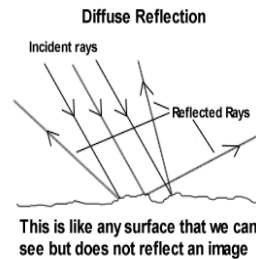
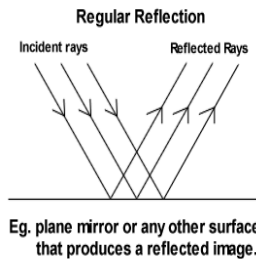
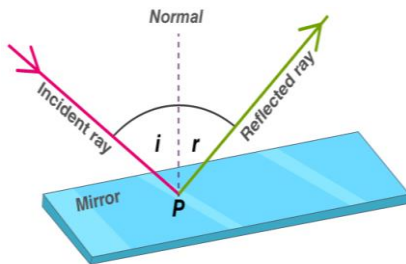


Properties of Light

- 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.
- Light casts shadow.
- Speed of light is maximum in vacuum. Its value is $3 \times 10^8 \text{ ms}^{-1}$.

Reflection

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

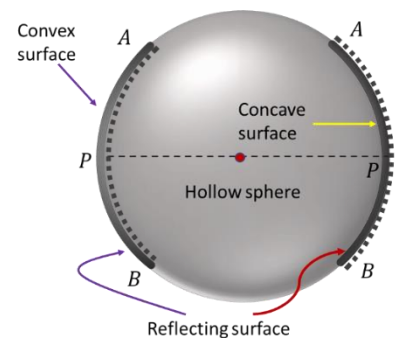


Laws of Reflection

- Angle of incidence is equal to the angle of reflection.
- The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.

Virtual and Real image

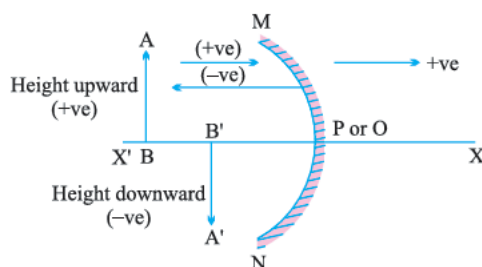
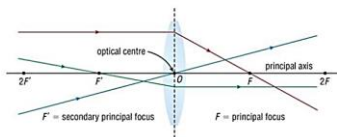
Real Image	Virtual Image
<ul style="list-style-type: none"> Formed when light rays actually meet. Can be obtained on screen. Inverted E.g., image formed on cinema screen. 	<ul style="list-style-type: none"> Formed when light rays appear to meet. Can't be obtained on screen. Erect E.g., image formed by plane mirror or convex mirror.



Rules for drawing ray diagrams

These are the rules for how light rays are bent by the lens:

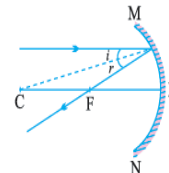
- Parallel Ray (red):** a light ray parallel to the axis refracts through the far focal point (principal focus).
- Centre Ray (blue):** A light ray passing through the center of the lens is not refracted at all.
- Focal Ray (green):** A light ray passing through the secondary focus refracts parallel to the axis.



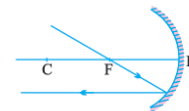
SIGN CONVENTION - CARTESIAN

Rules for making ray diagrams by concave mirror

- A ray parallel to the principal axis will pass through the principal focus, after reflection.



- A ray passing through the principal focus of concave mirror will emerge parallel to principal axis after reflection.



- A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path as it is a normally incident ray.



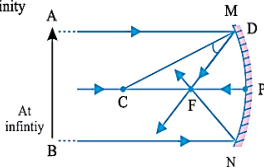
- A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angle.



RAY DIAGRAM IN MIRRORS

(i) When object is at infinity :

Parallel rays from object at infinity



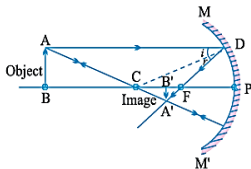
Image

Position – At 'F'

Nature – Real, inverted

Size – Point sized or highly diminished

(ii) When object is beyond 'C'



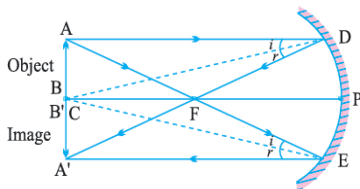
Image

Position – Between 'F' and 'C'

Nature – Real, inverted

Size – Diminished

(iii) When object is at 'C'



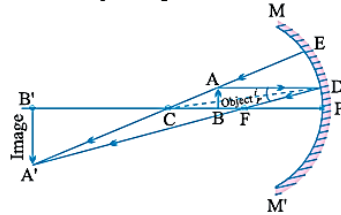
Image

Position – At 'C'

Nature – Real, inverted

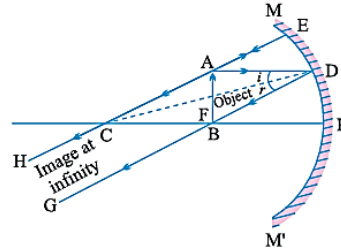
Size – Same size as that of object

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



Position – Beyond 'C'
Nature – Real, inverted
Size – Enlarged

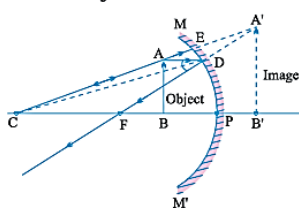
(v) When object is placed at 'F'



Image

Position – At Infinity
Nature – Real, inverted
Size – Highly enlarged

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

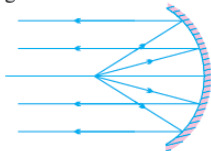


Image

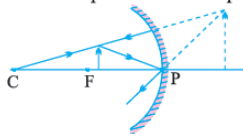
Position – Behind the mirror
Nature – Virtual, erect
Size – Enlarged

Uses of Concave Mirror

- Used in torches, search lights and vehicles headlights to get powerful parallel beam of light.



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

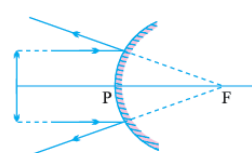


- Concave mirror is used as shaving mirror to see a larger image of the face.

- Large concave mirrors are used to concentrate sunlight to produce heat in solar furnace.

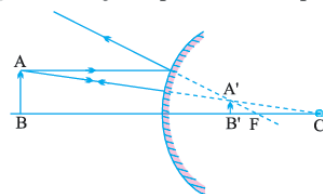
Ray diagrams of images formed by convex mirror

(i) When object is placed at infinity : Image



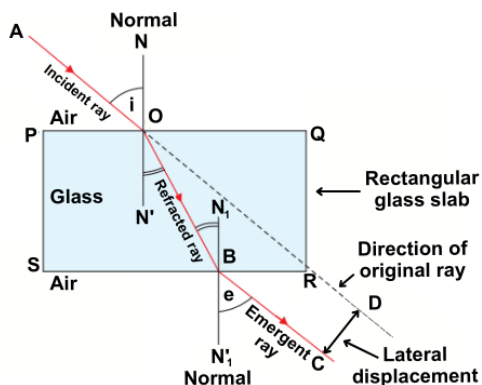
Position – At 'F'
Nature – Virtual, erect
Size – Point sized

(ii) When object is placed between pole and infinity: Image



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

- A full length image of a tall building/tree can be seen in a small convex mirror.



Refraction through a rectangular glass slab

REFRACTION : THROUGH GLASS SLAB

- The extent of bending of ray of light at the opposite parallel faces of rectangular glass slab is equal and opposite, so the ray emerges parallel to incident ray. The perpendicular distance between incident and emergent rays is called lateral displacement.
- Lateral displacement depends on :
 - Refractive index of glass slab
 - Thickness of the glass slab
 - Wavelength of light rays
 - Angle of incidence

Laws of Refraction

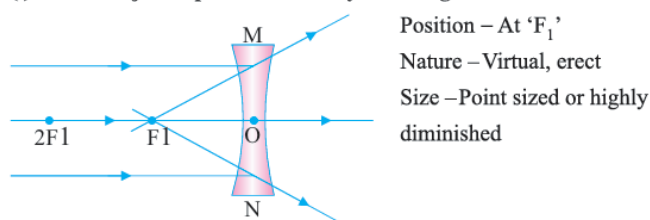
- The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
- Snell's law** : The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for a light of given colour and for a given pair of media.

$$\frac{\sin i}{\sin r} = \text{constant}$$

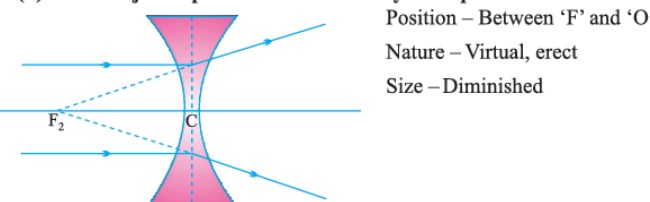
Object distance (u)	Ray diagram	Type of image	Image distance (v)	Uses
$u = \infty$		- inverted - real - diminished	$v = f$ - opposite side of the lens	- object lens of a telescope
$u > 2f$		- inverted - real - diminished	$f < v < 2f$ - opposite side of the lens	- camera - eye
$u = 2f$		- inverted - real - same size	$v = 2f$ - opposite side of the lens	- photocopier making same-sized copy
$f < u < 2f$		- inverted - real - magnified	$v > 2f$ - opposite side of the lens	- projector - photograph enlarger
$u = f$		- upright - virtual - magnified	- image at infinity - same side of the lens	- to produce a parallel beam of light, e.g. a spotlight
$u < f$		- upright - virtual - magnified	- image is behind the object - same side of the lens	- magnifying glass

Ray Diagrams of Images Formed by a Concave Lens

- When object is placed at infinity : Image



- When object is placed between infinity and optical centre



Lens Formula and Magnification

Category	Formula/Information	Description/Notes
Lens Formula	$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$	Relates object distance (u), image distance (v), and focal length (f) for lenses.
Magnification (m)	$m = \frac{h'}{h} = \frac{v}{u}$	Magnification formula for lenses.
Power (P)	$P = \frac{1}{f}$	Power of a lens in dioptres (D). f is the focal length in meters.

Mirror Formula and Magnification

Category	Formula/Information	Description/Notes
Mirror Formula	$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$	Relates object distance (u), image distance (v), and focal length (f).
Magnification (m)	$m = \frac{h'}{h} = -\frac{v}{u}$	Magnification formula for mirrors, where h' is the image height and h is the object height.

Refraction and Refractive Index

Category	Formula/Information	Description/Notes
Refraction	$\frac{\sin i}{\sin r} = \text{constant}$	Snell's Law.
Refractive Index (R.I.)	$R.I. = \frac{m_1}{m_2}$	m_1 and m_2 are the speeds of light in two different media.
Absolute R.I.	Absolute R.I. = $\frac{c}{V}$	c is the speed of light in air (or vacuum), and V is the speed of light in the medium.

Power of a lens :

It is defined as the reciprocal of focal length in meter.

The degree of convergence or divergence of light rays is expressed in terms of power.

$$\text{Power} = \frac{1}{\text{focal length (in meter)}} \quad P = \frac{1}{f}$$

- SI unit of Power = dioptre = D
1 D = 1 m⁻¹
1 dioptre is the power of lens whose focal length is one meter.
- Power of convex lens = Positive
- Power of concave lens = Negative
- Power $\propto \frac{1}{\text{focal length}}$
- Power of a lens combination
 $P = P_1 + P_2 + P_3, \dots$