

# UNIQUE STUDY POINT

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<b>Class:</b> X	<b>Subject:</b> Science	<b>Session:</b> 2025-26
<b>Chapter:</b> 10 - The Human Eye and the Colourful World	<b>Time:</b> 1½ Hours	<b>Max. Marks:</b> 40

## General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

## SECTION A - Multiple Choice Questions (1 mark each)

1. The diameter of a normal human eyeball is approximately:  
(a) 1.3 cm  
(b) 2.3 cm  
(c) 3.3 cm  
(d) 4.3 cm
2. To correct myopia, we need a lens whose focal length is:  
(a) Positive  
(b) Negative  
(c) Zero  
(d) Infinite
3. The part of eye that sends electrical signals to the brain is:  
(a) Retina  
(b) Optic nerve  
(c) Iris  
(d) Pupil
4. When white light passes through a prism, the colour that deviates the least is:  
(a) Violet  
(b) Red  
(c) Green  
(d) Blue
5. Bi-focal lenses are required to correct:  
(a) Myopia  
(b) Hypermetropia

- (c) Presbyopia
  - (d) Astigmatism
6. The apparent position of a star is different from its actual position due to:
- (a) Reflection
  - (b) Refraction
  - (c) Dispersion
  - (d) Scattering
7. The phenomenon that makes the path of light visible when it passes through smoke is:
- (a) Reflection
  - (b) Dispersion
  - (c) Tyndall effect
  - (d) Refraction
8. When ciliary muscles are relaxed, the eye lens becomes:
- (a) Thicker
  - (b) Thinner
  - (c) Cloudy
  - (d) Opaque
9. The sun appears reddish at sunset because:
- (a) Red light has more energy
  - (b) Blue light gets scattered away
  - (c) The sun becomes cooler
  - (d) Red light travels faster
10. The time difference between actual sunset and apparent sunset is about:
- (a) 30 seconds
  - (b) 1 minute
  - (c) 2 minutes
  - (d) 5 minutes

### SECTION B - Short Answer Questions (2 marks each)

11. How does the eye adjust to view objects at different distances? Name this ability of the eye.
12. Why are danger signals made red in colour? Give scientific reason.
13. What is cataract? How can it be treated?
14. A rainbow can be seen in the sky only after rainfall. Why is this so?

### SECTION C - Short Answer Questions (3 marks each)

15. Explain the three main defects of vision. Name the type of lens used to correct each defect.
16. How did Isaac Newton demonstrate that white light is made up of seven colours? Describe his experiment.
17. Why does the sun appear flattened at sunrise and sunset? Explain the role of atmospheric refraction.

## SECTION D - Long Answer Question (5 marks)

- 18.** (a) What is meant by scattering of light? Explain how the size of particles affects the colour of scattered light.
- (b) A person needs a lens of power  $-4.0$  D for distance vision. What is the nature and focal length of this lens? What defect is being corrected?

## SECTION E - Case Study Based Questions (4 marks each)

### 19. Case Study 1:

Mr. Sharma is 55 years old and works as an accountant. He has been experiencing difficulty in both reading fine print and seeing distant objects clearly. When he consulted an eye specialist, he was told that his ciliary muscles have weakened and his eye lens has lost flexibility. The doctor prescribed him special lenses that have two parts - the upper portion to see distant objects and the lower portion to see nearby objects.

Based on the above information, answer the following questions:

- (a) What defect is Mr. Sharma suffering from? (1 mark)
- (b) What type of special lenses were prescribed to him? (1 mark)
- (c) Which part of his bifocal lens contains a concave component? (1 mark)
- (d) What are the two main causes of this defect? (1 mark)

### 20. Case Study 2:

During a vacation trip to a hill station, Meera observed that the sun appeared to rise about 2 minutes before its actual position crossed the horizon. In the evening, she noticed that the sun was visible for about 2 minutes even after it had actually set below the horizon. Her father, who is a physics teacher, explained that this happens due to the bending of light as it travels through layers of the atmosphere with different densities. He also mentioned that the same phenomenon causes stars to appear slightly higher than their actual position.

Based on the above information, answer the following questions:

- (a) What is the phenomenon responsible for advance sunrise and delayed sunset? (1 mark)
- (b) Why does light bend when traveling through the atmosphere? (1 mark)
- (c) By how many minutes is the day extended due to this phenomenon? (1 mark)
- (d) Does the moon also appear to rise early due to the same phenomenon? (1 mark)

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SECTION A - Answers to MCQs

1. (b) 2.3 cm

The human eyeball is approximately spherical in shape with a diameter of about 2.3 cm.

2. (b) Negative

To correct myopia, we need a concave lens which has negative focal length. A concave lens diverges the light rays before they enter the eye.

3. (b) Optic nerve

The optic nerve carries electrical signals generated by light-sensitive cells in the retina to the brain. The brain then interprets these signals.

4. (b) Red

Red light deviates (bends) the least when passing through a prism. This is because red light has the longest wavelength. Violet deviates the most.

5. (c) Presbyopia

Bifocal lenses are required to correct presbyopia, an age-related defect where a person cannot see both near and far objects clearly. Bifocal lenses have both concave and convex components.

6. (b) Refraction

The apparent position of a star is different from its actual position due to atmospheric refraction. The starlight undergoes continuous refraction while passing through the earth's atmosphere.

7. (c) Tyndall effect

The Tyndall effect is the phenomenon of scattering of light by colloidal particles. When light passes through smoke, the path becomes visible due to scattering by smoke particles.

8. (b) Thinner

When ciliary muscles are relaxed, the eye lens becomes thinner and its focal length increases. This enables us to see distant objects clearly.

9. (b) Blue light gets scattered away

At sunset, sunlight travels a longer distance through the atmosphere. Blue light (shorter wavelength) gets scattered away, while red light (longer wavelength) reaches our eyes, making the sun appear reddish.

10. (c) 2 minutes

The time difference between actual sunset and apparent sunset is about 2 minutes. This occurs due to atmospheric refraction, which makes the sun visible even when it is below the horizon.

SECTION B - Answers to Short Answer Questions

11. Eye's Adjustment Mechanism

The eye adjusts to view objects at different distances through a process called **accommodation**.

The ciliary muscles change the curvature of the eye lens, which alters its focal length. When viewing distant objects, the ciliary muscles relax, making the lens thinner and increasing focal length. When viewing nearby objects, the ciliary muscles contract, making the lens thicker and decreasing focal length. This ability to adjust focal length is called power of accommodation.

## 12. Red Colour for Danger Signals

Danger signals are made red because red light has the longest wavelength among visible colours and is least scattered by atmospheric particles like fog, smoke, or dust. Due to minimal scattering, red light can travel longer distances through the atmosphere without significant loss of intensity. This ensures that danger signals remain visible even in adverse weather conditions, making them effective for warning purposes.

## 13. Cataract

**Cataract** is a condition in which the crystalline lens of the eye becomes milky and cloudy, usually occurring at old age. This causes the lens to lose its transparency, resulting in partial or complete loss of vision. The person's vision becomes blurred and they cannot see clearly.

**Treatment:** Cataract can be treated through cataract surgery, in which the cloudy lens is removed and often replaced with an artificial lens. This can restore vision effectively.

## 14. Rainbow After Rainfall

A rainbow can only be seen after rainfall because it requires tiny water droplets suspended in the atmosphere. These water droplets act as small prisms that refract, disperse, and internally reflect sunlight. During rainfall, countless water droplets remain suspended in the air, providing the necessary conditions for rainbow formation. Additionally, the observer must be positioned with the sun behind them to see the rainbow formed by light reflecting from the water droplets.

# SECTION C - Answers to Short Answer Questions

## 15. Three Main Defects of Vision

### 1. Myopia (Near-sightedness):

- Cannot see distant objects clearly
- Image forms in front of retina
- **Corrected by:** Concave lens

### 2. Hypermetropia (Far-sightedness):

- Cannot see nearby objects clearly
- Image forms behind retina
- **Corrected by:** Convex lens

### 3. Presbyopia:

- Age-related defect affecting both near and far vision
- Loss of accommodation power
- **Corrected by:** Bifocal lenses (combination of concave and convex lenses)
  - Upper portion (concave) for distant vision
  - Lower portion (convex) for near vision

## 16. Newton's Experiment on White Light

### Isaac Newton's Experiment:

#### Step 1 - Dispersion:

Newton allowed sunlight to pass through a glass prism. The white light split into seven colours

(VIBGYOR), forming a spectrum on a screen.

### **Step 2 - Attempt to Split Further:**

He tried to split the individual colours of the spectrum further using another prism, but could not obtain any more colours. This showed that the seven colours are the fundamental components.

### **Step 3 - Recombination:**

Newton placed a second identical prism in an inverted position with respect to the first prism. All the seven colours of the spectrum passed through this second prism and recombined to form white light again.

### **Conclusion:**

This experiment conclusively proved that white light (sunlight) is made up of seven colours. The prism does not add colours but merely separates the existing component colours of white light.

## **17. Apparent Flattening of Sun**

The sun appears flattened (oval-shaped) at sunrise and sunset due to atmospheric refraction.

### **Explanation:**

- At sunrise and sunset, the sun is near the horizon
- Light from different parts of the sun travels through different thicknesses of atmosphere
- Light from the upper edge travels through less atmosphere than light from the lower edge
- Due to varying atmospheric refraction, light from different parts bends differently
- The lower portion appears to be lifted more than the upper portion
- This differential refraction makes the sun's disc appear flattened or oval

When the sun is overhead at noon, it appears circular because light travels through nearly uniform atmosphere, causing uniform refraction from all parts of the sun's disc.

## **SECTION D - Answer to Long Answer Question**

### **18. (a) Scattering of Light; (b) Lens Calculation**

#### **(a) Scattering of Light:**

Scattering of light is the phenomenon in which light rays are absorbed and then re-emitted in different directions by particles in the medium through which it travels.

#### **Effect of Particle Size on Colour:**

##### **1. Very Fine Particles (size < wavelength of light):**

- Scatter blue light (shorter wavelength) more strongly
- Example: Molecules of air scatter blue light, making sky appear blue

##### **2. Particles of Larger Size:**

- Scatter light of longer wavelengths (red, orange, yellow)
- Example: During sunset, larger particles scatter red-orange light

##### **3. Very Large Particles:**

- Scatter all wavelengths almost equally
- Scattered light appears white
- Example: Water droplets in clouds scatter all colours, making clouds appear white

The colour of scattered light thus depends directly on the size of scattering particles relative to the

wavelength of light.

**(b) Lens Calculation:**

**Given:** Power of lens,  $P = -4.0 \text{ D}$

**Nature of Lens:**

Since power is negative, the lens is a **concave lens** (diverging lens).

**Calculation of Focal Length:**

We know:  $P = 1/f$  (in meters)

Therefore:  $f = 1/P$

$f = 1/(-4.0)$

$f = -0.25 \text{ m}$

$f = -25 \text{ cm}$

The focal length is **-25 cm** (negative sign indicates concave lens).

**Defect Being Corrected:**

A concave lens with negative power is used to correct **Myopia (near-sightedness)**. This person cannot see distant objects clearly and needs a diverging lens to bring the image back onto the retina.

## SECTION E - Answers to Case Study Based Questions

### 19. Case Study 1 - Answers

**(a)** Mr. Sharma is suffering from **Presbyopia**.

**(b)** The doctor prescribed **bifocal lenses** to Mr. Sharma.

**(c)** The **upper portion** of the bifocal lens contains the concave component, which is used for viewing distant objects clearly.

**(d)** The two main causes of presbyopia are:

1. Gradual weakening of ciliary muscles with age
2. Diminishing flexibility of the eye lens due to aging

### 20. Case Study 2 - Answers

**(a)** The phenomenon responsible for advance sunrise and delayed sunset is **atmospheric refraction**.

**(b)** Light bends when traveling through the atmosphere because the atmosphere has **layers of different densities**. As light passes from one layer to another with different refractive indices, it undergoes continuous refraction. The atmosphere bends light towards the normal, making celestial objects appear higher than their actual position.

**(c)** The day is extended by approximately **4 minutes** due to this phenomenon - about 2 minutes of advance sunrise and about 2 minutes of delayed sunset.

**(d) Yes**, the moon also appears to rise early due to atmospheric refraction. The same phenomenon that affects the sun's apparent position also affects the moon and stars, making them all appear slightly higher than their actual positions.

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