



THE HUMAN EYE AND THE COLOURFUL WORLD

CBSE Class X – EXAM REVISION PACK

1 THE HUMAN EYE – STRUCTURE & WORKING

The human eye is like a **camera**.

Main Parts & Functions

- **Cornea:** Major refraction of light
- **Iris:** Controls size of pupil
- **Pupil:** Regulates amount of light entering eye
- **Eye lens (crystalline lens):** Fine adjustment of focus
- **Ciliary muscles:** Change curvature of eye lens
- **Retina:** Light-sensitive screen (image formed here)
- **Optic nerve:** Sends signals to brain

✓ Image formed on retina is **real, inverted**

✓ Brain interprets it as **erect**

(Structure shown in **Fig 10.1, page 161**)

2 POWER OF ACCOMMODATION

Definition:

The ability of the eye lens to **adjust its focal length** to see objects at different distances.

- Distant objects → ciliary muscles relaxed → focal length ↑
- Nearby objects → ciliary muscles contract → focal length ↓

✓ **Near point (least distance of distinct vision) = 25 cm**

✓ **Far point of normal eye = Infinity**

3 DEFECTS OF VISION & THEIR CORRECTION

(A) Myopia (Near-sightedness)

- Cannot see distant objects clearly
- Image formed **in front of retina**

Causes:

- Excessive curvature of eye lens
- Elongated eyeball

Correction:

✓ **Concave lens**

(Fig 10.2)

(B) Hypermetropia (Far-sightedness)

- Cannot see nearby objects clearly
- Image formed **behind retina**

Causes:

- Focal length too long
- Short eyeball

Correction:

✓ **Convex lens (Fig 10.3)**

(C) Presbyopia

- Occurs due to **ageing**
- Power of accommodation decreases
- Near point moves away
- ✓ Corrected using **bi-focal lenses**
 - Upper part: concave (distance)
 - Lower part: convex (near)

4 REFRACTION THROUGH A PRISM

- Prism has **non-parallel refracting surfaces**
- Emergent ray is **deviated**
- Angle between incident and emergent ray = **angle of deviation**

(Refraction shown in Fig 10.4)

5 DISPERSION OF WHITE LIGHT

Definition:

Splitting of white light into its constituent colours.

- ✓ Colours sequence: **VIBGYOR**
(Violet bends most, Red bends least)
- ✓ Band of colours formed = **Spectrum**
- ✓ Newton proved sunlight is made of **seven colours**
(using prism recombination – Fig 10.6)

6 RAINBOW FORMATION

Caused due to:

1. **Refraction**
 2. **Dispersion**
 3. **Total internal reflection**
- ✓ Water droplets act like tiny prisms
 - ✓ Rainbow is always seen **opposite to the Sun**
(Fig 10.8)

7 ATMOSPHERIC REFRACTION

(A) Twinkling of Stars

- Due to continuous refraction in atmosphere
- Stars are **point sources**
- Apparent position changes → flickering
- ✓ Stars appear **slightly higher** than actual position

(B) Why Planets Do Not Twinkle?

- Planets are **extended sources**
- Light variations average out

(C) Advance Sunrise & Delayed Sunset

- Sun visible ~2 minutes early & late
- Due to atmospheric refraction
- Sun appears **flattened** at horizon

(Fig 10.10)

8 SCATTERING OF LIGHT

Tyndall Effect

- Scattering of light by **colloidal particles**
- Makes light path visible
- Seen in smoke-filled room, forest mist

Why is the Sky Blue?

- Air molecules scatter **shorter wavelengths**
- Blue light scattered most
- Without atmosphere → sky would appear dark

Why Are Danger Signals Red?

- Red has **longer wavelength**
- Least scattered by fog/smoke
- Visible from long distance

9 BOARD-STYLE QUESTIONS WITH ANSWERS

Q1. What is power of accommodation?

Ability of eye lens to adjust focal length to see near and distant objects.

Q2. Where is image formed in human eye?

On the **retina**.

Q3. Which lens is used to correct myopia? Why?

Concave lens; it diverges rays to form image on retina.

Q4. Why do stars twinkle?

Due to atmospheric refraction of starlight.

Q5. Why planets do not twinkle?

They are extended sources; light variations cancel out.

Q6. Name the phenomenon responsible for rainbow formation.

Dispersion of sunlight by water droplets.

Q7. What is dispersion of light?

Splitting of white light into its constituent colours.



EXTRA CONCEPTUAL TRAPS (TOPPER POINTS)

- ✓ Image on retina is **real & inverted**
- ✓ Violet bends **most**, red **least**
- ✓ Myopia → concave lens (NOT convex)
- ✓ Hypermetropia → convex lens
- ✓ Stars twinkle, planets don't

- ✓ Sky appears dark to astronauts (no scattering)
- ✓ Near point of normal eye = **25 cm**



LAST-DAY MEMORY BLOCK

- Near point \rightarrow 25 cm
- Far point (normal eye) $\rightarrow \infty$
- Myopia \rightarrow image before retina \rightarrow concave lens
- Hypermetropia \rightarrow image behind retina \rightarrow convex lens
- VIBGYOR \rightarrow dispersion
- Red \rightarrow least scattered
- Blue \rightarrow most scattered



SECTION 9 (EXPANDED): BOARD-STYLE QUESTIONS WITH FULL-MARK ANSWERS

Q1. What is the power of accommodation of the human eye? Explain.

Answer:

The **power of accommodation** is the ability of the eye lens to **adjust its focal length** so that objects at different distances can be seen clearly.

- When viewing **distant objects**, the ciliary muscles relax and the eye lens becomes thinner, increasing its focal length.
- When viewing **nearby objects**, the ciliary muscles contract and the eye lens becomes thicker, decreasing its focal length.

Due to this ability, a normal human eye can see objects clearly from **infinity to 25 cm**.

Q2. Where is the image formed in the human eye? State two characteristics of the image.

Answer:

The image is formed on the **retina** of the human eye.

Characteristics of the image:

1. The image formed on the retina is **real**.
2. The image is **inverted**.

The brain interprets the inverted image and makes us perceive it as **erect**.

Q3. What is myopia? State its causes and method of correction.

Answer:

Myopia (near-sightedness) is a defect of vision in which a person can see **nearby objects** clearly but **cannot see distant objects distinctly**.

Causes:

- Excessive curvature of the eye lens
- Elongation of the eyeball

As a result, the image of a distant object is formed **in front of the retina**.

Correction:

Myopia is corrected by using a **concave lens** of suitable power, which diverges the incoming rays so that the image is formed on the retina.

Q4. What is hypermetropia? State its causes and method of correction.

Answer:

Hypermetropia (far-sightedness) is a defect of vision in which a person can see **distant objects clearly** but **cannot see nearby objects distinctly**.

Causes:

- Focal length of the eye lens becomes too long
- Eyeball becomes shorter

Thus, the image of a nearby object is formed **behind the retina**.

Correction:

Hypermetropia is corrected by using a **convex lens** of suitable power, which converges the rays to form the image on the retina.

Q5. What is presbyopia? How is it corrected?

Answer:

Presbyopia is a defect of vision that occurs due to **ageing**, in which the power of accommodation of the eye decreases.

Reason:

- Weakening of ciliary muscles
- Loss of flexibility of eye lens

Correction:

Presbyopia is corrected using **bifocal lenses**:

- Upper part → concave lens (for distant vision)
- Lower part → convex lens (for near vision)

Q6. What is dispersion of light? Why does violet light bend more than red light?

Answer:

Dispersion of light is the phenomenon of splitting of white light into its constituent colours when it passes through a prism.

Violet light bends more than red light because:

- Violet light has a **shorter wavelength**
- It travels more slowly in glass compared to red light

Hence, violet light undergoes maximum deviation, while red light deviates the least.

Q7. Explain the formation of a rainbow.

Answer:

A rainbow is formed due to the **dispersion, refraction, and total internal reflection** of sunlight in water droplets present in the atmosphere.

The process involves:

1. Refraction and dispersion of sunlight when it enters the water droplet
2. Total internal reflection inside the droplet
3. Refraction again when light emerges out

Different colours emerge at different angles, forming a **circular arc spectrum** called a rainbow.

Q8. Why do stars twinkle but planets do not twinkle?

Answer:

Stars twinkle due to **atmospheric refraction**.

- Stars are very far away and appear as **point sources of light**
- Due to continuous refraction in the atmosphere, their apparent position keeps changing, causing fluctuation in brightness

Planets do not twinkle because:

- They are closer and appear as **extended sources**
- Variations in light cancel out due to the large apparent size

Q9. Why does the Sun appear reddish at sunrise and sunset?

Answer:

At sunrise and sunset, sunlight has to travel a **longer distance through the atmosphere**.

- Shorter wavelengths (blue and violet) are scattered away
- Longer wavelengths (red) reach the observer's eyes

Hence, the Sun appears **reddish** at sunrise and sunset.

Q10. Why is the sky blue in colour?

Answer:

The sky appears blue due to the **scattering of light by air molecules** in the atmosphere.

- Blue light has a **shorter wavelength**
- It is scattered more than other colours

Therefore, scattered blue light reaches our eyes from all directions, making the sky appear blue.

Q11. Why are danger signals red in colour?

Answer:

Danger signals are red in colour because:

- Red light has the **longest wavelength**
- It undergoes the **least scattering** by air, fog, or smoke

Thus, red signals are visible from a **long distance**, even in poor visibility conditions.

Q12. Why does the sky appear dark to astronauts in space?

Answer:

The sky appears dark to astronauts because:

- There is **no atmosphere in space**
- Hence, no scattering of sunlight occurs

As a result, the sky appears **black instead of blue**.