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The Human Eye And The Colourful World



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Previous Years Questions

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Q. A person is suffering from both myopia and hypermetropia. What kind of lenses can correct this defect? [CBSE 2020]

Ans. The lens which can correct the vision of such a person suffering from both myopia and hypermetropia is a bifocal lens.

Q. Trace the sequence of events which occur when a bright light is focused on your eyes. [CBSE 2019]

Ans. When a bright light focused on our eyes, then light first passes through the cornea and enters into the pupil, where size of pupil contracts which is controlled by iris. Hence less light enters the eye through the pupil. Then light passes through the eye lens and image is formed on the retina. The nature of image formed will be real and inverted.

Q. With the help of scattering of light, explain the reason for the difference in colours of the Sun as it appears during sunrise/sunset and noon. [CBSE 2019, 15, 11]

Ans. The Sun appears reddish at sunrise as well as at the sunset and appears white at noon when it is overhead.

At sunrise/sunset, the blue light of shorter wavelength get scattered away while passing through the thicker layer of air and red light of longer wavelength reach our eye. At noon, the Sun is overhead and the light of the Sun travels relatively shorter distance to our eyes and little of blue and violet colours are scattered, and white light reaches our eye.

Q. Define dispersion of white light and name the colours of white light in order. [CBSE 2012, 14]

Ans. The splitting of white light into its constituent wavelengths is called dispersion of light. White light splits into the following colours violet, indigo, blue, green, yellow, orange and red.

Q. Why does the clear sky appear blue? How would the sky appear in the absence of earth's atmosphere? [CBSE 2011]

Ans. The blue colour of the sky is due to the scattering by molecules of gases in atmosphere. The blue colour being scattered more than any other colour.

In the absence of atmosphere on earth, no scattering will occur, therefore the sky will appear black.

Q. How is the sense of vision carried from the eye to the brain? [CBSE 2016]

Ans. Through the optic nerve.

Q. How is the eye lens held in its position? [CBSE 2011, 13]

Ans. Ciliary muscles hold the eye lens in position.

Q. Why is blind spot so called? [CBSE 2015]

Ans. An image formed at this point is not sent to the brain.

Q. Give reason for the following natural phenomenon

[CBSE 2016]

(i) Stars twinkle

(ii) Planets do not twinkle

(iii) Stars appear raised in the sky.

Ans. (i) Owing to constant changes in density of different layers of air due to convection current or motion of the earth's atmosphere, the refractive index of the layers also changes. Thus, the apparent position of the stars appears to be changing. This also makes the light from the star to increase or decrease in intensity. Since the stars are very distant, they approximate point-sized sources of light. This makes the star sometimes to appear brighter and sometimes dimmer. The light coming from the stars, therefore, presents a quivering (shaking) appearance, thus, giving the impression as if the stars are twinkling.

(ii) The stars, although very large as compared to the planets, appear as tiny specks in the sky due to their immense distance from the earth as compared to the huge size of the planets. Thus, the stars appear as point sources of light and the planets appear as a large combination of such sources. Thus, the change in the path of light coming from the planets is negligible as compared to that coming from the stars. Therefore, the planets do not seem to twinkle like star.

(iii) As the light from the stars enters the earth's atmosphere it undergoes refraction and bends towards the normal. As a result to an observer on the Earth the Star appears to be slightly higher in the Sky than its actual position.

Q. Why does the sun appear reddish early in the morning? Will this phenomenon be observed by an observer on the moon? Justify your answer with a reason.

[CBSE 2016, 18]

Ans. Early in the morning, the sun is near the horizon, sunlight reaches us after travelling a longer distance through thick layers of atmosphere. Thus most of the blue light and shorter wavelengths are scattered away by the particles in the atmosphere. The light that reaches us is of longer wavelengths giving a reddish appearance. This phenomenon will not be observed by an observer on the moon because of the absence of atmosphere on the moon.

Q. State the reasons which lead to hypermetropia. With the help of suitable diagram, explain this defect of vision and its correction.

[CBSE 2015]

Ans. Hypermetropia is a defect in which a person is not able to see clearly the nearby objects but can see distant one. It means the near point has shifted away from eye. It occurs due to shortening of the eyeball or due to increase in focal length of eye lens. It can be corrected by convex lens of suitable power.

Q. What is the number of receptors contained in the retina?

[CBSE 2016]

Ans. The retina contain more than 125 million receptors.

Q. What is meant by far point?

[CBSE 2015]

Ans. The farthest point upto which an eye can see clearly is called the far point of the eye.

Q. What is presbyopia? [CBSE 2014]

Ans. Presbyopia is that defect of human eye, due to which an old person cannot read and write comfortably.

Q. State one function each of iris, pupil, and cornea. [CBSE 2014]

Ans. Iris-->It regulates the amount of light entering the eye by dilating the pupil in light of low intensity and contracting the pupil in high intensity light.

Pupil-->This is portion of the eye which allows the light to enter the eye.

Cornea-->It is a transparent spherical membrane covering the bulge in front of the eyeball. Light enters the eye through cornea where it is refracted the most.

Q. A person needs a lens of power-2.5 dioptres for correcting his vision. Name the defect of vision he is suffering from. Which lens will be using for the correction? Also, find the focal length of lens. [CBSE 2012]

Ans. The person is using a concave lens of power-2.5 D. The person is, therefore, suffering from myopia. He is using a concave lens for correction of eye.

Since $P = 1/f$, therefore,

$$f = 1/p = 1/2.5 = 0.4 \text{ m} = 40 \text{ cm}$$

Q. Name the part of the eye where image is formed by the eye lens. What is the nature of the image formed? How is this image sent to the brain? [CBSE 2012]

Ans. The image of the object formed by the eye lens is at the retina of the eye. The image formed on the retina is real and inverted. The image is sent to the brain with the help of the optic nerve.

Q. Explain how a normal human eye is able to see distinctly the object placed at a distance as well as those placed at a nearer distance. [CBSE 2012]

Ans. For seeing distant objects, the focal length of the eye lens should be large and for seeing near objects the focal length of the eye lens should be small. The focal length of the eye lens can be adjusted with the help of ciliary muscles holding the lens in position.

Q. Why sky appears dark to the passengers flying at high altitudes? [CBSE 2011, 12]

Ans. This is due to the atmosphere being absent at high altitudes. As a result no light reaches the eye after scattering. Hence, the sky appears to be dark.

Q. How does refraction take place in the atmosphere? Why do Stars twinkle but not the planets? [CBSE 2015]

Ans. Change in the direction of propagation of light rays travelling through the atmosphere due to change in density of the different layers of air is called atmospheric refraction. The atmosphere of earth is not evenly distributed it is optically and molecularly denser at the bottom and becomes rarer as we go up, so the velocity of light changes from layer to layer. The molecules of different gases and dust particles have different optical densities, moreover, the hot air is optically rarer than the cold air.

These factors form different layers of air and different optical densities atmospheric refraction. cause Stars appear to twinkle because the light coming from the Star passes through the atmosphere having various optical densities.

Sometimes the atmosphere refracts more amount of starlight, that time the star appears bright and sometimes refracts less starlight, that time the Star appears dim. This bright and dim appearance of light gives it the twinkling effect. The planets are closer to and the intensity of light coming from them is more and slight refraction does not bring much difference to the brightness of the planet.



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Multiple Choice Questions

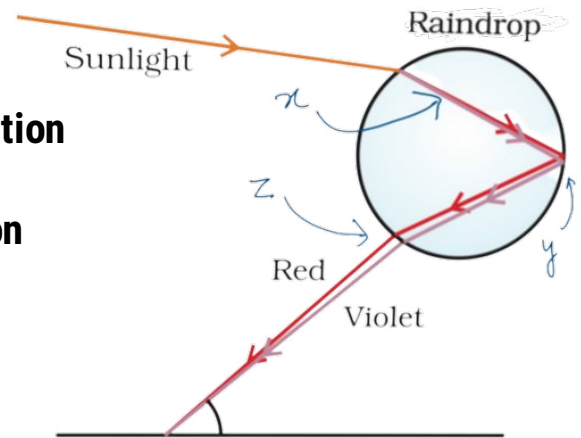
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1. Name the following X,Y,Z phenomena of light involved in the formation of a rainbow?

- (a) Reflection, refraction and dispersion
- (b) Refraction, dispersion and total internal reflection
- (c) Refraction, dispersion and internal reflection
- (d) Dispersion, total internal reflection & refraction

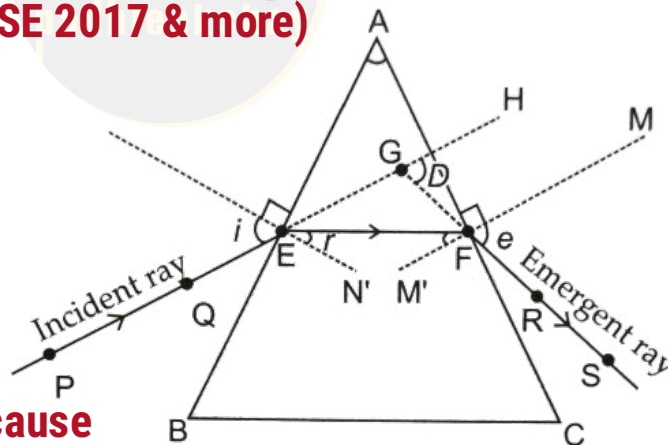


2. Which of the following statements is correct regarding the propagation of light of different colours of white light in air?

- (a) Red light moves fastest
- (b) Blue light moves faster than green light
- (c) All the colours of the white light move with the same speed
- (d) Yellow light moves with the mean speed as that of the red and the violet light

3. A student very cautiously traces the path of a ray through a glass slab for different values of the angle of incidence (i). He then measures the corresponding values of the angle of refraction (r) and the angle of emergence (e) for every value of the angle of incidence. On analysing these measurements of angles, his conclusion would be 1 object. (CBSE 2017 & more)

- (a) $i > r > e$
- (b) $i = e > r$
- (c) $i < r < e$
- (d) $i = e < r$



4. The clear sky appears blue because

- (a) blue light gets absorbed in the atmosphere
- (b) ultraviolet radiations are absorbed in the atmosphere
- (c) violet and blue lights get scattered more than lights of all other colours by the atmosphere
- (d) light of all other colours is scattered more than the violet and blue colour lights by the atmosphere

5. The colour of the scattered light depends on the _____ of the scattering particles?

- (a) density
- (b) refractive index
- (c) size
- (d) mass

6. Difference in actual and apparent time of sunrise & sunset and apparent flattening of sun's disc occurs due to _?(CBSE 2019 & more)

- (a) Dispersion
- (b) Atmospheric refraction
- (c) Total internal reflection
- (d) None of the above

7. A rainbow is always formed in a direction_____to that of the Sun.

- (a) perpendicular
- (b) parallel
- (c) opposite
- (d) adjacent

8. Mark the correct reason behind twinkling effect of stars.(CBSE 2016 & more)

- (a) Difference in sizes of different stars
- (b) Light coming from stars to us vary continuously
- (c) Both A & B
- (d) Stars are luminous objects

9. Why stars appear to twinkle but planets do not? (CBSE 2018 & more)

- (a) due to difference in Size
- (b) due to difference in distance from Earth
- (c) due to difference in refractive indices
- (d) None of the above

10. The phenomenon of splitting of white light into seven colours on refraction is called as _ ? (CBSE 2020 & more)

- (a) Emergence
- (b) Diffraction
- (c) Scattering
- (d) Dispersion

11. Why do different colors of white light bend through different angles with respect to the incident beam of light on any object? (CBSE 2019 & more)

- (a) difference in colour
- (b) different in intensity
- (c) difference in velocity
- (d) none of the above

12. What is the range of wavelength of visible light? (CBSE 2018)

- (a) 480 to 700 nanometers
- (b) 320 to 750 nanometers
- (c) 280 to 500 nanometers
- (d) 380 to 700 nanometers

13. Assertion- We observe at first the orange red colour and then bright crimson red colour on the screen when a beam of white light is passed through a colloidal solution

Reason- This is due to scattering of short wavelengths by minute colloidal particles.

14. Assertion- The sky appears dark to passengers flying at very high altitudes

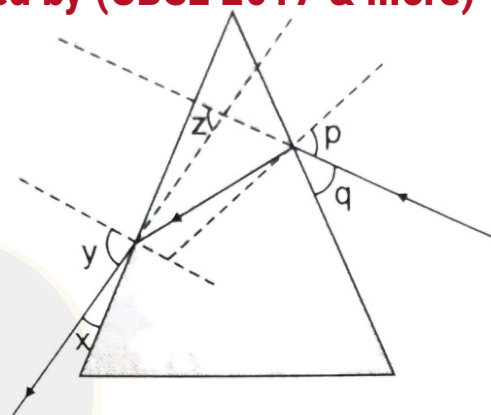
Reason- Scattering is not prominent at such heights.

15. Assertion- 'DANGER' signal lights are red in colour.

Reason - The red is most scattered by fog or smoke.

16. In this diagram, the angle of incidence, the angle of emergence and the angle of deviation respectively have been represented by (CBSE 2017 & more)

- (a) y, p, z
- (b) x, q, z
- (c) p, y, z
- (d) p, z, y



ANSWERS

- 1.-- d
- 2.-- c
- 3.-- b
- 4.-- c
- 5.-- c
- 6.-- b
- 7.-- c
- 8.-- b
- 9.-- b
- 10.- d

- 11.- c
- 12.- d
- 13.- a
- 14.- a
- 15.- a
- 16.- a

**** Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:**

- A. Both A and R are true and R is the correct explanation of A
- B. Both A and R are true and R is not the correct explanation of A
- C. A is true but R is false
- D. A is False but R is true



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Case-Based Questions

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Read the passage and answer the following questions

QUESTION 1:

The spreading of light by the air molecules is called scattering of light. The light having least wavelength scatters more. The sun appears red at sunrise and sunset, appearance of blue sky it is due to the scattering of light. The colour of the scattered light depends on the size of particles. The smaller the molecules in the atmosphere scatter smaller wavelengths of light. The amount of scattering of light depends on the wavelength of light. When light from sun enters the earth's atmosphere, it gets scattered by the dust particles and air molecules present in the atmosphere. The path of sunlight entering in the dark room through a fine hole is seen because of scattering of the sun light by the dust particles present in its path inside the room.

- (i) To an astronaut in a spaceship, the colour of earth appears**
(a) red
(b) blue
(c) white
(d) black
- (ii) At the time of sunrise and sunset, the light from sun has to travel.**
(a) longest distance of atmosphere
(b) shortest distance of atmosphere
(c) both (a) and (b)
(d) can't say
- (iii) The colour of sky appears blue, it is due to the**
(a) refraction of light through the atmosphere
(b) dispersion of light by air molecules
(c) scattering of light by air molecules
(d) all of these.
- (iv) At the time of sunrise and sunset**
(a) Blue colour scattered and red colour reaches our eye
(b) Red colour scattered and blue colour reaches our eye
(c) Green and blue scattered and orange reaches our eye
(d) None of these

ANSWERS

- i. b**
ii. a
iii. c
iv. a

QUESTION 2:

Atmospheric refraction is the phenomenon of bending of light on passing through earth's atmosphere. As we move above the surface of earth, density of air goes on decreasing. Local conditions like temperature etc. also affect the optical density of earth's atmosphere. On account of atmospheric refraction, stars seen appear higher than they actual are; advanced sunrise; delayed sunset, oval appearance of the sun at sunrise and sunset; stars twinkle, planets do not.

(i) Due to atmospheric refraction, apparent length of the day

- (a) increases
- (b) decreases
- (c) remains the same
- (d) all of these

(ii) Apparent position of the star appears raised due to

- (a) atmospheric refraction
- (b) scattering of light
- (c) both (a) and (b)
- (d) none of these

(iii) The sun appears oval shaped or flattened due to

- (a) dispersion
- (b) scattering
- (c) atmospheric refraction
- (d) cannot say

(iv) Twinkling of stars and non-twinkling of planets is accounted for by

- (a) scattering of light
- (b) dispersion of light
- (c) atmospheric refraction
- (d) none of these

ANSWERS

i. a

ii. a

iii. c

iv. c