UNIQUE STUDY POINT

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Class: X	**Subject:** Science	**Session:** 2025-26
Chapter: 10 - The Human Eye and the Colourful World	**Time:** 1½ Hours	**Max. Marks:** 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 opening in the iris through which light enters the eye is called:
(a) Cornea
(b) Retina
(c) Pupil
(d) Lens

2. A person with hypermetropia should use spectacles with:
(a) Plane glass
(b) Concave lens
(c) Convex lens
(d) Plano-convex lens only

3. The function of the iris in the eye is to:
(a) Focus the image
(b) Control the amount of light
(c) Send signals to brain
(d) Produce tears

4. The rainbow formation involves which phenomena?
(a) Reflection and refraction only
(b) Dispersion only
(c) Refraction, dispersion and internal reflection
(d) Scattering only

5. The wavelength of red light is approximately how many times that of blue light?
(a) 0.8 times
(b) 1.0 times

(c) 1.8 times
(d) 2.8 times

6. Which of the following can donate eyes after death?
(a) Only people with perfect vision
(b) People who don't wear spectacles
(c) People of any age or sex
(d) Only young people

7. The scattering of light by atmospheric particles is responsible for:
(a) Rainbow
(b) Blue colour of sky
(c) Sunset
(d) All of the above

8. In a myopic eye, the far point is:
(a) At infinity
(b) Beyond infinity
(c) Nearer than infinity
(d) At the near point

9. Planets do not twinkle because:
(a) They are very small
(b) They are closer and appear as extended sources
(c) They don't emit light
(d) They have no atmosphere

10. The angle between the two lateral faces of a prism is called:
(a) Angle of incidence
(b) Angle of the prism
(c) Angle of deviation
(d) Angle of emergence

SECTION B - Short Answer Questions (2 marks each)

11. Define the least distance of distinct vision. What is its value for a normal human eye?

12. Where does most of the refraction of light occur in the human eye? Why is this important?

13. What is the role of water droplets in rainbow formation? Explain briefly.

14. Why can we see a rainbow through a waterfall with the sun behind us?

SECTION C - Short Answer Questions (3 marks each)

15. What is presbyopia? Explain why bifocal lenses are used to correct it. Describe the structure of bifocal lenses.

16. Explain with diagrams how light gets refracted through a triangular glass prism. Define angle of deviation.

17. Why does the sun visible about 2 minutes before actual sunrise? Draw a diagram to explain atmospheric refraction causing this phenomenon.

SECTION D - Long Answer Question (5 marks)

18. (a) Describe the structure and functioning of the human eye with a well-labeled diagram. How does the eye focus images of objects at different distances?
(b) What is Tyndall effect? Give two examples where this effect can be observed.

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

19. Case Study 1:

Ravi is a 12-year-old student who loves reading books. His mother noticed that he holds books very close to his eyes while reading. When she took him to an eye specialist, the doctor found that his eyeball had become slightly elongated. The doctor measured his far point and found it to be 150 cm. The doctor prescribed spectacles with appropriate concave lenses, and after using them, Ravi could see both near and distant objects clearly.

Based on the above information, answer the following questions:

(a) What is the defect in Ravi's eyes? (1 mark)

(b) Where does the image form in Ravi's eyes when he looks at distant objects without spectacles? (1 mark)

(c) Why was a concave lens prescribed? (1 mark)

(d) What is the main cause of this defect in Ravi's case? (1 mark)

20. Case Study 2:

During a school science project, students were asked to separate white light into its component colours. They set up an experiment where they allowed sunlight to pass through a narrow slit and then through a glass prism. They observed seven distinct colours on a white screen placed beyond the prism. When they measured the angles of deviation for different colours, they found that violet deviated the most and red the least. They also noted that the order of colours was always the same - VIBGYOR.

Based on the above information, answer the following questions:

(a) What is the splitting of white light into seven colours called? (1 mark)

(b) Why does violet light deviate more than red light? (1 mark)

(c) What does VIBGYOR stand for? (1 mark)

(d) If the students use a water prism instead of glass prism, will they still observe dispersion? (1 mark)

DETAILED ANSWER KEY - PAPER 04

SECTION A - Answers to MCQs

1. (c) Pupil

The pupil is the opening in the iris through which light enters the eye. The iris controls the size of the pupil to regulate the amount of light entering the eye.

2. (c) Convex lens

A person with hypermetropia (far-sightedness) should use spectacles with convex lenses of appropriate power. The convex lens provides additional converging power to focus nearby objects on the retina.

3. (b) Control the amount of light

The iris is a dark muscular diaphragm that controls the size of the pupil, thereby regulating the amount of light entering the eye based on the intensity of ambient light.

4. (c) Refraction, dispersion and internal reflection

Rainbow formation involves refraction (bending of light), dispersion (splitting into colours), and internal reflection (reflection inside the water droplet). All three phenomena work together to create a rainbow.

5. (c) 1.8 times

The wavelength of red light is approximately 1.8 times greater than that of blue light. This difference in wavelength causes different amounts of bending when light passes through a prism.

6. (c) People of any age or sex

Eye donors can belong to any age group or sex. Even people who wear spectacles or have been operated for cataract can donate eyes. The important factor is that they should not have certain communicable diseases.

7. (b) Blue colour of sky

The scattering of light by fine atmospheric particles is directly responsible for the blue colour of the sky. Blue light (shorter wavelength) is scattered more effectively than other colours.

8. (c) Nearer than infinity

In a myopic eye, the far point is nearer than infinity. A person with myopia may see clearly only up to a distance of a few meters, which becomes their far point.

9. (b) They are closer and appear as extended sources

Planets do not twinkle because they are much closer to Earth and appear as extended sources of light. The variations in light from different points of the planet average out, nullifying the twinkling effect.

10. (b) Angle of the prism

The angle between the two lateral faces of a prism is called the angle of the prism. This is one of the important parameters that determines how much light will be deviated.

SECTION B - Answers to Short Answer Questions

11. Least Distance of Distinct Vision

Definition: The minimum distance at which objects can be seen most distinctly without strain is called the least distance of distinct vision. It is also known as the near point of the eye.

Value: For a young adult with normal vision, the least distance of distinct vision is about **25 cm**. If an object is held closer than 25 cm, the image becomes blurred or the person feels strain in the eye.

12. Refraction in the Eye

Most of the refraction of light rays entering the eye occurs at the **outer surface of the cornea**. The cornea provides the major refractive power needed to focus light.

Importance: This is important because the cornea, being the first surface light encounters, bends most of the light rays. The crystalline lens then provides only the fine adjustment of focal length (accommodation) required to focus objects at different distances on the retina.

13. Role of Water Droplets

Water droplets suspended in the atmosphere after rainfall act like tiny glass prisms. Each water droplet:
• Refracts the incident sunlight when it enters
• Disperses it into seven colours (different colours bend by different amounts)
• Reflects it internally from the back surface
• Refracts it again when it emerges

Due to this combined effect of refraction, dispersion, and internal reflection, different colours reach the observer's eye from countless water droplets, forming a circular arc of seven colours - the rainbow.

14. Rainbow Through Waterfall

We can see a rainbow through a waterfall with the sun behind us because the water spray from the waterfall contains numerous tiny water droplets suspended in air. These droplets act as prisms and disperse sunlight. Since we are positioned with the sun behind us, the dispersed and internally reflected light from the droplets comes towards us, allowing us to see the rainbow. This is the same principle as seeing a rainbow after rainfall - both require suspended water droplets and the sun positioned behind the observer.

SECTION C - Answers to Short Answer Questions

15. Presbyopia and Bifocal Lenses

Presbyopia:
Presbyopia is an age-related defect of vision in which the power of accommodation of the eye decreases. The near point gradually recedes away, making it difficult to see nearby objects comfortably and distinctly.

Cause:
• Gradual weakening of ciliary muscles
• Diminishing flexibility of the eye lens with aging

Why Bifocal Lenses:
People with presbyopia often have difficulty seeing both near and far objects. Sometimes they may also suffer from myopia or hypermetropia along with presbyopia. Therefore, they need bifocal lenses which can correct both defects simultaneously.

Structure of Bifocal Lenses:
Bifocal lenses consist of two parts:
• **Upper portion:** Contains a concave lens component for distant vision (corrects myopia if present)
• **Lower portion:** Contains a convex lens component for near vision (corrects presbyopia)

This allows the person to look through the upper part when viewing distant objects and through the lower part when reading or doing close work.

16. Refraction Through Prism

Refraction Through a Triangular Glass Prism:

When light passes through a triangular glass prism:

At First Surface (AB):
• Light enters from air (rarer medium) to glass (denser medium)
• The incident ray (PE) bends towards the normal
• This produces the refracted ray (EF) inside the prism

Inside the Prism:
• Light travels through the glass prism along EF

At Second Surface (AC):
• Light exits from glass (denser medium) to air (rarer medium)
• The ray bends away from the normal
• This produces the emergent ray (FS)

Angle of Deviation:
The peculiar shape of the prism makes the emergent ray bend at an angle to the direction of the incident ray. This angle is called the **angle of deviation**. It is the angle between the direction of incident ray and emergent ray.

[Diagram should show: Triangular prism ABC with incident ray PE, refracted ray EF, emergent ray FS, normals at E and F, and angle of deviation ∠D marked between the extensions of incident and emergent rays]

17. Advance Sunrise Due to Atmospheric Refraction

Why Sun is Visible Before Actual Sunrise:

The sun is visible about 2 minutes before actual sunrise because of atmospheric refraction. Here's how:

Process:
• The earth's atmosphere has layers of different densities
• Denser layers are near the earth's surface
• When the sun is below the horizon, its light enters the atmosphere
• Light undergoes continuous refraction through layers of gradually changing refractive index
• The atmosphere bends sunlight towards the normal at each layer
• This makes light rays curve downward toward earth
• Due to this bending, sunlight reaches our eyes even when the sun is below the horizon
• The sun appears to be above the horizon (apparent position) when it is actually still below it (actual position)

Result:
We can see the sun about 2 minutes before it actually crosses the horizon.

[Diagram should show: Earth's curved surface with atmosphere layers, actual sun position below horizon, light rays bending through atmosphere layers (showing refraction), observer on earth, and apparent sun position above horizon. Arrows should indicate the curved path of light through the atmosphere.]

SECTION D - Answer to Long Answer Question

18. (a) Structure and Function of Human Eye; (b) Tyndall Effect

(a) Structure and Functioning of Human Eye:

Structure: [Labeled diagram showing all parts]

The human eye is approximately spherical in shape with a diameter of about 2.3 cm. Its main parts are:

1. Cornea: Transparent front bulge through which light enters. Most refraction occurs here.

2. Iris: Dark muscular diaphragm behind the cornea. Controls pupil size.

3. Pupil: Opening in the iris. Regulates amount of light entering the eye.

4. Crystalline Lens: Transparent, biconvex lens made of fibrous jelly-like material. Provides fine focusing adjustment.

5. Ciliary Muscles: Muscles attached to the lens. Control lens curvature for accommodation.

6. Retina: Light-sensitive screen at the back of the eye. Contains enormous number of light-sensitive cells.

7. Optic Nerve: Carries electrical signals from retina to brain.

8. Aqueous Humour: Fluid between cornea and lens.

9. Vitreous Humour: Fluid filling the main eyeball cavity.

Functioning - How Eye Focuses at Different Distances:

For Distant Objects:
• Ciliary muscles relax
• Eye lens becomes thinner
• Focal length increases
• Image forms on retina

For Nearby Objects:
• Ciliary muscles contract
• Eye lens becomes thicker (increased curvature)
• Focal length decreases
• Image forms on retina

This ability to adjust focal length by changing lens curvature is called **power of accommodation**.

Image Formation:
The lens system forms a real, inverted image on the retina. Light-sensitive cells get activated and generate electrical signals. These signals travel via optic nerve to the brain, which interprets them so we perceive objects as they are (erect).

(b) Tyndall Effect:

Definition:
The phenomenon of scattering of light by colloidal particles is called Tyndall effect. When a beam of light strikes fine particles, the path of the beam becomes visible as light is scattered by these particles.

Examples:

1. Sunlight Through Smoke-filled Room:
When a fine beam of sunlight enters a smoke-filled room through a small hole or window, the path of the light beam becomes visible. This is because smoke particles scatter the light, making the beam visible. The light reaches our eyes after being reflected diffusely by the smoke particles.

2. Sunlight Through Forest Canopy:
When sunlight passes through a dense forest, especially in the early morning when there is mist, the light beams become visible. Tiny water droplets in the mist scatter the sunlight, creating visible beams of light streaming through the trees. This creates a beautiful visual effect demonstrating Tyndall effect in nature.

SECTION E - Answers to Case Study Based Questions

19. Case Study 1 - Answers

(a) Ravi has **Myopia** (near-sightedness) in his eyes.

(b) When Ravi looks at distant objects without spectacles, the image forms **in front of the retina** instead of at the retina.

(c) A concave lens was prescribed because it is a diverging lens that spreads out light rays before they enter the eye. This divergence compensates for the excessive convergence by Ravi's elongated eyeball, allowing the image to form exactly on the retina instead of in front of it.

(d) The main cause of this defect in Ravi's case is **elongation of the eyeball**. The doctor found that his eyeball had become slightly longer than normal, causing light rays to converge before reaching the retina.

20. Case Study 2 - Answers

(a) The splitting of white light into seven constituent colours is called **Dispersion**.

(b) Violet light deviates more than red light because different colours of light have different wavelengths and bend through different angles when passing through the prism. Violet has a shorter wavelength and bends more, while red has a longer wavelength (1.8 times that of blue) and bends less.

(c) VIBGYOR stands for:
V - Violet
I - Indigo

B - Blue
G - Green
Y - Yellow
O - Orange
R - Red

(d) Yes, the students will still observe dispersion if they use a water prism instead of a glass prism. Dispersion occurs in any transparent medium that has a refractive index different from air. However, the amount of dispersion (separation between colours) may be slightly less in water compared to glass because the refractive index of water is lower than that of glass.
