10. The Human Eye and the Colourful World - Board Exam Questions

2 Mark Questions

1) *Why is the concave lens used as a corrective lens for a myopic eye?*

In a myopic eye, the image forms in front of the retina. A concave lens of the right power spreads the rays a little, so the image moves back onto the retina.

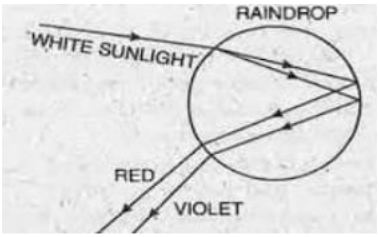
2) *What happens when light is scattered from (i) very fine particles and (ii) very large size particles of medium? Justify your answer in each case.*

(i) Mostly blue light is scattered, because very fine particles scatter light of short wavelength.

(ii) The scattered light looks white, because large particles scatter light of all wavelengths.

3) *With the help of a ray diagram, explain any phenomenon of formation of spectrum in nature.*

A rainbow is a natural spectrum. Sunlight enters tiny water drops in the air. Each drop refracts and disperses the light, reflects it inside, and refracts it again as it comes out.



4) *(i) How does the change in curvature of the eye lens helps us in the process of seeing the nearby objects clearly? (ii) State the range of the power of accommodation of a normal human eye.*

(i) For nearby objects, the eye lens becomes more curved (thicker). Its focal length becomes shorter, so the image still forms on the retina.

(ii) From 25 cm (near point) to infinity (far point).

5) *A student has difficulty in reading his textbooks but can read the blackboard clearly while sitting in the last row. Name the defect of vision the student is suffering from. List two reasons due to which this defect arises. Write the nature of the lenses required to correct this defect.*

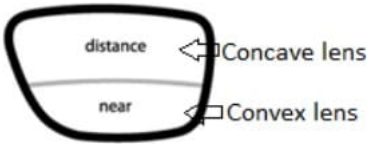
Hypermetropia (long-sightedness).

Reasons: (i) The focal length of the eye lens is too long. (ii) The eyeball has become too small.

Correction: convex lens.

6) *Name the type of lenses required by the persons for the correction of their defect of vision called presbyopia. Write the structure of the lenses commonly used for the correction of this defect giving reason for such designs.*

Bifocal lenses. The upper part is a concave lens for seeing far objects, and the lower part is a convex lens for reading (near objects).



7) *What is a rainbow? "We see a rainbow in the sky only after the rainfall." Why?*

A rainbow is a natural spectrum seen in the sky after a rain shower.

After rain, tiny water drops stay in the air. Each drop acts like a small prism: it refracts and disperses sunlight.

8) *When do we say that a particular person is suffering from hypermetropia? List two causes of this defect. Name the type of lens used to correct this defect.*

When the person can see far objects clearly but cannot see nearby objects clearly.

Causes: The focal length of the eye lens is too long. The eyeball has become too small.

Correction: convex lens.

9) *A person suffering from presbyopia needs bifocal lens. If he needs two lens of power -4.0 dioptre and +2.0 dioptre, which one of these two lenses is for the correction of distant vision and what is its focal length?*

The −4.0 D lens (a concave lens) is for distant vision.

f = 1/P = 1/(−4.0) = −0.25 m = −25 cm

10) *It is observed that the power of an eye to see nearby objects as well as far off objects diminishes with age. (i) Give reason for the above statement. (ii) Name the defect that is likely to arise in the eyes in such a condition. (iii) Draw a labelled ray diagram to show the type of corrective lens used for restoring the vision of such an eye.*

(i) With age, the ciliary muscles become weak and the eye lens becomes less flexible.

(ii) Presbyopia

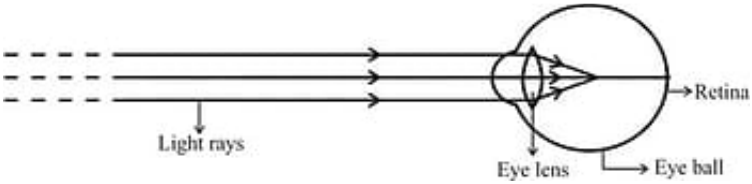
(iii) A bifocal lens: concave in the upper part and convex in the lower part.

11) *What is scattering of light? Why does the clear sky appear blue?*

Scattering is the spreading of light in different directions when it strikes particles of the medium.

Tiny particles in the air scatter blue light (short wavelength) much more than red light (long wavelength). So the sky looks blue.

12) *Observe the following diagram and answer the questions following it: (i) Identify the defect of vision shown. (ii) List its two causes. (iii) Name the type of lens used for the correction of this defect.*

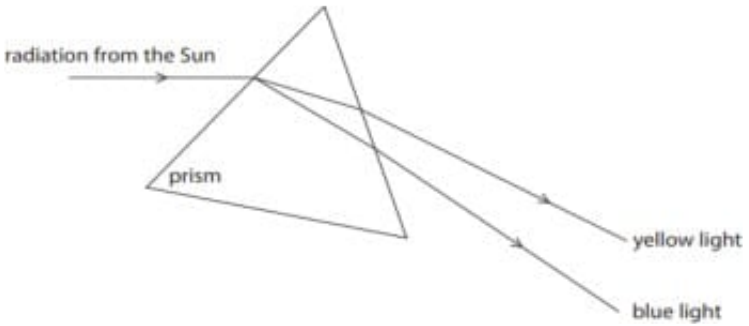


(i) Myopia (short-sightedness)
(ii) The eye lens is too curved. The eyeball is too long.
(iii) Concave lens

13) *The colour of clear sky from the earth appears blue but from the space it appears black. Why?*

• The particles in the air are smaller than the wavelength of light, so they scatter mostly short-wavelength (blue) light. So the sky looks blue from the earth.
• In space there is no air, so there is no scattering, and the sky looks black.

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

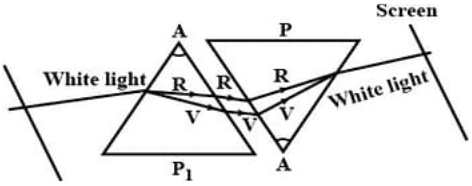


Dispersion: white light splits into seven colours when it passes through a prism.

Yellow light has the longer wavelength. For the same frequency, speed depends on wavelength, and yellow light travels faster than blue in the prism (it bends less).

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

Place the second prism upside down (inverted) next to the first. The first prism splits white light into seven colours. The second prism bends them back by the same amount in the opposite direction, so the colours join again and white light comes out.



3 Mark Questions

1) *(a) State one important function of the following parts of the human eye: (i) Retina (ii) Pupil (b) State the role of ciliary muscles in focussing objects at varying distances from the eye.*

(a) (i) Retina: it is a light-sensitive screen on which the image forms.

(ii) Pupil: it controls the amount of light entering the eye.

(b) The ciliary muscles relax or contract to change the curvature of the eye lens. This changes its focal length, so objects at different distances can be focused.

2) *Define the term power of accommodation of human eye. Write the name of the part of eye which plays a major role in the process of accommodation and explain what happens when human eye focuses (i) nearby objects and (ii) distant objects.*

Power of accommodation is the ability of the eye lens to change its focal length.

The ciliary muscles play the main role.

(i) Nearby objects: the ciliary muscles contract, the lens becomes thicker, and its focal length decreases.

(ii) Distant objects: the ciliary muscles relax, the lens becomes thinner, and its focal length increases.

3) *Define the term power of accommodation of human eye. What happens to the image distance in the eye when we increase the distance of an object from the eye? Name and explain the role of the part of human eye responsible for it in this case.*

Power of accommodation is the ability of the eye lens to change its focal length.

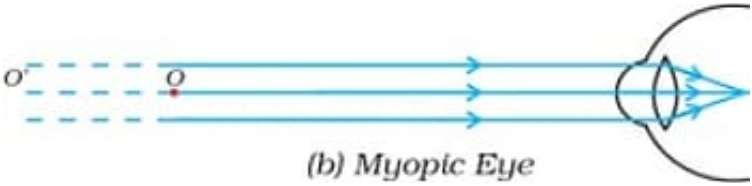
The image distance stays the same (the image always forms on the retina).

Ciliary muscles: for distant objects, they relax, the lens becomes thinner, and its focal length increases.

4) *State reasons for Myopia. With the help of ray diagrams, show the (a) image formation by a myopic eye, and (b) correction of myopia using an appropriate lens.*

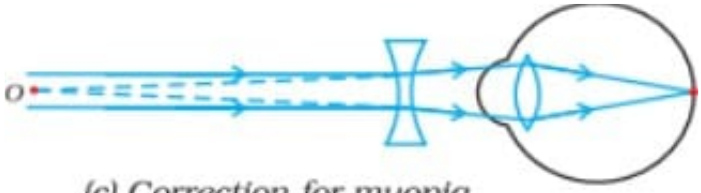
Reasons: The eye lens is too curved. The eyeball is too long.

(a)



(b) Myopic Eye

(b) A concave lens corrects it.



(c) Correction for myopia

5) *The power of a lens is –0.25 D. Based on this information, find out (a) The type of lens and its focal length. (b) The eye defect for which it may*

be used as a corrective lens. (c) The nature and size of the image formed by this lens when an object is placed between F and 2F from the optical centre of this lens.

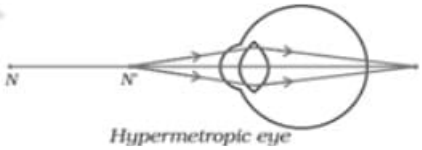
(a) Concave lens. f = 1/P = 1/(−0.25) = −4 m

(b) Myopia

(c) Virtual, erect and diminished (a concave lens always forms such an image).

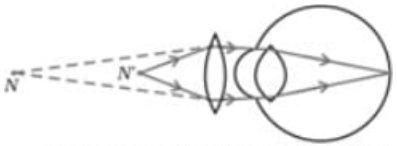
6) *A person is unable to read a book placed closer than 1 meter from his eyes. Identify the defect of vision in his eyes. Draw the ray diagrams to show the defect of vision and its correction.*

Hypermetropia. The image of a near object forms behind the retina.



Hypermetropic eye

Correction with a convex lens:



Correction for Hypermetropic eye

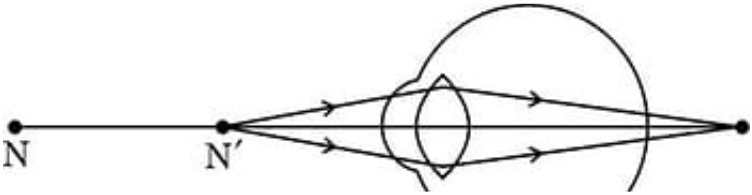
7) *A person uses lenses of +2.0 D power in his spectacles for the correction of his vision. (a) Name the defect of vision the person is suffering from. (b) List two causes of this defect. (c) Determine the focal length of the lenses used in the spectacles.*

(a) Hypermetropia (a positive power means a convex lens).

(b) The eyeball has become too small. The focal length of the eye lens is too long.

(c) f = 1/P = 1/2 = +0.5 m = 50 cm

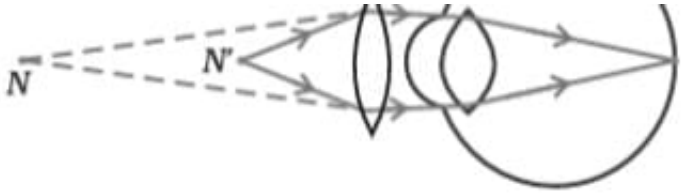
8) *Study the given diagram and answer the questions that follow: (a) Write the name of the eye defect shown in the diagram. Where is the image formed in this eye defect with respect to the retina of the eye? (b) List two causes of this eye defect. (c) With the help of a diagram, show how this eye defect of vision is corrected.*



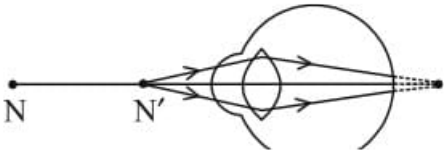
(a) Hypermetropia. The image forms behind the retina.

(b) The focal length of the eye lens is too long. The eyeball has become too small.

(c) With a convex lens:



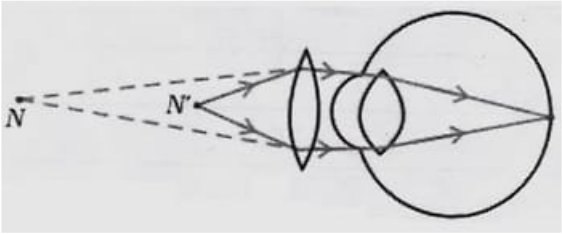
9) *Study the diagram given below and answer the questions that follow: (i) Name the defect of vision represented in the diagram. Give reason for your answer. (ii) List two causes of this defect. (iii) With the help of a diagram show how this defect of vision is corrected.*



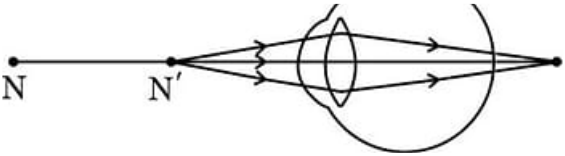
(i) Hypermetropia, because the image forms behind the retina.

(ii) The focal length of the eye lens is too long. The eyeball has become too small.

(iii) With a convex lens:



10) *Study the diagram given below and answer the questions that follow: (i) Name the defect of vision depicted in this diagram stating the part of the eye responsible for this condition. (ii) List two causes of this defect. (iii) Name the type of lens used to correct this defect and state its role in this case.*

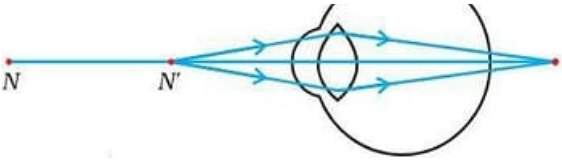


(i) Hypermetropia. The ciliary muscles (which change the focal length of the lens) are responsible.

(ii) The focal length of the eye lens is too long. The eyeball has become too small.

(iii) A converging (convex) lens. It gives the extra focusing power needed to form the image on the retina.

11) *A. What is the fundamental difference between hypermetropia and myopia in terms of the optical experience of a person? B. The diagram below shows a special case of an eye defect. (i) What is the defect that is shown in the figure? (ii) State one cause for such a defect? (iii) Explain with reason if a concave lens can be used to correct the defect.*



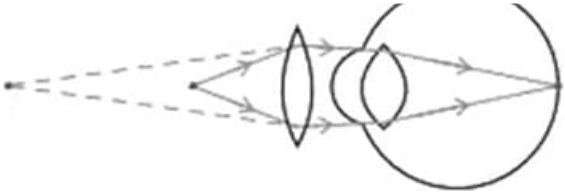
A. In hypermetropia, near objects look blurred but far objects are clear. In myopia, far objects look blurred but near objects are clear.

B. (i) Hypermetropia

(ii) The eyeball has become too short.

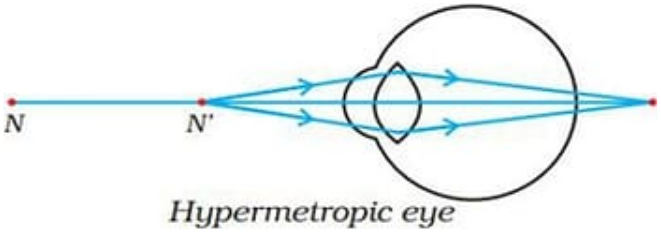
(iii) No. A concave lens spreads the rays out and pushes the image even further back. A convex lens is needed to bring the rays together onto the retina.

12) *The above image shows a corrective measure for a particular defect of vision. (i) Identify the defect of vision and state what kind of lens is used to correct this deficiency. (ii) Draw and label a ray diagram that shows the defect of vision in the above case before correction.*



(i) Hypermetropia. A convex lens is used.

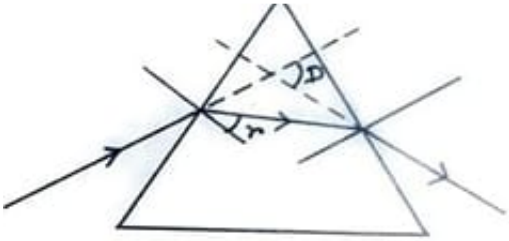
(ii)



Hypermetropic eye

13) *(a) Draw the ray diagram for refraction of light through a glass prism and mark angle of refraction and angle of deviation. (b) When the path of a light ray refracted through a glass prism is reversed how will the angle of deviation change? Explain.*

(a) The angle between the incident ray (extended) and the emergent ray is the angle of deviation.



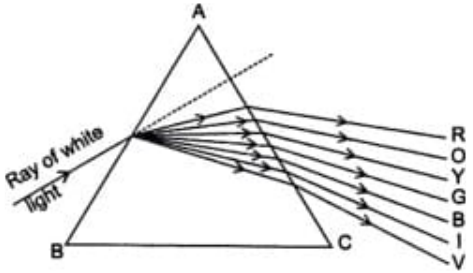
∠r = angle of refraction
∠D = angle of deviation

(b) The angle of deviation stays the same. The ray simply goes back along its original path.

14) *What is dispersion of white light? State its cause. Draw a diagram to show dispersion of a beam of white light by a glass prism.*

Dispersion is the splitting of white light into its seven colours.

Cause: Different colours bend through different angles in the prism. Red bends the least and violet the most.



15) *Explain the phenomenon of rainbow formation in the sky. Draw the labelled ray diagram in support of your explanation.*

A rainbow is formed by dispersion of sunlight by tiny water drops in the air.

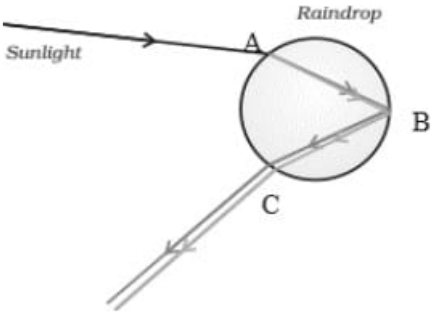
The drops act like small prisms. They refract and disperse sunlight, reflect it inside, and refract it again as it comes out.
(refer 3rd 2 mark question for the diagram)

16) *What is a rainbow? Draw a labelled diagram to show its formation.*

A rainbow is a natural spectrum seen in the sky after a rain shower.

(refer 3rd 2 mark question for the diagram)

17) *Draw a ray diagram to show the formation of a rainbow in the sky. On this diagram mark A – where dispersion of light occurs, B – where internal reflection of light occurs and C – where refraction of light occurs. List two necessary conditions to observe a rainbow.*



Conditions: (i) There must be tiny water drops in the air (after rain). (ii) The Sun must be behind the observer (the rainbow is opposite the Sun).

18) *What is scattering of light? How is scattering of light different from reflection of light? Explain.*

Scattering is the spreading of light in different directions when it strikes particles of the medium.

In reflection, light bounces back in one fixed direction. In scattering, light spreads out in many directions.

19) *Name and explain the phenomenon of light due to which the path of a beam of light becomes visible when it enters a smoke filled room through a small hole. Also state the dependence of colour of the light we receive on the size of the particle of the medium through which the beam of light passes.*

Scattering of light (Tyndall effect).

The light strikes the fine smoke particles and is scattered in all directions, so its path becomes visible.

Very fine particles scatter mostly blue light. Larger particles scatter light of longer wavelengths (and very large ones scatter all colours, so the light looks white).

20) *Give reasons for the following: (a) Danger signals installed at airports and at the top of tall buildings are of red colour. (b) The sky appears dark to the passengers flying at very high altitudes. (c) The path of a beam of light passing through a colloidal solution is visible.*

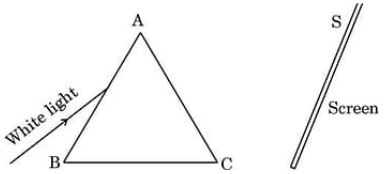
(a) Red light is scattered the least by fog or smoke, so it can be seen from far away.

(b) At very high altitudes there is almost no air, so there is no scattering of light.

(c) The particles of a colloid are big enough to scatter the light.

4 Mark Questions (Case Study)

1) *A person allowed a narrow beam of white light from the sun to enter a dark room through a small aperture and placed a glass prism in its path in such a manner that the beam falls on the face AB of the prism as shown in the figure. A screen S is placed on the other side of the prism, facing AC. On turning the prism slowly, a beautiful band of colours is obtained on the screen. It is the spectrum of sunlight.*



(a) Name the phenomenon due to which a prism splits the incident white light into a band of colours. (1)

Dispersion of light

(b) State the reason of getting a band of seven colours in the above case. (1)
(refer 14th 3 mark question)
(c) (i) Explain with the help of a labelled ray diagram, an experimental arrangement to show the recombination of the spectrum of white light. (2)
(refer 15th 2 mark question)
OR (c) (ii) Draw a labelled ray diagram to show the formation of a rainbow.
(refer 16th 3 mark question)

2) *The students in a class took a thick sheet of cardboard and made a small hole in its centre. Sunlight was allowed to fall on this small hole and they obtained a narrow beam of white light. A glass prism was taken and this white light was allowed to fall on one of its faces. The prism was turned slowly until the light that comes out of the opposite face of the prism appeared on the nearby screen. They studied this beautiful band of light and concluded that it is a spectrum of white light.*
(i) Give any one more instance in which this type of spectrum is observed. (1)

A rainbow

(ii) What happens to white light in the above case? (1)

It splits into seven colours (dispersion).

(iii) (A) List two conditions necessary to observe a rainbow. (2)
(refer 17th 3 mark question)
OR (iii) (B) Draw a ray diagram to show the formation of a rainbow. Mark on it, points (a), (b) and (c) as given below: (a) Where dispersion of light occurs. (b) Where light gets reflected internally. (c) Where final refraction occurs.
(refer 17th 3 mark question)

5 Mark Questions

1) *I. What is meant by accommodation of the human eye?*
II. What is the near point of a normal eye and what does it signify?
III. Name which type of lens is used to correct the defect in which a person cannot see distant objects clearly.
IV. Draw a diagram to show how the choice of your lens in (d) helps to see distant objects clearly?

I. The ability of the eye lens to change its focal length, so that objects at different distances are focused on the retina.

II. The nearest point at which an object can be seen clearly (about 25 cm for a normal eye). Objects closer than this look blurred.

III. A diverging (concave) lens, to correct myopia.

IV. (refer 4th 3 mark question)

2) *I. What is dispersion of light?*
II. Which colour of light deviates the least during dispersion through a prism?
III. State why the sky appears dark to an astronaut in outer space.
IV. Draw a simple labelled diagram to show how white light splits into different colours while passing through a glass prism.

I. (refer 14th 3 mark question)

II. Red

III. There is no air in space to scatter sunlight, so the sky looks dark.

IV. (refer 14th 3 mark question)