

Lesson at a Glance

- We can see an object only when light from an object enters our eyes. The light may have been emitted by the object or may have been reflected by the object.
- A mirror changes the direction of light that falls on it.
- Actually a narrow *beam of light* is made of several rays. For simplicity, we use the term ray for a narrow beam of light.
- **Reflection:** The mirror surface or a shiny surface scatters back a beam of light falling on it. **This scattering back of light by mirror or shiny surface is known as reflection.**
- The ray of light which falls on the mirror is called **incident ray**. The point at which incident ray falls on the surface of a mirror is called **point of incidence**.
- The ray that comes back from the surface of a mirror after reflection is known as the **reflected ray**.
- **Normal:** A *perpendicular* (a line making an angle of 90°) at the *point of incidence* (where the incident ray strikes the mirror) is known as *normal* to the reflecting surface at point.
- The angle between the incident ray and the normal is called the **angle of incidence ($\angle i$)**.

The angle between the *normal* and *reflected ray* is called the **angle of reflection ($\angle r$)**.

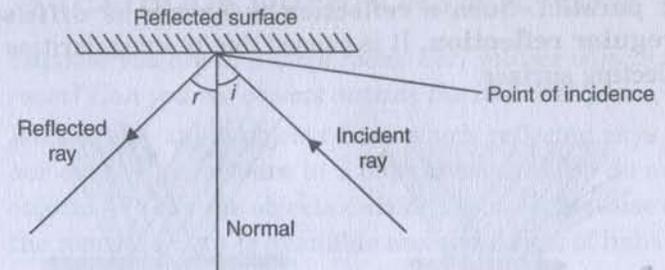


Fig. 16.1. Angle of incidence and angle of reflection.

• Laws of reflection

- The angle of incidence ($\angle i$) is always equal to the angle of reflection ($\angle r$), i.e. $\angle i = \angle r$.
- The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane.
- The image formed by a plane mirror is *erect*. It is *virtual* (image cannot be obtained on screen) and is of the *same size as the object*. The image is at the *same distance behind the mirror as the object is in front of it*.
- The image formed by a plane mirror: The *left side* of the object is *seen on the right side* in the image, and right side of the object appears to be on the left side in the image. This is known as **lateral inversion**.

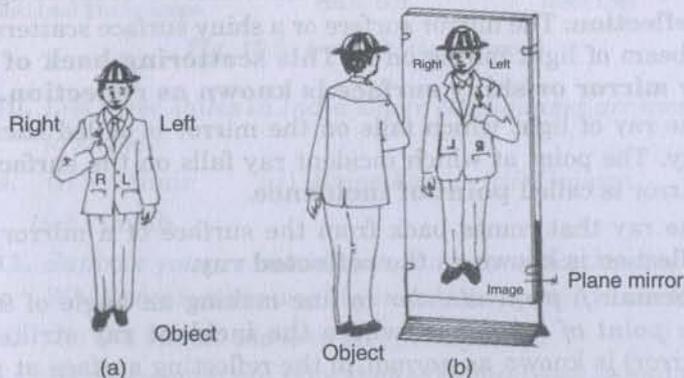


Fig. 16.2. Lateral inversion in a plane mirror.

- **Irregular and regular reflection:** When rays of light fall on *uneven shiny surface*, the reflected rays are scattered in all directions, as shown in Fig. 16.3. In this case reflected rays are not parallel. Such a reflection is known as **diffused** or **irregular reflection**. It is caused due to irregularities of the reflecting surface.

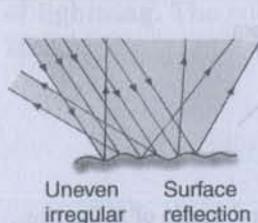


Fig. 16.3

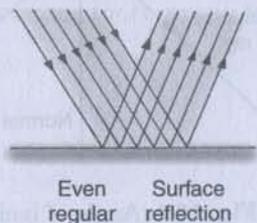


Fig. 16.4

When rays of light fall on smooth shiny surface, they are reflected in a particular direction as shown in Fig. 16.4 and are parallel. Such a reflection is called **regular reflection**. Images are formed by regular reflection.

- Nearly everything we see around is *seen due to reflected light*. The objects which shine in the light of other object are called *illuminated objects*. The objects which emit their own light are known as *luminous objects*.
- **Periscope:** The periscope makes use of *two* plane mirrors placed in 'z' shaped box at 45° , as shown in Fig. 16.5.

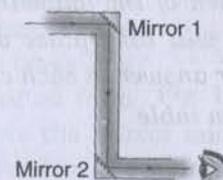


Fig. 16.5. Mirror 1 and Mirror 2 placed at 45° .

Due to reflection from mirror 1 and reflection from mirror 2 one is able to see objects which are not visible directly. Periscopes are used in submarines, tanks and also by soldiers in bunker to see things outside.

• Kaleidoscope

- It is based on the *principle of multiple reflections*. It consists of three *plane mirror strips* arranged at 60° to each other in a tube (hard card board tube).

■ TEXTBOOK QUESTIONS SOLVED ■

Q. 1. Suppose you are in a dark room. Can you see objects in the room? Can you see objects outside the room? Explain.

Ans. We see only those objects from which reflected rays enter our eyes. When we are in a dark room then we do not see objects. We can see objects outside the room because out of the room the light is available and those rays of light enter our eyes after reflection.

Q. 2. Differentiate between regular and diffused reflection. Does diffused reflection mean the failure of the law of reflection?

Ans. Difference between regular and diffused reflection:

Regular Reflection	Diffused Reflection
1. It takes place on a smooth and shiny surface.	1. It takes place on a rough surface.
2. In this case all rays are parallel after reflection.	2. Reflected rays are in different direction.

Diffused reflection is not due to the failure of the laws of reflection. It is caused by the irregularities in the reflecting surface.

Q. 3. Mention against each of the following whether regular or diffused reflection will take place when a beam of light strikes. Justify your answer in each case.

- Polished wooden table
- Chalk powder
- Card board surface
- Marble floor with water spread over it.
- Mirror
- Piece of paper.

Ans. (a) A regular reflection takes place on a polished wooden table because its surface is smooth.
 (b) A diffused reflection takes place on a chalk powder because its surface is uneven.
 (c) Card board surface has minute irregularities on it, so it will have a irregular reflection.
 (d) Marble floor with water spread over acts as a surface for a regular reflection as it will act like a plane surface.
 (e) Mirror has a regular reflection. Its surface is also shiny and has smooth surface.
 (f) At a piece of a paper takes irregular or diffused reflection because it has uneven surface.

Q. 4. State the laws of reflection.

Ans. There are two laws of reflection.

- Angle of incidence is always equal to the angle of reflection.

$$\text{i.e. } \angle i = \angle r$$

- The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane.

Q. 5. Describe an activity to show that the incident ray, the reflected ray and the normal at the point of incidence lie in the same plane.

Ans. For this experiment take a plane mirror and stand it on a plane sheet of paper with a block. Now draw an incidence line AB. Now see in the mirror and mark the points on the paper, where you fill the line is travelling after getting reflected from the mirror. Remove the mirror and draw a perpendicular on the mirror line. Join the points to make the reflected ray. You will see that incident ray, reflected ray and normal will be in the same plane, i.e. on the sheet of paper.

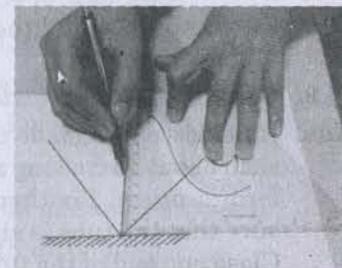


Fig. 16.6. Drawing the normal.

Q. 6. Fill in the blanks in the following:

- A person 1 m in front of a plane mirror seems to be _____ m away from his image
- If you touch your _____ ear with right hand in front of a plane mirror it will be seen in the mirror that your right ear is touched with _____.
- The size of the pupil becomes _____ when you see in dim light.
- Night birds have _____ cones than rods in their eyes.

Ans. (a) 2 (b) left, left hand
 (c) large (d) lesser

Choose the correct option in Questions 7-8:

Q. 7. Angle of incidence is equal to the angle of reflection.

- Always
- Sometimes
- Under special condition
- Never.

Ans. (a) Always

Q. 8. Image formed by a plane mirror is:

- virtual, behind the mirror and enlarged.
- virtual, behind the mirror and of the same size as the object.
- real at the surface of the mirror and enlarged.
- real, behind the mirror and of the same size as the object.

Ans. (b) Virtual, behind the mirror and of the same size as the object.

Q. 9. Describe the construction of a kaleidoscope.

Ans. Kaleidoscope is made up of three rectangular mirror strips each about 15 cm long and 4 cm wide. Join them together to form a prism. Fix them in circular cardboard tube. Make sure that the tube is slightly longer than the mirror strips. Close one end of the tube by a cardboard disc having a hole in the centre. To make the disc durable, paste a piece of transparent plastic sheet under the cardboard disc. At the other end, touching the mirrors, fix a circular plane glass plate.

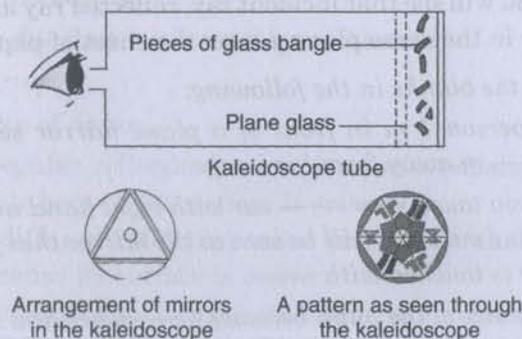
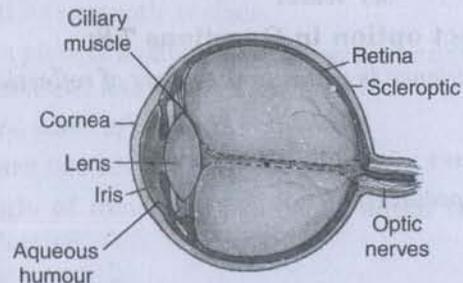


Fig. 16.7. Making a kaleidoscope.

Q. 10. Draw a labelled sketch of the human eye.

Ans.



Q. 11. Gurmit wanted to perform activity 16.6 using a laser torch. Her teacher advised her not to do so. Can you explain the basis of the teacher's advise?

Ans. Laser light is harmful for eye and can cause a permanent defect in the eye. She can lose her eyesight also.

Q. 12. Explain how you can take care of your eyes.

Ans. Following cares are required for our eyes:

- Do not read in too little or too much light.
- Wash your eyes with cold water at least three times.
- Do not look at the sun or powerful light directly.
- Always read at the normal distance for vision.
- Do not rub your eyes with dirty hand.

Q. 13. What is the angle of incidence of a ray if the reflected ray is at an angle of 90° to the incident ray?

Ans. The angle of incidence ray will be 45° .

Q. 14. How many images of a candle will be formed if it is placed between two parallel mirrors separated by 40 cm?

Ans. Infinite number of images will be formed.

Q. 15. Two mirrors meet at right angles. A ray of light is incident at an angle of 30° as shown in Fig. 16.8. Draw the reflected ray from the second mirror.

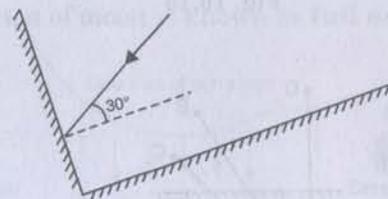
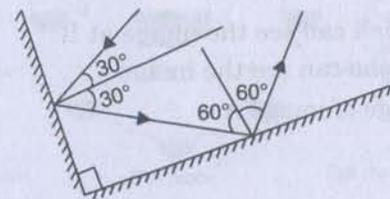


Fig. 16.8

Ans.



- Q. 16.** Boojho stands at A just on the side of a plane mirror as shown in Fig. 16.9. Can he see himself in the mirror? Also can he see the image of objects situated at P, Q and R?

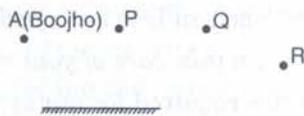


Fig. 16.9

Ans. He cannot see his image himself. He can see only the image of P but not Q and R.

- Q. 17.** (a) Find out the position of the image of an object situated at A in the plane mirror (Fig. 16.10).
 (b) Can Paheli at B see the image?
 (c) Can Boojho at C see this image?
 (d) When Paheli moves from B to C, where does the image of A move?

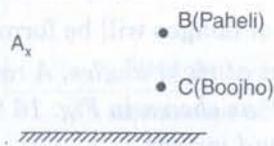
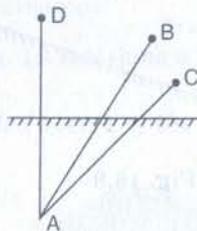


Fig. 16.10

Ans. (a)



- (b) Yes, Paheli can see the image at B.
 (c) Yes, Boojho can see the image.
 (d) No change of image A.