The Human Eye and the Colourful World

Standard difficulty · 20 questions · 40 marks · Time: 40 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. A short-sighted person cannot see clearly beyond 25 cm. The power of the lens needed to correct this is:

(a) +4 D **(b)** −4 D **(c)** −8 D **(d)** −0.25 D

2. Which part of the eye fine-tunes the focus to form a real, inverted image on the retina?

(a) The eye lens **(b)** The rod cells **(c)** The cone cells **(d)** The retina

3. Objects seen through the hot air above a fire appearing to waver is due to:

(a) scattering of light **(b)** reflection of light
(c) dispersion of light **(d)** atmospheric refraction

4. In the spectrum of white light, which colour lies between blue and yellow?

(a) green **(b)** violet **(c)** yellow **(d)** red

5. The least distance of distinct vision for a normal young eye is about:

(a) 25 cm **(b)** 2.5 cm **(c)** 1 m **(d)** 25 m

6. A person whose eye has an eyeball that is too short is helped by:

(a) surgery to replace the eye lens **(b)** a convex lens
(c) a concave lens **(d)** a bifocal lens

7. Rohan's near point is 2 m. To read a recipe held at 25 cm, the power of the lens needed is:

(a) +3.5 D **(b)** +4.5 D **(c)** −3.5 D **(d)** +0.5 D

8. Assertion (A): A person who cannot see beyond 40 cm needs a concave lens of focal length −40 cm.
Reason (R): A convex lens corrects myopia by converging the light before it enters the eye.

(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.

Section B — Short answer — 8 × 2 = 16 marks

9. Rahul can see clearly only up to 20 cm. Name the defect, and find the nature, focal length and power of the lens needed.

10. Arjun is long-sighted, with a near point of 2 m. Find the power and focal length of the lens that lets Arjun read at 25 cm.

11. Explain clouds looking white.

12. Distinguish between a star and a planet.

13. White light falls on a glass prism. Which colour is deviated the most and which the least? Which of yellow and red bends more?

14. An optician prescribes a lens of power +4 D. Find its focal length, and say whether it corrects short sight or long sight.

15. An older person needs a lens of power +2.5 D to read and −2.5 D to see distant objects. What kind of lens is used? Find the focal length of each part.

16. Which is scattered more by the tiny particles of air, red light or yellow light? Why?

Section C — Word problems — 4 × 4 = 16 marks

17. Zoya sits at the back of the class and cannot read the board, which is farther than 5 m, but can read a book easily. (a) Name the defect. (b) Give two possible causes. (c) Find the type, focal length and power of the lens needed.

18. Zoya's uncle can read a newspaper only when it is held 5 m away. (a) Name the defect if it is due to age, and say why it happens. (b) Find the power and focal length of the lens that lets the newspaper be read at 25 cm.

19. Why does a glass prism split white light but a glass slab does not?

20. Ananya's far point is 50 cm. Ananya wants to see a signboard 2.5 m away clearly. Find the focal length and power of the lens needed.

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Answer key

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Q	Answer	Working
1	**(b) −4 D**	a concave lens of focal length −25 cm; P = 100 ÷ (−25)
2	**(a) The eye lens**	—
3	**(d) atmospheric refraction**	Hot air is less dense than the cooler air around it, and its density keeps changing.
4	**(a) green**	VIBGYOR: violet, indigo, blue, green, yellow, orange, red
5	**(a) 25 cm**	the near point
6	**(b) a convex lens**	this is hypermetropia
7	**(a) +3.5 D**	convex lens with u = −25 cm, v = −200 cm: 1/f = 1/v − 1/u = 1/25 − 1/200
8	**(c) A is true, but R is false.**	A is true: a concave lens makes distant objects appear to be at the far point, 40 cm away. R is false.
9	**myopia; concave lens, f = −20 cm, P = −5 D**	the lens must make distant objects seem to be at 20 cm: f = −20 cm
10	**P = +3.5 D (convex); f = 28.57 cm**	1/f = 1/25 − 1/200 (in cm), so P = 100/f = 3.5 D
11	**Scattering of light: Water droplets are large enough to scatter all colours about equally.**	—
12	**A star is so far away that it is a point source, so it twinkles; a planet is nearer and acts as many points, so the changes average out and it does not twinkle.**	—
13	**violet most, red least; yellow bends more**	the order of deviation, most to least: violet, indigo, blue, green, yellow, orange, red
14	**f = +25 cm; a convex lens, for long sight (hypermetropia or presbyopia)**	f = 100 ÷ P cm
15	**a bifocal lens; upper part concave, f = −40 cm; lower part convex, f = +40 cm**	f = 100 ÷ P cm for each part
16	**Yellow, because it has the shorter wavelength**	small particles scatter shorter wavelengths more
17	**(a) myopia; (b) the eyeball is too long, or the eye lens is too curved; (c) concave, f = −500 cm, P = −0.2 D**	the image of a distant object forms in front of the retina; the lens must give a virtual image at 500 cm
18	**(a) presbyopia: the ciliary muscles weaken and the eye lens becomes less flexible; (b) P = +3.8 D, f = 26.32 cm (convex)**	1/f = 1/25 − 1/500 (in cm)

Q	Answer	Working
19	**In a prism the two faces are inclined, so each colour is deviated by a different angle and they spread out. In a slab the faces are parallel, so the colours bend back by the same amount and emerge together.**	—
20	**f = −62.5 cm (concave); P = −1.6 D**	the lens must form the image of the sign at the far point: u = −250 cm, v = −50 cm; 1/f = 1/v − 1/u

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