DELHI PUBLIC SCHOOL BANGALORE - EAST

CHAPTER NOTES

CLASS: X

REFLECTION OF LIGHT

NAME: **SEC:_____** **DATE:**

LIGHT - REFLECTION

Light is the form of energy that provides sensation of vision.

Properties of Light

→ Light is an electromagnetic wave, so does not require any medium to travel.

→ Light tends to travel in straight line.

→ Light has dual nature i.e. wave as well as particle.

⟶ Speed of light is maximum in vacuum. Its value is 3×10^8 ms^{-1}.

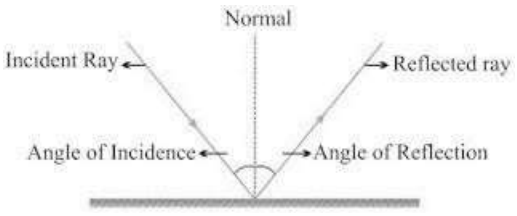
Reflection

→ Bouncing back of light when it strikes on a polished surface like mirror.

Laws of Reflection

i) Angle of incidence is equal to the angle of reflection.

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

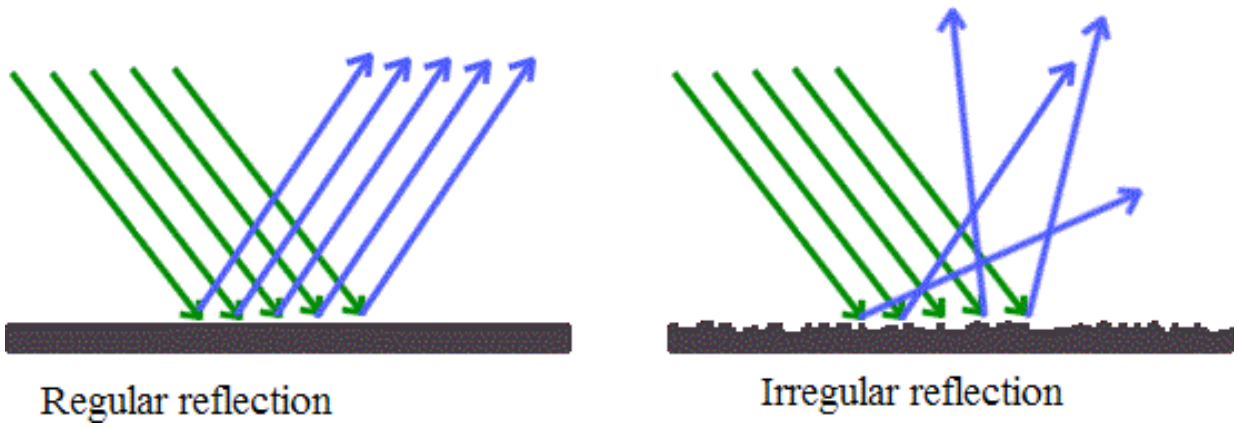


Types of reflection

1. Regular reflection 2. Irregular reflection (diffuse reflection)

When a beam of parallel light rays is incident on a smooth and plane surface, the reflected rays will also be parallel. This type of reflection is called Regular Reflection.

When a beam of parallel light rays fall on irregular or uneven surface, it gets scattered in all directions. This type of reflection is called "Irregular or Diffuse Reflection".



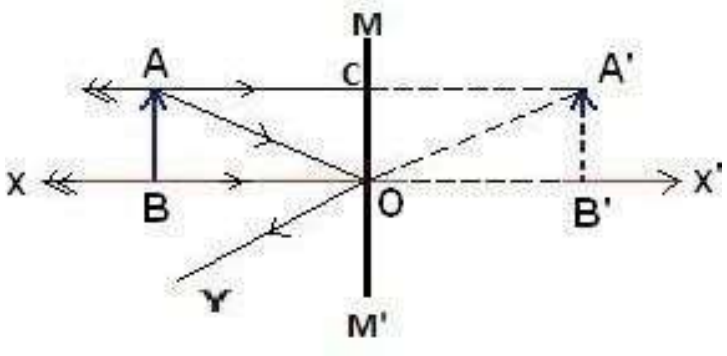
Regular reflection

Irregular reflection

Differentiate between Virtual and Real image

Real Image	**Virtual Image**
Formed when light rays actually meet.	Formed when light rays appearto meet.
Can be obtained on screen.	Can't be obtained on screen.
Inverted	Erect
Example: image formed on cinema screen and formed by concave mirror.	Example: image formed by plane mirror or convex mirror.

Image Formed by Plane Mirror (ray diagram for image formation by a plane mirror isgiven below)



Characteristics of Image formed by Plane Mirror

(i) Virtual and erect.
(ii) Size of image is equal to the size of object.
(iii) Image is formed as far behind the mirror as the object is in front of it (ie object distance u = image distance v)
(iv) Laterally inverted.

Lateral Inversion: The right side of the object appears left side of the image and vice-versa.

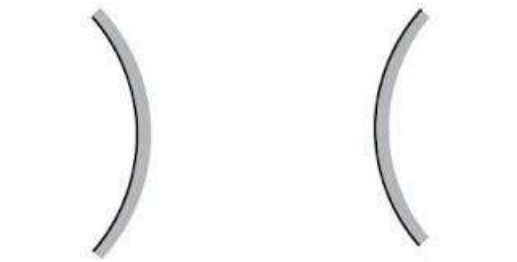
Q. Differentiate between the image of your face in a plane mirror and in a photograph.

Ans: *TO BE WRITTEN BY THE STUDENT WITH A PENCIL*

Spherical Mirrors

→ Mirrors whose reflecting surface is curved.

→ There are two types of spherical mirrors:
(i) Convex Mirror
(ii) Concave Mirror

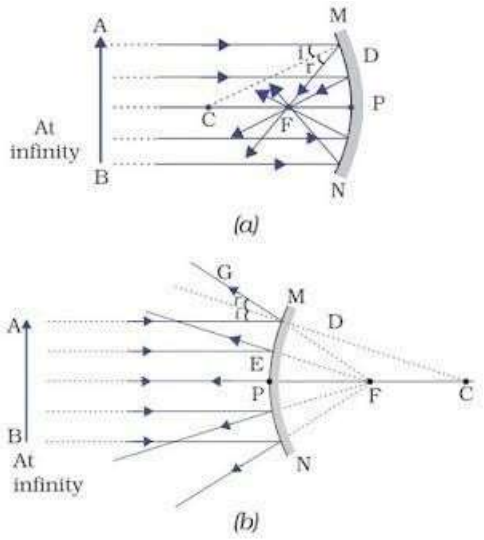


Properties of Concave mirror

- Reflecting surface is curved inwards.
- Converging mirror

Properties of Convex mirror

- Reflecting surface is curved outwards.
- Diverging mirror



(a) Concave mirror
(b) Convex mirror

Terminology related to Spherical mirrors

→ **Principal axis:** The line passing through the pole and center of curvature.

→ **Pole (P):** The centre of the spherical mirror.

→ **Aperture (MN):** It is the effective diameter of the spherical mirror.

→ **Center of Curvature (C):** The centre of the hollow glass sphere of which themirror was a part.

→ **Radius of Curvature (R):** The distance between the pole and the centre ofcurvature (radius of the sphere of which a mirror is a part)

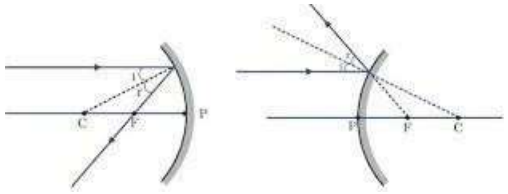
→ **Focus (F) of a concave mirror:** The point on principal axis where all the parallel light rays actually meet after reflection from the concave mirror.(Fig a)
Focus (F) of a convex mirror The point on principal axis where all the parallel light rays appear to meet after reflection from the convex mirror. (Fig b)

→ **Focal length (f):** The distance between the pole and the focus.

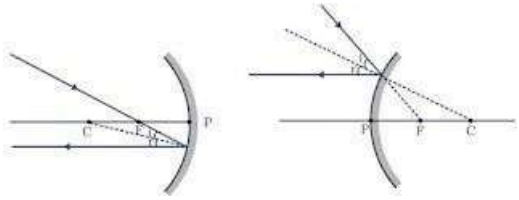
→ Relationship between focal length and radius of curvature: f = R/2

Rules for making ray diagrams by spherical mirror

(i) A ray parallel to the principal axis, after reflection, will pass through the principal focus in case of a concave mirror or appear to diverge from the principal focus in case of a convex mirror.

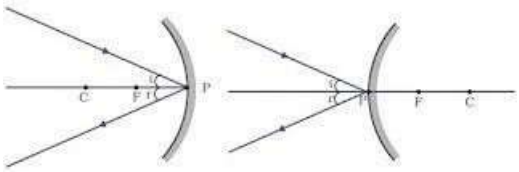


(ii) A ray passing through the principal focus of a concave mirror or a ray which is directed towards the principal focus of a convex mirror, after reflection, will emerge parallel to the principal axis.



(iii) A ray passing through the centre of curvature of a concave mirror or directed in the direction of the centre of curvature of a convex mirror, after reflection, is reflected back along the same path.(WHY?)

(iv) A ray incident obliquely to the principal axis, towards a point P(pole of the mirror), on the concave mirror or a convex mirror, is reflected obliquely. The incident and reflected rays follow the laws of reflection atthe point of incidence (point P), making equal angles with the principalaxis.



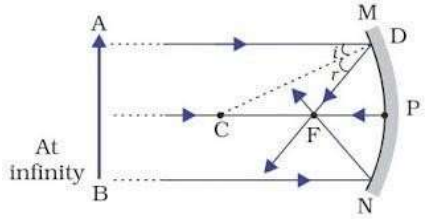
Ray diagrams for images formed by concave mirror

(i) **When object is at infinity**

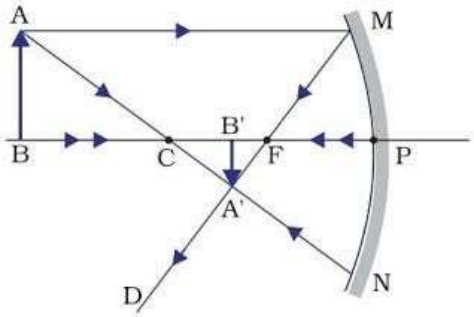
Image Position − At 'F'

Nature of image – Real, inverted

Size – Point sized or highly diminished



(ii) **When object is beyond 'C'** Image Position – Between 'F' and 'C'Nature of image – Real, inverted Size Diminished

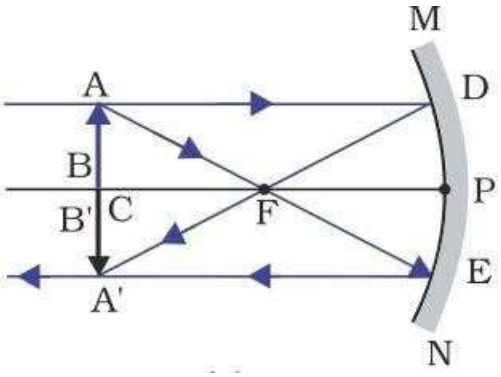


(iii) **When object is at 'C'**

Image Position – At 'C'

Nature of image – Real, inverted

Size – Same size as that of object

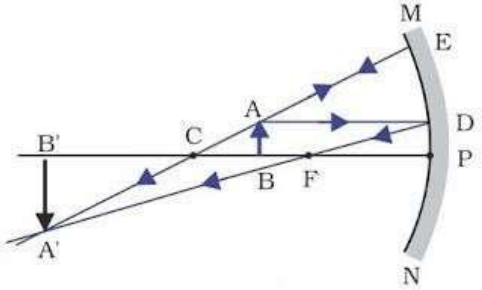


(iv) **When object is placed between 'F' and 'C'**

Image Position – Beyond 'C'

Nature of image– Real, inverted

Size – Enlarged

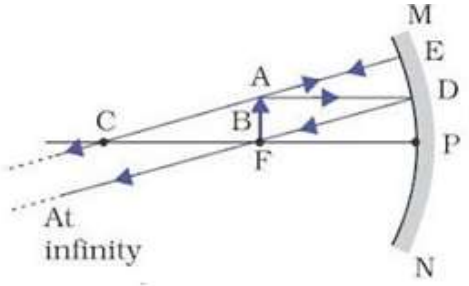


(v) **When object is placed at 'F'**

Image Position – At Infinity

Nature of image – Real, inverted

Size – Highly enlarged



(vi) When object is between 'P' and 'F'

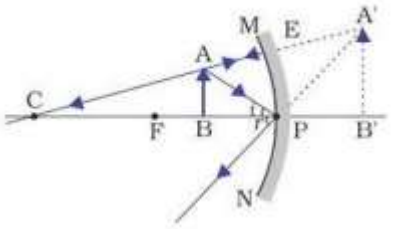


Image Position – Behind the mirror
Nature of image – Virtual, erect
Size – Enlarged

Uses of Concave Mirror

(i) Used in torches, search lights and vehicles headlights to get powerful parallel beam oflight.

(ii) Concave mirrors are used by dentists to see large image of teeth of patients. (Teeth have to be placed between pole and focus).

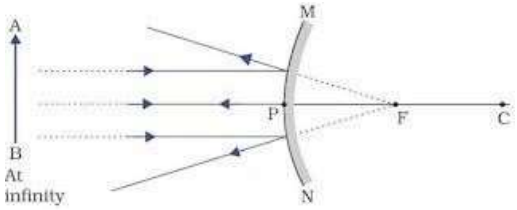
(iii) Concave mirror is used as shaving mirror to see a larger image of the face.

(iv) Large concave mirrors are used to concentrate sunlight to produce heat in solarcooker.

Ray diagrams of images formed by convex mirror

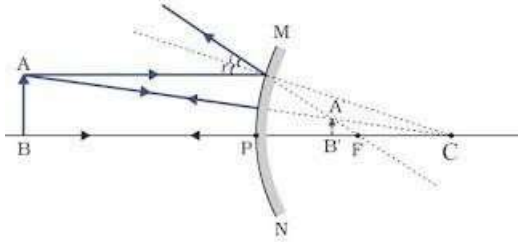
(i) When object is placed at infinity

Image Position − At 'F'
Nature of image –Virtual, erect
Size – Point sized



(ii) When object is placed between pole and infinity

Image Position – Between 'P' and 'F'
Nature of image– Virtual, erect
Size – Diminished



A full length image of a tall building/tree can be seen in a small convex mirror.(TO BE WRITTEN UNDER RAY DIAGRAMS OF IMAGE FORMATION BY CONVEX MIRROR

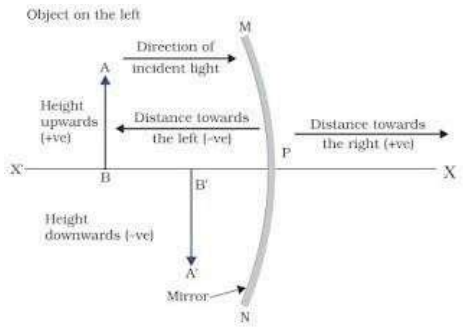
Uses of Convex Mirror

(i) Convex mirrors are used as rear view mirrors in vehicles because
→ they always give an erect image though diminished image.
→ they have a wider field of view as they are curved outwards.

(ii) Convex mirrors are used at blind turns and on points of merging traffic to facilitate vision of both side traffic.

(iii) Used in shops as security mirror.

Sign Convention rules for Reflection by Spherical Mirror



(i) The object is placed to the left of the mirror.

(ii) All distances parallel to the principal axis are measured fromthe pole of the mirror.

(iii) All distances measured in the direction of incident ray (**OR** towards right side OR along + X- axis) are taken as positive and those measured against the direction of incident ray (**OR** towards left side OR along — X-axis) are taken as negative.

(iv) Distance measured perpendicular to and above the principalaxis are taken as positive.

(v) Distances measured perpendicular to and below the principal axis are taken as negative.

- Object distance = 'u' is always negative.
- Focal length of concave mirror = Negative
- Focal length of convex mirror = Positive

Mirror Formula

$1/v + 1/u = 1/f$

where, v = Image distance
u = Object distance
f = Focal length

Magnification of Spherical Mirrors

It is the ratio of the height of image to the height of object.m = Height of image/Height of object

$\Rightarrow m = hi/ho$

Also, $m = -v/u$

→ If 'm' is negative, image is real.
→ If 'm' is positive, image is virtual.
→ If $h_i = h_o$ then m = 1, i.e., image is equal to object.
→ If $h_i > h_o$ then m > 1 i.e., image is enlarged.
→ If $h_i < h_o$ then m < 1 i.e., image is diminished.

→Magnification of plane mirror is always + 1.
'+' sign indicates virtual image.
'1' indicates that image is equal to object's size.

- If 'm' is '+ve' and less than 1, it is a convex mirror.
- If 'm' is '+ve' and more than 1, it is a concave mirror.
- If 'm' is '-ve', and equal or greater than one or less than one,it is a concave mirror.

****