

The Human Eye and the Colourful World

Class 10 - CBSE Science | Chapter 10 | Worksheet & Test Paper

15 MCQs | 8 board questions | 6 practice problems

Video lesson, notes and an interactive quiz: learn.ultimatetools.io

SECTION A - Multiple Choice Questions (1 mark each)

1. Which part of the eye controls the amount of light entering it?

- (a) Cornea
- (b) Iris (by changing pupil size)
- (c) Retina
- (d) Ciliary muscles

2. The image formed on the retina of the human eye is:

- (a) Virtual and erect
- (b) Real and erect
- (c) Real and inverted
- (d) Virtual and inverted

3. The near point of a normal human eye is at:

- (a) Infinity
- (b) 2.5 cm
- (c) 25 cm
- (d) 25 m

4. The eye's ability to change the focal length of its lens is called:

- (a) Power of accommodation
- (b) Persistence of vision
- (c) Dispersion
- (d) Refraction

5. A person cannot see distant objects clearly. The defect and its correction are:

- (a) Hypermetropia; convex lens
- (b) Myopia; concave lens
- (c) Myopia; convex lens
- (d) Presbyopia; plane glass

6. In hypermetropia, the image of a nearby object forms:

- (a) On the retina
- (b) In front of the retina
- (c) Behind the retina
- (d) On the cornea

7. Presbyopia occurs mainly because:

- (a) The eyeball becomes too long
- (b) Ciliary muscles weaken and the lens loses flexibility with age
- (c) The pupil becomes larger
- (d) The retina becomes insensitive

8. Which colour of light bends the MOST when white light passes through a prism?

- (a) Red
- (b) Yellow
- (c) Green
- (d) Violet

9. The splitting of white light into its component colours is called:

- (a) Reflection
- (b) Dispersion
- (c) Scattering
- (d) Deviation

10. Stars twinkle because of:

- (a) Dispersion of starlight

- (b) Atmospheric refraction of starlight
- (c) Scattering by dust
- (d) Reflection from clouds

11. Planets do not twinkle because:

- (a) They emit their own steady light
- (b) They are extended sources, so variations average out
- (c) They are outside the atmosphere
- (d) They reflect only red light

12. The sky appears blue because:

- (a) Blue light is absorbed by air
- (b) Air molecules scatter blue light more than red
- (c) The sun emits mostly blue light
- (d) Blue light travels fastest in air

13. Danger signal lights are red because red light:

- (a) Is scattered the least by fog and smoke
- (b) Is scattered the most
- (c) Has the shortest wavelength
- (d) Is brightest to the eye

14. A person's far point is 1 m. The power of the corrective lens needed is:

- (a) +1 D
- (b) -1 D
- (c) +2 D
- (d) -0.5 D

15. In a cataract, vision is lost because:

- (a) The optic nerve breaks
- (b) The eye lens becomes cloudy and milky
- (c) The retina detaches
- (d) The pupil closes permanently

SECTION B - Board-style Questions

1. What is meant by the power of accommodation of the eye? [2 marks]

2. A student sitting on the last bench cannot read the blackboard clearly. Name the defect, state two possible causes, and explain the correction with the type of lens used. [3 marks]

3. The near point of a hypermetropic eye is 1 m. What is the power of the lens required to read at the normal near point of 25 cm? [3 marks]

4. Why does the sky appear blue on a clear day? [2 marks]

5. Why does the sky appear dark instead of blue to an astronaut? [2 marks]

6. Explain why stars twinkle but planets do not. [3 marks]

7. What is dispersion of white light? Which colour deviates the most and which the least through a glass prism? [2 marks]

8. Why does it take some time to see objects in a dim room when you enter from bright sunlight? [2 marks]

SECTION C - Practice Problems

1. A myopic person has a far point of 80 cm. Find the nature, focal length and power of the corrective lens.

Hint: The lens must form the image of a very distant object at the far point: $f = -(\text{far point})$.

2. The near point of an elderly person is 50 cm. Find the power of the reading lens needed to bring the near point to 25 cm.

Hint: Object at $u = -25$ cm must give a virtual image at $v = -50$ cm. Use $1/f = 1/v - 1/u$.

3. A person can see clearly only up to 2 m. What lens should they use to see distant objects clearly, and what is its power?

Hint: Far point = 2 m $\rightarrow$ myopia. $f = -(\text{far point})$.

4. Which colour of white light travels fastest inside the glass of a prism, and which slowest? Relate this to which bends most.

Hint: Bending depends on how much a colour slows down: bigger slowdown $\rightarrow$ bigger refractive index $\rightarrow$ more bending.

5. A bifocal spectacle has an upper portion of power -0.75 D and a lower portion of +1.5 D. Find the focal length of each portion and state which defect each part corrects.

Hint: $f = 1/P$ (in metres). Negative $\rightarrow$ concave $\rightarrow$ distance vision; positive $\rightarrow$ convex $\rightarrow$ reading.

6. Because of atmospheric refraction, approximately how much longer does the day appear, and why?

Hint: The sun is visible before actual sunrise and after actual sunset.

ANSWER KEY

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Section A - MCQ answers

1. (b) Iris (by changing pupil size)

The iris is the coloured muscular diaphragm that expands or contracts the pupil - the opening through which light enters.

2. (c) Real and inverted

The eye's converging lens system forms a real, inverted image on the retina; the brain interprets it as upright.

3. (c) 25 cm

25 cm is the least distance of distinct vision - the closest a normal eye can focus comfortably.

4. (a) Power of accommodation

Ciliary muscles change the lens thickness, adjusting its focal length for near and far objects - the power of accommodation.

5. (b) Myopia; concave lens

Blurred distant vision = myopia; the image forms in front of the retina, so a diverging (concave) lens is used.

6. (c) Behind the retina

The eye converges too little for near objects, so the image would form behind the retina - corrected with a convex lens.

7. (b) Ciliary muscles weaken and the lens loses flexibility with age

Ageing reduces the power of accommodation - the near point recedes, making reading difficult without a convex reading lens (bifocals if myopia is also present).

8. (d) Violet

Violet has the shortest wavelength of the visible colours and is deviated the most; red is deviated the least.

9. (b) Dispersion

Dispersion happens because different colours travel at slightly different speeds in glass and so bend by different amounts.

10. (b) Atmospheric refraction of starlight

Continuously changing air densities keep bending the starlight, so the star's apparent position and brightness flicker.

11. (b) They are extended sources, so variations average out

Being much closer, planets appear as a collection of many point sources; the tiny shifts cancel each other out on average.

12. (b) Air molecules scatter blue light more than red

Molecules scatter shorter wavelengths far more strongly; scattered blue light reaches us from all directions of the sky.

13. (a) Is scattered the least by fog and smoke

Red's long wavelength scatters least, so a red signal remains visible from far away and through fog.

14. (b) -1 D

Myopia correction: concave lens with $f = -(\text{far point}) = -1 \text{ m}$, so $P = 1/f = -1 \text{ D}$.

15. (b) The eye lens becomes cloudy and milky

The crystalline lens turns opaque with age in some people; vision is restored surgically, usually with an artificial lens.

Section B - Model answers

1. What is meant by the power of accommodation of the eye?

The ability of the eye lens to adjust its focal length - by the action of the ciliary muscles - so that objects at different distances are focused clearly on the retina. The muscles relax (thin lens, longer focal length) for distant objects and contract (thick lens, shorter focal length) for nearby objects.

2. A student sitting on the last bench cannot read the blackboard clearly. Name the defect, state two possible causes, and explain the correction with the type of lens used.

The defect is myopia (near-sightedness). Causes: (i) elongation of the eyeball, or (ii) excessive curvature (too short focal length) of the eye lens. The image of distant objects forms in front of the retina. Correction: a concave (diverging) lens of suitable power, which diverges the incoming light so the image forms exactly on the retina.

3. The near point of a hypermetropic eye is 1 m. What is the power of the lens required to read at the normal near point of 25 cm?

The corrective lens must form a virtual image at 1 m (the defective near point) of an object at 25 cm. $u = -25$ cm, $v = -100$ cm. Lens formula: $1/f = 1/v - 1/u = (-1/100) - (-1/25) = (-1 + 4)/100 = 3/100 \rightarrow f = +33.3$ cm = +0.33 m. Power $P = 1/f = +3$ D. A convex lens of +3 dioptre is required.

4. Why does the sky appear blue on a clear day?

Air molecules are much smaller than the wavelength of visible light, and such particles scatter shorter wavelengths far more strongly than longer ones. Blue light is therefore scattered in all directions much more than red; this scattered blue light entering our eyes from every part of the sky makes it appear blue.

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

At very high altitudes and in space there is practically no atmosphere, so there are no air molecules to scatter sunlight. Since no scattered light reaches the astronaut's eyes, the sky appears dark instead of blue.

6. Explain why stars twinkle but planets do not.

Starlight entering the atmosphere is refracted continuously by air layers whose density keeps changing; since a star is effectively a point source, its apparent position and brightness fluctuate - it twinkles. A planet is much closer and behaves as an extended source (a collection of many point sources); the fluctuations from different points average out to zero, so planets do not twinkle.

7. What is dispersion of white light? Which colour deviates the most and which the least through a glass prism?

The splitting of white light into its component colours (VIBGYOR) on passing through a prism is called dispersion; it occurs because different colours bend by different amounts. Violet deviates the most and red the least.

8. Why does it take some time to see objects in a dim room when you enter from bright sunlight?

In bright light the pupil is contracted. In the dim room, the iris takes some time to expand the pupil and let in more light (and the retina's sensitivity adjusts), so vision takes a few moments to adapt.

Section C - Solutions

1. A myopic person has a far point of 80 cm. Find the nature, focal length and power of the corrective lens.

Concave lens with $f = -80$ cm = -0.8 m. Power $P = 1/f = 1/(-0.8) = -1.25$ D.

2. The near point of an elderly person is 50 cm. Find the power of the reading lens needed to bring the near point to 25 cm.

$1/f = (-1/50) - (-1/25) = (-1 + 2)/50 = 1/50 \rightarrow f = +50$ cm = +0.5 m. $P = +2$ D (convex lens).

3. A person can see clearly only up to 2 m. What lens should they use to see distant objects clearly, and what is its power?

Concave lens with $f = -2$ m. $P = 1/(-2) = -0.5$ D.

4. Which colour of white light travels fastest inside the glass of a prism, and which slowest? Relate this to which bends most.

Red travels fastest in glass (smallest refractive index) and bends the least; violet travels slowest (largest refractive index) and bends the most - which is exactly why dispersion happens.

5. A bifocal spectacle has an upper portion of power -0.75 D and a lower portion of +1.5 D. Find the focal length of each portion and state which defect each part corrects.

Upper: $f = 1/(-0.75) = -1.33$ m (concave - corrects myopia, for distant vision). Lower: $f = 1/1.5 = +0.667$ m ~ +66.7 cm (convex - corrects presbyopia/hypermetropia, for reading).

6. Because of atmospheric refraction, approximately how much longer does the day appear, and why?

About 4 minutes longer: refraction lets us see the sun roughly 2 minutes before it actually rises and 2 minutes after it actually sets, because light from the sun below the horizon bends down towards us through the denser lower atmosphere.

