

PRACTICE PAPER 01 (2026-27)
CHAPTER 10: THE HUMAN EYE AND THE COLOURFUL WORLD
(STEP-BY-STEP SOLUTIONS)

SUBJECT: SCIENCE

MAX. MARKS : 40

CLASS : X

DURATION : 1½ hrs

General Instructions:

- (i) All questions are compulsory.
- (ii) This question paper contains **20** questions divided into five Sections A, B, C, D and E.
- (iii) **Section A** comprises 10 MCQs and Assertion-Reason questions of **1 mark** each. **Section B** comprises 4 Very Short Answer questions of **2 marks** each. **Section C** comprises 3 Short Answer questions of **3 marks** each. **Section D** comprises 1 Long Answer question of **5 marks**. **Section E** comprises 2 Case Study Based questions of **4 marks** each.
- (iv) There is no overall choice. Internal choice is provided in Section E.
- (v) Use of calculators is not permitted.

SECTION - A

Questions 1 to 10 carry 1 mark each.

1. Most of the refraction of light rays entering the human eye takes place at the

- | | |
|----------------------|---------------------------------|
| (a) crystalline lens | (b) outer surface of the cornea |
| (c) pupil | (d) retina |

Solution:

Ans: (b) outer surface of the cornea

- The eye lens only provides the finer adjustment of focal length.

2. The part of the eye that controls the size of the pupil is the

- | | |
|------------|---------------------|
| (a) cornea | (b) retina |
| (c) iris | (d) ciliary muscles |

Solution:

Ans: (c) iris

- The iris is a dark muscular diaphragm; the pupil regulates the amount of light entering the eye.

3. For a young adult with normal vision, the near point and the far point of the eye are respectively

- | | |
|------------------------|----------------------|
| (a) 25 m and infinity | (b) 25 cm and 25 m |
| (c) 25 cm and infinity | (d) 2.5 cm and 25 cm |

Solution:

Ans: (c) 25 cm and infinity

4. When we look at a nearby object, the ciliary muscles

- (a) relax and the eye lens becomes thinner
- (b) contract and the focal length of the eye lens increases
- (c) contract and the eye lens becomes thicker
- (d) relax and the focal length decreases

Solution:

Ans: (c) contract and the eye lens becomes thicker

- Greater curvature → shorter focal length → nearby objects are focused on the retina.

5. In an eye, the image of a distant object is formed in front of the retina. The defect and the lens needed to correct it are
- (a) myopia – concave lens (b) myopia – convex lens
(c) hypermetropia – convex lens (d) presbyopia – concave lens

Solution:

Ans: (a) myopia – concave lens

6. In a common type of bi-focal lens, the upper portion is a
- (a) convex lens, for near vision (b) concave lens, for distant vision
(c) convex lens, for distant vision (d) concave lens, for near vision

Solution:

Ans: (b) concave lens, for distant vision

- The lower part is a convex lens for near vision.

7. When white light passes through a glass prism, the colour that bends the least is
- (a) violet (b) blue
(c) green (d) red

Solution:

Ans: (d) red

- Red bends the least and violet the most, giving the spectrum VIBGYOR.

8. 'Danger' signal lights are red in colour because red light
- (a) is scattered the most by fog or smoke
(b) is scattered the least by fog or smoke
(c) has the shortest wavelength
(d) is absorbed by air molecules

Solution:

Ans: (b) is scattered the least by fog or smoke

- So it can be seen in the same colour from a distance.

In the following questions 9 and 10, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.

9. **Assertion (A):** Planets do not twinkle.

Reason (R): Planets are seen as extended sources, and the variations in light from their many point-sized sources average out to zero.

Solution:

Ans: (a)

- Being much closer than stars, planets are extended sources; this nullifies the twinkling effect. R explains A.

10. **Assertion (A):** The sky appears dark to passengers flying at very high altitudes.

Reason (R): Air molecules scatter red light more strongly than blue light.

Solution:

Ans: (c)

- (A) is true – scattering is not prominent at such heights. (R) is false – fine particles scatter **blue** (shorter wavelengths) more strongly than red.

SECTION - B

Questions 11 to 14 carry 2 marks each.

- 11.** What is meant by the power of accommodation of the eye? How do the ciliary muscles help us see (a) a distant object and (b) a nearby object clearly?

Solution:

The ability of the eye lens to **adjust its focal length** to focus near and distant objects is accommodation. [$\frac{1}{2}$]

(a) Distant object: ciliary muscles **relax** → lens becomes **thin** → focal length **increases**. [$\frac{3}{4}$]

(b) Nearby object: ciliary muscles **contract** → curvature increases, lens becomes **thick** → focal length **decreases**. [$\frac{3}{4}$]

- 12.** A student cannot see objects beyond 2 m clearly. Name the defect of vision. Find the nature and power of the lens needed to correct it.

Solution:

Defect: **myopia (near-sightedness)**; far point = 2 m. [$\frac{1}{2}$]

The corrective lens must form the image of a distant object ($u = -\infty$) at the far point ($v = -2$ m).

$$1/f = 1/v - 1/u = 1/(-2) - 0 \rightarrow f = -2 \text{ m} \rightarrow \text{a concave lens. [1]}$$

$$P = 1/f = 1/(-2) = -0.5 \text{ D. } [\frac{1}{2}]$$

- 13.** Explain how a rainbow is formed. In which direction is it seen with respect to the Sun?

Solution:

Tiny water droplets in the atmosphere act like small prisms. Sunlight is (i) **refracted and dispersed** on entering a droplet, (ii) **reflected internally**, and (iii) **refracted again** on coming out. Due to dispersion and internal reflection, different colours reach the observer's eye. [$1\frac{1}{2}$]

A rainbow is always formed in the direction **opposite to the Sun** (the Sun behind the observer). [$\frac{1}{2}$]

- 14.** The Sun is visible to us about 2 minutes before actual sunrise and about 2 minutes after actual sunset. Explain why. Name one other effect due to the same cause.

Solution:

Light from the Sun just below the horizon is **bent (refracted) by the earth's atmosphere**, whose refractive index changes gradually. So we see the Sun at an **apparent position above the horizon** before it actually rises and after it actually sets. [$1\frac{1}{2}$]

Other effect: **apparent flattening of the Sun's disc** at sunrise and sunset (or twinkling of stars). [$\frac{1}{2}$]

SECTION - C

Questions 15 to 17 carry 3 marks each.

15. (a) What is hypermetropia? State its two possible causes.
(b) The near point of a hypermetropic eye is 50 cm. Find the nature and power of the lens required to correct this defect. (Near point of a normal eye = 25 cm)

Solution:

(a) Far-sightedness: a person can see distant objects clearly but not nearby objects; the near point is farther than 25 cm, and light from a close object is focused **behind the retina**. [$\frac{1}{2}$]

Causes: (i) **focal length of the eye lens is too long**; (ii) **eyeball has become too small**. [$\frac{1}{2}$ + $\frac{1}{2}$]

(b) The lens must form a virtual image at 50 cm of an object kept at 25 cm: $u = -25$ cm, $v = -50$ cm.

$$1/f = 1/v - 1/u = -1/50 + 1/25 = (-1 + 2)/50 = 1/50 \rightarrow f = +50 \text{ cm} = +0.5 \text{ m} \rightarrow \text{convex lens.}$$

[1]

$$P = 1/f = 1/0.5 = +2 \text{ D. } [\frac{1}{2}]$$

16. (a) Why do stars twinkle?
(b) Why does a star appear slightly higher than its actual position when seen near the horizon?

Solution:

(a) Starlight undergoes continuous **atmospheric refraction** in a medium of gradually changing refractive index. Since the physical conditions of the atmosphere keep changing, the path of the light and the **apparent position** of the star keep changing slightly. Stars are very distant and act as **point sources**, so the amount of light entering the eye **flickers** - brighter at one moment, fainter at another. This is twinkling. [2]

(b) The atmosphere **bends starlight towards the normal**, so the light appears to come from a higher point. [1]

17. Write the function of each of the following parts of the human eye: (a) cornea (b) iris (c) pupil (d) retina (e) optic nerve (f) crystalline lens.

Solution:

(a) **Cornea** - thin transparent membrane through which light enters; most refraction occurs at its outer surface. [$\frac{1}{2}$]

(b) **Iris** - dark muscular diaphragm that controls the size of the pupil. [$\frac{1}{2}$]

(c) **Pupil** - regulates and controls the amount of light entering the eye. [$\frac{1}{2}$]

(d) **Retina** - light-sensitive screen on which the image is formed; its cells generate electrical signals. [$\frac{1}{2}$]

(e) **Optic nerve** - carries electrical signals from the retina to the brain. [$\frac{1}{2}$]

(f) **Crystalline lens** - provides the finer adjustment of focal length to focus objects at different distances. [$\frac{1}{2}$]

SECTION - D

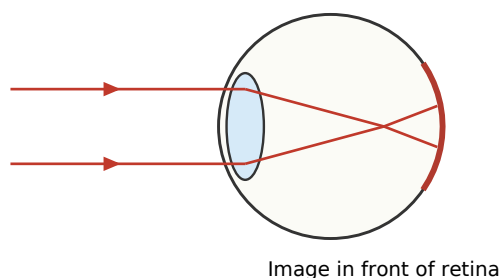
Question 18 carries 5 marks.

- 18.** (a) What is myopia? State its two possible causes. With the help of ray diagrams, show (i) a myopic eye and (ii) its correction.
(b) What is presbyopia and why does it occur? How do bi-focal lenses help?
(c) A person needs a lens of power -4.0 D to correct distant vision and $+2.0\text{ D}$ for near vision. Find the focal lengths of the two lenses.

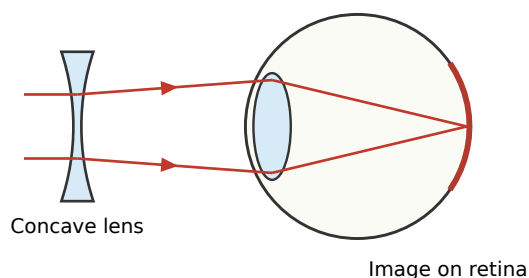
Solution:

(a) Near-sightedness: nearby objects are seen clearly but distant objects are not; the far point is nearer than infinity and the image of a distant object forms **in front of the retina**. Causes:

(i) **excessive curvature of the eye lens**; (ii) **elongation of the eyeball**. Correction: a **concave lens** of suitable power. [1]



(b) Myopic eye



(c) Correction with a concave lens

[1 mark for diagrams]

(b) Presbyopia: the power of accommodation decreases with age and the near point recedes, due to **gradual weakening of the ciliary muscles** and **diminishing flexibility of the eye lens**. [1] Bi-focal lens: upper concave part for distant vision, lower convex part for near vision. [$\frac{1}{2}$]

(c) Distant vision: $f = 1/P = 1/(-4.0) = -0.25\text{ m} = \mathbf{-25\text{ cm}}$ (concave). Near vision: $f = 1/(+2.0) = +0.5\text{ m} = \mathbf{+50\text{ cm}}$ (convex). [$1\frac{1}{2}$]

SECTION - E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. A student traced the path of a ray of light through a triangular glass prism ABC using pins, as shown below.

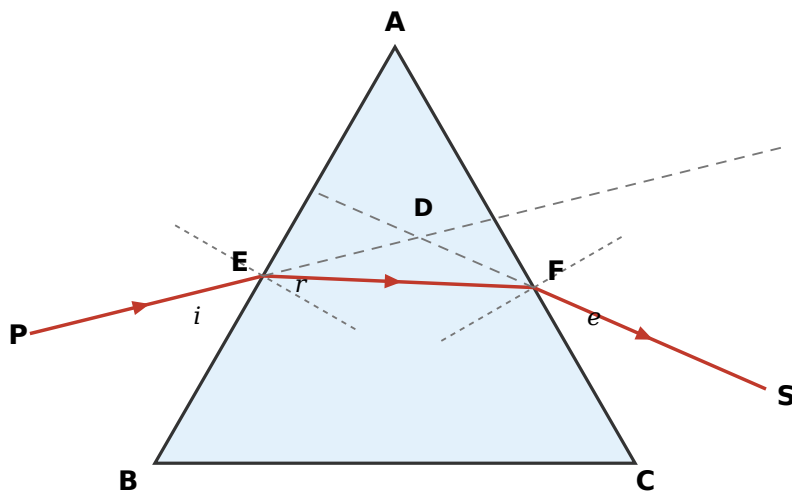


Figure: Refraction of light through a triangular glass prism

- (a) Name the incident ray, the refracted ray and the emergent ray. **(1)**
(b) What is the angle marked D called? At which face does the ray bend away from the normal, and why? **(1)**
(c) If a narrow beam of white light is used instead, what will be seen on a screen beyond the prism? Name the phenomenon and explain why it happens. **(2)**

OR

- (c) Describe Newton's experiment with two identical prisms. What did it show about sunlight? **(2)**

Solution:

(a) Incident ray: **PE**; refracted ray: **EF**; emergent ray: **FS**. [1]

(b) D is the **angle of deviation**. [$\frac{1}{2}$] At face **AC** (at F) – the ray goes from glass to air, i.e. from a denser to a rarer medium. [$\frac{1}{2}$]

(c) A band of seven colours – **VIBGYOR** – the spectrum, with violet at the bottom and red at the top. The phenomenon is **dispersion**. [1]

Different colours bend through **different angles** as they pass through the prism – red the least, violet the most – so they emerge along different paths. [1]

OR

(c) Newton obtained the spectrum of sunlight with one prism and placed a second identical prism in an **inverted position** next to it. All the colours passed through the second prism and a **beam of white light** emerged. [1]

This showed that **sunlight is made up of seven colours**. [1]

20. Read the passage and answer the questions that follow.

The earth's atmosphere is a heterogeneous mixture of smoke, tiny water droplets, dust and molecules of air. When a fine beam of sunlight enters a smoke-filled room through a small hole, its path becomes visible. The colour of the light scattered depends on the size of the scattering particles. Air molecules are smaller than the wavelength of visible light and scatter shorter wavelengths more strongly. An astronaut in space, however, sees a dark sky.

(a) Name the phenomenon that makes the path of the beam visible in the smoke-filled room.

Give one more natural example. (1)

(b) How does the colour of scattered light depend on the size of the scattering particles? (1)

(c) Explain why the clear sky appears blue to us but dark to the astronaut. (2)

OR

(c) If the earth had no atmosphere, how would the sky appear during the day, and how would the time of sunrise and sunset be affected? (2)

Solution:

(a) **Tyndall effect** (scattering of light by colloidal particles). Example: sunlight passing through the **canopy of a dense forest**, where mist droplets scatter light. [$\frac{1}{2} + \frac{1}{2}$]

(b) **Very fine particles scatter mainly blue light**; larger particles scatter longer wavelengths; very large particles make the scattered light appear **white**. [1]

(c) Air molecules and fine particles scatter **blue (shorter wavelength)** light much more strongly than red (red's wavelength is about 1.8 times that of blue). The scattered blue light enters our eyes, so the sky looks blue. [1]

In space (or at very high altitudes) there is practically no atmosphere to scatter light, so **no scattered light reaches the eye** and the sky looks dark. [1]

OR

(c) With no atmosphere there would be **no scattering**, so the sky would look **dark**. [1]

There would be no atmospheric refraction, so the Sun would be seen only at the actual sunrise and up to the actual sunset – sunrise about **2 minutes later** and sunset about **2 minutes earlier**, making the day shorter by about 4 minutes. [1]

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