The Human & Eye & the Colourful World

Previous Years' CBSE Board Questions

10.1 The Human Eye

SA I (2 marks)

1. Define the term power of accommodation. Write the modification in the curvature of the eye lens which enables us to see the nearby objects clearly? *(Delhi 2019)* U

SA II (3 marks)

2. Trace the sequence of events which occur when a bright light is focused on your eyes. *(Delhi 2019)*
3. Write about power of accommodation of human eye. Explain why the image distance in the eye does not change when we change the distance of an object from the eye? *(Delhi 2017)* Ap

LA (5 marks)

4. (a) State the role of ciliary muscles present in our eye.
   (b) Identify the defect of vision in each of the following cases and suggest its corrective measure :
   (i) The eye lens has become milky and cloudy.
   (ii) The eye lens has excessive curvature.
   (iii) The eye lens has large focal length (longer than normal).
   (iv) Ciliary muscles have weakened. *(2019C)*
5. Write the function of each of the following parts of human eye:
   (i) Cornea (ii) Iris
   (iii) Crystalline lens (iv) Ciliary muscles
   (2/5, 2018, Delhi 2016) R
6. State the function of each of the following parts of the human eye :
   (i) Cornea (ii) Iris (iii) Pupil (iv) Retina
   (2/5, Foreign 2015)
7. (a) List the parts of the human eye that control the amount of light entering into it. Explain how they perform this function?
   (b) Write the function of retina in human eye.
   (3/5, AI 2014) Ev

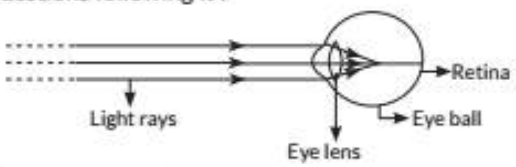
10.2 Defects of Vision and their Correction

MCQ

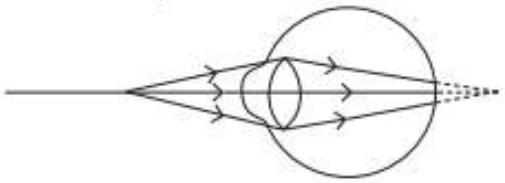
8. Person suffering from cataract has
   (a) elongated eyeball
   (b) excessive curvature of eye lens
   (c) weakened ciliary muscles
   (d) opaque eye lens. *(2020)* R

SA I (2 marks)

9. Observe the following diagram and answer the questions following it :



   (i) Identify the defect of vision shown.
   (ii) List its two causes.
   (iii) Name the type of lens used for the correction of this defect. *(2023)* U An
10. Observe the following diagram showing an image formation in an eye:



   (a) Identify the defect of vision shown in the figure.
   (b) List its two causes and suggest a suitable corrective lens to overcome this defect. *(2023)*

SA II (3 marks)

11. A student uses spectacles of focal length – 2·5 m.
   (a) Name the defect of vision he is suffering from.
   (b) Which lens is used for the correction of this defect ?
   (c) List two main causes of developing this defect.
   (d) Compute the power of this lens. *(2020)* Ap
12. (a) List two causes of hypermetropia.
   (b) Draw ray diagrams showing (i) a hypermetropic eye and (ii) its correction using suitable optical device. *(2020)*
13. (a) A person is suffering from both myopia and hypermetropia.
   (i) What kind of lenses can correct this defect?
   (ii) How are these lenses prepared?
   (b) A person needs a lens of power +3 D for correcting his near vision and –3 D for correcting his distant vision. Calculate the focal lengths of the lenses required to correct these defects. *(2020)* An
14. A person may suffer from both myopia and hypermetropia defects.
   (a) What is this condition called?

(b) When does it happen?

(c) Name the type of lens often required by the persons suffering from this defect. Draw labelled diagram of such lenses. *(2020)* Ap

LA (5 marks)

15. A student is unable to see clearly the words written on the black board placed at a distance of approximately 3 m from him. Name the defect of vision the boy is suffering from. State the possible causes of this defect and explain the method of correcting it. *(3/5, 2018)*

OR

A student is unable to see clearly the words written on the blackboard placed at a distance of approximately 4 m from him. Name the defect of vision the boy is suffering from. Explain the method of correcting this defect. Draw ray diagram for the

(i) defect of vision and also

(ii) for its correction *(Delhi 2015)* An

16. A student suffering from myopia is not able to see distinctly the objects placed beyond 5 m.

(a) List two possible reasons due to which this defect of vision may have arisen. With the help of ray diagrams, explain.

(i) Why the student is unable to see distinctly the objects placed beyond 5 m from his eyes?

(ii) The type of the corrective lens used to restore proper vision and how this defect is corrected by the use of this lens?

(b) If, in this case, the numerical value of the focal length of the corrective lens is 5 m, find the power of the lens as per the new Cartesian sign convention. *(AI 2017)* Ev

17. Millions of people of the developing countries of world are suffering from corneal blindness. These persons can be cured by replacing the defective cornea with the cornea of a donated eye. A charitable society of your city has organised a campaign in your neighbourhood in order to create awareness about this fact. If you are asked to participate in this mission how would you contribute in this noble cause?

(a) State the objective of organising such campaigns.

(b) List two arguments which you would give to motivate the people to donate their eyes after death.

(c) List two values which are developed in the persons who actively participate and contribute in such programmes. *(VBQ, 3/5, Delhi 2016)*

OR

Millions of people of the developing countries are suffering from corneal blindness. This disease can be cured by replacing the defective cornea with the cornea of a donated eye. Your school has organised a campaign in the school and its neighbourhood in order to create awareness about this fact and motivate people to donate their eyes after death. How can you along with your classmates contribute in this noble cause? State the objectives of organising such campaigns in schools.

(VBQ, 3/5, Foreign 2015) An

18. Write the importance of ciliary muscles in the human eye. Name the defect of vision that arises due do gradual weakening of the ciliary muscles in old age. What type of lenses are required by the persons suffering from this defect to see the objects clearly?

Akshay, sitting in the last row in his class, could not see clearly the words written on the blackboard. When the teacher noticed it, he announced if any student sitting in the front row could volunteer to exchange his seat with Akshay. Salman immediately agreed to exchange his seat with Akshay. He could now see the words written on the blackboard clearly. The teacher thought it fit to send the message to Akshay's parents advising them to get his eyesight checked.

In the context of the above event, answer the following questions:

(a) Which defect of vision is Akshay suffering from? Which type of lens is used to correct this defect?

(b) State the values displayed by the teacher and Salman.

(c) In your opinion, in what way can Akshay express his gratitude towards the teacher and Salman? *(VBQ, AI 2015)*

19. Do you know that the corneal-impairment can be cured by replacing the defective cornea with the cornea of the donated eye? How and why should we organise groups to motivate the community members to donate their eyes after death?

(2/5, AI 2014) An

20. What is myopia? List two causes for the development of this defect? How can this defect be corrected using a lens? Draw ray diagrams to show the image formation in case (i) defective eye and (ii) corrected eye. *(Foreign 2014)* An

10.3 Refraction of Light Through a Prism

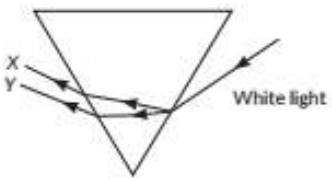
LA (5 marks)

21. Draw a ray diagram to explain the term angle of deviation. *(1/5, Delhi 2017)* An

10.4 Dispersion of White Light by a Glass Prism

MCQ

22. In the diagram given below, *X* and *Y* are the end colours of the spectrum of white light. The colour of 'Y' represents the



(a) Colour of sky as seen from earth during the day
(b) Colour of the sky as seen from the moon
(c) Colour used to paint the danger signals
(d) Colour of sun at the time of noon.

(Term I, 2021-22) An

SA I (2 marks)

23. Draw a labelled diagram to show (i) dispersion of a beam of white light and (ii) formation of a rainbow. *(2023)* U

24. Draw a labelled diagram to explain the formation of a rainbow in the sky. *(Foreign 2015)* An

SA II (3 marks)

25. Define the term dispersion of white light. State the colour which bends (i) the most, (ii) the least while passing through a glass prism. Draw a diagram to show the dispersion of white light. *(2023)* U

26. What is a rainbow ? Draw a labelled diagram to show its formation. *(2023)* U

27. How will you use two identical glass prisms so that a narrow beam of white light incident on one prism emerges out of the second prism as white light? Draw and label the ray diagram. *(2020)* Ap

28. Differentiate between a glass slab and a glass prism. What happens when a narrow beam of (i) a monochromatic light and (ii) white light passes through (a) glass slab and (b) glass prism? *(2020)*

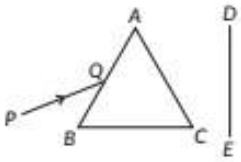
29. (a) With the help of labelled ray diagram show the path followed by a narrow beam of monochromatic light when it passes through a glass prism.
(b) What would happen if this beam is replaced by a narrow beam of white light? *(2020)* An

30. What is rainbow? Draw a labelled diagram to show the formation of a rainbow. *(Delhi 2019)*

31. What is 'dispersion of white light'? State its cause. Draw a ray diagram to show the dispersion of white light by a glass prism. *(AI 2017)* Ap

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

33. A narrow *PQ* of white light is passing through a glass prism *ABC* as shown in the diagram.



Trace it on your answer sheet and show the path of the emergent beam as observed on the screen *DE*.
(i) Write the name and cause of the phenomenon observed.
(ii) Where else in nature is this phenomenon observed?
(iii) Based on this observation, state the conclusion which can be drawn about the constituents of white light. *(AI 2014)* An

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

35. What is a spectrum? How can we recombine the components of white light after a glass prism has separated them? Illustrate it by drawing a diagram. *(Foreign 2014)*

LA (5 marks)

36. (a) Why do the component colours of incident white light split into a spectrum while passing through a glass prism? Explain.
(b) Draw a labelled ray diagram to show the formation of a rainbow. *(4/5, Delhi 2017)* U

37. (a) What is dispersion of white light? State its cause.
(b) "Rainbow is an example of dispersion of sunlight." Justify this statement by explaining, with the help of a labelled diagram, the formation of a

rainbow in the sky. List two essential conditions for observing a rainbow. *(Foreign 2016)*

38. Describe an activity to show that the colours of white light splitted by a glass prism can be recombined to get white light by another identical glass prism. Also draw ray diagrams to show the recombination of the spectrum of white light. *(AI 2016)* Ap

10.5 Atmospheric Refraction

MCQ

39. Which one of the following is the correct reason for twinkling of stars ?
    (a) Atmospheric reflection of starlight.
    (b) Atmospheric refraction of starlight.
    (c) Scattering of starlight.
    (d) Dispersion of starlight. *(2021 C)* R

SA I (2 marks)

40. Why do stars appear to twinkle ? Explain. *(Foreign 2015)*

41. Explain why the planets do not twinkle. *(Foreign 2015)*

SA II (3 marks)

42. Explain in brief the reason for each of the following:
    (a) Advanced sun-rise
    (b) Delayed sun-set
    (c) Twinkling of stars *(Foreign 2016)* Ap

43. What is meant by advance sunrise and delayed sunset? Draw a labelled diagram to explain these phenomena. *(Foreign 2015)*

LA (5 marks)

44. (a) With the help of diagram explain Isaac Newton's experiment that led to the idea that the sunlight is made up of seven colours.
    (b) What is atmospheric refraction ? List two natural phenomena based on atmospheric refraction. *(2019 C)*

45. What is atmospheric refraction? Use this phenomenon to explain the following natural events.
    (a) Twinkling of stars
    (b) Advanced sun-rise and delayed sun-set.
    Draw diagrams to illustrate your answers. *(AI 2016)* An

10.6 Scattering of Light

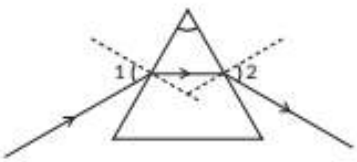
MCQ

46. Which of the following statements is not true for scattering of light?
    (a) Colour of the scattered light depends on the size of particles of the atmosphere.
    (b) Red light is least scattered in the atmosphere.
    (c) Scattering of light takes place as various colours of white light travel with different speed in air.
    (d) The fine particles in the atmospheric air scatter the blue light more strongly than red. So the scattered blue light enters our eyes. *(Term I 2021-22)* An

47. Light seems to travel along straight line paths in a transparent medium. But when light enters obliquely from one transparent medium to another, some changes are observed. This is because different mediums have different optical densities. The extent of the change in the direction of light that takes place when it enters obliquely in a given pair of media is expressed in terms of a 'constant'. Light travels the fastest in vacuum. Light gets refracted through a transparent prism. Several phenomena are observed due to the reflection, refraction, dispersion and scattering of light by various mediums.

(i) Rainbow is a natural spectrum. It is produced because of :
    (a) dispersion of sunlight by tiny water droplets.
    (b) refraction of sunlight by dust particles.
    (c) reflection of sunlight by plane shining surfaces.
    (d) scattering of sunlight by tiny water droplets. R

(ii) In the given diagram showing refraction of a narrow beam of a monochromatic light through a glass prism, the angles marked ∠1 and ∠2 respectively are :



    (a) angle of incidence and angle of refraction.
    (b) angle of incidence and angle of emergence.
    (c) angle of emergence and angle of refraction.
    (d) angle of emergence and angle of deviation. R

(iii) Blue colour of clear sky is due to :
    (a) Refraction of light
    (b) Reflection of light
    (c) Absorption of light
    (d) Scattering of light

(iv) The apparent flattening of the Sun's disc at sunrise and sunset is due to:
    (a) Dispersion of light

(b) Scattering of light
(c) Atmospheric refraction of light
(d) Tyndall effect U

(v) Consider the following statements:
I. Very fine particles scatter mainly blue light.
II. Advance sunrise and delayed sunset are due to atmospheric refraction.
III. Violet light bends the least while red light bends the most when a beam of white light passes through a glass prism.
The correct statement(s) is/are :
(a) I only (b) III only
(c) I and II (d) II and III *(2021 C)* R

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

SA I (2 marks)

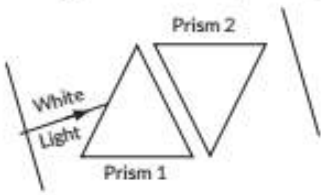
49. The colour of clear sky from the earth appears blue but from the space it appears black. Why? *(2023)* U

SA II (3 marks)

50. Give reasons :
(a) Red colour is selected for danger signals.
(b) The sky appears dark in space.
(c) The time difference between actual sunset and apparent sunset is about 2 minutes. *(2020)* R

51. Why is Tyndall effect shown by colloidal particles? State four instance of observing the Tyndall effect. *(2020)* U

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



(2020) Ev

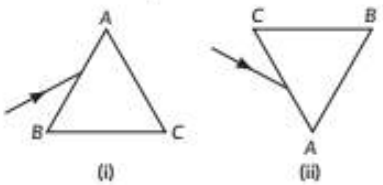
CBSE Sample Questions

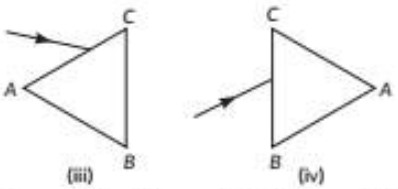
10.3 Refraction of Light Through a Prism

MCQ

1. If a beam of red light and a beam of violet light are incident at the same angle on the inclined surface of a prism from air medium and produce angles of refraction *r* and *v* respectively, which of the following is correct?
(a) $r = v$ (b) $r > v$ (c) $r = 1/v$ (d) $r < v$
(Term I, 2021-22) Ap

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

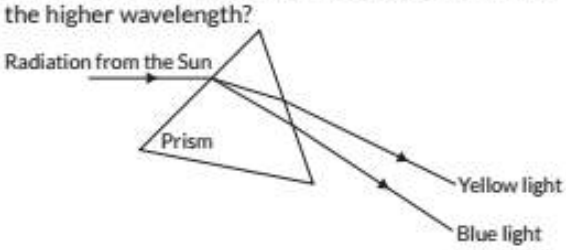




(a) (i) (b) (ii) (c) (iii) (d) (iv)
(Term I, 2021-22) U

SA I (2 marks)

3. State the phenomena observed in the above diagram. Explain with reference to the diagram, which of the two lights mentioned above will have the higher wavelength?

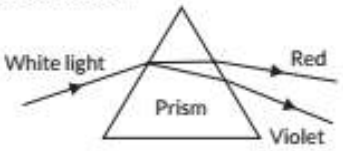


(2022-23)

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. (2022-23)

5. A student observes the a phenomenon in the lab as a white light passes through a prism. Among many other colours, he observed the position of the colours red and violet.



What is the phenomenon called? What is the reason for the violet light to bend more than the red light? (2020-21) U

10.6 Scattering of Light

MCQ

Question No. 6 consist of two statements Assertion (A) and Reason (R). Answer the question selecting the appropriate option given below.

6. **Assertion (A) :** Sky appears blue in the day time.
Reason (R) : White light is composed of seven colours.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true, and R is not correct explanation of A.
(c) (A) is true, but R is false.
(d) (A) is false but R is true. (*Term I, 2021-22*) Ap

Detailed SOLUTIONS

Previous Years' CBSE Board Questions

1. The ciliary muscles modifies the curvature to some extent. The change in the curvature of the eye-lens can thus change its focal length. When the ciliary muscles contract, the lens becomes thick and its focal length decreases, thus enables us to see nearby objects clearly.

Key Points

- The ability of the eye lens to adjust its focal length is called power of accommodation.

2. When a bright light enters the eye then most of the refraction for the light rays entering the eye occurs at the outer surface of the cornea. Then, the crystalline lens merely provides the finer adjustment of focal length required to focus object at different distances on the retina. The pupil regulates and controls the amount of light entering the eye. At retina, the light-sensitive cells get activated upon illumination and generate electric signals. These signals are sent to the brain via the optic nerves. The brain interprets these signals and finally, processes the information so that we perceive objects as they are.

3. The ability of the eye-lens to adjust its focal length is called power of accommodation.
The ciliary muscles modifies the curvature to some extent. The change in the curvature of the eye lens can thus change its focal length. Thus, the focal length of the human lens increases or decreases depending on the distance of the object value to this distance of the image does not change. For example, when the ciliary muscles are relaxed, the lens becomes thin and its focal length increases, thus enables us to see distant object clearly.

4. (a) Ciliary muscles holds the eye lens and help in the adjustment of its focal length.
(b) (i) Cataract is a condition in which crystalline lens of eye becomes milky and cloudy due to growth of membrane over it.
Corrective measure - Cataract surgery is needed for removal of cataract in which the clouded lens is removed and replaced it with a clear at artificial lens.
(ii) Myopia is a defect in which the curvature of lens increase.
Corrective measure: This defect can be corrected by using concave lens of suitable power in which it diverge and shift the image to the retina.
(iii) Hypermetropia is a defect in which eye lens has large focal length or low converging power of eye lens. It is also due to the smaller size of eye ball.
Corrective measure: It is corrected by using a convex lens which converges and shifts the image to the retina from beyond.
(iv) Presbyopia is a defect in which ciliary muscles have weathered.
Corrective measure: It can be corrected by using bi-focal lens.

5. (i) Cornea : It is a transparent bulge on the front surface of eyeball which refracts most of the light rays entering the eye.
(ii) Iris : Iris is a dark muscular diaphragm that controls the size of the pupil.
(iii) Crystalline lens : The crystalline lens of human eye focuses the light that enters the eye and form the image on the retina.
(iv) Ciliary muscles : Ciliary muscles holds the eye lens and helps in the adjustment of its focal length.

6. (i) Cornea : It is a transparent bulge on the front surface of eyeball which refracts most of the light rays entering the eye.
(ii) Iris : Iris is a dark muscular diaphragm that controls the size of the pupil.

(iii) Pupil : It controls the amount of light entering into the eye.
(iv) Retina : It captures light and converts it into electric signals that are translated into images by the brain.

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

8. (d): A person suffering from cataract has cloudy opaque eye-lens.

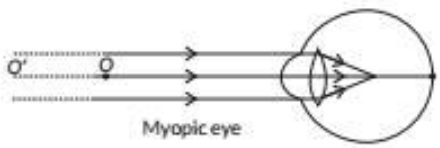
Concept Applied

➲ Cataract is a condition in which crystalline lens of eye becomes milky and cloudy due to growth of membrane over it.

9. Student is suffering from myopia.

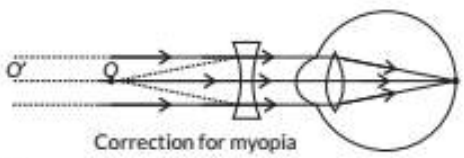
The two possible reasons due to which the defect of vision arises are : excessive curvature of the eye-lens and elongation of the eye-ball.

A student with myopia has the far point nearer than infinity, thus, the image of a distant object is formed in front of the retina.



Myopic eye

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

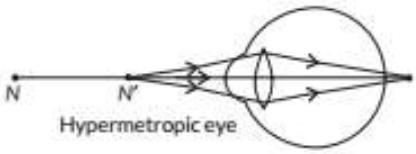


Correction for myopia

10. (a) Hypermetropia
(b) Hypermetropia is caused due to following reasons:
(i) Shortening of the eyeball
(ii) Focal length of crystalline lens is too long
It is corrected by using a convex lens which converges and shifts the image to the retina from behind.

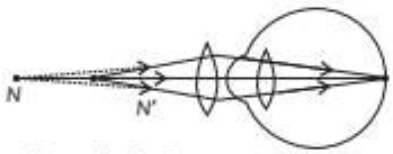
11. (a) A student uses spectates of focal length - 2.5 m hence he is suffering from myopia or near-sightedness.
(b) It is corrected by using concave lens which diverges and shifts the image to the retina.
(c) Cause for Myopia-
(i) Excessive curvature of eye lens.
(ii) Elongation of eye ball.
(d) Power of this lens $P = \frac{1}{f\,(\text{in metre})} D$
Here, focal length of concave lens = −2.5 m
Power of lens $P = \frac{1}{f} D$ or $\frac{1}{-2.5} D$ = − 0.4 D

12. (a) Hypermetropia is caused due to following reasons :
(i) Shortening of the eyeball
(ii) Focal length of crystalline lens is too long.
(b) (i)



Hypermetropic eye

(ii)



Correction for Hypermetropic eye

13. (a) (i) The lens which can correct the vision of such a person suffering from both myopia and hypermetropia is a bifocal lens.
(ii) A common type of bifocal lens contains both concave and convex lens. It is prepared with the upper portion consisting of a concave lens facilitating distant vision and the lower portion consisting of convex lens facilitating near vision.
(b) The power for correcting his near vision, P_N = +3 D.

As $P = \frac{1}{f\,(\text{m})}$

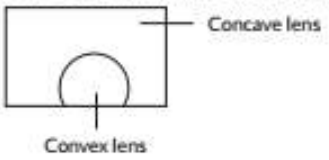
∴ Focal length of convex lens needed,

$$f_N = \frac{1}{P_N} = 0.33\,\text{m} = +33.33\,\text{cm}$$

Power required to correct distant vision, P_D = −3 D
∴ Focal length of concave lens,

$$f_D = \frac{1}{P_D} = -0.33\,\text{m} = -33.33\,\text{cm}.$$

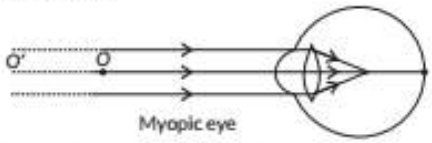
14. (a) This condition is called presbyopia.
(b) It happens due to gradual weakening of ciliary muscles and diminishing flexibility of eye lens due to agening.
(c) It can be corrected by using bifocal lenses.



Key Points

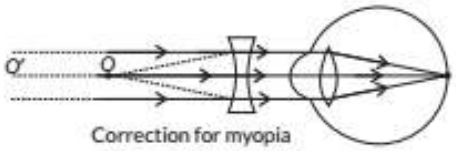
- In a bi-focal lens, upper portion consists of a concave lens which facilitates distant vision, and the lower part is convex lens which facilitates near vision.

15. Student is suffering from myopia.
The two possible reasons due to which the defect of vision arises are : excessive curvature of the eye lens and elongation of the eye ball.
A student with myopia has the far point nearer than infinity, thus, the image of a distant object is formed in front of the retina.



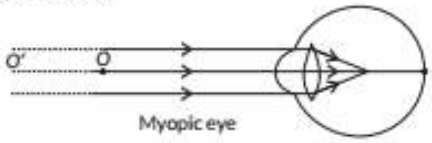
Myopic eye

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



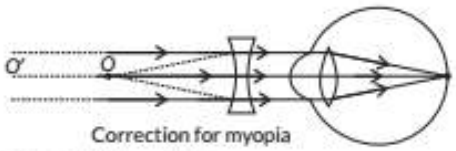
Correction for myopia

16. (a) The two possible reasons due to which the defect of vision arises are : excessive curvature of the eye lens and elongation of the eye ball.
(i) A student with myopia has the far point nearer than infinity, thus, the image of a distant object is formed in front of the retina.



Myopic eye

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



Correction for myopia

(b) Focal length, $f = -5$ m

$$P = \frac{1}{f\,(\text{in meters})} \text{ or, } P = \frac{1}{-5} = -0.2\ \text{D}$$

Commonly Made Mistake

- Sometimes students forget to convert focal length into meters while calculating power of a lens. For power to be in Diopters (D), focal length should always be in meters (m).

17. We can encourage people to participate in the camp and also register ourselves as a donator.
(a) The objective of organising such campaign is to make people aware and realize their duties towards society.
(b) (i) By donating our eyes after we die, we can light the life of a blind person.
(ii) One pair of eyes gives vision to two corneal blind people.
(c) (i) It shows the concern for others.
(ii) It also shows the responsible behavior towards the society.

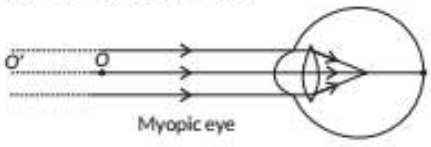
18. Ciliary muscles modifies the curvature of eye lens and hence adjusts its focal length. This enables us to see objects
The defect of vision arises due to weakening of ciliary muscles in old age is presbyopia. Person suffering from this defect should wear bifocal lenses. These lenses consists of both concave and convex lenses.
(a) Akshay is suffering from myopia or near-sightedness. He should use concave lens to correct this defect.
(b) Teacher and Salman are concerned and caring.
(c) Akshay can show his gratitude by saying thank you.

Concept Applied

- The focal length of eye lens is adjusted automatically by the action of ciliary muscles such that a sharp image of the object is formed on the retina.

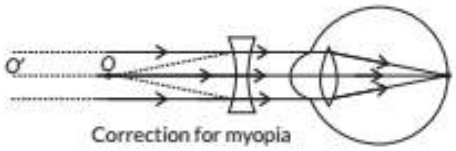
19. Yes, we know that the corneal - impairment can be cured by replacing the objective cornea with the cornea of the donated eye. We can provide the importance of eye donation to the community members. Our eyes can live even after our death. By donating our eyes after death, we can light the life of a blind person. The human eye is one of the most valuable and sensitive sense organs. It enables us to see the wonderful world and colours around us. It is however, impossible to identify colours while closing the eyes. Thus of all the sense organs, the human eye is the most significant one as it enables as to see the beautiful colourful world around us. Hence, we should donate our eyes after death.

20. Myopia is also known as near–sightedness defect in which a person can see nearby objects clearly but cannot see distant objects distinctly. This defect may arise due to
(a) excessive curvature of the eye.
(b) elongation of the eye ball.



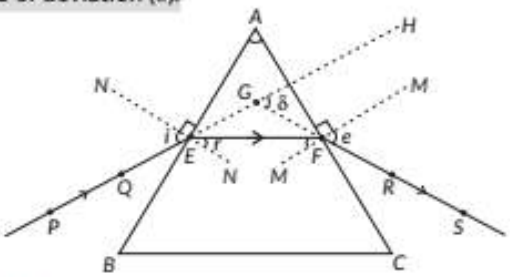
Myopic eye

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



Correction for myopia

21. The emergent ray bends at an angle to the direction of the incidence, this angle between them is known as angle of deviation (δ).



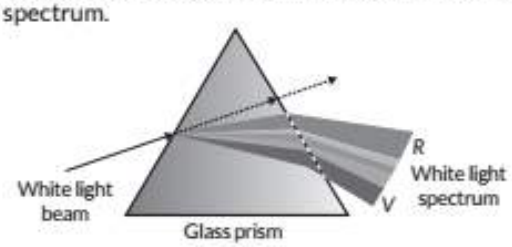
22. (c) : Red colour is used to paint the danger signals. As we know, visible spectrum has violet, indigo, blue, green, yellow, orange and red colour and these colours are arranged with red on the top and violet at the bottom (near base of the prism) on the basis of wavelength and frequency, and among these colours red colour has largest wavelength (≈ 750 nm). Thus, here Y will be red.

Key Points

- The frequency of light increase from red to violet light.

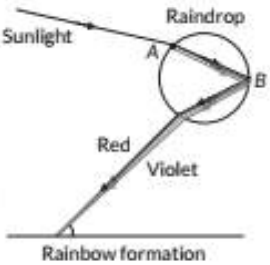
23. Splitting of white light into its seven constituent colours due to refraction is known as dispersion of white light.

Cause of dispersion : When a beam of white light enters a prism, it gets refracted and splits into seven constituent colours. The splitting of the light ray occurs due to the different bending angle for each colour. Thus, each colour ray when passing through the prism bends at different angles with respect to the incident beam, thus giving rise to a spectrum.



Dispersion of white light by the glass prism

After a rain-shower, the sunlight gets dispersed by tiny droplets, present in the atmosphere. The water droplets acts like small glass prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to dispersion of light and internal reflection, different colours reaches the observer's eye, which is called a rainbow.



A rainbow is a natural spectrum caused by dispersion of sunlight by tiny water droplets, present in the atmosphere.

Point A denotes dispersion and point B denotes internal reflection.

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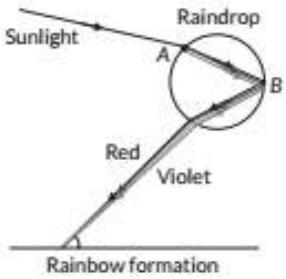
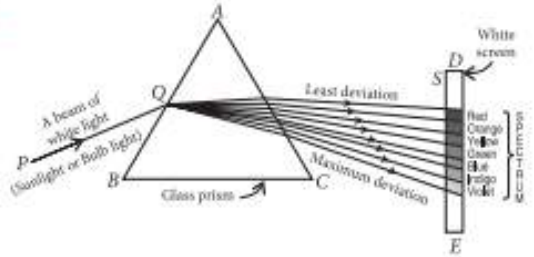
Point A denotes dispersion and point B denotes internal reflection.



25.



(i) The phenomenon of the splitting up of the white light into its constituents colours is called dispersion of light. Dispersion of light is caused due to, different constituents colours of light after different refractive indices to the material of the prism.

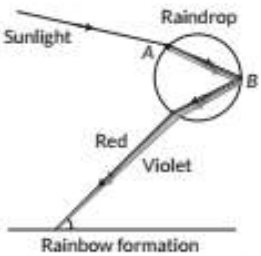
(ii) The formation of rainbow is caused by the dispersion of the white sunlight into its constituent colours.

(iii) Based on the dispersion of white light into its constituents colours, we can conclude that

(a) The white light consists of seven colours.

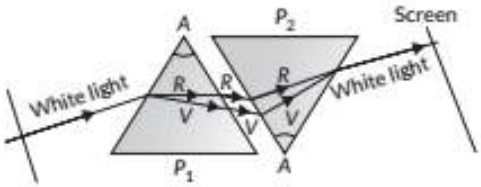
(b) The violet light suffers maximum deviations and the red light suffers minimum deviation.

26. After a rain-shower, the sunlight gets dispersed by tiny droplets, present in the atmosphere. The water droplets acts like small glass prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to dispersion of light and internal reflection, different colours reaches the observer's eye, which is called a rainbow.



27. Newton was the first to use a glass prism to obtain the spectrum of a white light. He then placed a second identical prism in an inverted position with respect to the first prism. This allowed all the colours of the white

light to pass through the second prism combining to form a white light emerging from the other side of the second prism. This made him believe that white light was composed of different colours.



28. Glass slab :

(1) It is a substance made of glass having three dimension and has cuboidal structure.

(2) It does not deviate the path of light falling on it but produces a lateral displacement of the light ray after refraction. The incident and emergent ray are parallel to each other.

Glass prism :

(1) A prism is a structure made of glass with two triangle bases and three rectangular lateral surfaces. These surfaces are inclined to each other.

(2) A prism deviates the path of light ray falling on it. Here the incident ray and emergent ray are not parallel to each other.

(i) When a narrow beam of monochromatic light falls on a

(a) Glass slab, it gets refracted at its surface and the emergent ray is laterally displaced from the incident ray.

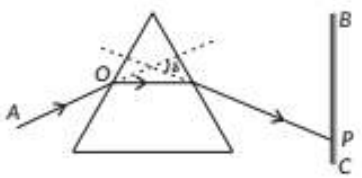
(b) Prism, it gets refracted at the surface and the light gets deviated from its initial path. The angle between the incident ray and emergent ray is known as angle of deviation.

(ii) When a white light passes through a

(a) Glass slab, the light does not undergo dispersion as its two refracting surfaces are parallel to each other. The white light is laterally displaced from its initial path.

(b) Prism, the white light undergoes dispersion and splits into its constituent colours along with deviation from its initial path.

29. (a)



Here, in the figure, $\angle\delta$ is the angle of deviation of the given monochromatic light by the glass prism.

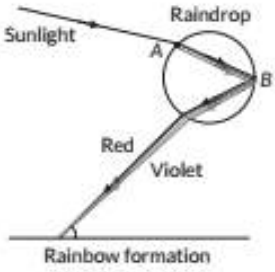
(b) If *AO* is a ray of white light, then on screen *BC*, a spectrum will be observed, consisting of seven colours arranged from bottom to top as follows :

Violet, Indigo, Blue, Green, Yellow, Orange, Red (VIBGYOR)

Concept Applied

➲ Different colours of light pass through this prism at different angles with respect to incident ray. The red light bends the least, while the violet light the most.

30. After a rain-shower, the sunlight gets dispersed by tiny droplets, present in the atmosphere. The water droplets acts like small glass prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop.



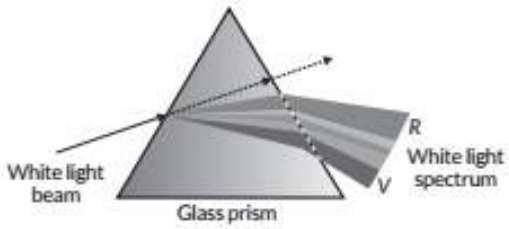
Due to dispersion of light and internal reflection, different colours reaches the observer's eye, which is called a rainbow.

A rainbow is a natural spectrum caused by dispersion of sunlight by tiny water droplets, present in the atmosphere.

Point *A* denotes dispersion and point *B* denotes internal reflection.

31. Splitting of white light into its seven constituent colours due to refraction is known as dispersion of white light.

Cause of dispersion : When a beam of white light enters a prism, it gets refracted and splits into seven constituent colours. The splitting of the light ray occurs due to the different bending angle for each colour. Thus, each colour ray when passing through the prism bends at different angles with respect to the incident beam, thus giving rise to a spectrum.



Dispersion of white light by the glass prism

32. Splitting of white light into its seven constituent colours due to refraction is known as dispersion of white light.

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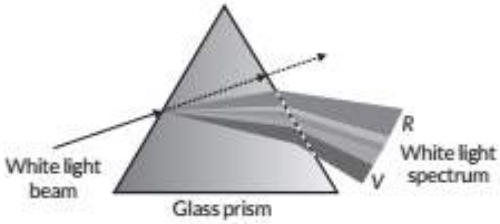
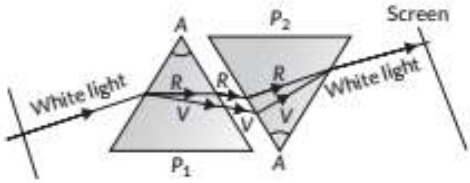
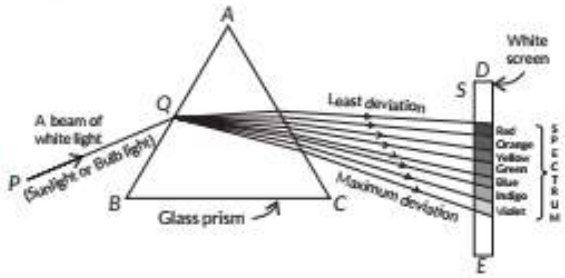


Dispersion of white light by the glass prism

Newton was the first to use a glass prism to obtain the spectrum of a white light. He then placed a second identical prism in an inverted position with respect to the first prism. This allowed all the colours of the white light to pass through the second prism combining to form a white light emerging from the other side of the second prism. This made him believe that white light was composed of different colours.



33.



(i) The phenomenon of the splitting up of the white light into its constituents colours is called dispersion of light. Dispersion of light is caused due to, different constituents colours of light after different refractive indices to the material of the prism.

(ii) The formation of rainbow is caused by the dispersion of the white sunlight into its constituent colours.

(iii) Based on the dispersion of white light into its constituents colours, we can conclude that

(a) The white light consists of seven colours.

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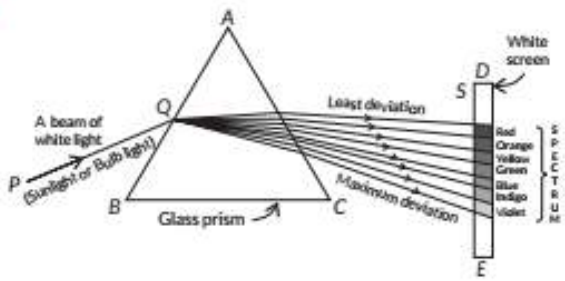
34.



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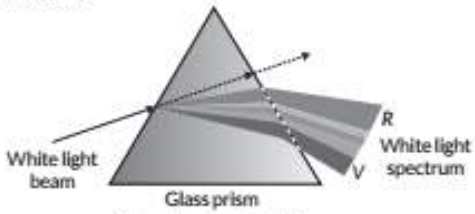
The violet light suffers maximum deviations and the red light suffers minimum deviation.

35. Splitting of white light into its seven constituent colours due to refraction is known as dispersion of white light.

Cause of dispersion : When a beam of white light enters a prism, it gets refracted and splits into seven constituent colours. The splitting of the light ray occurs due to the different bending angle for each colour. Thus, each colour ray when passing through the prism bends at different angles with respect to the incident beam, thus giving rise to a spectrum.



Dispersion of white light by the glass prism

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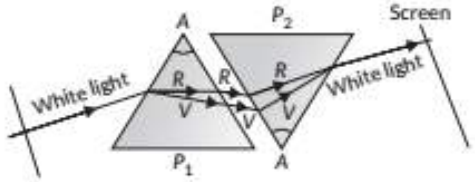
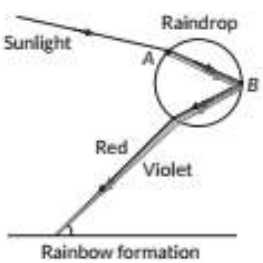


36. (a) When a beam of light incidents on a prism, it first gets refracted and splits into seven constituent colors. The splitting of the light ray occurs due to the different bending angle for each colour. Thus each colour ray when passing through the prism bends at different angles with respect to the incident beam. This gives rise to the formation of the spectrum.

(b) A rainbow is a natural spectrum caused by dispersion of sunlight by tiny water droplets, present in the atmosphere.

Point *A* denotes dispersion and point *B* denotes internal reflection.



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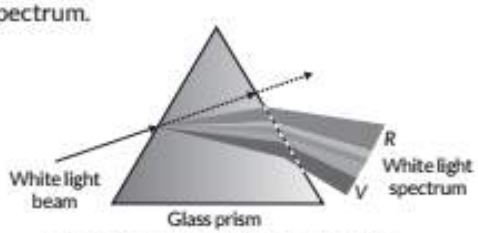


Dispersion of white light by the glass prism

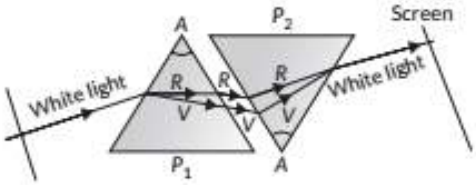
(b) After a rain-shower, the sunlight gets dispersed by tiny droplets, present in the atmosphere. The water droplets acts like small glass prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to dispersion of light and internal reflection, different colours reaches the observer's eye, which is called a rainbow.

Two essential conditions for observing rainbow are

(i) Sun should be at the back of the observer.

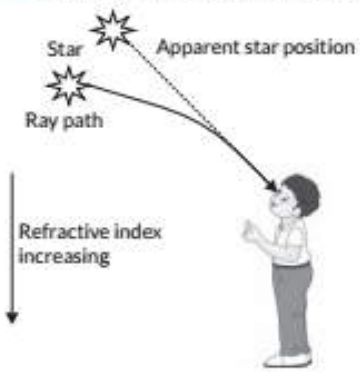
(ii) Rainbow should be seen after rainfall or through a waterfall or water fountain.

38. Newton was the first who use a glass prism to obtain the spectrum of a white light. He then placed a second identical prism in an inverted position with respect to the first prism. This allowed all the colours of the white light to pass through the second prism combining to form a white light emerging from the other side of the second prism. This made him believe that white light was composed of different colours.



39. (b): Atmospheric refraction of starlight.

40.



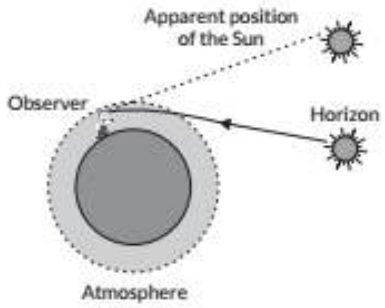
Due to atmospheric refraction, position of star visible from sun is slightly different from its actual position. This apparent position of the star is not stationary, but keeps on changing with change in physical condition on earth's atmosphere. Since the stars are very distant, they are approximately point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect.

Concept Applied

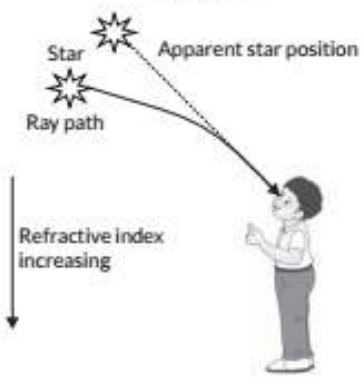
➲ The Earth's atmosphere has different temperatures at different altitudes, which makes refractive index to vary at different altitudes of the atmosphere. Therefore, due to different refractive indices, atmospheric refraction occurs.

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

42. (a, b) The Sun is visible to us about two minutes before the actual sunrise, and about two minutes after the actual sunset because of atmospheric refraction. By actual sunrise, we mean the actual crossing of the horizon by the Sun. Figure shows the actual and apparent positions of the Sun with respect to the horizon. The time difference between actual sunset and the apparent sunset is about two minutes. The apparent flattening of the Sun's disc at sunrise and sunset is also due to the same phenomenon.



(c)



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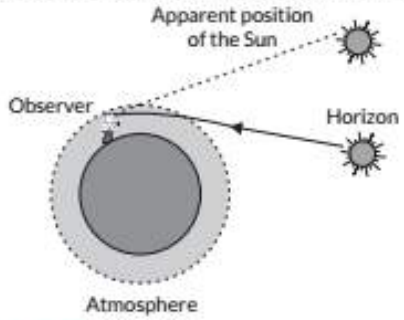
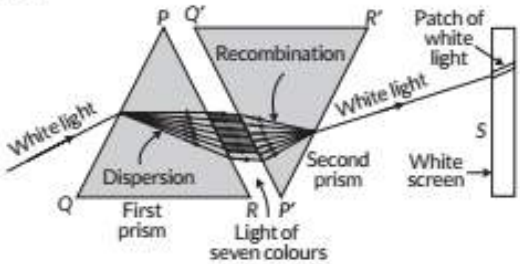


Concept Applied

➲ Due to atmospheric refraction, sun-rays reaches us earlier, thus we are able to see it before actual sunrise.

44. (a) Newton was the first person who tried to split the colours of sunlight (white light). He showed that reverse of dispersion of light is possible.

Newton kept two identical glass prisms close to each other one in an exact position and other in inverted position.



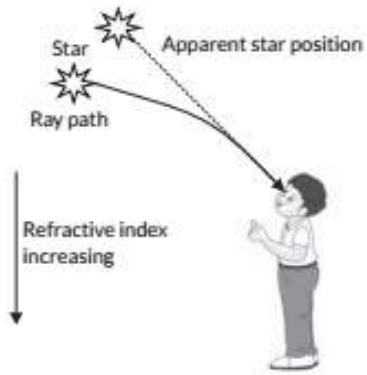
(b) Atmospheric refraction : Refraction of light caused by earth's atmosphere due to the variation in optical densities of air layers.

Natural phenomena due to atmospheric refraction.

- Twinkling of stars
- Advanced sunrise and delayed sunset

45. Refraction of the light by the different layers of the atmosphere having different refractive indices is known as atmospheric refraction.

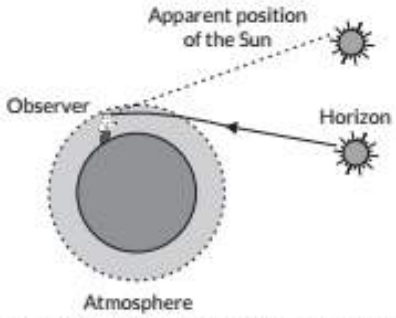
(a) Twinkling of stars :



Due to atmospheric refraction, position of star visible from sun is slightly different from its actual position. This apparent position of the star is not stationary, but keeps on changing with change in physical condition on earth's atmosphere. Since the stars are very distant, they are approximately point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect.

(b) Advanced sun-rise and delayed sun-set :

The Sun is visible to us about two minutes before the actual sunrise, and about two minutes after the actual sunset because of atmospheric refraction. By actual sunrise, we mean the actual crossing of the horizon by the Sun. Figure shows the actual and apparent positions of the Sun with respect to the horizon. The time difference between actual sunset and the apparent sunset is about two minutes. The apparent flattening of the Sun's disc at sunrise and sunset is also due to the same phenomenon.



46. (c) : Scattering of light is the phenomenon of change in the direction of light on striking a particle. Various colours of white light do not travel with different speeds in air.

47. (i) (a) : Water droplets acts as small prisms. These water droplets refract and disperse the incident sunlight, the reflect internally and finally, refract it again when it comes out of the rain drop.

(ii) (b) : Angle of incidence and angle of emergence.
(iii) (d) : Blue colour of Sky is due to scattering of light. Shorter the wavelength greater will be scattering.
(iv) (c) : Atmospheric refraction of light result in apparent flattening of Sun.
(v) (c) : Shorter the wavelength greater will be scattering and blue are usually scattered by small particles due to their shorter wavelength. Refraction of light by Earth's atmosphere causes advance sunrise & delayed sunset light having shorter wavelength deviates maximum.

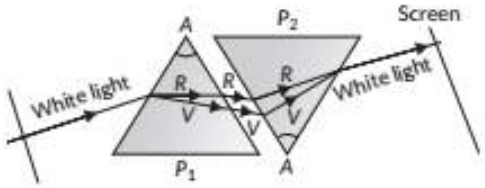
48. (a): The scattering of light occurs with the help of particle present in atmosphere, but at higher attitude the particle are not enough.

49. As our earth has atmosphere and space has no atmosphere, so the sunlight scatters by the particles in atmosphere. The amount of scattering of light is inversely proportional to wavelength thus violet, blue colours scatter more than red and hence the colour of sky appears blue from earth.

50. (a) Red colour of light is least scattered as it has a longer wavelength. Therefore, red light is able to travel the longest distance in air particle, rain and fog.
(b) There is no atmosphere in space, so that sky appears black.
(c) The sun is visible to us about two minutes before he actual sunrise, and about two minutes after the actual sunset because of atmospheric refraction.
By actual sunrise, we mean the actual crossing of the horizon by sun.

51. The phenomenon of scattering of light by the colloidal particles give rise to Tyndall effect. When a beam of light strike colloidal particles, the path of the beam becomes visible . This is known as Tyndall effect.
This phenomenon can be observed when
(i) sunlight passes through a canopy of dense forest, when tiny water droplets in the mist scatter light.
(ii) torch light is switched on in a foggy environment, light rays are visible after being scattered by the fog particles in the surrounding air.
(iii) a fine beam of sunlight enters a smoke-filled room through a small hole.
(iv) shining a flashlight beam into a glass of dilated milk produces Tyndall effect.

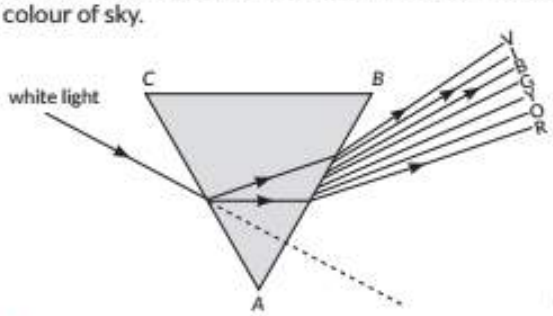
52. (a) The colour of scattered light depends on the size of the scattering particle. Very fine particles scatter short wavelengths such as blue and violet lights. Large size particles scatter light of longer wavelengths.
(b) The basic cause of this observation is atmospheric refraction. As hot air is less denser then the colder air surrounding it, it has a slightly lower refractive index. Since the physical condition of the refracting medium, in air is not stationary, the apparent position of an object, when seen through hot air fluctuates.
(c) Newton was the first to use a glass prism to obtain the spectrum of a white light. He then placed a second identical prism in an inverted position with respect to the first prism. This allowed all the colours of the white light to pass through the second prism combining to form a white light emerging from the other side of the second prism. This made him believe that white light was composed of different colours.



CBSE Sample Questions

1. (b): Red light has longest wavelength, therefore, the refractive index of the medium is least for red light and consequently violet colour deviates the most and red deviates the least $\therefore r > v$. (0.80)

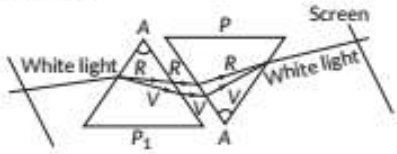
2. (b): In position (ii), the dispersed beam is as known in figure. The third colour from the top is blue, which is the colour of sky.



(0.80)

3. The phenomena observed is dispersion in which the splitting of white light into seven colours take place on passing through a prism. Velocity is directly proportional to wavelength gives constant frequency. So yellow will have greater wavelength than blue as the velocity of yellow light is greater than blue. (2)

4. Angle of deflections of the two prisms need to be equal and opposite. While the first prism splits the light in the seven colours due to different angles of deflection, the second prism combines the spectrum along a single ray and the colours again combine to give white light as the emergent light. (2)



5. The phenomenon is called dispersion.
The speed of violet light inside the prism is slowest and that of red is highest. Hence, deviation of violet light is maximum and that of red is minimum. (1)

6. (b): The blue colour of clear sky is due to Rayleigh elastic scattering of sunlight. (0.80)