

### Lesson at a Glance

- **Light** is a form of electromagnetic radiation (radiation energy) which produces in us the sensation of vision.
- Light travels along straight line.
- A highly polished or shiny surface, such as mirror, reflects most of the light falling on it.
- **Reflection of light:** A mirror, or shiny surface that acts as mirror, changes the direction of light that falls on it. This change in direction of light by a mirror is called *reflection of light*.
- **Spherical mirrors:** The surface of a mirror or a shining spoon could be considered as a curved mirror. The most commonly used type of curved mirror is the spherical mirror. The reflecting surface of such mirrors can be considered to form a part of the surface a sphere. Such mirrors, whose reflecting surfaces are spherical are called *spherical mirrors*.
- The surface of water (clear fresh water) can also act like a mirror and change the path of light.
- **Image** (optical): An optical appearance produced by light or other radiations from an object reflected in the mirror or refracted through a lens is called *image*.

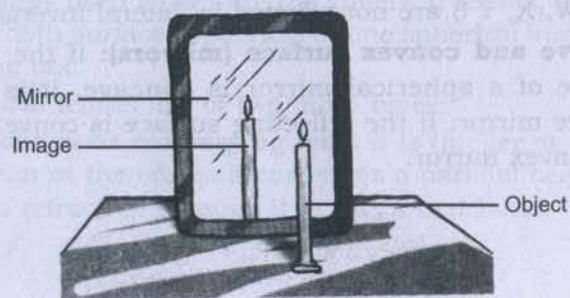


Fig. 15.1 Image of a candle in a plane mirror.

An image formed by a plane mirror is erect and of the same size as the object.

- **Ray of light:** The direction or path along which light energy travels in a medium is called a *ray of light*.
- **Beam of light:** A group of rays is called a *beam of light*, which can be parallel, convergent or divergent.
- **Lateral inversion:** If we stand before a plane mirror and move our right hand, our image appears to move its left hand. In fact, our entire image is reversed sideways. This sideways reversal of the image is known as *lateral inversion*.

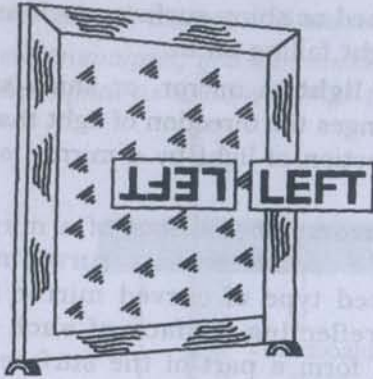


Fig. 15.2 Lateral inversion before a mirror.

**Cause of lateral inversion:** Lateral inversion is due to the fact that in a plane mirror the image is as far behind the mirror as the object is in front of it and that the front of the image and the front of the object face each other. The laterally inverted image of the word LEFT is as shown in fig. The image of symmetrical letters like A, H, I, M, O, T, U, V, W, X, Y 8 are not affected by lateral inversion.

- **Concave and convex surface (mirrors):** If the reflecting surface of a spherical mirror is concave, it is called a concave mirror. If the reflecting surface is convex, then it is a convex mirror.

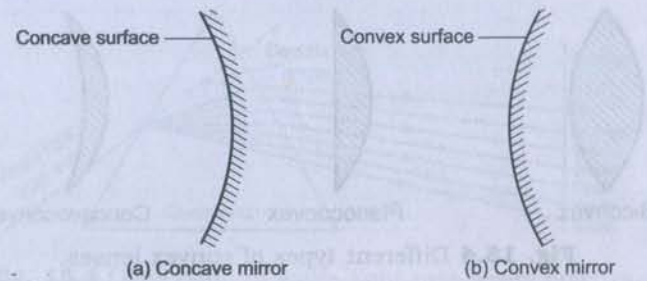


Fig. 15.3

Concave mirrors are used as reflectors in torches, headlights of cars and scooters.

Convex mirrors are used as side mirrors of scooters and rear view mirrors of cars to see the traffic behind.

- **Real image:** If a beam of rays starting from a point source of light, after reflection or refraction, actually converges to a point, then the second point is called the *real image* of the first. A real image is inverted and can be obtained on a screen.
- **Virtual image:** If a beam of rays starting from a point source of light, after reflection or refraction, appears to diverge from another point, then the second point is called the *virtual image* of the first. A virtual image is erect and cannot be obtained on a screen.
- **Mirror:** A highly polished surface which is smooth enough to reflect a good fraction of light incident on it is called a *mirror*.  
The image formed by a plane mirror cannot be obtained on a screen.
- **Lens:** A *lens* is a piece of a refracting medium bounded by two surfaces, at least one of which is a curved surface. The commonly used lenses are the spherical lenses, which have either both surfaces spherical or one spherical and the other a plane one.  
Spherical lenses are of two main types:
  - (i) **Convex or converging lens:** It is thicker at the centre than at the edges. It converges a parallel beam of light on refraction through it. It has a real focus.

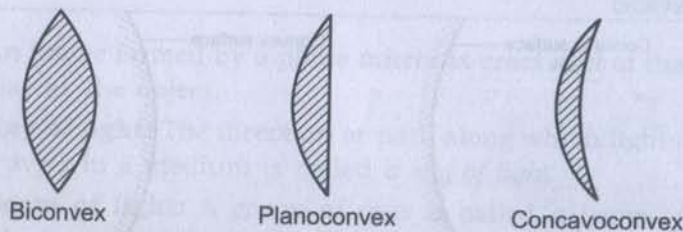


Fig. 15.4 Different types of convex lenses.

#### Types of convex lenses:

- Double convex or biconvex lens:* Both the surfaces are convex.
  - Planoconvex lens:* One surface is convex and the other is plane.
  - Concavoconvex:* One surface is convex and the other is concave.
- (ii) **Concave or diverging lenses:** It is thinner at the centre than at the edges. It diverges a beam of light on refraction through it. It has a virtual focus.



Fig. 15.5 Different types of concave lenses.

#### Types of concave lenses:

- Double concave or biconcave lens:* Both the surfaces are concave.
  - Planoconcave lens:* One surface is concave and the other is plane.
  - Convexoconcave:* One surface is concave and the other is convex.
- Dispersion:** When a narrow beam of white light (sunlight or torch light) is passed through a triangular glass prism, it splits into a band of seven colours. The seven colours are in order violet, indigo, blue, green, yellow, orange and red. The red colour is deviated the least while the violet colour is deviated the most. The colour sequence can be remembered by the acronym *Vibgyor*.

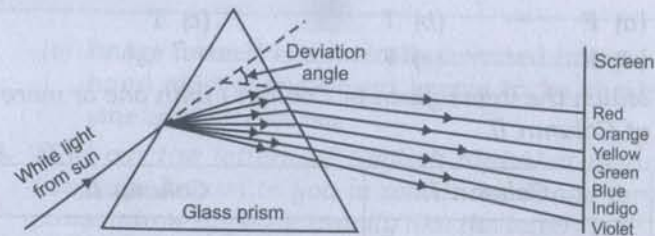


Fig. 15.6 Dispersion of white light into seven colours.

The phenomenon of splitting of white light into its component colours on passing through a refracting medium such as a glass prism is called *dispersion of light*. The pattern of the coloured bands obtained on the screen is called *spectrum*.

*Rainbow* forms in the sky due to dispersion of sunlight after the rain. You can see a rainbow only when back is towards the sun.

### TEXTBOOK QUESTIONS SOLVED

#### Q.1. Fill in the blanks:

- An image that cannot be obtained on a screen is called \_\_\_\_\_.
- Image formed by a convex \_\_\_\_\_ is always virtual and smaller in size.
- An image formed by a \_\_\_\_\_ mirror is always of the same size as that of the object.
- An image which can be obtained on a screen is called a \_\_\_\_\_ image.
- An image formed by a concave \_\_\_\_\_ cannot be obtained on a screen.

Ans. (a) virtual image (b) mirror (c) plane (d) real (e) lens

#### Q.2. Mark 'T' if the statement is true and 'F' if it is false:

- We can obtain an enlarged and erect image by a convex mirror. (T/F)
- A concave lens always form a virtual image. (T/F)
- We can obtain a real, enlarged and inverted image by a concave mirror. (T/F)
- A real image cannot be obtained on a screen. (T/F)
- A concave mirror always form a real image. (T/F)

- Ans.** (a) F (b) T (c) T  
(d) F (e) F

**Q.3.** Match the items given in Column I with one or more items of Column II.

Column I	Column II
(a) A plane mirror	(i) Used as a magnifying glass.
(b) A convex mirror	(ii) Can form image of objects spread over a large area.
(c) A convex lens	(iii) Used by dentists to see enlarged image of teeth.
(d) A concave mirror	(iv) The image is always inverted and magnified.
(e) A concave lens	(v) The image is erect and of the same size as the object. (vi) The image is erect and smaller in size than the object.

**Ans.**

Column I	Column II
(a) A plane mirror	(v) The image is erect and of the same size as the object.
(b) A convex mirror	(ii) Can form image of objects spread over a large area.
(c) A convex lens	(i) Used as a magnifying glass.
(d) A concave mirror	(iii) Used by dentists to see enlarged image of teeth.
(e) A concave lens	(vi) The image is erect and smaller in size than the object.

**Q.4.** State the characteristics of the image formed by a plane mirror.

- Ans.** (i) Plane mirror forms an erect image.  
(ii) It forms a virtual image.  
(iii) Size of the image is same as that of the object.  
(iv) Image is formed at the same distance behind the mirror as the object stands in front of it.

(v) Image formed is a laterally inverted image i.e., right hand side of the object seems to be the left hand side and vice-versa.

**Q.5.** Find out the letters of English alphabet or any other language known to you in which the image formed in a plane mirror appears exactly like the letter itself. Discuss your findings.

**Ans.** Letters like A, H, I, M, O, T, U, V, W etc. appear same when seen through a plane mirror.

**Q.6.** What is a virtual image? Give one situation where a virtual image is formed.

**Ans.** The image which cannot be taken on a screen is called virtual image. When some object is placed very close to the concave mirror we don't get any image on the white screen placed behind the mirror. Such image is called virtual image.

**Q.7.** State two differences between a convex and a concave lens.

**Ans.**

Convex lens	Concave lens
(i) Convex lens can form both real and virtual images.	(i) Concave lens always forms a virtual image.
(ii) It can form magnified image.	(ii) Image is always diminished in size.

**Q.8.** Give one use each of a concave and a convex mirror.

**Ans.** Use of concave mirror:

Concave mirror is used by dentists to examine the teeth.

Use of convex mirror:

Convex mirror is used as side view mirror in vehicles.

**Q.9.** Which type of mirror can form a real image?

**Ans.** Concave mirror can form a real image.

**Q.10.** Which type of lens forms always a virtual image?

**Ans.** Concave lens always forms a virtual image.

Choose the correct option in Questions 11–13:

**Q.11.** A virtual image larger than the object can be produced by a

- (i) concave lens                      (ii) concave mirror  
(iii) convex mirror                  (iv) plane mirror

**Ans.** (ii) concave mirror

**Q.12.** David is observing his image in a plane mirror. The distance between the mirror and his image is 4 m. If he moves 1 m towards the mirror, then the distance between David and his image will be

- (i) 3 m                                      (ii) 5 m  
(iii) 6 m                                    (iv) 8 m

**Ans.** (iii) 6 m

**Q.13.** The rear view mirror of a car is a plane mirror. A driver is reversing his car at a speed of 2 m/s. The driver sees in his rear view mirror the image of a truck parked behind his car. The speed at which the image of the truck appears to approach the driver will be

- (i) 1 m/s                                    (ii) 2 m/s  
(iii) 4 m/s                                   (iv) 8 m/s

**Ans.** (iii) 4 m/s

### EXTENDED LEARNING — ACTIVITIES AND PROJECTS

**Q.1.** Play with a mirror

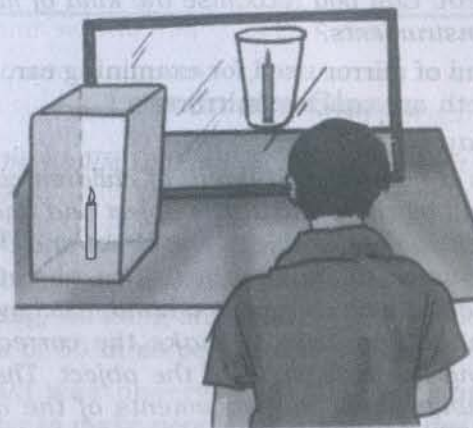
Write your name with a sketch pen on a thin sheet of paper, polythene or glass. Read your name on the sheet while standing in front of a plane mirror. Now look at your image in the mirror.

**Ans.** Do it yourself.

**Q.2.** A burning candle in water

Take a shoe box, open on one side. Place a small lighted candle in it. Place a clear glass sheet (roughly 25 cm × 25 cm) in front of this candle (Fig. 15.7). Try to locate the image of the candle behind the glass sheet. Place a glass of water at its position. Ask your friends to look at the image of the candle through the sheet of glass. Ensure

that candle is not visible to your friends. Your friends will be surprised to see the candle burning in water. Try to explain the reason.



**Fig. 15.7** Candle burning in water.

**Ans.** The plane glass sheet is transparent so the image of burning candle is formed behind the glass sheet. We see burning candle behind the sheet. When we put the glass filled with water then the image of burning candle appears to be in it. So friends see burning candle in water.

**Q.3.** Make a rainbow

Try to make your own rainbow. You can try this project in the morning or in the evening. Stand with your back towards the sun. Take a hosepipe or a water pipe used in the garden. Make a fine spray in front of you. You can see different colours of rainbow in the spray.

**Ans.** Do it yourself.

**Q.4.** Visit a laughing gallery in some science centre or a science park or a village mela. You will find some large mirrors there. You can see your distorted and funny images in these mirrors. Try to find out the kind of mirrors used there.

**Ans.** Students write the answer or tell the kind of mirror with their own experiences.

**Q.5.** Visit a nearby hospital. You can also visit the clinic of an ENT specialist, or a dentist. Request the doctor to show you the mirrors used for examining ear, nose, throat and teeth. Can you recognise the kind of mirror used in these instruments?

**Ans.** The kind of mirror used for examining ear, nose, throat and teeth are concave mirrors.

**Q.6.** Role play

Here is a game that a group of children can play. One child will be chosen to act as object and another will act as the image of the object. The object and the image will sit opposite to each other. The object will make movements, such as raising a hand, touching an ear. etc. The image will have to make the correct movement following the movement of the object. The rest of the group will watch the movements of the image. If the image fails to make the correct movement, she/he will be retired. Another child will take her/his place and the game will continue. A scoring scheme can be introduced. The group that scores the maximum will be declared the winner.

**Ans.** Do it yourself.