11

The Human Eye and the Colourful World

INTEXT Questions

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1. What is meant by power of accommodation of the eye?

Ans. The power of accommodation of the eye is the ability of the eye to observe the distinct objects clearly which are situated at a large distance from the eye. The ciliary muscles are responsible to change the focal length of the eye lens. The value of the power of accommodation of the normal human eye is (d = 25 cm) = $100/f = 100/d = 100/25$ = 4 dioptres. The value of power of accommodation of human eye is about 4 D.

2. A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?

Ans. The far point for myopic eye is 1.2 m.

$\therefore \quad u = -\infty, v = -1.2$ m, $P = ?$

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

Using lens formula,

We get, $P = -\frac{1}{1.2} - \frac{1}{-\infty} = -0.83$ D

So, a concave lens of power – 0.83 D is required to restore proper vision.

3. What is the far point and near point of the human eye with normal vision?

Ans. For the human eye with normal vision, the far point is at infinity and the near point is at 25 cm from the eye.

4. A student has difficulty reading the blackboard while sitting in the last row. What could be the defect the child is suffering from? How can it be corrected?

Ans. Myopia or short-sightedness. It can be corrected using concave lens.

TEXTBOOK Questions

1. The human eye can focus objects at different distances by adjusting the focal length of the eye lens. This is due to
(*a*) presbyopia.
(*b*) accommodation.
(*c*) near-sightedness.
(*d*) far-sightedness.

Ans. **(*b*)** Accomodation

2. The human eye forms the image of an object at its

(a) cornea. **(b) iris.**

(c) pupil. **(d) retina.**

Ans. (d) Retina

3. The least distance of distinct vision for a young adult with normal vision is about

(a) 25 m **(b) 2.5 cm**

(c) 25 cm **(d) 2.5 m**

Ans. (c) 25 cm

4. The change in focal length of an eye lens is caused by the action of the

(a) pupil. **(b) retina.**

(c) ciliary muscles. **(d) iris.**

Ans. (c) Ciliary muscles

5. A person needs a lens of power–5.5 dioptres for correcting his distant vision. For correcting his near vision he needs a lens of power +1.5 dioptre. What is the focal length of the lens required for correcting

(i) distant vision (ii) near vision?

Ans. (i) Focal length of the lens for distant vision

$$= \frac{1}{\text{Power}} = \frac{100}{-5.5}\ \text{cm}$$

$= -18$ cm (approx.)

(ii) Focal length of the lens for near vision $= \frac{100}{1.5}$ cm $= 66.6$ cm.

6. The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Ans. The far point of a normal eye is infinity. Since the far point of the defective eye is given as 80 cm, the eye is short-sighted. To correct it, one should bring the object at infinity to 80 cm.

$\therefore u = -\infty, v = -80$ cm

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

we get, $\frac{1}{f} = \frac{1}{-80} - \frac{1}{(-\infty)}$

$$= -\frac{1}{80}$$

$\therefore$ Focal length of lens is -80 cm.

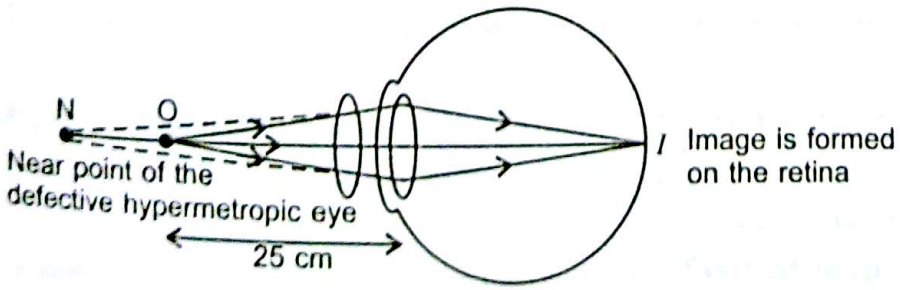
The correction is done by concave lens of focal length 80 cm.

Power of the lens $= \frac{100}{f(\text{in cm})}$

$$= -\frac{100}{80} = -1.25\ \text{D}.$$

7. Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is 1 m. What is the power of a lens required to correct this defect? Assume that near point of the normal eye is 25 cm.

Ans.



To correct the defect, the image of an object at 25 cm should be brought at 100 cm.

$\therefore$ $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-100} - \frac{1}{-25}$

$$\Rightarrow \quad \frac{1}{f} = \frac{-1}{100} + \frac{1}{25} = \frac{-1+4}{100} = \frac{3}{100}$$

$$\therefore \quad f = +\frac{100}{3} = +33.3 \text{ cm.}$$

So, a convex lens of focal length 33.3 cm is required.

Power, $P = \frac{100}{33.3} = 3.0$ D.

8. Why is a normal eye not able to see clearly the objects placed closer than 25 cm?

Ans. Focal length of the eye lens cannot be reduced below a certain limit.

9. What happens to the image distance in the eye when we increase the distance of an object from the eye?

Ans. In eye image is always formed on retina. Image distance is the distance between eye lens and retina. When we increase the distance of object from the eye, the focal length of the eye-lens increases due to the action of ciliary muscles so that image of object in formed on retina and therefore, image distance remains the same.

10. Why do stars twinkle?

Ans. The stars twinkle at night, because the star light reaching our eyes increases and decreases continuously due to atmospheric refraction. When star light reaching our eyes increases, the star looks bright and when the star light reaching our eyes decreases, it appears dim.

11. Explain why the planets do not twinkle.

Ans. Planets being close to earth appear larger in size. A planet can be considered as a collection of large number of small sized objects. Twinkling effect of these objects cancel each other. So, planets do not appear to twinkle.

12. Why does the sun appear reddish early in the morning?

Ans. At sunrise, the sun looks almost reddish because only red colour ($\lambda_b < \lambda_r$) which is least scattered is received by our eye and appears to come from sun. Hence the appearance of sun at sunrise, near the horizon looks almost reddish.

13. Why does the sky appear dark instead of blue to an astronaut?

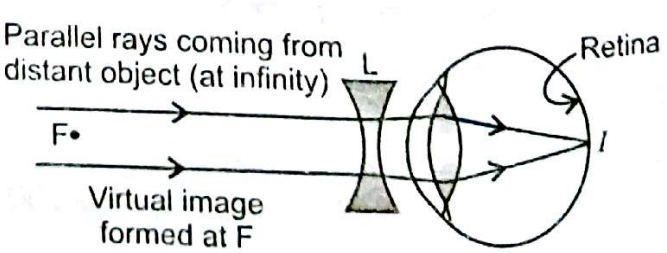
Ans. At such huge heights due to absence of atmosphere, no scattering of the light takes place. Therefore sky appears dark.

Selected NCERT Exemplar Problems

Short Answer Questions

1. 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.

Ans. The student is suffering from short-sightedness. Doctor will advise to her to wear a concave lens having suitable power for correcting the vision.



2. How are we able to see nearby as well as the distant objects clearly?

Ans. Accommodation: The ability of the ciliary muscles to adjust the curvature and thereby the focal length to get clear view of objects is called accommodation. There is always a limit up to which ciliary muscles can increase or decrease the focal length of eye lens. This change enables us to see nearer and far-off objects clearly.

3. 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?

Ans. (a) Defect is Myopia (Short-sightedness).

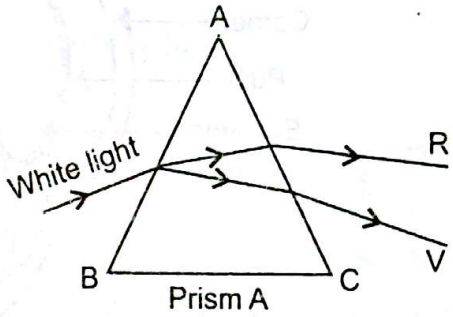
(b) Focal length $= \frac{1}{\text{Power}}$

$= -\frac{100}{4.5} = -22.2$ cm.

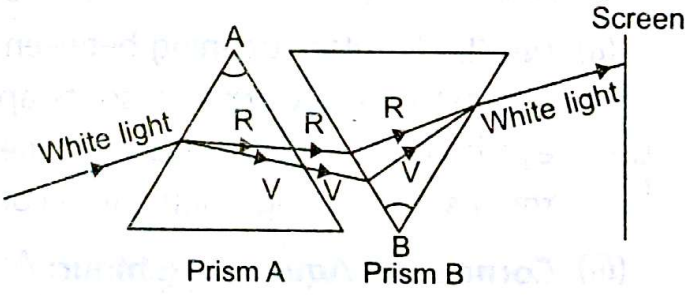
(c) The lens is a concave lens.

4. 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.

Ans. Consider a prism *A*. When white light falls on it, it splits into seven constituent colours. The violet colour deviates the most and red colour deviates the least, as shown.



If another prism *B* is placed such that they are as shown below, the light that emerges out of *A* will be made to merge together to come out as white light.



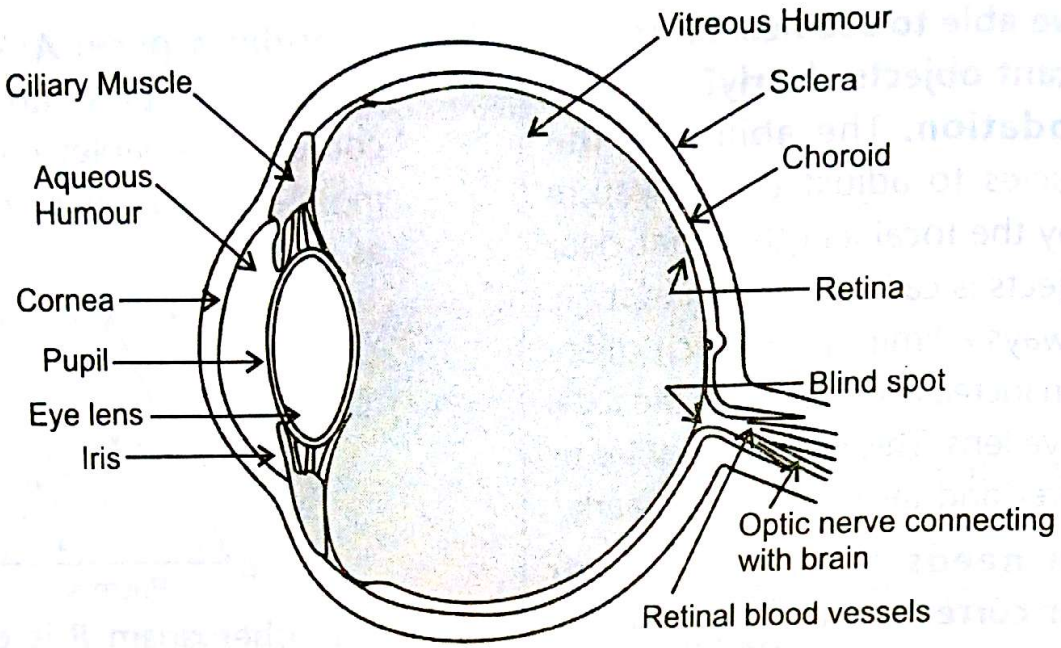
5. Is the position of a star as seen by us its true position? Justify your answer.

Ans. Light from stars passing through the atmosphere, bends due to changing refractive index of different layers of the atmosphere and appears as if it comes from a higher level than they are actually. So, the stars appear slightly higher than the actual position.

Long Answer Questions

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

Ans. Human Eye: The natural optical device through which one could see objects around him. It forms an inverted and real image on a light sensitive surface called the retina.



Parts of human eye are:

(*i*) **Iris:** It is a dark muscular diaphragm that controls the size of the pupil.

(*ii*) **Pupil:** The black opening between the aqueous humour and the lens. Since, light does not get reflected from it, so its appearance is dark. The amount of light entering the eye is controlled by the size of the pupil. In dim light, it opens up completely through the iris, but in bright light, it becomes very small.

(*iii*) **Cornea and Aqueous Humour:** Acting as lens, they provide the refraction for light rays entering the eye. Cornea is a thin membrane covering the surface of eyeball, through which light enters. Aqueous humour is a transparent gelatinous fluid filled between cornea and eye-lens.

(*iv*) **Ciliary Muscles:** These muscles hold the eye lens in vertical position and change the focal length of eye lens to form the sharp image of objects located at different distances on the retina.

(*v*) **Retina:** The light sensitive surface of eye on which image is formed. It is equivalent of the photographic film in a camera. It contains rods and cones.

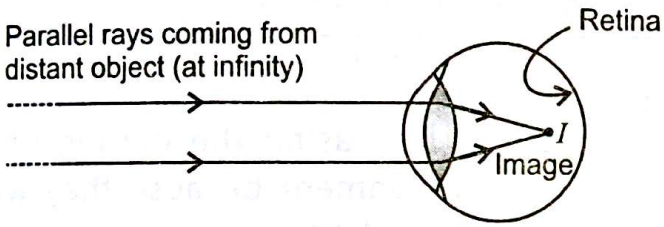
(*vi*) **Rods and Cones:** The cells in retina, which are light and colour sensitive. Rods respond to the intensity of light. Cones respond to the colour. There are around 125 million rods and cones. The cells generate signals which are transmitted to the brain through optical nerves. The brain process the information via these electric signals and give the impression of erect image to us.

To see nearby as well as distant objects, ciliary muscles modify the curvature of eye lens. This leads to variation in focal length. When the muscles are relaxed, the focal length of the lens has its maximum value, equal to the distance from the retina. So, parallel rays coming into the eye get focussed on the retina. When the eye looks at nearby objects, the ciliary muscles are strained and the focal length decreases. So, that sharp image again forms on the retina.

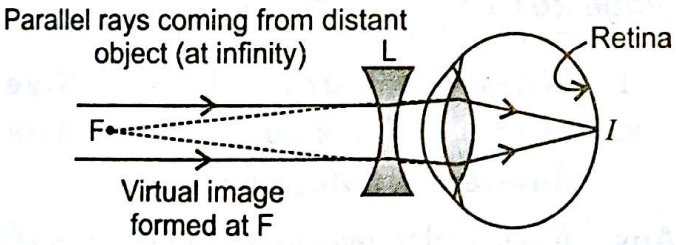
7. When do we consider a person to be myopic or hypermetropic? Explain using diagrams how the defects associated with myopic and hypermetropic eye can be corrected?

Ans. A person can be considered as myopic when he can see nearby objects clearly but cannot see distant objects distinctly. This defect of eye is called myopia.

Myopia:



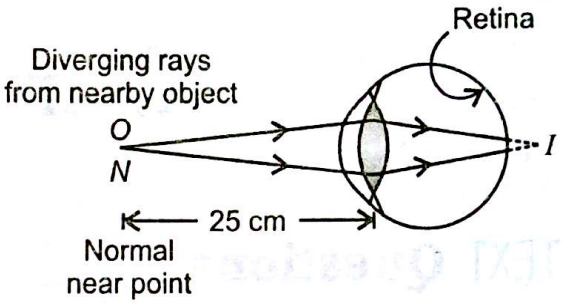
In a myopic eye, image of distant object is formed in front of the eye (and not on the retina).



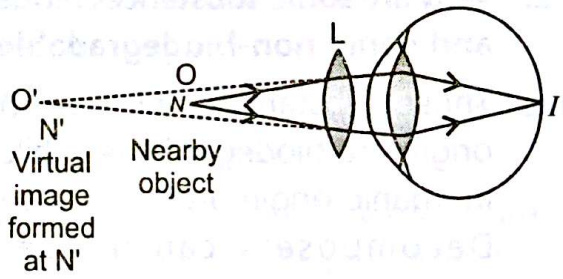
Correction of Myopia: The concave lens placed in front of eye lens forms a virtual image of distant object at far point (F) of the myopic eye.

When the person cannot see nearby objects clearly but able to see distant objects clearly, the person can be treated as hypermetropic. The eye defect is called hypermetropia.

Hypermetropia:



In a hypermetropic eye, the image of nearby object lying at normal near point N (at 25 cm) is formed behind the retina.



Correction of Hypermetropia: The convex lens forms a virtual image of the object (lying at normal near point N) at the near point N' of the defective eye. It helps the eye to form the image on the retina.

11

The Human Eye and the Colourful World

PREVIOUS YEARS' **Questions**

2007

LONG ANSWER TYPE QUESTION **[5 Marks]**

1. A 14-year old student is not able to see clearly the questions written on the blackboard placed at a distance of 5 m from him.

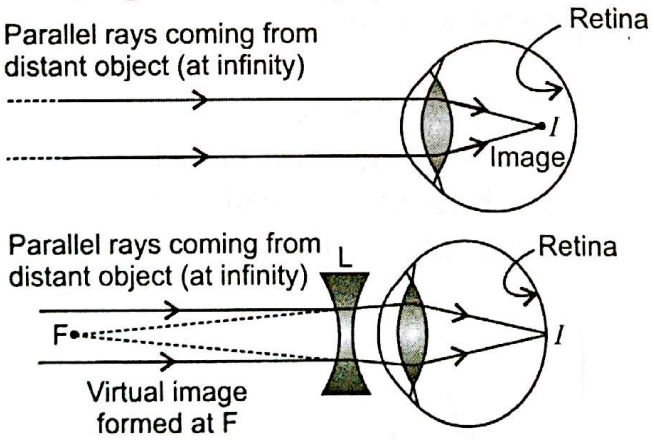
(*a*) Name the defect of vision he is suffering from.

(*b*) With the help of labelled ray diagrams show how this defect can be corrected.

(*c*) Name the type of lens used to correct this defect. *[All India]*

Ans. (*a*) Short-sightedness (Myopia).

(*b*)



(*c*) Concave lens.

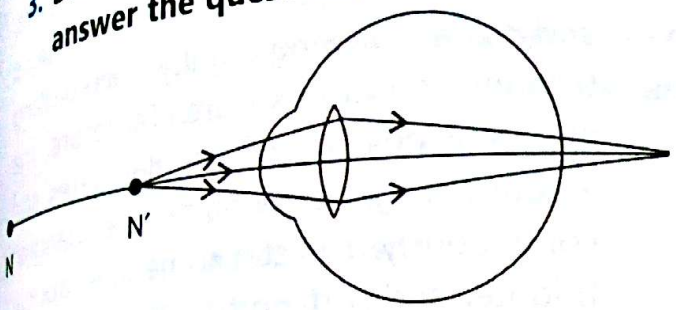
2008

VERY SHORT ANSWER TYPE QUESTION **[1 Mark]**

2. Why is red colour selected for danger signal lights? *[Delhi]*

Ans. Wavelength of red colour is more and so, it is least scattered. It can be easily seen through a large distance.

3. **Study the diagram given below and answer the questions that follow it:**



(a) Which defect of vision is represented in this case? Give reason for your answer.

(b) What could be the two causes of this defect?

(c) With the help of a diagram show how this defect can be corrected by the use of a suitable lens.

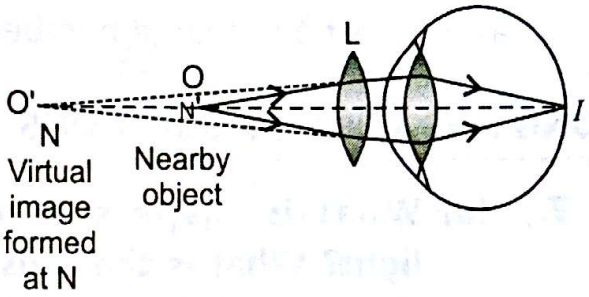
[Delhi(C)]

Ans. (a) Hypermetropia as the image is formed beyond the retina.

(b) (i) Due to greater focal length of the lens and

(ii) As eyeball becomes smaller.

(c) It can be corrected by using a convex lens of suitable focal length as shown below.

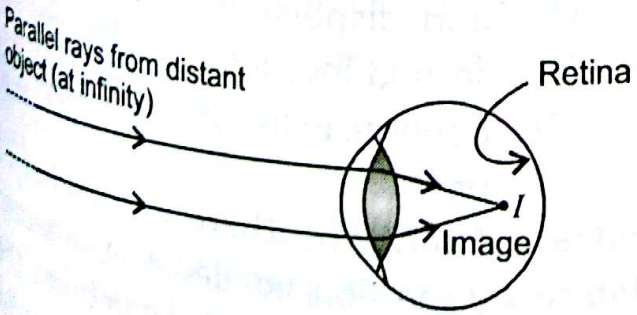


2009

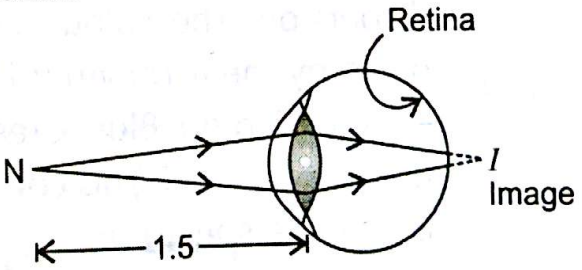
SHORT ANSWER TYPE QUESTIONS[I] [2 Marks]

4. **Student sitting at the back bench in a class is not able to see what is written on the blackboard. He however, sees it clearly when sitting on the front seat at an approximate distance of 1.5 m from the blackboard. Draw ray diagrams to illustrate the image formation of the blackboard when he is seated at the (i) back seat (ii) front seat.** *[All India(C)]*

Ans. (i) When student is seated at the back seat

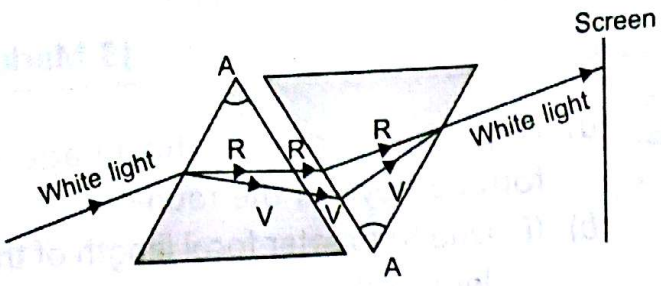


(ii) When student is seated at front seat.



5. **What is meant by spectrum of white light? How can we recombine the components of white light after a prism has separated them? Draw a diagram to illustrate it.** *[Foreign, All India(C)]*

Ans. The coloured pattern VIBGYOR formed by a prism by splitting the incident white light is called a spectrum. By having two prisms, inverted to each other, one can recombine the light to get white light again.



6. Explain why do the planets not twinkle but the stars twinkle.

[Delhi(C); Delhi 2011]

Ans. Planets being of larger size can be taken as a collection of large number of point-sized objects/sources of light, which nullify the twinkling effect of each other.

Due to varying conditions of atmosphere, starlight undergoes multiple refractions and its path varying slightly while passing through the atmosphere. Therefore, the apparent position of star fluctuates and amount of light entering the eye changing continuously. The star sometimes appear brighter and some other time, it appears fainter. This causes twinkling of star.

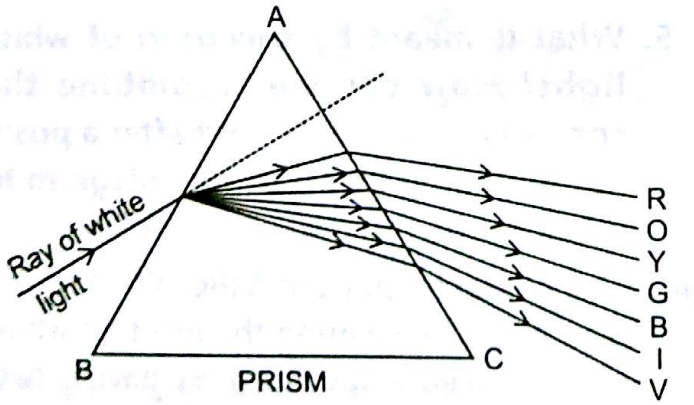
LONG ANSWER TYPE QUESTIONS

[5 Marks]

7. (*a*) What is dispersion of white light? What is the cause of such dispersion? Draw a diagram to show the dispersion of white light by a glass prism.

(*b*) A glass prism is able to produce a spectrum when white light passes through it but a glass slab does not produce any spectrum. Explain why is it so? *[All India]*

Ans. (*a*) The splitting up of white light into its constituent colours is called dispersion. The colour sequence is given by the acronym V I B G Y O R – Violet, Indigo, Blue, Green, Yellow, Orange and Red. This colour pattern is called a spectrum.



Dispersion takes place because the speed of light of different colours through a glass prism is different and so, refractive index, therefore, each colour bends (refracts) through different angles with respect to incident ray as they pass through a prism. The red colour has maximum speed in glass prism. So, it is least deviated while the violet colour has minimum speed so its deviation is maximum. Thus, the ray of each colour emerges along different paths and becomes distinct.

(*b*) For dispersion, the two refracting surfaces must be inclined to each other as in case of prism. In rectangular glass slab, the refracting surfaces are parallel to each other. So, dispersion cannot occur. This is due to fact that the rectangular glass slab can be considered as equivalent of two identical prisms in inverted position placed in an inverted position with respect to each other. The deviation and dispersion produced by the second inverted prism is equal and opposite to that produced by the first prism.

Therefore, there will neither be dispersion, nor deviation, *i.e.* second inverted prism recombines the colour to give a white light parallel

to the incident ray again and will undergo only lateral displacement. Hence, rectangular glass slab cannot produce any spectrum.

8. (a) Explain the following terms used in relation to defects in vision and correction provided by them:

(i) Myopia

(ii) Astigmatism

(iii) Bifocal lenses

(iv) Far-sightedness.

(b) Why is the normal eye unable to focus on an object placed within 10 cm from the eye? *[All India]*

Ans. (a) (i) **Myopia:** Short-sightedness is caused due to excessive curvature in cornea or elongation of eyeball. Image is formed before of the retina. So, a concave lens is used to correct it.

(ii) **Astigmatism:** The inability to focus the light in both vertical and horizontal lines is called astigmatism. It is caused due to varying curvature in lens both horizontally and vertically. It is corrected by using cylindrical lens.

(iii) **Bifocal lenses:** These are used to correct presbyopic eye. These contain lenses with upper concave and lower convex surface. Presbyopia arises with age.

(iv) **Far-sightedness:** Hypermetropia or far-sightedness is caused due to greater focal length of eye lens and/or when eyeball becomes smaller. Image is formed beyond the retina and can be corrected using a convex lens.

(b) The focal length of the lens cannot be changed upto an extent that objects nearer than 25 cm can be viewed (its near point is 25 cm). So it is not able to focus for 10 cm.

2010

VERY SHORT ANSWER TYPE QUESTIONS **[1 Mark]**

9. Name the part of our eyes that helps us to focus near and distant objects in quick succession. *[Delhi]*

Ans. Ciliary muscles help in changing the focal length of the eye lens.

10. A person is advised to wear spectacles with concave lenses. What type of defect of vision is he suffering from? *[All India]*

Ans. Myopia or short-sightedness.

11. A person is advised to wear spectacles with convex lenses. What type of defect of vision is he suffering from? *[All India]*

Ans. Hypermetropia or far-sightedness.

12. Why do different components of white light deviate through different angles when passing through a triangular glass prism? *[All India]*

Ans. Due to change in refractive index offered by the medium.

13. A person can comfortably read a book but finds it difficult to read the number on a bus parked 5 m away from him. Name the type of defect of vision he is suffering from. Which type of lens should he use in his spectacles to correct his vision? *[Foreign]*

Ans. Myopia or short-sightedness. Concave lens should be used to correct his vision.

14. What will be the colour of the sky, when it is observed from a place in the absence of any atmosphere? Why?
[All India; Delhi 2012]

Ans. Sky appears dark.

Reason: In the absence of atmosphere, there would have been no scattering of sunlight at all.

15. The sky appears dark instead of blue to an astronaut. State its reason.
[Delhi; Delhi 2012]

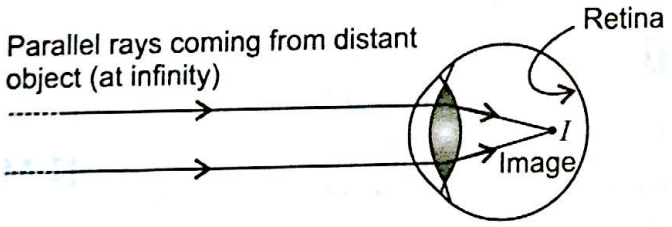
Ans. The sky appears dark to the astronaut as scattering does not take place at very high altitude due to the absence of atmosphere.

SHORT ANSWER TYPE QUESTIONS[I] [2 Marks]

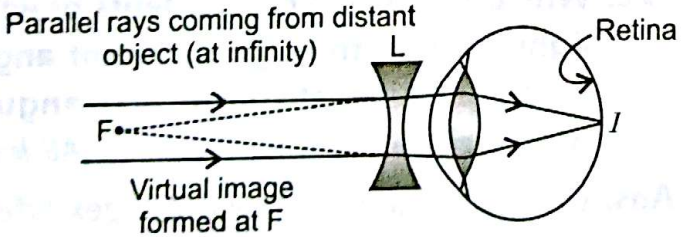
16. What is myopia (near-sightedness)? Draw a ray diagram to show how it can be corrected using a lens. *[Delhi]*

Ans. Myopia is the inability of an eye in viewing long distant objects. The image in this case is formed before the retina. For every myopic eye, there exists a far point beyond which clear image cannot be seen.

The short-sightedness is corrected by using a concave lens which diverges and shifts the image to the retina.



Myopic eye

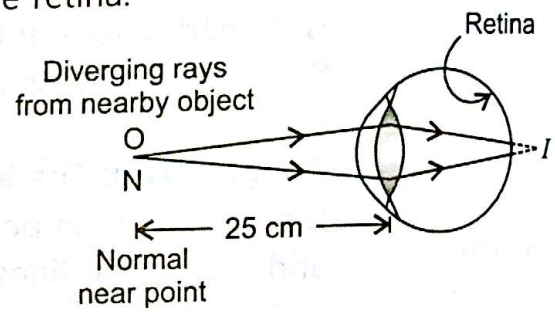


Correction of Myopia

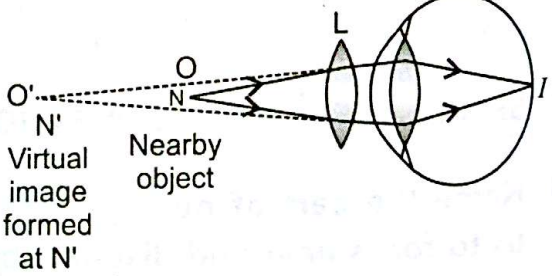
17. What is hypermetropia (far-sightedness)? Draw a ray diagram to show how this defect can be corrected using a lens. *[Delhi]*

Ans. Hypermetropia is the inability of an eye in viewing the nearby objects. The image in this case is formed beyond the retina. For a hypermetropic eye, there exists a near point.

It is corrected by using a convex lens, which converges and shifts the image to the retina.



Hypermetropic eye



Correction of Hypermetropia

18. Define the term dispersion of white light. State the colour which bends (*i*) the least and (*ii*) the most while passing through a glass prism.
[All India; All India 2012]

Ans. The splitting up of white light into its component colours is called dispersion.

The colour which bends

(*i*) the least is red, and

(*ii*) the most is violet, while passing through a glass prism.

VERY SHORT ANSWER TYPE QUESTIONS [1 Mark]

19. What is Tyndall effect? [Delhi]

Ans. The phenomenon of scattering of light by the colloidal particles is called Tyndall effect.

20. Give an example of optical phenomena which occurs in nature due to atmospheric refraction. [Delhi]

Ans. Twinkling of stars.

21. Give an example of a phenomenon where Tyndall effect can be observed. [All India]

Ans. When a fine beam of sunlight enters a room containing suspended particles of dust, the path of the beam of light is visible. It is due to the scattering of light (Tyndall effect).

22. Name the type of particles which acts as a prism in the formation of rainbow in the sky. [All India]

Ans. Water droplets present in the atmosphere.

23. What is the cause of dispersion of white light on passing through a prism? [Foreign]

Ans. The refractive index of the material of a prism is different for different colours of light as different colours have different speeds in the material of a prism. Also, prism has non-parallel surfaces.

24. Name the atmospheric phenomenon due to which the sun can be seen above the horizon about two minutes before actual sunrise. [Foreign]

Ans. Atmospheric refraction.

SHORT ANSWER TYPE QUESTIONS[I] [2 Marks]

25. Give reasons:

(i) The extent of deviation of a ray of light on passing through a glass prism depends on its colour.

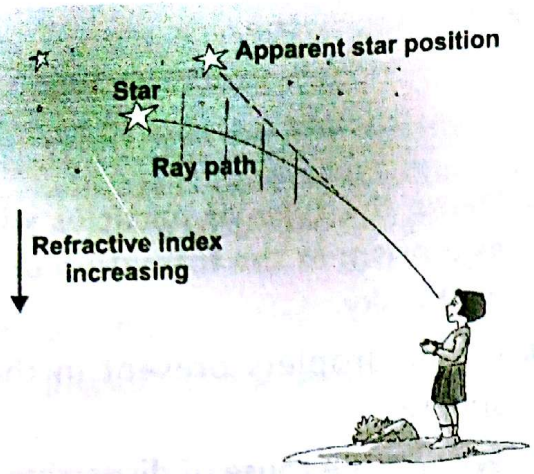
(ii) Lights of red colour are used for danger signals. [Foreign]

Ans. (i) Refractive index of a medium is different for different colours of light.

(ii) Due to large wavelength, red colour is least scattered and travel to large distance.

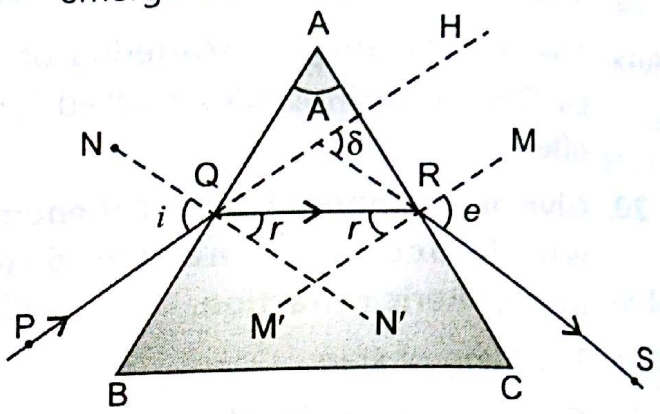
26. A star appears slightly higher (above) than its actual position in the sky. Illustrate it with the help of a labelled diagram. [Delhi; All India 2012]

Ans. The gradual change in the refractive index of different layers of the atmosphere due to the varying conditions of it causes atmospheric refraction. When starlight enters the atmosphere, it gets refracted continuously. The higher level of air acts as a rarer medium while the dense air near the surface of earth acts as a denser medium. So, the atmosphere bends the starlight towards the normal. As a result, the apparent position of star is slightly different from its actual position. Thus, star appears slightly higher (above) than its actual position in the sky.



27. 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. *[All India]*

Ans. i – incident angle, r – refraction angle, δ – angle of deviation, e – angle of emergence.



Refraction of light through a glass prism

SHORT ANSWER TYPE QUESTIONS[II] [3 Marks]

28. (*a*) What is meant by the power of accommodation of an eye?

(*b*) A person with a myopic eye cannot see objects beyond 1.2 m directly. What should be the type of the corrective lens used? What would be its power? *[All India]*

Ans. (*a*) The maximum variation in power of the lens so that the far-off and nearby objects are viewed clearly is called power of accommodation.

(*b*) To correct, an object at infinity has to be brought as an image to 120 cm.

$$\therefore \quad \frac{1}{f} = \frac{1}{-120} - \frac{1}{(-\infty)} = \frac{1}{-120}$$

$$\Rightarrow \quad f = -120 \text{ cm}$$

$$P = \frac{100}{-120} = \frac{-5}{6} \text{ D}$$

$$= -0.83 \text{ D}$$

A concave lens of focal length 120 cm and power – 0.83 D is to be used.

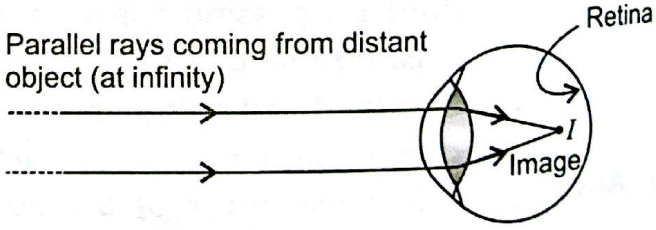
29. (*a*) What are the values of (*i*) near point and (*ii*) far point of vision of a normal adult person?

(*b*) A student has difficulty in reading the blackboard while sitting in the last row. What could be his defect of vision? Draw a ray diagram to illustrate this defect of vision. *[All India]*

Ans. (*a*) (*i*) 25 cm (*ii*) Infinity (∞)

(*b*) Short-sightedness. The image in this case falls before the retina.

It can be corrected by using concave lens.



Myopic eye

30. Name the three common defects of vision. What are their causes? Name the type of lens used to correct each of them. *[Foreign]*

Ans. (*i*) **Myopia:**

Cause: Elongation of eyeball,

Type of lens used for correction: Concave lens of suitable power.

(ii) **Hypermetropia:**
Cause: Shrinking of eyeball,
Type of lens used for correction: Convex lens of suitable power.

(iii) **Presbyopia:**
Cause: Weakening of ciliary muscles,
Type of lens used for correction: Bifocal lens.

2012

VERY SHORT ANSWER TYPE QUESTIONS [1 Mark]

31. Which phenomenon is responsible for making the path of light visible? *[Delhi]*

Ans. Tyndall effect.

32. State one function of iris in human eye. *[All India]*

Ans. Iris controls the size of pupil.

33. State one function of pupil in human eye. *[All India]*

Ans. Pupil regulates and controls the amount of light entering the eye.

34. State one role of ciliary muscles in the human eye. *[All India]*

Ans. Ciliary muscles help the eye lens to focus the image of an object on the retina by increasing or decreasing the curvature of eye lens.

35. State one function of the crystalline lens in the human eye. *[Foreign]*

Ans. Crystalline (eye) lens forms a real and inverted image of the object on the retina.

36. State two properties of the image formed by the eye lens on the retina. *[Foreign]*

Ans. (i) Image on the retina is real and inverted.
(ii) Diminished in size.

37. State one function of cornea in human eye. *[Foreign]*

Ans. Cornea provides the refraction of light rays entering the eye.

38. Why does the sun appear reddish at sunrise? *[Foreign]*

Ans. At sunrise, the sun looks almost reddish because only red colour ($\lambda_b < \lambda_r$), which is least scattered is received by our eye and appears to come from the sun. Hence, the appearance of sun at sunrise, near the horizon may look almost reddish.

SHORT ANSWER TYPE QUESTIONS[I] [2 Marks]

39. A star sometimes appears brighter and some other times fainter. What is this effect called? State the reason for this effect. *[Delhi]*

Ans. This effect is called Twinkling effect.

Reason: It is due to atmospheric refraction of starlight. The atmosphere has varying layers. The gradual change in the refractive index of different layers of atmosphere causes atmospheric refraction and starlight undergoes multiple refraction. So, the fluctuation in the position of star occurs continuously due to the changing amount of light entering the eye. The star sometimes appears brighter and at some other times, it appears fainter. This causes twinkling of star.

40. What is the colour of the clear sky during day time? Give reason for it. *[All India]*

Ans. Clear sky appears blue.

Reason: When sunlight passes through the atmosphere having the molecules of air and other fine particles, whose size is smaller than the wavelength of visible light, these molecules and particles scatter the blue colour more strongly than the other colours of spectrum as the wavelength of blue colour is more. This scattered blue light enters our eye. So, the colour of sky appears blue to us during day time.

41. What is a spectrum? Why do different coloured rays deviate differently on passing through a glass prism? *[All India]*

Ans. The band of coloured component of a light beam is called its spectrum. The colour sequence is given by the acronym V I B G Y O R — Violet, Indigo, Blue, Green, Yellow, Orange and Red.

The speed of light of different colours in a medium like glass is different. Varying speeds for different colours lead to different refractive indices for different colours. It has been observed that the refractive index of glass for violet colour is more than that for red colour. All the colours present in white light refract through different angles and hence, emerge out from the prism with different directions and become distinct.

SHORT ANSWER TYPE QUESTION[II] [3 Marks]

42. What is meant by the term 'power of accommodation' of human eye? How does it help a person to see nearby as well as distant objects clearly? *[Foreign]*

Ans. The ability of eye lens to adjust its focal length to form the sharp image of the object at varying distances on the retina is called its power of accommodation.

When we see the nearby object, the ciliary muscles contract, it increases the thickness of eye lens. The eye lens then becomes thicker. As a result, the focal length of eye lens decreases in such a way that the clear sharp image of nearby object is formed on the retina. Thus, the object is seen clearly to us.

When we see the distant object, these muscles becomes relaxed, thus the eye lens becomes thinner, and consequently focal length of the lens increases. Therefore, the parallel rays coming from the distant object are focused on the retina and object is seen clearly to us. Thus, the accommodation power of an eye helps a person to see nearby as well as distant objects clearly.

LONG ANSWER TYPE QUESTION [5 Marks]

43. (*a*) A student cannot see clearly a chart hanging on a wall placed at a distance 3 m from his eye. Name the defect of vision he is suffering from. Draw a ray diagram to illustrate this defect. List its two possible causes.

(*b*) Draw a ray diagram to show how this defect may be corrected using a lens of appropriate focal length. *[Delhi]*

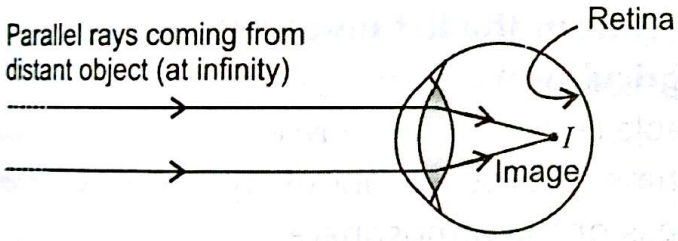
(c) An eye donation camp is being organised by social workers in your locality. How and why would you help in this cause? *[All India]*

Ans. (a) Myopia or Short-sightedness is the inability of an eye in viewing long distance objects. The image in this case falls before the retina. For every myopic eye, there exists a far point beyond which clear image cannot be seen. Short-sightedness is caused due to

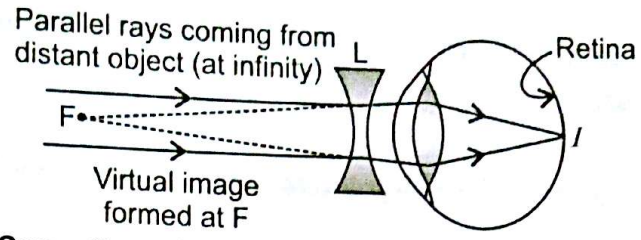
(i) excessive curvature in cornea.

(ii) elongation of eyeball.

(b) The short-sightedness is corrected by using a concave lens which diverges and shifts the image to the retina.



In a myopic eye, image of distant object is formed in front of the retina (and not on the retina)



Correction of Myopia. The concave lens placed in front of eye forms a virtual image of distant object at far point (F) of the myopic eye.

(c) Reasons for donating eyes:

(i) A person's corneal blindness can only be elevated by a human donor's cornea.

(ii) It is opportunity to restore someone's sight.

Methods for supporting this cause:

(i) Make it a family tradition of donating the eyes.

(ii) Motivate and educating others about eye donation.

(iii) Help removing all the myths about eye donation.