The Human Eye And The Colourful World

Multiple Choice Questions

Question 1.
A person cannot see distinctly objects kept beyond 2 m. This defect can be corrected by using a lens of power
A. + 0.5 D

B. – 0.5 D

C. + 0.2 D

D. – 0.2 D

Answer:
Since the person is suffering from Myopia and he should use concave lens of power – 0.5 D.

Question 2.
A student sitting on the last bench can read the letters written on the blackboard but is not able to read the letters written in his text book. Which of the following statements is correct?
A. The near point of his eyes has receded away

B. The near point of his eyes has come closer to him

C. The far point of his eyes has come closer to him

D. The far point of his eyes has receded away

Answer:
The student can see the object which are far from him but can't see nearby objects. It means that the near point of his eyes has receded away. This condition is known as Hypermetropia.

Question 3.

A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in Figure 11.1. In which of the following cases, after dispersion, the third colour from the top corresponds to the colour of the sky?

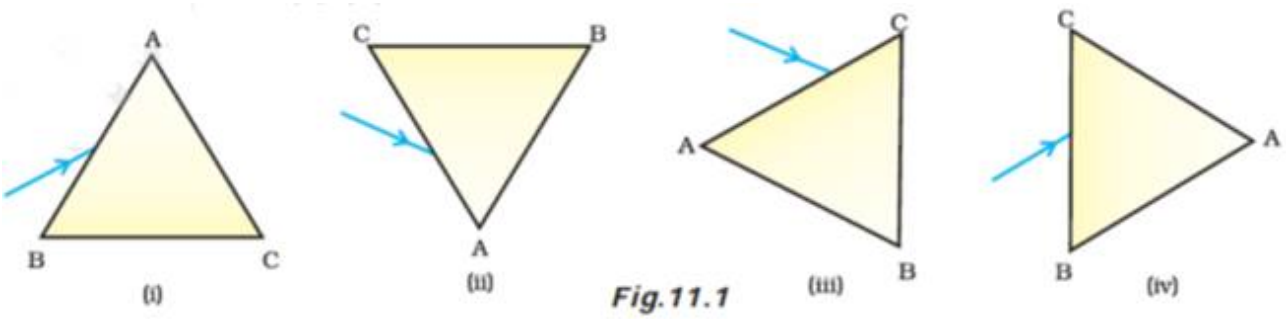


Fig.11.1

A. (i)

B. (ii)

C. (iii)

D. (iv)

Answer:
When the prism is inverted, then after dispersion the colors which will be observed are: VIBGYOR. So, the figure (ii) is the correct image to get third color as the color of sky i.e. Blue.

Question 4.
At noon the sun appears white as
A. light is least scattered

B. all the colors of the white light are scattered away

C. blue color is scattered the most

D. red color is scattered the most

Answer:
At noon, the position of Sun is directly over the head due to which Sun light travels a little distance due to which the blue and red color is scattered less.

Question 5.
Which of the following phenomena of light are involved in the formation of a rainbow?
A. Reflection, refraction and dispersion

B. Refraction, dispersion and total internal reflection

C. Refraction, dispersion and internal reflection

D. Dispersion, scattering and total internal reflection

Answer:
Rainbow is formed due to the phenomena: Refraction, dispersion and internal reflection due to falling of sun light on rain droplets.

Question 6.
Twinkling of stars is due to atmospheric
A. dispersion of light by water droplets

B. refraction of light by different layers of varying refractive indices

C. scattering of light by dust particles

D. internal reflection of light by clouds

Answer:
Stars twinkle due to atmospheric refraction of light by different layers of atmosphere which are having different refractive indices.

Question 7.
The clear sky appears blue because
A. blue light gets absorbed in the atmosphere

B. ultraviolet radiations are absorbed in the atmosphere

C. violet and blue lights get scattered more than lights of all other

colours by the atmosphere

D. light of all other colours is scattered more than the violet and

blue colour lights by the atmosphere

Answer:
The clear sky is blue in color because blue light is scattered more than other colour of light by molecules of air.

Question 8.
Which of the following statements is correct regarding the propagation of light of different colours of white light in air?
A. Red light moves fastest

B. Blue light moves faster than green light

C. All the colors of the white light move with the same speed

D. Yellow light moves with the mean speed as that of the red and

the violet light

Answer:
All the colors of white light move with the same speed because speed of light doesn't depend on color and has a constant value.

Question 9.
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 colors, 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 air

Answer:
Red color of danger signal installed at the top of tall building can be easily seen from a distance than other colors because red colour, having longest wavelength, is

scattered least by smog or fog than other colors and that's why it is visible from a distance.

Question 10.
Which of the following phenomena contributes significantly to the reddish appearance of the sun at sunrise or sunset?
A. Dispersion of light

B. Scattering of light

C. Total internal reflection of light

D. Reflection of light from the earth

Answer:
At Sunrise or Sunset, the reddish appearance of Sun is due to scattering of light and since Red color has highest wavelength and is scattered least.

Question 11.
The bluish colour of water in deep sea is due to
A. the presence of algae and other plants found in water

B. reflection of sky in water

C. scattering of light

D. absorption of light by the sea

Answer:
The bluish color of water in deep sea is due to scattering of light because blue colour has smallest wavelength than other colors and therefore, due to scattering of water particles by Sun's radiations, the color of water is blue in deep sea.

Question 12.
When light rays enter the eye, most of the refraction occurs at the
A. crystalline lens

B. outer surface of the cornea

C. iris

D. pupil

Answer:
Cornea is a thin membrane through which light is entered. The incident light rays are bent due to cornea and are converged which results in image formation at retina. So, most of the refraction occurs at the iris of the eye.

Question 13.
The focal length of the eye lens increases when eye muscles
A. are relaxed and lens becomes thinner

B. contract and lens becomes thicker

C. are relaxed and lens becomes thicker

D. contract and lens becomes thinner

Answer:
The focal length of eye lens will get increased, When the eye muscles are relaxed and lens becomes thin

Question 14.
Which of the following statement is correct?
A. A person with myopia can see distant objects clearly

B. A person with hypermetropia can see nearby objects clearly

C. A person with myopia can see nearby objects clearly

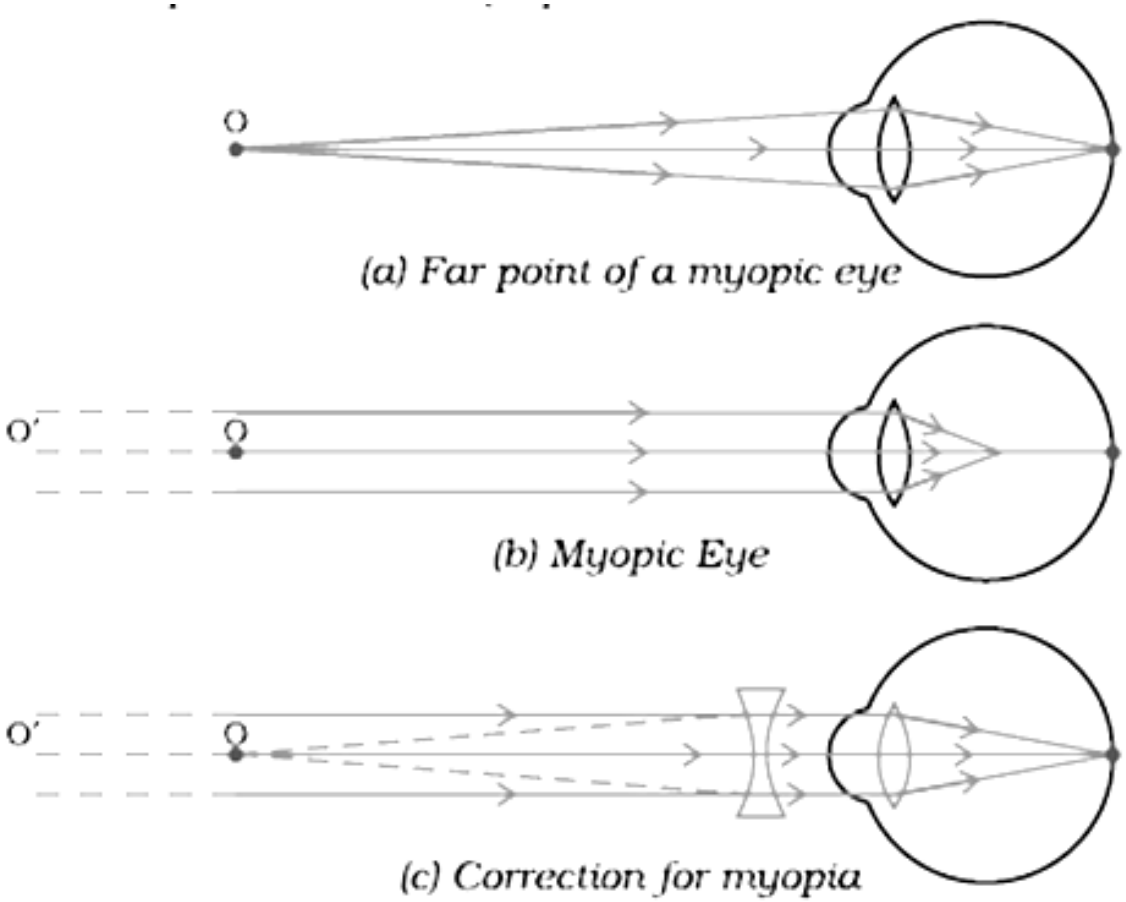
D. A person with hypermetropia cannot see distant objects clearly

Answer:
Person suffering from Myopia can’t see distant objects clearly but it can see nearby objects clearly.

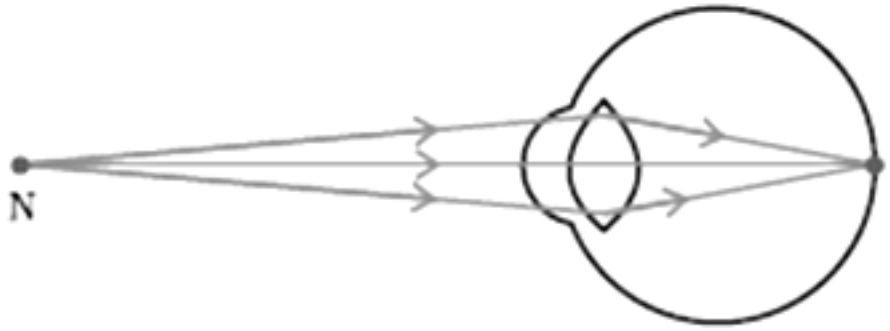
Short Answer Questions

Question 1.
Draw ray diagrams each showing (i) myopic eye and (ii) hypermetropic eye.

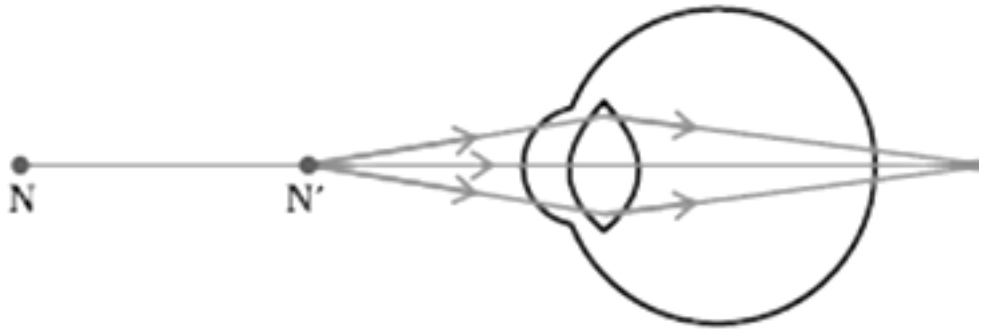
Answer:
(i) Ray diagram showing Myopic eye is:



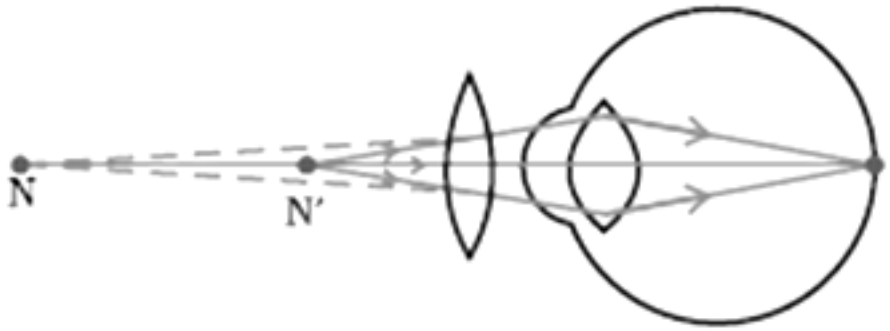
(ii) Ray diagram showing hypermetropic eye is:



(a) Near point of a Hypermetropic eye



(b) Hypermetropic eye



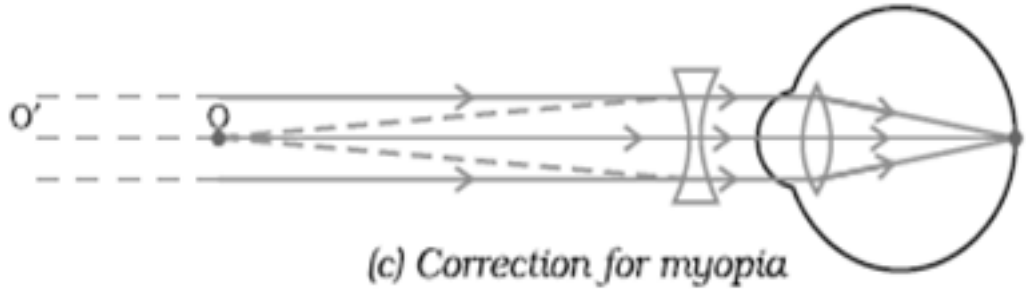
(c) Correction for Hypermetropic eye

Question 2.
A student sitting at the back of the classroom cannot read clearly the letters written on the blackboard. What advice will a doctor give to her? Draw ray diagram for the correction of this defect.

Answer:

The student sitting at the back of the classroom cannot read clearly the letters written on the blackboard, it means that the student is suffering from Myopia. The doctor will suggest her, a concave lens of suitable power which will bring the image back on retina and therefore the defect will be corrected.

Ray diagram for the correction of this defect is as follows:



(c) Correction for myopia

Question 3.
How are we able to see nearby and also the distant objects clearly?

Answer:
We are able to see nearby and also the distant object clearly by using bifocal lenses which consists of both concave and convex lens. The upper part of lens is Concave lens which is used for distant vision and the lower part of lens is convex lens which is for nearby objects. Bifocal lens are used in Presbyopia condition when the person can't see distant as well as nearby objects.

Question 4.
A person needs a lens of power –4.5 D for correction of her vision.

(a) What kind of defect in vision is she suffering from?

(b) What is the focal length of the corrective lens?

(c) What is the nature of the corrective lens?

Answer:
(a) She is suffering from Myopia defect.

(b). Focal length is given by the reciprocal of power i.e.

Focal Length = 1/ Power of lens

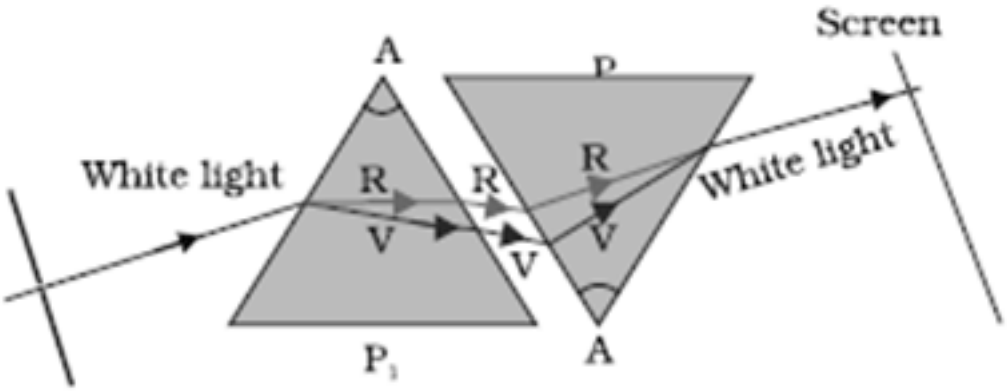
Focal length = -100/4.5 cm

Focal length = -22.2 cm

(c) The corrective lens will be a concave lens.

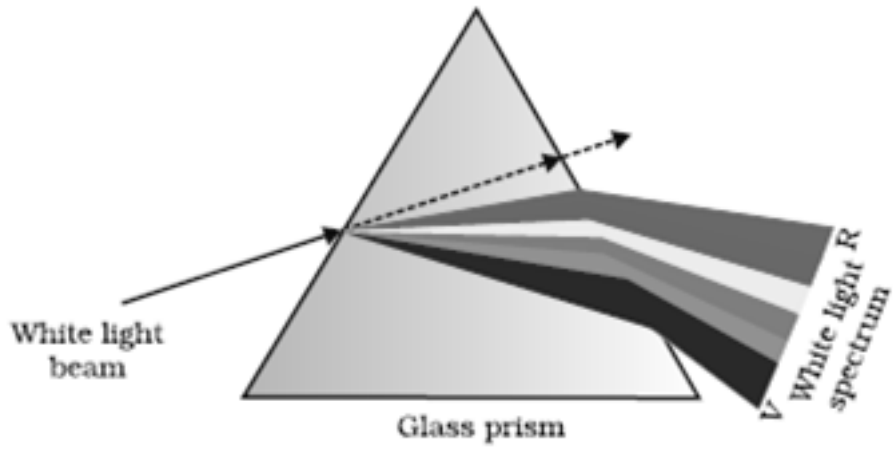
Question 5.
How will you use two identical prisms so that a narrow beam of white light incident on one prism emerges out of the second prism as white light? Draw the diagram.

Answer:
We know that, when light falls on a prism, then the light gets split into its seven colors in form of ROYGBIV. When two the same prism is kept with an identical prism, but in inverted form, then the light emerging out from first prism will merge together as result in white light. The ray diagram showing it is as follows:



Question 6.
Draw a ray diagram showing the dispersion through a prism when a narrow beam of white light is incident on one of its refracting surfaces. Also indicate the order of the colours of the spectrum obtained.

Answer:
When a narrow beam of white light is incident on one of its refracting surfaces can be shown with the help of the following diagram:



The order of the colors will be as follows:

ROYGBIV- Red, Orange, Yellow, Green, Blue, Indigo and Violet.

Question 7.
Is the position of a star as seen by us its true position? Justify your answer.

Answer:
No, the position of a star as seen by us is not its true position. The stars appears slightly higher than the actual position because light coming from Stars suffers refractions due to different layers of atmosphere which is due to different refractive indices value. It seems as if stars are slightly higher than they actually appear.

Question 8.
Why do we see a rainbow in the sky only after rainfall?

Answer:
We see rainbow in the sky only after rainfall due to dispersion of sunlight by the tiny water droplets of rain present in the atmosphere. The water droplets acts like small prisms. The rain drops are refracted, dispersed and reflected internally and then

refracted again. Due to these phenomena, we see a rainbow in the sky after rainfall.

Question 9.
Why is the colour of the clear sky blue?

Answer:
The color of the clear sky is blue because blue color is scattered more than other colour of light by molecules of air as blue color has lowest wavelength and is scattered more.

Question 10.
What is the difference in colours of the Sun observed during sunrise/sunset and noon? Give explanation for each.

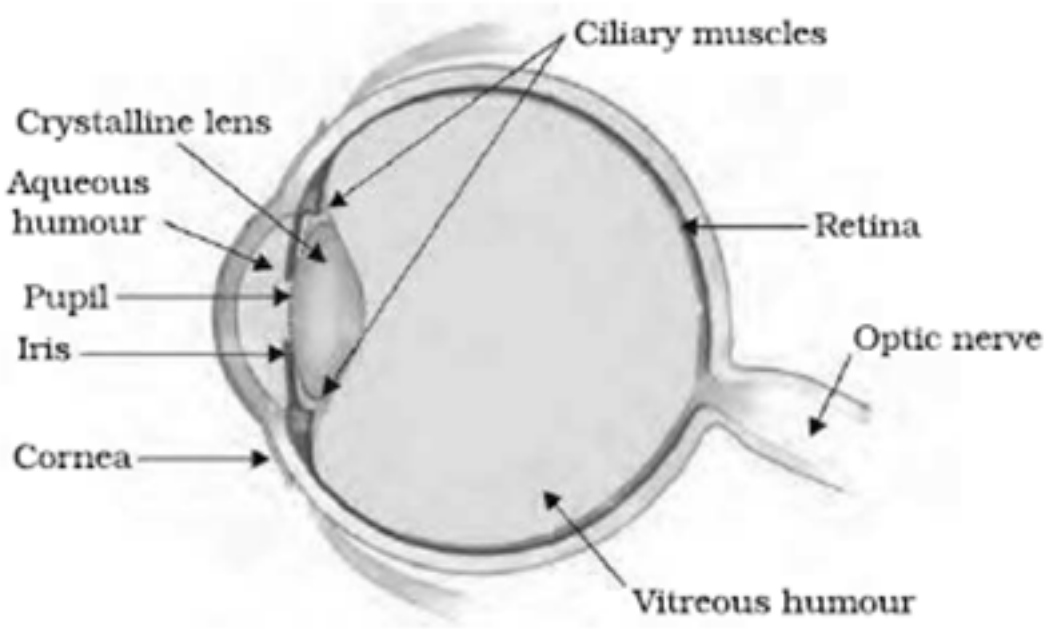
Answer:
At noon, the Sun appears white in color because only little blue and violet color are scattered. In sunrise/sunset, light from the Sun near the horizon passes through different thicker layers of air and larger distance is travelled. So, the color of the Sun is reddish because of scattering of light and since Red color has highest wavelength and is scattered least.

Sun at noon is at overhead and travels shorter distance and is therefore white in color.

Long Answer Questions

Question 1.
Explain the structure and functioning of Human eye. How are we able to see nearby as well as distant objects?

Answer:
The structure of human eye is as follows:



Function of human eye:

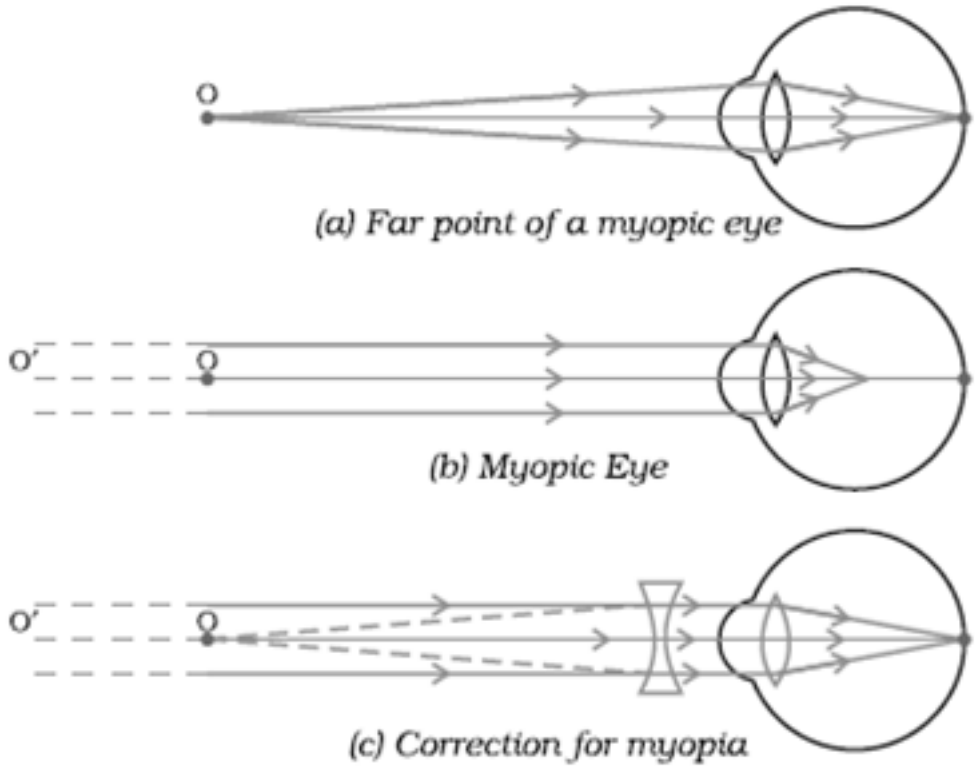
The human eye acts as a camera. The lens system of eye forms image on Retina which is a light sensitive screen. Light is entered through a thin membrane known as cornea. It forms the transparent bulge on the front surface of eye ball. The eye ball is of diameter 2.3 cm. The maximum refraction of light is refracted at the outer surface of cornea of eye. The crystalline lens provides adjustment of focal length which is required to focus different images on the retina. Iris is a dark muscular diaphragm which controls the size of the pupil. Light entering the eye is controlled by the iris. An inverted, real image is formed by lens on retina. Retina is a delicate membrane which consists of number of light sensitive cells. Upon illumination, the light sensitive cells get activated and electrical signals are generated. These signals are then sent to brain through optic nerves. The signals are interpreted by the brain and the information is processed and we can see the objects.

Question 2.
When do we consider a person to be myopic or hypermetropic? Explain using diagrams how the defects associated with myopic and hypermetropic eye can be corrected?

Answer:

A person is considered to be myopic if he/ she can see nearby objects but is unable to see distant object. A person is said to hypermetropic, if the person is not able to see nearby objects but can see distant objects.

The myopia defect can be corrected with the help of concave lens of suitable power. The ray diagram of Myopic eye are as follows:

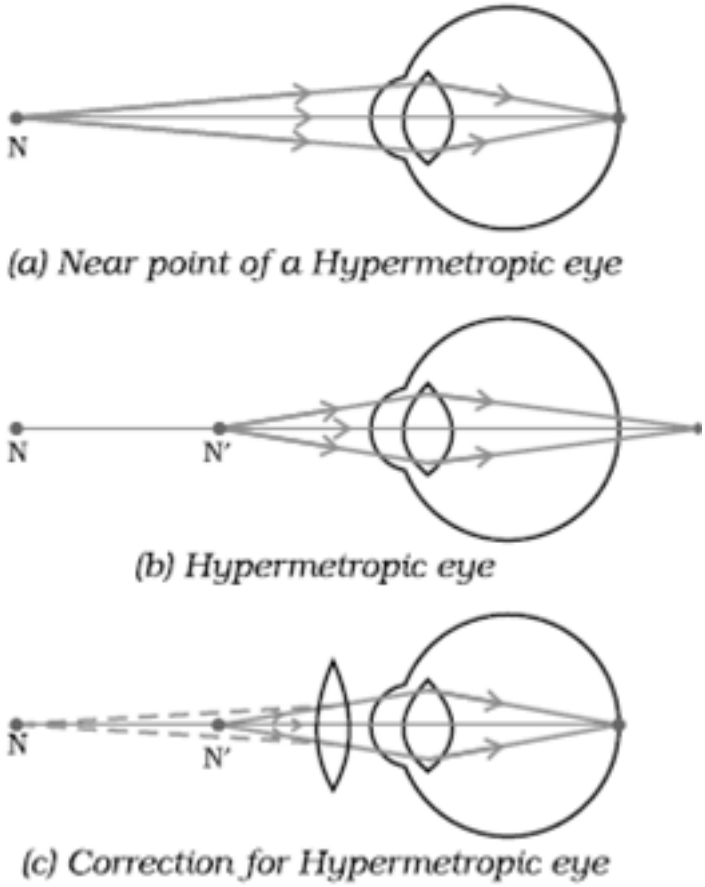


(a) Far point of a myopic eye

(b) Myopic Eye

(c) Correction for myopia

The hypermetropia defect can be corrected with the help of convex lens of suitable power. The ray diagram of hypermetropia eye are as follows:



(a) Near point of a Hypermetropic eye

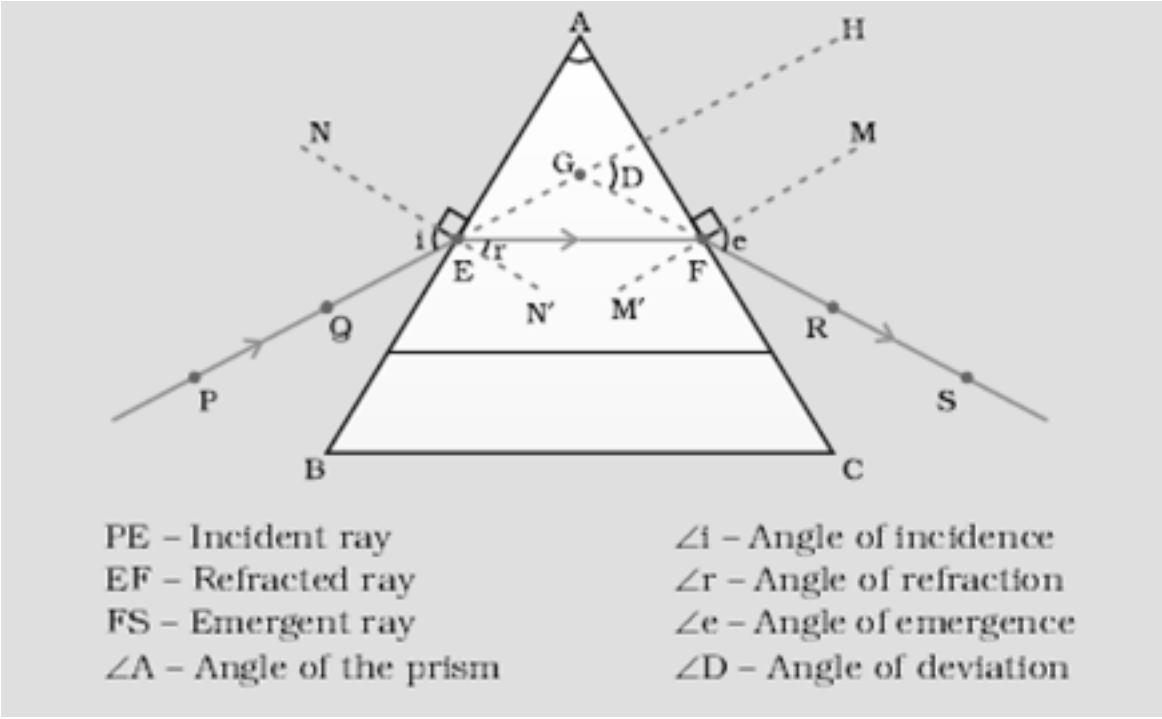
(b) Hypermetropic eye

(c) Correction for Hypermetropic eye

Question 3.
Explain the refraction of light through a triangular glass prism using a labelled ray diagram. Hence define the angle of deviation.

Answer:
Let PE is the incident light on the prism, EF is the refracted ray and FS is the emergent ray. When a ray of light is entered through surface AB from air to glass, then the light ray suffer refraction and bend towards the normal ray. At the second surface AC, the rays enter from glass to air which results in bending away from the normal ray. The angle of incidence and the angle of refraction are equal. The emergent ray bend at an angle towards the direction of incident ray. This angle is known as Angle of deviation.

It can be shown with the following ray diagram:



Question 4.
How can we explain the reddish appearance of sun at sunrise or sunset? Why does it not appear red at noon?

Answer:
In sunrise/sunset, light from the Sun near the horizon passes through different thicker layers of air and larger distance is travelled. So, the color of the Sun is reddish because of scattering of light and since Red color has highest wavelength and is scattered least.

Sun doesn't appears red at noon, because at noon, Sun is at the overhead and travels shorter distance and is therefore white in color.

Question 5.
Explain the phenomenon of dispersion of white light through a glass prism, using suitable ray diagram.

Answer:
Dispersion is the phenomena of splitting of white light into seven colors.

The band of colored components of seven colors is known as spectrum.

As light ray travels through glass prism, different colors of light bend at different angles to the incident ray. The violet light bends the most and the red light bends at least angle. The rays of prism bends along different paths and becomes distinct.

The ray diagram showing dispersion of colors through a prism can be shown as follows:

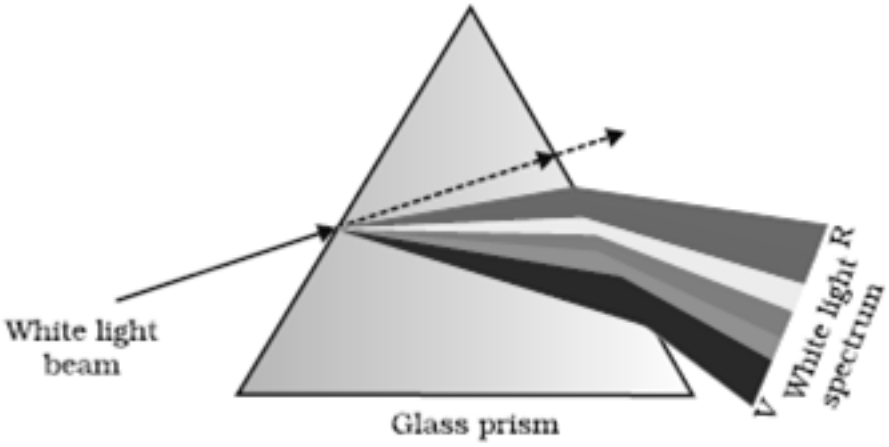


Figure 11.5 *Dispersion of white light by the glass prism*

Question 6.
How does refraction take place in the atmosphere? Why do stars twinkle but not the planets?

Answer:
Light gets refracted at different layers of atmosphere. The air just above the radiator becomes hotter than the air farther up. Since the hotter air is less dense than the cooler air above it and has less refractive index than cooler air. The physical conditions of the atmosphere are not same, the apparent position of the object through hot air fluctuates. This is known as atmospheric refraction.

Twinkling of stars is due to atmospheric refraction of star light. The star light after entering the earth's atmosphere undergoes refraction in a continuous manner before it reaches the Earth. The atmospheric refraction is due to change in the refractive index at different level in atmosphere. The star light bends towards the normal, the apparent position is different from the actual position of star. Since atmosphere is not stationary and keeps changing. As path of rays of light coming from star varies slightly then the apparent position of star also varies slightly and

the amount of light entering the eye flickers. Sometimes, it is brighter and sometimes the star seems fainter. In this way, stars twinkle but planets don’t twinkle because planets are much closer to Earth and are seen as extended sources. If planet is considered as collection of point sources of light, the total amount of light entering the eye on average is zero and therefore the twinkling effect of planets is nullified.