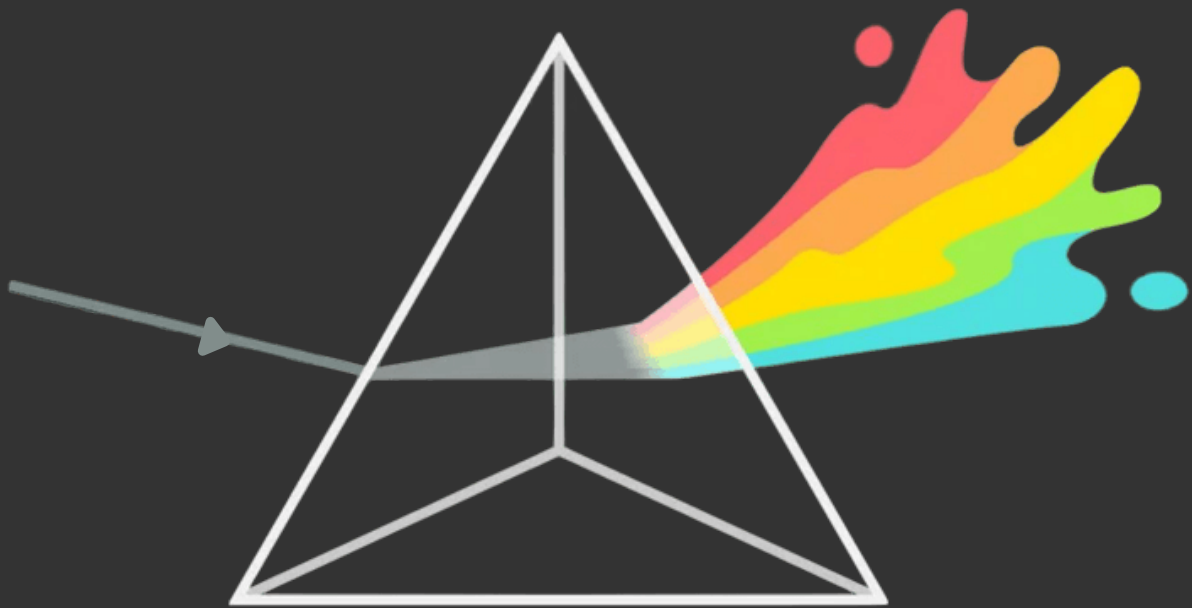



LIGHT

Reflection & Refraction

Handwritten Notes



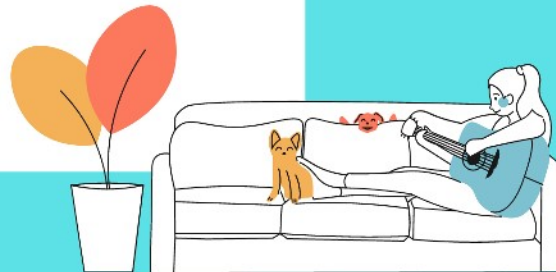
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LIGHT

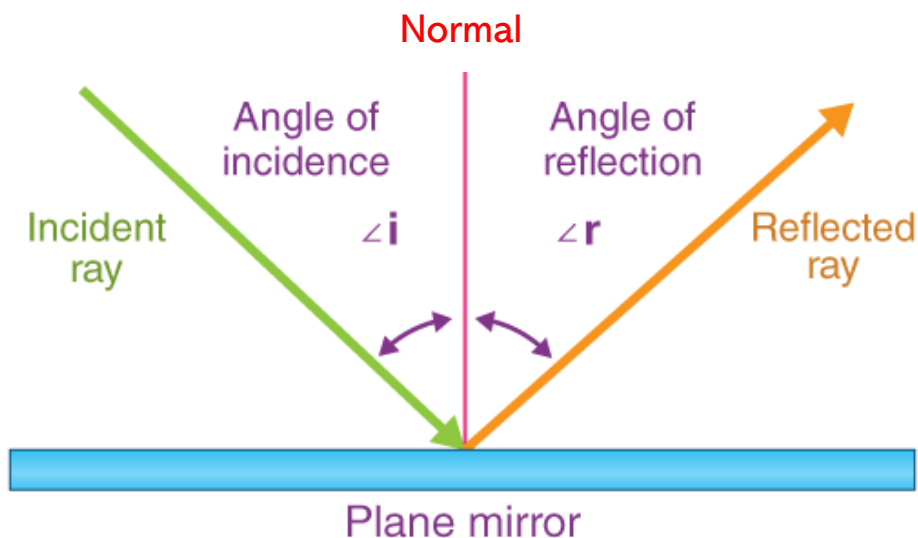
- It is a form of energy that enables us to see.
- Light always travels in straight line.
- Light makes shadow. Without light Shadow is not possible.
- Light has the maximum speed in this world. Its value is 3×10^8 m/s.

Reflection

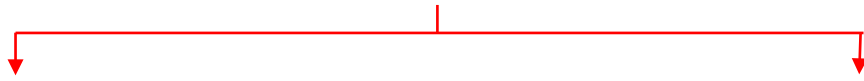
Coming back of light rays to the same medium when they fall on a surface.

Laws of Reflection

- 1) Angle of Incidence = Angle of Reflection
- 2) Incident ray, normal at the point of incidence and reflected ray all lie in the same plane.



Types of Images



Real Image

- 1) Real images are inverted
- 2) A real image is formed by Convex lens and Concave Mirror
- 3) These are formed on Screen
- 4) These are formed due to actual intersection of rays
- 5) Example -



Virtual Image

- 1) Virtual images are Erect (Straight)
- 2) A virtual image is formed by Plane Mirror and Convex Mirror, Concave Lens
- 3) These are not formed on Screen
- 4) These are formed due to imaginary intersection of rays.
- 5) Example -

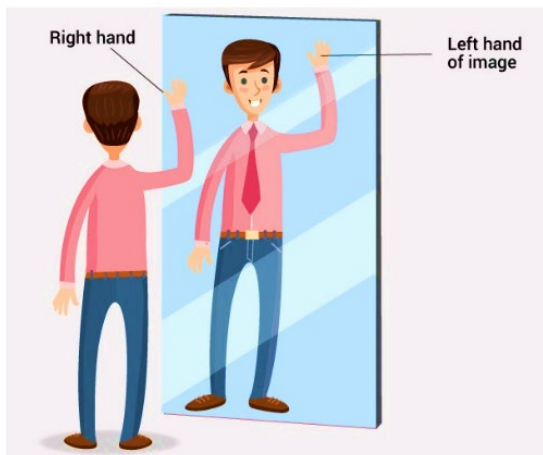


Types of Mirrors

1) Plane Mirror

- Object and Image are at equal distance from Plane Mirror.
- If object is real, then image will be virtual and vice versa.
- Size of image is equal to size of object.

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



Uses - Looking Glass, Periscope, Kaleidoscope etc.



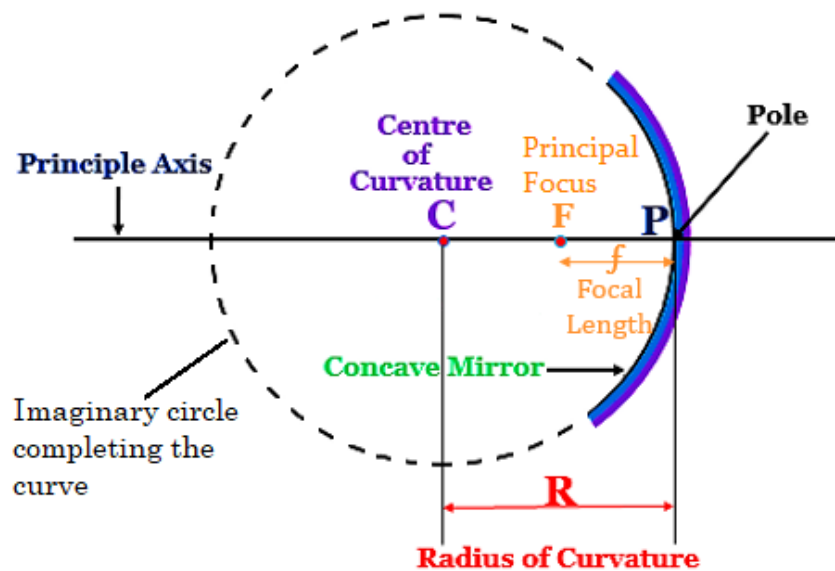
Looking Mirror



Kaleidoscope

2) Spherical Mirror

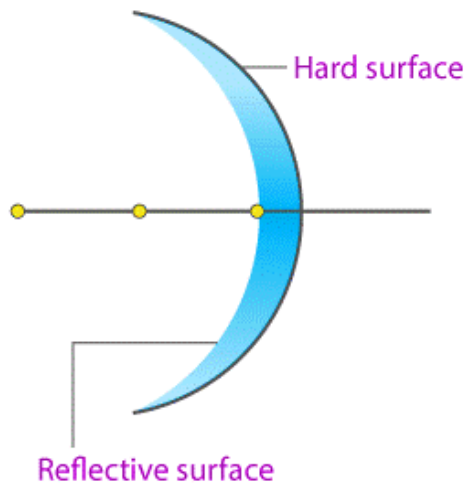
- Whose reflecting surfaces are spherical.



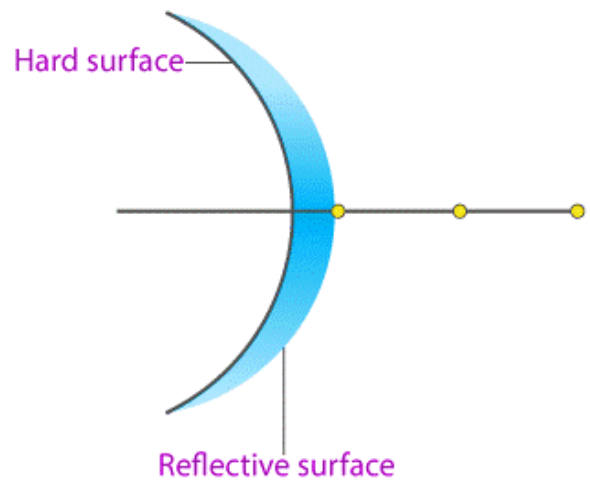
- Radius of Curvature (R)** - Distance between Pole and the Centre of Curvature.
- Centre of Curvature (C)** - Centre of that imaginary sphere of which, mirror is part.
- Pole (P)** - It is the mid-point of its reflecting surface.
- Principal Axis** - Line joining Pole and Centre of Curvature.
- Focus (F)** - Point on principal axis where all the parallel light rays actually meet or appear to meet after reflection.
- Aperture** - Effective diameter of the spherical mirror.
- Focal Length (f)** - Distance between Pole and the Focus.

$$\text{Focal Length} = \frac{\text{Centre of Curvature}}{2}$$

Types of Spherical Mirrors -



Concave Mirror

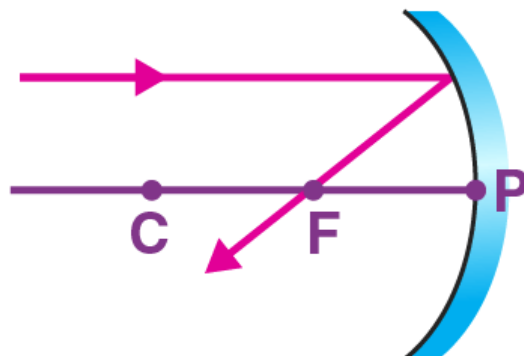


Convex Mirror

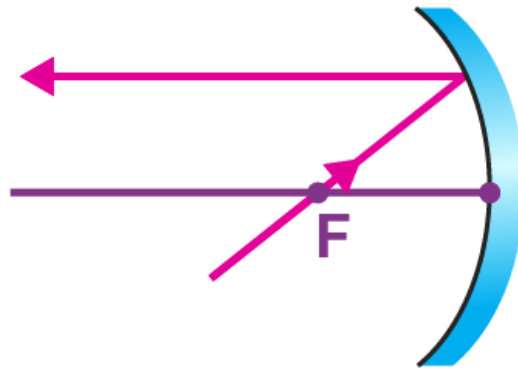
RAY DIAGRAMS

Some Rules -

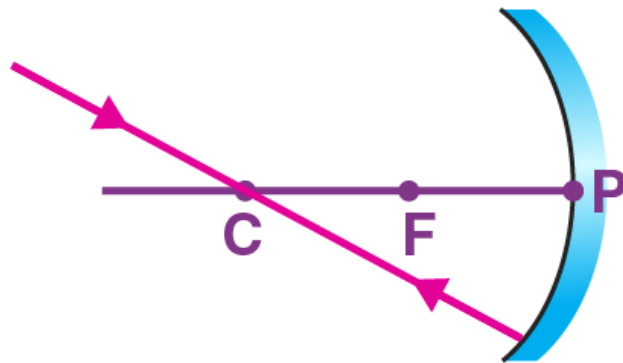
- 1) A ray parallel to principal axis, will pass through the Focus after reflection.



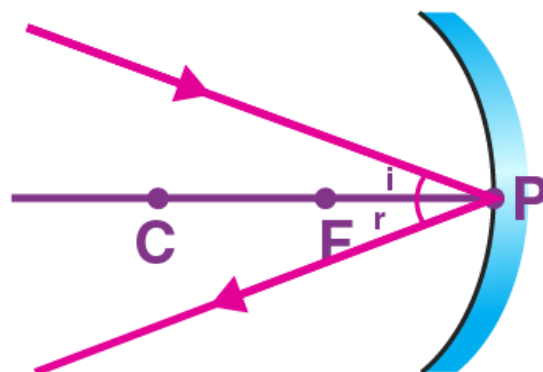
- 2) A ray passing through principal focus of concave mirror will emerge parallel to principal axis after reflection.



- 3) Ray passing through Center of Curvature of a Concave mirror gets reflected back in same path.

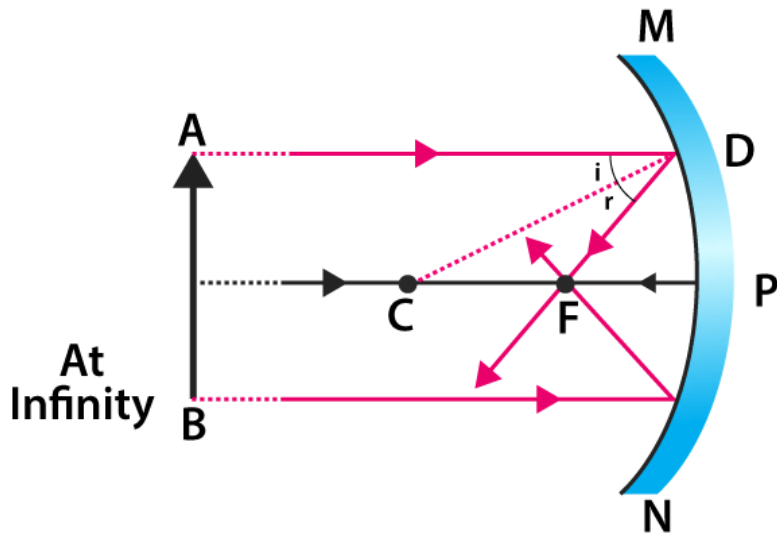


- 4) The Incident and Reflected rays make equal angles with Principal Axis.



CONCAVE MIRROR

1) Object placed at Infinity



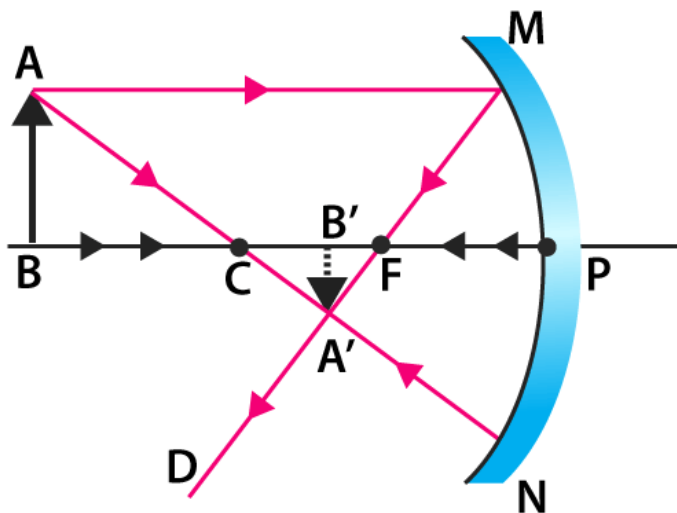
Image

Position – At 'F'

Nature – Real, Inverted

Size – Very Small

2) Object placed behind Center of Curvature



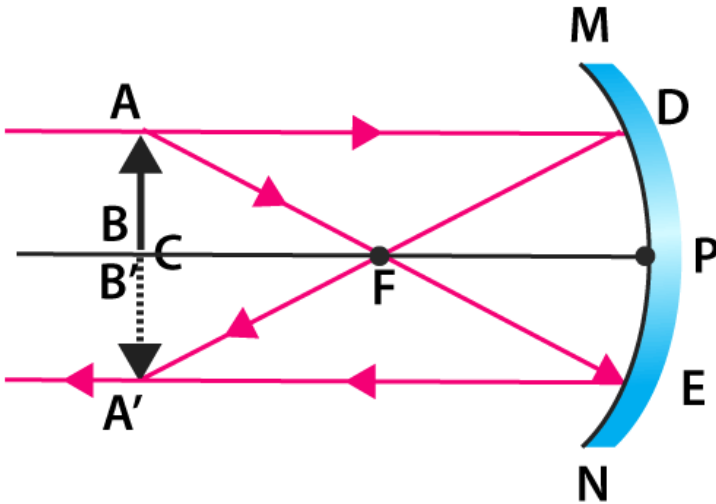
Image

Position – Between 'F' and 'C'

Nature – Real, Inverted

Size – Small

3) Object placed at Centre of Curvature



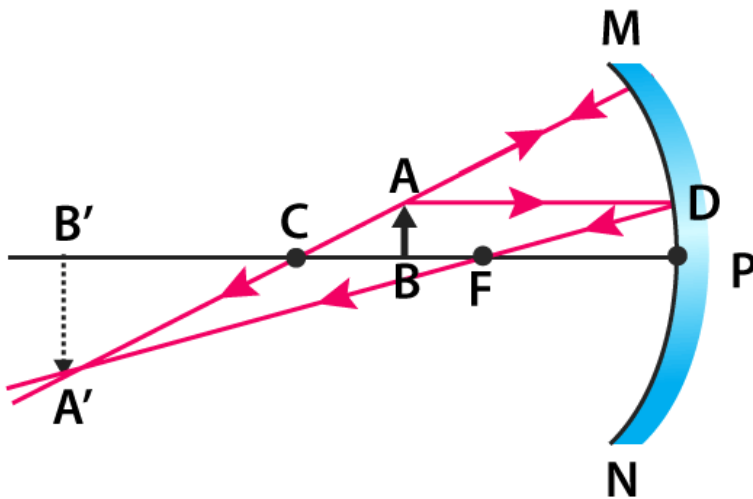
Image

Position – At 'C'

Nature – Real, Inverted

Size – Same Size

4) Object placed between Focus and Centre of Curvature



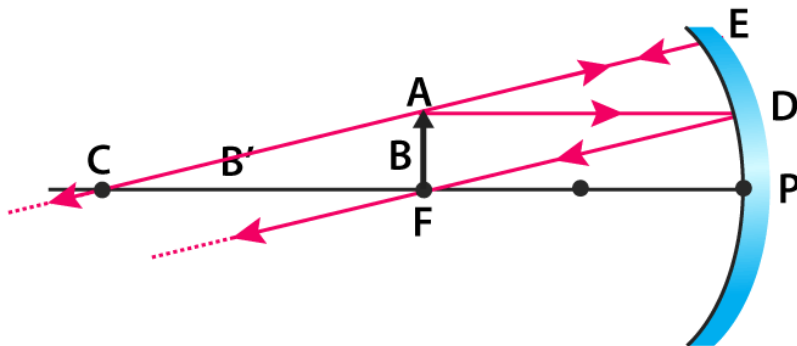
Image

Position – Beyond 'C'

Nature – Real, Inverted

Size – Big Size

5) Object placed at Focus



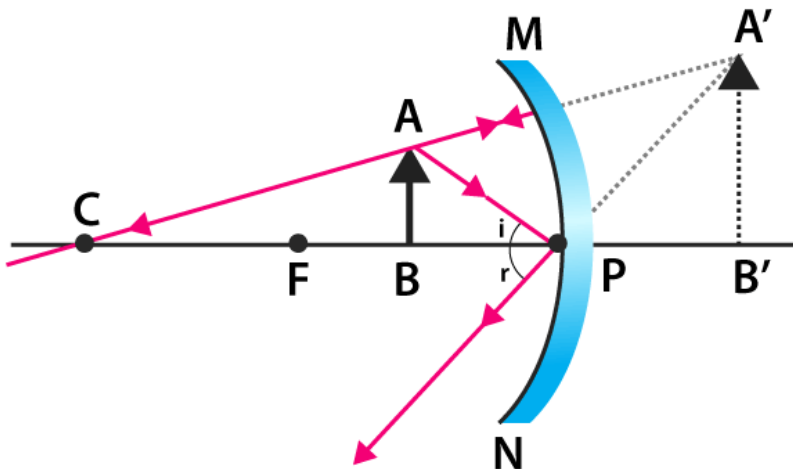
Image

Position – At Infinity

Nature – Real, Inverted

Size – Very Big Size

6) Object placed between Focus and Pole



Image

Position – Behind Mirror

Nature – Virtual, Erect

Size – Big Size

Position of Object	Position of Image	Size of Image	Nature of Image
<u>At Infinity</u>	At the focus F	Very Small	Real and Inverted
<u>Beyond C</u>	Between F and C	Small	Real and Inverted
<u>At C</u>	At C	Same Size	Real and Inverted
<u>Between C and F</u>	Beyond C	Big	Real and Inverted
<u>At F</u>	At Infinity	Very Big	Real and Inverted
<u>Between F and P</u>	Behind mirror	Big	Virtual and Erect

Uses of Concave Mirror -

- 1) Shaving mirror, torch, dentists, solar furnace



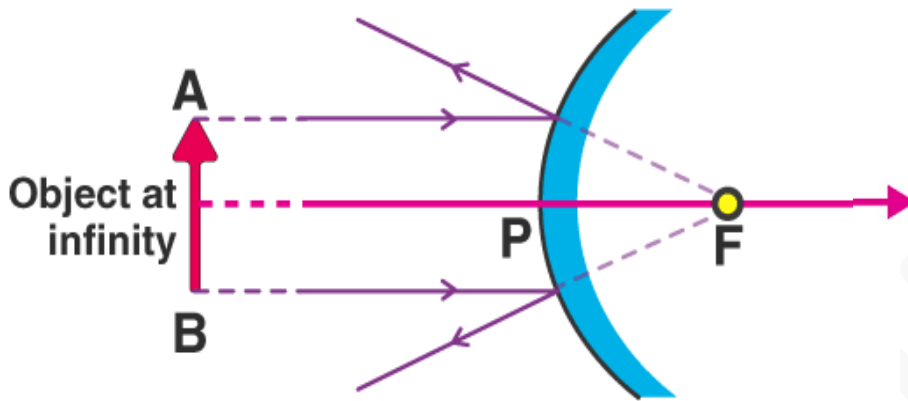
Dentists using Concave Mirror



Solar Furnace

CONVEX MIRROR

1) Object placed at Infinity



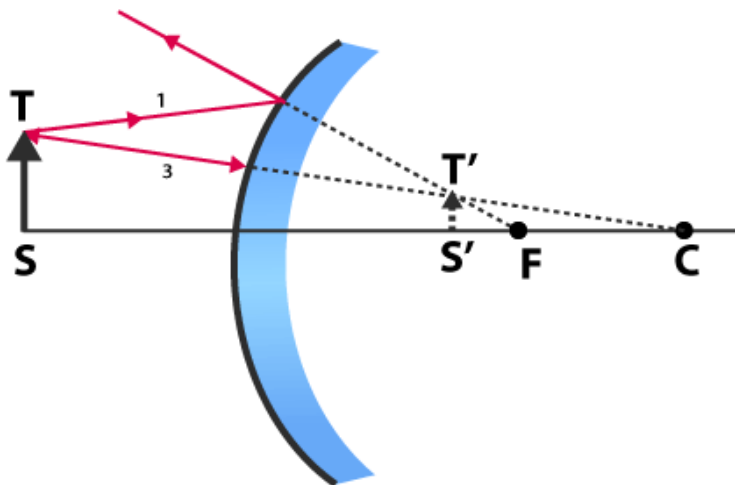
Image

Position – At 'F'

Nature – Virtual, Erect

Size – Very Small Size

2) Object placed between Infinity and Pole



Image

Position – Between 'P' and 'F'

Nature – Virtual, Erect

Size – Small Size

There are only two possible positions for Object

Position of Object	Position of Image	Size of Image	Nature of Image
<u>At Infinity</u>	At the focus F, Behind the mirror	Very Small	Virtual and Erect
<u>Between Infinity and Pole</u>	Between P and F, Behind the mirror	Small	Virtual and Erect

Uses of Convex Mirror -

- 1) Rear view mirrors in vehicles because they always give an erect image and have wider field of view as they are curved outward.
- 2) Big convex mirrors used in front of Schools, Buildings, Shops.



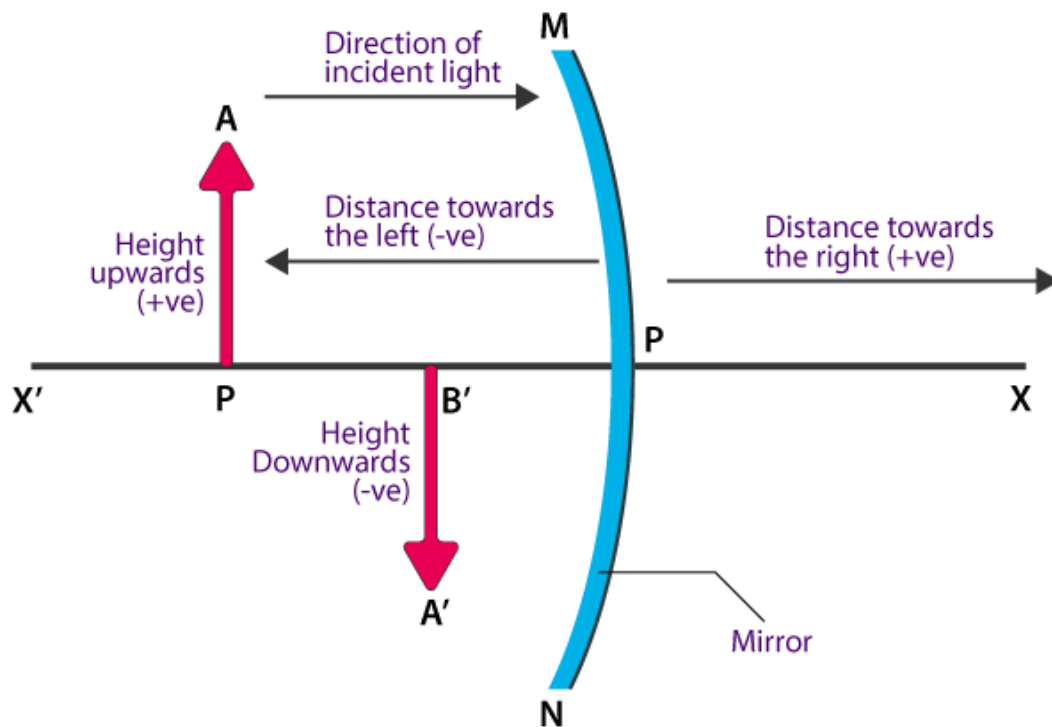
Convex Mirror in front of School



Car Mirror

Sign Convention

- 1) Object is placed to the left of mirror.
- 2) All distances parallel to principal axis are measured from pole of the mirror.
- 3) Pole is origin.
- 4) Principal axis is x-axis.



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

Mirror Formula

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

f → Focal length

v → Image distance

u → Object distance

Magnification

It is the ratio of the height of image to the height of object.

$$m = \frac{h_i}{h_o} = \frac{-v}{u}$$

h_i → height of Image

h_o → height of Object

If

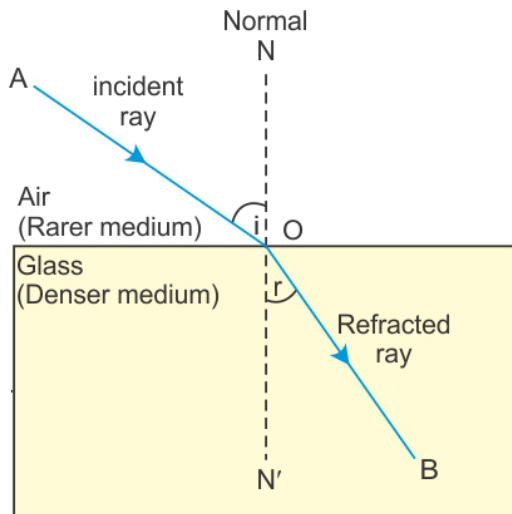
$m = -ve$ → Image will be Real and Inverted

$m = +ve$ → Image will be Virtual and Erect(Straight)

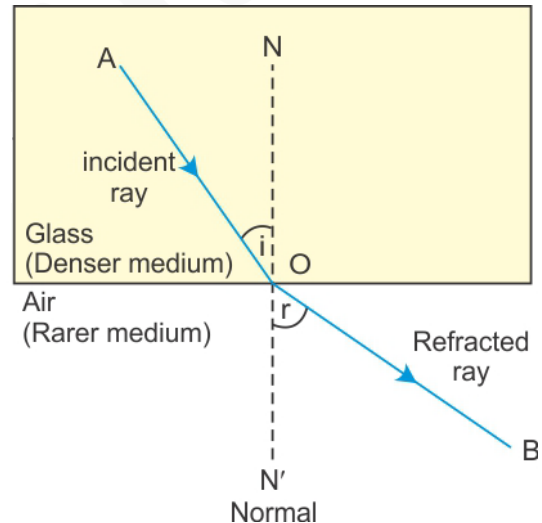
REFRACTION

Change in path of a light ray as it passes from one medium to another medium is called Refraction of Light.

1) When light ray goes from denser to rarer medium it bends away from normal.

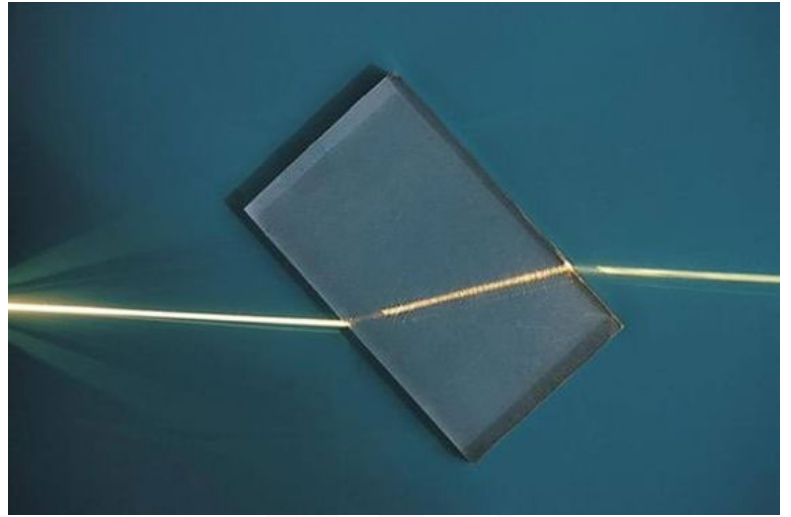


2) When light rays go from rarer to denser medium it bends towards the normal.

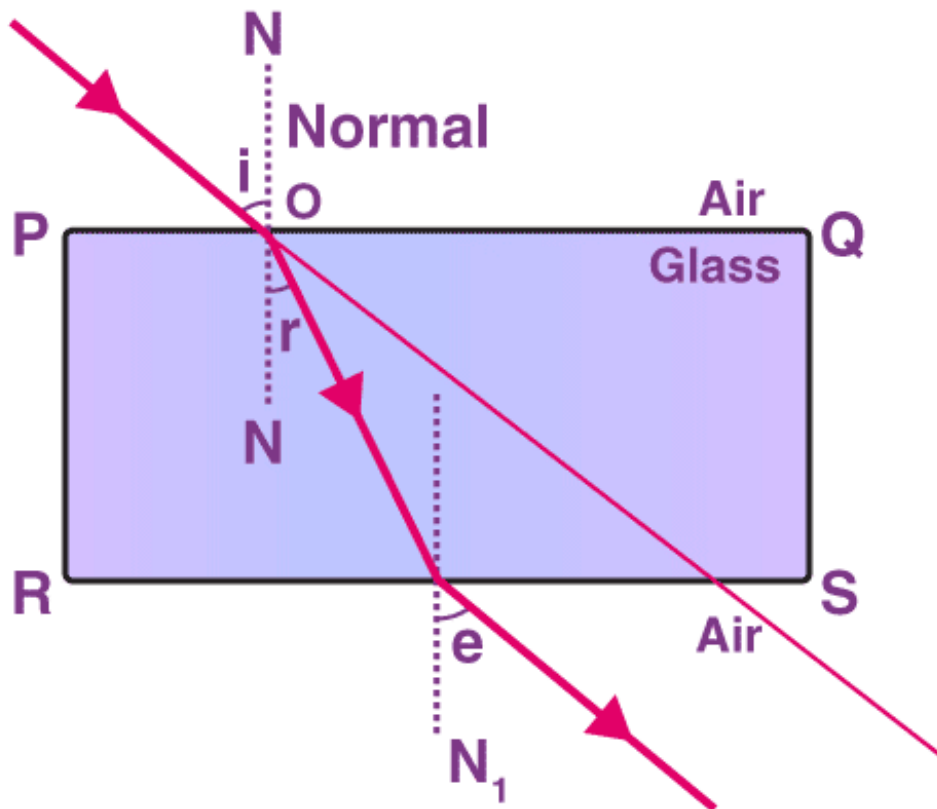


Cause of Refraction?

As we know speed of light is different in different media, i.e. more in rarer medium and comparatively less in denser medium. So, when light enters a denser medium, its speed reduces and it bends towards the normal and when it enters rarer medium, its speed increases and it bends away from the normal



Refraction through a Rectangular Glass Slab :-



i = Angle of incidence

r = Angle of Refraction

e = Angle of Emergence

- Angle of incidence = Angle of Emergence, $\angle i = \angle e$
- If the incident ray falls normally to the surface of glass slab, then there is no bending of ray of light ; i.e. it goes straight.

Laws of Refraction

- 1) 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.
- 2) Snell's Law - The ratio of sine of angle of incidence to the sine of angle of refraction is constant, for a light of given color and for a given pair of media.
 - It is expressed as :

$$\frac{\sin i}{\sin r} = \mu = \text{constant} \quad [\text{"}\mu\text{" is refractive index }]$$

Refractive Index

- The extent of change in direction that takes place in a given pair of media is expressed in terms of refractive index.

- ${}_1\mu_2$ represents refractive index of medium 2 with respect to medium 1, when light is going from medium 1 to medium 2.

$${}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r}$$

- The refractive index of a medium with respect to vacuum is called Absolute refractive index of medium.

For Glass/ Water pair -

$${}_w\mu_g = \frac{{}_a\mu_g}{{}_a\mu_w}$$

- If question is related to speed:

$$\mu = \frac{\text{Speed of light in vacuum/air}}{\text{Speed of light in Medium}} = \frac{c}{v}$$

For e.g.,

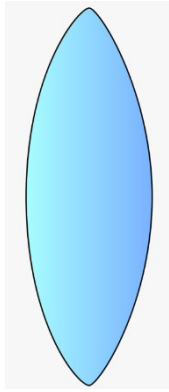
$${}_a\mu_g = \frac{\text{velocity of light in air}}{\text{velocity of light in glass}} = \frac{c}{v_g}$$

or

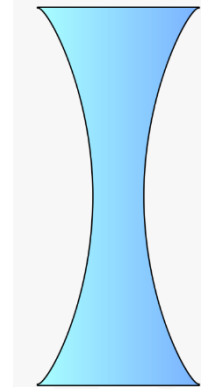
$${}_a\mu_w = \frac{\text{velocity of light in air}}{\text{velocity of light in water}} = \frac{c}{v_w}$$

Spherical Lens

A transparent material bound by two surfaces, of which both surfaces are spherical, forms a lens.



Convex Lens

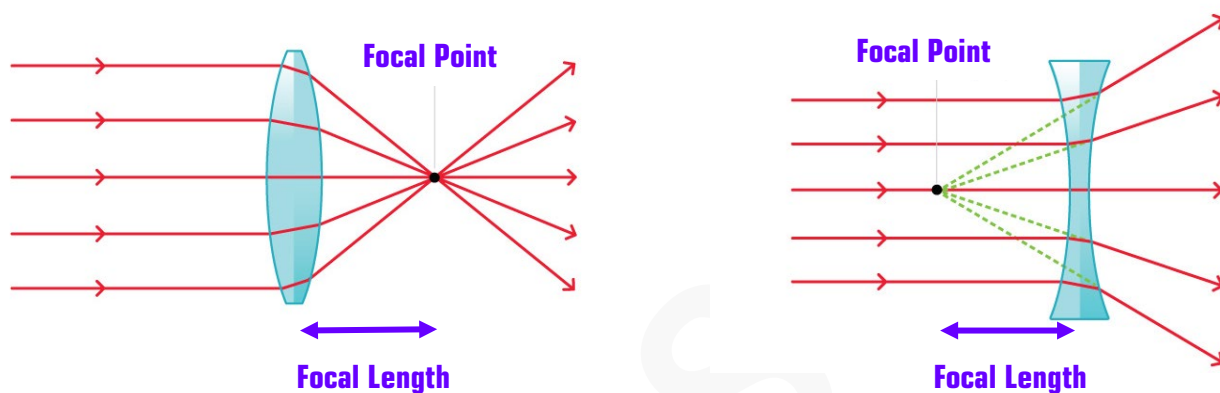


Concave Lens

- a) **Centre of Curvature (C)** - A lens has two spherical surfaces. Each surface forms a part of a sphere. The center of these spheres are called Centre of curvature. [ऊपर C_1 & C_2] [or $2F_1$ & $2F_2$]
- b) **Principal Axis** - An imaginary straight line passing through the two centers of curvature of a lens is called its Principal Axis.
- c) **Optical Centre (O)** - Central Point of a lens is called optical center.
- d) **Aperture** - Effective diameter of the circular outline of a spherical lens is called its aperture.

e) **Principal Focus (F)** - The point where the rays parallel to principal axis after refraction meet is called principal focus. A lens has two principal foci.

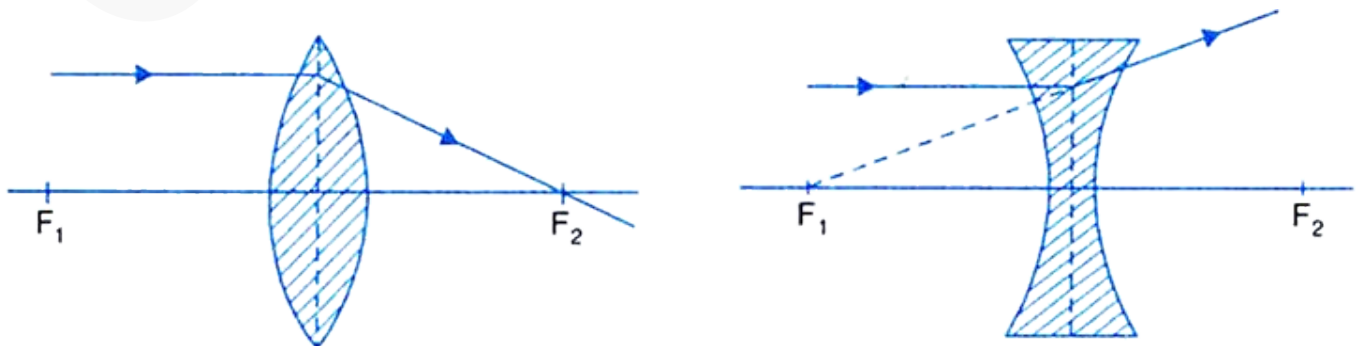
f) **Focal Length (f)** - The distance of principal focus from optical center.



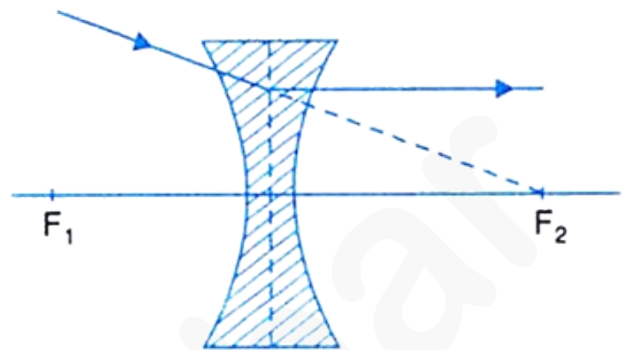
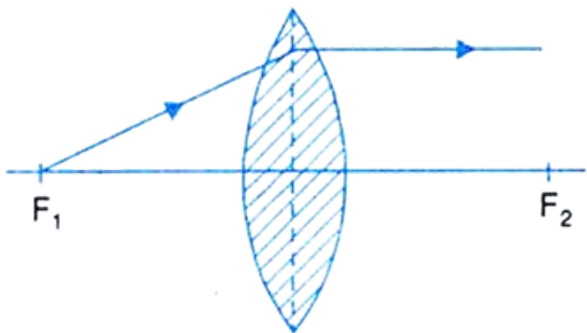
RAY DIAGRAMS

Some Rules -

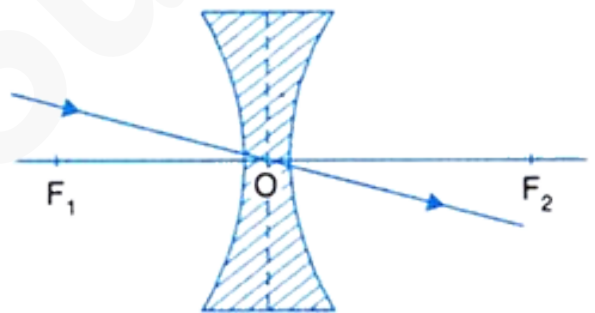
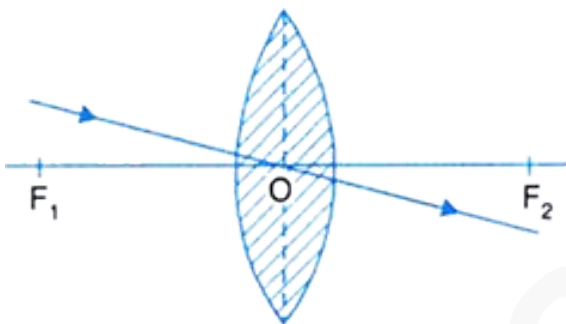
- 1) Rays which are parallel to principal axis, after refraction will pass through principal focus in case of convex lens and will appear to be coming from principal axis in case of concave lens.



- 2) Ray passing through the focus will emerge parallel to principal axis.

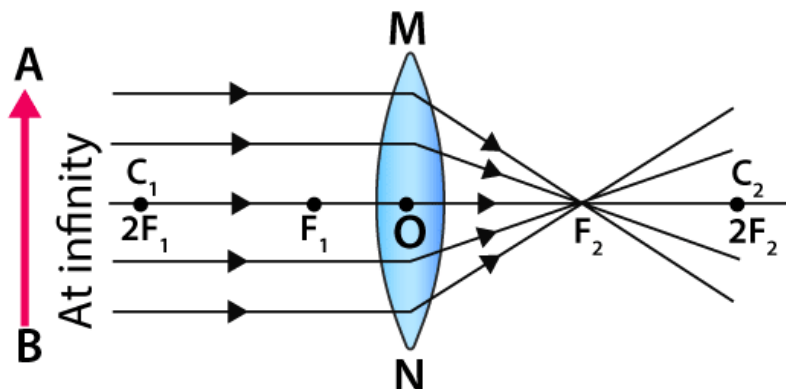


- 3) Ray directed to Optical Centre will emerge out undeviated.



CONVEX LENS

- 1) Object placed at Infinity



Image

Position – At 'F'

Nature – Real, Inverted

Size – Very Small



Burning Paper using Convex Lens

जिनकी पास की नज़र कमजोर है सिर्फ उन्हीं के चश्मे से होगा ये क्योंकि उनके चश्मे में ही Convex Lens होता है

2) Object placed behind Center of Curvature

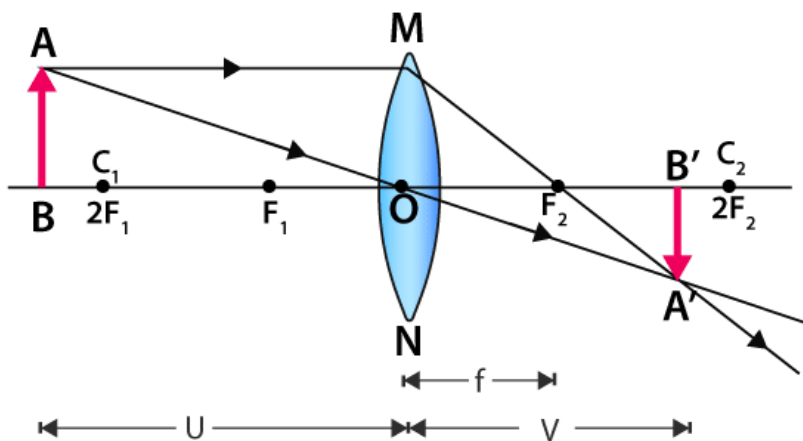


Image
 Position – **Between 'F' and 'C'**
 Nature – **Real, Inverted**
 Size – **Small**

3) Object placed at Centre of Curvature

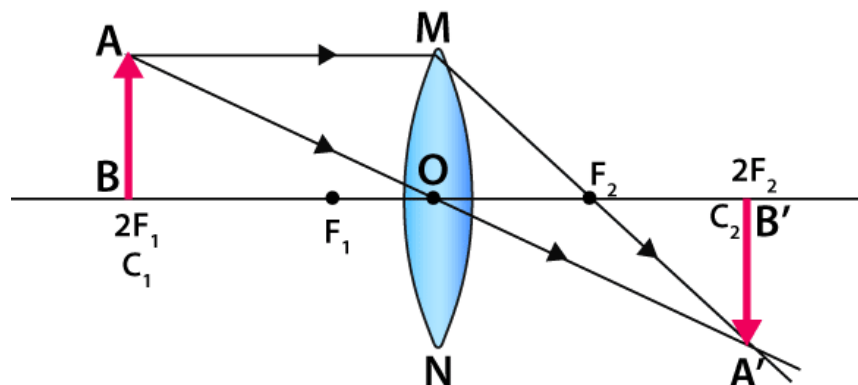
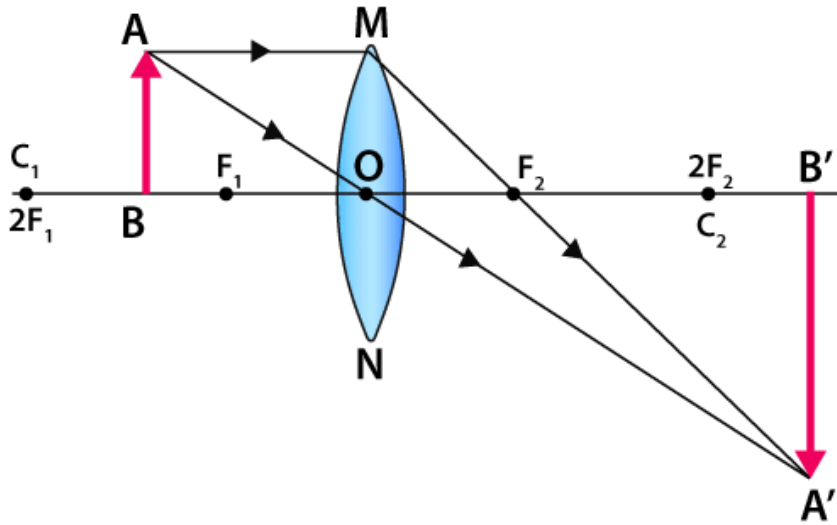


Image
 Position – **At 'C'**
 Nature – **Real, Inverted**
 Size – **Same Size**

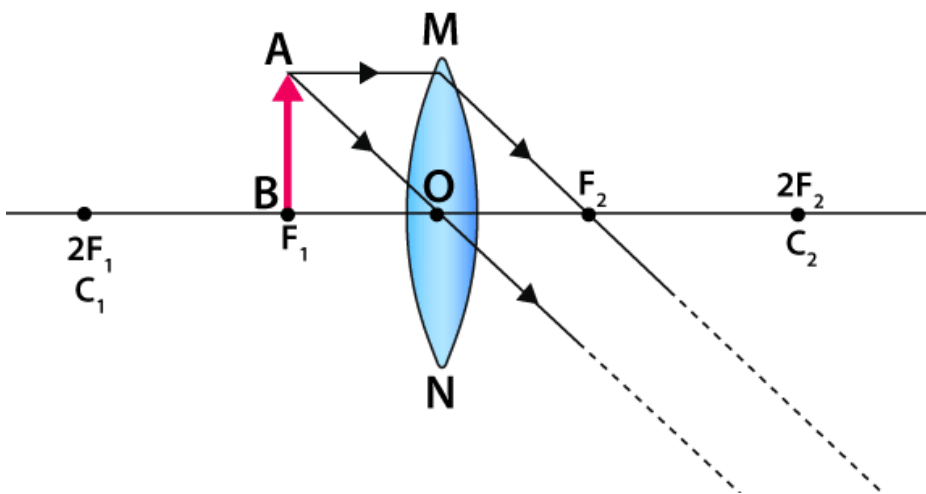
4) Object placed between Focus and Centre of Curvature



Image

Position – Beyond 'C'
Nature – Real, Inverted
Size – Big Size

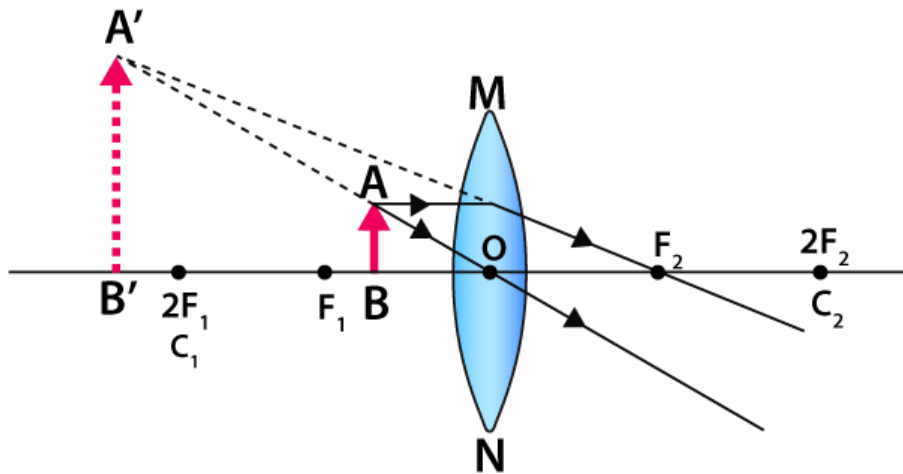
5) Object placed at Focus



Image

Position – At Infinity
Nature – Real, Inverted
Size – Very Big Size

6) Object placed between Focus and Pole



Image

Position – Behind Mirror

Nature – Virtual, Erect

Size – Big Size

Position of Object	Position of Image	Size of Image	Nature of Image
<u>At Infinity</u>	At F_2	Very Small	Real and Inverted
<u>Beyond $2F_1$</u>	Between $2F_2$ and F_2	Small	Real and Inverted
<u>Between $2F_1$ and F_1</u>	Beyond $2F_2$	Big	Real and Inverted
<u>At F_1</u>	At Infinity	Very Big	Real and Inverted
<u>At $2F_1$</u>	At $2F_2$	Same Size	Real and Inverted
<u>Between F_1 and O</u>	On Same side of the Object	Big	Virtual and Erect

Uses of Convex Lens -

1) Used for making Microscopes, Magnifying glasses



Microscopes



Magnifying Glass

2) Used for making Specs and Cameras



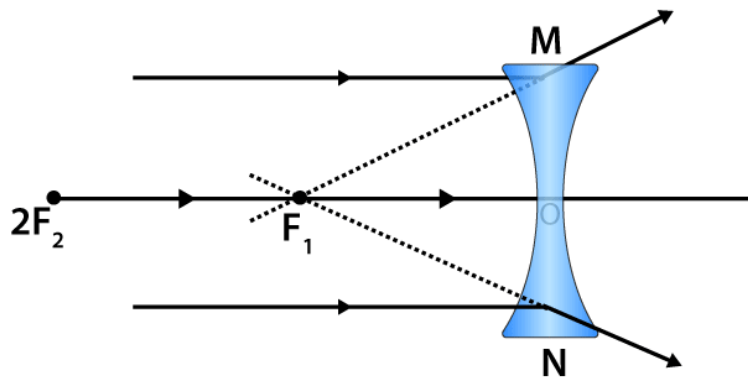
जिनकी पास की नज़र कमजोर होती है
उनकी चश्मा(Specs) में Convex
Lens होता है



Used in making Camera Lens

CONCAVE LENS

1) Object placed at Infinity



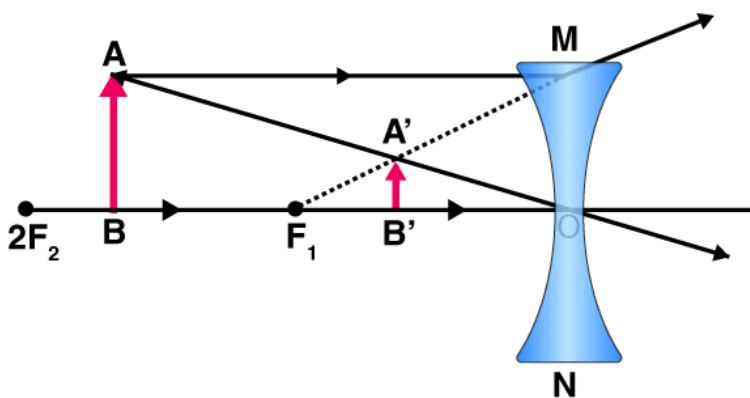
Image

Position – At 'F'

Nature – Virtual, Erect

Size – Very Small Size

2) Object placed between Infinity and Pole



Image

Position – Between 'P' and 'F'

Nature – Virtual, Erect

Size – Small Size

There are only two possible positions for Object

Position of Object	Position of Image	Size of Image	Nature of Image
<u>At Infinity</u>	At the focus (F_1)	Very Small	Virtual and Erect
<u>Between Infinity and Optical Center</u>	Between Focus (F_1) and Optical Center (O)	Small	Virtual and Erect

Uses of Concave Lens -

- 1) Used for making Specs, Lasers, Cameras



जिनकी दूर की नज़र कमजोर होती है
उनकी चश्मा(Specs) में **Concave**
Lens होता है



Laser Light

Sign Convention

- 1) Sign conventions are same like mirrors, now the measurements are taken from Optical Center instead of Pole.
- 2) Focal Length of Convex Lens = Positive (+)
- 3) Focal Length of Concave Lens = Negative (-)

Lens Formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

f → Focal length

v → Image distance

u → Object distance

Magnification

$$m = \frac{h_i}{h_o} = \frac{v}{u}$$

h_i → height of Image

h_o → height of Object

If

$m = -ve$ → Image will be Real and Inverted

$m = +ve$ → Image will be Virtual and Erect(Straight)

POWER OF LENS (P)

Ability of a lens to converge or diverge light rays is called power (P) of the lens.

$$P = \frac{1}{f}$$

f → Focal length in meter

- SI Unit → D (called Dioptre = m^{-1})
- Power of Convex Lens is (+ve) because focal length of Convex Lens is also +ve
- Power of Concave Lens is (-ve) because focal length of Concave Lens is also -ve
- Power of a lens combination

$$P = P_1 + P_2 + P_3$$

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I have created all Subjects and all Chapters Notes 🖱️

CHEMICAL REACTIONS & EQUATIONS

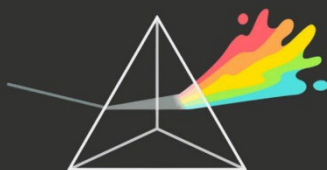
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Acid, Base & Salt

Handwritten Notes



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Magnetic Effects of Electric Current

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Periodic Classification of Elements

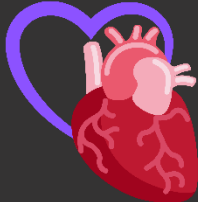
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LIFE PROCESSES


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CARBON & its compounds

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RISE OF NATIONALISM IN EUROPE

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NATIONALISM IN INDIA


Handwritten Notes



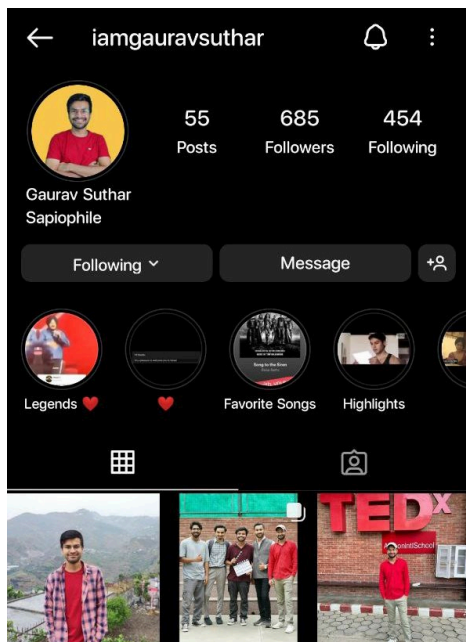
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METALS & NON-METALS

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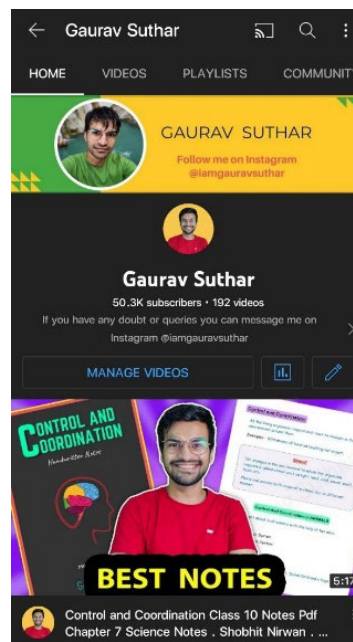
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Control and Coordination Class 10 Notes Pdf Chapter 7 Science Notes . Shobhit Nirwan