पु॰ना International School

Shree Swaminarayan Gurukul, Zundal

Class – X

Physics

Year 2022-23

Index

CHAPTER – 10
LIGHT-REFLECTION & REFRACTION

Light is a **form of energy,** which enable us to see the object.

In this chapter we will study the phenomena of reflection and refraction using the property of light i.e. straight line propagation (Light wave travel from one point to another, along a straight line).

Reflection of Light

When the light is allowed to fall on highly polished surface, such as mirror, most of the light gets reflected.

Laws of Reflection

1. The angle of incidence is always equal to angle of reflection.
   i = r
2. The incident ray, reflected ray and the normal to the reflecting surface at the point of incidence lie in the same plane.

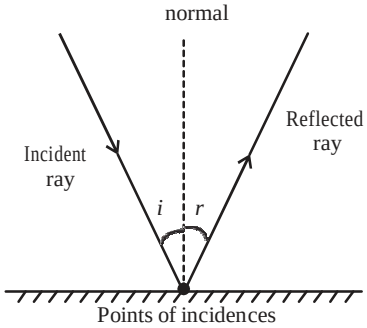
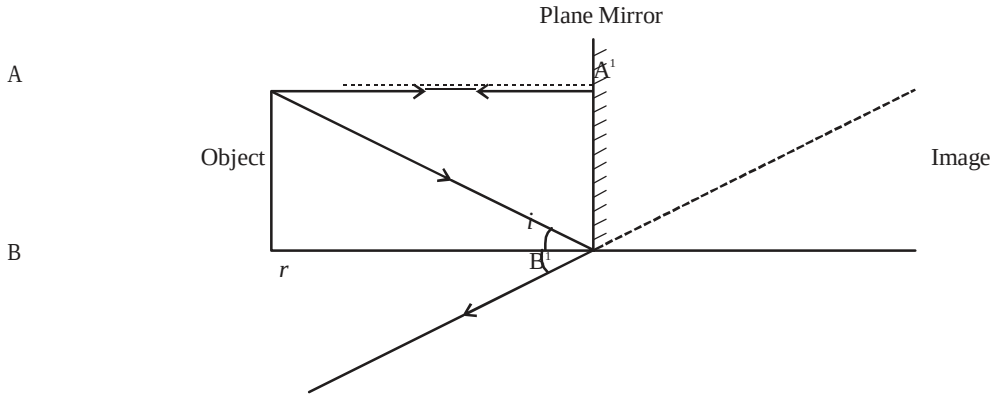


Image formed by Plane Mirror (Plane reflecting surface)



1) Virtual (imaginary) &**Erect (Virtual** The image that do not form on screen.)
2) Laterally inverted (The left side of object appear on right side of image)
3) The size of image is equal to that of object

4. The image formed is as for behind the mirror as the object is in front of it.

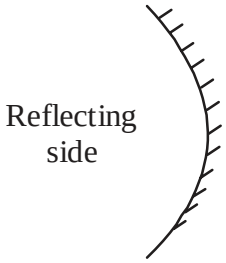
Reflection of light by spherical Mirrors

Mirrors, whose reflecting surface are curved inward or outward spherically are called spherical mirror.

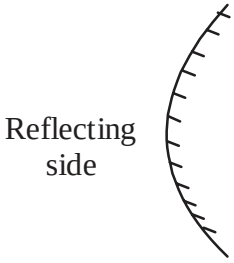
For example - Spoon } The curved surface of shinning spoon can be considered as curvedmirror.

If it is curved inward Act as concave mirror

If it is curved outward Act as a convex mirror.

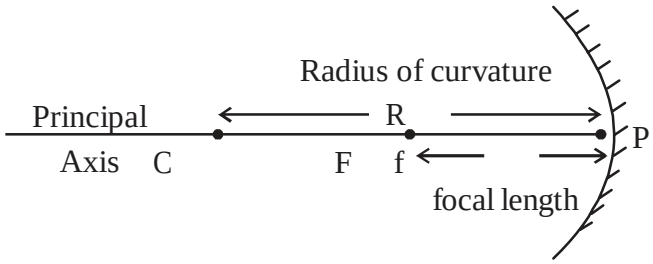


Concave
Mirror
OR CONVERGING
MIRROR

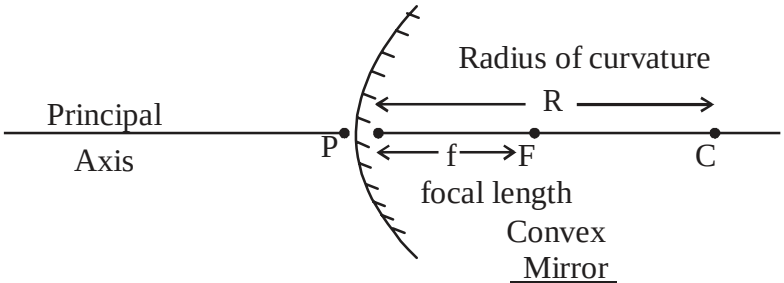


Convex
mirror
OR DIVERGING
MIRROR

Few Basic terms related to Spherical Mirror



Concave
Mirror



Convex
Mirror

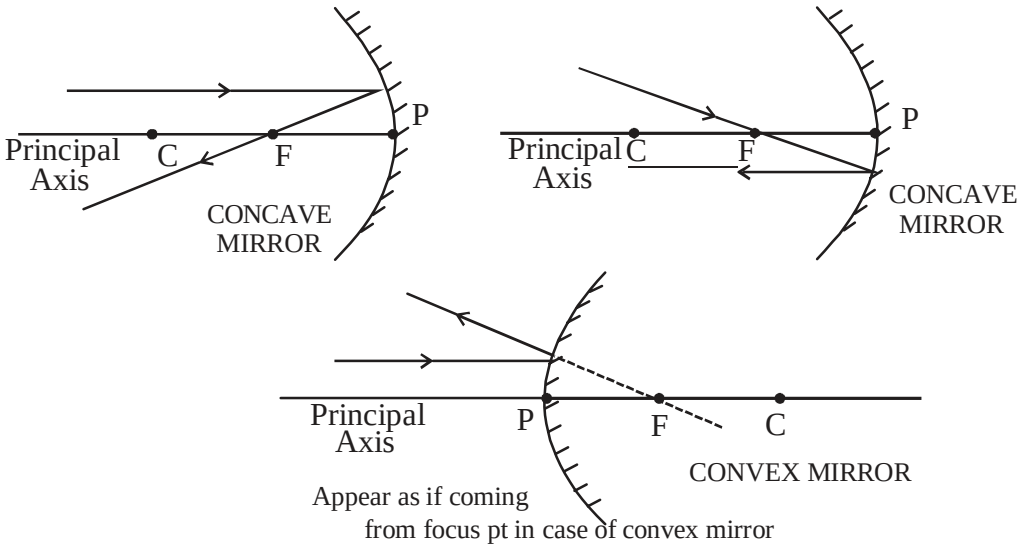
1. **Principal axis :** Line joining the pole and centre of curvature of the spherical mirror.
2. **Pole :** The geometrical central point of the reflecting spherical surface. (aperture), denoted by (P).
3. **Aperture :** The width of reflecting spherical surface.
4. **Centre of curvature :** The reflecting surface of a spherical mirror form a part of sphere. It has a centre, which is known as centre of curvature, denoted by (C)
5. **Radius of curvature :** The separation between the pole and the centre of curvature. ie. $\boxed{PC = R}$
6. **Focus point :** The point on the principal axis, where all parallel rays meet after reflection, denoted by (F)
7. **Focal length :** The length between the pole and focus point i.e. $\boxed{PF = f}$
8. **Relationship between focal length** and **Radius of curvature**.

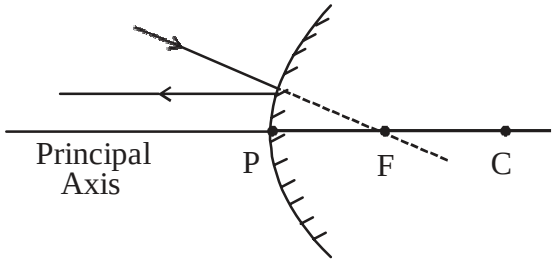
$$F = \frac{R}{2}$$

Image formation by spherical Mirror

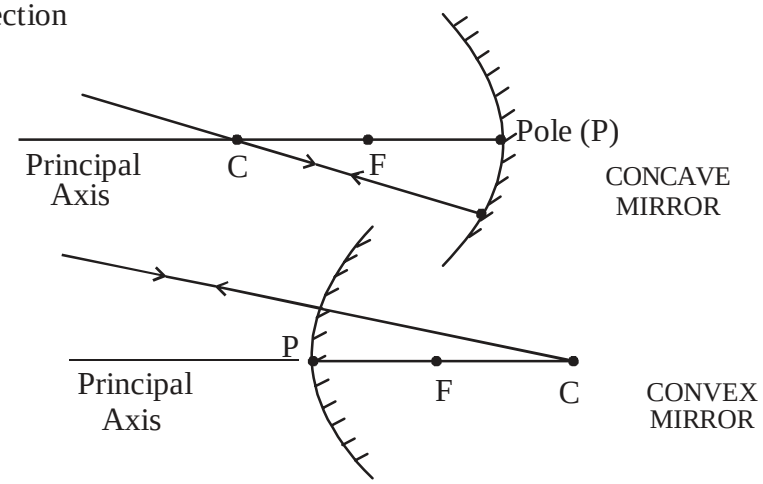
Before we learn the formation of image or ray diagram, let us go through few tips

a) Remember, A say of light which is parallel to principle axis always pass through focus (meet at focus) or **vice-versa**

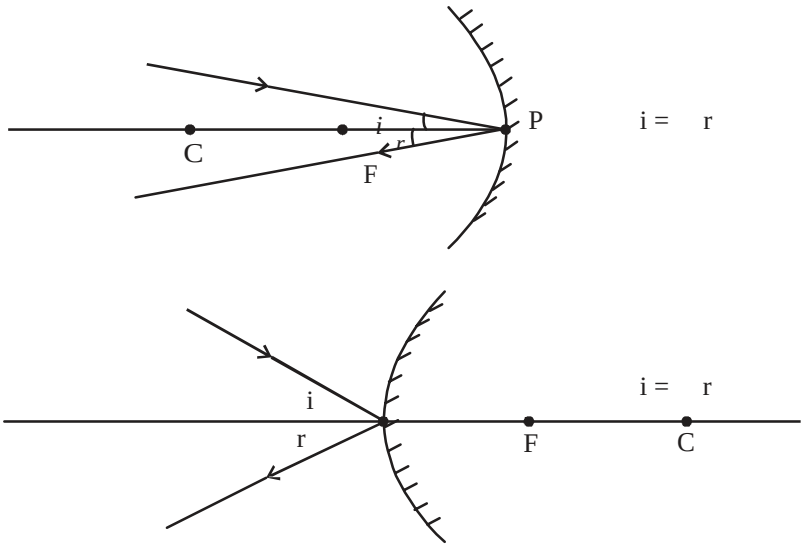




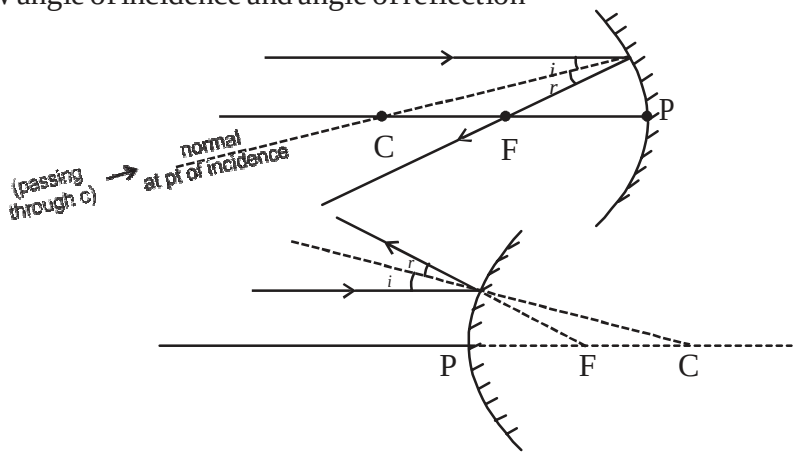
b) A ray of light which passes through centre of curvature (it is also known as normal at the point of incidence on spherical mirror) will retrace their path after reflection



c) Aray of light falling on pole get reflected at the same angle on the other side of principal axis.

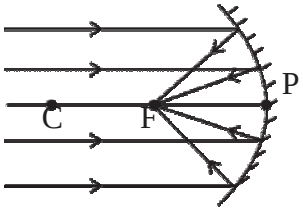


Note : A ray of light passes through centre of cus-valerie reflecting spherical surface is always act as normal at the point of incidence. If we know the normal we can draw angle of incidence and angle of reflection



Note : The image will only form when two or more rays meets at apoint. Image formation by a concave mirror for different position of the object

1. Object
At infinity

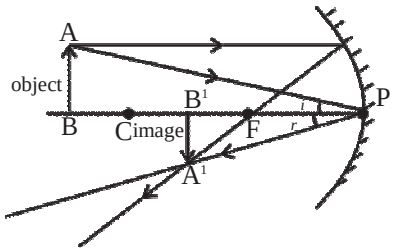


Position of Image
At focus

Size of Image
Highly diminished (point size)

Nature
Real and Inverted

2. Object
Beyond C

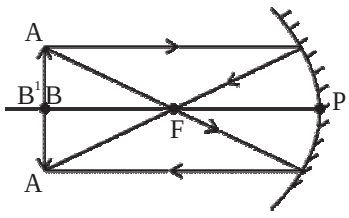


Position of Image
Between F&C

Size of Image
Small

Nature
Real and Inverted

3. Object
At C

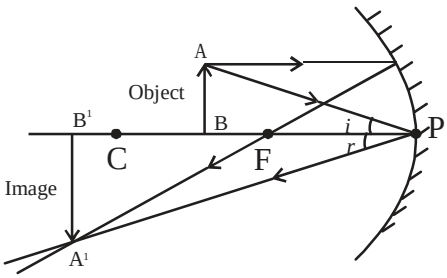


Position of Image
At C

Size of Image
Same Size of object

Nature
Real and Inverted

4. Object
Between C&F



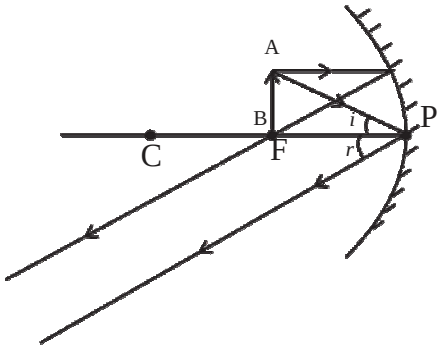
$i = r$

Position of Image
Beyond C

Size of Image
Enlarged

Nature
Real and Inverted

5. Object
At F



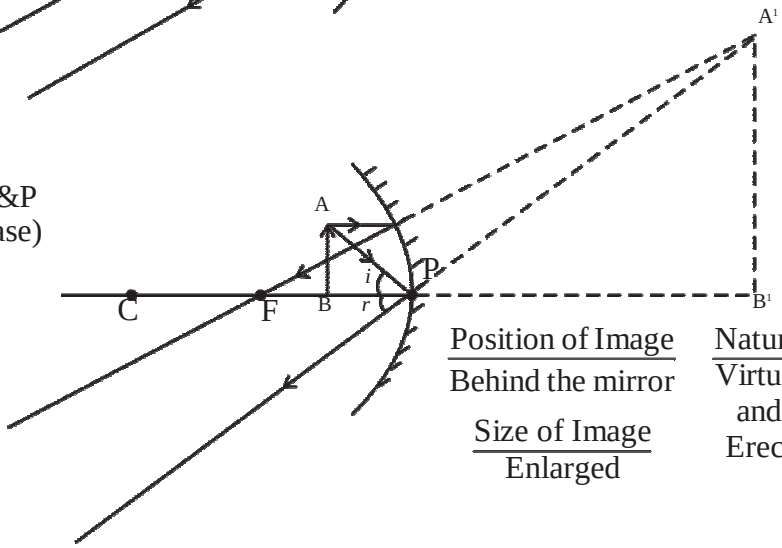
$i = r$

Position of Image
At (infinity)

Size of Image
Highly enlarged

Nature
Real and Inverted

6. Object
Between F&P
(Special Case)



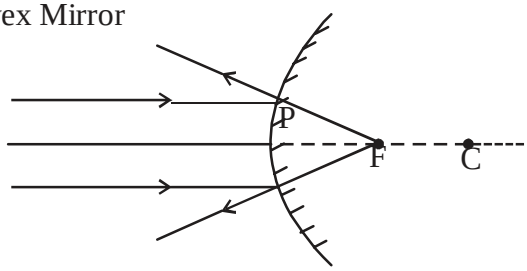
Position of Image
Behind the mirror

Size of Image
Enlarged

Nature
Virtual and Erect

Image formation by Convex Mirror

1. Object
At infinity

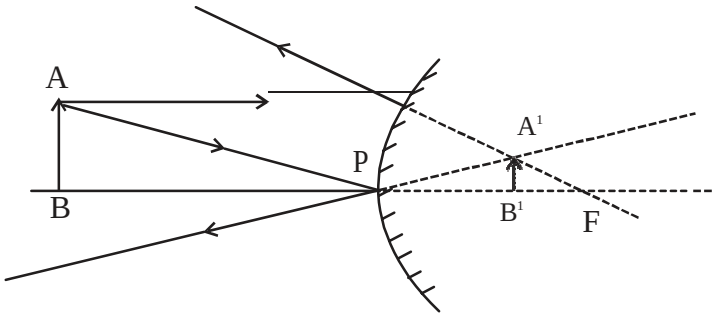


Position of Image
At focus

Size of Image
Highly diminished

Nature
Virtual & erect

1. Object
Anywhere between infinity and pole of the mirror



Position of Image	Size of Image	Nature
Between P & F	Very small	Virtual & erect

Uses of Concave Mirror

1. Used in torches, search light and headlight of vehicle.
2. Used to see large image of face as shaving mirror
3. Used by dentist to see large images of the teeth
4. Large concave mirror used to focus sunlight (heat) in solar furnaces.

Uses of Convex Mirror

1. Used as rear-view mirror in vehicles because it gives erect image. It also helps the driver to view large area.

Sign Convention for Reflection by Spherical Mirror

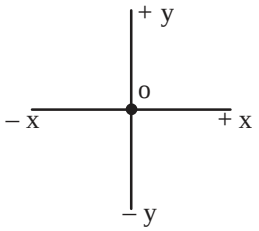
1. The object is always placed to the left side of mirror.
2. Alldistance should be measured from pole (P); parallel to principal axis.
3. Take **'P'** as **origin.** Distances measured

   Right of the origin (+ x - Axis) are **taken positive**

   Left of the origin (– x-Axis) are **taken negative**

   Perpendicular to and above principal axis (+y-Axis) are **taken positive**

   Perpendicular to and below principal axis (–y-Axis) are **taken negative**



(Cartesian system)

MIRROR FORMULA

$$\frac{1}{F} = \frac{1}{v} + \frac{1}{u}$$

f distance between F and Pole
v distance of image from Pole
u distance of object from Pole
R distance between centre of curvature and pole.

where $f = \frac{R}{2}$

MAGNIFICATION

It is expressed as the ratio of the height of the image to height of the object

$$m = \frac{\text{height of image}}{\text{height of object}} = \frac{h^1}{h} \quad \text{——— (1)}$$

It is also related to 'u' and 'v'

$$m = \frac{-v}{u} \quad \text{——— (2)}$$

$\therefore$ from 1 and 2 equation

$$m = \frac{h^1}{h} = \frac{-v}{u}$$

where h^1 image height from principle axis
h^1 Object height from principle axis.

It magnitude
m > 1 _____ Image is magnified
m = 1 _____ Image is of same size
m < 1 _____ Image is dimirushed

Few tips to remember sign convention for Spherical mirror

Object height (h) always positive | Image height (h^1) } Real - negative, Virtual - positive

Object distance from pole (u) is always negative

Image distance from pole (v) } Real - Image always negative; Virtual - Image always positive

Focal length (f) } Concave mirror – always negative; Convex mirror – always positive

REFRACTION OF LIGHT

Refraction of Light : Happens in Transparent medium when a light travels from one medium to another, refraction takes place.

A ray of light bends as it moves from one medium to another