The Human Eye and the Colourful World

11

Objective Section (1 mark each)

Q. 1. 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.

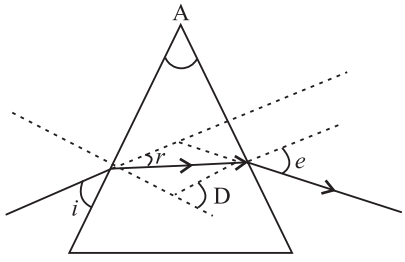
(c) The size of molecules is smaller than the wavelength of visible light.

(d) The light gets scattered towards the earth. [CBSE OD, Set 1, 2020]

Ans. (a) Scattering of light is not enough at such heights.

Very Short Answer Type Questions (1 mark each)

Q. 1. In the following diagram the correctly marked angles are:



(a) ∠ A and ∠ *e*

(b) ∠ *i*, ∠ A and ∠ D

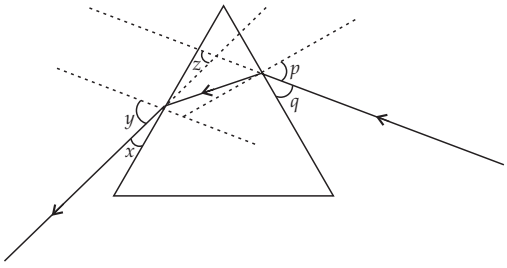
(c) ∠ A, ∠ *i* and ∠ *e*

(d) ∠ A, ∠ *r* and ∠ D

[CBSE Delhi, Term 2, Set 1, 2017]

Ans. (a) ∠ A and ∠ *e*

Q. 2. Study the following ray diagram



In this diagram, the angle of incidence, the angle of emergence and the angle of deviation respectively have been represented by

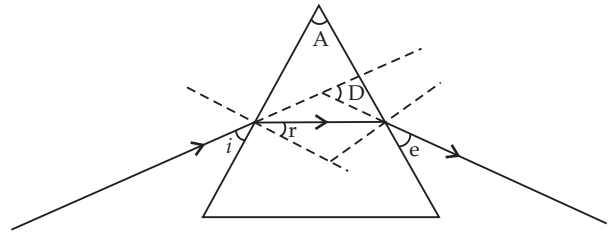
(a) *y*, *p*, *z* **(b) *x*, *q*, *z***

(c) *p*, *y*, *z* **(d) *p*, *z*, *y***

[CBSE OD, Term 2, Set 1, 2017]

Ans. (c) *p*, *y*, *z*

Q. 3. In the following ray diagram the correctly marked angle are:



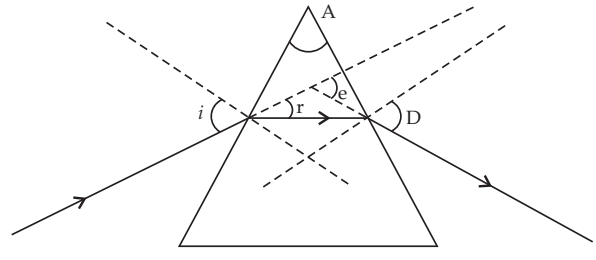
(a) ∠*i* and ∠*e* **(b) ∠A and ∠D**

(c) ∠*i*, ∠*e* and ∠D **(d) ∠*r*, ∠A and ∠D**

[CBSE OD, Term 2, Set 1, 2016]

Ans. (d) ∠*r*, ∠A and ∠D

Q. 4. Study the following figure in which a student has marked the angle of incidence (∠*i*), angle of refraction (∠*r*), angle of emergence (∠*e*), angle of prism (∠A) and the angle of deviation (∠D). The correctly marked angles are:



(a) ∠A and ∠*i*

(b) ∠A, ∠*i* and ∠*r*

(c) ∠A, ∠*i*, ∠*e* and ∠D

(d) ∠A, ∠*i*, ∠*r* and ∠D

[CBSE Delhi, Term 2, Set 1, 2016]

Ans. (a) ∠A and ∠*i*

Q. 5. A student traces the path of a ray of light through a triangular glass prism for different values of angle of incidence. On analysing the ray diagrams, which one of the following conclusions is he likely to draw?

(a) The emergent ray is parallel to the incident ray.

(b) The emergent ray bends at an angle to the direction of the incident ray.

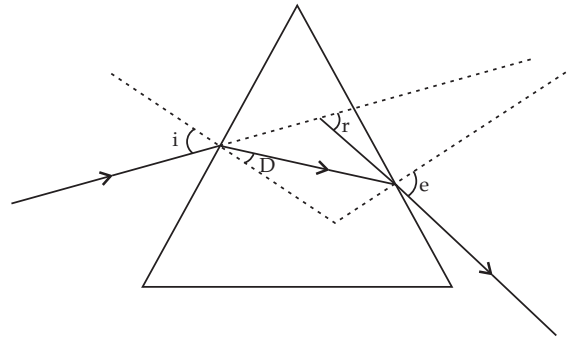
(c) The emergent ray and the refracted ray are at right angles to each other.

(d) The emergent ray is perpendicular to the incident ray.

[CBSE OD, Term 2, Set 1, 2015]

Ans. **(b)** The emergent ray bends at an angle to the direction of the incident ray.

Q. 6. After tracing the path of a ray of light through a glass prism a student marked the angle of incidence ($\angle i$), angle of refraction ($\angle r$), angle of emergence ($\angle e$) and the angle of deviation ($\angle$D) as shown in the diagram. The correctly marked angles are:



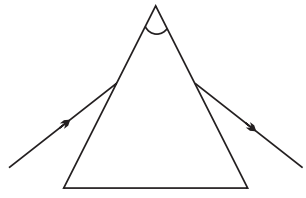
(a) $\angle i$ and $\angle r$
(b) $\angle i$ and $\angle e$
(c) $\angle i$, $\angle e$ and $\angle$D
(d) $\angle i$, $\angle r$ and $\angle e$

[CBSE Delhi, Term 2, Set 1, 2015]

Ans. **(b)** $\angle i$ and $\angle e$

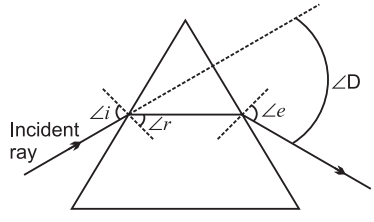
Short Answer Type Questions-I (2 marks each)

Q. 1. A student traces the path of a ray of light through a glass prism as shown in the diagram, but leaves it incomplete and unlabelled. Redraw and complete the diagram. Also label on it $\angle i$, $\angle e$, $\angle r$, and $\angle$D.



[CBSE OD, Set 1, 2019]

Ans.



Q. 2. What is atmospheric refraction? List two phenomena which can be explained on the basis of atmospheric refraction.

[CBSE OD, Set 3, 2019]

Ans. In atmosphere, there are layers of different densities and refractive indices, when light ray is passed through these layers refraction of light takes place which is called atmospheric refraction.

Two phenomenon that can be explained on the basis of atmospheric refraction are:

(i) Twinkling of stars.

(ii) Early sunset and delayed sunrise.

Q. 3. Define the term power of accommodation. Write the modification in the curvature of the eye lens which enables us to see the nearby objects clearly?

[CBSE Delhi, Set 1, 2019]

Ans. The ability of the eye lens to adjust its focal length, is called the power of accommodation. There should be a contraction of ciliary muscles, that will increase the curvature of the eye lens and becomes thicker, so the focal length of the eye lens will decrease. It will thus enable us to see the objects clearly.

Q. 4. Write the structure of eye lens and state the role of ciliary muscles in the human eye.

[CBSE Delhi, Set 2, 2019]

Ans. The eye lens of the human eye is a convex lens that is thick in the middle and thin from the edges. It converges the incident light rays and forms the image on retina.

Role of ciliary muscles:

(i) It changes the shape of the lens in eye to help with focussing.

(ii) It helps to regulate the flow of aqueous humour in eye.

Q. 5. What happens to the image distance in the normal human eye when we decrease the distance of an object, say 10 m to 1 m? Justify your answer.

[CBSE OD, Set 3, 2019]

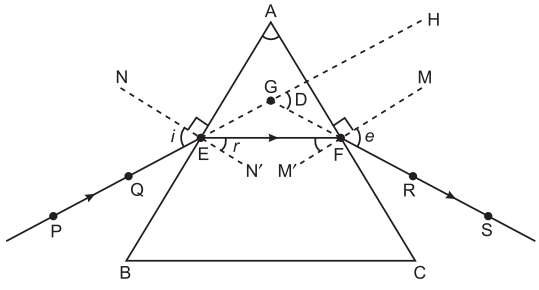
Ans. The image distance will remain unaffected even if we change the object distance because the image is formed on the retina.

Short Answer Type Questions-II (3 marks each)

Q. 1. (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.

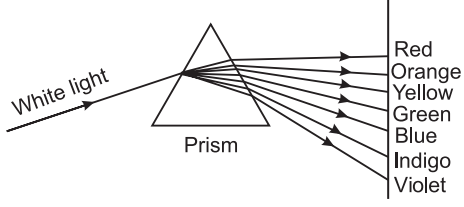
(b) What would happen if this beam is replaced by a narrow beam of white light? [CBSE OD, Set 1, 2020]

Ans. (a)



PE – Incident ray
EF – Refracted ray
FS – Emergent ray
∠A – Angle of the prism
∠*i* – Angle of incidence
∠*r* – Angle of refraction
∠*e* – Angle of emergence
∠D – Angle of deviation

(b) The prism will split the incident white light into a band of colours. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red.



Q. 2. (a) A person is suffering from both myopia and hypermetropia.

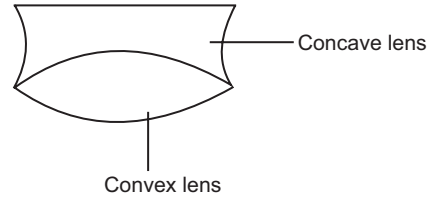
(i) What kind of lenses can correct this defect?

(ii) How are these lenses prepared?

(b) A person needs a lens of power + 3D for correcting his near vision and – 3D for correcting his distant vision. Calculate the focal lengths of the lenses required to correct these defects. [CBSE OD, Set 1, 2020]

Ans. (a) (i) If a person suffer from both myopia and hypermetropia, such people often require bifocal lenses.

(ii) A common type of bifocal lenses consists of both concave and convex lenses. The upper portion consists of a concave lens. It facilitates distant vision. The lower part is a convex lens. It facilitates near vision.



(b) For correcting distant vision;

Power, P = – 3 D

Using P = (1/*f*) where *f* = focal length of the lens.

$$\Rightarrow \quad f = \frac{1}{-3\text{D}} = -0.33 \text{ m}$$

The focal length of the lens for correcting distant vision = – 0.33 m.

Minus sign of focal length tells us that it is a concave lens.

For correcting near vision

Power, P = + 3 D

Using P = (1/*f*) where *f* = focal length of the lens.

$$\Rightarrow \quad f = (1/3) = +0.33 \text{ m}$$

The focal length of the lens for correcting distant vision = + 0.33 m.

Plus sign of focal length tells us that it is a convex lens.

Q. 3. Why is Tyndall effect shown by colloidal particles? State four instances of observing the Tyndall effect.

[CBSE Delhi, Set 1, 2020]

Ans. The Tyndall effect is the scattering of light as a light beam passes through a colloid. The individual suspension particles scatter and reflect light, making the beam visible.

(i) The visible beam of headlights in fog is caused by the Tyndall effect. The water droplets scatter the light, making the headlight beams visible.

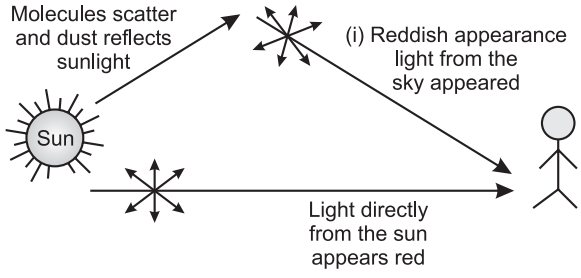
(ii) The Tyndall effect is used in commercial and lab settings to determine the particle size of aerosols.

(iii) Opalescent glass displays the Tyndall effect. The glass appears blue, yet the light that shines through it appears orange.

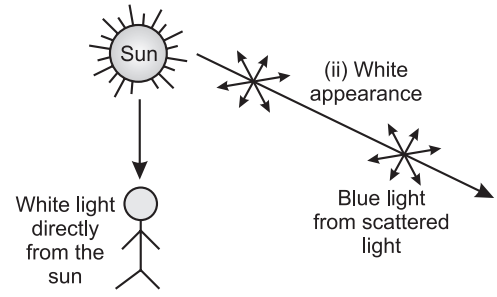
(iv) Blue eye colour is from Tyndall scattering through the translucent layer over the eye's iris.

Q. 4. Draw a labelled diagram to show (i) reddish appearance of the sun at the sunrise or the sunset and (ii) white appearance of the sun at noon when it is overhead. [CBSE Delhi, Set 1, 2020]

Ans. **(i)** During sunrise and sunset, the rays have to travel a larger part of the atmosphere because they are very close to the horizon. Therefore, light other than red is mostly scattered away. Most of the red light, which is the least scattered, enters our eyes. Hence, the sun and the sky appears red.



(ii) At noon, the sun is overhead in the sky and the light coming from the sun travels a relatively shorter distance through the atmosphere to reach the earth. As the light coming from the overhead sun contains almost all its component colours in the right proportion, the sun appears white to us at noon.



Q. 5. The near point of the eye of a person is 50 cm. Find the nature and power of the corrective lens required by the person to enable him to see clearly the objects placed at 25 cm from the eye.

[CBSE Delhi, Set 3, 2020]

Ans. It is the case of hypermetropia.

For a hypermetropic eye, $u = -25$ cm and $v = -50$ cm

Using lens formula

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

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

$$\Rightarrow \quad \frac{1}{f} = \frac{1}{50}$$

We get focal length is $f = 50$ cm $= 0.5$ m

From the formula, $P = \frac{1}{f}$

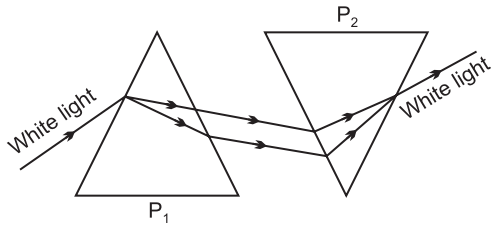
$$\Rightarrow \quad P = \frac{1}{0.5} = 2 \text{ D}$$

So the power of the lens is 2 dioptre and the nature of lens is a converging lens or a convex lens.

Q. 6. What happens to a beam of white light when it gets refracted through glass prism? Which colour deviates the most and the least after refraction through a prism? What is likely to happen if a second identical prism is placed in an inverted position with respect to the first prism. Justify your answer.

[CBSE OD, Set 3, 2019]

Ans. When white light is refracted through a glass prism, it gets split into its constituting colours at different angles. This phenomenon is called Dispersion of Light. Forming a rainbow,



Least deviated colour is red whereas most deviated colour is violet.

When second identical prism is placed in an inverted position with respect to first prism, recombination of the spectrum will take place and white light will be obtained.

Q. 7. A student needs spectacles of power –0.5 D for the correction of his vision.

(i) Name the defect in vision the student is suffering from.

(ii) Find the nature and focal length of the corrective lens.

(iii) List two causes of this defect.

[CBSE OD, Set 3, 2019]

Ans. **(i)** Myopia.

(ii) Concave lens with the focal length of 200 cm

Given, $P = -0.5$ D

We have,

$$P = \frac{1}{f} \text{ m}$$

$$f = \frac{1}{P} = \frac{1}{(-0.5)}$$

$$f = -2 \text{ m}$$

$$\Rightarrow \quad f = -200 \text{ cm}$$

(iii) Two causes of Myopia are:

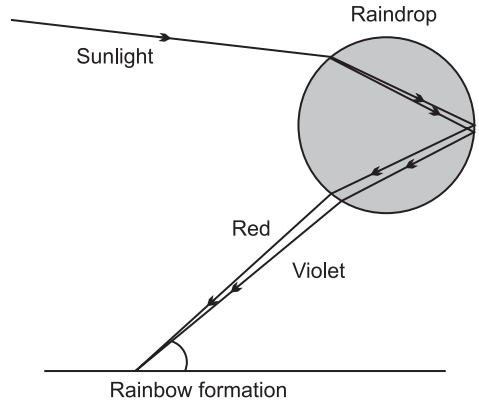
1. Elongation of eye ball.

2. High converging power of eye lens.

Q. 8. What is a rainbow? Draw a labelled diagram to show the formation of a rainbow.

[CBSE Delhi, Set 1, 2019]

Ans. The Rainbow is a natural phenomenon in which the white light or sunlight splits into beautiful 7 colours by the water droplets which remain suspended in air after rain.



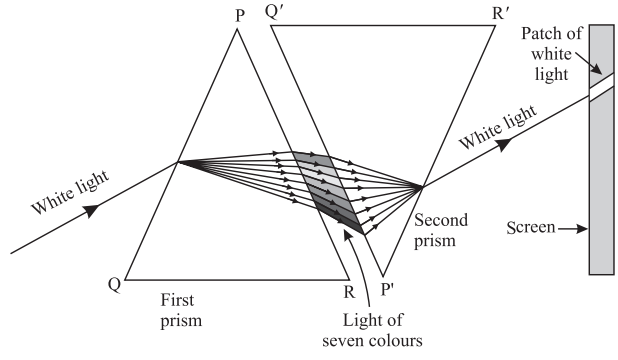
Q. 9. State the cause of dispersion of white light by a glass prism. How did Newton, using two identical glass prisms show that white light is made of seven colours? Draw a ray diagram to show the path of a narrow beam of white light, through a combination of two identical prisms arranged together in inverted position with respect to each other, when it is allowed to fall obliquely on one of the faces of the first prism of the combination.

[CBSE OD, Term 2, Set 1, 2017]

[CBSE Delhi, Term 2, Set 3, 2016]

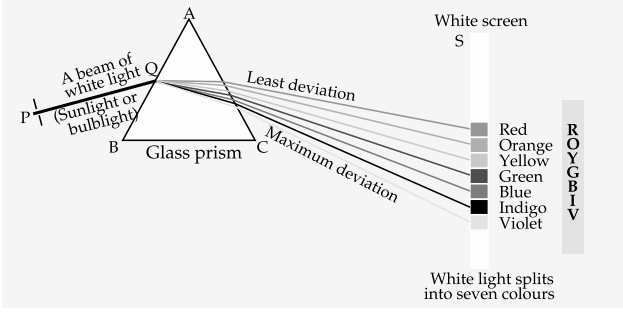
Ans. When a beam of white light enters a prism, it gets refracted at point and splits into its seven constituent colours. This splitting of the white light occurs because of different angles of bending for each colour and this different angles of bending occurs because different components of light have different refractive indices when passing through the glass prism.

Firstly, Newton made white light to fall on a prism, this cause dispersion of white light into seven colours. Newton then placed an inverted prism in the path of a colour band of seven colours. Only a beam of white light comes out from the second prism. So, Newton concluded that white light comprises of seven component colours.



Q. 10. What is 'dispersion of white light'? State its cause. Draw a ray diagram to show the dispersion of white light by a glass prism. [CBSE OD, Term 2, Set 2, 2017]

Ans. The phenomenon of splitting of white light into its seven constituent colours, when it passes through a glass prism, is called the dispersion of light.

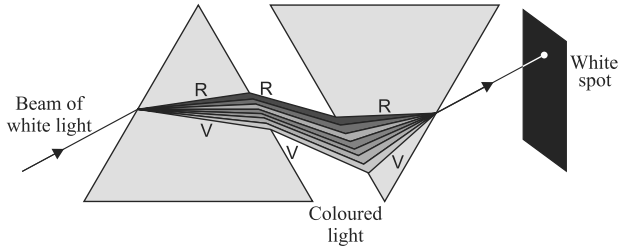


When a beam of white light enters a prism, it gets refracted at point and splits into its seven constituent colours *i.e.*, violet, indigo, blue, green, yellow, orange and red *i.e.*, VIBGYOR. This splitting of light rays occurs because of the different angles of bending for each colour and this different angles of bending occurs because different components of light have different refractive indices or speed of different colours is different in glass when passing through the glass prism. When a beam of sunlight is allowed to fall on one of the rectangular surfaces of the glass prism, we obtain a coloured spectrum with red and violet colour at its extremes.

Q. 11. What is "dispersion of white light"? Draw a labelled diagram to illustrate the recombination of the spectrum of white light. Why is it essential that the two prisms used for the purpose should be identical and placed in an inverted position with respect to each other?

[CBSE OD, Term 2, Set 3, 2017]

Ans. The phenomenon of splitting of white light into its constituent colours on passing through a prism is known as the dispersion of white light. This splitting of the light rays occurs because of the different angles of bending for each colour and this different angles of bending occurs because different component of light faces different refractive index (or speed of different colours is different) when passing through the glass prism.



It is essential that the two prisms used for the purpose should be identical and placed in an inverted position with respect to each other so that the second prism completely nullifies the dispersion caused by the first prism and we get pure white light.

Q. 12. Due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens a certain defect of vision arises. Write the name of this defect. Name the type of lens required by such persons to improve the vision. Explain the structure and function of such a lens.

[CBSE Delhi, Term 2, Set 1, 2017]

Ans. The defect caused due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens is **presbyopia**. Presbyopia is the defect of eye in which a person cannot see nearby objects comfortably and distinctly without corrective eye glasses. A presbyopic eye has its near point greater than 25 cm and gradually increases as the eye becomes older. The type of lens required by such person to improve the vision is bifocal lens.

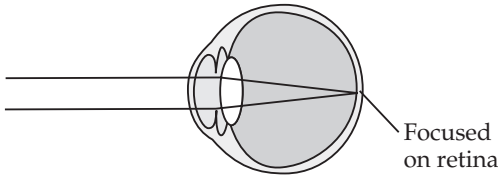
A bifocal lens consists of both convex and concave lenses. The convex lens used in bifocal lens is used to correct hypermetropia (far sightedness) and concave lens is used to correct myopia (near sightedness).

Q. 13. 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?

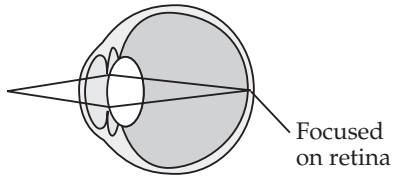
[CBSE Delhi, Term 2, Set 3, 2017]

Ans. The ability of the eye to see object, at varying distances, clearly by adjusting the focal length of its lens is called power of accommodation.

The focal length of the human eye can change *i.e.* increase or decrease, depending on the distance of objects and due to this the image distance in the eye does not change. When the distance of an object is changed from the eye, it is the ciliary muscles that modify the curvature of the lens to change its focal length.



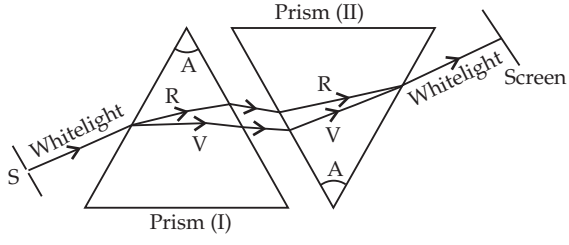
Distant object



Near object

Q. 14. 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 diagram to show the recombination of the spectrum of white light. [CBSE OD, Term 2, Set 1, 2016]

Ans.



Two prisms (I) and (II) of same material are used with same refracting angle (A). They are arranged as shown in the above figure. Sunlight from a narrow slit 'S' falls on the first prism and gets dispersed into constituent colours (VIBGYOR). Now this dispersed light falls on the second prism so that it deviates the light upwards. It is found that the light coming out from the second prism is almost white and is in direction parallel to the direction of light incident on the first prism. Thus prism (I) and prism (II) combined together effectively act like a parallel sided glass slab. This shows that prism (I) disperses the white light into its constituent colours so it is called dispersing prism and prism (II) recombines these colours to form white light so it is called recombination prism.

Q. 15. Why does the sun appear reddish early in the morning? Will this phenomenon be observed by an observer on the moon? Justify your answer with a reason.
[CBSE Delhi, Term 2, Set 1, 2016]

Ans. Early in the morning, the sun is near the horizon, sunlight reaches us after travelling a longer distance through thick layers of atmosphere. Thus, most of the blue light and shorter wavelength light are scattered away by the particles in the atmosphere. The light that reaches us is of longer wavelength giving reddish appearance.

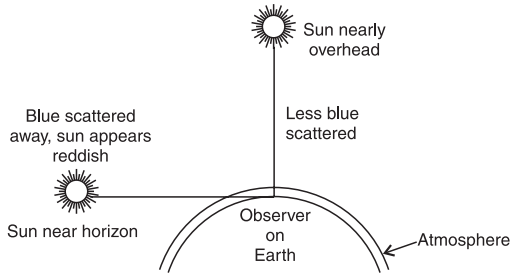
No, because of absence of atmosphere this phenomenon will not be observed on moon.

Q. 16. What is meant by scattering of light? Use this phenomenon to explain why the clear sky appears blue or the sun appears reddish at sunrise.
[CBSE Delhi, Term 2, Set 2, 2016]
[CBSE OD, Term 2, Set 1, 2015]

Ans. Scattering of light is the phenomenon by which a beam of light is redirected in many different directions when it strikes minute particles in the atmosphere.

The light from sun has to travel a long distance of the earth's atmosphere before reaching us. As light travels through the atmosphere, it gets scattered in different direction by the air molecules present in its path. The blue light due to its short wavelength is scattered more as compared to the red light of long wavelength. Thus the light

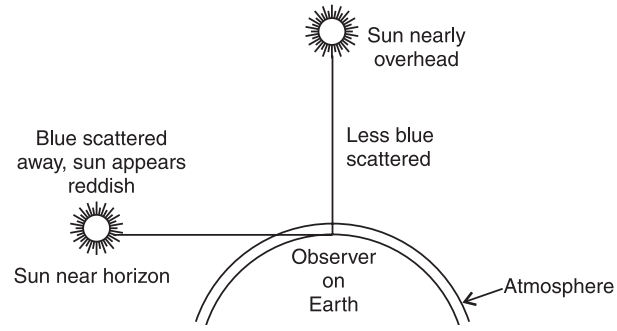
reaching our eye directly from sun is rich in red colour, while the light reaching our eye from all other directions is the scattered blue light. Therefore the sky in direction, other than the direction of sun, is seen blue.



Q. 17. With the help of a labelled diagram, explain why the sun appears reddish at the sun-rise and the sun-set.

[CBSE Delhi, Term 2, Set 1, 2015]

Ans.



At the time of sunrise and sunset, when the sun is near the horizon, the sunlight has to travel the greatest distance through the atmosphere to reach us. During this long journey of sunlight, most of the shorter wavelength blue-colour present in it is scattered out and away from our line of sight. So, the light reaching us directly from the rising sun or setting sun consists mainly of longer wavelength red colour due to which the sun appears red during sun-rise and sun-set.

Long Answer Type Questions (5 marks each)

Q. 1. When do we consider a person to be myopic or hypermetropic? List two causes of hypermetropia. Explain using ray diagrams how the defect associated with hypermetropic eye can be corrected.

[CBSE OD, Set 1, 2019]

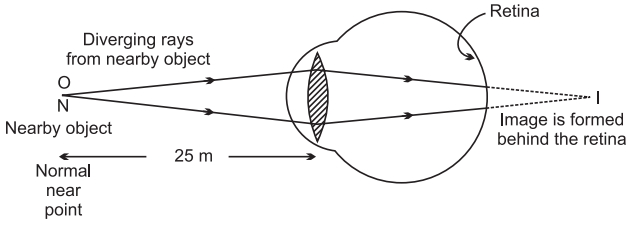
Ans. Myopia is the defect in vision in which a person cannot see the distant objects clearly whereas in hypermetropia is the defect in which a person cannot see near-by objects clearly.

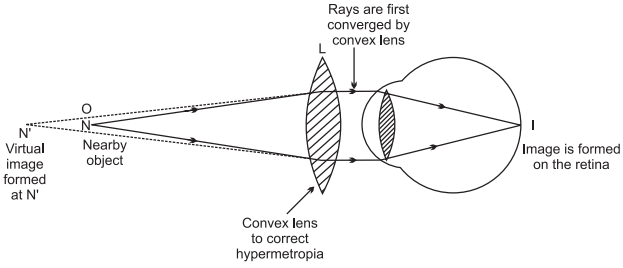
Hypermetropia is caused due to:

(i) Decrease in converging power of eye-lens.

(ii) Too short eye ball.

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





Hypermetropia and its correction by using convex lens.

Hypermetropic eye can be corrected using convex lenses. When a convex lens of suitable power is placed in front of hypermetropic eye, then the diverging rays of light from the object are converged first by the convex lens used. This form a virtual image of the object at another near point N′.

Now, the rays can be easily focused by the eye lens to form an image on retina.

Q. 2. (a) What is scattering of light? Explain how the colour of the scattered light depends on the size of the scattering particles.

(b) Explain the reddish appearance of the Sun at sunrise or sunset. Why does it not appear red at noon?

[CBSE OD, Set 2, 2019]

Ans. **(a)** Scattering of light is the phenomenon in which a part of the incident light is dispersed in different directions.

Dependence of colour and scattered light on the size of particles:

(i) When the particles like dust and water droplets present in the atmosphere are large in size, the scattered light appears white.

(ii) When the particles are extremely minute in size, they will scatter blue light present in the white sunlight.

(b) The reddish appearance of the sun at sunrise and sunset is due to the scattering of blue colour present in the sunlight away from our line of sight and leaves behind mainly red colour of the direct sunlight which reaches human eye.

The reason for Sun not appearing red at the noon is that the light has to travel a relatively shorter distance through the atmosphere to reach us and therefore, only a litte of blue colour of the white light is scattered.

Q. 3. (a) A student is unable to see clearly the words written on the blackboard 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.

(b) Why do stars twinkle? Explain.

[CBSE, 2018]

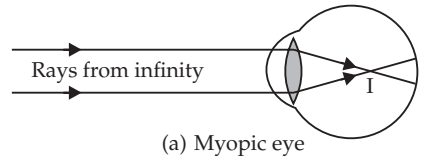
Ans. **(a)** The boy is suffering from myopia.

This defect is caused due to:

(i) increase in length of eyeball, and

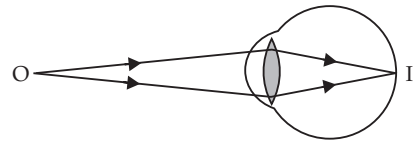
(ii) decrease in focal length of eye lens, when the eye is fully relaxed.

Correction: The image of a distant object (*i.e.*, at infinity) is formed in front of the retina of eye suffering from myopia as shown in figure (a).



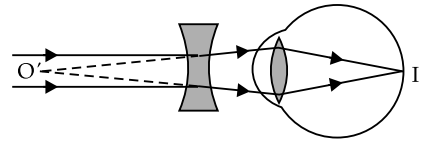
(a) Myopic eye

As the image of the object lying at infinity is not formed on the retina of the eye, so such object can not be seen clearly by the myopic eye. The far point of such an eye is near to the eye as shown in fig. (b).



(b) Far point of a myopic eye

This defect can be corrected by using a concave lens (minus powered) of suitable focal length. So, a man suffering from this defect wears spectacles having concave lens of suitable focal length. The concave lens diverges the rays of light entering the eye from infinity. Hence, this lens makes the rays of light appear to have come from the far point (O′) of the defective eye as shown in figure (c).



(c) Correction of myopia

(b) The twinkling of a star is due to atmospheric refraction of starlight. The atmospheric refraction occurs in a medium of gradually changing refractive index.

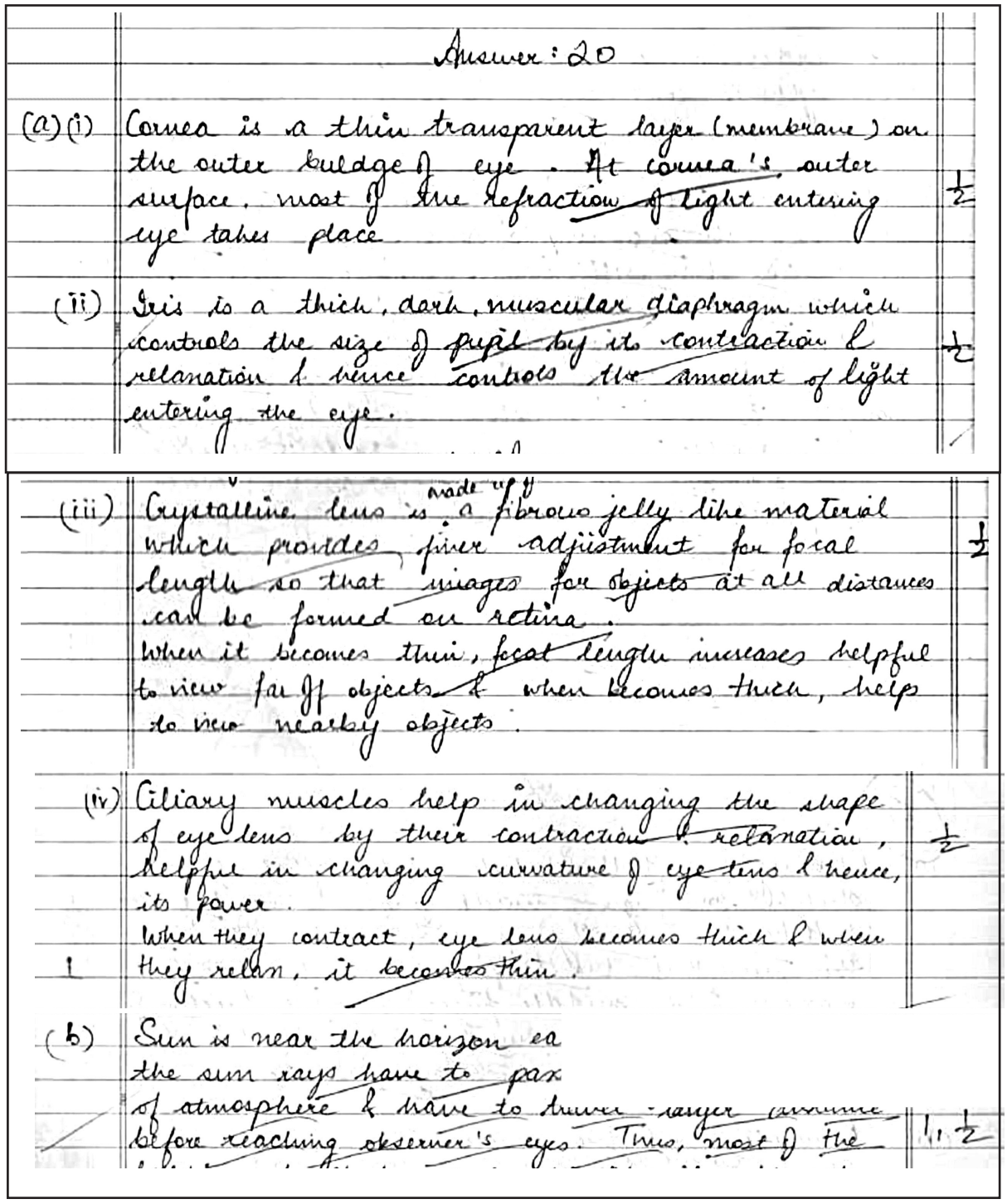
Since the atmosphere bends starlight towards the normal, the apparent position of the star is slightly different from its actual position. This apparent position of the star is not stationary, but keeps on changing slightly, as the physical conditions of the earth's atmosphere are not stationary. Since the stars are very distant, they approximate point-sized sources of light. As the path of light rays coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight

entering the eye flickers i.e., the star sometimes appear brighter, and at some other time, fainter, which is the twinkling effect.

Q. 4. (a) Write the function of each of the following parts of human eye:
(i) Cornea (ii) Iris
(iii) Crystalline lens
(iv) Ciliary muscles

(b) Why does the sun appear reddish early in the morning? Will this phenomenon be observed by an astronaut on the Moon? Give reason to justify your answer. [CBSE, 2018]

Topper's Answers



Answer: 20

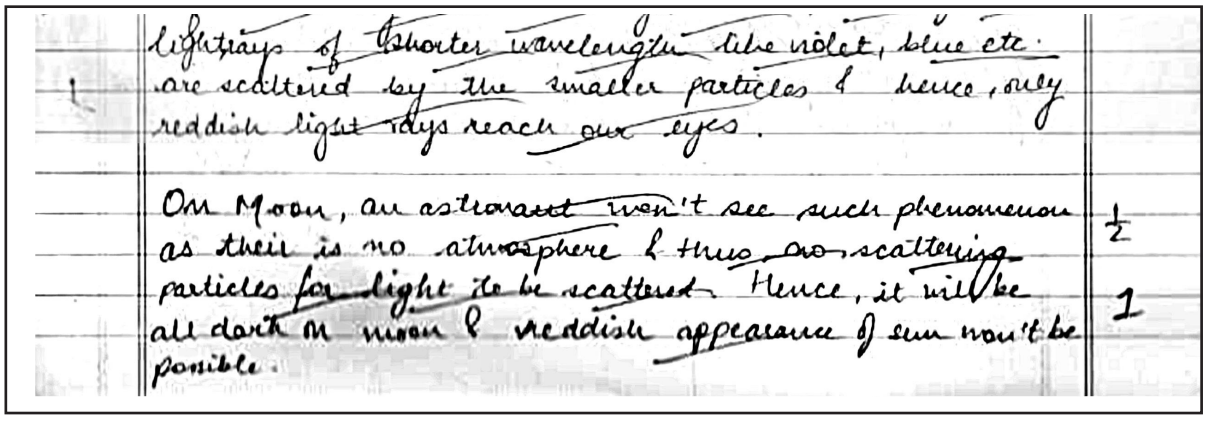
(a)(i) Cornea is a thin transparent layer (membrane) on the outer bulge of eye. At cornea's outer surface, most of the refraction of light entering eye takes place. ½

(ii) Iris is a thick, dark, muscular diaphragm which controls the size of pupil by its contraction & relaxation & hence controls the amount of light entering the eye. ½

(iii) Crystalline lens is made of a fibrous jelly like material which provides finer adjustment for focal length so that images for objects at all distances can be formed on retina. ½
When it becomes thin, focal length increases helpful to view far off objects & when becomes thick, helps to view nearby objects.

(iv) Ciliary muscles help in changing the shape of eye lens by their contraction & relaxation, ½
helpful in changing curvature of eye lens & hence, its power.
When they contract, eye lens becomes thick & when they relax, it becomes thin.

(b) Sun is near the horizon ea
the sun rays have to pas
of atmosphere & have to travel greater distance
before reaching observer's eyes. Thus, most of the 1, ½


light rays of shorter wavelength like violet, blue etc. are scattered by the smaller particles & hence, only reddish light rays reach our eyes.

On Moon, an astronaut won't see such phenomenon as there is no atmosphere & thus no scattering particles for light to be scattered. Hence, it will be all dark on moon & reddish appearance of sun won't be possible. ½ 1

Ans. (a) (i) Cornea: It is a thin membrane, covering the surface of eyeball, through which light enters. It acts as a primary lens, which provides the refraction for light rays entering the eye.

(ii) Iris: It is a dark muscular diaphragm that controls the size of the pupil and is located just behind the cornea in the eye.

(iii) Crystalline lens: It is converging in nature, made by the jelly-like proteinaceous material. The focal length of the crystalline lens is changed by the ciliary muscles. Its function is to focus the incoming light rays from the object on the retina using its refractive property.

(iv) Ciliary muscles: It modifies the curvature and thereby the focal length of the eye lens by contracting or relaxing itself to focus the image of an object on the retina according to the distance of the object. It also holds the eye lens in position.

(b) At the sunrise, the light from the sun has to travel the longest distance to reach the observer. Therefore, the sun looks almost reddish because only red colour ($\lambda_b < \lambda_r$) which is least scattered, is received by our eye and appears to come from the sun. Hence, the appearance of the sun at the sunrise, near the horizon looks almost reddish.

This phenomenon will not be observed by an astronaut on Moon, since there is no atmosphere so no scattering of light takes place, thus the Sun appears dark.

Q. 5. (a) A student suffering from myopia is not able to see distinctly the objects placed beyond 5 m. 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.

[CBSE OD, Term 2, Set 1, 2017]

Ans. (a) Two possible reasons due to which this defect of vision may have arisen are:

- Increase in curvature of the lens.
- Elongation of the eyeball.

(i) A myopic eye has its far point nearer than infinity. It forms the image of a distant object in front of the retina as shown below:

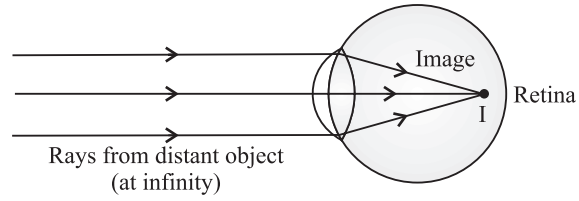


Image is formed in front of retina.

In the given case, student's far point is 5 m. So, image of the object placed beyond 5 m from his eyes is formed in front of the retina and object appears blurred. That is why the student is unable to see distinctly the objects placed beyond 5 m from his eye.

(ii) Since a concave lens has an ability to diverge the incoming rays. Therefore, it is used to correct this defect of vision. The image is formed at the retina by the use of a concave lens of suitable power as shown.

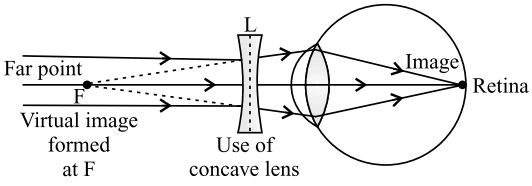


Image is formed on retina

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

$$P = -\frac{1}{5} = -0.2 \text{ D.}$$

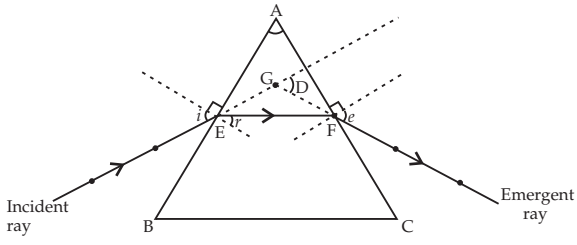
Q. 6. (a) Draw a ray diagram to explain the term angle of deviation.

(b) Why do the component colours of incident white light split into a spectrum while passing through a glass prism, explain.

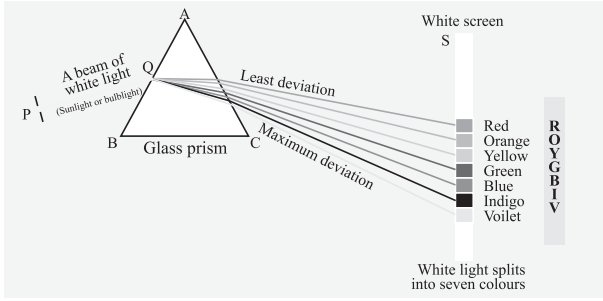
(c) Draw a labelled ray diagram to show the formation of a rainbow.

[CBSE Delhi, Term 2, Set 1, 2017]

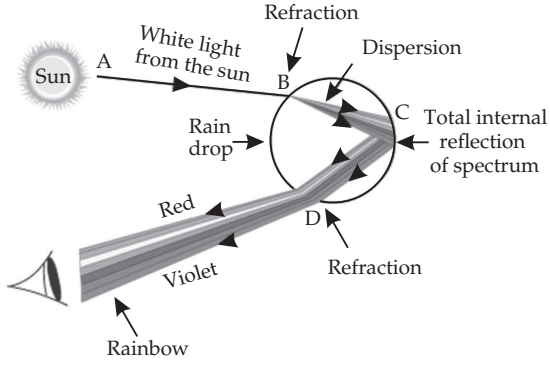
Ans. (a) The angle between incident ray, produced forward and emergent ray, produced backward is called angle of deviation D.



(b) The splitting up of white light into its constituent colours on passing through a refracting medium like a glass prism is called dispersion of light. The dispersion of white light occurs because different colours of light bend through different angles with respect to the incident ray, as they travel with different speeds in a prism. The red light bends the least while the violet light the most as shown below



(c) The given diagram shows the formation of rainbow in the sky.



Q. 7. 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.

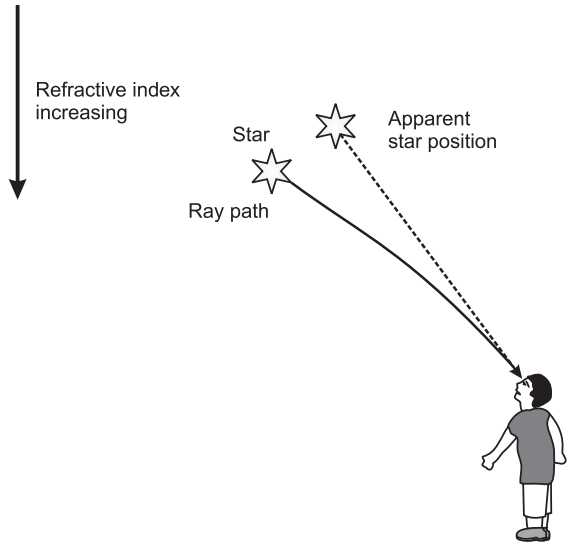
Draw diagrams to illustrate your answers.

[CBSE OD, Term 2, Set 1, 2016]

Ans. Atmospheric refraction: Refraction of light caused by the earth's atmosphere due to change in the refractive indices of different layers.

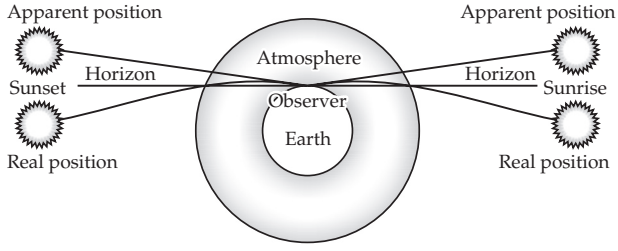
(a) Twinkling of Stars: Stars are distant point sized source of light. The path of the rays of light coming from the star goes on varying due to atmospheric refraction. Thus apparent position of the stars fluctuates and the

amount of star light entering the eye flickers giving the twinkling effect.



(b) Advanced sunrise: When the sun is slightly below the horizon, light rays coming from the sun travel from the rarer to denser layers of air. Because of atmospheric refraction of light, light appears to come from a higher position above the horizon. Thus, sun appears to rise earlier than actual sunrise.

Delayed sunset: A similar phenomenon occurs at the time of sunset.



Q. 8. (a) Write the function of each of the following parts of human eye: Cornea; iris; crystalline lens; ciliary muscles.

(b) 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?

(i) State the objective of organising such campaigns.

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

[CBSE Delhi, Term 2, Set 1, 2016]

Ans. (a) Cornea: Refracts the rays of light falling on the eye.

Iris: Controls the size of the pupil and thus the amount of light reaching the retina.

Crystalline lens: Focuses the image of the object on the retina.

Ciliary muscles: Holds the eye lens and adjusts its focal length.

(b) (i) These campaigns are organised to make people aware and realise their duties towards society.

(ii) Following arguments can be given:

- One person can give sight to two people.
- Our eyes can live even after our death.

Q. 9. Write the importance of ciliary muscles in the human eye. Name the defect of vision that arises due to 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) In your opinion, in what way can Akshay express his gratitude towards the teacher and Salman?

[CBSE OD, Term 2, Set 1, 2015]

Ans. Ciliary muscles modify the curvature of the eye lens to enable the eye to focus objects at varying distances.

The defect of vision that arises due to gradual weakening of the ciliary muscles in old age is presbyopia and it can be corrected by using a bi-focal lens of suitable power.

(a) Akshay is suffering from myopia or near sightedness and it can be corrected by using a concave lens of suitable power.

(b) By thanking the teacher and Salman.

Q. 10. 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

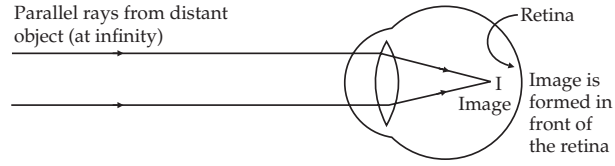
(ii) for its correction.

[CBSE Delhi, Term 2, Set 1, 2015]

Ans. The boy is suffering from myopia or near sightedness and it can be corrected by using a concave lens of suitable power.

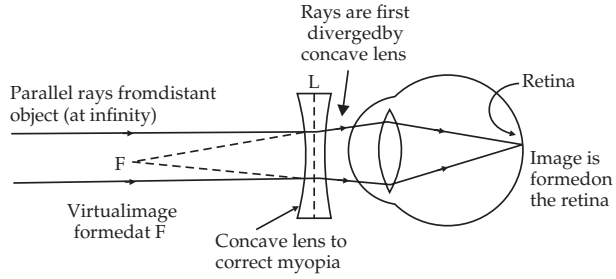
The required ray diagrams are given below:

(i)



Myopic Eye

(ii)



Correction of Myopia