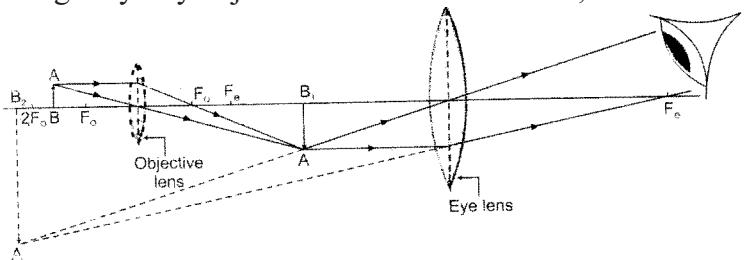
CHAPTER-10 : LIGHT

A. Answer the following questions :

1. The change in direction or bending of ray of light as it passes from one transparent medium to another is called refraction of light.
2. Refractive Index of a medium is defined as the ratio of the velocity of light in free space (almost equal to the velocity of light in air) to the velocity of light in that medium.
   That is Refractive Index $= \frac{\text{Velocity of light in air}}{\text{Velocity of light in that medium}}$
3. Laws of refraction
   (i) The incident ray, refracted ray and normal to the surface, at the point of incidence, are all the same plane.
   (ii) The ratio of the sine of angle of incidence (i) to the sine of angle of refraction (r) is constant for the two given media i.e., sin i/sin r = constant. This constant is called as *refractive index*.
4. Spectrum is the band of seven colours obtained after dispersion of white light into seven different colours.
   Formation of rainbow
   In the sky, after rain, each drop of water acts like a prism and when the white light of the sun falls on them, it splits into its component colours, i.e., VIBGYOR. This is because they bend by different amount while passing through drops of water. Red light bends the least, violet bends the most. The rays of each colour, while emerging, take slightly different paths, thus being distinct. It is this band of distinct colours that we see as a beautiful *rainbow*.
5. Lenses are used in the following instruments.
   (i) Magnifying glass (ii) Compound microscope
   (iii) Telescope (iv) Camera
6. **Real image**—When the rays of light after getting reflected from a mirror actually meet at a point, a *real image* is formed. A real image can be obtained on a screen.
   Virtural image—When the rays of light after getting reflected from a mirror appear to meet at a point, a *virtual image* is formed at that point. Such image can only be seen through a mirror but cannot be obtained on the screen.
7.

Convex lens	Concave lens
(i) The lens which has two convex surfaces is called a convex lens.	(i) A lens which has two concave surface is called a concave lens.
(ii) Convex lenses are thicker in the middle than at the edges.	(ii) Concave lenses are thicker at edges than in the middle
(iii) Convex lens converges a parallel beam of light rays.	(iii) Concave lens diverges a paralle beam of light rays.
(iv) The objects seen through them look bigger.	(iv) The objects seen through them look smaller.

8. A compound microscope is an optical instrument which is used for viewing very tiny objects like bacteria and cells, etc.

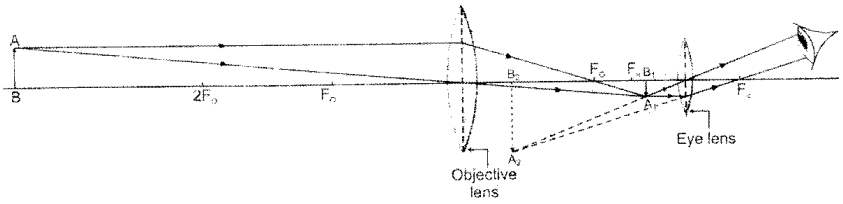


9. A telescope is an optical instrument which is used for viewing distant objects such as the moon, stars, planets, etc.

Working

A telescope consists of two convex lenses, i.e., objective tens of very large focal length and eye lens of very small focal length. These lenses are mounted on separate metallic (not shown in diagram), which can easily slide into one another. The tubes are blackened from inside so as to prevent reflection of light from its side (Fig. 10.29).

AB is a distant object in front of the objective lens. It forms its image A_1 B_1 which is inverted and diminished almost close to its principal focus F_o. The eye lens is so adjusted that the image A_1B_1 falls within the optical centre and the principal focus F_e of the eye lens. This gives rise to a divergent beam, which on reaching the eye, appears to come from point A_2B_2. Thus, A_2B_2 is the virtual, erect and magnified image of the object formed close to the eye lens.



10. **Human eye**

Human eye is almost a spherical ball, with a slight bulge in the front. The structure and function of each part of the eye is given below :

(i) **Sclerotic :** It is the outermost covering of the eye ball. It is made of white tough fibrous tissues. Its function is to house and protect the vital internal parts of the eye.

(ii) **Cornea :** It is the front bulging part of the eye. It is made of transparent tissues. It allows the light to enter in the eye ball.

(iii) **Choroid :** It is a grey membrane attached to the sclerotic from the inner side. Its function is to darken the eye from inside and, hence, prevent any internal reflection.

(iv) **Optic nerve :** It is a bundle of approximately 70,000 nerves originating form the brain and entering the eye ball from behind.

Its function is to carry optical messages (visual messages) to the brain.

(v) **Retina :** The optic nerve on entering the ball, spreads like a canopy, such that each nerve end attaches itself to the choroid. The nerve endings form a hemispherical screen called retina. These nerve endings on the retina are sensitve to visible light. The function of retina is to receive the optical image of the object and then convert it to optical pulses. These pulses are then sent to the brain through optic nerve.

(vi) **Yellow spot :** It is a small area, facing the eye lens. It has high concentration of nerve endings and is slightly raised as well as slightly yellow in colour. Its function is to form a very clear image by sending a large number of optical pulses to brain.

(vii) **Blind spot :** It is a region on the retina, where the optic nerve enters the eye ball. It has no nerve endings and hence, is insensitive to light. It does not seem to have any function. Any image formed on this spot is not visible.

(viii) **Crystalline lens :** It is a double convex lens made of transparent tissues. It is held in position ciliary muscles. Its function is to focus the images of different objects clearly on the retina.

(ix) **Ciliary muscles :** It is a ring of muscles which holds the crystalline lens in position. When these muscles relax, they increase the focal length of the crystalline lens and vice versa. Its function is to alter the focal length of crystalline lens so that the images of the objects, situated at different distances, are clearly focussed on the retina.

(x) **Iris :** It is a circular diaphragm suspended in front of the crystalline lens. It has a tiny hole in the middle and is commmonly called *pupil*. It has tiny muscles arranged radially around the pupil. These muscles can increase or decrease the diameter of the pupil.

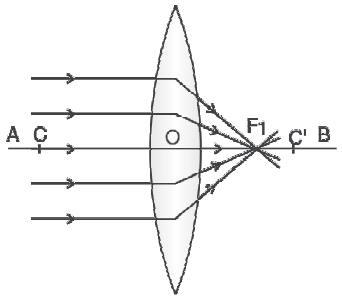
The human eye is like a camera. In the eye, a convex lens (called eye-lens) forms a real and inverted image of an object on the light-sensitive screen called retina whereas in a camera, the convex lens (called camera-len) forms a real and inverted image of an object on the light-sensitive photographic film.

B. Fill in the blanks :

1. refraction 2. prism 3. spectrum 4. converge, diverge
5. Principal axis 6. focal length 7. objective, eyepiece
8. lenses 9. power of accommodation

C. Do it yourself.

D. Write in brief on the following terms :



(a) **Centre of curvature :** The centres of the intersecting spheres form the lens surface are called the centres of curvature of the lens. In the diagram below C_1 and C_2 are the centres of curvature for the biconvex lens as shown in the figure.

(b) **Optical centre :** A point within a lens, where a line drawn through the diameter of lens meets principal axis, is called optical centre. In the diagram, the point O is shown as the centre (or optic axis) of the lens.

(c) **Principal axis :** The line passing through the centres of curvature C_1 and C_2 is called the principal axis. In the diagram, AB is the principal axis.

(d) **Simple microscope :** Microscope is a device that is used to obtain an enlarged image of very small objects that cannot be seen with unaided or naked eyes.

(e) **Optic nerve :** It is a bundle of approximately 70,000 nerves originating form the brain and entering the eye ball from behind. Its function is to carry optical messages (visual messages) to the brain.

(f) **Retina :** The optic nerve on entering the ball, spreads like a canopy, such that each nerve end attaches itself to the choroid. The nerve endings form a hemispherical screen called retina. These nerve endings on the retina are sensitive to visible light. The function of retina is to receive the optical image of the object and then convert it to optical pulses. These pulses are then sent to the brain through optic nerve.

E. Write the difference between the following :

1. **Refractive index of glass :** Refractive index of glass is defined as the ratio of the velocity of light in free space to the velocity of light in glass

$$\text{i.e,} \quad \frac{300{,}000 \text{ km/s}}{200{,}000 \text{ km/s}} = \frac{3}{2} = 1.5$$

Refractive index of water : Refractive index of water is defined as the ratio of the velocity of light in free space to the velocity of light in water.

$$\text{i.e,} \quad \frac{300{,}000 \text{ km/s}}{225{,}000 \text{ km/s}} = \frac{4}{3} = 1.33$$

2.

Convex lens	Concave lens
(i) It is thicker in the middle than at the edges.	It is thinner in the middle than at the edges.
(ii) It is converging in nature	It is diverging in nature
(iii) It has a real focus	It has a virtual focus

3.

Simple microscope	Compound microscope
(i) A single convex lens is used in this microscope.	Two convex lenses are used in this microscope.
(ii) Magnification power of this microscope is lesser than compound microscope	Magnification power of this microscope is greater than simple microscope.

4.

Short-sightedness	Long-signtedness
(i) Short-sighted is also called myopia.	Long-sightedness is also called hypermetropia
(ii) A myopic eye cannot see distant objects but can see only the nearby objects.	A hypermetropic eye cannot see nearby objects.
(iii) In myopic eye the image is formed in front of the retina.	In hypermetropic eye the image is formed in beyond the retina.
(iv) This defect can be rectified by using concave lens.	This defect can be rectified by the use of a convex lens.

5. **How eye focuses nearer objects**

In order of focus nearer objects, the ciliary muscles contract. In doing so, they decrease the focal length of crystalline lens. Thus, the images of the objects nearer to the eye are clearly focussed on the retina.

How eye sees far-off objects

The rays coming form far-off objects are almost parallel and, hence, on passing through lens meet at principal focus. In order to focus far-off objects, the ciliary muscles relax. This in turn increases the focal length of the crystalline lens. Thus, the images of the far-off objects are clearly focussed on the retina, which at the moment is on the principal focus of the crystalline lens.

F. Tick (✓) the right option :

1. (a) 2. (a) 3. (b) 4. (c)

G. Match the column I with the column II :

1. Splitting of light into seven colours	Dispersion
2. Converging lens	Thicker at its centre
3. Diverging lens	Thinner at its centre
4. Most bending colour	Violet
5. Least bending colour	Red
6. Band of seven colours	Spectrum