5 LIGHT

INTRODUCTION :

Light is the form of energy which makes object visible. It means that 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 it. You may have also seen beams of light from the torch, head light of vehicles.

SOURCES OF LIGHT :

Those bodies which emit light in all directions are called sources of light. The sources can be point one or extended one. The sources of light are of two types :

(i) **Luminous sources :** Those objects which by itself emit light are called luminous sources.

Eg. : Sun and stars (natural luminous sources), electric lamps, candles and lanterns (artificial luminous sources).

(ii) **Non-luminous sources :** Those objects which do not emit light but become visible only when light from luminous objects falls on them. They are called non-luminous sources.
Eg. : Moon, planets (natural non- luminous sources), wood, table (artificial non-luminous sources) etc.

MEDIUM OF LIGHT :

Substance through which light propagates or tends to propagate is called a medium of light.
According to the medium of light objects are divided into three parts :

(i) **Transparent object :**

Bodies that allow light to pass through them i.e. transmit light through them, are called transparent bodies.

Eg. : Glass, water, air etc.

(ii) **Translucent object :** Bodies that can transmit only a part of light through them are called translucent objects.

Eg. : Froasted or ground glass, greased paper, paraffin wax etc.

(iii) **Opaque object :** Bodies that do not allow light to pass through them at all are said to be opaque objects.

Eg. : Chair, desk etc.

PROPERTIES OF LIGHT :

(i) Light is invisible form of energy .

(ii) Light does not require material medium for its propagation i.e. light can travel through vacuum.

(iii) The speed of light in free space (vacuum) is 3×10^8 m/s. Its speed is marginally less in air. Its speed decreases considerably in glass or water.

Some definition related to the light :

(A) Ray of Light :

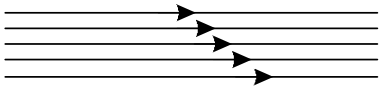
The path along which light energy travels in a given direction is called ray of light. A ray of light is represented as a straight line. The arrow head on it gives the direction of light.

(B) Beam of Light :

A collection of rays of light is called beam of light. However, if the number of rays is too small then such a collection of rays is called Pencil of light.

(C) Parallel Beam :

When the rays of light travel parallel to each other, then the collection of such rays is called parallel beam of light. For example, sun rays entering into a room through a ventilator constitute a parallel beam .



RECTILINEAR PROPAGATION OF LIGHT :

Light travels in a straight line. In vacuum or air, light travels with the velocity of 3×10^8 m/s.

Examples of rectilinear propagation of light in everyday life :

(i) When the sunlight enters through a small hole in a dark room, it appears to travel in straight lines.

(ii) The light emitted by the head light of a scooter at night appears to travel in straight lines.

(iii) If we almost close our eyes and try to look towards a lighted bulb, it appears to give light in the form of straight lines, which travel in various direction.

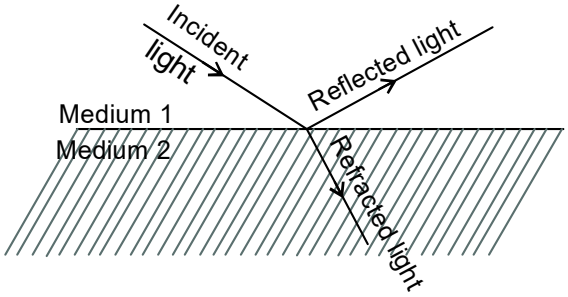
BEHAVIOUR OF LIGHT AT THE INTERFACE OF TWO MEDIA :

When light travelling in one medium falls on the surface of a second medium, the following three effects may occur :

(i) A part of the incident light is turned back into the first medium. This phenomenon is called reflection of light.

(ii) A part of the incident light is transmitted into the second medium along a changed direction. This phenomenon is called refraction of light.

(iii) The remaining third part of light energy is absorbed by the second medium. This phenomenon is called absorption of light.



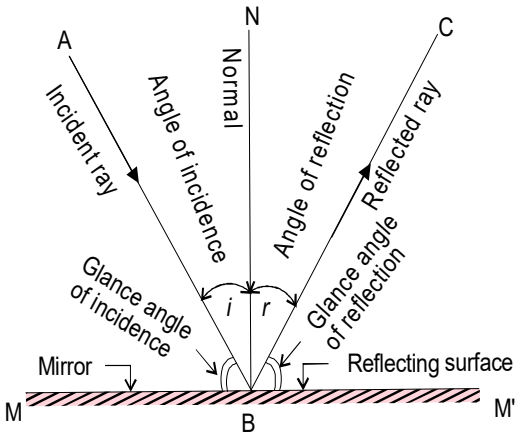
REFLECTION OF LIGHT :

When a ray of light falls upon a smooth surface like a mirror, the ray of light is reflected in another direction in the same medium. This phenomenon is called reflection of light.

(a) General definitions about reflection :

(i) Mirror :

A smooth polished surface from which regular reflection can take place is called mirror. MM' is the mirror as shown in figure.



(ii) Incident ray :

A ray of light which travels towards the mirror is called incident ray. Ray AB is incident ray in figure.

(iii) Point of incidence :

The point on the mirror, where an incident ray strikes is called point of incidence. 'B' is the point of incidence in figure.

(iv) Reflected ray :

A ray of light which bounces off the surface of a mirror, is called reflected ray. BC is reflected ray in figure.

(v) Normal :

The perpendicular drawn at the point of incidence, to the surface of mirror is called normal. BN is the normal in figure.

(vi) Angle of incidence :

The angle made by the incident ray with the normal is called angle of incidence. $\angle$ABN is the angle of incidence in figure. It is denoted by $\angle$i.

(vii) Angle of reflection

The angle made by the reflected ray with the normal is called angle of reflection. $\angle$CBN is the angle of reflection in figure. It is denoted by $\angle$r.

(viii) Glance angle of incidence

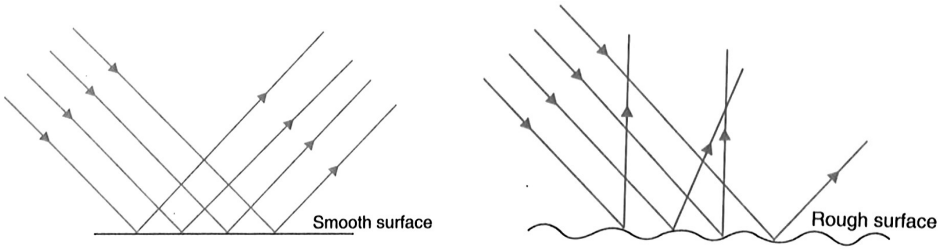
The angle which the incident ray makes with the **mirror** is called glance angle of incidence. $\angle$MBA is the glance angle of incidence in figure.

(ix) Glance angle of reflection

The angle which the reflected ray makes with the **mirror** is called glance angle of reflection. $\angle$M'BC is the glance angle of reflection in figure.

REGULAR AND DIFFUSED REFLECTION :

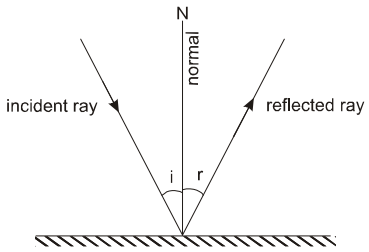
When a beam of light falls on a smooth, highly polished surface, almost entire light gets reflected in the same medium in a definite direction. This type of reflection is called **regular reflection.** We can see our image formed by a mirror due to the phenomenon of regular reflection.



When a beam of light falls on an opaque, rough and uneven surface, the light gets reflected in different directions. This type of reflection is called **irregular** or **diffused reflection.** We can read a book or a newspaper due to diffused reflection.

LAWS OF REFLECTION :

The reflection of light from a surface obeys certain laws called laws of reflection. They are :

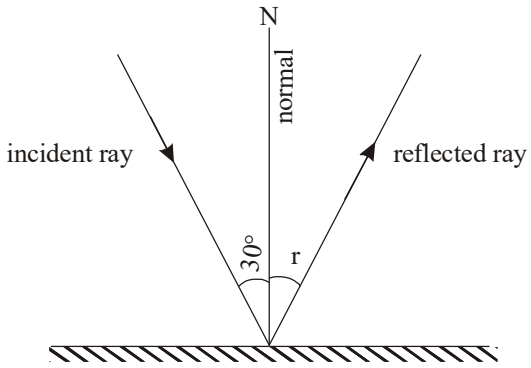


(i) The angle of incidence is equal to the angle of reflection. i.e., $\angle i = \angle r$.

(ii) The incident ray, the reflected ray and the normal at the point of incident, all lie in the same plane.

The laws of reflection are applied for all type of reflections.

Ex.1 Calculate the angle of reflection.



Sol. According to the law of reflection, incident angle equal to reflected angle. So angle of reflection $\angle r = 30°$.

MIRROR :

It is a highly polished surface, which is quite smooth and capable of reflecting a good fraction of light from its surface.

(a) Object :

Anything which gives out light rays (either its own or reflected) is called an object.

(b) Image :

The reproduction of object formed by mirror or lens is called an image.

REAL AND VIRTUAL IMAGES :

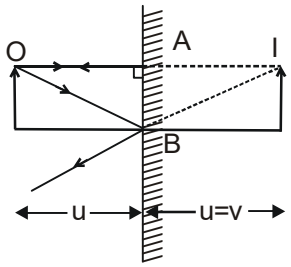
The image which can be obtained on a screen is called a real **image.** It is formed when light rays, after reflection, actually intersect each other. It is always inverted.

The image which cannot be obtained on a screen is called a **virtual image.** It is formed when light rays, after refection, intersect when extended in backward direction. Its is always erect.

PLANE MIRROR:

Image Formation by Plane Mirror :

Consider a point source of light placed at a point O at a distance **u** in front of the plane mirror. Light rays leave the source and are reflected from the mirror. After reflection, the rays diverge but they appear to come from a point **I** located behind the mirror. Point **I** is called the image of the object O. Point **I** is at a distance **v** behind the mirror.



CHARACTER STICS OF IMAGE :

(i) Image is virtual, erect and of the same size as object.
(ii) It is as far behind the mirror as the object is in front of it
(iii) Laterally inverted : When left appears right and right appears left.

NOTE :

(i) Minimum size of the mirror required to see full image of a person is at least half of his own height.

(ii) If object moves with a speed V towards plane mirror then image moves with a speed 2V towards object.

(iii) If mirror moves with a speed V towards stationary object then image moves with a speed 2V towards object.

Uses of Plane Mirror

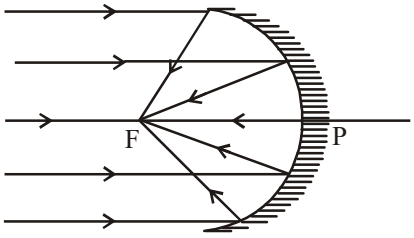
✪ In looking mirrors, hair saloons, reflecting periscopes & kaleidoscopes.

SPHERICAL MIRRORS :

Mirrors, whose reflecting surfaces are spherical or curved, are called spherical mirrors. These are of two types:

(i) **Concave mirror:** If the reflecting surface of the spherical mirror is curved inwards, it is called a concave mirror. The image formed by a concave mirror can easily be taken on the screen. You must have played with concave mirror to obtain image of sun on the ground or wall by positioning it to in a specific way. It means a concave mirror can form real or virtual image. In concave mirror when a parallel beam of light after reflection from a concave mirror converges at a point in front of the mirror. Due to this it is known as **converging** mirror.

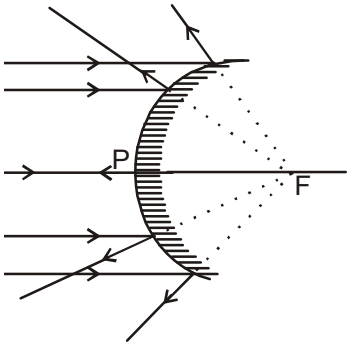
Concave mirror



Converging Mirror (Concave)

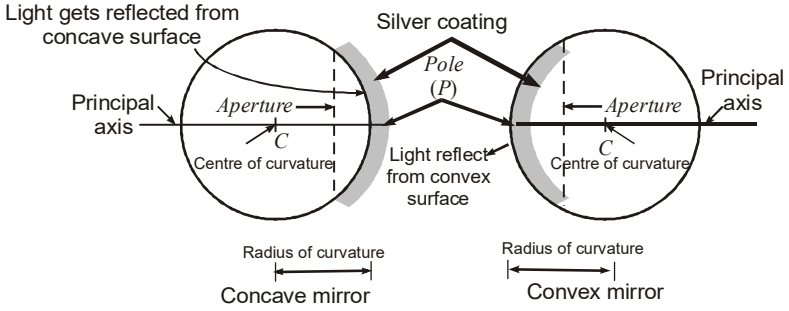
(ii) **Convex mirror:** If the reflecting surface of the spherical mirror is curved outwards, it is called a convex mirror. It means a convex mirror always forms virtual image. In convex mirror when a parallel beam of light after reflection from a convex surface diverges and the rays do not meet. Due to this it is known as **diverging** mirror.

Convex



Diverging mirror (convex)

Some terms related to Spherical Mirrors :



(i) **Pole :** The central point of a mirror is called its pole.

(ii) **Centre of curvature :** The centre of the sphere of which the mirror is a part, is called centre of curvature.

(iii) **Radius of curvature :** The radius of the sphere of which the mirror is a part, is called radius of curvature.

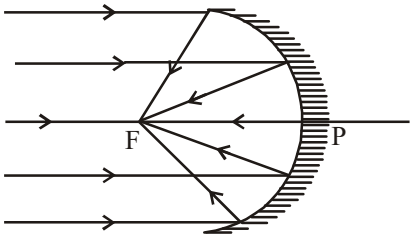
(iv) **Principal axis :** The straight line joining the pole and the centre of curvature is called the principal axis.

(v) **Focal length :** The distance between the pole and the focus is called the focal length. The focal length is half of the radius of curvature.

(vi) **Aperture :** The size of the mirror is called its aperture.

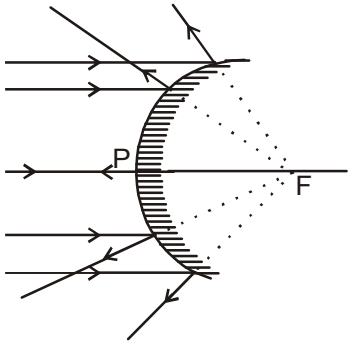
(vii) **Focus point :**

(a) In concave mirror when a parallel beam of light after reflection from a concave mirror converges at a point in front of the mirror. This point (F) is the focus of a concave mirror and it is real.



Focus of concave mirror

(b) when a parallel beam of light after reflection from a convex surface diverges and the rays do not meet. However on producing backward, the rays appear to meet at a point behind the mirror. This point is focus of the convex mirror and it is virtual.



Focus of convex mirror

USES OF CONCAVE MIRROR :

(i) Concave mirror is used by doctors for examining eyes, ears, nose and throat.
(ii) They are also used by dentist to see an enlarged image of the teeth.
(iii) The reflector of torches, headlights of cars and scooters are concave in shape.

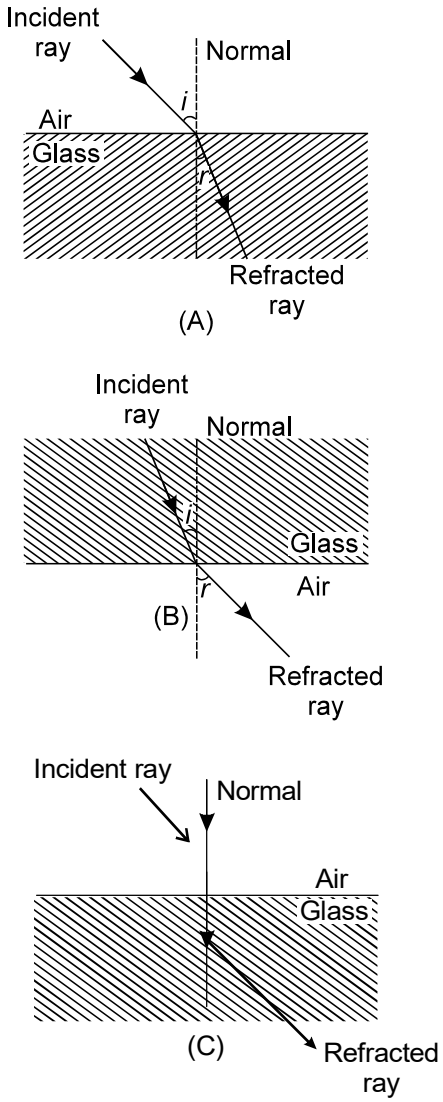
USES OF CONVEX MIRROR :

(i) Convex mirrors are used as rear view mirrors to see the vehicle coming from behind. These mirror covers a wider view and form upright small size (diminished) image.
(ii) They are used as reflector in street lamps so as to diverge light over a large area.

REFRACTION OF LIGHT :

When light travels in the same homogeneous medium, it travels along a straight path. However, when it passes from one transparent medium to another, the direction of its path changes at the interface of the two media. This is called refraction of light.

The phenomenon of the change in the path of the light as it passes from one transparent medium to another is called refraction of light. The path along which the light travels in the first medium is called incident ray and that in the second medium is called refracted ray. The angles which the incident ray and the refracted ray make with the normal at the surface of separation are called angle of incidence ($\angle$i) and angle of refraction ($\angle$**r**) respectively.



- **It is observed that :**

(i) When a ray of light passes from an optically rarer medium to a denser medium, it bends towards the normal ($\angle r < \angle i$), as shown in figure (A).

(ii) When a ray of light passes from an optically denser to a rarer medium, it bends away from the normal ($\angle r > \angle i$) as shown in figure (B) .

(iii) A ray of light travelling along the normal passes undeflected, as shown in figure (C). Here $\angle i = \angle r = 0°$.

Cause of Refraction :

Refraction occurs because the speed of light is different in different media. Light travels with a greater velocity in a rarer medium like air and with lower velocity in a denser medium like glass or water.

The lower the velocity of light in the medium than that in air, the greater the bending because the greater would be the need to take a shorter path.

REFRACTION THROUGH SPHERICAL LENSES :

A lens is a piece of transparent refracting material bounded by two spherical surfaces or one spherical and other plane surface.In case of a lens, the light rays do not bounce off its surface, instead, the light rays pass through it but in doing so they change their path i.e., they bend from their original path.

A lens is the most important optical component used in microscopes, telescopes, cameras, projectors etc.

Basically lenses are of two types :

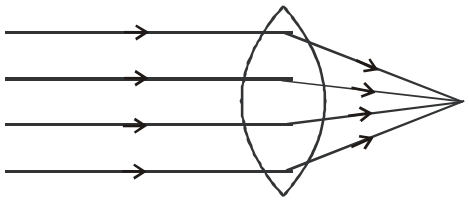
(i) Convex lens or converging lens

(ii) Concave lens or diverging lens

(a) Convex Lens :

A lens which is thick at the centre and thin at the edges is called a convex lens. The most common form of a convex lens has both the surfaces bulging out at the middle. When a convex lens is held close to an object, it always forms an enlarged, virtual and erect image. In a convex lens, when rays parallel to principal axis falls on lens after refraction they meet or appears to meet at a point. So due to this it is known is converging lens.

Double convex lens

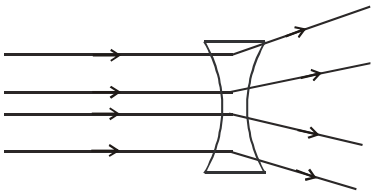


Converging lens (convex)

(b) Concave Lens :

A lens which is thin at the middle and thick at the edges is called a concave lens. The most common form of a concave lens has both the surfaces depressed inward at the middle. When a concave lens is held close to an object, it always forms a diminished, virtual and erect image.In a concave lens, when rays parallel to principal axis falls on lens after refraction they move away from the lens. So due to this it is known is diverging lens.

Double Concave Lens



Diverging lens (concave)

(c) Definitions in connection with Spherical Lens :

(i) Centre of curvature : The centre of curvature of the surface of a lens is the centre of the sphere of which it forms a part, because a lens has two surfaces, so it has two centres of curvature. In figure (a) and (b) points C_1 and C_2 are the centres of curvature.

(ii) Radius of curvature : The radius of curvature of the surface of a lens is the radius of the sphere of which the surface forms a part. R_1 and R_2 in the figure (a) and (b) represents radius of curvature.

(iii) Principal axis : It is the line passing through the two centres of curvature (C_1 and C_2) of the lens.

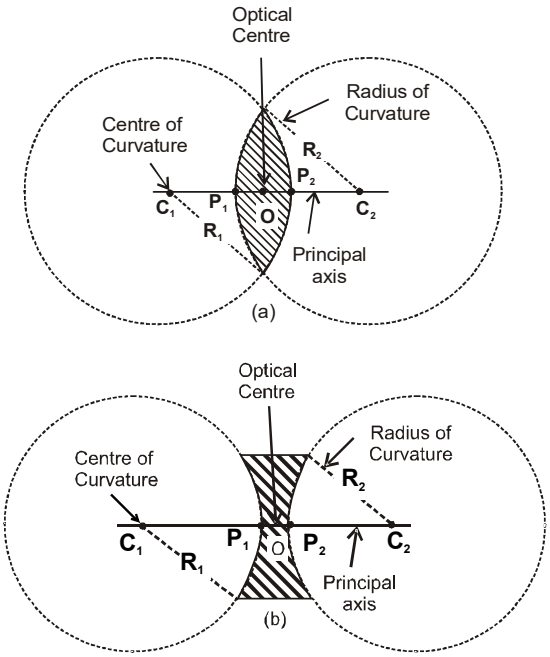
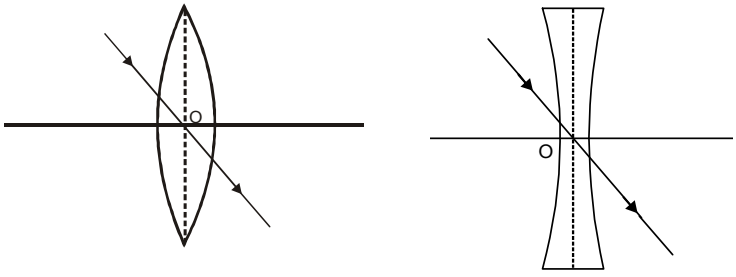


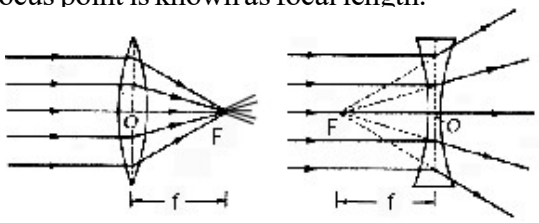
Figure : Characteristics of convex and concave lenses

(iv) Optical centre : If a ray of light is incident on a lens such that after refraction through the lens the emergent ray is parallel to the incident ray, then the point at which the refracted ray intersects, the principal axis is called the optical centre of the lens. In the figure O is the optical centre of the lens.

If the radii of curvature of the two surfaces are equal, then the optical centre coincides with the geometric centre of the lens.



(v) Focus point and focal length : When rays parallel to principal axis falls on lens after refraction they meet or appears to meet at a point on principal axis, this point is known as principal focus. The distance between optical centre and focus point is known as focal length.



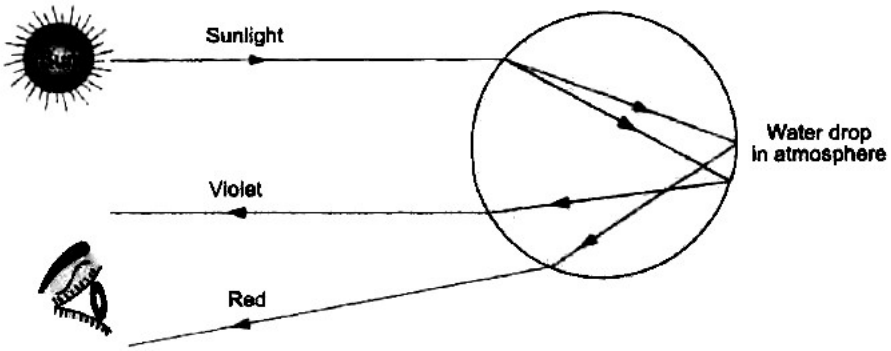
SUNLIGHT WHITE OR COLOURED :

There are many phenomenons in which we can see sunlight is white or coloured. The followings are given below :

(a) Rainbow :

White light is composed of seven colours, e.g., violet, indigo, blue, green, yellow, orange and red. Phenomenon of appearance of rainbow in the sky is a proof of seven colours. A rainbow appears usually after rain in the morning or evening when the sun is low in the sky. It is formed when white light.from the sun passes through tiny prism-like water droplets and splits into different colours. -This phenormeon of splitting of white light into several different component of colors is called dispersion of light. A rainbow is arch-shaped. There are seven colours in the rainbow which gradually change from one to another. The set of colours formed on splitting of white light is called the **spectrum of white light.** They are seen in the order VIBGYOR, i.e., violet, indigo, blue, green, yellow, orange and red.

Since white light splits into seven colours, we should be able to get white light by mixing the seven colours ofa rainbow.

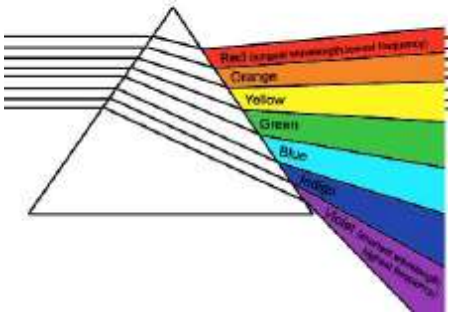


Formation of Rainbow

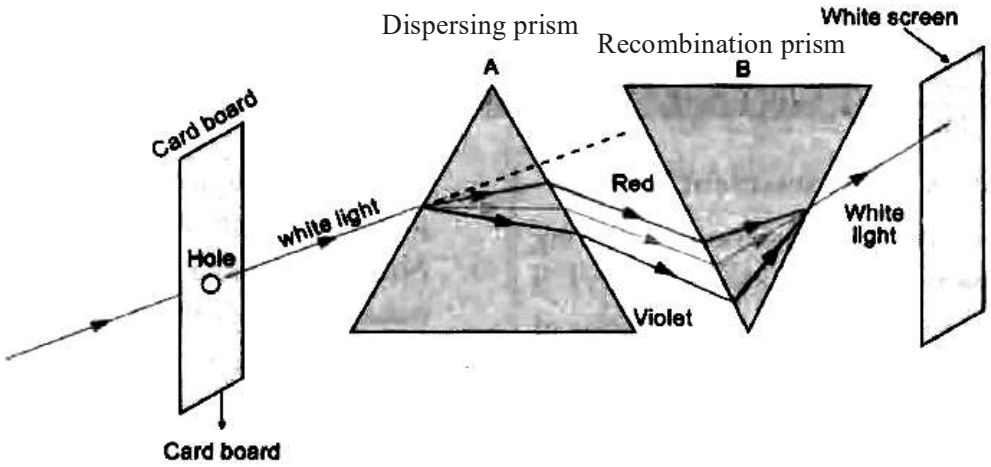
(b) Glass prism :

If we take a glass prism, and put a narrow beam of sunlight through a small hole in the window of a dark room, so, we can easily see a colourful band on the paper or screen or wall.

Refraction of Sunlight through glass prism



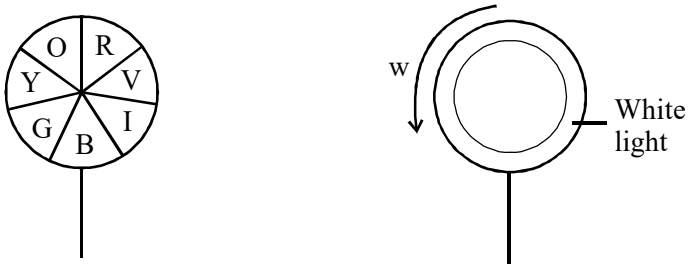
This shows that light consists of seven colours. If we take another prism and place it in upside down position with respect to first prism, we again get a beam of white light.



Recombination of light

(c) Newton's Disc :

The famous English physicist Sir Isaac Newton for the first time explained this phenomenon of mixing. To prove his point, he made a disc on which the seven colours of the rainbow were painted in equal sections as shown in figure. When' this disc was rotated, all the colours disappeared and white colour appeared. This is because when the disc spins fast, all the colours pass through a spot rapidly one followed by the other. This gives the effect of putting all the colours together in one place. The colours mix and appear white. Such a disc is popularly known as Newton's disc.



On the basis of these experiments it is confirmed that white light is made of seven colours (VIBGYOR).

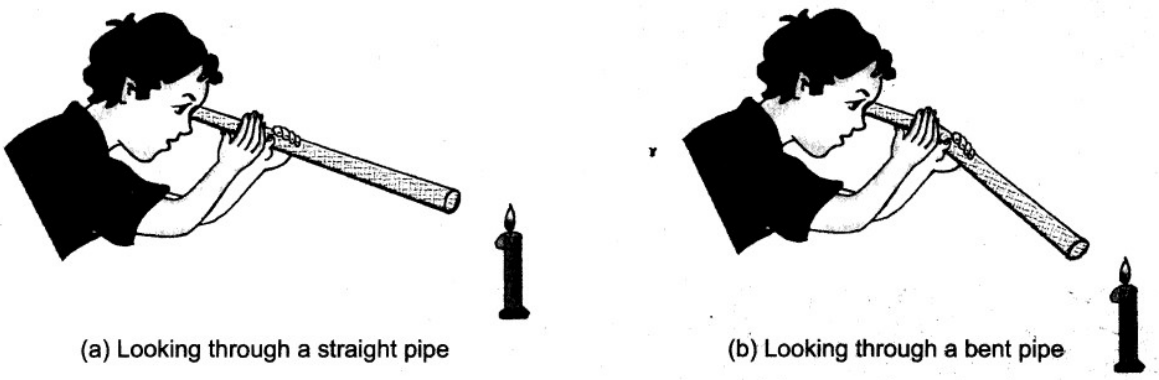
EXTENDED LEARNING – ACTIVITIES AND PROJECTS

1. To observe the path of light.

• Take a chart paper and roll it into a pipe. Look at a lighted candle through it as shown in Fig. 14.3(a). Take care not to touch the chart paper with the flame.

• Now bend the pipe from the middle and repeat the activity as shown in Fig. 14.3(b). Why are you not able to see the lighted candle through the bent pipe?

Light travels in a straight line and does not bend with the pipe.



Looking at a lighted candle

2. To prove that light travels in a straight line.

• Take three cardboards of similar size and make a hole in the centre of each. Make sure that the size and position of the hole is the same in each cardboard .

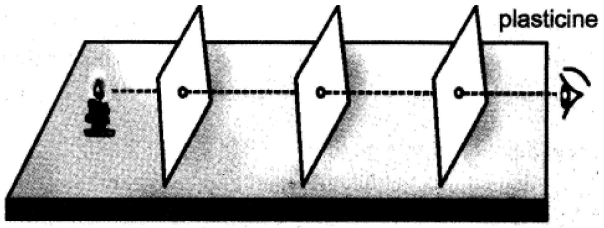
• Now put the three cardboards in vertical position with the help of a brick of plasticine or clay in such a way that the holes in the three cardboards are in a straight line.

• Place a lighted candle in front of the cardboards as shown in figure. Look through the hole of the last cardboard.

Are you able to see the flame of the lighted candle? What happens when you displace one of the cardboards?

The flame can be seen clearly through the holes in the first case. On diplacing one of the cardboards, no flame can be seen as light cannot bend.

Light travels in a straight line. No flame can be seen when the holes of the three cardboards are not in a straight line because light cannot bend.



Rectilinear propagation of light

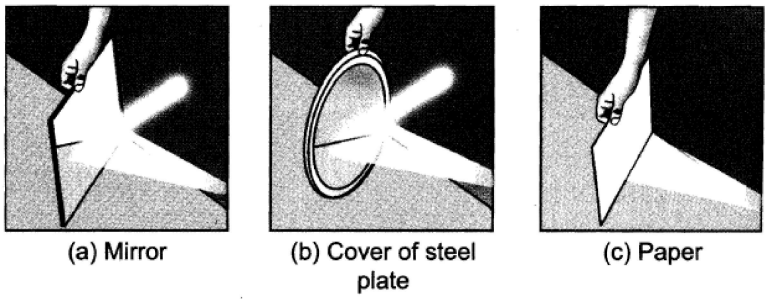
3. To prove that smooth and shiny surfaces reflect light better.

• Place objects like a mirror, a shiny steel plate, a plastic plate or a sheet of paper near a screen which can be a wall or a paper sheet.

• Shine a beam of light through a torch on these objects in such a way that reflected light falls on the screen as shown in figure.

You will observe that in case of the plate mirror, a bright patch of light is seen on the screen. Similarly, in case of the steel plate, a patch of light is visible on the screen. But when you use a paper sheet, no patch of light can be seen on the screen.

Shiny and polished objects like steel plate, mirror, polished wood piece, etc. reflect more light and form a brighter patch on the screen. Rough and dull surfaces, on the other hand, reflect less light and do not make a patch on the screen.



Reflection of torch light

4. To observe the reflection of light through a plane mirror.

• Take a torch and cover its glass portion with a chart paper having three slits as shown in figure.

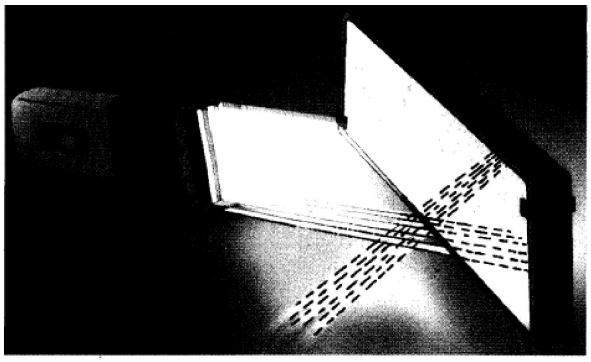
• Put a plane mirror vertically on another chart paper fixed on a wooden board.

• Now switch 'on' the torch and direct the beam of light on the mirror through the slits at an angle.

• Put the torch in such a way that its reflected light is seen on the chart paper. You can do this activity in a dark room also to have better results.

What do you observe? Is there any change in the direction of light rays which fall on the surface of ' the mirror? Move the torch to either sides and see what happens. Do you find any change in the direction of reflected light? Look into the mirror along the direction of the reflected light. Do you see the slits in the mirror?

The beam of light gets reflected from the surface of plane mirror.



Reflection of light through plane mirror

5. To observe the nature of an image formed by a plane mirror.

• Take a looking glass and place an object such as a candle or a matchbox or even a flower vase in front of it.

• Note your observations.

Do you find that a similar object is placed behind the mirror ?

Now change the position of the object and observe the image carefully (figure). Put a vertical screen or chart paper behind the mirror and try to get the image of the object on it. Are you able to do so ?

Now place the same screen in front of the mirror and see whether you are able to get the image of the object on it. Are you able to get the image on the screen in either case ? But why ?

• The image formed by the plane mirror cannot be taken on the screen. Thus, it is a virtual image.

• The image formed by plane mirror is erect.

• The image formed by plane mirror is of the same size as that of the object.

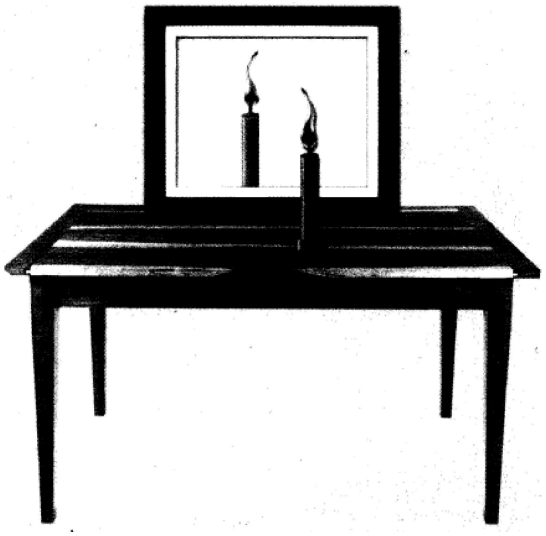


Image of a candle in plane mirror

6. To observe that an image formed by a plane mirror interchanges sides.

• Stand in front of a looking glass (plane mirror) and observe your image.Also observe the distance between you and your image from the mirror.

• Now raise your left hand and note which hand does your image raise (figure).

• Touch your right ear with your left hand and observe your image. Do you find that in the imag, the right hand touches the left ear ?

• Write a name for example AMIT on a piece of paper and hold it in front of a plane mirror. Are you able to read it ?

Now interchange the sides and see what happens ?

Image formed by a plane mirror interchanges sides, i.e., on a plane mirror, left appears right and right appears left. This interchange of sides between the object and its image is called lateral inversion. Also the image is as far behind the plane mirror as the object is in front of it.

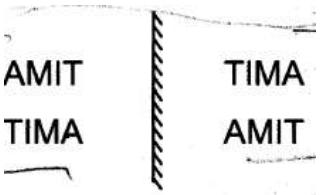


figure (a)

figure (b)

Lateral inversion of image in plane mirror

7. To show that convex lens converges the rays of light whereas concave lens does not.

• Place a sheet of white paper in bright sunlight and adjust the positiqn of the convex lens in such a way that you are able to see a bright spot on the paper as shown in figure.

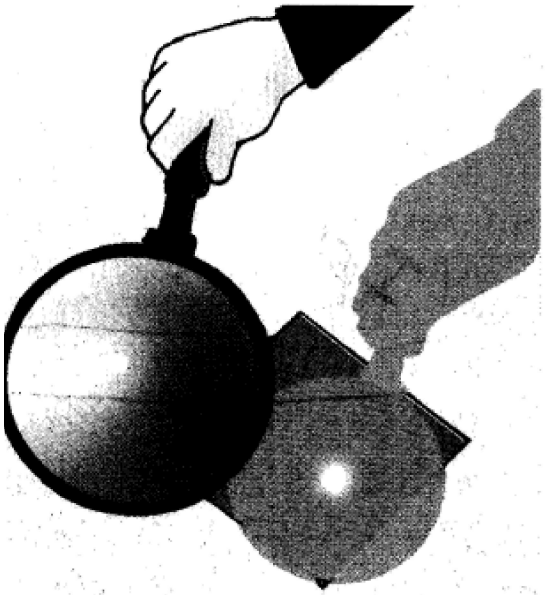
• Hold the lens in the same position for a few minutes. What do you observe?

You will find that the paper starts burning from that spot.

Now replace the convex lens by the concave lens and repeat the activity. Are you able to get a bright spot on the paper this time also? Why not?

• Convex lens converges the rays of light from the sun at the focus of the lens and you see a sharp image of the sun on the paper.

• Concave lens does not form the image of the sun on the paper as it diverges the rays of light.



Real image of the sun by convex lens

❑❑❑❑❑

LET US RECAPITULATE

POINT TO REMEMBER :

1. Light travels along a straight line.
2. **Mirror:** A smooth, shiny or polished surface, which rebounds the light back in same or in different directions is called a mirror.

   Spherical mirrors : Mirrors, whose reflecting surfaces are spherical or curved, are called spherical mirrors. These me of two types:

   (i) **Concave mirror:** If the reflecting surface of the spherical mirror is curved inwards, it is called a concave mirror.

   (ii) **Convex mirror :** If the reflecting surface of the spherical mirror is curved outwards, it is called a convex mirror.
3. An image which can be obtained on the screen is called a real image.
4. An image which cannot be obtained on the screen is called a virtual image.
5. The image formed by a plane mirror is erect. It is virtual 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.
6. A phenomenon in which an image is formed by a mirror and the left side of the object is seen as the right side in the image, and right side of the object appears to be left side in the image. This is called lateral inversion.
7. A concave mirror forms a real and inverted image. When an object is placed very close to the mirror, the image formed is virtual, erect and magnified.
8. Image formed by a convex mirror is erect, virtual and smaller in size than the object, but covers a wide range of area.

   Lens: A lens is a piece of refracting transparent medium bounded by two surfaces in which at least one has curved surface. The commonly used lenses are the spherical lenses which are of two types.

   (i) **Convex Lens:** It is thicker in the middle and thinner at the edges.

   (ii) **Concave lens:** It is thicker at the edges and thinner at the middle.
9. A convex lens can form real and inverted image. When the object is placed very close to the lens, the image formed is virtual, erect and magnified. When a convex lens is used to see objects magnified, it is called a magnifying glass.
10. A concave lens always forms erect, virtual and smaller image than the object
11. It can be seen that white light is composed of seven colours, if it passes through prism.
12. The eye is a natural optical instrument.

KEYWORDS :

1. **Concave mirror :** A spherical mirror, which has the inside surface as the reflecting surface.
2. **Convex mirror :** A spherical mirror, which has the outside surface as the reflecting surface.
3. **Erect image :** If the direction of the image and object are same, then the formed image is called erect image.
4. **Magnified image :** If the size of the image is larger than the object it is called magnified image.
5. **Magnifying glass :** Any object viewed through a convex lens is seen as bigger. It used for observing small or minute object. Hence, convex lens is also called magnifying lens or magnifying glass.
6. **Prism :** It is a transparent glass pyramid, bounded by four triangular surface that separates white light into a spectrum of colours.
7. **Rainbow :** A big arch or a band of seven colours is formed in the sky in the direction opposite to the location of the sun. We identify seven colours in a rainbow as Violet, Indigo, Blue, Green, Yellow, Orange and Red.
8. **Real image :** It is formed if two or more reflected rays actually meet on the screen.
9. **Rear view mirror :** Convex mirror are widely used as rear view mirrors in cars and other vehicles. In rear view mirror, a virtual, upright and diminished image of the object is seen.
10. **Side mirror :** Rear view mirror is also used as side mirror in motor vehicles.
11. **Spherical mirror :** Mirrors having curved surfaces are known as spherical mirrors.
12. **Virtual image :** If ray of incident from a point of source on a mirror or lens, after reflection or refraction, appear to diverge from another point, then the second point is called the virtual image of the first. It cannot be obtained on the screen.

CONCEPT APPLICATION LEVEL - I [NCERT Questions]

Fill in the blanks :

Q.1 An image that cannot be obtained on a screen is called .....
Ans. Virtual image

Q.2 Image formed by a convex ..... is always virtual and smaller in size.
Ans. Mirror

Q.3 An image formed by a ..... mirror is always of the same size as that of the object.
Ans. Plane

Q.4 An image which can be obtained on a screen is called a ..... image.
Ans. Real

Q.5 An image formed by a concave ..... cannot be obtained on a screen.
Ans. Lens

Write Ture and False for the given statement below :

Q.1 We can obtain an enlarged and erect image by a convex mirror.
Ans. False

Q.2 A concave lens always forms a virtual image.
Ans. True

Q.3 We can obtain a real, enlarged and inverted image by a concave mirror.
Ans. True

Q.4 A real image cannot be obtained on a screen.
Ans. False

Q.5 A concave mirror always forms a real image.
Ans. False

Match the items given in Column-I with one or more items of Column-II

Q.1

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. (a) v (b) ii (c) i (d) iii (e) vi

Q.2 State the characteristics of the image formed by a plane mirror.

Ans. **Image formation by a plane mirror.** We are able to see images using a mirror. Image formed by a mirror (flat) has following features :

Left hand appears on the rightside in the image

(i) Reflected image retains the colour of the object.
(ii) Image is erect but laterally inverted.
(iii) **Lateral inversion :** Right side of the object appears as left side in the image formed by a plane mirror. For example, if we show our right hand, image in the mirror will show its left hand.
(iv) It forms a virtual image.
(v) Image is formed at the same distance behind the mirror as the objects in front of the mirror.

Q.3 Find out the latters of English alphabet or any other language known to you in which the image formed in a plane mirror asppears exactly like the letter itself. Discuss your findings.

Ans. A, H, I, M, O, T, U, V, W, X, Y

Q.4 What is a virtual image ? Give one situation where a virtual image is formed.

Ans. A virtual image is formed when two reflected (or refracted) rays do not meet actually. A virtual image cannot be obtained on the screen. Image formed by a plane mirror is always a virtual image.

Q.5 State two differences between a convex and a concave lens

Ans.

	Convex lens	Concave lens
1	It is thicker in the middle and thinner at the edges.	It is thinner in the middle and thicker at the edges.
2	Converges the light falling on it.	Diverges the light falling on it.
3	Can form virtual, erect and magnified image.	Always forms erect, virtual and smaller image.

Q.6 Given one use each of a concave and a convex mirror.

Ans. **Use of concave mirror :** Doctors use concave mirrors for examining eyes, ears, nose, throat and teeth.
Use of convex mirror : Convex mirror is used as a side view mirror in motor vehicles.

Q.7 Which type of mirror can form a real image?

Ans. A concave mirror can form a real image.

Convex mirror as side view mirror

Q.8 Which type of lens forms always a virtual image?

Ans. A concave lens.

Choose the correct option in questions

Q.1 A virtual image large than the object can be produced by a

(A) concave lens (B) concave mirror (C) convex mirror (D) plane mirror

Ans. (B) concave mirror

Q.2 David is observing his image in a plane mirror. The distance between the mirror and his image is 4m. If he moves 1m towards the mirror, then the distance between David and his image will be :

(A) 3m (B) 5 m (C) 6 m (D) 8 m

Ans. (C) 6 m

Q.3 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 truch parked behind his car. The speed at which the image of the truck appears to approach the driver will be :

(A) 1 m/s (B) 2 m/s (C) 4 m/s (D) 8 m/s

Ans. (C) 4 m/s

CONCEPT APPLICATION LEVEL - II

Light Travels along a straight line :

Q.1 What is rectilinear propagation of light ?

Ans. Light travels in a straight line, this property is called rectilinear propagation of light.

Q.2 How can we change the path of light ?

Ans. By placing a mirror or lens in its path.

Q.3 Can you see a candle light through a bent pipe ? Explain.

Ans. No. Since the light travels in a straight line and when the pipe is bent it is no longer straight line.

Reflection of Light :

Q.1 What is regular reflection?

Ans. When light falls on a polished surface, they change the direction of light falling on it in a well defined manner. This is called regular reflection.

Q.2 Define 'Mirror'.

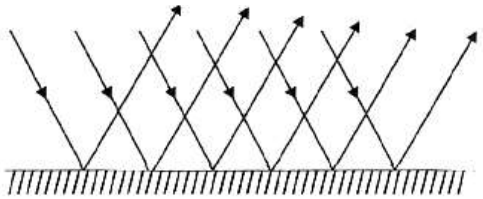
Ans. A smooth, shining and flat surface, which rebounds the light back in the same or in different direction is called a mirror.

Q.3 Why do we need a siny surface for reflection?

Ans. The extent of reflection depends upon the shine and smoothness of the surface. More is the shine and smoothness of the surface, more will be the reflection. That is why, mirrors reflect most of the light falling on it. Hence for reflection, shiny surfaces is required.

Q.4 What is reflection?

Ans. When the ray of light falls on a smooth and shiny surface, the whole of light is sent back in the same direction. It is called reflection. Mirrors do not allow even a small amount of light to pass through them. Mirrors show regular and complete reflection.



Reflection of light

Q.5 How many reflected rays can there be for a given single incident ray falling on a plane mirror ?

Ans. For one incident ray, there is only one reflected ray.

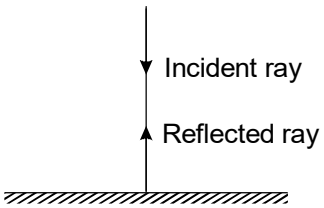
Q.6 What is an object and an image ?

Ans. Any point or body placed against a mirror or lens is called an object. The object which appears inside

the mirror is called an image.

Q.7 What happens when a ray of light falls normally (or perpendicularly) on the surface of a mirror ?

Ans. A ray of light which is incident normally on a mirror, is reflected back along the same path because the angle of incidence as well as angle of reflection for such a ray of light are zero.



Normal Incidence

Right or Left :

Q.1 Define lateral inversion.

Ans. Phenomenon of changing position of image w.r.t. object appear left to be in right and right of an object appear to be left by the mirror, while forming images is called lateral inversion.

Q.2 While standing before a plane mirror, if you move your right hand, which hand does your image move?

Ans. If we move our right hand, our image will move left hand. It is because in a plane mirror our "left appears right" and "right appears left". This is called lateral inversion. Hence, we can say that the plane mirror forms laterally inverted images.

An Ambulance

Q.3 Explain why the word 'AMBULANCE' is written as in figure?

Ans. When the driver of a vehicle ahead of an ambulance looks in his/her rear view mirror, he/she can 'AMBULANCE' written on it which appears in the correct form is the rear view and give way to it.

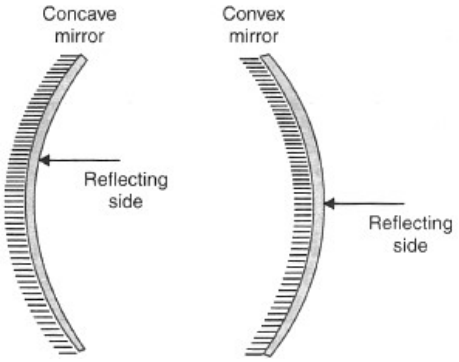
Playing with spherical mirrors :

Q.1 What are spherical mirrors ? Give their types.

Ans. Mirrors having curved surfaces are known as spherical mirrors. Their name is so, becuase they are considered as a part of a hollow sphere. Mirrors are mainly of two types : concave mirrors and convex mirrors:

(i) **Concave mirror :** Its reflecting surface is in curving i.e., inside surface.

(ii) **Convex mirror :** Its reflecting surface is bulged out i.e., outside surface.



Q.2 State two uses of concave mirror.

Ans. (i) Concave mirrors are used in head lights of the cars, buses, shaving mirrors etc.
(ii) Used by dentists and doctors.

Q.3 What type of image can be obtained by a convex mirror ?

Ans. A convex mirror always produces the virtual, erect and smaller images behind the mirror.

Q.4 Why is a convex mirror used as a rear view mirror in cars and other vehicles.

Ans. Convex mirror has a wider field of view than a plane or concave mirror. So, it can well be used to see what is behind us rather well. Hence the drivers use convex mirror to see the traffic following them.

Q.5 What type of image is formed by a concave mirror ?

Ans. Real and Inverted image is formed but if the object is placed very near to the mirror, then the image formed is virtual and erect.

Q.6 Write two differences between real and virtual images.

	Real Image	Virtual Image
1	Formed when reflected or refracted rays actually meet at a point.	Formed when reflected/refracted rays seem to come from a point.
2	Can be taken on a screen.	Cannot be taken on screen.
3	It is always inverted	It is always erect.

Q.7 What type of mirror is used in scooters?

Ans. Convex mirror is used in scooters.

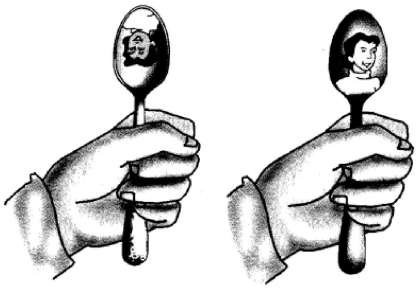
Q.8 Why is convex mirror used as side mirrors in vehicles ?

Ans. Convex mirrors can form images of objects spread over a large area. These help the drivers to see the

traffic behind them. Thus, convex mirrors are used as side mirrors in vehicles.

Q.9 "Spoon is concave mirror or convex mirror", explain ?

Ans. In stainless steel spoon, the back of the spoon curves outwards and serves as a convex mirror whereas the front side of the spoon which curves inwards and is hollow from the inside, serves as a concave mirror. If you look at the concave side of the spoon, you will see your inverted image there figure (a). The convex side of the spoon, on the other hand, shows an erect image figure (b). That means stainless steel spoon work as concave as well as convex mirror.



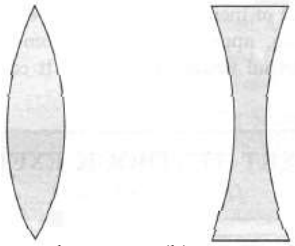
(a) Concave side (b) Convex side

Images formed by Lenses :

Q.1 Explain the types of lenses.

Ans. Lenses are of two types :

1. **Convex Lens :** Those lenses which feel thicker in the middle than at the edges are convex lenses.
2. **Concave Lens :** Those lenses which feel thinner in the middle than at the edges are concave lenses.



(a) Convex lens (b) Concave lens

Q.2 What are converging and diverging lens ?

Ans. A convex lens converges (bends inwards) all the light falling on it. Therefore, it is called a converging lens. On the other hand, a concave lens diverges (bends outward) all the light falling on it and is called a diverging lens.

Q.3 Why should we not look at the sun through convex lens?

Ans. When the light passes through a convex lens, it concentrates at a point, so it can damage our eyes permanently.

Q.4 Compare the images formed by a concave lens and a convex lens.

Ans.

Image formed by a concave lens	Image formed by a convex lens
Image formed by a concave lens is always virtual, erect and diminished	Image formed by convex lens is mostly real, magnified and inverted except when object is very close

Q.5 Explain the uses of concave and convex mirrors and also concave and convex lenses.

Ans. The uses of concave and convex mirrors

Concave Mirror :

(i) Doctors use concave mirror for examining eyes, ears, nose and throat.

(ii) Concave mirrors also used by dentists to see an enlarged image of the teeth.

(iii) The reflectors of torches, headlights of cars and scooters are concave in shape.

Convex Mirror :

(i) Convex mirror is used as side view mirror. These help the drivers to see the traffic behind them.

The uses of concave and convex lenses :

Concave Lens : Concave lens is used in spectacles to correct short sightedness.

Convex Lens : (i) Convex lens is used as a magnifying glass, and also in microscopes, teleschopes, etc.

(ii) It is used in spectacles to correct far sightedness.

Sunlight - White or Coloured :

Q.1 What is rainbow ?

Ans. It is a large colourful arc in the sky, i.e., opposite to sun mostly seen in rainy season.

Q.2 How many colours are found in a rainbow?

Ans. There are seven different colours in a rainbow, though it may not be easy to distinguish all of them. They are as VIBGYOR, and the colours are red, orange, yellow, green, blue, indigo and violet.

Q.3 Other than a rainbow, where do we seen many colours?

Ans. Many colours can be seen on soap bubbles and on the surface of a Compact Disc (CD).

Q.4 Give an activity to show that seven colours can be mixed to get white light.

Ans. Take a circular cardboard disc of about 10 cm diameter. Divide this disc into seven segments. Paint each segment with the seven different rainbow colours, as shown in the following figure. Make a small hole at the centre of the disc. Fix the disc loosely on the tip of a refill of a ball pen. Rotate the disc in the day light and when the disc will rotate fast, the colours get mixed together and the disc appears to be whitish. Such a disc is popularly known as Newton's disc.

A disc with seven colours

It appears white on rotating

CONCEPT APPLICATION LEVEL - III

Section - A

Match the items in Column-I with Column-II :

Q.1

	Column-I		Column-II
(i)	Concave lens	(a)	Lateral inversion
(ii)	Always virtual image	(b)	Reflecting surface is bulged out
(iii)	Changing position of image	(c)	Concave mirror
(iv)	Wax paper	(d)	Seven colours
(v)	Image obtained on screen	(e)	Real image
(vi)	Convex mirror	(f)	Real image
(vii)	Used by dentists	(g)	Thinner in the middle
(viii)	White light composed	(h)	Concave lens

Section - B

Fill in the blank space in the following statements :

Q.1 Uneven surfaces show..... reflection.

Q.2 Incident ray, the reflected ray and ..... lie in the same .....

Q.3 Laws of..... is applicable in playing back shots in the carroms.

Q.4 Changing of right side to left is called .....

Section - C

Choose the true and false statements from the following :

Q.1 Concave mirror is converging in nature.

Q.2 Convex mirror is diverging in nature.

Q.3 Plane mirror forms virtual image.

Q.4 Concave mirror has a virtual focus.

Q.5 Spherical mirrors do not obey laws of reflection.

Q.6 During lateral inversion, the image becomes inverted.

Q.7 Angle between incident ray and reflected ray is double that of the angle of incidence.

Section - D

Choose the correct option in the following :

Q.1 The path of the light is
(A) always a straight line (B) a curved line
(C) a zig-zag line (D) depends on the medium

Q.2 Which one shows lateral inversion ?
(A) Plane mirror (B) Convex mirror
(C) Concave mirror (D) All of these

Q.3 Image formed by a plane mirror is
(A) virtual and erect (B) real and erect
(C) virtual and inverted (D) real and inverted

Q.4 An image which can be obtained on a screen is called
(A) erect (B) inverted (C) real (D) virtual

Q.5 Image formed by a convex mirror is
(A) erect, virtual and smaller (B) inverted, virtual and smaller
(C) erect, real and smaller (D) erect, virtual and magnified

Q.6 Which is used a side view mirror ?
(A) plane mirror (B) concave mirror (C) convex mirror (D) none of these

Q.7 A concave lens always forms :
(A) erect, virtual and smaller image (B) erect, virtual and magnified image
(C) erect, real and smaller image (D) inverted, virtual and smaller image

Q.8 White light is composed of
(A) seven colours (B) three colours (C) five colour (D) eight colours

SECTION–E

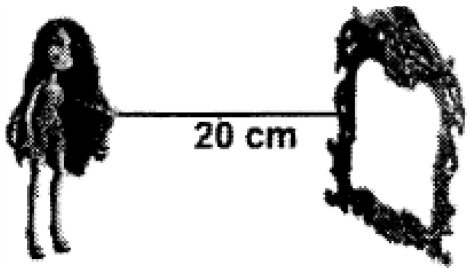
OBJECTIVE TYPE QUESTIONS

Q.1 Match column I and column II and select the correct options from the codes given below.

Column - I	**Column - II**
(a) Lateral inversion	(i) An image which cannot be caught on a screen
(b) Luminous	(ii) Objects that allow some light to pass through
(c) Translucent	(iii) Object producing light by itself
(d) Virtual	(iv) Turned around from left to right

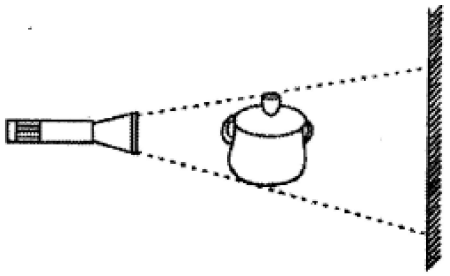
(1) a-(i), b-(ii), c-(iii), d-(iv) (2) a-(iv), b-(iii), c-(ii), d-(i)
(3) a-(iii), b-(i), c-(iv), d-(ii) (4) a-(ii), b-(iv), c-(i), d -(iii)

Q.2 Miss Megha is 20 cm away from the plane mirror. If she moves few steps closer to the mirror, what will happen to the image size in the mirror ?



(1) The size of image will decrease (2) The size of image will increase
(3) The size of image will be same (4) Cannot say

Direction (Q.No. 3 & 4) : Read the passage carefully and answer the given questions.
Aman sets up the experiment as shown. The positions of the torch and object are fixed.



Q.3 When Aman switches the torch on, which one of the following shows the correct shadow formed on the screen ?

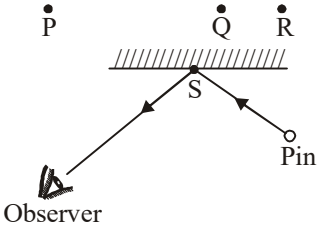
(1)  (2)  (3)  (4) 

Q.4 To cast a bigger shadow on the screen, Aman should move _____.
(1) The object closer to the torch (2) The screen closer to the object
(3) The object away from the torch (4) The torch away from the object

Q.5 The image formed by a slide projector on the screen is _____
(1) Real, inverted and diminished (2) Virtual, upright and diminished
(2) Virtual, upright and magnified (4) Real, inverted and magnified

Q.6 In the game of basketball, the ball is bounced (with no spin) towards a player at an angle of 40 degrees to the normal. What will be the angle of reflection ?
(1) 30° (2) 45° (3) 60° (4) 40°

Q.7 If a pin is placed in front of, and to the right of a plane mirror as shown in figure. Where is the image of the pin formed ?



(1) P (2) Q (3) R (4) S

Q.8 The images of clouds and trees in water are always less bright than in reality, it is because :
(1) Water is making the image dirty
(2) There is an optical illusion due to which the image appears to be less bright
(3) Only a portion of the incident light is reflected and quite a large portion goes mid water
(4) Air above the surface of water contains a lot of moisture

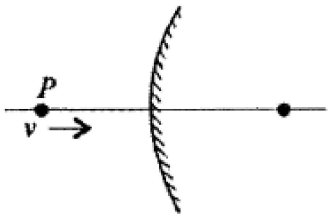
Q.9 Match the column I with column II.

	Column I		**Column -II**
(a)	Convex mirror	(i)	used as magnifying glass
(b)	Convex lens	(ii)	used as side view mirror in vehicles
(c)	Concave mirror	(iii)	Image is erect and smaller than object
(d)	Concave lens	(iv)	used by dentists to see enlarged image

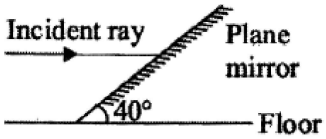
(1) a-(i), b-(iii), c-(iv), d-(ii) (2) a-(iv), b-(ii), c-(iii), d-(i)
(3) a-(ii), b-(i), c-(iv), d-(iii) (4) a-(iii), b-(iv), c-(ii), d-(i)

Q.10 Human eye has converging lens system that produces an image at the back of the eye. If the eye views a distant object, which type of image is produced ?
(1) Real, erect, same size (2) Real, inverted, diminished
(3) Virtual, erect, diminished (4) Virtual, inverted, magnified

Q.11 A point object P moves towards a convex mirror with a constant speed v, along its optic axis. The speed of the image :
(1) Is always less than v
(2) Is always more than v
(3) Is equal to v
(4) Decreases as P comes closer to the mirror

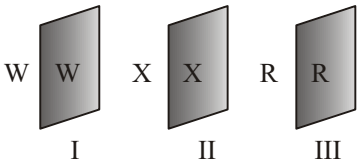


Q.12 A ray of light parallel to the floor strikes a plane mirror, which is inclined at an angle 40° as shown in figure. What is the angle of reflection ?



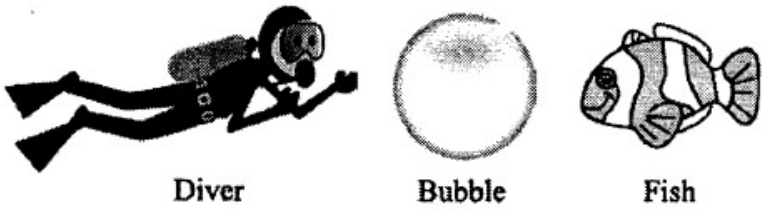
(1) 40° (2) 80° (3) 50° (4) 90°

Q.13 Reyansh placed three different types of glasses in front of letters as shown below :
Which of the following observations is correct ?



(1) Glass I is transparent and unclear
(2) Glass I is translucent and clear
(3) Glass II is opaque and frosted
(4) Glass III is translucent and frosted

Q.14 A fish sees the face of a scuba diver through a thin bubble, as shown in figure. Compared to the face of the driver, the image seen by the fish will be

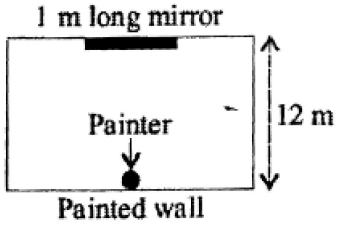


(1) Smaller and erect
(2) Smaller and inverted
(3) Larger and erect
(4) Cannot predict

Q.15 A camera makes use of a converging lens to produce an image. If the camera captures a distant object, then which of the following sets of characteristics of image is correct ?

(1) Virtual, inverted, same size
(2) Real, inverted, diminished
(3) Real, upright, same size
(4) Virtual, upright, diminished

Q.16 A painter leans his back against a painted wall while looking into a 1 m long mirror at the opposite end of a rectangular room as shown in the given figure. How much of the painted wall can he see through the given mirror ?



(1) 1m
(2) 2m
(3) 6 m
(4) 12 m

ANSWER KEY

CONCEPT APPLICATION LEVEL - III

Section - A

Q.1 (i) g (ii) h (iii) a (iv) f (v) e (vi) b (vii) c (viii) d

Section - B

Q.1	Irregular	Q.2	normal, plane	Q.3	reflection	Q.4	Lateral inversion

Section - C

Q.1	True	Q.2	True	Q.3	True	Q.4	False	Q.5	False
Q.6	False	Q.7	True						

Section - D

Q.1	A	Q.2	A	Q.3	A	Q.4	C	Q.5	A
Q.6	C	Q.7	A	Q.8	A				

Section–E

Q.1	2	Q.2	3	Q.3	2	Q.4	1	Q.5	4
Q.6	4	Q.7	3	Q.8	3	Q.9	3	Q.10	2
Q.11	1	Q.12	3	Q.13	4	Q.14	1	Q.15	2
Q.16	2								