

## Chapter 16. Light \_ Refraction and dispersion of light living science question with answer

A. MULTIPLE-CHOICE QUESTIONS: Choose the most appropriate answer.

- If medium A is optically denser than medium B, then the speed of light is
  - the same in both mediums.
  - higher in medium A than in medium B.
  - higher in medium B than in medium A.
  - higher in medium A or B depending on which medium is thicker.
- When light travels from an optically denser medium to a rarer medium,
  - it bends away from the normal.
  - it bends towards the normal.
  - it is undeviated.
  - it is laterally displaced.
- The splitting of white light into its constituent colours is called
  - refraction.
  - dispersion.
  - deviation.
  - displacement.
- At what position of the object does a convex lens act as a magnifying glass?
  - between F and 2F
  - between F and O
  - beyond F
  - beyond 2F
- Which of the following is true for a person suffering from myopia?
  - can see far-off objects clearly but near objects appear blurred
  - can be corrected using a convex lens
  - far point is at finite distance, and not at infinity
  - near point is beyond 25 cm
- If a person is suffering from Hypermetropia, which object is he/she most likely to see blurred?
  - object 25 cm away
  - object 10 m away
  - object 100 m away
  - object at infinity
- Which one of these controls the amount of light entering the eye?
  - pupil
  - iris
  - cornea
  - ciliary muscles
- Myopia is corrected by using spectacles with
  - convex lenses.
  - concave lenses.
  - glass slabs.
  - prisms.
- When white light passes through a prism, it is
  - deviated and dispersed.
  - deviated but not dispersed
  - laterally displaced and not dispersed.
  - reflected
- How many dots does the Braille system use?
  - 5
  - 6
  - 10
  - 11

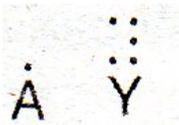
Answer: . 1. c 2.a 3.b 4. b 5. c 6. a 7. b 8. b 9. a 10. b

B. VERY SHORT-ANSWER QUESTIONS: Give one-word answers.

- Refractive index can be defined for both transparent and opaque objects. True or false?
- Light bends as it passes from one medium to another. What is this phenomenon called?
- If light enters from water to air it bends the normal.
- A pencil dipped obliquely in water appears bent at the surface due to dispersion. True or false?
- In a prism, the emergent ray is parallel to the incident ray. True or false?
- A transparent medium bends light by the same amount irrespective of the colour of light. True or false?
- Which of these has a smaller focal length—a thick lens or a thin lens?
- If an object is situated at the focal point of a convex lens, where is the image formed?
- A diverging lens forms a real image of an object, placed beyond F, and a virtual image of an object placed between O and F. True or false?
- The far point of a hypermetropic eye is at a finite distance from the eye. True or false?
- Which lens is used to correct myopia—convex or concave?

12. A normal eye cannot clearly see objects closer than \_\_\_\_\_cm  
13. In cataract, the lens of the eye becomes cloudy. True or false?  
14. Write Braille codes for letters A and Y

- Ans: 1. False    2. Refraction    3. away from    4. False    5. False  
6. False    7. A thick lens    8. At infinity    9. False    10. False  
11. concave    12. 25    13. True  
14.



### C. SHORT-ANSWER QUESTIONS (TYPE I): Answer in a sentence or two.

1. What do you mean by refraction of light? In which direction will light bend when travelling from an optically rarer medium to an optically denser medium?

Ans: The bending of light as it passes from one transparent medium to another is called refraction. It occurs because light travels at lower speed in an optically denser medium. Light bends towards the normal at the point of incidence as it passes from an optically rarer to an optically denser medium.

2. Why does refraction occur?

Ans: Refraction occurs because of the difference in speed of light in different mediums.

3. What is dispersion?

Ans: The splitting of light into its constituent colours is called dispersion.

4. Which medium will bend light more—glass or water? Why?

Ans: Light will bend more in glass than in water as glass is optically denser than water.

5. What is 'white light'?

Ans: Sunlight is a mixture of light of several colours. It is known as white light.

6. What is the order of colours in a spectrum of 'white light'?

Ans: Red, orange, yellow, green, blue, indigo and violet.

7. Distinguish between near point and far point of the eye.

Ans: The least distance at which the eye can see an object clearly is called the near point whereas the far point of the eye is the maximum distance at which it can see clearly.

8. What is the 'blind spot' of the eye?

Ans: Blind spot is the region of the retina at the junction of the optic nerve and the retina. There are no sensory cells at this spot, hence any image formed here cannot be seen.

### D SHORT-ANSWER QUESTIONS (TYPE II): Answer in about 30 words.

1. What is the difference between the displacement produced by a rectangular glass slab in a ray of light and the deviation produced by a glass prism?

Ans: Displacement by a rectangular glass slab

(i) A glass slab causes a ray of light to be laterally displaced after refraction through it.

(ii) Emergent ray is parallel to the incident ray but laterally displaced from it.

(iii) No spectrum forms here.

Deviation by a glass prism

(i) A prism causes an incident ray to be deviated from its path by an angle called the angle of deviation.

(ii) The emergent ray is deviated from the incident ray.

(iii) Deviation of light through a glass prism causes to form spectrum.

2. Explain the term 'spectrum'. Why does a glass prism split white light into its constituent colours?

Ans: The splitting up of white light into its constituent colours is called dispersion. The patch of coloured light obtained due to dispersion through a glass prism on the screen is known as a spectrum. A glass prism splits white light into its constituent colours because of deviation. Different colours of light are deviated by different amounts. Hence the colours separate out on emerging from the prism.

3. Distinguish between converging and diverging lenses.

Ans: Converging lenses

(i) The lens which converges all the parallel rays at a point on its principal axis after refraction, is known as converging lens or convex lens.

(ii) It is thick in the middle and becomes thinner at the edges.

Diverging lenses

(i) The lens which diverges all the parallel rays of light after passing through it outwardly is known as diverging lens or concave lens.

(ii) It is thin in the middle and thicker at the edges.

4. Define the following terms for a lens:

a. optical centre b. principal axis c. principal focus d. focal length

Ans: (a) Optical centre: The optical centre of a lens is a point on the principal axis such that a ray passing through it does not undergo any deviation.

(b) Principal axis: A straight line passing through the centres of curvature  $C_1$  and  $C_2$  of the two surfaces of the lens is called the principal axis.

(c) Principal focus: If a beam of light parallel to the principal axis is incident on a converging lens, the rays of light after passing through the lens converge at a point  $F$ . This point is called the principal focus or simply the focus of the lens.

(d) Focal length: The distance between the optical centre and the focus of a lens is called the focal length of the lens.

5. Why does a concave lens always form a virtual image of an object? Draw a diagram to illustrate this.

Ans: Image formed by a concave lens: The rays falling on a concave lens, after refraction, always diverge. Therefore, no matter where the object is kept, a diverging lens always forms a virtual image, which is erect and smaller in size than the object. It is formed between the optical centre and the focus, on the same side of the lens as the object.

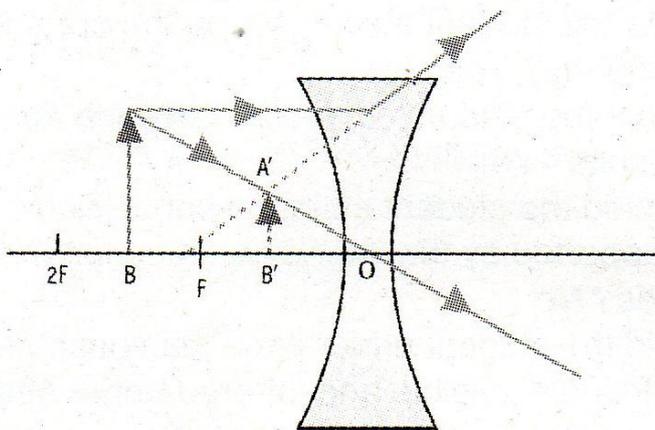


Image formed by a concave lens

6. What do you mean by the accommodation of the eye? What gives the eye the power of accommodation?

Ans: The ability of the eye to alter the focal length of its lens so that it can clearly see all objects within a certain range (25 cm, near point to infinity far point) is called accommodation of the eye.

7. How are letters written in the Braille system? Give two examples.

Ans: The Braille system employs groups of raised dots to represent printed letters and numbers.

The letter "Y" has dots 1, 3, 4, 5, and 6.	
A "Period" is written with dots 2, 5, and 6.	

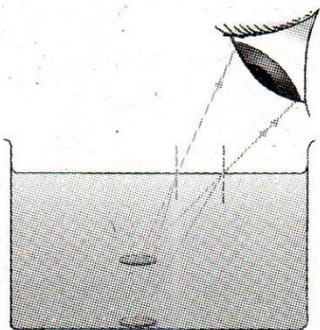
8. What is meant by 'persistence of vision'? How is this property of the eye used in movie films?

Ans: When an image of an object is formed on the retina, it stays for about 1/16th of a second. This is called persistence of vision. Moving images that we see on the TV or in a cinema depend on this property of the eye. If successive still images of any moving object, person or animal are flashed before our eyes at the rate of more than 16 images per second, we would see it as a movie of running of that object, person or animal.

E. LONG-ANSWER QUESTIONS: Answer in about 60 words.

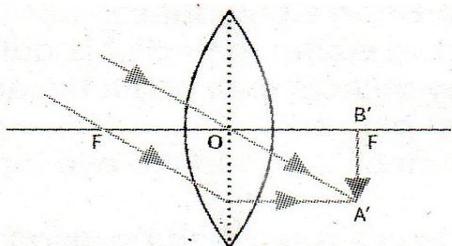
1. A coin kept at the bottom of a glass bowl full of water appears to be higher than it actually is. With the help of a labelled diagram, explain why this happens.

Ans: A coin kept at the bottom of a glass bowl full of water appears to be higher than it actually is. This happens because rays of light from any point (say A) on the coin, refract away from the normal as they emerge from water into air. The rays appear to come from a point A' above A. Thus, A' is the virtual image of A. In the same way, each point on the coin has a corresponding virtual image above the original point. Thus, the coin appears to be higher than it actually is.

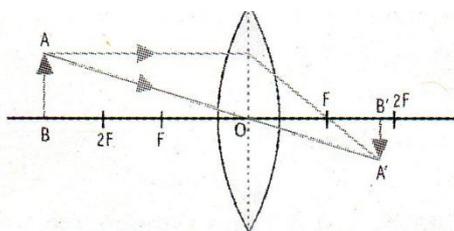


2. As an object is slowly brought from infinity to the focus of a convex lens, the image travels from the focus to infinity.' Show this with the help of diagrams with five different positions of the object.

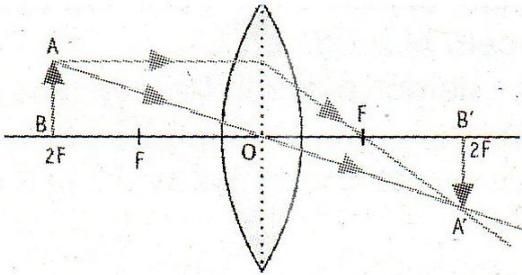
Ans: As the object is slowly brought from infinity to the focus of a convex lens, the image travels from the focus to infinity. The following diagrams show the five different positions of the object and the image.



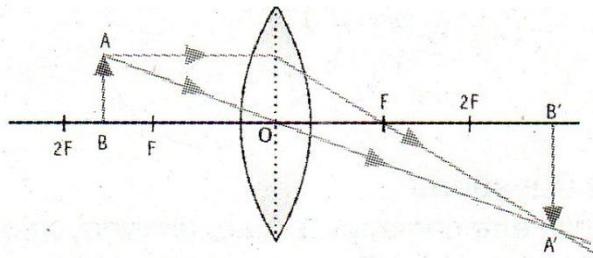
Object at infinity, image at focus



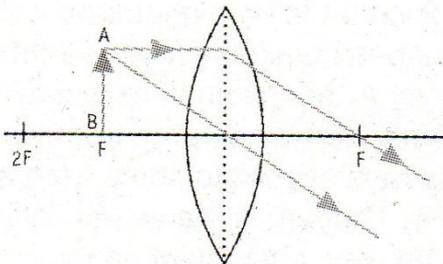
Object beyond 2F, image between F and 2F



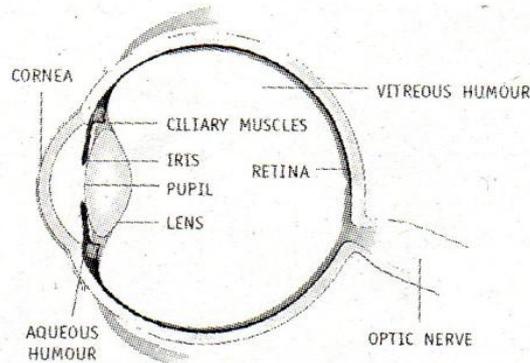
Object and image both at 2F



Object between 2F and F, image beyond 2F



Object at F, image at infinity



3. Draw a labelled diagram of the eye and answer the following questions: a. From where does light enter inside the eye? b. Which muscles control the focal length of the eye lens? c. Where is the image formed? d. Which nerve sends the image signals to the brain?

Ans: (a) Light enters the eye through the cornea.

(b) Ciliary muscles control the focal length of the eye lens.

(c) Image is formed on the retina.

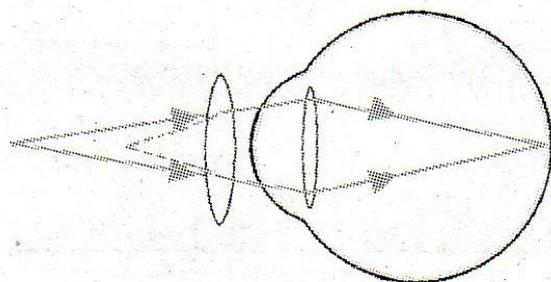
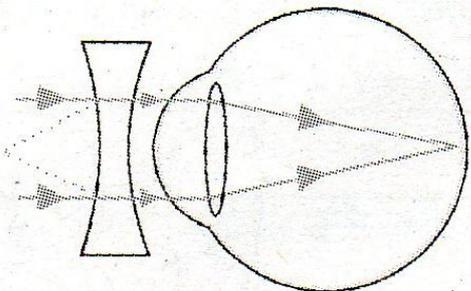
(d) Optic nerve sends the image to the brain.

4. Distinguish between myopia and hypermetropia. Draw diagrams to show how these defects can be corrected by using suitable lenses.

Ans: Myopia or Short sightedness

(i) A person suffering from this defect can see nearby objects clearly but distant objects appear blurred.

(ii) This defect is due to the eye lens being too thick. (iii) This defect is rectified by using a concave lens.



Hypermetropia or Long sightedness

(i) A person suffering from this defect can see distant objects clearly but nearby objects appear blurred.

(ii) This defect is due to the eye lens being too thin.

(iii) This defect is rectified by using a convex lens.

HOTS QUESTIONS: Think and answer.

1. Can a glass slab bend different coloured lights by different amounts?

Ans: While entering a glass slab, different coloured lights bend by different amounts. However on emerging from the slab, the lights bend in the opposite direction and emerge parallel to the initial direction.

2. You have seen that a prism splits up light into different colours as it bends different colour lights by different amounts. Why does a glass slab not cause dispersion? (HINT: Observe the path of light in a glass slab—especially what happens to it when it emerges from the slab.)

Ans: As explained in HOTS Q. 1 above, a glass slab does not cause dispersion as the emergent ray emerges parallel to the incident ray and there is no bending of light.

3. Suppose a swimming pool is filled with an imaginary liquid which is optically rarer than air. For a person looking at the pool from outside, will the apparent depth of the pool be less than or greater than the real depth? Give reasons.

Ans: The apparent depth of the pool will be greater than the real depth if the swimming pool is filled with an imaginary liquid which is optically rarer than air. This will happen because rays of light from any point of the floor of the pool refract towards the normal as they emerge from a rarer to a denser medium.

4. What type of image is formed when rays of light coming from a point on the object diverge after reflection or refraction—real or virtual?

Ans: When rays of light coming from a point on the object diverge after reflection or refraction, a virtual image is formed.

5. Will a spectrum be formed if blue light falls on a prism? Give reasons.

Ans: No. It is a light of single colour. So it will not be splitted up to form a spectrum.