11 HUMAN EYE AND THE COLOURFUL WORLD

CONCEPTS

- To understand the various parts which constitute the human eye and their functions.
- To understand the concept of accommodation in Human eye.
- To learn about simple defects in human eye and their corrections.
- To learn about refraction of light through glass prism and various terms related to it.
- To introduce the concept of dispersion of light through a prism.
- To introduce the recombination of dispersed light into white light.
- To introduce the concept of atmospheric dispersion in the form of rainbow.
- To learn the atmospheric refraction which gives rise to natural phenomena, such as twinkling of stars, apparent position of stars, increase in the length of daylight and appearance of sun larger during sunrise and sunset.
- To learn the concept of scattering of light and Tyndall effect.
- To learn phenomena occurring in nature on account of scattering.

I. SUMMATIVE ASSESSMENT

NCERT QUESTIONS WITH THEIR ANSWERS

SECTION A : IN-TEXT QUESTIONS

Page 190

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

Ans. The process by which ciliary muscles alter the focal length of cystalline lens, so as to focus the nearer or far-off objects clearly on the retina is called accommodation of eye.

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

Ans. A concave lens of focal length 1.2 m should be used to restore vision.

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

Ans. The far point for normal eye is infinity and the near point is 25 cm.

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

Ans. The defect is myopia. It can be corrected by using a concave lens of appropriate focal length.

SECTION B : QUESTIONS FROM THE END OF CHAPTER

1. The human eye can focus objects of different distances by adjusting the focal length of eye lens. This is due to :

(a) Presbyopia (b) Accommodation (c) Near-sightedness (d) Far-sightedness

Ans. (b) The accommodation is the correct choice.

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

(a) Cornea (b) Iris (c) Pupil (d) Retina

Ans. (d) The retina is the correct choice.

3. The least distance of distinct vision for 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 is the correct choice.

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

(a) Pupil (b) Retina (c) Ciliary muscles (d) Iris

Ans. (c) The ciliary muscles is the correct choice.

5. A person needs a lens of power –5.5 dioptres for correcting distant vision. For correcting his near vision he needs a lens of power + 1.5 dioptre. What is focal length of lens required for correcting : (i) distant vision, and (ii) near vision ?

Ans. Power of the eye glass for distant vision = – 5.5 D

Correction for power of the eye glass of near vision = + 1.5 D

(i) Focal length of distant viewing eye glass $= \frac{100\,\text{cm}}{\text{power}} = \frac{100\,\text{cm}}{-5.5}$ = – **18.18 cm**

(ii) Focal length of near viewing section of eye glass = $\frac{100\,\text{cm}}{\text{power}} = \frac{100\,\text{cm}}{1.5}$ **= 66.66 cm**

6. The far point of a myopic person is 80 cm in front of the eye. What is the nature and the power of lens required to enable him to see very distant objects clearly?

Ans. Far-off point of myopic eye (v) = – 80 cm

Distance of the very far-off object from the eye glass (u) = ∞

Focal length of the correcting lens (f) = ?

Now $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-80\,\text{cm}} - \frac{1}{\infty} = -\frac{1}{80\,\text{cm}}$

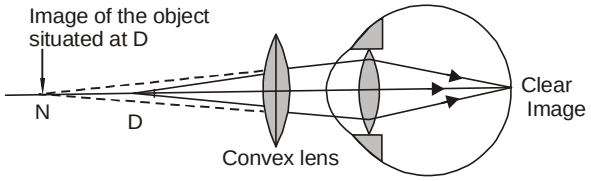
$\therefore \quad f$ = – 80 cm

$\therefore$ Power of the correcting lens (P) = $\frac{100}{-80} = -1.25$ **D**

As, the power of the correcting lens is negative, therefore, it is a **concave lens.**

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

Ans. (i)



(ii) Distance of the object for eye lens = Distance of normal near point, $u = -25$ cm
Distance of the image from eye lens = Near point of hypermetropic eye
$v = -1$ m $= -100$ cm.

Applying, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-100} - \frac{1}{-25} = \frac{1}{25} - \frac{1}{100} \Rightarrow \frac{1}{f} = \frac{4-1}{100} = \frac{3}{100}$

$\therefore \quad f = \frac{100}{3}\text{cm}$ $\because$ Power of lens $= \frac{1(\text{m})}{f} = \frac{100\,\text{cm}}{f} = \frac{100\,\text{cm} \times 3}{100\,\text{cm}} =$ **+ 3D**

Thus, a convex lens of power + 3D is required.

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

Ans. If the distance of the objects is less than 25 cm., then the image is formed behind the retina. In other words, the rays starting from object do not meet at retina, but behind it. In such a situation a blurred image is formed on the retina, and hence, the object is not seen clearly.

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

Ans. The image distance remains unchanged and is equal to the focal length of the eye lens.

10. Explain, why do the stars twinkle?

Ans. The atmosphere consists of a number of layers of air of varying densities, such that most dense layer is near the surface of the earth and least dense layer is far away from the surface of earth. When the rays of light coming from a distant star, pass through these layers of air, they suffer refraction and bend towards the normal. When these refracted rays ultimately reach the eye, then to the eye they appear to come from different position to the position at which star is located. This is called apparent position of star which is higher and closer than the true position of star.

Now the different layers of air are not stationary, but continuously intermix with each other. This results in a shift in the apparent position of the star. Thus, when the star is within the line of sight, it is visible. However, when it is out of the line of sight, it is not visible. This on the whole gives a twinkling effect.

11. Explain, why the planets do not twinkle?

Ans. Compared to stars, the planets are very close to us. The light coming from the planets on passing through atmosphere does suffer refraction, with the result the apparent position of the planets change. However, the size of apparent image of the planets is fairly large, such that it seldom falls outside the line of sight of the observer. Hence, the planets do not appear to twinkle.

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

Ans. During sunrise, the sunlight travels maximum distance through the atmosphere. With the increase in distance, the size and number of particles suspended in air also increase. Thus, not only the violet, indigo or blue, but the yellow, orange and red wavelengths in the white light scatter.

As the red wavelengths scatter last of all and nearest to the eye, therefore, the sun appears reddish.

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

Ans. The sky will appear blue only, if there is an atmosphere around the spaceship. As there is complete vacuum around the spaceship, therefore, no scattering of light takes place. Thus, the space around the spaceship (sky) appears dark.

ADDITIONAL QUESTIONS
As Per CCE Pattern

A. Very Short Answer Questions [1 Mark]

Previous Years' Questions

1. Name the component of white light that deviates the least and the component that deviates the most while passing through a glass prism. **[2010, 2011 (T-II)]**

Ans. Red deviates the least and violet deviates the most.

2. Name the part of the human eye that helps in changing the focal length of the eye lens. **[2011 (T-II)]**

Ans. Ciliary muscles

3. Write the value of near point of distinct vision for normal eye. **[2011 (T-II)]**

Ans. 25 cm.

4. What is the role of pupil in a human eye? **[2011 (T-II)]**

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

5. What is the range of vision of a normal human eye? **[2011 (T-II)]**

Ans. The range of vision of a normal human eye is 25 cm to infinity.

6. Name the part of the eye
(a) that controls the amount of light entering into the eye.
(b) that has real, inverted image of the object formed on it. **[2011 (T-II)]**

Ans. (a) Pupil (ii) Retina

7. A person is advised to wear spectacles with convex lenses. State the defect of vision he is suffering from. **[2011 (T-II)]**

Ans. Hypermetropea (Long sightedness)

8. When one enters a dim-light room from bright light, one is unable to see the objects in the dim-light room for sometime. Why? **[2011 (T-II)]**

Ans. Pupil takes sometime to adjust in order to control the light so one is not able to see the objects for sometime.

9. What is meant by near point of a human eye? **[2011 (T-II)]**

Ans. The point of smallest distance from eye beyond which it can see the objects distinctly.

10. Why is the refractive index of atmosphere different at different altitudes? **[2011 (T-II)]**

Ans. Refractive index is different at different altitudes due to difference of density (optical) of the atmosphere.

11. When a light ray passes obliquely through the atmosphere in an upward direction, how does its path generally change? **[2011 (T-II)]**

Ans. In an upward direction of the atmosphere, the optical density is decreasing continuously, so when light ray passes in such direction it bends away from the normal.

12. A person is advised to wear spectacles with concave lenses. What type of defect of vision is he suffering from? **[2010]**

Ans. Myopia.

13. What will be the observed colour of the sky on a planet where there is no atmosphere? Why? **[2010]**

Ans. **Black.** Because there is no scattering of colour of light.

Other Important Questions

1. What is the function of crystalline lens in the human eye?

Ans. It focuses the image of an object on the retina.

2. What is the function of ciliary muscles in the human eye?

Ans. The ciliary muscles alter the focal length of the crystalline lens.

3. What is the function of cornea in the human eye?

Ans. Cornea acts as a window to the world and allows the light rays to enter the eye ball.

4. What is the function of retina in the human eye?

Ans. Retina receives the image of the objects and then transmits it to brain in the form of electric pulses.

5. A person can see nearer objects clearly, but not the far-off objects. Name the defect in the eye.

Ans. The defect is myopia or short-sightedness.

6. A person can see far-off objects clearly, but not the nearer objects. Name the defect in the eye.

Ans. The defect is hypermetropia or long-sightedness.

7. A person can neither see nearer object, nor the far-off objects clearly. Name the defect in the eye.

Ans. The defect is called presbyopia.

8. To a person the lines drawn parallel to one another appear distorted. Name the defect in the eye?

Ans. Astigmatism is the defect.

9. What do you understand by the term “normal eye”?

Ans. When an eye can see the nearer or far-off objects clearly without any external aid, the eye is said to be normal eye.

10. What do you understand by the term “defective eye”?

Ans. A condition in the eye due to which it cannot see clearly, whether far-off objects or nearer objects or both, is called defective eye.

11. Define prism.

Ans. Prism is a piece of glass or any other transparent material, bounded by two triangular and three rectangular surfaces.

12. What do you understand by the refracting surface of the prism.

Ans. The rectangular surface of the prism is called refracting surface.

13. What is the refracting edge of a prism?

Ans. The line along which two refracting surfaces of a prism meet is called refracting edge of the prism.

14. What do you understand by the term refracting angle of a prism?

Ans. The angle between the two refracting surfaces of a prism is called refracting angle of the prism.

15. Define angle of deviation for a prism.

Ans. The angle between the incident ray and the emergent ray (produced backward) is called angle of deviation.

16. Define dispersion of light.

Ans. The phenomenon due to which white light splits into seven colours on passing through a prism is called dispersion of light.

17. What do you understand by the term spectrum?

Ans. A band of seven colours taken on a white screen when dispersion of white light takes place through a prism, is called spectrum.

18. Which colour of the spectrum formed from white light deviates least ?

Ans. The red colour of the spectrum formed from white light, deviates least.

19. Which colour of the spectrum formed from white light deviates most ?

Ans. The violet colour of the spectrum formed from white light, deviates most.

20. A mixture of yellow and orange light is dispersed through a prism. Which colour will deviate least?

Ans. The yellow colour will deviate least.

21. What is an impure spectrum?

Ans. A spectrum in which the bands of different colour don't have sharp boundaries, is called impure spectrum.

22. How the dispersed colours of white light can be recombined?

Ans. This can be achieved by placing another prism in an inverted position in the path of dispersed light.

23. What is a rainbow?

Ans. An arc of seven colours formed in the sky, just after the rain during the day time, is called rainbow.

24. How is rainbow formed?

Ans. Rainbow is formed just after the rain during day time by the dispersion of sunlight, by tiny droplets of water suspended in air.

25. It stops raining at 4 pm and the Sun comes up. In which direction the rainbow is formed?

Ans. At 4 pm the Sun will be in the west direction. So the rainbow will be formed in the east direction.

26. Which colour will appear on the lower arc of rainbow?

Ans. Violet colour will appear on the lower arc of the rainbow.

27. What is Tyndall effect?

Ans. The phenomenon due to which colloidal solutions scatter blue colour of the white light is called Tyndall effect.

28. What do you understand by the term scattering of light?

Ans. The phenomenon due to which an incident ray of light whose wavelength is less than particle on which it is incident, is absorbed by the particle and then radiated out in all directions, is called scattering of light.

29. Which colour of white light are likely to scatter most while passing through atmosphere?

Ans. Violet, indigo and blue colours are likely to scatter most, when white light is passed through the atmosphere.

B. Short Answer Questions–I [2 Marks]

Previous Years' Questions

1. What is the cause of dispersion of white light passing through a prism? Which colour of light deviates the -

(i) most; (ii) least **[2011 (T-II)]**

Ans. White light is a combination of seven colours having different wavelengths. The colour which have smallest wavelength deviates most and that having largest wavelength deviates least. This is cause of dispersion of white light passing through a prism.

(i) Violet colour deviates most.

(ii) Red colour deviates least.

2. Why does the clear sky appear blue? How would the sky appear in the absence of earth's atmosphere? **[2011 (T-II)]**

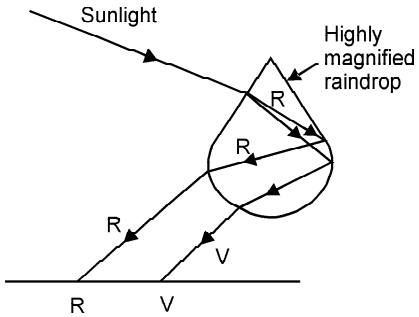
Ans. Blue colour of light has smaller wavelength, so it scatters more in upper layer of atmosphere, in comparison to the other colours. Thus sky appears blue. The sky will appear dark in the absence of earth's atmosphere.

3. Why do we observe difference in colours of the Sun during sunrise, sunset and noon? **[2011 (T-II)]**

Ans. Red colour of light has largest wavelength, so it scatters least in comparison to the other colours. Due to least scattering of red light, sun appears red during sunrise and sunset. While at the time of noon scattering is least, almost all of the colours reach to the eye of observer and sun appears as of its original colour (white).

4. Describe the formation of rainbow in the sky with the help of a diagram. **[2011 (T-II)]**

Ans. The rainbow is produced due to the dispersion of sunlight by tiny droplets of water suspended in air, just after rain.



5. A person needs a lens of power –0.5 dioptre 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 his

(i) distant vision, (ii) near vision? **[2011 (T-II)]**

Ans. (i) Focal length, $f = \frac{1}{P} = \frac{1}{-0.5}$ = –2 m **= – 200 cm**

(ii) Focal length, $f = \frac{1}{P} = \frac{1}{1.5}$ = 0.67 m **= 67 cm**

6. Explain, why sun appears white when it is over head at Noon? **[2011 (T-II)]**

Ans. When sun is overlead at Noon, the sunlight travels least distance through atmosphere and scattering is not so prodominant. So all components of sunlight reach to the eyes of the viewers, hence sun appears white.

7. Why is normal eye not able to see clearly the objects kept closer than 25 cm? Explain in brief. **[2011 (T-II)]**

Ans. This is because the focal length of eye lens cannot be reduced below a certain minimum limit, i.e., least distance of distinct vision (25 cm). Thus when the objects kept closer than 25 cm then their images are not formed on retina so eye cannot see clearly that objects.

8. A person suffering from short-sightedness can see clearly only upto a distance of 2 metres. Find the nature and power of the lens required to correct his vision. **[2011 (T-II)]**

Ans. For correction of vision,

$u = -\infty$ (For normal eye)

v = –2 m = – 200 cm, f = ?

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{200} - \frac{1}{-\infty} = -\frac{1}{200} + 0 = -\frac{1}{200}$$

$\therefore$ Focal length of the lens, f = –200 cm = –2 m

– ve sign shows that nature of lens is concave lens.

Thus, power of the lens, $P = \frac{1}{f} = \frac{1}{-2}$ **= – 0.5 D**

9. Why does it take some time to see objects in a cinema hall when we just enter the hall from bright sunlight? Explain in brief. **[2011 (T-II)]**

Ans. When we just enter the cinema hall from bright sunlight, very little light reaches the eye lens due to the dim light. It takes some time for the eye to adjust the pupil (expand it) to allow more light to enter the eye. This is why it takes some time to see objects in a cinema hall when we just enter the cinema hall from bright sunlight.

10. What is the scattering of light? Explain with the help of an example. **[2011 (T-II)]**

Ans. The phenomenon due to which a particular wave of light is absorbed by a particle, which is greater in diameter than the wavelength of light and then transmits in all possible directions is called scattering of light.

When the white sunlight enters the atmosphere of earth, the particle size is smallest. Thus, the violet light which have the smallest wavelength in white light scatters.

11. A person can read the number plate of a distant bus clearly but he finds difficulty in reading a book. What type of defect of vision he is suffering from? Name the type of lens he needs to correct this defect. Write the causes of this defect. **[2011 (T-II)]**

Ans. He is suffering from defect of vision of hypermetropia. He needs to correct this defect by convex lens of proper focal length.

Cause of this defect :

(i) Ciliary muscles become stiff.

(ii) Eye ball becomes smaller.

12. Stars twinkle while the planets do not twinkle. Why? **[2011 (T-II)]**

Ans. The light rays from the star keep on changing their paths continuously due to variable optical density. Thus the number of rays entering pupil of the eye goes on changing with time and stars twinkle. While for the planets, they are near to the earth and subtends larger angles to the eye and the number of rays entering in the eye do not change significantly and no twinkling effect is perceived.

13. A boy uses spectacles of focal length – 60 cm. Name the defect of vision he is suffering from. Which lens is used for the correction of this defect? Compute the power of this lens. **[2011 (T-II)]**

Ans. Focal length of spectacles = – 60 cm = $\frac{-60}{100}\text{m} = -\frac{3}{5}\text{m}$

–ve sign shows that lens is concave lens, which is used in defect of vision of myopia (short sightedness). Power of the lens, $P = \frac{1}{f\,(\text{in m})} = \frac{1}{-3/5} = -\frac{5}{3}\text{D}$ **= –1.67 D**

14. A person cannot see clearly objects beyond a distance of 1.2 m. Name the defect of vision he is suffering from. What would be the power of correcting lens used to restore proper vision? **[2011 (T-II)]**

Ans. Name the defect of vision — myopia (short sightedness)

$u = -\infty$ (For normal eye)

$v = -1.2$ m

Now, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-1.2} - \frac{1}{-\infty} = -\frac{1}{1.2} + 0 = -\frac{1}{1.2}$

$\therefore$ Focal length of the required lens, $f = -1.2$ m

Thus, power of the lens, $P = \frac{1}{f\,(\text{in m})} = -\frac{1}{1.2}$ **= – 0.83 D**

–ve sign shows that lens is concave lens.

15. A person needs a lens of power –2.0 D for correcting his distant vision and lens of +1.5 D to correct his near vision. What is the focal length of the lens required for correcting

(i) distant vision (ii) near vision? **[2011 (T-II)]**

Ans. (i) Focal length of the lens, $f = \frac{1}{P} = \frac{1}{-2.0} = -0.5$ m **= –50 cm**

(ii) Focal length of the lens, $f = \frac{1}{P} = \frac{1}{1.5} = -0.67$ m **= 67 cm**

16. While sitting in the last row, a student has difficulty in reading the black board clearly. State the defect of vision the student is suffering from. Mention two causes of this defect. Suggest a suitable lens for the correction of this defect. **[2011 (T-II)]**

Ans. Defect of vision — myopia (short sightedness)

Two causes of this defect :

(i) Ciliary muscles get weak.

(ii) Eye ball gets elongated.

Suitable lens for the correction of this defect is concave lens.

Other Important Questions

1. (i) What is retina?

(ii) Name two important points on retina.

Ans. (i) Retina is a hemispherical screen formed by the nerve endings of the optic nerve, which is sensitive to light.

(ii) Two important points on the retina are (a) yellow spot, (b) blind spot

2. What is the function of the following in human eye?

(i) Yellow sport (ii) Choroid

Ans. (i) Yellow sport is situated at the centre of the retina. Its function is to form an extremely clear image.

(ii) It is a grey membrane lining the sclerotic. Its function is to darken the eye ball from inside so that no reflection takes place from its sides.

3. How does eye regulate the light entering into it?

Ans. The pupil regulates the light entering in the eye. If the light outside is very bright, then the muscles present in the iris relax and make the size of pupil very small with result small amount of light enters in the eye ball. Conversely, if the light is dim, the muscles contract and increase the size of the pupil.

4. (i) What is the least distance of distinct vision for normal eye?

(ii) Does the above distance increase or decrease for long-sighted eye?

Ans. (i) Least distance of distinct vision is 25 cm for a normal eye.

(ii) The least distance of distinct vision increases for a long-sighted person.

5. Name the kind of lens used for correcting

(i) myopic eye, (ii) hypermetropic eye.

Ans. (i) Concave lens is used for correcting myopic eye.

(ii) Convex lens is used for correcting hypermetropic eye.

6. Where do the parallel rays meet on passing through crystalline lens of :

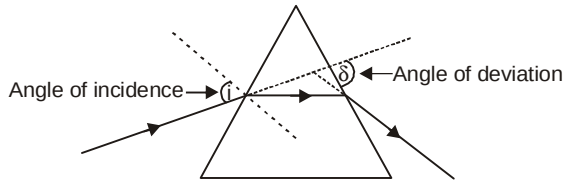
(i) long-sighted eye, (ii) short-sighted eye?

Ans. (i) In case of long-sighted eye, the parallel rays tend to meet behind the retina.

(ii) In case of short-sighted eye, the parallel rays tend to meet in front of the retina.

7. By drawing a neat labelled diagram, show the course of a ray of light through an equilateral glass prism show clearly the angle of incidence and angle of deviation.

Ans.



8. What is stropsis as applied to human eyes? Explain.

Ans. The phenomenon due to which we can judge the depth of distance of an object due to the positioning of our eyes few centimeters from each other is called stropsis.

As our eyes are separated by few centimeter, each eye receives an image which is slightly different. When these images are combined by the brain into one image, the sensation of depth is produced.

9. (i) In how many hours after the death of donor, the eyes should be removed?

(ii) What kind of persons cannot donate their eyes?

Ans. (i) The eyes should be removed within 4-6 hours after death.

(ii) People infected with AIDS, Hepatitis B and C, rabies, tetanus, etc cannot donate their eye.

10. Name all the colours of visible spectrum in the decreasing order of their wavelengths.

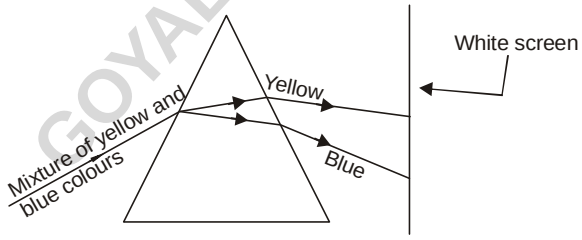
Ans. Red, orange, yellow, green, blue, indigo and violet.

11. Amongst the yellow, green and violet colours, which colour is likely to deviate : (i) least; (ii) most, when passed through and equilateral prism?

Ans. (i) Yellow colour will deviate least. (ii) Violet colour will deviate most.

12. A mixture of yellow and blue light is passed through an equilateral prism. Draw a neat diagram when the light emerges out of the prism.

Ans.



13. What is rainbow? How is rainbow formed?

Ans. A band of seven colours formed in the sky just after the rain is called rainbow. The rainbow is caused because the tiny droplets of water suspended in air disperse white light.

14. Explain, why sky appears dark on the surface of Moon?

Ans. The sky will appear blue only, if there is an atmosphere around the heavenly body. As there is no atmosphere around the Moon, therefore, no scattering of lights takes place, and hence, sky appears dark.

15. Why is no rainbow formed on the Moon?

Ans. The rainbow is formed only, if the atmosphere contains large number of tiny droplets of water suspended in the air. As the Moon has neither atmosphere nor water, therefore, no rainbow is formed.

16. Why do the faces of persons sitting opposite to you around a camp fire appear to shimmer?

Ans. This happens due to the refraction of light. The rays of light reflected from the face of a person, sitting opposite to you, on passing through the hot air (produced by the burning of wood), get refracted. Since the air is rapidly moving and its optical density is continuously changing, therefore, the part of refracted rays passing through it also changes. This gives rise to shimmering effect.

17. Why is the sunlight reaching the earth, yellowish?

Ans. When the white light (coming from Sun) passes through upper atmosphere, the violet, indigo and blue colours scatter. However, after the scattering of these colours the white light is deficient of violet, indigo and blue. Thus, it appears yellowish instead of white.

18. Why does the Sun appear yellowish?

Ans. When the violet, indigo and blue colours, scatter in the upper atmosphere, the resultant sunlight is yellowish in colour. When our eyes received this sunlight, to us the Sun appears yellowish.

19. Why does the smoke coming out of coal fired chimney appear blue on a misty day?

Ans. The tiny particles of carbon and moisture in the smoke scatter blue colour of white light in all possible directions. When this scattered blue light reaches our eyes, the smoke appears blue.

20. Why is red light used as universal danger signal?

Ans. The red light has the longest wavelength amongst the spectral colours and hence is least scattered by the atmosphere. Thus, red light can easily pass through fog or mist, without getting scattered and hence is visible from a long distance. Thus, it is used as universal danger signal.

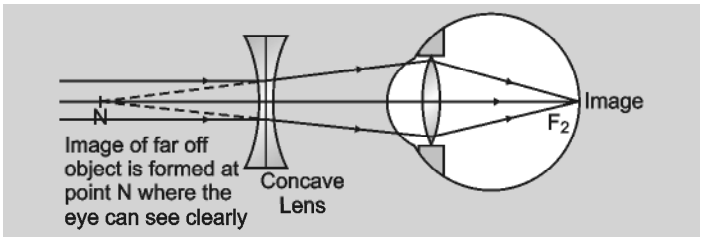
C. Short Answer Questions-II [3 Marks]

Previous Years' Questions

1. A person cannot see objects farther than 12 m from the eye clearly. Name the, defect of vision he is suffering from and the lens that should be used for correction of this defect. Illustrate with the help of a diagram, how this lens will correct the defective vision. **[2011 (T-II)]**

Ans. Name the defect of vision — myopia (short sightedness).

Lens used for correction of this defect – concave lens.



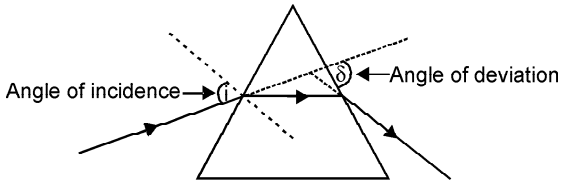
To enable such a person see the objects situated at infinity, a concave lens is used, so that the image of the object is formed at the far-off point of clear vision. The focal length of concave lens depends upon the degree of abnormality in the eye.

2. (a) Define dispersion of light.

(b) Draw a ray diagram to show the path of a light ray that enters the glass prism obliquely. Label on it the angle of incidence and angle of deviation. **[2011 (T-II)]**

Ans. (a) The phenomenon due to which a white light splits in to its component colours, when passed through a prism is called dispersion.

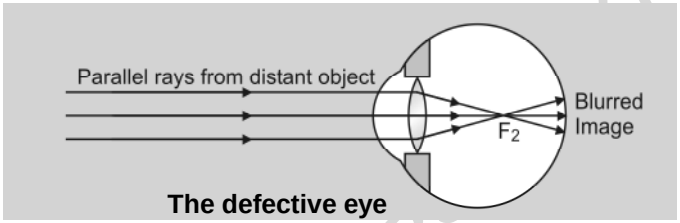
(b)



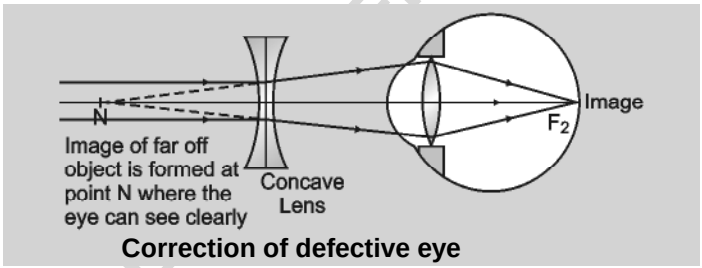
3. A person wears spectacles of power – 2.5 D. Name the defect of vision he is suffering from. Draw the ray diagram for (i) the defective eye (ii) its correction. **[2011 (T-II)]**

Ans. Name the defect of vision – myopia (short sightedness)

(i)



(ii)

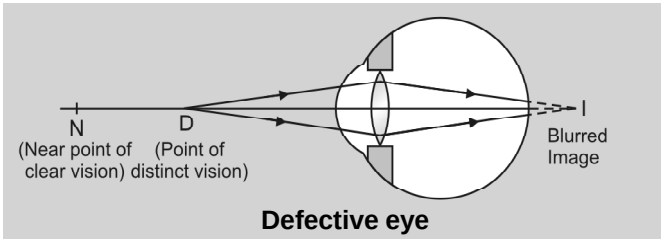


4. A person cannot read a book at distances less than 50 cm. Name the defect of vision he is suffering from. How can it be corrected? Draw ray diagrams to show the image formation (i) by defective eye and (ii) after using corrective lens. **[2011 (T-II)]**

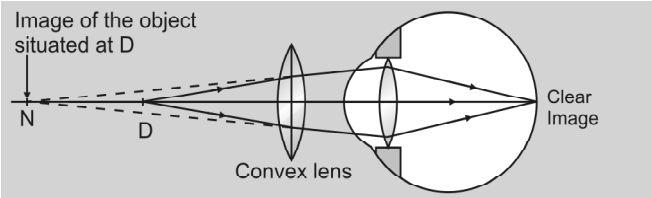
Ans. Name the defect of vision – Hypermetropia (Far sightedness).

By using convex lens of appropriate focal length it can be corrected.

(i)



(ii)



After using corrective lens

5. A person cannot see objects less than 40 cm from his eyes clearly. Name the defect of vision he is suffering from. Calculate the power of the lens he should use to read a book at 25 cm distance from his eyes. Draw a ray diagram for correction of the defect using the lens.

[2011 (T-II)]

Ans. Name of the defect of vision – hypermetropia

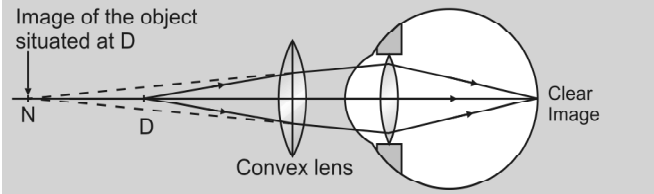
u = –25 cm (For normal eye)

v = – 40 cm

Now, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = -\frac{1}{40} - \frac{1}{-25} = \frac{-5+8}{200} = \frac{3}{200}$

$\therefore$ Focal length of the lens = $\frac{200}{3}\text{cm} = \frac{200}{3} \times \frac{1}{100}\text{m} = \frac{2}{3}\text{m}$

Thus, power of the lens, P = $\frac{1}{f\,(\text{in m})} = \frac{1}{2/3}\text{D} = \frac{3}{2}\text{D} = 1.5\text{ D}$



Correction of the defect using the lens

6. The near point of a person suffering from hypermetropia is 75 cm. Calculate the focal length and power of the lens required to enable him to read the newspaper which is kept at 25 cm from the eye. **[2011 (T-II)]**

Ans. u = –25 cm (For normal eye)

v = –75 cm

Now, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-75} - \frac{1}{-25} = \frac{-1+3}{75} = \frac{2}{75}$

Thus, focal length of the lens, f = $\frac{75}{2}\text{cm} = \frac{75}{2\times100}\text{m} = \mathbf{\frac{3}{8}m}$

Power of the lens, P = $\frac{1}{f\,(\text{in m})} = \frac{1}{3/8} = \frac{8}{3}\text{D}$ **= 2.67 D.**

7. (i) When white light is incident on a glass prism surface it splits into constituent colours, Why?

(ii) Write the colours in the order as they appear in the spectrum.

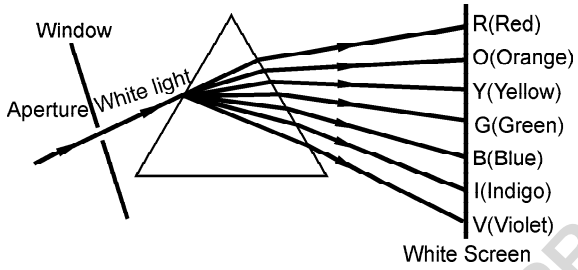
(iii) Draw a ray diagram to show dispersion of white light as it passes through a glass prism.

[2011 (T-II)]

Ans. (i) The refractive index of the material of prism is different for different colours of light, therefore when white light incident on a glass prism surface, it splits into its constituent colours.

(ii) The colours in the order from bottom to top as they appear in the spectrum are violet, indigo, blue, green, yellow, orange and red respectively.

(iii)



Other Important Questions

1. How does normal eye achieve accommodation?

Ans. In order to focus far-off objects, the ciliary muscles relax, and in doing so, increase the curvature and focal length of the crystalline lens. Thus, the image of far-off object is clearly focussed on the retina, which is at the principal focus of crystalline lens.

Conversely, to focus near objects, the ciliary muscles contract and in doing so, decrease the curvature and hence, focal length of crystalline lens. Thus, the images of objects, nearer to the eye are clearly focussed on the retina, which is between F and 2F of crystalline lens.

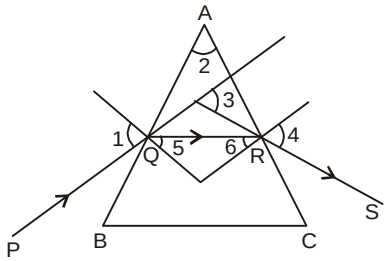
2. The given diagram shows the path of a ray of light through an equilateral prism. Answer the following questions :

(i) Which is the refracted ray? (ii) Which is the emergent ray?

(iii) What name is given to angle 1? (iv) What name is given to angle 3?

(v) What name is given to angle 5?

(vi) What is the relation between angles 1, 2, 3 and 4?



Ans. (i) QR is the refracted ray. (ii) RS is the emergent ray.

(iii) Angle 1 is called angle of incidence. (iv) Angle 3 is called angle of deviation.

(v) Angle 5 is the angle of refraction on face AB.

(vi) $\angle 2 + \angle 3 = \angle 1 + \angle 4$.

3. What is vitreous humour? Where is it found in the eye ball? State two function of vitreous humour.

Ans. Vitreous humour is a dense, jelly like fluid, slightly gray in colour and transparent to light. It is found in posterior part of the eye ball.

Functions :

(i) It prevents the posterior part of eye ball from collapsing due to change in atmospheric pressure.

(ii) It practically helps in focussing the image clearly on the retina.

4. What is aqueous humour ? Where is it found in the eye ball? State its two functions.

Ans. Aqueous humour, is a saline, watery fluid, transparent in nature. It fills in anterior part of the eye between the cornea and eye lens.

Functions :

(i) It prevents the anterior part of eye ball from collapsing due to the change in atmospheric pressure.

(ii) It keeps the cornea moist and prevents it from shrivelling.

5. Why can't we see clearly when we enter a dimly lit room from bright sunlight?

Ans. The pupil in the eye acts as a variable aperture whose size is increased or decreased by the muscles present in the iris. When the light is bright, the iris muscles decrease the size of aperture of the pupil. This allows less light to enter in the eye ball.

However, in dim light the iris muscles take few seconds to increase the aperture of the pupil, so that more light could enter the eye ball. It is this small interval of time in which you cannot see clearly.

6. Why does sun appear bigger during sunset or sunrise?

Ans. The atmosphere consists of a number of layers of air of varying densities, such that the densest layer is close the surface of earth and rarest layer far away from the surface of the earth.

The rays of light coming from the heavenly bodies such as Sun, Moon and stars on passing through the atmosphere, bend towards the normal and hence when they reach the eye, then the heavenly bodies appear at some other point than their actual position and also closer to the earth.

During sunset or sunrise, the rays coming from the Sun pass through maximum depth of atmosphere and hence suffer maximum refraction. Thus, the apparent image of the Sun is formed very close to the earth. Thus, the Sun appears bigger, during sunrise or sunset.

7. How does atmospheric refraction increases the light of day time?

Ans. When the Sun is below the horizon early in the morning, the rays of light coming from it, on passing through atmosphere bend inward, i.e., towards the normal and hence manage to reach earth. This results in formation of dawn.

It has been found that Sun is visible to us 2 minutes before the actual sunrise and 2 minutes after the actual sunset on account of refraction. Thus, the formation of twilight (during dawn and dusk) and appearance of Sun 2 minutes earlier during sunrise and 2 minutes latter during sunset increase the light of day time.

8. Why does sky appear blue? Explain.

Ans. When the white light coming from the Sun passes through the atmosphere, the violet, indigo and blue wavelength in it encounter suspended particles in air whose diameter is more than their wavelengths. Thus, these waves are absorbed and then scattered in all possible directions. The scattered light form these particles, suspended all around in the sky reach our eyes and hence the sky appears blue.

9. Why do the distant hills covered with trees appear blue?

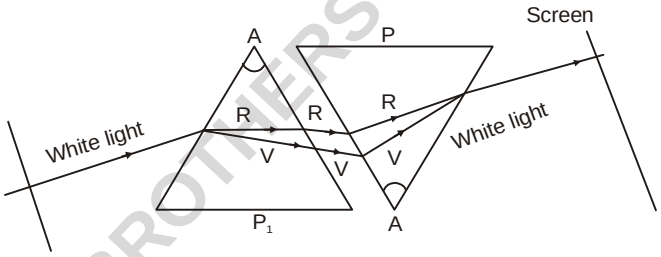
Ans. In the thick growth of trees on the hills there is always present tiny droplets of water in air. When the white light passes through moisture laden air, the blue light is scattered. When this scattered blue light reaches our eyes, the hills appear blue.

10. Why do motorists use orange lights, rather than normal white light on a foggy day?

Ans. If a motorist uses normal white light while driving in fog, then tiny droplets of water in air scatter large amount of blue light. This scattered blue light on reaching the eyes, decreases visibility and hence driving becomes extremely difficult. However, when orange lights are used, they do not get scattered on account of their longer wavelengths. Thus, the driver can see clearly in the fog.

11. 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. **[HOTS]**

Ans. By using two identical prisms, one placed inverted with respect to the other.



D. Long Answer Questions [5 marks]

Previous Years' Questions

1. A person cannot see the objects distinctly, when placed at a distance less than 50 cm.

(a) Identify the defect of vision.

(b) Give two reasons for this defect.

(c) Calculate the power and nature of the lens he should be using to see clearly the object placed at a distance of 25 cm from his eyes.

(d) Draw the ray diagrams for the defective and the corrected eye. **[2011 (T-II)]**

Ans. (a) Hypermetropia (Long-sightedness)

(b) Two reasons for this defect

(i) Ciliary muscles become stiff.

(ii) Eye ball becomes smaller in size.

(c) $u = -25$ cm, $v = -50$ cm, f = ?

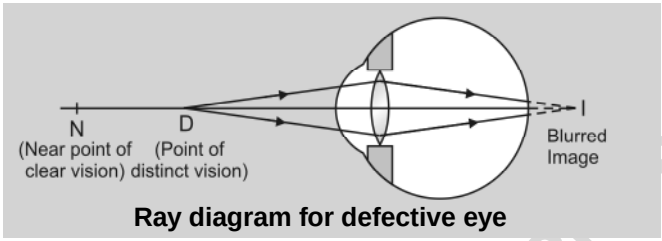
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-50} - \frac{1}{-25} = \frac{-1+2}{50} = \frac{1}{50}$$

$$\therefore \quad f = 50 \text{ cm} = \frac{50}{100}\text{m} = \frac{1}{2}\text{m}$$

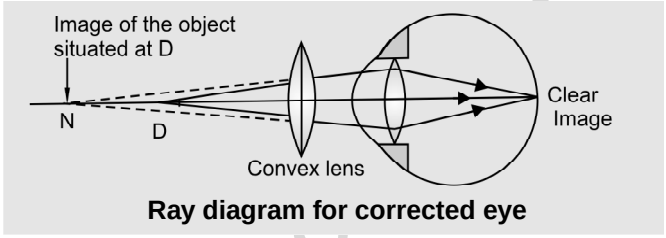
Thus, Power of the lens, P = $\frac{1}{f\,(\text{in m})} = \frac{1}{1/2}$ **= 2D**

The convex lens having power of 2D is used for this correction.

(d)



Ray diagram for defective eye



Ray diagram for corrected eye

2. A person cannot see the objects distinctly, when placed beyond 2 m.

(a) Identify the eye defect.

(b) Give two reasons for this defect.

(c) Calculate the power and nature of the lens he should be using to see the distant objects clearly.

(d) Draw the ray diagrams for the defective and the corrected eye. **[2011 (T-II)]**

Ans. (a) Myopia (Short-sightedness)

(b) Two reasons for this defect

(i) Ciliary muscles get weak.

(ii) Eye ball gets elongated.

(c) In this case,

$u = -\infty$, $v = -2$ m, f = ?

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-2} - \frac{1}{-\infty} = -\frac{1}{2} + 0 = -\frac{1}{2}$$

$\therefore$ $f = -2$ m,

Thus, power of the lens, $P = \frac{1}{f\,(\text{in m})} = \frac{1}{-2}$ **= –2 D**

The concave lens having power of –2D is used for this correction.

(d)

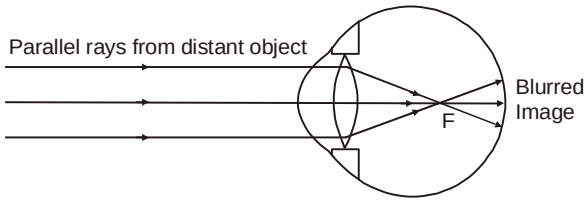


Diagram for the defective eye.

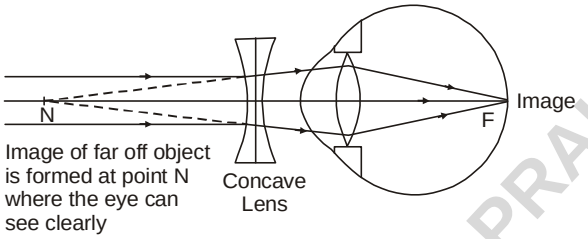


Diagram for the corrected eye.

3. (a) What is Myopia? State two causes of Myopia. With the help of a labelled ray diagram show the correction of Myopia using appropriate lens.

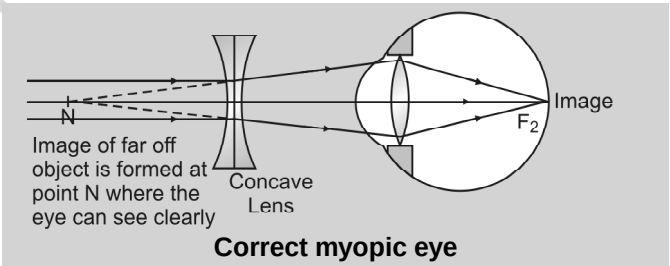
(b) The near point of a hypermetropic eye is 1 m. Find the power of the lens required to correct this defect. Assume that near point of the normal eye is 25 cm. **[2011 (T-II)]**

Ans. (a) Myopia : A person suffering from this defect can see nearer objects clearly, but cannot see the far-off objects clearly.

Two causes of myopia :

(i) The ciliary muscles get weak.

(ii) The eye ball gets elongated.



Correct myopic eye

(b) For the correction of hypermetropic eye,

$u = -25$ cm, $v = -1$ m $= -100$ cm, f = ?

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = -\frac{1}{100} - \frac{1}{-25} = \frac{-1+4}{100} = \frac{3}{100}$$

$$\therefore f = \frac{100}{3}\text{cm} = \frac{100}{3\times100}\text{m} = \frac{1}{3}\text{m}$$

Power of the lens, $P = \frac{1}{f\,(\text{in m})} = \frac{1}{1/3}$ **= 3D**

Thus, convex lens having power of 3D is used for the correction of hypermetropic eye.

4. A student finds the writing on the black board as blurred and unclear when sitting on the last desk of the class room. He however sees clearly when sitting on the front desk of an approximate distance 2 m from the black board.

(a) Draw the ray diagram to illustrate the formation of image of the black board writing by his eye lens when he sits at the :

(i) last desk (ii) front desk

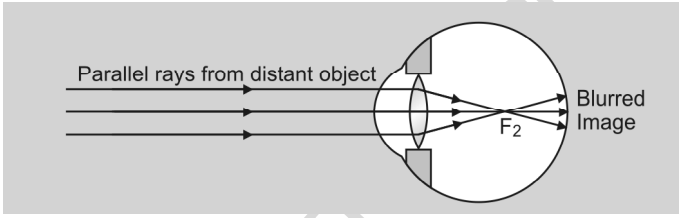
(b) Name the defect of vision the student is suffering from. Also list two causes of this defect.

(c) Name the kind of lens that would enable him to see clearly when he is seated at the last desk. Draw the ray diagram to illustrate how this lens helps him to see clearly.

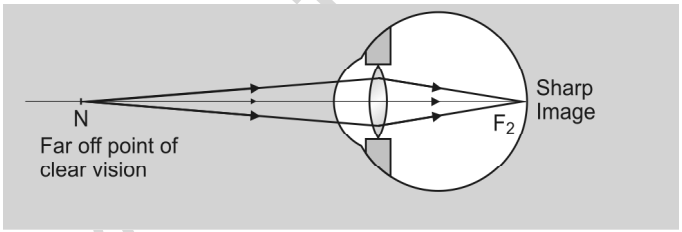
[2011 (T-II)]

Ans. (a)

(i)



(ii)

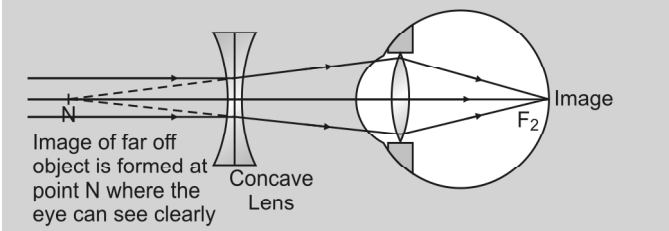


(b) Defect of vision — myopia (Short-sightedness)

Two causes of this defect :

(i) Ciliary muscles get weak. (ii) Eye ball gets elongated.

(c) Concave lens is used for the correction of myopic eye (seated at last desk)



Correct myopic eye

5. (i) What is meant by dispersion of light?

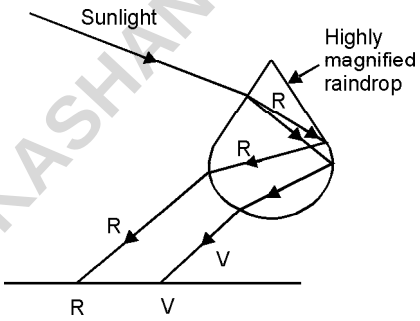
(ii) Describe the formation of rainbow in the sky.

(iii) What is meant by accommodation of eye? Name the part of eye which helps in this phenomenon and state how does it help. **[2011 (T-II)]**

Ans. (i) Dispersion of light : The phenomenon due to which a white light splits into its component colours, when passed through a prism.

White light is combination of seven different colours of light having different wavelengths. More is the wavelength of light, less is the angle of deviation for the same material and same angle of incidence. This is caused of dispersion of white light.

(ii) The rainbow is produced due to the dispersion of sunlight by tiny droplets of water suspended in air, just after rain.



From the figure when the sunlight is incident on the side A of the droplet of water, it gets refracted as well dispersed. The dispersed rays on striking the surface B of tiny droplets, suffer total internal reflection and moves towards surface A, the rays further suffer refraction and emerge out as the band of colours in the form of a circular arc (rainbow) along the horizon. The red colour appears upper arc and violet colour on the innermost arc of the rainbow.

(iii) Accommodation of eye : The phenomenon by which the ciliary muscles alter the focal length of the crystalline lens, so as to focus nearer or far-off objects clearly on the retina is called accommodation of the eye.

In order to focus at far-off objects, the ciliary muscles relax to make crystalline lens thin and its focal length increases. In order to focus nearer objects, ciliary muscles contract to make crystalline lens thick and its focal length decreases.

Other Important Questions

1. (i) State two causes of myopic vision.

(ii) By drawing two diagrams show :

(a) How an uncorrected myopic eye sees far-off objects?

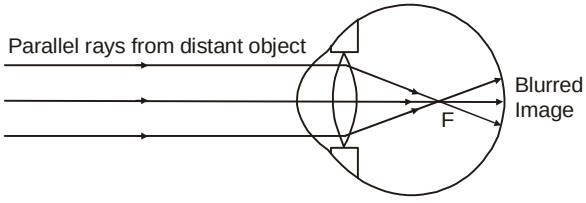
(b) How does a corrected eye sees far-off objects?

Ans. (i) **Causes of myopic eye :**

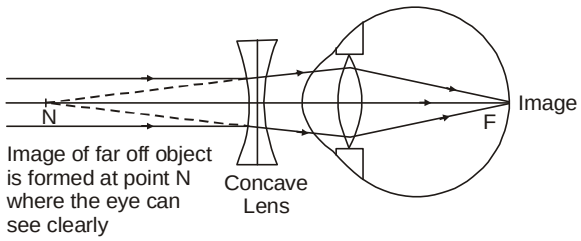
(a) Due to age or disease, the ciliary muslces weaken and do not increase focal length of crystalline lens.

(b) The eye ball gets elongated and hence the image is formed in front of retina.

(ii) (a)



(b)



2. (i) State two causes of hypermetropic vision

(ii) By drawing two diagrams show :

(a) How an uncorrected hypermetropic eye sees objects at the least distance of distinct vision?

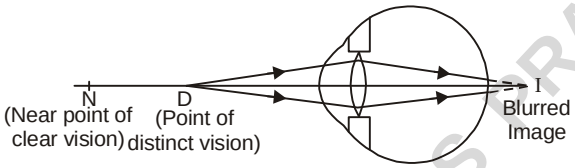
(b) How does corrected eye sees objects at the least distance of distinct vision?

Ans. (i) **Causes of hypermetropic vision:**

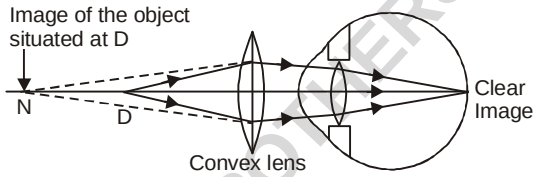
(a) Due to some disease, the ciliary muscles get stiff and do not decrease the focal length of crystalline lens.

(b) The eye ball gets shortened, and hence, the image is formed behind the retina.

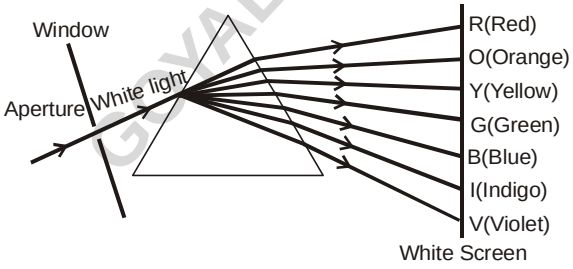
(i) (a)



(ii) (b)



3. A ray of white light passes through an equilateral prism and breaks up into component colours. Draw a neat ray diagram to show the path of rays and state which colour : (i) deivates least, (ii) deivates most.



Ans.

(i) Red colour deviates the least (ii) Violet colour deivates the most.

4. Given an explanation of dispersion of light.

Ans. When the rays of light of different colour, and hence different wavelengths pass through the prism, they deviate through different angles. The light of larger wavelength deviates through small angle, whereas the light of smaller wavelength deviates through larger angle. Thus, when white light is incident on the face of a prism, the waves of different wavelengths (colours)

deviate through different angles and in the process get dispersed. While passing out from the opposite face of the prism they do not suffer any dispersion, but suffer refraction.

5. (i) When is a rainbow formed in the sky?

(ii) Relative to the position of the Sun in which direction rainbow is formed?

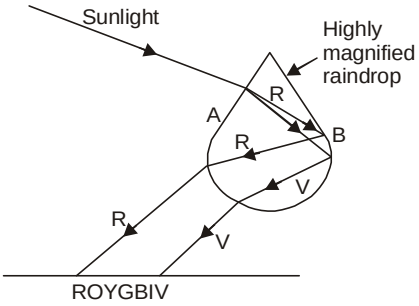
(iii) Draw ray diagram to show how a droplet of water produces a rainbow.

(iv) Which colour is on the outer arc of rainbow?

Ans. (i) Rainbow is formed just after the rain when a bright Sun appear in the sky.

(ii) The rainbow is formed in the direction, opposite to the direction of the Sun.

(iii)



(iv) Red colour is on the outer arc of the rainbow.

6. By giving reasons state your observations when a parallel beam of white light :

(i) is passed through by hypo-solution and then focussed on a white screen

(ii) is passed through hypo-solution (to which few drops of sulphuric acid is added) and then focussed on a white screen.

Ans. (i) The path of white light is not visible in the hypo-solution. The beam focuses on the white screen as a bright white spot.

Reason : The white light does not get scattered because the size of particles in the hyposolution is too small compared to the wavelengths in white light.

(ii) (a) In 2-3 minutes, after the addition of sulphuric acid, the sides of container start emiting blue light.

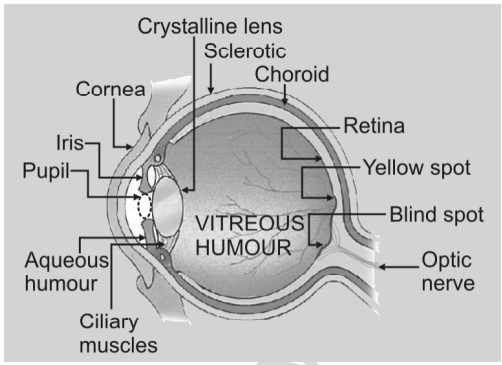
(b) The light coming out of the container is initially orange, then red and focusses on the screen. This light gradually changes to crimson red.

Reason : The sulphuric acid reacts with hyposolution to form colloidal sulphur. Initially these sulphur particles are very small and hence scatter blue light. Thus, the deficient light passing out of the container is orange in colour. However, as the reaction proceeds, more and more colloidal particles of sulphur are formed. These sulphur particles then join to form bigger sulphur particles. These bigger particles scatter red colour and hence the light coming out of the container is crimson red.

7. Explain the structure and functioning of Human eye. How are we able to see nearby as well as distant objects? **[HOTS]**

Ans. The human eye is almost a ***spherical ball with a slight bulge in the front part.*** The structure and function of each part of the eye is discussed below :

(i) Sclerotic : It is the outermost covering of the eye. It consists of white tough fibrous tissue. ***Its function is to protect and contain the vital internal parts of the eye.***



(ii) Cornea : It is the front bulging portion of the eye. It is made of *transparent tissues* and contains *no blood vessels*. ***Its function is to act as a window to the world,*** i.e., to allow the light to enter the eye ball.

Most of the refraction of light takes place while passing through cornea.

(iii) Choroid : It is a grey membrane attached to the sclerotic from the inner side. ***Its function is to darken the eye from inside, and hence, prevent any internal reflection.***

(iv) Optic nerve : It is a bundle of approximately 70,000 nerves originating from the brain and entering the eye ball from the posterior side. The left eye receives optic nerves from the right side of the brain and the right eye from the left side of the brain. ***Its function is to carry the optical messages to the brain.***

(v) Retina : The optic nerve on entering the eye ball, spreads like a canopy and each nerve attaches itself to the choroid. The nerve endings form a kind of hemispherical screen called retina. The nerve endings are sensitive to light. Thus, any image formed on the retina is converted into optical impulses, which are then sent to the brain. The retina has two very important regions, which are called the yellow spot and the blind spot. ***The function of the retina is to receive the optical image of an object and then convert it into electrical pulses which are finally sent to the brain through the optic nerve.***

(vi) Yellow spot : It is situated at the centre of the retina and is slightly raised. It has a little depression called ***Fovea-Centralis,*** which is extremely sensitive to light. ***Its function is to form an extremely clear image,*** i.e., when we want to examine an object very minutely, its image is brought to focus at this point.

(vii) Blind spot : The region on the retina, where the optic nerve enters the eye ball is called the blind spot. It has no nerve endings, and hence, is insensitive to the light. ***Apparently it has no function. Any image formed at this spot is not visible.***

(viii) Crystalline lens : It is a double convex lens, more bulging on the posterior side. It is made of transparent, flexible tissues. It is held in position by a ring of muscles, commonly called ciliary muscles. It divides the eye ball into two unequal parts. The front part of the eye is called the ***anterior portion*** and the rear part is called the ***posterior portion. Its function is to focus the images of the objects at different distances, clearly on the retina.***

The crystalline lens merely provides the fine adjustments in focal length, so that objects at different distances are clearly focussed on the retina.

(ix) Ciliary muscles : It is a ring of muscles, which along with the suspensory ligament, holds the crystalline lens in position. When these muscles contract, they decrease the focal length of the crystalline lens. Similarly, when these muscles relax, they increase the focal length of the crystalline lens.

Its function is to alter the focal length of the crystalline lens, so that the image of the objects at various distances is clearly focussed on the retina.

(x) Iris : It is a circular contractile diaphragm, suspended in front of the crystalline lens. It has a tiny hole in the middle, commonly called the **pupil.** The diaphragm has tiny muscles arranged radially and is heavily pigmented. The colour of the eye depends upon the colour of the pigment.
Its function is to control the amount of light entering the eye. This is achieved by the muscles present in the diaphragm. When the muscles contract, they increase the size of the pupil, thus allowing more light to enter the eye and vice-versa.

(xi) Vitreous humour : It is a dense, jelly like fluid, slightly grey in colour, filling the posterior part of the eye ball. It has the following functions :
(a) It prevents the eye ball from collapsing, due to the changes in the atmospheric pressure.
(b) It partially helps in focussing the image clearly on the retina.

(xii) Aqueous humour : It is a watery, saline fluid, filling the anterior portion of the eye. It has the following functions :
(a) It prevents the anterior portion of the eye from collapsing, due to change in the atmospheric pressure.
(b) When we wink our eyes, a tiny drop of the aqueous humour flows out from the side of the eye. Then it washes the eye and keeps the cornea moist. Otherwise, the cornea will shrivel and become opaque.

We can see nearby as well as distant object by altering the focal length of crystalline lenes with the help of ciliary muscles. This process is called accommodation of the eye.

8. 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. When a person is not able to see distant objects clearly but can see nearby objects clearly then he is considered to be myopic. If it is otherwise, he is hypermetropic.

Correction of short-sighted eye : A short-sighted person can see clearly to some distance (say 4 m). Beyond this distance, the images get blurred. The farthest point from which a short-sighted person can see clearly is called ***far-off point of clear vision***. To enable such a person see the objects situated at infinity, we must use some lens, so that the image of the object is formed, at the *far-off point of clear vision*. Generally, the lens used is a ***concave lens*** and its focal length depends upon the degree of abnormality in the eye.

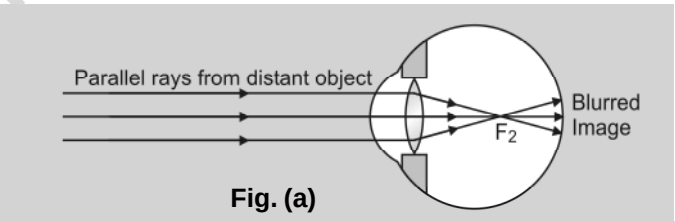


Fig. (a)

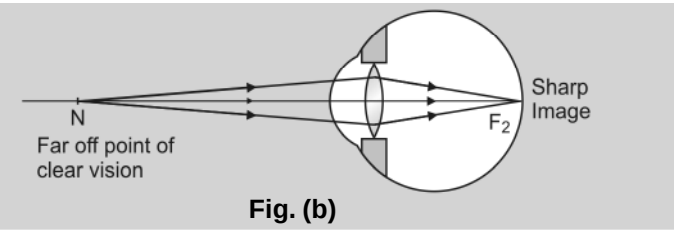


Fig. (b)

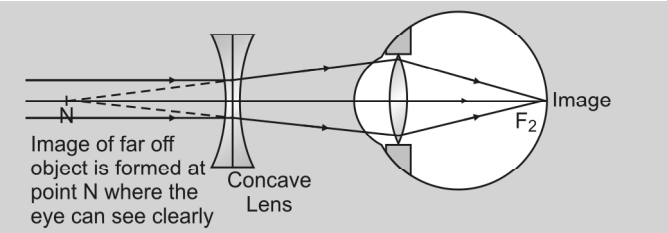


Fig. (c)

Figures given alongside show how short-sightedness can be corrected with the help of a concave lens.

Fig. (a) shows a defective short-sighted eye when the image of a far-off object is formed in front of the retina.

Fig. (b) shows a defective short-sighted eye when the object is situated at the far-off point of clear vision.

Fig. (c) shows a corrected short-sighted eye when image of a distant object is formed at the far-off point of clear vision.

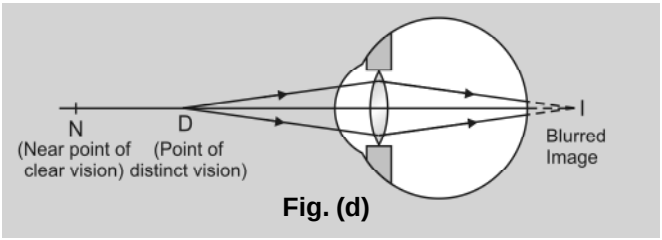


Fig. (d)

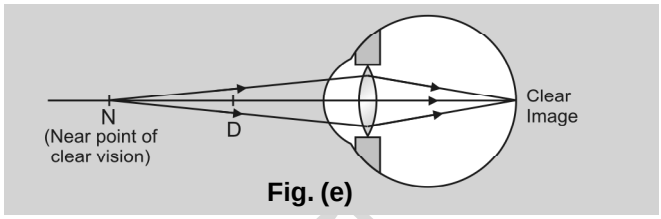


Fig. (e)

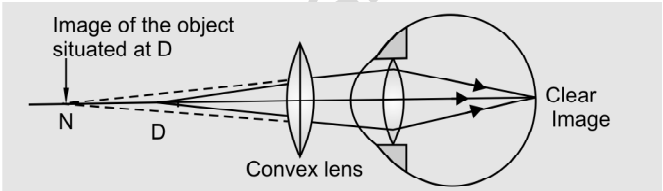


Fig. (f)

Correction of long-sightedness : A long-sighted person can see a near object clearly, if it is held at some distance away from the point of distinct vision (say 75 cm). This minimum distance from which a person can see clearly is called the ***near distance of clear vision.***

To enable such a person to see from a distance of 25 cm, a lens must be used, such that it forms the image of the object at the ***near distance of clear vision***. Generally, the lens used is convex lens. The focal length of the lens used, depends upon the abnormality in the eye length. Fig. (d) shows a defective long-sighted eye when the object is situated at the point of distinct vision and its image is formed behind the retina. Fig. (e) shows a defective long-sighted eye when the object is situated at the near point of clear vision and its image is clearly formed on the retina. Fig. (f) shows a corrected long-sighted eye when the convex lens forms the image at the point of clear vision.

9. Name the four common defects of vision and state the cause of each defect. A person cannot see distinctly objects placed beyond 2 metres. State the nature and focal length of the lens which could be used to correct this defect.

Ans. (a) **Myopia or near-sightedness**

Cause : This defect is either due to the weakening of ciliary muscles which do not increase the focal length of crystallline lens or due to elongation of eye ball.

(b) **Hypermetropia or far-sighedness**

Cause : This defect is either due to the stiffness of ciliary muscles which do not decrease focal length of crystalline lens or due to shortening of the eye ball.

(c) **Presbyopia**

Cause : This defect arises due to the gradual weakening of the ciliary muscles and diminishing flexibility by the crystalline lens.

(d) **Astigmatism**

Cause : This defect is usually due to the cornea that is not perfectly spherical.

Given far point of the defective eye (v) = – 2m

Distance of the object from eye (u) = $-\infty$

Focal length of the corective lens (f) = ? (To be calculated)

Now , $\frac{1}{f}=\frac{1}{v}-\frac{1}{u} \Rightarrow \frac{1}{f}=\frac{1}{-2}-\frac{1}{-\infty}=-\frac{1}{2}$ or f = **–2m**

Thus, a concave lens of focal length 2 m should be used as corrective lens so as to restore proper vision.

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

(a) Myopia (b) Astigmatism (c) Bifocal lenses (d) Far sightedness

(ii) Describe with a ray diagram how a person with myopia can be helped by spectacles

Ans. (i) (a) **Myopia :** Myopia is a defect in which a person can see the nearer objects clearly, but cannot see the far-off objects clearly. This defect can be corrected by using concave lens of appropriate focal length.

(b) **Astigmatism :** Astigmatism is a defect. This defect is usually due to the cornea that is not perfectly spherical. This defect can be corrected by using cylindrical lens.

(c) **Bifocal lenses :** Bifocal lens is a lens in which both concave and convex lenses are combined . Bifocal lens is used to overcome **presbyopia** defect.

(d) **Far-sightedness :** Far-sightedness or hypermetropia is a defect in which a person can see far-off objects clearly, but cannot see clearly the objects situated at a distance of 25 cm or at the distance of distinct vision. This defect can be corrected by using convex lens of appropriate focal length.

(ii)

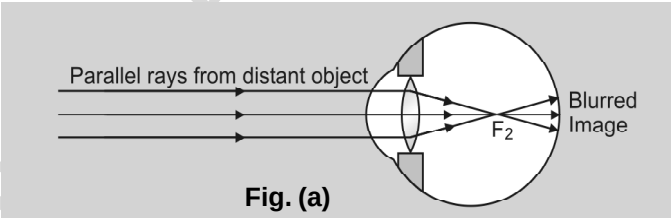


Fig. (a)

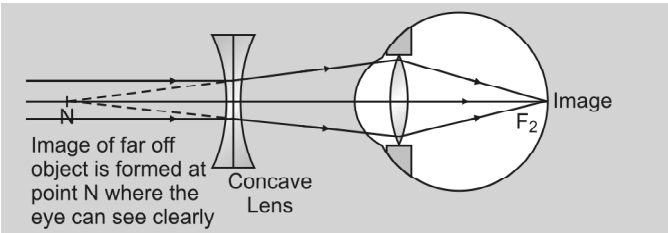


Fig. (b)

11. What is long-sightedness? List two causes for development of long-sightedness. Describe with the ray diagram, how this defect may be corrected by using spectacles.

Ans. **Long-sightedness :** Long-sighteness is a defect in which a person can see clearly the far-off objects but cannot see clearly the nearer objects.

Causes : (i) Due to some diseases, the ciliary muscles get stiff and do not decrease the focal length of crystalline lens.

(ii) The eye ball gets shortened, and hence, the image is formed behind the retina.

Correction of long-sightedness : A long-sighted person can see a near object clearly, if it is held at some distance away from the point of distinct vision (say 75 cm). This minimum distance from which a person can see clearly is called the ***near distance of clear vision.***

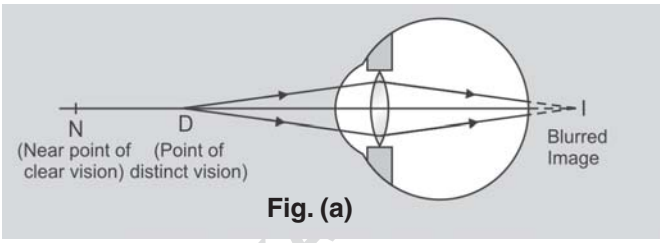


Fig. (a)

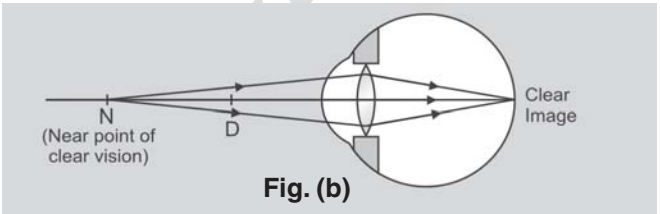


Fig. (b)

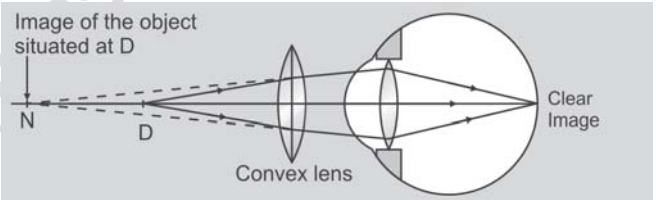


Fig. (c)

To enable such a person to see from a distance of 25 cm, a lens must be used, such that it forms the image of the object at the ***near distance of clear vision***. Generally, the lens used is convex lens. The focal length of the lens used, depends upon the abnormality in the eye length. Fig. (a) shows a defective long-sighted eye when the object is situated at the point of distinct vision and its image is formed behind the retina. Fig. (b) shows a defective long-sighted eye when the object is situated at the near point of clear vision and its image is clearly formed on the retina. Fig. (c) shows a corrected long-sighted eye when the convex lens forms the image at the point of clear vision.

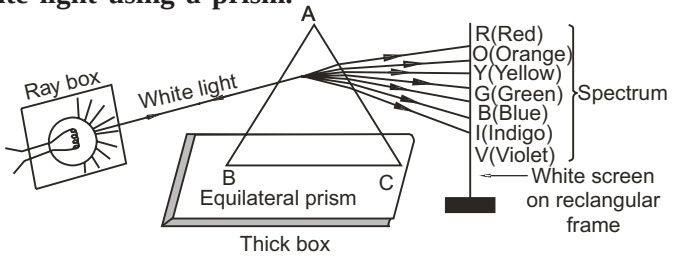
II. FORMATIVE ASSESSMENT

A. Demonstrations

1. Objective : To obtain spectrum of white light using a prism.

Materials Required :

A ray box fitted with 100 W bulb, an equilateral glass prism, a white sheet of paper mounted on a rectangular frame, a thick box.



Procedure :

1. Close the doors, windows and ventilators of the laboratory so as to create dark room. Switch on an electric bulb for working.
2. Place the equilateral glass prism in the middle of thick box lying flat on the table.
3. Place the ray box forward the side AB of the prism. In case ray box is not available you can make one, by facing an electric bulb in a cardboard box and making a pinhole on the side of facing the bulb.
4. Switch off laboratory light. Switch on ray box's bulb. You will find on side AC a spectrum is formed. In case spectrum is not seen, adjust the screen so that it falls on screen.

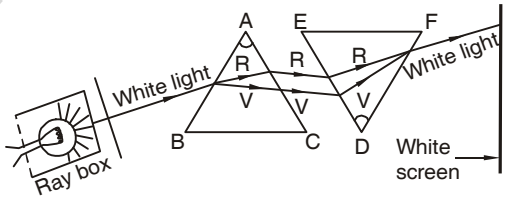
Conclusion :

1. White light on passing through prism splits into seven colours.
2. The seven colours are in the order of VIBGYOR, where 'V' stands for violet, 'I" for indigo 'B' for blue, 'G' for green, 'Y' for yellow, 'O' for orange and 'R' for Red.
3. The red colour bends least and violet colour bends most.
4. The phenomenon of splitting white light is called dispersion of light, whereas the band of seven colour is called spectrum.

2. Objective : To show dispersed colours of white light recombine to form white light.

Procedure :

Obtain the spectrum as explained in demonstration 1. Interpose another equilateral prism DEF in inverted position. You will notice that a small dot of white light is formed on the screen.



B. Activities

Activity 1

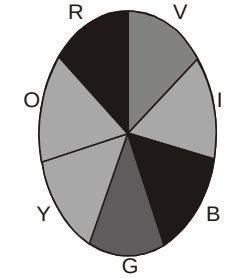
To show spectral colours can be recombined to form white light.

Materials required :

A wooden spinning wheel, glazed coloured papers of red, orange, yellow, green, blue, indigo and violet colours, scissors and glue.

Procedure :

1. With help of pencil, divide the top surface of spinning wheel into seven segments.
2. Cut strips of VIBGYOR from glazed papers with the help of scissors and paste them on the spinning wheel in the order of spectral colour.
3. Spin the spinning wheel as fast as you can. You will notice that seven colours disappear and instead a dull white colours is seen. The colour will reappear when the spinning wheel stops spinning.



Wooden spinning wheel

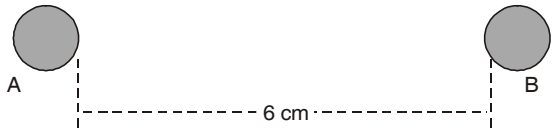
Activity 2

To find blind spot of your eye.

Materials required : **A stiff white card board, coloured pens, a scale.**

Procedure :

1. Paint a blue spot A on the stiff card board.
2. Measure a distance of 6 to 8 cm and paint red spot B.



3. Hold the stiff cardboard at arm's length from your face. Look at blue spot closely. You will find both blue and red spots are visible.
4. Now close your left eye and focussing on blue spot move stiff cardboard slowly towards your face.
5. You will find at same point the red spot disappears.

   This is the blind spot of your eye. The rays coming from red spot fall on that part of retina that is not senstive to eye and hence is blind spot.

Activity 3

To show binocular vision is essential for judging distances.

Materials required : Two sharp pencils

Procedure :

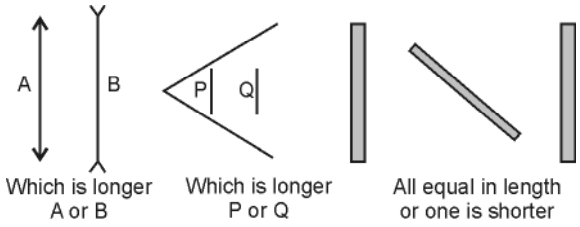
1. Hold one pencil in your left hand and a second pencil in your right hand.
2. Close one of your eyes, say the left eye.
3. Keeping the pencils at arm's length try to make the two pencil points to touch. You will find you fail to do so.
4. Repeat the activity with both eyes open. You will find you easily succeed in making the points to touch.

   Having two eyes open allows us to see an object from two slightly different angles, which gives us the perception of depth.

Activity 4

Optical Illusions

Judge each of the diagram given below with your eyes and then answer each question by measuring with metre-scale.



Activity 5

To find the distance of near point of clear vision

Procedure :

1. Hold your book (open) at arms length.
2. Slowly bring the book closer to your eyes, such that you can clearly see without straining your eyes.
3. The distance between your eyes and the book is your near point of clear vision.

C. Seminar

Invite eye specialilst and discuss with him

(i) Structure of eye (ii) Defects of eye

(iii) Cornea transplantation

(iv) Correction of eyesight by laser technology by changing shape of cornea

(v) Correction of eyesight by contact lenses.

D. Group Discussion

Discuss the following points regarding the eye.

1. Why should we not scratch our eyes, if some particle of dust or insect gets into it ?
2. How to remove dust particle or small insect from eye?
3. What kind of light should be used for reading?
4. How far an object should be kept for reading?
5. What harm is caused if we read books placed at a distance more than the distance of distinct vision?
6. Is the funiture (such as desks, tables, etc.), is of correct size for reading? If not suggest improvements.
7. Why should we wear sunglasses, in hot summer or on ice covered mountains?
8. Why should we not look at sun or high powered bulb or welding of iron objects?
9. Why must we clear spectacles time to time?
10. Why the eyes should be washed with cold and clean water.

E. Classroom Discussion

Discuss the following regarding atmospheric refraction and scattering of light

1. Why does the sun appears bigger during sunset or sunrise?
2. Why does the sun appears red or orange-red, during sunrise or sunset?
3. Why the sky appears inky blue after rains?
4. Why the sky sometimes appears reddish after a dust storm?
5. Which colour of white light scatters most and which colour scatters least?
6. Why do rescue workers wear orange clothes?
7. Why does the sky appears dark to the astronauts?
8. Why do motorists use orange light head lamps during foggy weather?
9. Why is red light is used as a universal danger signal?

10. Why is the smoke coming out of chimneys appear blue in colour.

F. Charts

1. Prepeare the chart of human eye clearly labelling its parts.

2. prepare a chart showing:

(i) Myopic eye seeing distant object.

(ii) Myopic eye seeing from the far-off point of clear vision.

(iii) Myopic eye corrected by a concave lens and seeing far-off objects.

3. Prepare a chart showing :

(i) Hypermetropic eye seeing from the point of distinct vision.

(ii) Hypermetropic eye seeing from near point of clear vision.

(iii) Corrected hypermetropic eye seeing from point of distinct vision.