Grade X - Science

Lesson 10. Human Eye and Colourful World

Objective Type Questions

(1 Mark each)

I. Multiple choice questions

1. When we enter a dark room coming from outside, immediately the things inside the room do not appear clear to our eyes. This is because
   a. Pupils do not open at all in the dark
   b. Pupils take time to adjust.
   c. light travels slower in a dark room.
   d. pupils open very quickly in the dark.
2. When light rays enter the eye, most of the refraction occurs at the
   a. crystalline lens
   b. outer surface of the cornea.
   c. iris.
   d. pupil.
3. The focal length of the eye lens increases when eye muscles
   a. are relaxed and lens becomes thinner.
   b. contract and lens become thicker.
   c. are relaxed and lens becomes thicker.
   d. contract and lens become thinner.
4. A person cannot see distinctly objects kept beyond 2 m. This defect can be corrected by using a lens of power
   a. +0.5 D. **b. -0.5 D.** c. +0.2 D. d. -0.2 D.
5. The human eye can focus objects at different distance by adjusting the focal length of the eye lens. This is due to
   a. presbyopia **b. accommodation.**
   c. nearsightedness d. farsightedness.

6. The muscular diaphragm that controls the size of the pupil is

a. Cornea b. ciliary muscles **c. iris** d. retina

7. Having two eyes facilitates in

A : Increasing the field of view

B : Brining three dimensional view

C : Developing the concept of distance/size

Then the correct option is/are

a. A only b. A and B only c. B only d. A,B and C

8. The black opening between the aqueous humour and the lens is called

a. retina b. iris c. cornea **d. pupil**

9. Near and far points of a young person normal eye respectively are:

a. 0 and infinity b. 0 and 25 cm

c. 25 cm and infinity d. 25 cm and 150 cm.

10. The defect of vision in which the person is able to see distant object distinctly but cannot see nearby object clearly is called

a. Long sightedness b. Far-sightedness **c. Hypermetropia** D. All above

11. Myopia and hypermatropia can be corrected by

a. Concave and plano-convex lens **b. Concave and convex lens**

c. Convex and concave lens d. Plano- concave lens for both defects

12. Bi-focal lens are required to correct

a. astigmatism b. coma

c. myopia d. presbyopia

13. The defective eye of a person has near point 0.5m and point 3 m. The power far corrective lens required for (i) reading purpose and (ii) seeing distant objects, respectively are:

a. 0.5 D and +3D **b. +2D and $-\frac{1}{3}$ D**

c. -2D and $+\frac{1}{3}$D d. 0.5 D and -3.0 D

14. The image formed on the retina of the human eye is

a. virtual and inverted **b. real and inverted**

c. real and erect d. virtual and erect

15. When white light enters a prism, it gets split into its constituent colours. This is due to

a. different refractive index for different wavelength of each colour.

b. each colours has same velocity in the prism

c. Prism material has high density.

d. Scattering of light.

16. The air layer of atmosphere whose temperature is less than the hot behaves as optically.

a. denser medium b. rarer medium

c. inactive medium d. either denser or rarer medium

17. Refraction of light the earth's atmosphere due to variation in air density is called

a. atmospheric reflection b. atmospheric dispersion

c. atmospheric scattering **d. atmospheric refraction**

18. The deflection of light by minute particles and molecules of the atmosphere in all direction is called _____ of light.

a. dispersion **b. Scattering** c. interference D. tyndall effect

19. One cannot see through the fog, because

a. refractive index of the fog is very high

b. light suffers total reflection at droplets

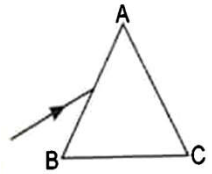
c. fog absorbs light

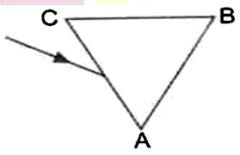
d. light is scattered by the droplets

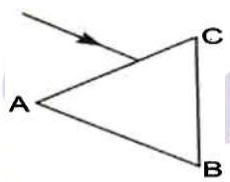
20. A person cannot see distinctly objects kept beyond 2 m. This defect can be corrected by using a lens of power.

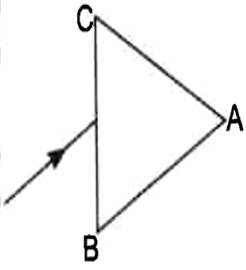
a. + 0.5 D **b. – 0.5 D** c. + 0.2 D D. – 0.2 D

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

a. 

b. 

c. 

d. 

Ans. b

22. At noon the sun appears white as

a. light is least scattered

b. all the colours of the white light are scattered away

c. blue colour is scattered the most

d. red colour is scattered the most

23. Twinkling of stars is due to atmospheric

a. dispersion of light by water droplets

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

c. scattering of light by dust particles

d. internal reflection of light by clouds

24. The clear sky appears blue because

a. blue light gets absorbed in the atmosphere.

b. ultraviolet radiations are absorbed in the atmosphere.

c. violet and blue light get scattered more than lights of all other colours by the atmosphere.

d. light of all other colours is scattered more than the violet and blue colour light by the atmosphere.

25. The danger signals installed at the top of tall buildings are red colour. These can be easily seen from a distance because among all other colours, the red light

a. is scattered the most by smoke of fog

b. is scattered the least by smoke or fog

c. is absorbed the most by smoke or fog

d. moves fastest in air

26. The bluish colour of water in deep sea is due to

a. the presence of algae and other plants found in water

b. reflection of sky in water.

c. scattering of light

d. absorption of light by the sea.

27. When light rays enter the eye, most of the refraction occurs at the

a. crystalline at the

b. outer surface of the cornea

c. iris

d. pupil

28. The focal length of the eye lens increases when eye muscles

a. are relaxed and lens becomes thinner

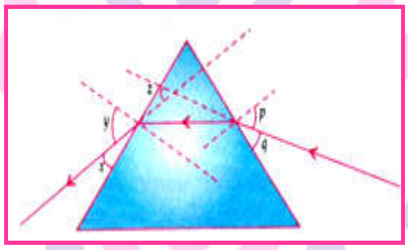
b. contract and lens becomes thicker

c. are relaxed and lens becomes thicker

d. contract and lens becomes thinner

II. Multiple choice questions

1. 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 and z b. x, q and z **c. p, y and z** d. p, z and y

2. Which of the following phenomena of light are involved in the formation of a rainbow?

a. Reflection, refraction and dispersion

b. Refraction, dispersion and total internal reflection

c. Refraction, dispersion and internal reflection

d. Dispersion, scattering and total internal reflection.

3. Twinkling of stars is due to atmospheric:

a. dispersion of light by water droplets.

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

c. scattering of light by dust particles.

d. internal reflection of light by clouds.

4. At noon the sun appears white as:

a. light is last scattered.

b. all the colours of the white light are scattered away.

c. blue colour is scattered the most.

d. red colour is scattered the most.

5. The clear sky appears blue because:

a. blue light gets absorbed in the atmosphere.

b. ultraviolet radiations are absorbed in the atmosphere.

c. violets and blue light get scattered more than light of all other colours by the atmosphere.

d. light of all other colours is scattered more than the violet and blue colour light by the atmosphere

6. In an experiment to trace the path of a ray of light through a triangular glass prism, a student would observe that the emergent ray.

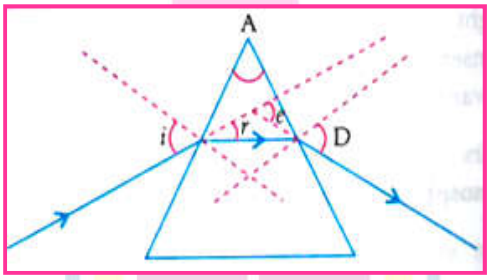
a. is parallel to the incident ray.

b. is along the same direction of incident ray.

c. gets deviated and bends towards the thinner part of the prism.

d. gets deviated and bends towards the thicker part(base) of the prism.

7. 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 divation (∠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

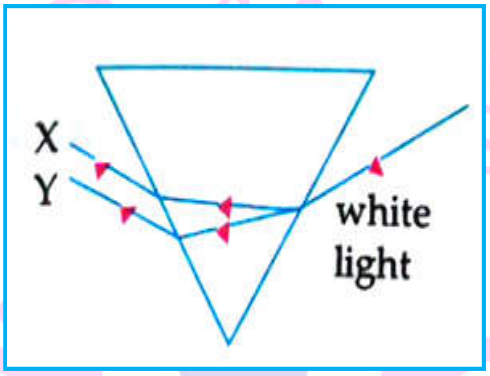
8. In the diagram given below, X and Y are the end colours of the spectrum of white light. The colour of 'Y' represents the

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.



9. What is the frequency of yellow light of wavelength 50 nm, if the speed of light is 3 X 10^8 m/s?

a. 5.4 X 10^{14} Hz

b. 3.4 X 10^{12} Hz

c. 3.0X 10^{14} Hz

d. 2.8 X 10^{12} Hz

10. Choose the incorrect statement.

a. In primary rainbow, red colour if formed on the outside and violet colour on the inside.

b. A normal human ye cannot clearly see all the object at the different distances.

c. A beam of while light gives a spectrum on passing through a glass slab.

d. Light rays of different colour travel with the same speed in vacuum and air.

I Assertion & Reason

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as.

(A) Both assertion (A) and reason (R) are true and assertion (R) is the correct explanation of (A).

(B) Both assertion (A) and reason (R) are true but assertion (R) is NOT the correct explanation of (A).

(C) Assertion (A) is true but reason (R) is false.

Assertion (A) is false and reason (R) is true.

1. **Assertion (A)** : A white light on passing through prism splits into its component colours as such that the red light emerges nearest to the base of the prism.

Reason (R) : Wavelength of red light is more than other component colours and hence, red light deviates least.

Ans. Option (D) is correct.

2. **Assertion (A)** : In case of rainbow, light at the inner surface of the water drop gets internally reflected.

Reason (R) : The angle between the refracted ray and normal to the drop surface is greater than the critical angle .

Ans. Option (A) is correct

3. **Assertion (A)** : Scattering of light is the reflection of light from an object in all directions.

Reason (R) : The colours of scattered light depends on the size of scattering particles and wavelength of light.

Ans. Option (B) is correct.

4. **Assertion (A)** : A beam of white light gives a spectrum on passing through a glass prism.

Reason (R) : Speed of light outside the prism is different from the speed of light inside the prism

Ans. Option (B) is correct.

II Assertion & Reason

Direction (Q1 to Q4): In the following questions, the Assertion and Reason have been but forward. Read the statements carefully and choose the correct alternative from the following:

(A) Both assertion (A) and reason (R) are true and assertion (R) is the correct explanation of (A).

(B) Both assertion (A) and reason (R) are true but assertion (R) is NOT the correct explanation of (A).

(C) Assertion (A) is true but reason (R) is false.

(D) Assertion (A) is false and reason (R) is true.

1. **Assertion (A)** : Eye lens has the ability to focus clearly on the retina by adjusting its focal length.

   Reason (R) : This phenomenon is known as power of accommodation.

   Ans. Option (A) is correct

2. **Assertion (A)** : A hypermetropic person prefers to remove his spectacles, while driving.

   Reason (R) : When a hypermetropic person wearing the spectacles looks at a distant object, the parallel the spectacles looks at a distant object, the parallel rays from the distant object get converged in front of the retina. This image thus appears blurred.

   Ans. Option (A) is correct.

3. **Assertion (A)** : Concave lens is used to correct myopia or short-sightedness.

   Reason (R) : A concave lens of suitable focal length diverges the parallel rays from the distant objects as if they are coming from the far point of the myopic eye. This helps the eye lens to form a clear image at the retina.

   Ans. Option (A) is correct.

4. **Assertion (A)** : Light from a distant object arriving at the eye lens may get converged at a point in front of the retina.

   Reason (R) : The eye is producing too much divergence in the incident beam.

   Ans. Option (C) is correct.

III. Assertion & Reason

Direction (Q1 to Q6): In the following questions, the Assertion and Reason have been but forward. Read the statements carefully and choose the correct alternative from the following:

(A) Both assertion (A) and reason (R) are true and assertion (R) is the correct explanation of (A).

(B) Both assertion (A) and reason (R) are true but assertion (R) is NOT the correct explanation of (A).

(C) Assertion (A) is true but reason (R) is false.

(D) Assertion (A) is false and reason (R) is true.

1. **Assertion** : Blind spot is a small area of the retina which is insensitive of light where the optic nerve leaves the eye.

   Reason : There are no rods or cones present at the junction of optic nerve and retina in the eye.

   Ans. Option (A) is correct.

2. **Assertion** : The near-point of a hypermetropic eye is more than 25 cm away

   Reason : Hypermetropia is corrected using spectacles containing concave lenses.

   Ans. Option (C) is correct.

3. **Assertion** : Myopia is the defect of vision in which a person cannot see the distant objects clearly.

   Reason : This due to eye-ball being too short.

   Anc. Option (C) is correct.

4. **Assertion** : Concave mirrors are used as reflectors in torches, vehicle head-lights and in search lights.

   Reason : When an object is placed beyond the centre of curvature of a concave mirror, the image formed is real and inverted.

   Ans. Option (B) is correct.

5. **Assertion** : The light emerges from a parallel sided glass slab in a direction perpendicular with that in which enter the glass slab.

   Reason : The perpendicular distance between the original path of incident ray and emergent ray coming out of glass slab is called lateral displacement ray of light

   Ans. Option (D) is correct.

6. **Assertion** : When a pencil is partly immersed in water and held obliquely to the surface, the pencil appears to bend at the water surface.

Reason : The apparent bending of the pencil is due to the refraction of light when it passes from water to air.

Ans. Option (A) is correct.

Fill in the blanks

1. Very fine particles scatter more of _____colour.

   Ans. blue

2. Red light is used for signals as it is ____ scattered.

   Ans. less.

3. Bi-focal lens is used to correct _____ refractive error.

   Ans. Presbyopic.

4. Hypermetropic eye is corrected by using ____ lens.

   Ans. Convex

5. When light falls at critical angle on the surface of a rarer medium while coming from a denser medium, the refracting angle is ____.

   Ans. 90^0

6. The dispersion of white light occurs because colours of white light at different ____ through the glass prism.

   Ans. Speed.

True or False

1. 28 frames are projected per second in motion picture.

   Ans. False

2. Myopia is caused due to excessive curvature in cornea.

   Ans. True

3. A lens of higher focal length has less power.

   Ans. True.

4. Power of accommodation for a normal eye is 4 dioptre.

   Ans. True.

5. The optical nerves carry signals to the brain.

Ans. True.

Match the following

Direction : Match the column I with column II.

Column I	Column II
(i) Twinkling stars	(A) Suspended water drops
(ii) Blue sky	(B) Group of colours
(iii)Rainbow	(C) Scattering
(iv) Spectrum	(D) Changing atmosphere

Ans. (i) (D), (ii) (C), (iii) (A), (iv) (B)

Subjective Type Questions

Very Short Answer Type Questions

(1 mark each)

1. Name the part of the human eye that helps in changing the focal length of the eye lens.

Ans. Ciliary muscles.

2. Name the part of the eye:

(i) Controls the amount of light entering into the eye.

(ii) Forms real, inverted image of the object formed on it.

Ans. (i)Pupil, (ii) Retina

3. What is the nature of the image formed on the retina?

Ans: Real, inverted and diminished in size.

4. A person is advised to wear spectacles with convex lenses. State the defect of vision he is suffering from.

Ans. The person is suffering from hypermetropia.

5. In a human eye, name the following parts:

(a) a thin membrane which allows light to enter the eye.

(b) the muscles which help in changing the focal length of eye lens.

Ans. (a) Cornea (b) Ciliary muscles

6. Name the part of our eyes that helps us to focus near and distant object in quick succession.

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

7. In which direction, the near point of hypermetropic eye is shifted from the normal near point?

Ans. The near point of hypermetropic eye is shifted farther away from the normal near point.

8. Name the part responsible for the power of accommodation of the human eye.

(OR)

Name the component of eye that is responsible for the adjustment of eye lens?

Ans. Ciliary muscles

9. A person suffering from an eye defect uses lenses of power ID. Name the defect he is suffering from and the nature of lens used.

Ans. Hypermetropia; convex lens.

10. What is the nature of eye lens of human eye and that of the image formed at the retina of the eye by it?

Ans. The nature of eye lens in human eye is convex nature of the image formed on the retina by it is real, inverted and diminished.

11. Mention the role of optic nerve in the human eye.

Ans. Role of optic nerve in human eye: It transmits the visual information in the form of electrical signal generated at retina to the brain.

12. What types of lens is used to correct

(a) Hypermetropia, **(b) Myopia?**

Ans. (a) Concave lens (b) Convex lens

13. Name the defect of vision in which the eye-lens loses its power of accommodation due to old age.

Ans. Presbyopia

14. Where do we see (i) concave and (ii) convex lens in bifocal lenses?

Ans. (i) Concave lens ___ Upper part

(ii) Convex lens ___ Lower part.

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15. **A person is able to see objects clearly only when these are lying at distances between 50 cm and 300 cm from his eyes. Name the kind of defects of vision he is suffering from?**

Ans. As person is suffering from both myopia and hypermetropia defect then this eye defect is presbyopia.

16. **Which component of white light is least scattered by fog or smoke?**

Ans. Red colours.

17. **Do all transparent bodies disperse light?**

Ans. No, bodies with parallel surfaces do not disperse the light.

18. **Give an example in nature which shows that sunlight may be made of different colours.**

Ans. Formation of rainbow.

19. **Name the phenomena due to which we get light from the sun before sunrise.**

Ans. Atmospheric refraction

20. **Which phenomenon is responsible for making the path of light visible?**

Ans. Tyndall effect.

21. **What is Tyndall effect?**

Ans. The scattering of light by colloidal solution is called Tyndall effect.

22. **Given an example of a phenomenon where Tyndall effect can be observed.**

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

23. **Why does the Sun appear white at noon?**

Ans. The light is least scattered at noon. Due to this reason, the sun appear white at noon.

24. **Name the component of white light that deviates the least and the most while passing through a prism.**

Ans. (i) Least deviation – Red.

(ii) Maximum deviation – Violet.

25. **Name the type of particles which acts as prism in the formation of rainbow in the sky.**

Ans. Water droplets present in the atmosphere.

26. **The sky appears dark to passengers flying at a very high altitude. Why?**

Ans. Due to lack of atmosphere, scattering is not prominent.

Short Answer Type Questions - I

(2 mark each)

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

Ans. Structure: Fibrous, jelly like structure

Role: To change the curvature of eye lens / to change the focal length of eye lens.

2. (a) Write the function of each of the following parts of human eye:

(i) Cornea (ii) Iris (iii) Crystalline lens (iv) Ciliary muscles

Ans.(a) Function of:

(i) Cornea: focuses light rays / permits the light to enter the eye.

(ii) Iris : Controls amount of light entering the eye and the size of pupil.

(iii) Crystalline Lens: Converges light rays at retina.

(v) Ciliary Muscles: Adjusts focal length of eye lens by contraction and relaxation so that sharp image can be obtained on the retina. / helps in accommodation.

3. (a) Which part of the ye has delicate membrane and containing large number of light sensitive cells?

(b) A person is advised to wear spectacles with convex lenses. What type of defect of vision is he suffering from?

(c) What happens to the size of pupil of our eye in (i) dim light, (ii) bright light?

Ans. (i) Retina contains large number of light sensitive cells known as rods and cones.

(ii) Hypermetropia or far-sightedness. In this defect person is unable to see nearby objects clearly due to increase in focal length of eye lens.

(i) Increases (ii) Decreases

4. (a) The near point of a hypermetropic eye is 50 cm. What is the nature and power of the lens required to enable him to read a book placed at 25 cm from the eye?

(b) Name the cells on the retina sensitive to

(i) bright light, (ii) dim light?

Ans. (a) Given: Object distance, u = 25, Image distance, υ = -50 cm, power of lens, p =?

Using lens formula,

$$\frac{1}{f} = \frac{1}{\upsilon} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-50} - \frac{1}{-25}$$

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

Or $f = +50\,cm = +0.5\,m$

The nature of lens is convex.

And power, $P = \frac{1}{f(m)} = \frac{1}{0.5} = +2.0\ D$

(b) (i) Cone cells (ii) Rod cells

5. (a) When a person said to have developed contract? How is the vision of such a person restored?

(b) Give reasons:

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

(ii) Light of red colour are used for danger signals.

Ans. (a) When the crystalline lens of eye becomes hazy (or even opaque) due to the formation of thin membrane over it, this causes partial or complete loss of vision. This defect of eye can be restored by the cataract surgery.

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

(ii) **Danger signals are Red.** The wavelength of red colour is longer among the other colours of visible spectrum of sunlight. According to Rayleigh scattering law (Scattering α $\frac{1}{\lambda^4}$), red colour is least scattered while passing through the atmosphere and therefore, travels large distance, i.e. red colour can be seen through a large distance. Hence, the danger signals make use of red light.

6. (a) In which of the following two cases the focal length of the eye lens will be more-

(i) When ciliary muscles of a normal eye is most relaxed.

(ii) When ciliary muscles of a normal eye is in most contracted state.

Explain with reason.

(b) Why are we not able to see the things clearly when we come out of a darkroom?

The focal length of the eye lens will be more in case (i), i.e When ciliary muscles of a normal

Ans. eye is most relaxed.

(i) **Reason** : When ciliary muscles are relaxed, the eye lens becomes thin. Thus, its focal length increases.

(ii) In case when ciliary muscles is in most contracted state, radius of curvature of eye lens increases. Lens become thicker. This decreases the focal length of eye lens.

(b) In dim light, the iris expands the pupil to allow more light to enter the eye. So, when we come out of a darkroom into the bright sunlight, a large amount of light enters into our

eyes and due to glare feeling, we are not able to see the things clearly. Gradually, the iris contracts the pupil to allow less light to enter the eye to see the objects clearly. It take some time for the pupil. For that time interval, person is unable to see the things.

7. (a) A person can see objects if they are placed at 1.5 m. What kind of lens would be required to read a book at a distance of 25 cm? What kind. eye to form focussed images from the objects that are located at varying distances from the eye? Calculate the power of lens used to correct the defect.

(b) The limitation of an eye is that the distance from the eye lens to where the image formed is always the same. How is then it possible for the eye to form focussed images from the objects that are located at varying distances from the eye?

Ans. (a) According to question, the nearest image scan by the person is 150 cm away from him but he want to see an object placed 25 cm away. Therefore mean point of eye is 150 cm. According eye defect is hypermetropia.

By putting u = -25 cm, v = - 150 cm in the lens formula,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, we get

$$\frac{1}{f} = \frac{1}{-150} - \frac{1}{-25}$$

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

or $f = +50\ cm = +0.5\ m$

The nature of lens is convex.

and power, $P = \frac{1}{f(m)} = \frac{1}{0.5} = +2.0\ D$

(b) (i) Cone cells (ii) Rod cells

8. (a) When a person said to have developed cataract? How is the vision of such a person restored?

(b) Give reasons:

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

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

Ans. (a) When the crystalline lens eye becomes hazy (or even opaque) due to the formation of thin membrane over it, this causes partial or complete loss of vision. This defect of eye is called cataract. The vision of the defect of eye is can be restored by the cataract surgery.

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

(ii) Danger Signal are Red. The wavelength of red colour is longer among the other colours of visible spectrum of sunlight. According to Rayleigh scattering law.

(Scattering $\alpha \frac{1}{\lambda^4}$), red colour is least scattered while passing through the atmosphere and therefore, travels large distance, i.e. red colour can be seen through a large distance. Hence, the danger signals make use of red light.

9. (a) In which of the following two cases the focal length of the eye lens will be more-

(i) When ciliary muscles of a normal eye is most relaxed.

(ii) When ciliary muscles of a normal eye is in most contracted state.

Explain with reason.

(b) Why are we not able to see things clearly when we come out of a darkroom?

Ans. (a) The focal length of the eye lens will be more in case (i), i.e. when ciliary muscles of a normal eye is most relaxed.

(ii) Reason : When ciliary muscles are relaxed, the eye lens becomes thin. Thus, its focal length increases.

In case when ciliary muscles in most contracted state, radius of curvature of eye lens increases. Lens becomes thicker. This decreases the focal length of eye lens.

(b) In dim light, the expands the pupil to allow more light to enter the yes. So, when we come out of a darkroom into the bright sunlight, a large amount of light enters into our eye and due to glare feeling, we not able to see the things clearly. Gradually, the iris contracts the pupil to allow less light to enter the eye to see the objects clearly. It take some time for the pupil. For that time interval, Person in unable to see the things.

10. (a) A person can see objects if they are placed at 1.5 m. What kind of lens would be required to read a book at a distance of 25 cm? What kind. Eye defect is it? Calculate the

power of lens used to correct the defect.

(b) The limitation of an eye is that the distance from the eye lens to where the image Formed is always the same. How is then it possible for the eye to form focussed images from the objects that are located at varying distances from the eye?

Ans. (a) According to question, the nearest image scan by the person is 150 cm away from him but he want to see an object placed 25 cm . Therefore mean point of eye is 150 cm.

According eye defect is hypermetropia.

By putting u = - 25 m, v = - 150 cm in the lens formula,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, we get

$$\frac{1}{f} = \frac{1}{-150} - \frac{1}{-25}$$

$$= -\frac{1}{150} + \frac{1}{25} = \frac{-1+6}{150}$$

$$= -\frac{5}{150} = -\frac{1}{30}$$

$$\Rightarrow \quad f = -30\ cm$$

Now, power, $P = \frac{1}{f(m)} = \frac{100}{f(cm)} = -\frac{100}{30}$

$= -3.3\ D$

(b) The ability of eye lens to adjust its focal length with the help of ciliary muscles, it is possible for the eye to form focussed images from the objects that are located at varying distances from the eye. This mechanism is called accommodation.

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

Or

What is power of accommodation? How ciliary muscles help in accommodation?

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

Help by the ciliary muscles in accommodation:

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

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

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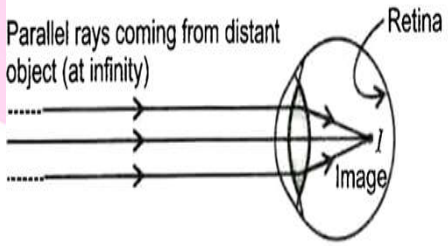
12. (a) What are the values of (i) near point and (ii)far point of normal adult person?

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

Ans. (a) (i) 25 cm (ii) Infinity (∞)

(a) Short-sightedness or myopia: The image in this case form in forms in front of the retina.



13. Explain why?

(a) A myopic person prefer to remove his spectacles while reading a book.

(b) A hypermetropic person prefer to remove his spectacles while looking at the sky.

Ans. (a) A Myopic person does not need spectacles while reading a book as he the near point at 25 cm.

It such person reads the book with corrective If such person reads the book with corrective lens(concave) he will have to keep the book at a distance greater than 25 cm so that the image of book will be formed by the concave lens at 25 cm and moreover, the size of the book appear to him is also smaller than actual size. Therefore, the person prefers to remove his spectacles while reading a book.

(b) A hypermetropic person does not need spectacles to see distant object as he has the far point at infinity.

If such person uses spectacles (convex lens) to see the distant objects, the image will be formed before the retina due to increases in converging power and hence the person cannot see person prefers to remove his spectacles while looking at the sky.

14. (a) Name the defects of vision when a person cannot see clearly:

(i) the nearby objects

(ii) the distant objects

(b) A person suffering from a defect of vision uses a corrective lens of power – 2D. Find thenature and focal length of the corrective lens.

(c) Why does power of eye to see clearly nearby as well as far off object diminishing with age? Name the defects that are likely to arise in eye in such a condition.

Ans. (a) (i) Hypermetropia (ii) Myopia

(b) The nature of corrective lens is concave

Focal length, $f = \frac{100}{p} cm = \frac{100}{-2} = -50\ cm$

(c) Due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens, the as far off object diminishes with age.

In such a condition, the defect of eye is known as presbyopia.

15. The near point of a hypermtropia person is 75 cm from the eye. What is the power of the lens required to enable hi to read clearly a book held at 25 cm from the eye?

Ans. The near of a hypermetropc person is 75 cm so the focusing for objects closer than 75 Cm not possible. The person is far-sighted and can be corrected by convex lens of proper focal length. The near point for a perfect eye is 25 cm, so u = - 25 cm,

v = - 75 cm

Using lens formula, $\frac{1}{f} = \frac{1}{\upsilon} - \frac{1}{u}$ we get

$$\frac{1}{f} = \frac{1}{-75} + \frac{1}{25} = \frac{-1+3}{75} = \frac{2}{75}$$

$$\therefore \quad f = \frac{75}{2} = 37.5\ cm$$

Power of lens, P = $\frac{1}{f(cm)} = \frac{200}{75} = 2.67\ D$

16. If the person in the previous problem, uses spectacles of power + 1.0 dioptre, what is the nearest distance of distinct vision for him?

Ans. Near point = 75 cm and power of lens = + 1 D

$$\therefore \quad P = \frac{100}{f(in\ cm)}$$

$$\Rightarrow \qquad f = \frac{100}{P} = \frac{100}{1} = 100\ cm$$

The distance of distinct vision υ can be found as below.

Using lens formula,

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

$$\Rightarrow \quad \frac{1}{\upsilon} = \frac{1}{f} + \frac{1}{u}$$

$$= \frac{1}{100} + \frac{1}{-75} = \frac{3-4}{300} = \frac{-1}{300}$$

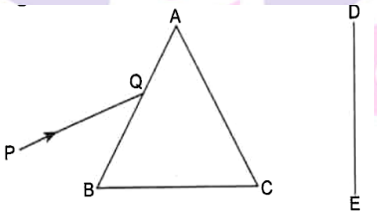
$\upsilon = -300\,cm = -3\,m$

17. You are given three lenses namely, bifocal lens, convex lens and concave lens. Which lens would you prefer to correct the myopia, hypermetropia, and presbyopia respectively?

Ans.

Eye defects	Corrective lenses
Myopia	Concave lens
Hypermetropia	Convex lens
Presbyopia	Bifocal lens

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



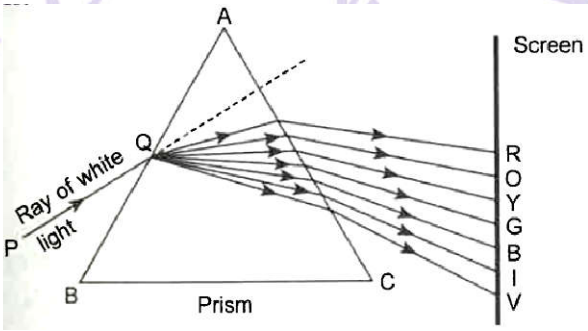
Trace it on your answer sheet and shows the path of the emergent beam as observed on the screen DE.

(i) Write the name and cause of the phenomenon observed.

(ii) Where else in nature is this phenomenon observed?

(iii) Based on this observed, state the conclusion which can be drawn about the constituents of white light.

Ans:



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(i) The splitting of light into its constituent colours is called dispersion. The dispersion of light is caused as the varying speeds of different constituent colours of white light different constituent indices to the material of the prism.

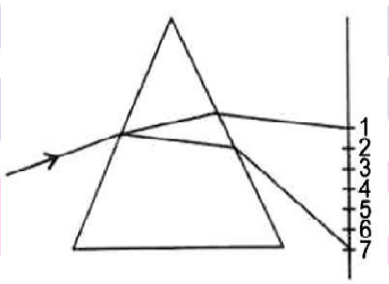
(ii) The formation of rainbow is caused by the dispersion of the sunlight into its constituent colours.

(iii) (a) A beam of white light consists of seven colours.

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

19. A beam of white light falling on a glass prism gets split up into seven colours marked 1 to 7 as shown in the diagram. A student makes the following statement about the spectrum observed on the screen.

The Human Eye and the colourful world



(a) The colours at positions marked 3 and 5 are similar to the colour of the sky and the colour of gold metal respectively.

Is the above statement made by the student correct or incorrect? Justify.

(b) Which two positions correspond closely to the colour of

(i) A brinjal

(ii) 'danger' or stop signal light?

Ans. (a) Incorrect as the student is stating the nature of colours in reverse order i.e. 3 represents the colours of gold metal and 5 represents the colour of the sky.

(b) (i) Colour marked 7 is violet.

(ii) Colour marked 1 is red.

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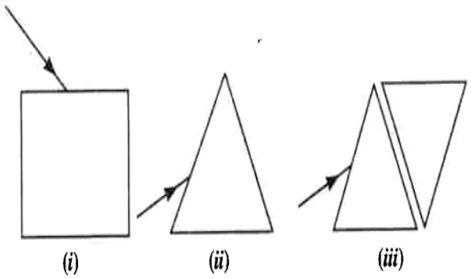
20. (a) A very thin narrow beam of white light is made incident on three glass objects as shown below. Comment on the nature of behaviours of the emergent beam in all three cases.



(b) There is a similarity between two of the emergent beams. Identify the two.

Ans. (a) (i) The emergent beam, refracted through a rectangular glass slab, emerges parallel to the incident ray and is shifted sideward slightly. Therefore, no dispersion occurs.

(ii) A prism splits the incident thin narrow beam of white light into a band of seven colours which are violet, indigo, blue, green, yellow, orange and red. These coloured rays emerge out through the prism along different direction and become distinct; hence the incident white light beam gets dispersed.

(iii) The emergent beam from the second identical inverted prism is a again a beam of white light and emerges parallel to the incident beam and shifted sideward slightly.

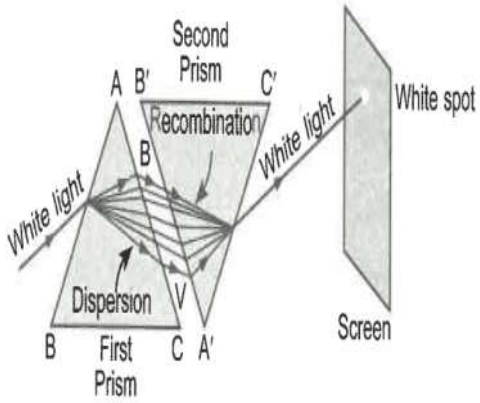
(b) The similarity between the emergent beam in cases (i) and (iii) is the same as in both the cases, the emergent beam is emerges from the opposite parallel faces and parallel to the incident ray.

21. Describe an activity to show that the colours of white light is split 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.

Ans. Recombination of Colours: The colours of white light split by a glass prism. Newton demonstrated this phenomenon of recombination of the coloured rays of a spectrum to get back white light.

(a) A triangular prism ABC is placed on its base BC.

(b) A similar prism A'B'C' is placed alongside with its refracting surface in the opposite direction, i.e. in an inverted position with respect to first prism as shown in figure.



(c)A beam of white light entering the prism ABC undergoes refraction and is dispersed into its constituent seven colours.

(d) These constituent seven coloured rays are incident on the second inverted prism A'B'C' and get further refracted.

(e)The second prism recombines them into a beam of white light and emerges from the other side of the second prism and falls on the screen.

(f)This is due to the fact that the refraction or bending produced by the second inverted prism is equal and opposite to the refraction or bending produced by the first prism. This causes the seven colours to recombine.

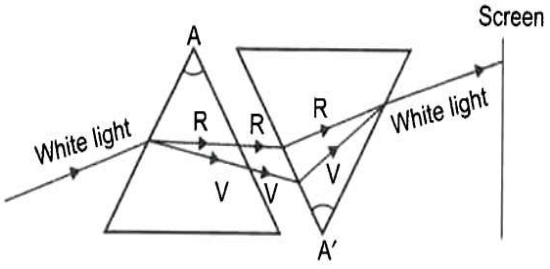
(g)A white patch of light is formed on the screen placed beyond the second prism. This proves the phenomenon of recombination of spectrum of white light.

22. 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.

Or

When we place a glass prism in the path of a narrow beam of white light, a spectrum is obtained. What happens when a second identical prism is placed in an inverted position with respect to the first prism? Draw a labelled ray diagram to illustrate it.

Ans. Spectrum: The band of the coloured components of a white light beam such as violet, indigo, blue, Green, yellow, Orange and Red, is called its spectrum.



We can recombine the components of the white light after a glass prism has separated them by placing a second identical prism in an inverted position with respect to the first prism.

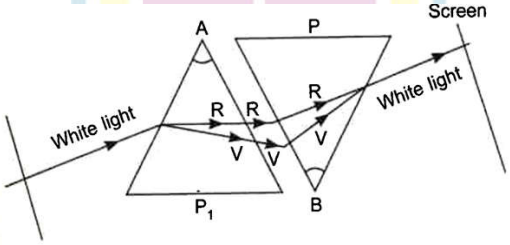
These constituent seven coloured rays refracted by the first prism are incident on the second inverted prism and get further refracted. These coloured rays again recombine by the second prism into a beam of white light, which emerges out from the other side of the second prism.

23. State the case 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, 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.

Ans. Cause of dispersion: From Snell's law of refraction, the angle of refraction of light in a prism depends on the refractive index of the prism material. Moreover, the refractive index of the material varied inversely with the speed of light and so varies inversely with the wavelength of light bend through different angles with respect to the incident light, as they pass through the glass prism.

Newton Experiment: Consider a prism A. When a beam of white light falls obliquely on one of the faces of this prism, it splits up into seven constituent colours. The violet colour deviated the most and the red colour deviated the least.

If another identical prism B is placed in an inverted position with respect to first prism A, the constituent coloured rays that emerge out of prism A will be made to merge together to come out as a beam of white light, as shown below.



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24. 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 required by such persons to improve the vision. Explain the structure and function of such of lens.

Ans.

- The defect of vision is presbyopia.
- Bifocal lens is required by such persons to improve the vision.

Structure and function of Bifocal lens

- To view far off object, the upper part of the bifocal lens is concave or diverging lens.
- To facilitate or view nearby objects, the Lower part of the bifocal lens is convex or converging lens.

25.Explain giving reason why the appear blue to an observer from the surface of the earth. What should the appearance of the sky be international space station orbiting the Earth? State reason to justify your answer.

Or

Explain giving reason why the sky appears blue to an observer from the surface of the earth? What will the colour of the sky be for an astronaut staying in the international space station orbiting the earth? Justify your answer giving reason.

Ans. When sunlight passes through the earth's atmosphere, it is scattered in all directions by the gaseous and blue colour has a shorted wavelength than the red. So, according to Rayleigh scattering law, the blue colours of sunlight is scattered more strongly by the large number of fine particles having size smaller atmosphere. The scattered blue light enters our eyes, hence the sky appears blue.

Foe an astronaut, staying in the international space station orbiting the earth, the colour of the sky will be black, i.e. sky will appear dark.

Reason: Sunlight does not scatter in the absence of atmosphere.

26. 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 from this defect to see the objects clearly?

Ans. Importance of ciliary muscles in the human eye:

(i) It modifies the curvature and thereby focal length of eye lens by contracting or relaxing itself to focus the image of an object on the retina according to the distance of object.

(ii) It holds the eye lens in position presbyopia is the defect of vision that arises due to gradual weakening of ciliary muscles in old age. Bifocal lenses are required.

27. What is scattering of light? Why is the colour of the clear sky blue? Explain.

Ans. Scattering of light: Phenomenon of deviation of ray of light from its original path when come in contact with particles of size equivalent to wavelength of light ray. Scattering is inversely proportional to wavelength of light fine. Fine particles present in atmosphere scatter rays of light to greater extent which are smaller in wave length. Blue colour present in visible light is scattered most and reach to earth in larger amount so sky appear blue. During sunset and sunrise, rays from sun propagate larger distance in atmosphere, so rays of smaller wavelength get scattered most to vanish and rays of large wavelength light like and orange reach to earth. Thus, sun appears reddish.

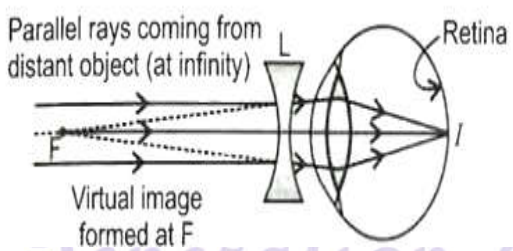
28. Name the type of defect of vision a person is suffering from, if he uses convex lenses in his spectacles for the correction of his vision. If the power of the lenses if +0.5 D, find the focal length of the lenses.

Ans. The defect of vision is hypermetropia.

Focal length of lenses, $f = \frac{1}{P} = \frac{1}{+0.5D} = +2\ m$

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

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



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

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

31. A person needs a lens a lens of power – 4.5 d for correction of his vision.

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

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

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

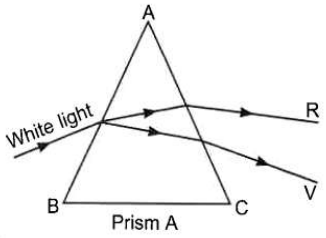
Ans. (a) The defect is myopia (short –sightedness).

(b) Focal length = $\frac{1}{power} = -\frac{100}{4.5} = -22.2\ cm$

(c) The lens is a concave lens.

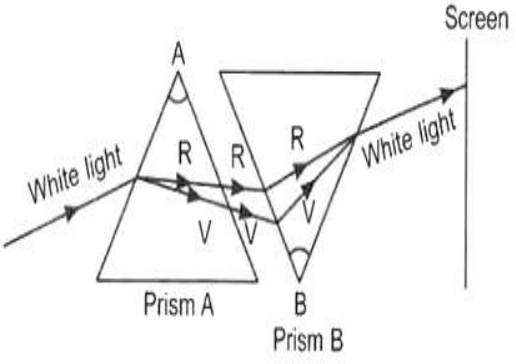
32. How will you use two identical prisms so that a narrow beam of white light incident on One prism emerges out of the second as white light? Draw the diagram.

Ans. Consider a prism A.



When a beam of white light falls on it, it splits up into seven constituent colours. The violet colour deviates the most and the red colour deviates the least as shown.

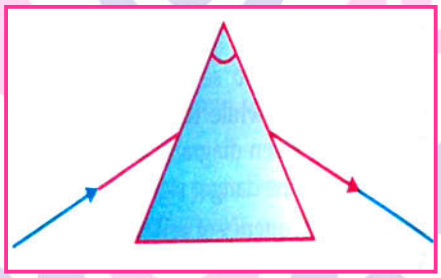
If another prism B is placed inverted to prism A as shown below, the constituent coloured rays that emerge out of prism A will be made to merge together to come out as a beam of white light.



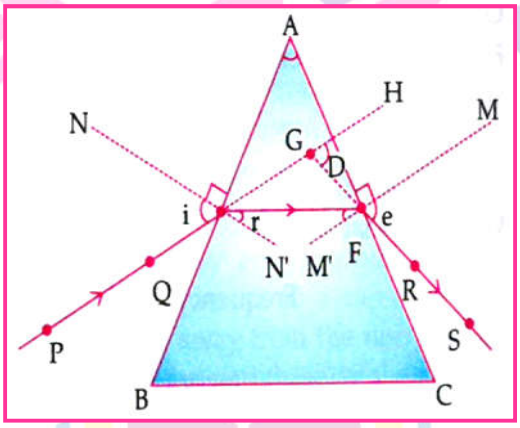
33. Is the position of a star as seen by us its true position? Justify your answer.

Ans. Light from the star passing through various layer of the atmosphere bends towards the normal due to the changing refractive indices of different layers of the atmosphere and appears as if it is coming from a higher level than their true position. As a result, the star appear slightly higher than its actual position.

34. 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 ∠i, ∠e, ∠r and ∠D.



Ans.



Detailed Answer:

The angle of incident is the angle made by the incident ray with the normal NN'. The angle emergence is the angle made by the ray coming out of the prism with the normal. The emergent ray shifts from its original path of the incident ray. The angle by which the emergent ray is shifted is known as angle of deviation.

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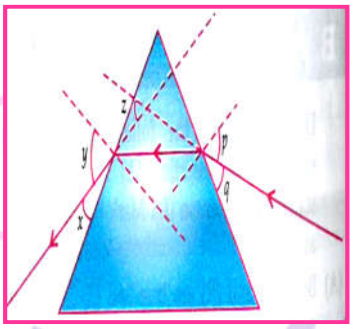
35. What is the value of angle of incidence, angle of emergence and angle of deviation from the following diagram?



Ans. The angle between the incident ray and the normal is known as the angle of incidence, and the angle between the emergent ray and the normal is known as the angle of emergence. The emergent ray is bent at an angle with the direction of the incident ray. This angle is called the angle of deviation. Thus, the angle of incidence, angle of emergence and angle deviation is p, y and z respectively.

36. What is presbyopia? State its cause. How is it corrected?

Ans. Presbyopia : When a person is unable to see nearby as well as far off objects clearly.

Causes: Gradual weakening of the ciliary muscles/diminishing flexibility of the eye lens.

Corrections: By the use of the eye lens.

Short Answer Type Questions - II

(3 mark each)

1. 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.

Ans. Given,

Object distance, u = - 25 cm

Image distance, v = -50 cm

Focal length, f = ?

Using formula,

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

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

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

$= \frac{-1+2}{50} = \frac{1}{50}$

f = 50 cm.

Power of the lens, $P = \frac{1}{f(in\ m)} = \frac{100}{f(in\ cm)}$

$\Rightarrow \quad P = \frac{100}{50} = +2D$

Hence, the corrective lens is convex, because power of lens is positive.

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

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

(ii) How are these lens prepared?

(b) A person needs a lens of power +3D for correcting his near vision and -3 D for correcting his distant vision. Calculate the focal lengths of the lenses requires to correct these defects.

Ans. (a) (i) The type of lens required by such person to improve the vision is bifocal lens.

(ii) A bifocal lens consists of both convex lens and concave lenses. The concave lens is used to correct hypermetropia (farsightedness) and concave lens is used to correct myopia (short-sightedness).

(b) $P = \frac{1}{f}$

$P_1 = +3D = \frac{1}{f}$

$F_1 = \frac{1}{3}$ m = + 0.33 m (Convex lens)

$P_2 = -3D = \frac{1}{f_2}$

$F_2 = -\frac{1}{3}$ = - 0.33 m (Concave lens)

3. A student needs spectacles of power -0.5 D for the corrections 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.

Ans. (i) Myopia

(ii) Concave / diverging lens and focal

Length = 200cm

(iii) (a) Excessive curvature of the eye lens

(b) Elongation of eye ball.

Detailed Answer:

(i) Negative power shows that lens is concave, so the student is suffereing from myopia/nearsightedness.

(ii) The nature of lens used to correct this defect is concave lens.

Focal length, $f = \frac{1}{p}$

$= \frac{1}{(-0.5)}$ = -2 m

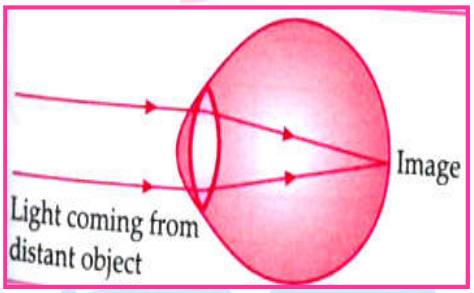
(iii) Causes of defect are:

(a) Excessive curvature of the eye lens.

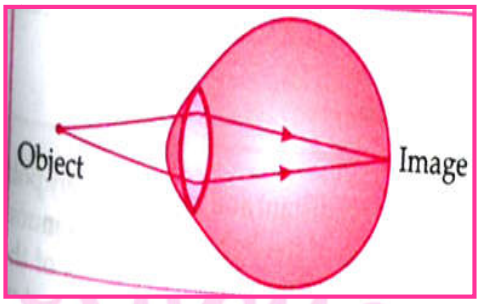
(b) Elongation of the eyeball.

4. With the help of ciliary muscles, the human eye length of its lens. State the changes the occur in the curvature and focal length of the eye lens while viewing: (i) a distant object, (ii) nearby object. Explain, why a normal eye is not able to see distinctly the object placed closer than 25 cm, without putting and strain on the eye.

Ans. (i) When we see distant objects, the ciliary muscles relax/expand to decrease the curvature and thereby increase the focal length of the lens. Hence, the lens becomes thin. Thin enable us to see the distant object clearly. Thus, the focal length of the eye lens increases while seeing distant object.



(ii) To see the nearby object clearly, the focal length of the lens should be shorter. For this, the ciliary muscles decrease the focal length of the lens. Hence, the lens becomes thick. This enables you to see the nearby objects clearly.



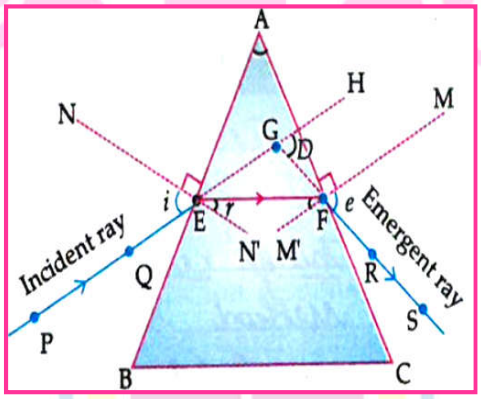
A normal eye is not able to see distinctly the objects placed closer than 25 cm, without putting any strain on the eye. This is because the ciliary muscles of eyes are unable to contract beyond a certain limit. If the objects are placed at a distance less than 25 cm from the eye, then the objects appear blurred because light rays coming from the object meet beyond the retina.

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

(b) Why do the component colour 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.

Ans. (a)



(b) Different colour of while light bend through different angles with respect to the incident light, as they pass through the glass prism. Thus, each colour emerges along a different path, forming a spectrum.

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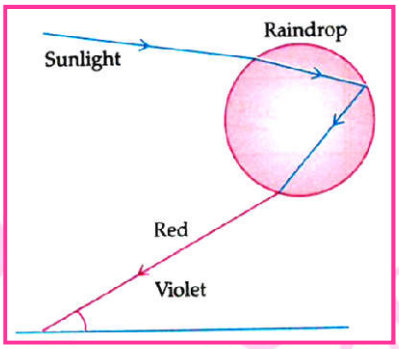
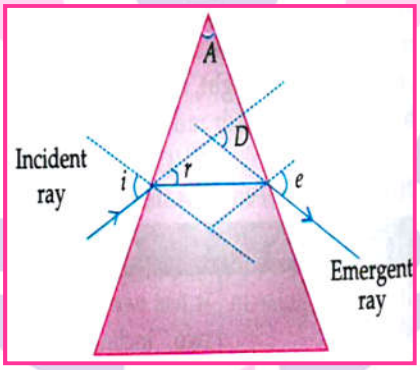


(c)

Detailed Answer:

(a) Emergent ray bend at an angle to the direction known as angle of direction of the incident ray and the angle between them is known as angle of deviation.



(b) When a beam of light enters a prism, it gets refracted and splits into its constituent colours. This splitting of the light ray occurs because of the different angles of bending of each colour. Hence, each colour passing through the prism bends at different angles with the respect to the incident beam. This gives to the formation of the spectrum.

(c) Same as in marking scheme Answer.

6. **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 lens.**

Ans. Presbyopia

Bifocal lens

Upper portion/part _ Concave / Diverging lens

_ To view far off object

Lower part _ Convex/converging lens

_ To facilitate view nearby object

Detailed Answer:

The defect caused due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens is presbyopia.

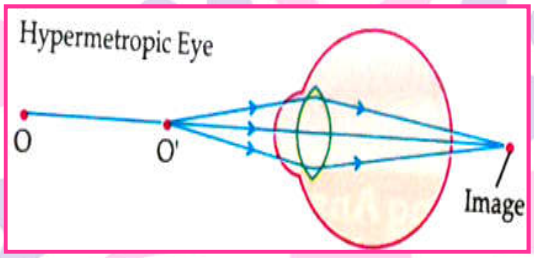
The type of lens required by such person to improve the vision is bifocal lens.

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

7. **A person is unable to see distinctly the words printed on a newspaper. Name the defect of vision he is suffering from. Draw ray diagram to illustrate this defect. List it two possible causes. Draw a ray diagram to shoe how this defect may be defect may be corrected using a lens of appropriate focal length.**

Sol. Hypermetropia/Farsightedness

Defective eye

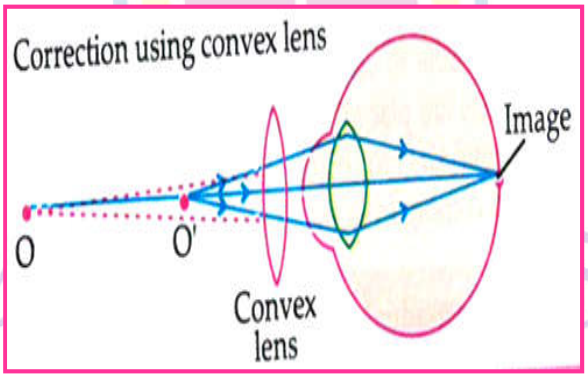


Two causes:

(i) The focal length of the eye lens is too long.

(ii) The eyeball has become too small.

(iii) Correction of the defect using appropriate lens.

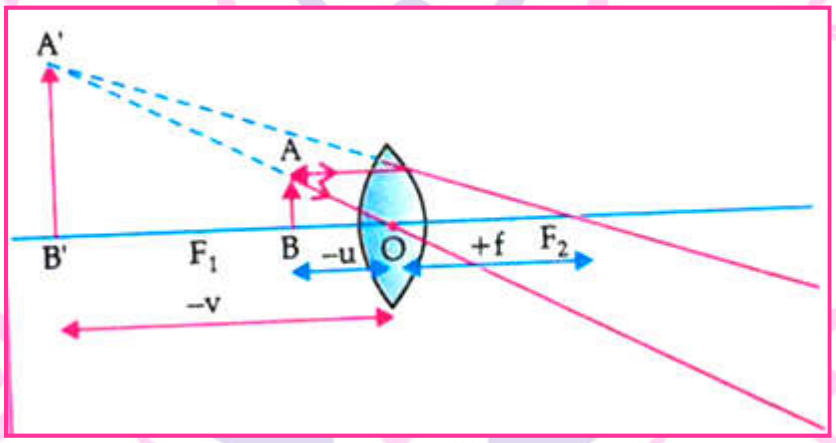


8. (a) Draw a ray diagram to show the formation of image by a convex lens when an object is place in front of the lens between its optical centre and principal focus.

(b) In the above ray diagram mark the object-distance (u) and the image-distance (v) with their proper signs (+ve or –ve as per the new Cartesian sign convention) and state how these distances are related to the focal length (f) of the convex lens in this case.

(c) Find the power of a convex lens which form a real, an inverted image of magnification -1 of an object placed at a distance of 20 cm from its optical centre.

Ans. (a)



(b) Relation: $\frac{1}{f} = \frac{1}{v} \frac{1}{u}$

(c) m = -1; u = -20 cm; v = ?, f = ? Marking of u & v

$$m = \frac{v}{u}$$

$\therefore$ v = + 20 cm

Thus object is at 2F

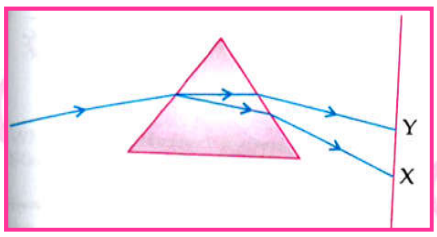
i.e., 2f = 20 cm

f = 10 cm = 0.1m

$$p = \frac{1}{f}$$

$$= \frac{1}{0.1} = + 10 \text{ D}$$

9. **In the figure given below, a narrow beam of white light is shown to pass through a triangular glass prism. After passing through the prism, it produces a spectrum XY on the screen.**

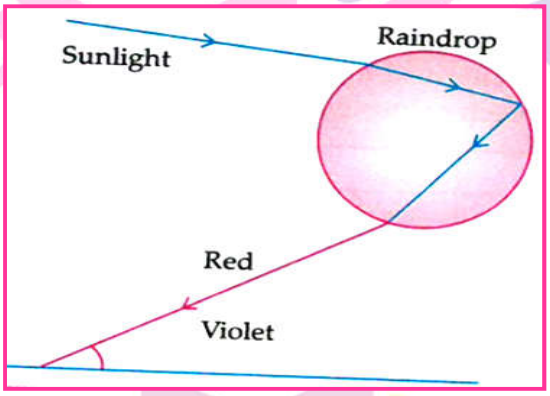


Ans.

(a) The phenomenon is called dispersion.
(b) X: violet, Y: Red
(c) Different colours of white light bend through different angles with respect to the incident beam of light due to difference is speed of light of difference in speed of light of difference wavelengths.

10. **What is a rainbow ? draw a labelled diagram to show the formation of a rainbow.**

Ans. Rainbow – A natural spectrum of sunlight appearing in the sky after a rain shower.



11. **What happens to beam of while light when it gets refracted through a 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 prism? Justify your answer.**

Ans. The white light splits into seven colours when it gets refracted through the glass prism (VIBGYOR)

The colour deviates most – Violet

The colour deviated least – Red

Colours disappear and again white light obtained.

Detailed Answer:

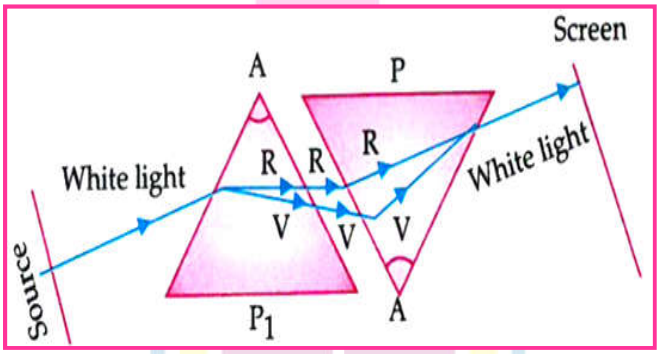
When a beam of white light refracted through a glass prism, it refracts through different angles causing a splitting of white light into its seven constituent colours (VIBGYOR). This gives rise to the formation of the colours spectrum.

Violet colour deviates the most and red colour deviates the least after refraction through a prism. When a second identical prism is placed in an inverted position with respect to first prism, a beam inverted position with respect to first prism, a beam of white light emerges from the other side of the second prism. The second prism recombines all the seven colours to give a beam of white light

12. **State the cause of dispersion of white passing through a glass prism. How did Newton show 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 prism are arranged together in inverted position with respect to each other and a narrow beam of while light is allowed to fall obliquely on one of the focus of the first prism**

Ans. Cause of dispersion of white light: Different colours of light bend through different angles with respect to the incident ray as they pass through a prism.

Violet light bends the most and red the least. Thus, the each colour emerges along different paths.



13. **How does refraction of light take place in the atmosphere? Explain the reason why stars appear to twinkle and the planets do not twinkle.**

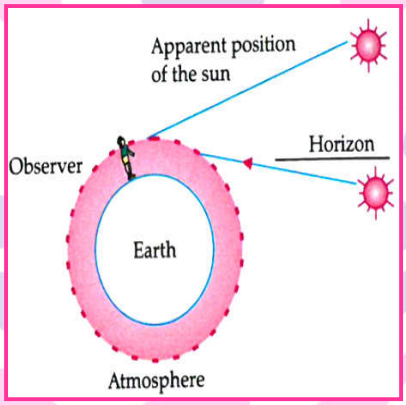
Ans. Since the atmosphere consists of varying densities the apparent position of the object, as seen through the hot air fluctuates. This wavering of light is an effect on atmospheric refraction .

The twinkling of a star is due to atmosphere refraction of star light. The atmospheric refraction of light occurs in a medium of gradually changing refractive index.

The planet are much closer to the earth and thus seen as extended sources. A planet is considered as a collection of large number of point sized sources of light, the total variation in the amount of light entering our eye from all individual point sized sources will average out to zero, thereby nullifying the twinkling effect.

14. **Name the phenomenon responsible for the early sunrise and delayed sunset. Explain with the help of a diagram the reason why the sun is visible to us about 2 minutes before the actual sun-rise and about 2 minutes after the actual sunset**

Ans. Atmospheric refraction.



The sun rise visible to us about 2 minutes before the actual sunrise , and about 2 minutes after the actual sunset because of atmospheric refraction.

15. **Explain in brief the reason for each of the following:**

a. At noon the sun appears white.

b. To an astronaut the sky appears dark instead of blue.

Ans. a. At noon, sun is overhead and light rays travel comparatively smaller distance and only little of blue/violet light scatter, so sun appears white.

b. There is no atmosphere in outer space for scattering so sky appears dark.

16. **Description of activity to show that the colours of white light split 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.**

Description of activity : When a glass prism is used to obtain as spectrum of sunlight identical prism in an inverted position with respect to the first position will allow all the colours of spectrum to recombine. Thus a beam of white light will emerge from the other side of the second prism.

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

Ans. Tyndall effect is shown by colloidal particles because the colloidal particles size are roughly equal to the wavelength of the light.

Four instances of observing tyndall effect are:

(i) In fog.

(ii) When light passes through canopy in forest.

(iii) Blue colour of the sky.

(iv) When light passes through the milk.

18. 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?

Ans. Difference between glass slab and glass prism

Glass slab	Glass prism
It is rectangular in shape.	It has two triangular sides, two inclined rectangular side and one rectangular base.
In this, the direction of incident ray and emergent ray of light are parallel to each other	In this, the direction of incident ray and emergent ray of light are not parallel to each

When a narrow beam of monochromatic light passes through:

(a) Glass slab: It has deviated from the actual path but the direction of the incident ray and the emergent ray are parallel to each other.

(b) Glass of prism: It has deviated from the actual path but the direction of the incident ray and the emergent ray are not parallel to each other.

When a narrow beam of white light passes through:

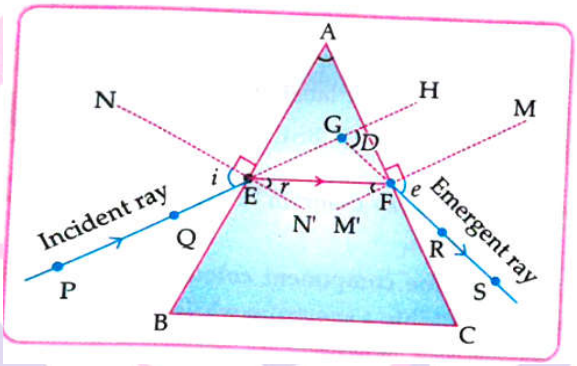
(a) Glass slab, it does not split into its constituent colour. The direction of incident ray and emergent ray of light are parallel to each other.

(b) Glass prism, it splits into its constituent seven colour. The direction of incident ray and emergent ray of light are not parallel to each other.

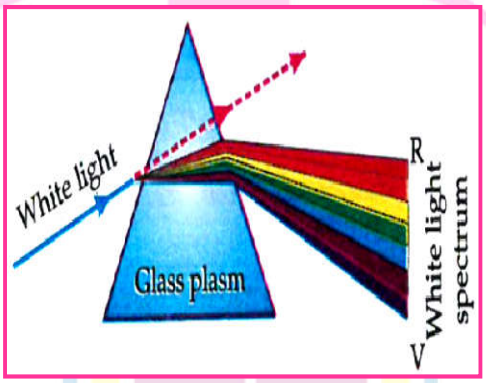
19. (a) With the help of labelled ray diagram show the path followed by a narrow beam of monochromatic light when it passes through a glass prism.

(b) What would happen if this beam is replaced by a narrow beam of white light?

Ans. (a) In case of monochromatic light, the ray will bend due to refraction but it will not show dispersion of light.

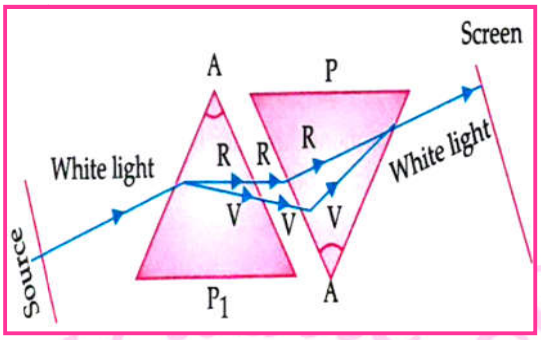


(b)If narrow beam of monochromatic light is replaced with beam of white light, a combination of narrow beam of seven colour out. The phenomenon of splitting of white light into its seven constituent colours when it passes through a glass prism is called dispersion of white light. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red. The different component colour of light bends at a different angle w.r.t the incident angle.



20. State the cause of dispersion of white light by a glass prism. How did Network, using two identical glass prism, 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.

Ans. Different colours of light bend through different angles with respect to the incident ray / different speed of different colours of light in glass / different values of refractive index of glass for different colours of light.



(5 mark each)

Long Answer Type Questions

1. (a) A student is unable to see clearly the words written on the back board placed at a distance of approximately 3 m from him. Name the defect of vision the boy is suffering from. State the possible cause of this defect and explain the method of correcting it.

(b) Why do stars twinkle? Explain.

Ans. (a) Defect of vision – Myopia of short-sightedness or near sightedness

Causes of myopia: (i) Excessive curvature of eye lens become more converging

(ii) Elongation of eyeball

Methods of correction: By the use of concave lens of suitable power or focal length the defect is correct. It can be presented by a suitable diagrammatic representation.

(c) Due to Atmospheric refraction

The density of different layer of air keep on changing due to which the apparent images of the stars keep on changing. This changing positions of stars appear as twinkling of stars.

Detailed Answer:

(a) The defect is Myopia a short-sightedness i.e., inability of an eye in viewing long distance objects. This defect is caused by elongation of eyeball excessive curvature of the lens.

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

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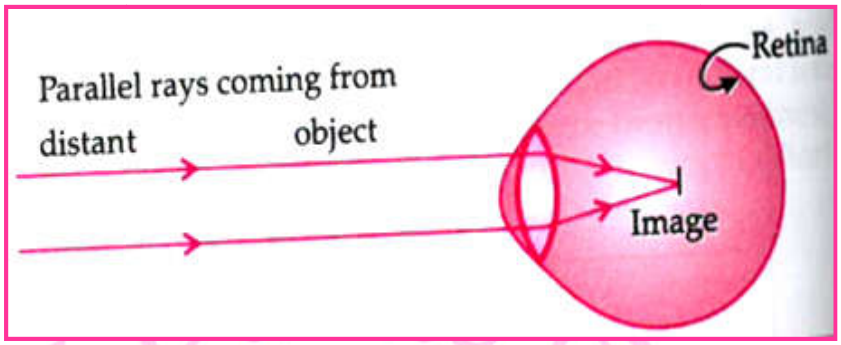
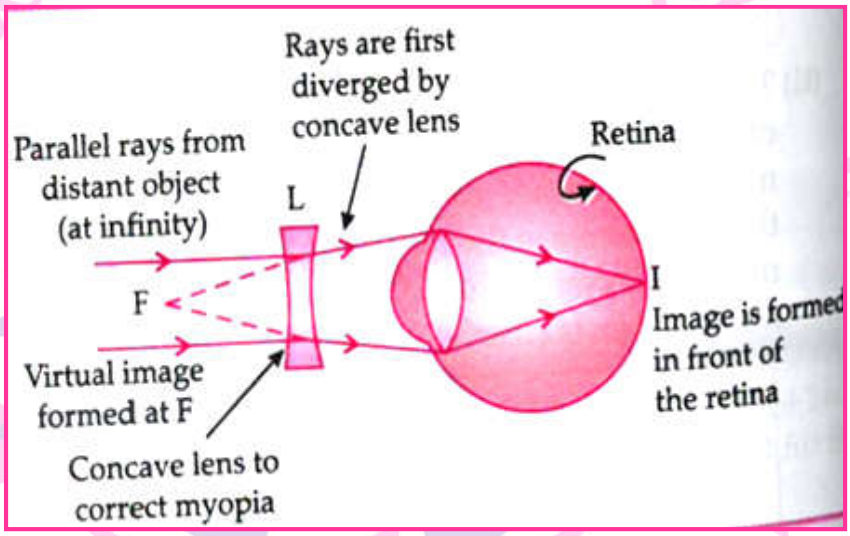




(b) Stars are very distant and approximately point-sized sources. Path of star light changes continuously due to gradual change in refractive index of the layer of earth's atmosphere. Thus, the apparent positions

3. (a) What is meant by the term 'power of accommodation'? Name the component of eye that is responsible for the power of accommodation.

(b) A student sitting at the back bench in a class has difficulty in reading. What could be his defect of vision? Draw ray diagram to illustrate the image formation of the blackboard when he sit at the (i) back seat (ii) front seat. State two possible causes of this defect. Explain the method of correcting this defect with the help of a ray diagram.

Ans. (a) Power of accommodation: It is the ability of the eye lens to adjust its focal length. Ciliary muscles of eye are responsible for change in its focal length.

(c) Myopia

Causes: (i) Excessive curvature of the eye lens

(ii) Elongation of eyeball.

This defect can be corrected by using a concave lens of suitable power.

For ray diagram refer NCERT page 189 figure 11.2 (a), (b) and (c)

Detailed Answer

(a) The ability or the property of the eye lens to adjust its focal length in order to focus both near and distant objects is known as the power of accommodation.

The component of eye that is responsible for the power of accommodation is ciliary muscles because they are responsible for change in its focal length.

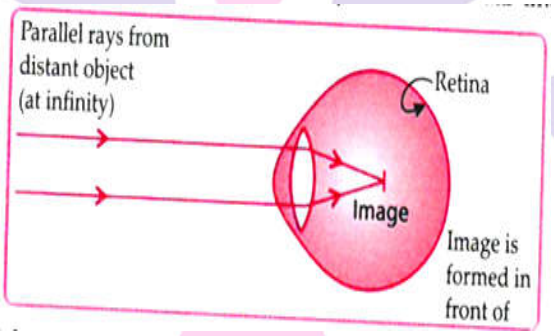
(b) The defect of vision is Myopia:

Causes of Myopia:

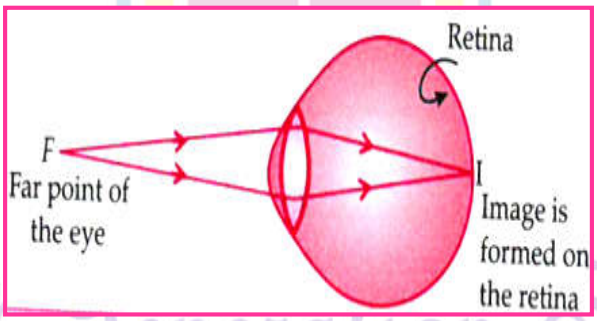
(i) Excessive curvature of the eye lens.

(ii) Elongation of eyeball.

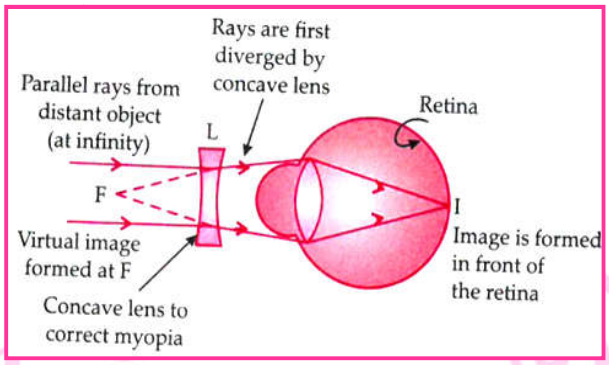
To correct myopia the concave lens placed in front of the eye forms a virtual image f distant object at far point.



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



The far point of a myopic eye is less than infinity.



To correct myopia the concave lens placed in front of the eye forms a virtual image of distant object at far point

4. **(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 diagram, 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 used of this lens.

(d) If, in this case, the numerical value if the foal length of the corrective lens is 5 m, find the power of the lens as per the new Cartesian sign convention.

Ans. (a) (i) The student is unable to see distinctly the object placed beyond 5 m from his eyes as he as suffering from myopia i.e., nearsightedness where is person can see nearby objects clearly but cannot see distant object distinctly.

(ii) Concave lens can be used as the corrective lens to restore proper vision. A concave of suitable power will bring the image back on to retina and thus the defect the image back on to the retina and thus the defect is corrected

(b) u = - ∞, v = - 5 m

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

$$= \frac{1}{-5} - \frac{1}{-\infty}$$

$$= \frac{1}{-5} - 0$$

F = -5 m

Then, $p = \frac{1}{f} = \frac{1}{-5} = -0.2$ D

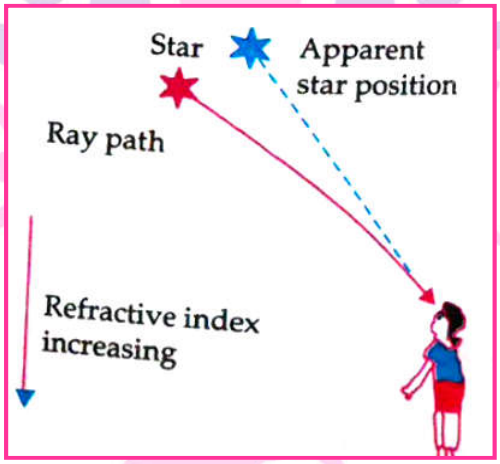
5. (a) What is dispersion of white light? State its cause.

(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.

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

(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 slightly. Thus apparent position of the stars fluctuates and the amount of star light entering the eye flickers giving the twinkling effect.

(b) Advanced sun rise: 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 earlier than actual sunrise.



6. (a) What is mean by least distance of distinct vision? How does this vary between the very young and old people?

(b) 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.

(c) Name the defect of vision due to

(i) Name the defect of vision due to

(ii) Focal length of the eye lens is too long.

Ans. The minimum distance at which an object can be seen most distinctly without strain by the eye, is termed at least distance vision.

For an infant, it is about 5 to 8 cm.

For an old person, the power of accommodation of the eye decreases due to gradual weakening of ciliary muscles and the diminishing flexibility of the eye lens. Hence the least distance vision for him generally increases.

(b) There is no change in the image distance in the eye. The eye lens has the ability to adjust its focal length called accommodation. When muscles contract and lens because thick and its foal length decreases. It facilitates the near vision.

(c) (i) short-sightedness

(ii) Long-sightedness.

7. (a) (i) What is meant by scattering of light?

(ii) state the factors on which the colour of scattered light perceived by us depends.

(c) Which of the two is scattered more easily-light of short wavelength or light of longer wavelength? Give reason.

(c) How is the eye defect of old person differing from near-sightedness and far-sightedness?

Ans. (a) (i) Scattering of Light: The phenomenon of the change in the direction of propagation of light caused by the large number of molecules, such as smoke, tiny water droplets, suspended particles of dust and molecules of air present in the earth's atmosphere, is called scattered of light.

(ii) The colour of the scattered light perceived by us depends on the size of the particles,i.e.

(b) Shorter wavelength is scattered more easily than longer wavelength as scattering of sunlight is inversely proportional to fourth power of wavelength.

(c) Presbyopia occurs when the natural lens in the eye losses its flexibility with aging while far-sightedness and near-sightedness are related to the change in shape of the eyeball and are caused by the genetic and the environment factors.

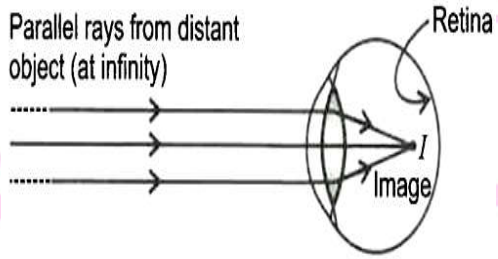
8. (a) What is meant by the term power of accommodation? Name the component of eye that is responsible for the power of accommodation.

(b) A student sitting at the back bench in a class her difficulty in reading. What could be his defect of visions? Draw ray diagram to illustrate the image formation of the blackboard when he is seated at the (i) back seat (ii) front seat. State two possible causes of this defect. Explain the method of correcting this defect with the help of a ray diagram.

Ans. (a) Power of accommodation: The ability of eye lens of adjust its focal length to form a sharp image of the object at varying distances on the retina is called power of accommodation. Ciliary muscles of eye responsible for change it the foal length of eye lens.

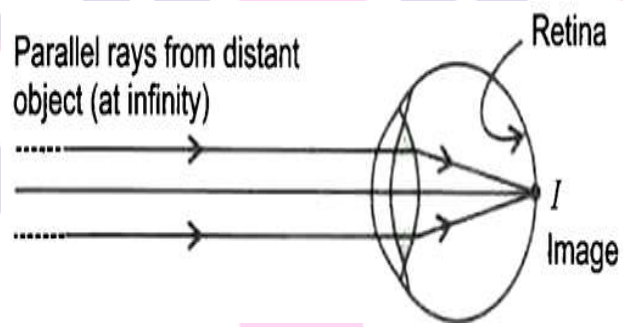
(b) Student is suffering from myopia or short sightedness or nearsightedness.

When student is seated at the back seat.



In this case student is suffering from myopia and have short focal length of eye lens.

(ii) When student is seated at front seat.

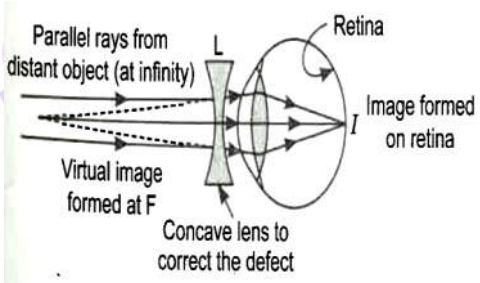


Causes:

(i) Excessive curvature of eye lens

(ii) Elongation of eye ball.

The defect is corrected by using a concave lens of suitable power placed in front of eye as shown below. It diverge the rays and forms a virtual image of distant object at far point of the myopic eye. These diverged rays enter into the eye and form the image on the retina. Thus, the concave lens shifts the image back onto the retina instead of in front of it and the defect is corrected.



9. 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 of (i) defective eye and (ii) corrected eye.

Or

A student is unable to see clearly the word 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 method of correcting this defect. Draw ray diagram for the:

(i) defects of vision and also

(ii) for its correction.

Or

What is myopia? State the two causes of myopia. With the help of a labelled ray diagram show (a) eye defect (b) correction of myopia.

Ans. Myopia or short-sightedness or Nearsightedness:

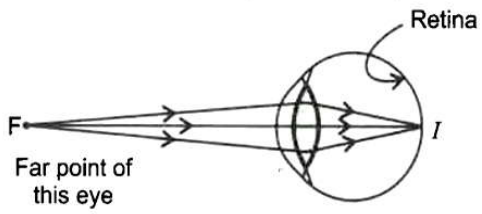
The defect of vision is due to which an eye cannot see distant object distinctly but can see nearby objects clearly. This defect of the eye is called myopia.

Short-sightedness is caused due to

(i) excessive is caused due to

(ii) elongation of eyeball.

The image in this case, forms in front of the retina, so the distant object looks blurred. For every myopic eye, there exists a far point beyond which a clear image cannot be seen. When the object lies at the far point, the image formed is focussed on the retina by the eye lens and therefore the object is clearly visible to us.



The far point (F) of a myopic eye is less than infinity: Image is formed on the retina

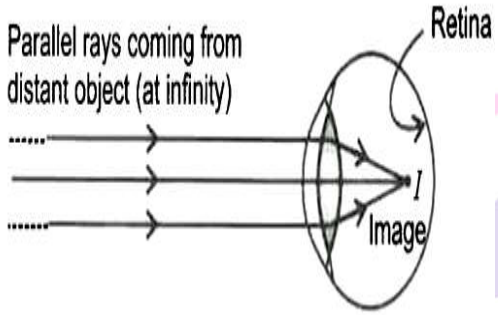
The short-sightedness is corrected by using a concave lens of suitable power placed in front of eye. It diverges the rays and forms a virtual image of distant objet at far point of the myopic eye. These diverged rays enter into the eye and form the image on the retina. Thus, the

concave lens shifts the image back onto the retina instead of in front of it and the defect is corrected.

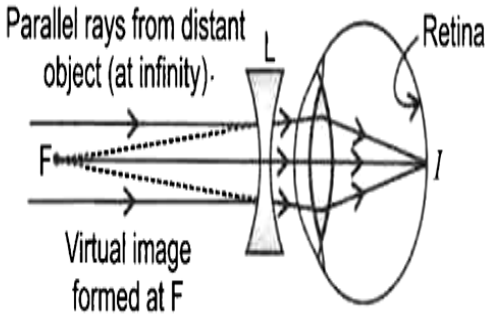
Ray diagram to show the image formation in case of:

(i) Defective eye

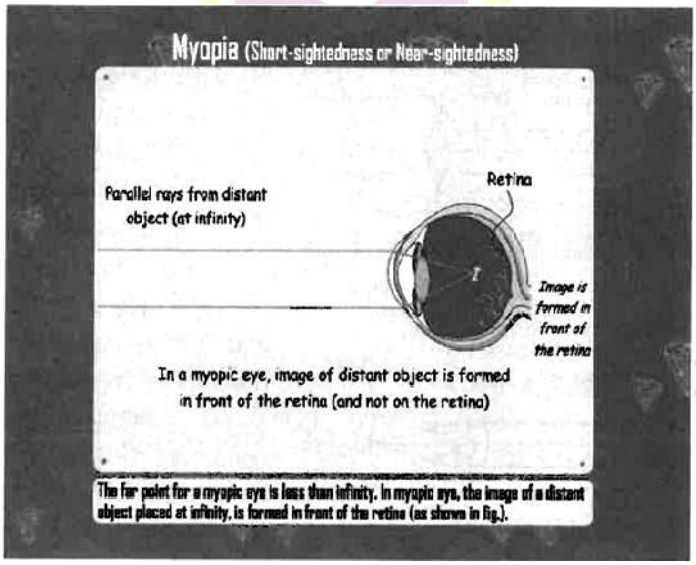
In a myopic eye, the image of distant object is formed in front of the retina(and not on the retina).



(ii) Corrected eye



A concave lens is placed in front of the ye which forms a virtual image of distant object at far point(F) of the myopic eye.



10. What is hypermetropia? List two causes for the development of this defect. Explain the method of correcting this defect with the help of ray diagrams.

Or

What is hypermetropia? State two causes. With the help of ray diagram show (a) eye defect (b) correction of hypermetropia.

Or

A person in unable to see distinctly the words printed on a newspaper. Name the defect of vision he is suffering from. Draw ray diagram to illustrate this defect. List its two possible causes. Draw a ray diagram to show this defect may be corrected using lens of appropriate focal length.

Or

An old person finds it difficult to see nearby objects comfortably and distinctly without corrective eye glasses.

(a) What defect of vision is he suffering from? What is it?
(b) List two causes for the development of this defect.
(c) What kind of lens will be required to see clearly the nearby as well as distant objects? Give reason.

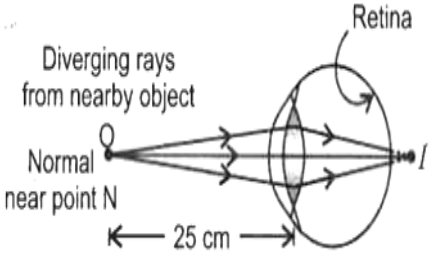
Ans. Hypermetropia or Long-sightedness or Far- sightedness. The defect of vision due to which an eye cannot see nearby objects clearly but can see distantly. This defect of the eye is called hypermetropia.

Long-sightedness is caused due to

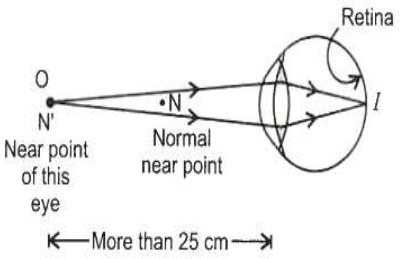
(i) greater focal length of the eye lens or

(ii) smaller eyeball.

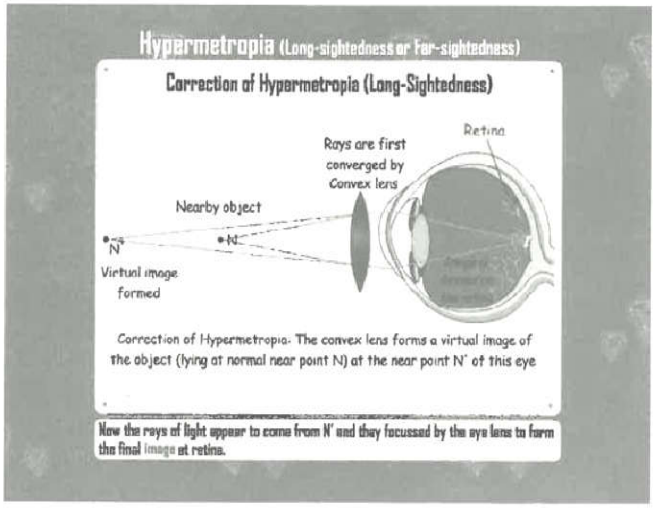
The image in this case, forms behind the retina, so the nearby objects looks blurred



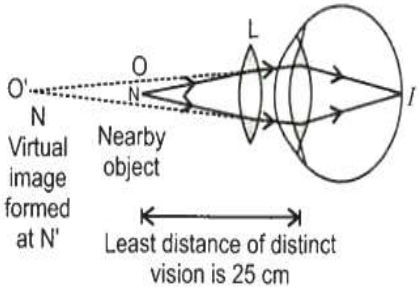
For every hypermetropic eye, there exists a near point N' which is more than the least distant of distinct vision, i.e.25 cm. The diverging rays from the object lying at the near point N' is focussed on the retina by the eye lens and therefore, the object is clearly visible to the eye.



Therefore, long-sightedness is corrected by using a convex lens of suitable power placed in front of the ye. It converges the rays coming from the object lying at normal near point N and forms its virtual image at near N' of the hypermetropic eye.



The rays appear to come from N' enter into the eye and get focussed by the eye lens on the retina. Thus, convex lens provides additional focussing power to the eye lens and shifts the image back onto the retina from beyond and therefore the defect is corrected.



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

(i) Myopia (ii) Bifocal lenses
(iii) Far-sightedness

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

Ans. (a) (i) Myopia or short-sightedness is caused due to excessive curvature of the eye lens or elongation of the eyeball. The image forms in front of the retina. So, a concave lens is use to correct it.

(ii) Bifocal lens: It is used to correct presbyopic eye. The upper portion of a bifocal lens is concave and its lower portion is convex. The concave lens is used for viewing ling distant objects and the convex lens is arises with age.

(iii) Far-sightedness or hypermetropia is caused due to greater focal length of the eye lens and /or eyeball becomes smaller. The image forms beyond the retina and can be corrected by using a convex lens.

(iv) The least distance vision for normal eye is 25 cm. The focal length of the eye lens cannot be further decreased by ciliary muscles to form an image on the retina for the objects nearer than 25 cm. Therefore, the normal eye is unable to focus on an object placed within 10 cm from the eye.

12. Instruction: Read the passage carefully and answer the following questions given below it.

You are given that the diameter of the eyeball is about 2.3 cm and a normal eye can adjust the focal length of its eye lens to see objects situated anywhere from 25 cm to an infinite distance away from it.

(a) What is the power of the(normal) eye lens when ciliary muscles are fully relaxed?

(b) What is the power of the (normal) eye lens, when ciliary muscles are in their maximum contract position.

(c) The maximum variation in the power of the eye lens, when it adjust itself, from the normal relaxed position to the position where the eye can see the nearby object clearly?

Ans. (a) The fully relaxed ciliary muscles enable us to see the distant clearly. In this case, the far point of the normal eye is at infinity, i.e u = ∞ and the image is formed on the retina so υ = 2.3cm

$\therefore$ Using lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{2.3} - \frac{1}{\infty} = \frac{1}{2.3}$$

$\therefore \quad f = 2.3\ cm$

$\therefore P = \frac{100}{f(cm)} = \frac{100}{2.3} = 43.48\ D$

(d) The maximum contract position of the ciliary muscles enables us to see the nearby object placed at the least distance of distinct vision. In this case, u= - 25 cm and $\upsilon = 2.3\ cm$

Using lens formula again,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{2.3} - \frac{1}{-25}$$

$$= \frac{10}{23} + \frac{1}{25} = \frac{273}{575}$$

$$\therefore P = \frac{100}{f(cm)} = \frac{100}{\frac{575}{273}}$$

$$= \frac{100X273}{575} = 47.48\ D$$

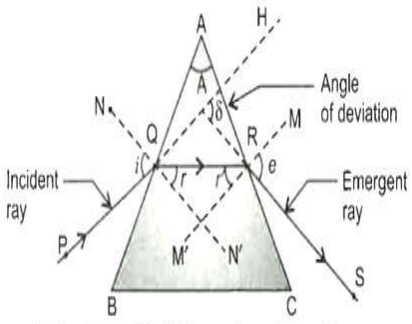
(c)Maximum variation of the power = 47.48 D – 43.48 D = 4 D

13. (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)Why does it take some time to see the objects in dim light when you enter the room from bright sunlight outside?

Ans. (a)



Refraction of light through a glass prism

(b) From Snell's law of refraction, the angle of refraction of light in a prism depends on the refractive index of the prism material. Moreover, the refractive index of the material

varied inversely with the speed of the incident light and also varies inversely with the wavelength of light through different angles with respect to the incident light, as they pass through the glass prism. Thus, each colour emerges along a different path becomes distinct and forming spectrum.

The red colour (longer wavelength) has maximum speed in glass prism, so it is least deviated, while the violet colour (shorter wavelength) has minimum speeds, so its deviation is maximum. Also, each colour (refracted).

(c)In bright sunlight, the iris contracts the pupil to allow less light to enter the eye and in dim light, the iris expands the pupil to admit more light to see the object clearly. Therefore, it takes some time to increase the size of pupil in dim light.

14. (a) What is dispersion of white light? State its cause.

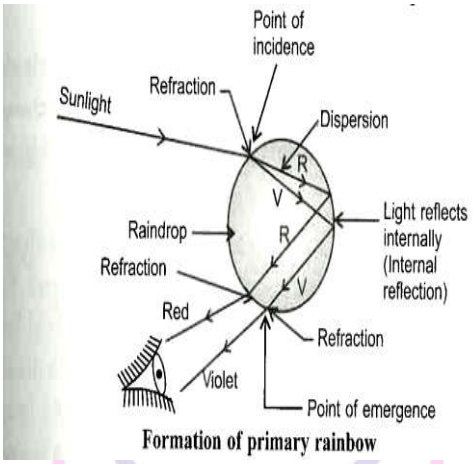
(b) ' Rainbow is an example of dispersion of sunlight,' Justify this statement by explaining, with the help of a labelled diagram, the formation of a rainbow in the sky. List two essential conditions for observing a rainbow.

Ans. (a) Dispersion: The splitting up of white light into its component colours is called dispersion.

Cause of dispersion: From Snell's law of refraction, the angle of refraction index of the prism material. Moreover, the refractive index of the material varies with the speed of light. The different speeds in the transparent material of prism. Hence for each colours/wavelength, the refractive index of prism material is different.

Therefore, each colour bends(refracted) through different angle with respect to incident rays, as they pass through the prism. The rd colour has maximum speed in glass prism, so it is least deviated, while the violet colour has minimum speed so its deviation is maximum. Thus, the ray of each colour emerges along different paths and becomes distinct.

(b) Rainbow: It is an optical natural spectrum, produced by the nature in the sky, n the form of a multicoloured arc. The rainbow is formed due to the dispersion of sunlight by water droplets suspended in the atmosphere after rainfall. These water droplets act like small prisms. The sunlight enters the water droplets. At the point of incidence, it refracts and disperses then gets reflected internally and family gets refracted again at the point of emergence as it comes out of the rain-drop.



Formation of primary rainbow

Therefore, due to refraction, dispersion and internal reflection of the sunlight, different colours reach the observer's eye along different paths and become distinct. It creates a rainbow in the sky.

Hence "Rainbow is an example of dispersion of sunlight".

Necessary conditions for the formation of a rainbow.

(i) The presence of water droplets in the atmosphere, and

(ii) The sun must be at the back of the observer, i.e. the observer must stand with his back towards the sun.

15. What is atmosphere refraction? Use this phenomenon to explain the following natural events.

(a) Twinkling of stars

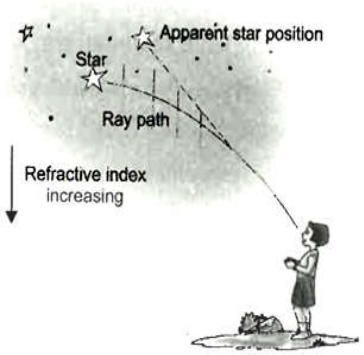
(b) Advanced sunrise and delayed sunset.

Draw diagrams to illustrate your answers.

Ans. Atmospheric Refraction: The refraction of light caused by the earth's atmosphere due to gradual change in the refractive indices of its different layers by the varying conditions of it, is called atmospheric refraction.

(a) Twinkling of stars.

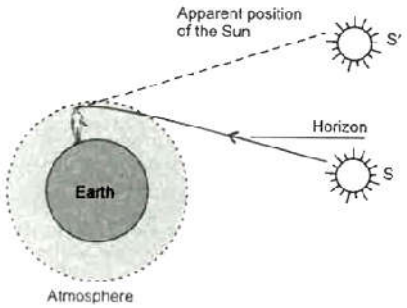
The hot layers (low densities) of air at a high altitude, behave as an optically rarer medium for the light rays, whereas the cold dense layer (high densities) of air near the earth's surface, behave as an optically denser medium for the light rays. So, when the light rays (starlight) pass through the various layers of atmosphere, they will get deviated and bend towards the normal. As a result, the apparent position of star is slightly different from its actual position of star is slightly different from its actual positions in the sky.



The fluctuation in the positions of the stars occurs continually due to the changing amount of light entering the eye. The stars sometimes appear brighter and at some other times, they appear fainter. This causes twinkling of stars.

(b) Advanced sunrise and delayed sunset.

The sun is visible 2 minutes before sunrise and 2 minutes after sunset because of atmospheric refraction. This can b explained as below.



Atmospheric refraction effects at sunset or sunrise

The figure shows the actual position of the sun S at the time of sunrise of sunset, just below the horizon while the apparent position S', above the horizon as appear to us.

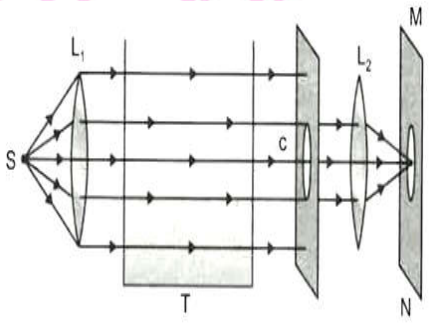
When the sun is lightly below the horizon while the apparent position S', above the horizon as appear to us.

When the sun is slightly below the horizon, the light rays move through the different layers of varying refractive indices of air and get bent towards the normal. These rays appear to come from S', Which is the apparent position of the sun. That is why, the sun is visible to us when it has been actually below the horizon by the sun at the time of sunrise or sunset. So, due to the atmospheric refraction, the phenomenon of advanced advance sunrise and delayed sunset is observed.

16. (i) Draw a figure which shows the arrangement for observing the phenomenon of scattering of light in the laboratory.

(ii) What colours would you observe in the experiment? Why?

Ans. (i) An arrangement for observing the scattering of light in the laboratory is as shown below.



(ii) (a) On the screen, first orange red colours and then bright crimson red colour patch is observed.

(b) From the other three sides of colloidal solution of sulphur in a glass tank (T), blue colour is observed.
This s because the very fine colloidal sulphur particles scatter away the blue colour from the path of beam and only of white light reaches the screen through the solution.

17. (a) What is presbyopia? State its cause. How is it corrected?

(b) Why does the sun appear reddish early in the morning? Explain with the help of a labelled diagram.

Ans. (a) (i) Presbyopia

- Presbyopia is a condition that occurs as a part of normal ageing .

Due to loss of power of accommodation of the ye, with age, objects at a normal near working distance will appear blurry. The near point gradually recedes away. This defect of eye is called presbyopia.

- Sometimes, a person may suffer from both myopia and hypermetropia.

(ii) Presbyopia is caused due to

Weakening of ciliary muscles, and

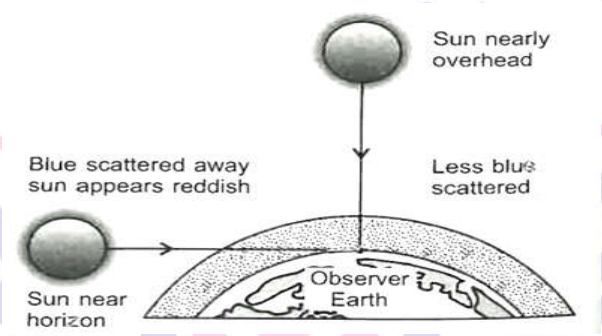
Eye lens becomes less flexible and elastic, i.e. reducing ability of eye lens to change it curvature with the help of ciliary muscles.

(iii) Bifocal lens will be required to see clearly nearby as well as the distant object. For myopic defect, upper part of bifocal lens consists of a concave lens used for distant vision and to

correct hypermetropia, lower part of bifocal lens consists of a convex lens. It facilitates near vision.

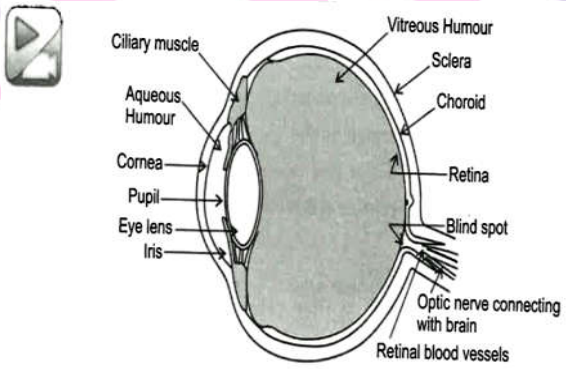
(b) At the time of sunrise/sunset, the sun is near the horizon, so the sunrays have to travel though a larger atmospheric distance. The fine particles of the atmosphere scatter away the blue component and other shorter wavelength of the sunlight.

As $\lambda_b < \lambda_r$, only red colour having longer wavelength and least scattered, reaches our eyes. Hence, the sun appears red at sunrise or sunset.



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

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



The parts of human eye and its functions:

(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) Aqueous Humour : It is a transparent gelatinous fluid, secreted from ciliary muscles and fills the space between the cornea and the eye lens. It provides nutrition to the ye tissues and increases the protection against dust, wind, pollen grains , etc.

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

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

(v) Ciliary muscle: (a) It modifies the curvature and thereby the focal length of the eye lens by contractinf or relaxing itself to focus the image of an object on the retina according to the the distance of the object (b) It holds the eye lens in postion.

(vi) Eye Lens: It is converging in nature, made by the jelly-like proteinaceous material. The focal length of the eye 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.

(vii) Vitreous Humour: It is transparent, colourless gelatinous mass that fills the space between the eye lens and the retina of the eyeball. It helps to keep retina in place by pressing it against the choroid.

(viii) Retina : It is a delicate membrane. It acts like a screen on which a real, inverted and diminished image of the object, is formed by the crystalline lens of the eye. It contains enormous number of light sensitive cells. These light receptors are known as rod and cone cells which generate electrical signals upon illumination. These electrical impulses are sent to the brain via optic nerves for further processing.

(ix) Rods and Cones: These are the light sensitive cells present in retina and get activated upon illumination. Roads respond to the intensity of light, whereas cones respond to the colour. These cells generate electrical signals which are transmitted to the brain through optical nerves. The brain processed the information via these electric signals and gives the impression of erect image to us.

To see nearby as well as distant objects, ciliary muscles modify the curvature of eye lens. This leads to the variation in focal length of the eye lens as explain below.

(a) When ciliary muscles are relaxed, the lens becomes thin. The focal length of the lens increases and has maximum value equal to the distance from the retina. So, the parallel rays coming focussed on the retina. This enables us to see distant objects clearly.

(b) When the eye looks at nearby objects, the ciliary muscles are strained/contract. This increases the curvature of the eye lens and it becomes thicker. As a result, it focal length decreases bu t increases its converging. Hence, the Sharp image of the nearby objects agin forms on the retina. This enables us to see nearby objects clearly.

(c) The phenomenon is called the power of accommodation of the eye.

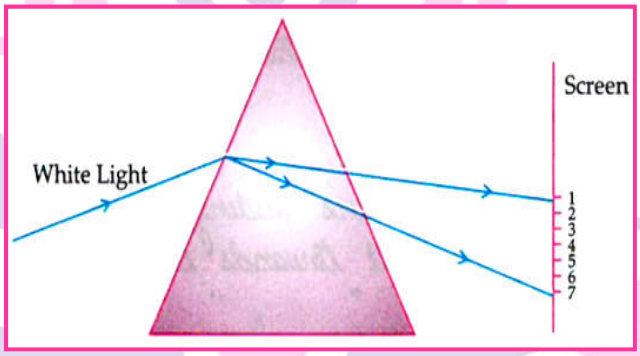
Competency Based questions

Case based MCQs

Attempt any 4 sub-part from each question each sub part carrier 1 mark.

I. Read the following passage and answer any four questions.

A narrow beam of white light is passing through a glass prism as shown in the diagram and answer any four questions from Q.1 to Q.5



1. The phenomenon observed in above set – up is
   a. Scattering of light
   b. Dispersion of light
   c. Reflection of light
   d. Refraction of light
2. In nature, this phenomenon is observed in
   a. Formation of rainbow
   b. Twinkling of stars
   c. Blue colours of sky
   d. Advance sunrise
3. Which of the following statement is correct about constituents of white light based on above observations?
   a. Whiter light consists of seven colours.
   b. Violet colour suffers minimum deviation
   c. Red light suffers maximum deviation.
   d. All the colours of the whiter light move with different speed in vacuum.
4. The cause of dispersion of light is

a. All the colours light travel with the speed more than the speed of light.

b. All the colours have different angles of deviation/

c. All the colours do not travel with the same speed of light.

d. All the colours have the same wavelength

5. Read the following statement carefully

(i) The prism behaves same as that of rectangular glass slab.

(ii) All the colours have different angles of deviation in case of dispersion through prism.

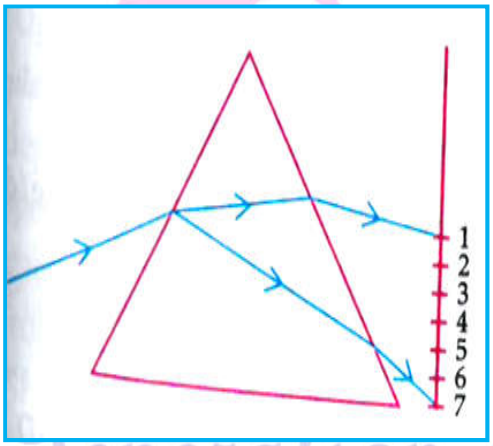
(iii) All the colours travel with the same speed of light in glass.

(iv) Dispersion of light is observed in case of rectangular glass slab

a. **Only (ii)** b. (i) and (ii) only c. (i), (ii) and (iv) only d. All of the above

II. Read the following passage and answer the following questions.

When lights of all colours are mixed in a certain proportion, the result is a colour less light, called white light . Sunlight is an example of white light. It is mixture of lights of seven main colours. On refraction, light of different colours bend by different colours bend by different amount . So, when light made up of different colours gets refracted, its component tend to separation between the component colours of light is so little that they are not visible. But if the components get bent very sharply, the separated colours become visible. For example, when white light falls at certain angles on a glass prism, it splits into its seven components colours marked 1 to 7 as shown in figure. The various colours seen are Violets, Indigo, Blue, Green, Yellow, Orange and Red. The sequence of colour can be remembered and Red . The sequence of colour can be remembered as VIBGYOR.



1. Based on the above diagram, which of the following statement is correct?

a. The colour at position marked 5 is similar to the colours of gold metal.

b. The colour at position marked 2 has longer wavelength than 1.

c. The colour at position marked 7 is violet.

d. The colour at position marked 5 has higher

2. Choose the correct statement.

a. The colours in the order of increasing wavelength are 1<2<3<4<5<6<7.

b. The colours in the order of increasing frequency are 1<2<3<4<5<6<7.

c. The colours in the order of decreasing speed are 7>6>5>4>3>2>1.

d. The colours in the order of decreasing deviation are 1>2>3>4>5>6>7

3. When a white light falls on a prism, the ray at its first surface suffers:

a. No Refraction

b. Dispersion Only

c. Deviation Only

d. Both (B) and (C)

4. What is the wavelength range of white light?

a. 4 nm to 8 nm

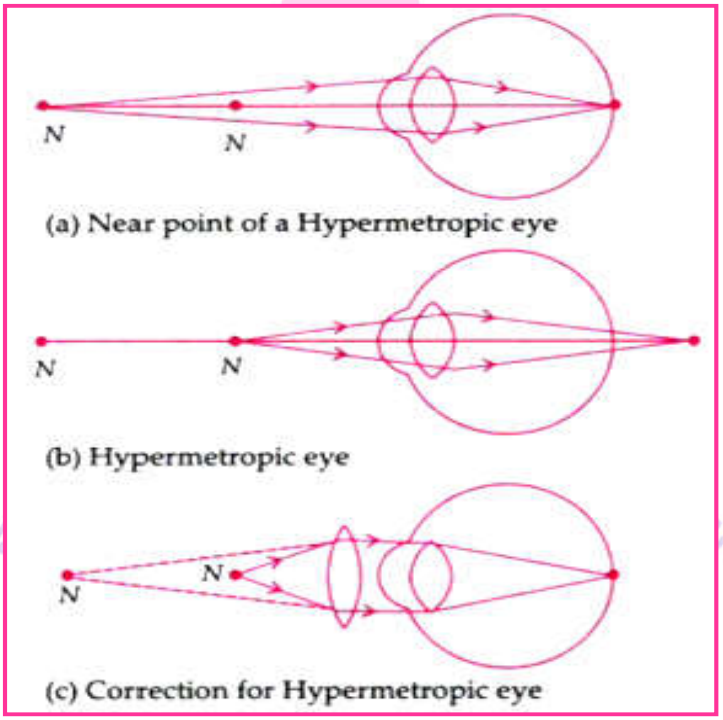
b. 40 nm to 80 nm

c. 400 nm to 800 nm

d. 4000 nm to 8000 nm

Case based Subjective Questions

1. Observe the following diagram and answer any four of the questions given below:



1. Which type of vision defect is shown in the diagram?

   Ans. Hypermetropia.

2. A person with this defect cannot see which objects distinctly? Nearby or faraway

   Ans. Nearby objects.

3. What is another name for this defect?

   Ans. Farsightedness.

4. Which type of lens is used to correct this defect?

   Ans. Convex lens of appropriate power.

5. State true or false: In hypermetropia, the light rays from a close by object are focussed a t point behind the retina.

   Ans. True.

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