Chapter-10

The Human Eye and the Colourful World

2 MARKS QUESTIONS

1.Why is a convex lens called a converging lens?
Answer:
A convex lens focuses all the parallel light rays at its focus after refraction. Hence, it is called a converging lens.

2. State the role of the eye lenses in the human eye?
Answer:
The eye lens focuses the light rays entering the eye on the retina forming a real and an inverted image of the object on the retina.

3. A person with a myopic eye cannot see objects beyond 1.21.2 **m distinctly. What should be the corrective lens used to restore proper vision?**
Answer:
Since the person is myopic and cannot see objects clearly beyond 1.21.2 m, he should use a concave lens having a focal length 1.21.2 m to restore his normal vision.

4. What is the far point and near the point of the human eye with normal vision?
Answer:
For a human eye with proper vision, the near point is 2525 cm from the eye and the far point is at infinity.

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

Answer:

Since, the student has difficulty reading the blackboard, sitting in the last row, he is suffering from myopia or short-sightedness. A concave lens of suitable power should be used to correct his vision defect.

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

Answer:

The normal eye is unable to see the objects clearly placed closer than 2525 cm because at a distance of 2525 cm power of accommodation gets exhausted. Hence, the eye is unable to focus the light rays on the retina, when the object is placed closer than 2525 cm.

7. Why does the Sun appear reddish early in the morning?

Answer:

During sunrise, the sun is at the farthest distance from the earth's surface. The light rays travel a large distance in the Earth's atmosphere before reaching our eyes.

While passing through the atmosphere, the light rays with shorter wavelengths get scattered by the Earth's atmosphere and the red-colored light with the longest wavelength is able to reach our eyes. Hence, the Sun appears reddish early in the morning.

8.Why do we observe random wavering or flicking of the objects near a fire or on a very hot day?

Answer: We observe random wavering or flicking of the objects near a fire or on a very hot day because of atmospheric refraction. The area above the fire is hot and is lighter than the cool air above it due to which its refractive index is low and density also does not remain the same. Therefore, the apparent position of the object flickers.

9. Why are we not able to see things clearly when we come out of a dark room?

Answer:

In a dark room, the iris expands the pupil which allows more light to enter the eye. As we come out of the darkroom, a large amount of light enters our eyes and because of the glare, we are not able to see things clearly.

10. What is the function of the optic nerve in the human eye?
Answer:
Optic nerve carries the visual information from the retina to the brain in the form of electrical signals.

11. Why do different colours deviate through different angles on passing through a prism?
Answer:
Different colours deviate through different angles on passing through a prism because different colours with different wavelengths travel through glass at different speeds and the glass has a different refractive index for different colours.

12. Name the defect of vision in the person
a. Whose near point is more than 2525 **cm away?**
Answer: Hypermetropia

b. Whose far point is less than infinity.
Answer: Myopia

13. What is a spectrum?
Answer:
A continuum of colour obtained by dispersion of white light by passing through a prism is called a spectrum.

14. Why does the clear sky look blue?
Answer:
As white light passes through the atmosphere, the tiny particles held in the atmosphere scatter the light of a shorter wavelength. Therefore, blue light having the shortest wavelength is scattered the most and the clear sky appears blue.

15. Can visible light be scattered by atoms/molecules in the earth's atmosphere?
Answer:
Yes, visible light is scattered by atoms/molecules in the earth's atmosphere as the size of molecules/atoms is much less than the wavelength of visible light.

16. Why does the sky appear dark instead of blue to an astronaut?
Answer:
Outer space does not have an atmosphere. As a result, the light does not scatter into its constituent colours in outer space and hence the sky appears dark instead of blue to an astronaut**.**

17. What is the basic cause of atmospheric refraction?
Answer:
Atmospheric refraction is caused by the bending of light when it passes through the layers of the Earth's atmosphere with different optical densities.

18. What is the range of vision?
Answer:
The range of vision of a normal human eye is the distance between the near point and far point of the human eye. Hence, for a normal human eye, it ranges from 2525 cm to infinity.

4 MARKS QUESTIONS

1.What is presbyopia? State the causes of this defect? How is the presbyopia of a person corrected?
Answer:
Presbyopia is a visual impairment mainly due to aging when a person is unable to see the near and far off objects clearly.
The main causes of presbyopia are as follows:

1. Stiffness of the eye lens
2. Due to aging, the power of accommodation of the eye may decrease.
3. The ciliary muscles become weak.

Presbyopia is corrected using a bifocal lens whose upper half has a concave nature and the lower half a convex nature.

2. The rainbow is a natural spectrum appearing in the sky after a rain shower.
a. Is it correct to say that a rainbow is always formed in a direction opposite to the sun?
Answer:

Yes, a rainbow is always formed in a direction opposite to the sun as a rainbow is just the sunlight that has been refracted and reflected.

b. Can it be seen on a sunny day?
Answer:

Yes, a rainbow can be seen on a sunny day if the Sun's beam passing through the droplets of water suspended in the atmosphere, reaches the observer's eye.

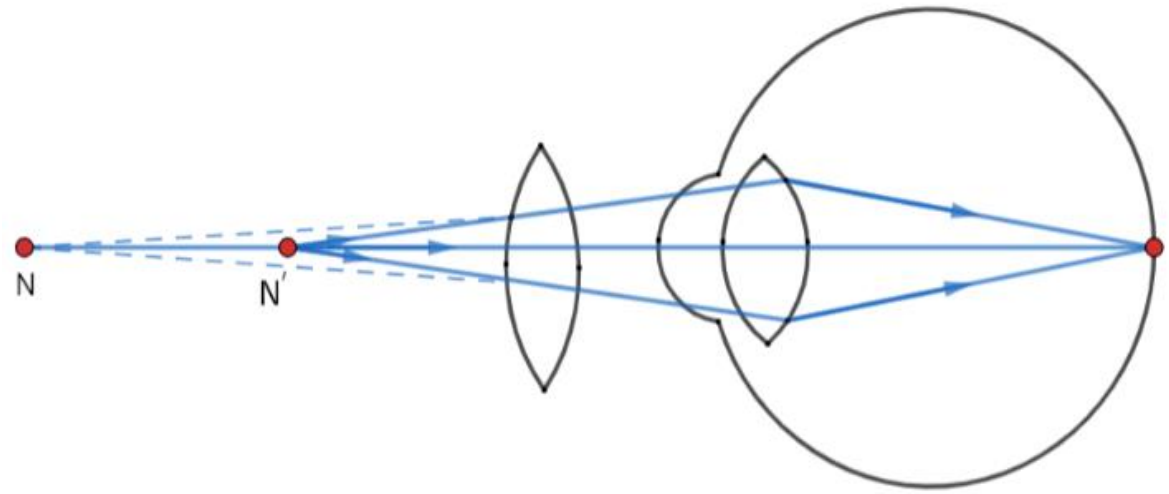
c. Arrange the sequence in correct sequential order Refraction, Internal Reflection, Refraction & Dispersion.
Answer:
The correct sequential order is:
Refraction & Dispersion, Internal Reflection, Refraction.

3.

a. Show a diagram to show the correctness of hypermetropia?

Answer:

Diagram to show the correctness of hypermetropia is shown below,



4. A reporter records the following observations of an astronaut from his spaceship. Justify each statement.

a. The length of the day is the same as observed on the earth.

Answer:

This statement is not true as the length of the day in space can be four minutes shorter than on Earth.

b. Space appears black in colour.

Answer:

The statement is correct because in space there is no atmosphere. Hence, there is no scattering of light.

c. The star appears to twinkle while the planets do not do so as they do on the earth.

Answer:

The statement is incorrect since we know that the twinkling of stars is due to atmospheric refraction and space has no atmosphere. Hence, the stars do not appear to twinkle in space.

5. Why do stars twinkle?
Answer:
Twinkling of stars is due to the atmospheric refraction of light. Stars behave as point sources of light since they are present far away. The path of the light rays from the star experiences atmospheric refraction and the position of the star appear to change. Also, the amount of light entering the eye flickers, so sometimes the star appears brighter and at other times fainter. Thus, the stars twinkle.

6. Explain why the planets do not twinkle.
Answer:
The planets are much closer to the earth than the stars. A planet can be considered a collection of a large number of limited light sources. Although light comes from individual point sources flickering, the total amount of light that enters our eye from all of the individual point sources will be the same. Thus, the planets appear equally brighter and there are no planetary blinks.

7.Why does the Sun appear reddish early in the morning?

Answer-

White light coming from the sun has to travel more distance in the atmosphere before reaching the observer. During this, the scattering of all coloured lights except the light corresponding to red colour takes place and so, only the red coloured light reaches the observer. Therefore, the sun appears reddish at sunrise and sunset.

8. What is meant by power of accommodation of eye?

Solution :

When the ciliary muscles are relaxed, the eye lens becomes thin, the focal length increases, and the distant objects are clearly visible to the eyes. To see the nearby objects clearly, the ciliary muscles contract making the eye lens thicker. Thus, the focal length of the eye lens decreases and the nearby objects become visible to the eyes. Hence, the human eye lens is

able to adjust its focal length to view both distant and nearby objects on the retina. This ability is called the power of accommodation of the eyes.

9. A person needs a lens of power -5.5 dioptre for correcting his distinct vision. For correcting his near vision he needs a lens +1.5 dioptre. What is the focal length of the lens required for correcting (i) distinct vision, and (ii) near vision?

Solution :

(i) Power of lens needed for correction distant vision of the person (P) = -5.5 D

Focal length of lens required for correcting distant vision (f)

= 1/P = 1/-5.5 m = 0.18 m = 18 cm.

(ii) For correcting near vision the power of lens required (P) = +1.5 D

Focal length of lens required for correcting near vision (f)

= 1/P = 1/1.5 m = 0.67 m = 66.7 cm.

10. Why does the sky appear dark instead of blue to astronaut?

Solution :

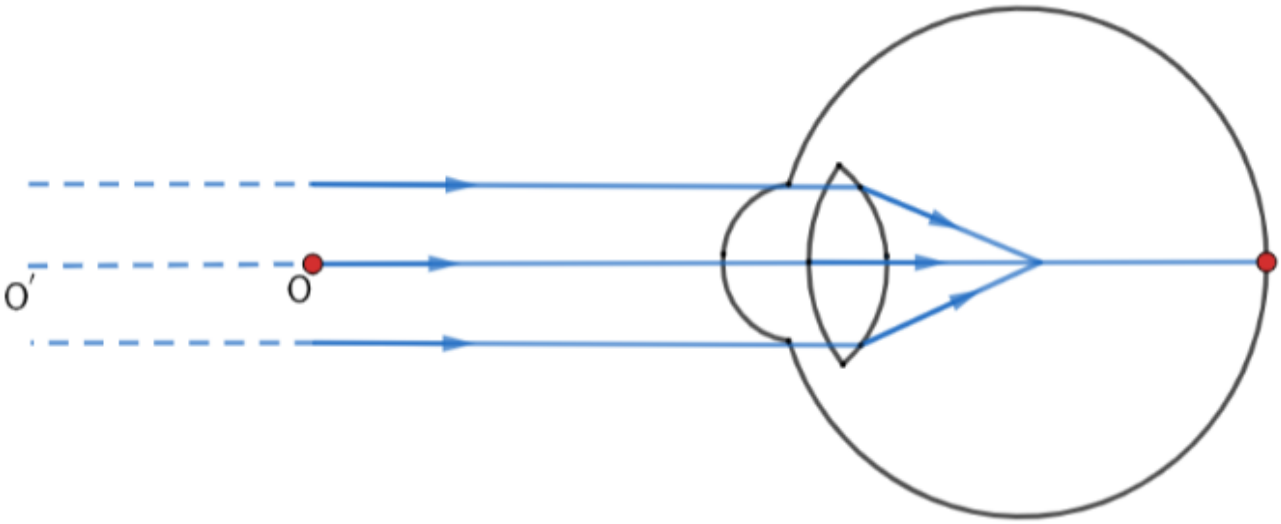
Blue colour of the sky is on account of scattering of light of shorter wavelength by particles in the atmosphere of earth. If the earth had no atmosphere, there would not have been any scattering and sky would have looked dark. When astronaut in his spacecraft goes above the atmosphere of earth, sky appears dark to him because there is no scattering of light.

7 MARKS QUESTIONS

1. A 14-year-old student is not able to clearly see the questions written on the blackboard placed at a distance of 55 m from him.
a. Name the defect of vision he is suffering from?
Answer:

The student is suffering from myopia.

b. Draw the diagram to show this defect?
Answer:
The diagram showing the myopic defect is drawn below.

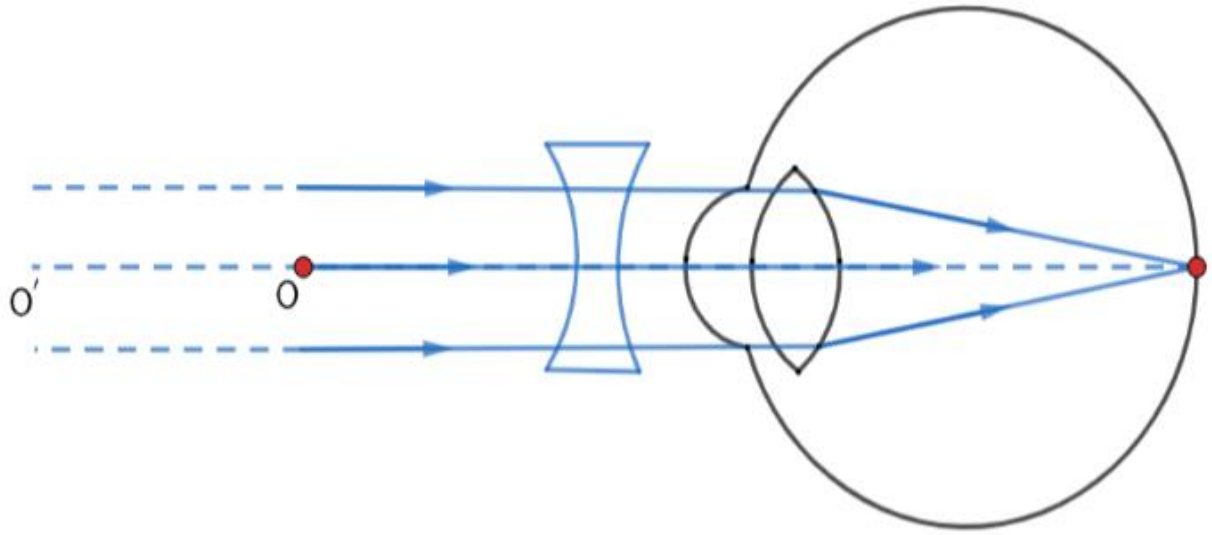


c. Name the type of lens used to correct this defect?
Answer:

A concave lens is used to correct myopia.

d. Name two possible causes of this defect.
Answer:
The two possible causes of myopia are:
i. Elongation of the eyeball
ii. Decrease in the focal length of the eye lens

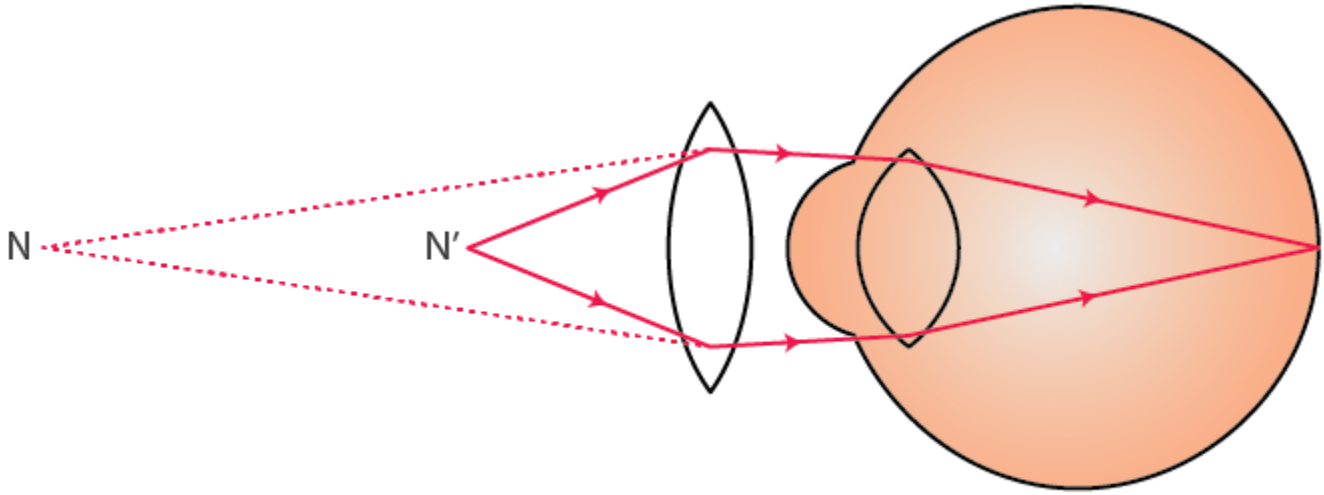
e. Draw the diagram to show how this defect can be corrected.
Answer:
The diagram showing how myopic defect is corrected is drawn below.



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

Answer-

An individual suffering from hypermetropia can see distinct objects clearly but he or she will face difficulty in clearly seeing objects nearby. This happens because the eye lens focuses the incoming divergent rays beyond the retina. This is corrected by using a convex lens. A convex lens of a suitable power converges the incoming light in such a way that the image is formed on the retina, as shown in the following figure.



Correction for hypermetropic eye

The convex lens creates a virtual image of a nearby object (N' in the above figure) at the near point of vision (N) of the individual suffering from hypermetropia.

The given individual will be able to clearly see the object kept at 25 cm (near point of the normal eye), if the image of the object is formed at his near point, which is given as 1 m.

Object distance, u= – 25 cm

Image distance, v= – 1 m = – 100 m

Focal length, *f*

Using the lens formula,

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

$$-\frac{1}{100} - \frac{1}{-25} = \frac{1}{f}$$

$$\frac{1}{f} = \frac{1}{25} - \frac{1}{100}$$

$$\frac{1}{f} = \frac{4-1}{100}$$

$$f = \frac{100}{3} = 33.3cm = 0.33m$$

$We\ know,$

$$Power, P = \frac{1}{f(in\ metres)}$$

$$P = \frac{1}{0.33} = +3.0D$$

A convex lens of power +3.0 D is required to correct the defect.

3.He far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Answer-

The individual is suffering from myopia. In this defect, the image is formed in front of the retina. Therefore, a concave lens is used to correct this defect of vision.

Object distance (u) = infinity = ∞

Image distance (v) = – 80 cm

Focal length = f

According to the lens formula,

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

$$-\frac{1}{80} - \frac{1}{\varpi} = \frac{1}{f}$$

$$\frac{1}{f} = -\frac{1}{80}$$

$$f = -80cm = -0.8\ m$$

$$We\ know,$$

$$Power, P = \frac{1}{f(in\ metres)}$$

$$P = \frac{1}{-0.8} = -1.25D$$

A concave lens of power – 1.25 D is required by the individual to correct his defect.

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

Answer-

The power (*P)* of a lens of focal length f is given by the relation

Power (P) = 1/*f*

(i) Power of the lens (used for correcting distant vision) = – 5.5 D

Focal length of the lens (*f)* = 1/*P*

f = 1/-5.5

f = -0.181 m

The focal length of the lens (for correcting distant vision) is – 0.181 m.

(ii) Power of the lens (used for correcting near vision) = +1.5 D

Focal length of the required lens (*f)* = 1/*P*

f = 1/1.5 = +0.667 m

The focal length of the lens (for correcting near vision) is 0.667 m.

5. The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Answer-

The individual is suffering from myopia. In this defect, the image is formed in front of the retina. Therefore, a concave lens is used to correct this defect of vision.

Object distance (u) = infinity = ∞

Image distance (v) = – 80 cm

Focal length = f

According to the lens formula,

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

$$-\frac{1}{80} - \frac{1}{\infty} = \frac{1}{f}$$

$$\frac{1}{f} = -\frac{1}{80}$$

$$f = -80cm = -0.8\ m$$

$We\ know,$

$$Power, P = \frac{1}{f(in\ metres)}$$

$$P = \frac{1}{-0.8} = -1.25D$$

A concave lens of power – 1.25 D is required by the individual to correct his defect.

MULTIPLE CHOICE QUESTIONS

1.A person went for a medical check-up and found that the curvature of his eye lens was increasing. Which defect is he likely to suffer from?

(a) Myopia

(b) Cataract

(c) Presbyopia

(d) Hypermetropia

Correct Answer: Option (a)

2) A person gets out in the sunlight from a dark room. How does his pupil regulate and control the light entering the eye?

(a) The size of the pupil will decrease, and less light will enter the eye

(b) The size of the pupil will decrease, and more light will enter the eye

(c) The size of the pupil will remain the same, but more light will enter the eye

(d) The size of the pupil will remain the same, but less light will enter the eye

Correct Answer: Option (a)

3) When light rays enter the eye, most of the refraction occurs at the

(a) Crystalline lens

(b) The outer surface of the cornea

(c) Iris

(d) Pupil

Correct Answer: Option (b)

4) In which part of the human eye is the image of an object formed?

(a) Iris

(b) Pupil

(c) Retina

(d) Cornea

Correct Answer: Option (c)

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

(a) is scattered the most by smoke or fog

(b) is scattered the least by smoke or fog

(c) is absorbed the most by smoke or fog

(d) moves fastest in the air

Correct Answer: Option (b)

6) 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

Correct Answer: Option (b)

7) A person sees an object closer to his eyes. What changes will take place in his eyes?

(a) the pupil size will expand

(b) the ciliary muscles will contract

(c) the focal length of the eye lens will increase

(d) the light entering the eye will be more

Correct Answer: Option (b)

8) The splitting of white light into different colours on passing through a prism is called

(a) reflection

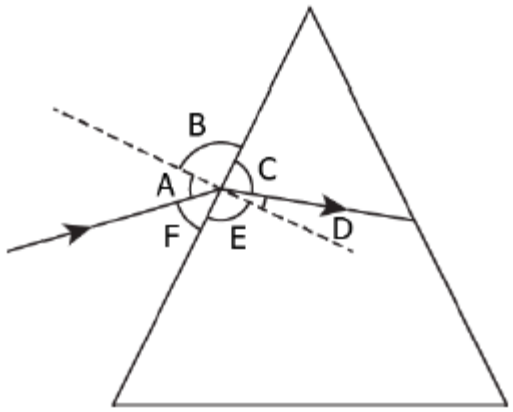
(b) refraction

(c) dispersion

(d) deviation

Correct Answer: Option (c)

9) The image shows a light ray incident on a glass prism.



The various angles are labelled in the image. Which angle shows the angle of incidence and angle of refraction, respectively?

(a) A and D

(b) B and E

(c) C and F

(d) D and F

Correct Answer: Option (a)

10) The deflection of light by minute particles and molecules of the atmosphere in all directions is called _____ of light.

(a) dispersion

(b) scattering

(c) interference

(d) Tyndall effect

Correct Answer: Option (b)

11) Which of the following phenomena contributes significantly to the reddish appearance of the sun at sunrise or sunset?

(a) Dispersion of light

(b) Scattering of light

(c) Total internal reflection of light

(d) Reflection of light from the earth

Correct Answer: Option (b)

FILL IN THE BLANKS

1.The transparent front part of the eye is called the _____.

Answer: Cornea

2.The colored part of the eye that controls the amount of light entering the eye is the _____.

Answer: Iris

3.The lens of the eye changes its shape to focus on objects at different distances; this process is known as _____.

Answer: Accommodation

4.The central part of the retina responsible for sharp and detailed vision is called the _____.

Answer: Fovea

5.The image formed on the retina is _____.

Answer: Real and inverted

6.The deficiency of this vitamin can lead to night blindness.

Answer: Vitamin A

7.The phenomenon of splitting light into its component colors is called _____.

Answer: Dispersion

8.The seven colors obtained when light undergoes dispersion are _____.

Answer: Violet, Indigo, Blue, Green, Yellow, Orange, Red

9.A person with myopia can see nearby objects _____.

Answer: Clearly, but distant objects appear blurred

10.The lens used to correct hypermetropia is a _____ lens.

Answer: Convex