus change its focal length. Thus, the focal length of the human lens increases or decreases depending on the distance of the object value to this distance of the image does not change. For example, when the ciliary muscles are relaxed, the lens becomes thin and its focal length increases, thus enables us to see distant object clearly.

Question 6. State the function of each of the following parts of human eye:
(i) Cornea
(ii) Iris
(iii) Pupil (1.5/3, Delhi 2013 C)
Answer:
(i) Cornea : It is a transparenl bulge on the front surface of eyeball which refracls most ol lhe light rays entering the eye.
(ii) Iris : Refer to answer 1.
(iii) Pupil: It controls the amount of light entering into the eye.

Question 7. Write the function of each of the following parts of human eye:
(i) Cornea (ii) Iris (iii) Crystalline lens (iv) Ciliary muscles (2/5, 2018, Delhi 2016)
Answer:
(i) Cornea : Refer to answer 6(i).
(ii) Iris : Refer to answer 1.
(iii) Crystalline lens : Refer to answer 2.
(iv) Ciliary muscles: Ciliary muscles holds the eye lens and helps in the adjustment of its focal length.

Question 8. State the function of each of the following parts of the human eye :
(i) Cornea (ii) Iris (iii) Pupil (iv) Retina (2/5, Foreign 2015)
Answer:
(i) Cornea : Refer to answer 6(i).
(ii) Iris : Refer to answer 1.
(iii) Pupil: Refer to answer 6(iii).
(iv) Retina: It capture light and convert it into electric signals that are translated into images by the brain.

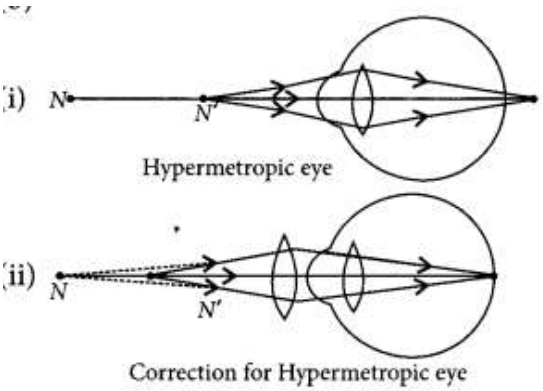
Question 9. (a) List the parts of the human eye that control the amount of light entering into it. Explain how they perform this function?
(b) Write the function of retina in human eye. (3/5, AI2014)

Answer: (a) The part of the human eye that controls the amount of light entering into it is pupil.
Light enters the eye through a thin membrane called the cornea. It forms the transparent bulge on the front surface of the eyeball most of the refraction for the light rays entering the eye occurs at the outer surface of the cornea, the crystalline lens merely provides the linear adjustment of focal length required to focus objects at different distances on the retina. Iris which is behind the cornea controls the size of the pupil. The pupil regulates and controls the amount of light entering the eye.

(b) Refer to answer 8(iv).

Question 10. Person suffering from cataract has
(a) elongated eyeball
(b) excessive curvature of eye lens
(c) weakened ciliary muscles
(d) opaque eye lens
Answer: (d) A person suffering from cataract has cloudy opaque eye lens.

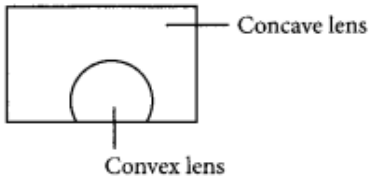
Question 11.
(a) List two causes of hypermetropia.
(b) Draw ray diagrams showing (i) a hypermetropic eye and (ii) its correction using suitable optical device. (2020)
Answer:
(a) Hypermetropia is caused due to following reasons:
(i) Shortening of the eyeball
(ii) Focal length of crystalline lens is too long.



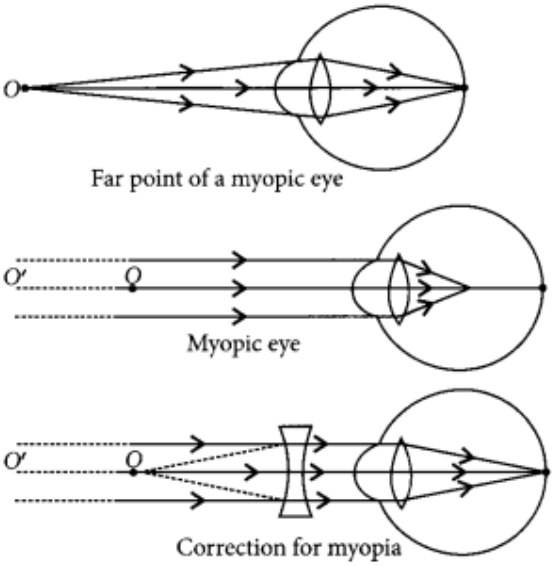
Question 12.
(a) A person is suffering from both myopia and hypermetropia.
(i) What kind of lenses can correct this defect?
(ii) How are these lenses prepared?
(b) A person needs a lens of power +3 D for correcting his near vision and -3 D for correcting his distant vision. Calculate the focal lengths of the lenses required to correct these defects. (2020)
Answer:
(a) (i) The lens which can correct the vision of such a person suffering from both myopia and hypermetropia is a bifocal lens.

(ii) A common type of bifocal lens contains both concave and convex lens. It is prepared with the upper portion consisting of a concave lens facilitating distant vision and the lower portion consisting of convex lens facilitating near vision, (b) The power for correcting his near vision,
P_N = +3 D.
As P = $1f(m)$
∴ Focal length of convex lens needed,
$f_N = 1P_N$ = 0.33 m = +33.33 cm
Power required to correct distant vision, PD = -3D
∴ Focal length of concave lens,
$f_D = 1P_D$ = -0.33 m = -33.33 cm.

Question 13. A person may suffer from both myopia and hypermetropia defects.
(a) What is this condition called?
(b) When does it happen?
(c) Name the type of lens often required by the persons suffering from this defect. Draw labelled diagram of such lenses. (2020)
Answer:
(a) This condition is called presbyopia.
(b) It happens due to gradual weakening of ciliary muscles and diminishing flexibility of eye lens due to agening.
(c) It can be corrected by using bifocal lenses.



Question 14. What eye defect is myopia? Describe with a neat diagram how this defect of vision can be corrected by using a suitable lens. (AI 2011)
Answer: Myopia is also known as near-sightedness. A person with myopia can see nearby objects clearly but cannot see distant objects distinctly.
Myopia can he corrected by using concave lens of appropriate local length.



Question 15. Name the three common defects of vision. What are their causes? Name the type of lens used to correct each of them. (Foreign 2011)
Answer:
Three common defects of vision are

- Myopia
- Hypermetropia
- Presbyopia

Myopia can be caused due to following reasons.

- Elongation of eyeball.
- Excessive curvature of eye lens.

Hypermetropia can be caused due to following reasons.

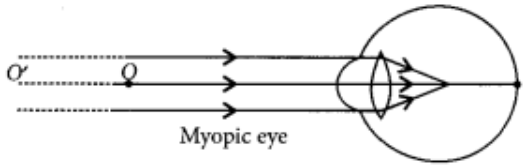
- Shortening of eyeball.
- Focal length of eye lens becomes too long.

Presbyopia is caused due to gradual weakening of ciliary muscles and diminishing flexibility of eye lens due to ageing.

Correction of these defects:

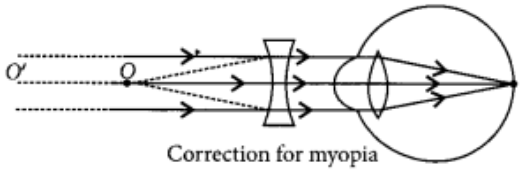
- Myopia can be corrected by using concave lens of appropriate focal length.
- Hypermetropia can he corrected by using convex lens of appropriate local length.
- Presbyopia can be corrected by using bifocal lens.

Question 16. A student is unable to see clearly the words written on the black board placed at a distance of approximately 3 m from him. Name the defect of vision the boy is suffering from. State the possible causes of this defect and explain the method of correcting it. (3/5, 2018)
Answer: Student is suffering from myopia.
The two possible reasons due to which the defect of vision arises are : excessive curvature of the eye lens and elongation of the eye ball.
A student with myopia has the far point nearer than infinity, thus, the image of a distant object is formed in front of the retina.



Myopic eye

Correction of myopia: This defect can be corrected by using a concave lens of suitable power as it brings the image back on to the retina, thus the defect is corrected.



Correction for myopia

Question 17. A student suffering from myopia is not able to see distinctly the objects placed beyond 5 m.
(a) List two possible reasons due to which this defect of vision may have arisen. With the help of ray diagrams, explain
(i) Why the student is unable to see distinctly the objects placed beyond 5 m from his eyes?
(ii) The type of the corrective lens used to restore proper vision and how this defect is corrected by the use of this lens.
(b) If, in this case, the numerical value of the focal length of the corrective lens is 5 m, find the power of the lens as per the new Cartesian sign convention. (AI 2017)
Answer:
(a) Refer to answer 16.
(b) Focal length, f = -5 m
$P = 1/f(in meters)$ or, $p = 1/-5 = -0.2D$
Hence, the power is – 0.2 D.

Question 18. Millions of people of the developing countries of world are suffering from corneal blindness. These persons can be cured by replacing the defective cornea with the cornea of a donated eye. A charitable society of your city has organised a campaign in your neighbourhood in order to create awareness about this fact. If you are asked to participate in this mission how would you contribute in this noble cause?
(a) State the objective of organising such campaigns.
(b) List two arguments which you would give to motivate the people to donate their eyes after death.
(c) List two values which are developed in the persons who actively participate and contribute in such programmes. (VBQ, 3/5, Delhi 2016)
Answer: We can encourage people to participate in the camp and also register ourselves as a donator.
(a) The objective of organising such campaign is to make people aware and realize their duties towards society.
(b) (i) By donating our eyes after we die, we can light the life of a blind person.
(ii) One pair of eyes gives vision to two corneal blind people.
(c) (i) It shows the concern for others.
(ii) It also shows the responsible behavior towards the society.

Question 19. A student is unable to see clearly the words written on the blackboard placed at a distance of approximately 4 m from him. Name the defect of vision the boy is suffering from.

Explain the method of correcting this defect. Draw ray diagram for the
(i) defect of vision and also
(ii) for its correction (Delhi 2015)
Answer: Refer to answer 16.

Question 20. Write the importance of ciliary muscles in the human eye. Name the defect of vision that arises due do gradual weakening of the ciliary muscles in old age. What type of lenses are required by the persons suffering from this defect to see the objects clearly?
Akshay, sitting in the last row in his class, could not see clearly the words written on the blackboard. When the teacher noticed it, he announced if any student sitting in the front row could volunteer to exchange his seat with Akshay. Salman immediately agreed to exchange his seat with Akshay. He could now see the words written on the blackboard clearly. The teacher thought it fit to send the message to Akshay s parents advising them to get his eyesight checked.
In the context of the above event, answer the following questions:
(a) Which defect of vision is Akshay suffering from? Which type of lens is used to correct this defect?
(b) State the values displayed by the teacher and Salman.
(c) In your opinion, in what way can Akshay
express his gratitude towards the teacher and Salman? (VBQ, AI 2015)
Answer: Ciliary muscles modifies the curvature of eye lens and hence adjusts its focal length. I his enables us to see objects.
The defect of vision arises due to weakening of ciliary muscles in old age is presbyopia, person suffering from this defect should wear bifocal lenses. These lenses consists of both concave and convex lenses.
(a) Akshay is suffering from myopia or near-sightedness. He should use concave lens to correct this defect.
(b) Teacher and Salman are concerned and caring.
(c) Akshay can show his gratitude by saying thank you.

Question 21. Millions of people of the developing countries are suffering from corneal blindness. This disease can be cured by replacing the defective cornea with the cornea of a donated eye. Your school has organised a campaign in the school and its neighbourhood in order to create awareness about this fact and motivate people to donate their eyes after death. How can you along with your classmates contribute in this noble cause? State the objectives of organising such campaigns in schools. (VBQ, 3/5, Foreign 2015)
Answer: Refer to answer 18.

Question 22. Do you know that the corneal-impairment can be cured by replacing the defective cornea with the cornea of the donated eye?
How and why should we organise groups to motivate the community members to donate their eyes after death? (2/5, AI 2014)
Answer: Yes, we know that the corneal – impairment can be cured by replacing the objective cornea with the cornea of the donated eye. We can provide the importance of eye donation to the community members. Our eyes can live even after our death. By donating our eyes after die, we can light the life of a blind person. The human eye is one of the most valuable and sensitive sense organs. It enables us to see the wonderful world and colours around us. It is however, impossible to identify colours while closing the eyes. Thus of all the sense organs, the human eye is the most significant one as it enables as to see the beautiful colourful word around us. Hence, we should donate our eyes after death.

Question 23. What is myopia? List two causes for the development of this defect? How can this defect be corrected using a lens? Draw ray diagrams to show the image formation in case (i) defective eye and (ii) corrected eye. (Foreign 2014)
Answer: Myopia is also known as near-sightedness defect in which a person can see nearby objects clearly but cannot see distant objects distinctly. This defect may arise due to
(a) excessive curvature of the eye.
(b) elongation of the eye ball.
This defect can be corrected by using a concave lens of suitable power.
Refer to answer 16.

Question 24. (a) A person cannot read newspaper placed nearer than 50 cm from his eyes. Name the defect of vision he is suffering from. Draw a ray diagram to illustrate this defect. List its two possible causes. Draw a ray diagram to show how this defect may be corrected using a lens of appropriate focal length.
(b) We see advertisements for eye donation on television or in newspapers. Write the importance of such advertisements. (Delhi 2013)
Answer:
(a) The person is suffering from hyperme-tropia.
Hypermetropia : It is a defect in an eye in which a person is not able to see nearby object distinctly but can see far objects clearly.
Refer to answer 11.

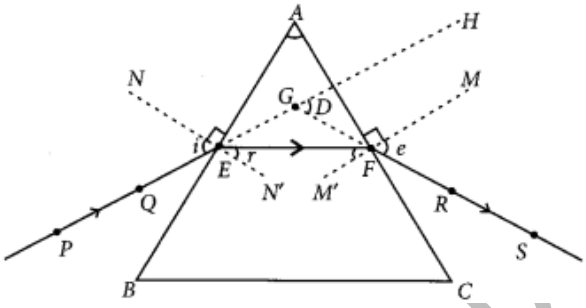
(b) It is important to advertise for eye donation on television or in newspaper because
(i) Few people are unaware about the fact that there can be an eye transplant through which blind people can see this colourful and beautiful world.
(ii) To encourage them to donate their eye by spreading awareness about it through television or newspaper.

Question 25. A student cannot see a chart hanging on a wall placed at a distance of 3 m from him. Name the defect of vision he is suffering from. How can it be corrected? Draw ray diagrams for the (i) defect of vision and also
(ii) for its correction. (Delhi 2012)
Answer: Refer to answer 16.

Question 26. An old man cannot see objects closer than 1 m from the eye clearly. Name the defect of vision he is suffering from. How can it be corrected? Draw ray diagram for the (i) defect of vision and also (ii) for its correction. (AI 2012)
Answer: He is suffering from hypermetropia. Refer to answer 24 (a).

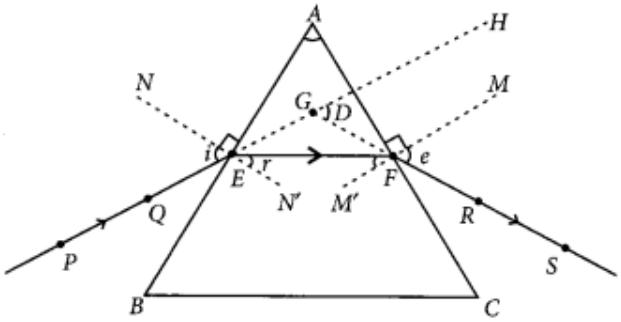
Question 27. Draw a diagram to show why distant objects cannot be seen distinctly by a myopic eye. List two reasons due to which this defect of vision may be caused.
A person with a myopic eye cannot see objects clearly beyond a distance of 2 m. Name the type of the corrective lens that would be needed to correct the defect of vision and draw a ray diagram to show how the defect gets corrected. (Foreign 2012)
Answer: Refer to answer 16.

Question 28. Draw a ray diagram to show the refraction of light through a glass prism. Mark on it (a) the incident ray, (b) the emergent ray and (c) the angle of deviation. (AI 2011)
Answer:

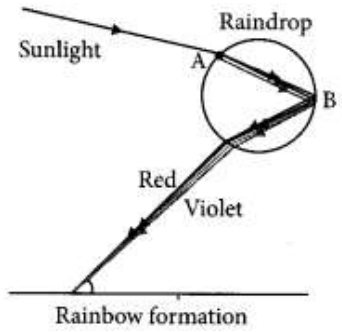


i = angle of incidence
(a) PE = incident ray
(b) FS = emergent ray
(c) ∠D = angle of deviation

Question 29. Draw a ray diagram to explain the term angle of deviation. (1/5, Delhi 2017)
Answer: The emergent ray bends at an angle to the direction of the incident, thus the angle between them is known as angle of deviation (D).

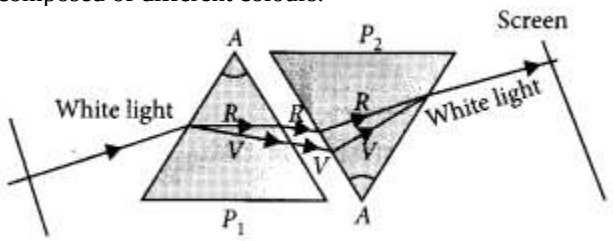


Question 30. Draw a labelled diagram to explain the formation of a rainbow in the sky. (Foreign 2015)
Answer: A rainbow is a natural spectrum caused by dispersion of sunlight by tiny water droplets, present in the atmosphere.



Point A denotes dispersion and point B denotes internal reflection.

Question 31. How will you use two identical glass prisms so that a narrow beam of white light incident on one prism emerges out of the second prism as white light? Draw and label the ray diagram. (2020)
Answer: Newton was the first to use a glass prism to obtain the spectrum of a white light. He then placed a second identical prism in an inverted position with respect to the first prism. This allowed all the colours of the white light to pass through the second prism combining to form a white light emerging from the other side of the second prism. This made him believe that white light was composed of different colours.



Question 32. Differentiate between a glass slab and a glass prism. What happens when a narrow beam of
(i) a monochromatic light and (ii) white light passes through (a) glass slab and (b) glass prism? (2020)
Answer: Glass slab:

- It is a substance made of glass having three dimension and has cuboidal structure.
- It does not deviate the path of light falling on it but produces a lateral displacement of the light ray after refraction. The incident and emergent ray are parallel to each other.

Glass prism:

- A prism is a structure made of glass with two triangle bases and three rectangular lateral surfaces. These surfaces are inclined to each other.
- A prism deviates the path of light ray falling on it. Here the incident ray and emergent ray are not parallel to each other.

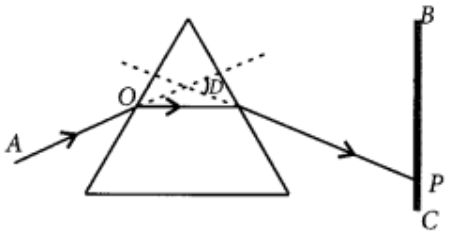
(i) When a narrow beam of monochromatic light falls on a
(a) glass slab, it gets refracted at its surface and the emergent ray is laterally displaced from the incident ray.
(b) prism, it gets refracted at the surface and the light gets deviated from its initial path. The angle between the incident ray and emergent ray is known as angle of deviation.

(ii) When a white light passes through a
(a) glass slab, the light does not undergo dispersion as its two refracting surfaces are parallel to each other. The white light is laterally displaced from its initial path.
(b) prism, the white light undergoes dispersion and splits into its constituent colours along with deviation from its initial path.

Question 33. (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? (2020)

Answer:

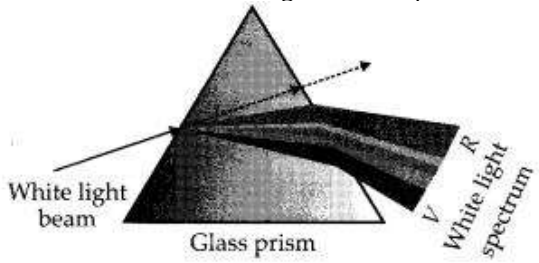
(a)



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)

Question 34. What is rainbow? Draw a labelled diagram to show the formation of a rainbow. (Delhi 2019)
Answer: After a rain-shower, the sunlight gets dispersed by tiny droplets, present in the atmosphere. The water droplets acts like small glass 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 dispersion of light and internal reflection, different colours reaches the observers eye, which is called a rainbow. Refer to answer 30.

Question 35. What is 'dispersion of white light'? State its cause. Draw a ray diagram to show the dispersion of white light by a glass prism. (AI 2017)
Answer: Splitting of white light into its seven constituent colours due to refraction is known as dispersion of white light.
Cause of dispersion : When a beam of white light enters a prism, it gets refracted and splits into seven constituent colours. The splitting of the light ray occurs due to the different bending angle for each colour. Thus, each colour ray when passing through the prism bends at different angles with respect to the incident beam, thus giving rise to a spectrum.

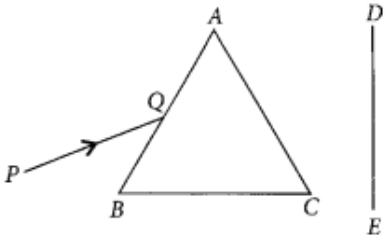


Dispersion of white light by the glass prism

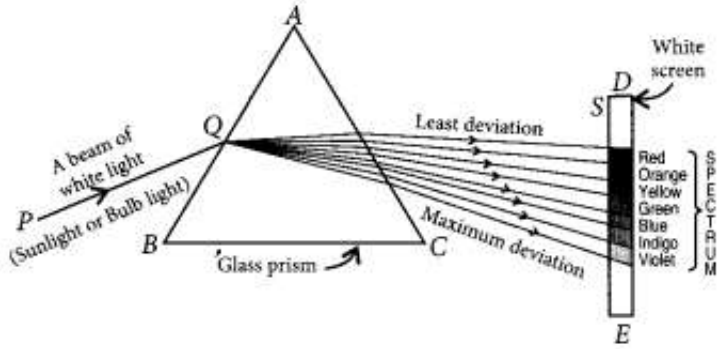
Question 36. State the cause of dispersion of white light passing through a glass prism. How did Newton showed that white light of sun contains seven colours using two identical glass prisms. Draw a ray diagram to show the path of light when two identical glass prisms are arranged together in inverted position with respect to each other and a narrow beam of white light is allowed to fall obliquely on one of the focus of the first prism. (Delhi 2016)
Answer: Refer to answer 35 and 31.

Question 37. Describe an activity to show that the colours of white light splitted by a glass prism can be recombined to get white light by another identical glass prism. Also draw ray diagrams to show the recombination of the spectrum of white light. (AI 2016)
Answer: Refer to answer 31.

Question 38. A narrow PQ of white light is passing through a glass prism ABC as shown in the diagram. Trace it on your answer sheet and show the path of the emergent beam as observed on the screen DE.



(i) Write the name and cause of the phenomenon observed.
(ii) Where else in nature is this phenomenon observed?
(iii) Based on this observation, state the conclusion which can be drawn about the constituents of white light. (AI 2014)
Answer:



(i) The phenomenon of the splitting up of the white light into its constituents colours is called dispersion of light. Dispersion of light is caused due to, different constituents colours of light after different refractive indices to the material of the prism.
(ii) The formation of rainbow is caused by the dispersion of the white sunlight into its constituent colours.
(iii) Based on the dispersion of white light into its constituents colours, we can conclude that
(a) The white light consists of seven colours.
(b) The violet light Millers maximum deviations and the red light suffers minimum deviation.

Question 39. Define the term dispersion of white light. Name the colour of light which bends (i) the most, (ii) the least while passing through a glass prism. Draw a ray diagram to justify your answer. (Foreign 2014)
Answer: Refer to answer 38.

Question 40. What is a spectrum? How can we recombine the components of white light after a glass prism has separated them? Illustrate it by drawing a diagram. (Foreign 2014)
Answer: Refer to answer 36.

Question 41. When we place a glass prism in the path of a narrow beam of white light, a spectrum is obtained. What happens when a second identical prism is placed in an inverted position with respect to the first prism? Draw a labelled diagram to illustrate it. (Delhi 2012)
Answer: Refer to answer 31.

Question 42. Draw a labelled ray diagram to illustrate the dispersion of a narrow beam of white light when it passes through a glass prism. (AI 2012)
Answer: Refer to answer 35.

Question 43. Draw a ray diagram to show the formation of a rainbow and mark the point where
(i) dispersion, (ii) internal reflection occurs. (Foreign 2012)
Answer: Refer to answer 30.

Question 44. What is meant by the dispersion of white light? Draw a diagram to show dispersion of white light by the glass prism. (Delhi 2011)
Answer: Refer to answer 35.

Question 45. Explain the formation of rainbow in the sky with the help of a diagram. (Foreign 2011)
Answer: Refer to answer 30.

Question 46. Give reasons:
(i) The extent of deviation of a ray of light on passing through a prism depends on the colour.
(ii) Lights of red colour are used for danger signals. (Foreign 2011)
Answer: (i) The extent of deviation of a ray of light on passing through a prism depends on the colour because the refractive index of glass for different colour is different. It depends on wavelength of a particular light.

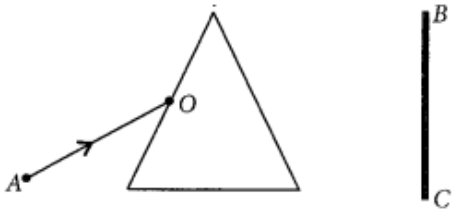
(ii) Since the wavelength of light is maximum in the spectrum, its penetration power in the air is maximum and so we can see red colour from farther distances. Thus, danger signal uses red colour.

Question 47. (a) Why do the component colours of incident white light split into a spectrum while passing through a glass prism, explain.
(b) Draw a labelled ray diagram to show the formation of a rainbow. (4/5, Delhi 2017)
Answer: (a) When a beam of light incidents on a prism, it first gets refracted and splits into seven constituent colors. The splitting of the light ray occurs due to the different bending angle for each colour. Thus each colour ray when passing through the prism bends at different angles with respect to the incident beam. This gives rise to the formation of the spectrum.

(b) Refer to answer 30.

Question 48.
(a) What is dispersion of white light? State its cause.
(b) "Rainbow is an example of dispersion of sunlight." Justify this statement by explaining, with the help of a labelled diagram, the formation of a rainbow in the sky. List two essential conditions for observing a rainbow. (Foreign 2016)
Answer:
(a) Refer to answer 35.
(b) Refer to answer 34.
Two essential conditions for observing rainbow are
(i) Sun should be at the back of the observer.
(ii) Rainbow should be seen after rainfall or through a waterfall or water fountain.

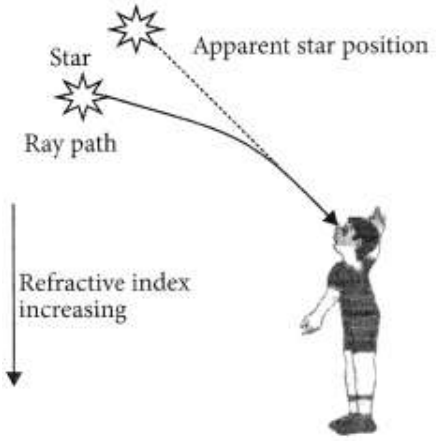
Question 49. (a) Trace on your answer sheet the path of a monochromatic ray AO incident on a glass prism and mark the angle of deviation.



(b) If AO were a ray of white light,
(i) describe what will you observe on the screen BC placed near the prism
(ii) write the name of this phenomenon
(iii) state the cause of this phenomenon
(iv) what does it prove about the constituents of white light? (Delhi 2013 C)
Answer:
(a) Refer to answer 33(a)

(b) (i) Refer to answer 33(b)
(ii) This phenomenon is known as dispersion of light.
(iii) Refer to answer 35.
(iv) It proves that a white light consists of seven colours and lower the wavelength higher will be the deviation of light.

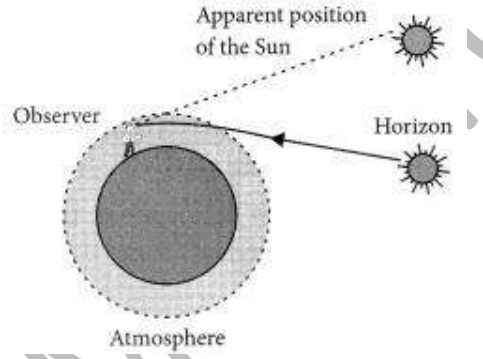
Question 50. Why do stars appear to twinkle ? Explain. (Foreign 2015)
Answer:



Due to atmospheric refraction, position of star visible from sun, is slightly different from its actual position. This apparent position of the star is not stationary, but keeps on changing with change in physical condition on earths atmosphere. Since the stars are very distant, they are approximately 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.

Question 51. Explain why the planets do not twinkle. (Foreign 2015)
Answer: Planets do not emit light. However, they become visible due to reflection of light falling on them. The planets are much closer to the earth and thus can be considered as the extended source of light. The fluctuations in the light coming from various points of the planet due to atmospheric refraction get averaged out. As a result, no twinkling of planets is seen.

Question 52. Explain in brief the reason for each of the following:
(a) Advanced sun-rise
(b) Delayed sun-set
(c) Twinkling of stars (Foreign 2016)
Answer: (a, b): 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. Figure shows the actual and apparent positions of the Sun with respect to the horizon. 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 the same phenomenon.



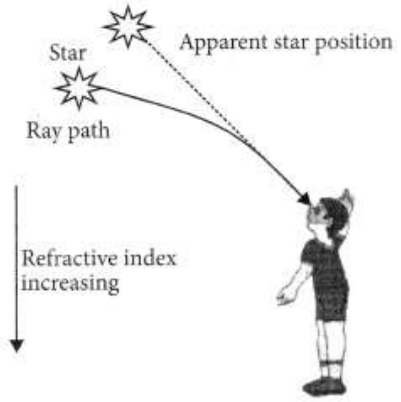
(c) Refer to answer 50.

Question 53. What is meant by advance sunrise and delayed sunset? Draw a labelled diagram to explain these phenomena. (Foreign 2015)
Answer: Refer to answer 52(a) and (b).

Question 54. Explain with the help of a labelled diagram, the cause of twinkling of stars. (Delhi 2014)
Answer: Refer to answer 50.

Question 55. A star sometimes appears brighter and some other times fainter. What is this effect called? State the reason for this effect. (Delhi 2012)
Answer: This effect is called twinkling of stars.
Refer to answer 50.

Question 56. A star appears slightly higher (above) than its actual position in the sky. Illustrate it with the help of a labelled diagram. (AI2012)
Answer: A star appears slightly above than its actual position in the sky. Since the starlight, on entering the earth's atmosphere undergoes refraction continuously in a medium of gradually changing refractive index, before it reaches the earth. Since the atmosphere bends starlight towards the normal, the star appears slightly above than its actual position.



Question 57. "The time difference between the actual sunset and the apparent sunset is about 2 minutes" What is the reason for the same? Explain with the help of a diagram. (Foreign 2012)
Answer: Refer to answer 52(a) and (b).

Question 58. Explain why the planets do not twinkle but the stars twinkle. (Delhi 2011)
Answer: Refer to answer 50 and 51.

Question 59. Why do stars twinkle ? Explain (2/3, 2018)
Answer: Refer to answer 50.

Question 60. What is atmospheric refraction? Use this phenomenon to explain the following natural events.
(a) Twinkling of stars
(b) Advanced sun-rise and delayed sun-set. Draw diagrams to illustrate your answers. (AI 2016)
Answer: Refraction of the light by the different layers of the atmosphere having different refractive indices is known as atmospheric refraction.
(a) Twinkling of stars : Refer to answer 50.
(b) Advanced sun-rise and delayed sun-set : Refer to answer 52(a) and (b).

Question 61. The sky appears dark to passengers flying at very high altitudes mainly because
(a) Scattering of light is not enough at such heights.
(b) There is no atmosphere at great heights.
(c) The size of molecules is smaller than the wavelength of visible light.
(d) The light gets scattered towards the earth. (2020)
Answer: (b) There is no atmosphere at great heights.

Question 62. Consider the following reasons for the reddish appearance of the sun at the sunrise or the sunset:
(A) Light from the sun near the horizon passes through thinner layers of air.
(B) Light from the sun covers larger distance of the earths atmosphere before reaching our eyes.
(C) Near the horizon, most of the blue light and shorter wavelengths are scattered away by the particles.
(D) Light from the sun near the horizon passes through thicker layers of air.
The correct reasons are
(a) A and C only
(b) B, C and D
(c) A and B only

(d) C and D only (2020)
Answer: (b) Near the horizon, the light rays from the sun has to travel a larger distance through the Earth's atmosphere as compared to when it is away from the horizon. Thus, when this light travels through the atmosphere, most of short wavelength lights are scattered away causing the reddish appearance of the sun.

Question 63. What will be the colour of the sky when it is observed from a place in the absence of any atmosphere? (Delhi 2012)
Answer: If the earth had no atmosphere, there would not have been any scattering. Then, the sky would look dark.

Question 64. Give an example of a phenomenon where Tyndall effect can be observed. (AI 2011)
Answer: The phenomenon of scattering of light by the colloidal particle give rise to Tyndall effect.
This phenomenon is seen when a fine beam of sunlight enters a smoke-filled room through a small hole. This can also be observed when sunlight passes through a canopy of a dense forest.

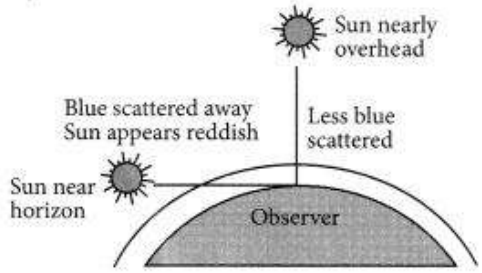
Question 65. Why is the colour of clear sky blue? (Foreign 2011)
Answer: When sunlight passes the atmosphere, the fine particles in air scatter blue colour more strongly than red. This scattered blue light enters our eye and the colour of clear sky appears blue.

Question 66. Why is Tyndall effect shown by colloidal particles? State four instance of observing the Tyndall effect. (2020)
Answer: The phenomenon of scattering of light by the colloidal particles give rise to Tyndall effect. When a beam of light strike colloidal particles, the path of the beam becomes visible. This is known as Tyndall effect.

This phenomenon can be observed when

- sunlight passes through a canopy of dense forest, when tiny water droplets in the mist scatter light.
- torch light is switched on in a foggy environment, light rays are visible after being scattered by the fog particles in the surrounding air.
- a fine beam of sunlight enters a smoke-filled room through a small hole.
- shining a flashlight beam into a glass of dilated milk produces Tyndall effect.

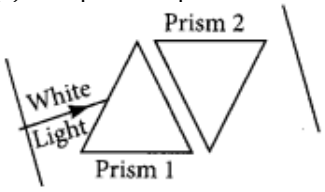
Question 67. Draw a labelled diagram to show (i) reddish appearance of the sun at the sunrise or the sunset and (ii) white appearance of the sun at noon when it is overhead. (2020)
Answer:
(i)



At sun-rise and the sun-set, light from the sun passes through thicker layers of air and larger distance in the earth's atmosphere. As the red colour has longest wavelength hence, it is least scattered by the air and dust particles. So, the sun appears reddish.

(ii) At noon, when sun is overhead, the distance to be travelled is least. All wavelengths are scattered equally and hence sun appears white.

Question 68.
(a) State the relation between colour of scattered light and size of the scattering particle.
(b) The apparent position of an object, when seen through the hot air, fluctuates or waves. State the basic cause of this observation.
(c) Complete the path of white light when it passes through two identical prisms placed as shown



Answer:

(a) The colour of scattered light depends on the size of the scattering particle. Very fine particles scatter short wavelengths such as blue and violet, lights. Large size particles scatter light of longer wavelengths.

(b) The basic cause of this observation is atmospheric refraction. As hot air is less denser then the colder air surrounding it, it has a slightly lower refractive index. Since the physical condition of the refracting medium, in air is not stationary, the apparent position of an object, when seen through hot air fluctuates.

(c) Refer to answer 31.

Question 69. With the help of a labelled diagram, explain why the sun appears reddish at the sun-rise and the sun-set. (Delhi 2015)
Answer: Refer to answer 67(i).

Question 70. What is meant by scattering of light? Use this phenomenon to explain why the clear sky appears blue or the sun appears reddish at sunrise. (AI 2015)
Answer: The phenomenon by which a beam of light is redirected in many different directions when it interacts with a particle of matter is known as scattering of light.
Refer to answer 65 and 67(i).

Question 71. Explain giving reason why the sky appears blue to an observer from the surface of the Earth. What should the appearance of the sky be during the day for an astronaut staying in the international space station orbiting the Earth? State reason to justify your answer. (Foreign 2015)
Answer: Refer to answer 65.
For an astronaut staying in the international space station orbiting the Earth, the appearance of the sky will be black due to absence of air molecules to scatter the light coming from the Sun.

Question 72. State the difference in colours of the sun observed during sunrise/sunset and noon. Give explanation for each. (Delhi 2013)
Answer: During sunrise or sunset, the suns rays pass through a maximum length of the atmosphere. Most of the blue and shorter wavelength get scattered. Only the red colour of light reaches the observer. That is why the Sun observed during sunset and sunrise appear red. At noon, the distance to be travelled is least. All wavelengths are scattered equally and hence sun appears white.

Question 73. Why does the sun appear reddish early in the morning? Will this phenomenon be observed by an astronaut on the Moon? Give reason to justify your answer. (3/5, 2018)
Answer: Refer to answer 67(i).
This phenomenon cannot be seen by an astronaut on the moon because there is no atmosphere on moon to scatter the light.