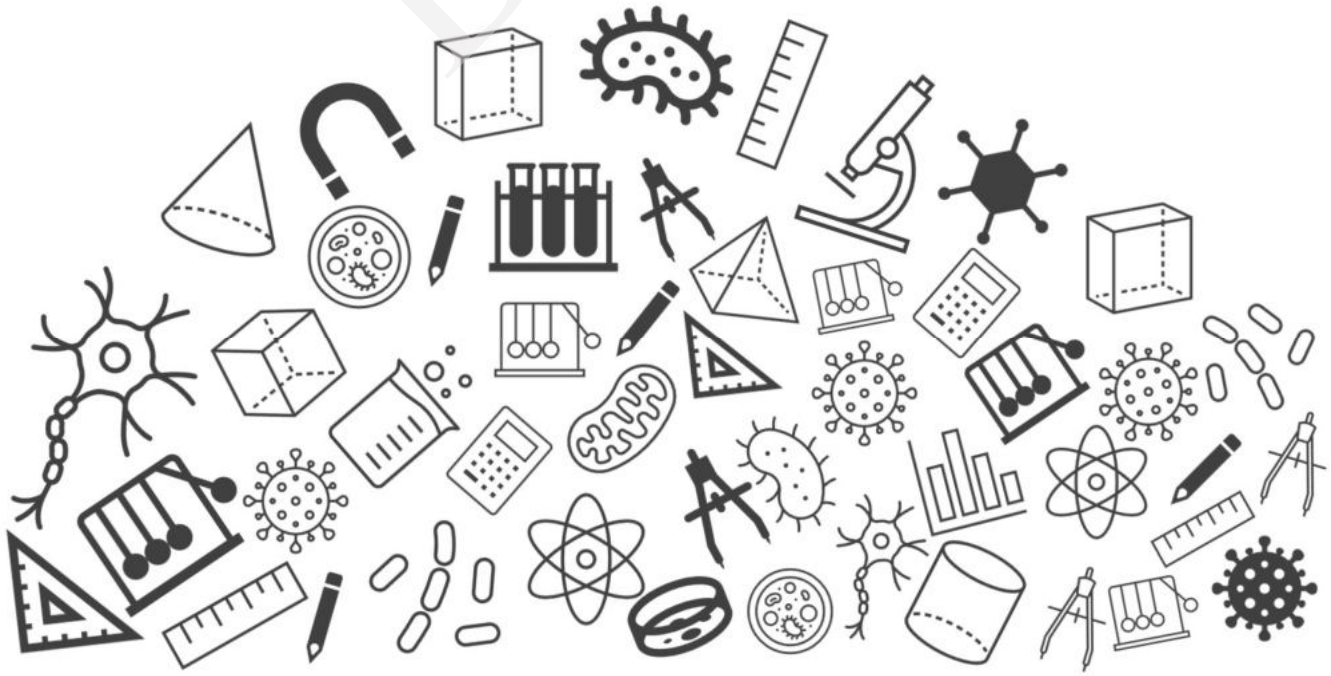
Grade 10: Science
Chapter Notes



BYJU'S

Chapter Notes

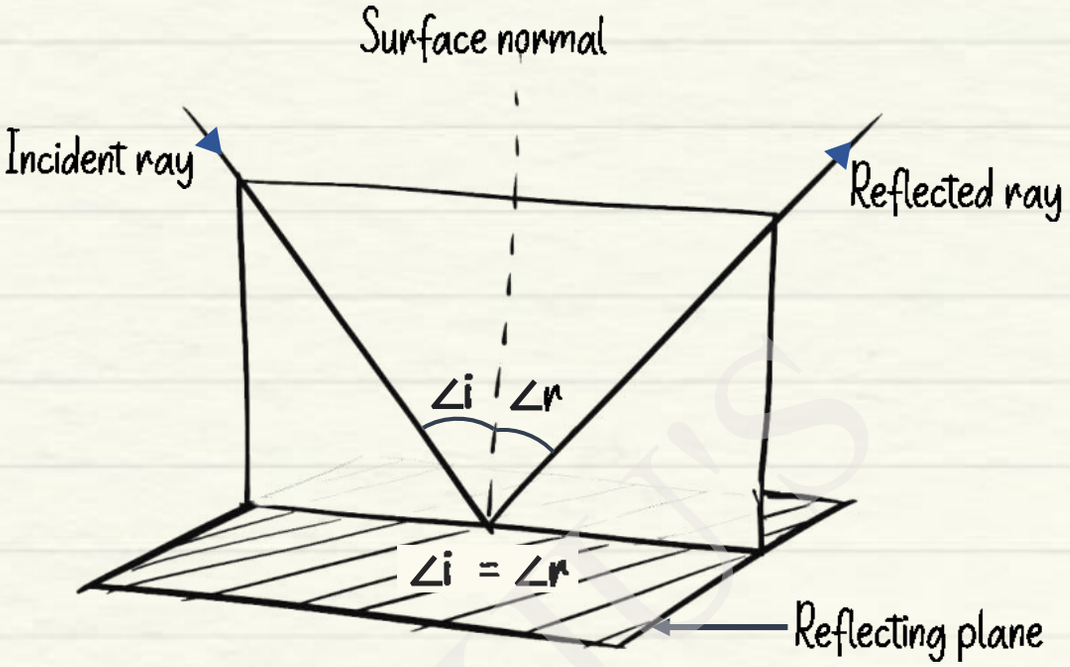
Light – Reflection and Refraction

Topics

1. Reflection of Light
2. Spherical Mirrors
3. Image Formation by Spherical Mirrors
4. Mirror Formula and Magnification
5. Refraction of Light
6. Refraction by Lenses
7. Image Formation by Lenses
8. Lens Formula and Magnification

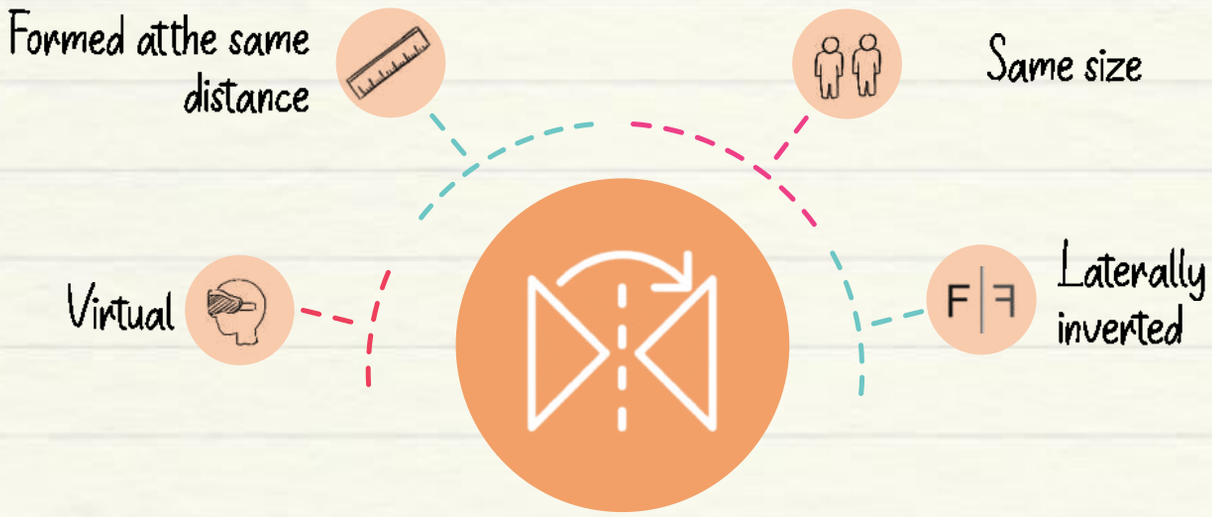
1. Reflection of Light

1.1 Laws of Reflection of Light



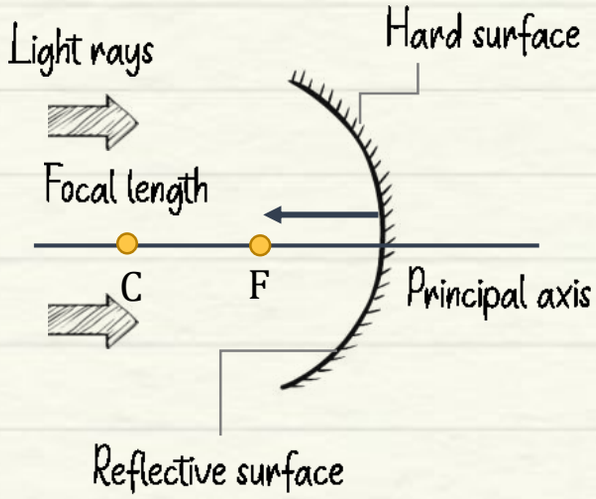
- Angle of incidence = Angle of reflection
- The incident ray, normal at the point of incidence, and reflected ray, all lie in the same plane.

1.2 Image Formation by a Plane Mirror

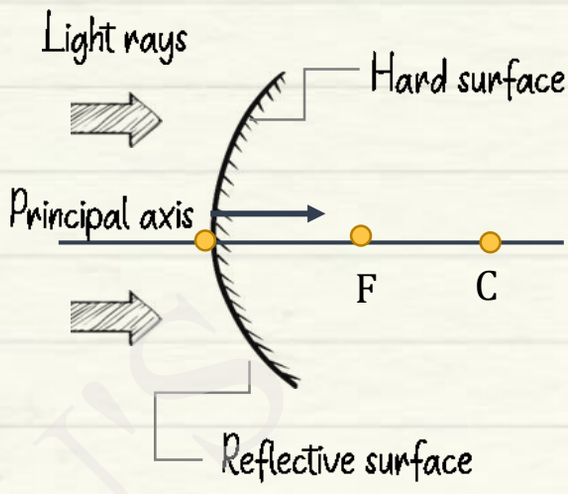


2. Spherical Mirrors

2.1 Terms Related to Spherical Mirrors



Concave Mirror



Convex Mirror

Pole (P) Centre of reflecting surface

Centre of Curvature (C)

The centre of sphere of which the mirror forms the part. The distance between C and O is called radius of curvature (R).

Focus (F)

Point on the principal axis at which the rays parallel to principal axis meet (concave mirror) or appear to meet (convex mirror) after reflection.

Principal Axis

The straight line joining P and C

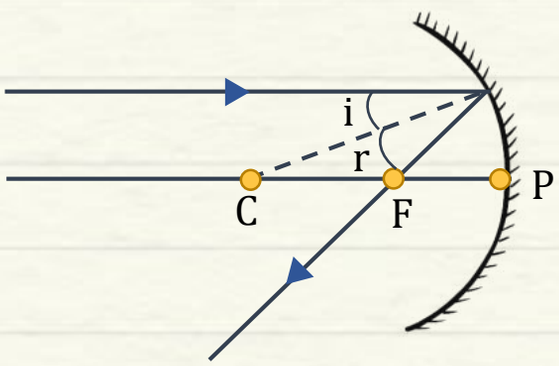
Focal Length (f)

Distance between the pole and the focus

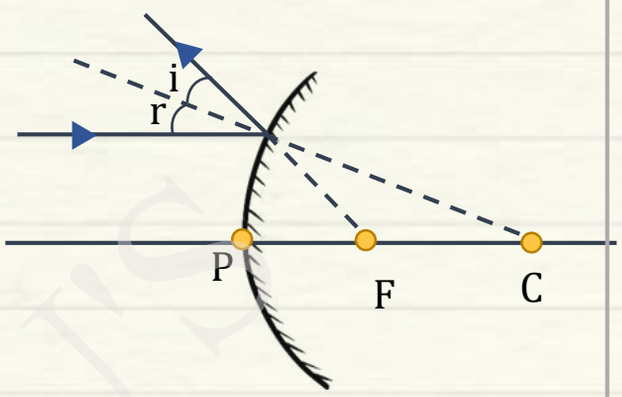
2.2 Special Rays

Rays Parallel to Principal Axis

Passes through the principal focus

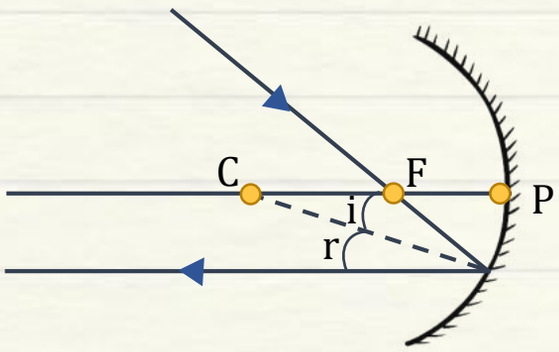


Appears to pass through the principal focus

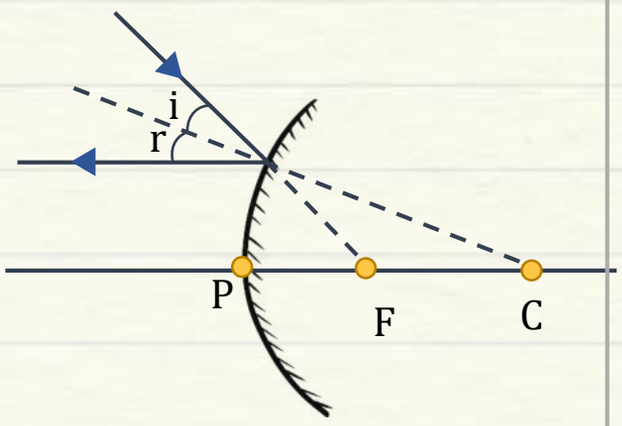


Rays Passing through the Principal Focus

Emerges parallel to the principal axis

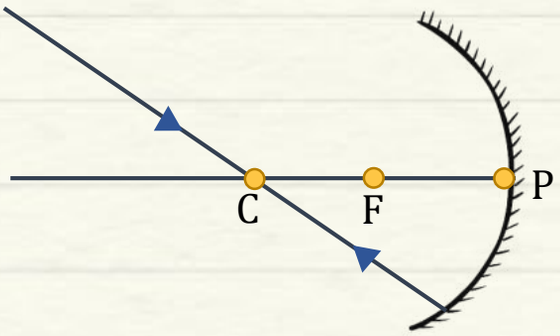


Emerges parallel to the principal axis

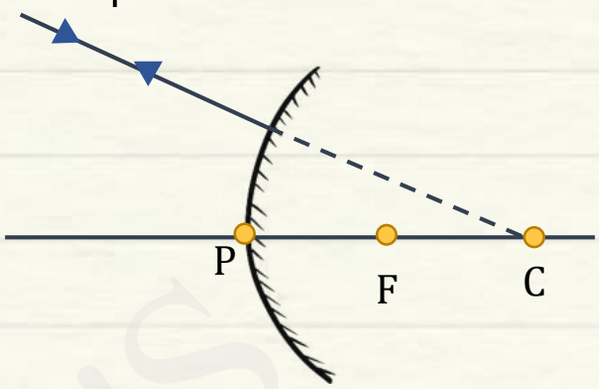


Ray Passing/Directing through the Centre of Curvature

Reflects along the same path

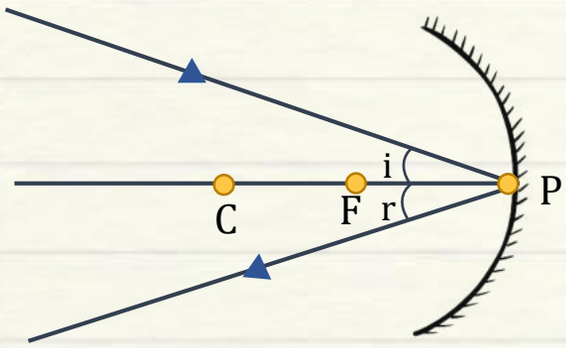


Reflects along the same path

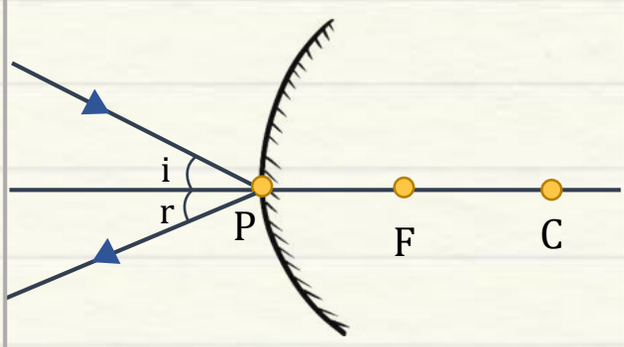


Ray Incident Obliquely to the Principal Axis, Towards the Pole of the Mirror

Reflects obliquely, following laws of reflection



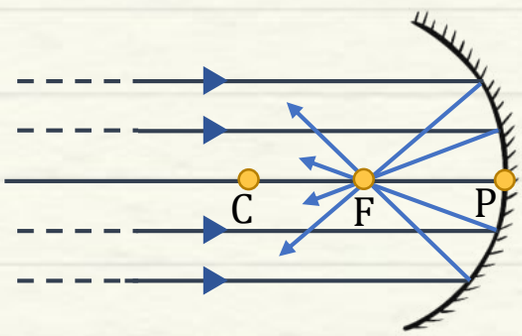
Reflects obliquely, following laws of reflection



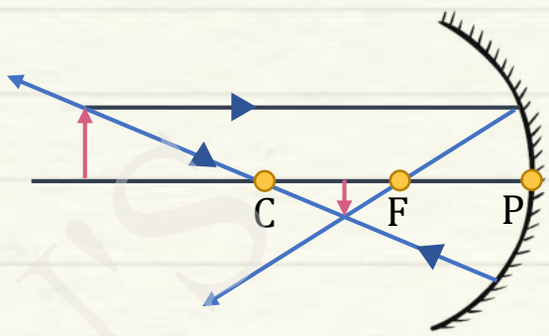
3. Image Formation by Spherical Mirrors

3.1 Concave Mirrors

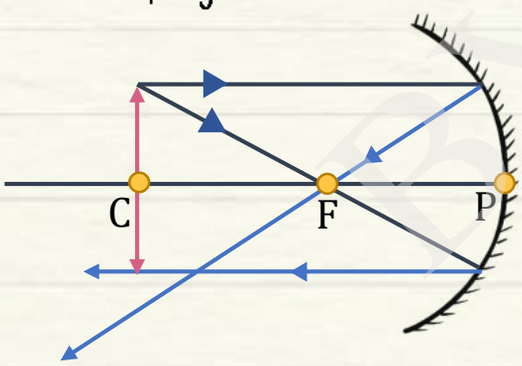
Position of Object: At infinity



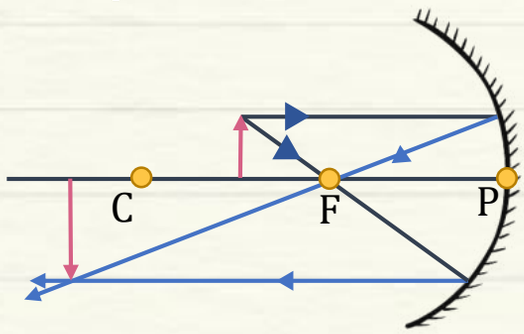
Position of Object: Beyond C



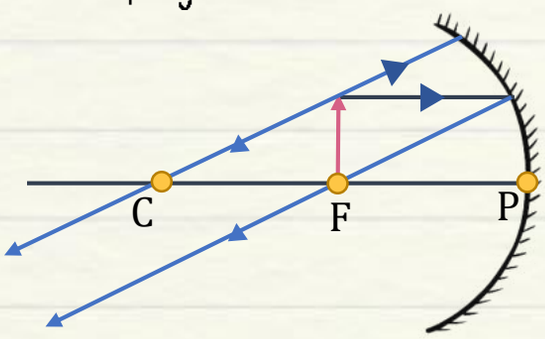
Position of Object: At C



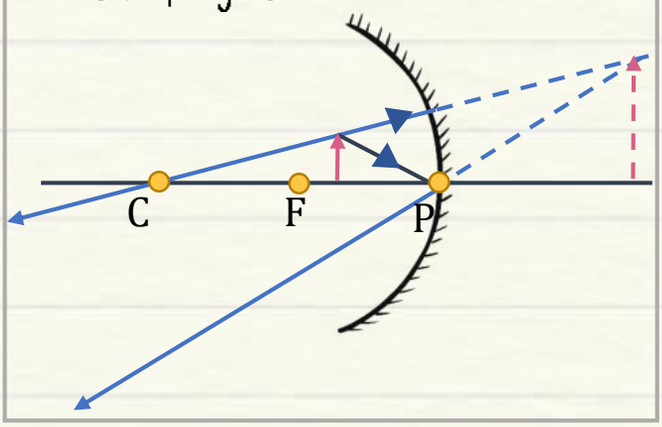
Position of Object: Between C and F



Position of Object: At F



Position of Object: Between F and P



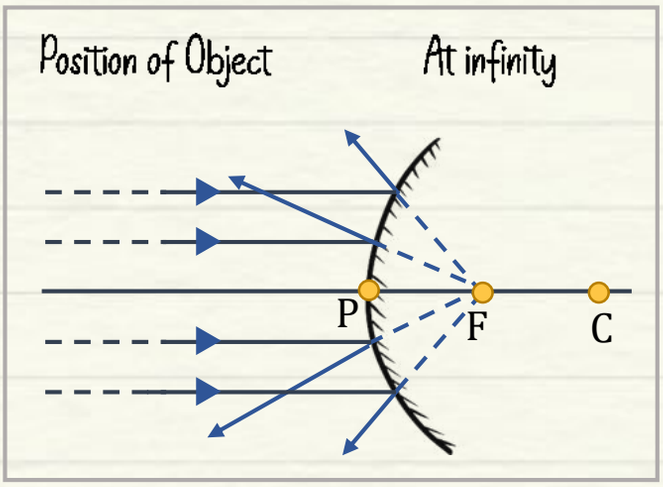
3.2 Characteristics of Images Formed by Concave Mirrors

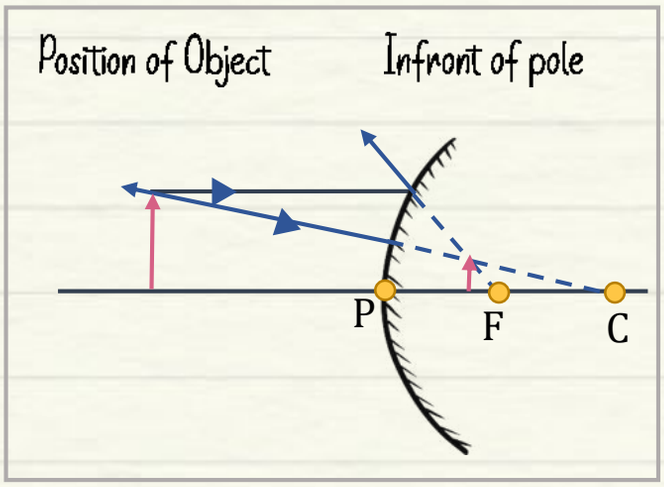
Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F	Highly diminished	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

3.3 Uses of Concave Mirrors

Used in torches, search-lights, vehicles headlights, and shaving mirrors

3.4 Image Formation by Convex Mirrors



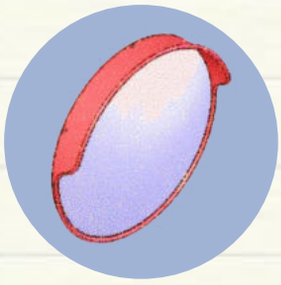


3.5 Characteristics of Images Formed by Convex Mirrors

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F	Highly diminished	Virtual and erect
Infront of pole	Between Pole P and focus F	Diminished	Virtual and erect

Image formed by a convex mirror is always virtual, erect and diminished.

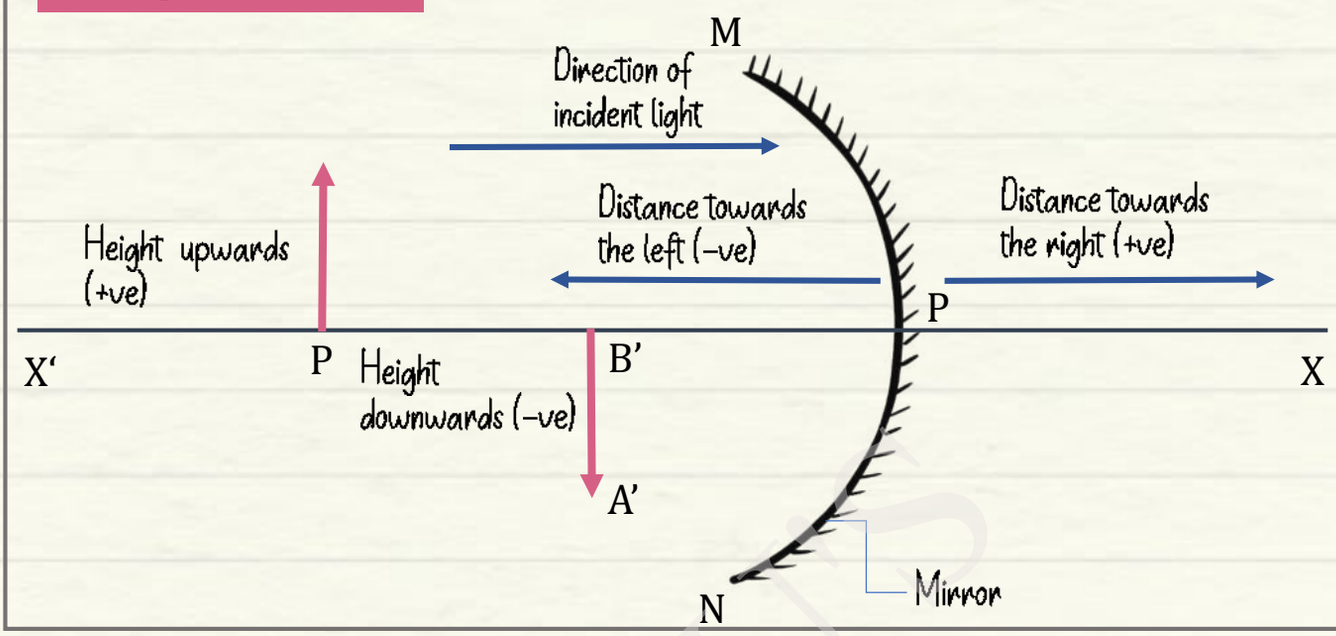
3.6 Uses of Convex Mirrors



Used as rear-view (wing) mirrors in vehicles, and as corner mirrors for road safety as well as at corners of large buildings

4. Mirror Formula

4.1 Sign Convention



4.2 Mirror Formula

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

u → The distance of object from the pole

v → The distance of image from the pole

f → Focal length of the mirror

4.3 Magnification

$$m=\frac{h'}{h}=-\frac{v}{u}$$

h" → Height of the image

h → Height of the object

5. Refraction

5.1 Refraction:

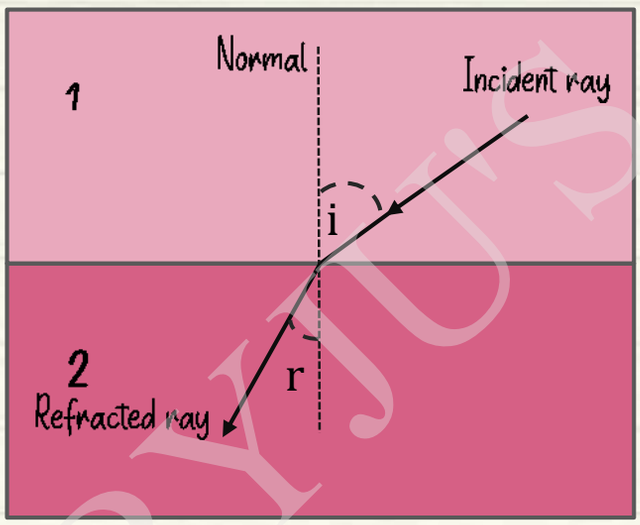
Bending of light when it travels obliquely from one medium to another

Denser to rarer:

- Bends away from normal
- Speed increases

Rarer to denser:

- Bends towards normal
- Speed decreases



5.2 Laws of Refraction:

I. The incident ray, the refracted ray and the normal all lie in the same plane.

II. Snell's law:

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

5.3 Refractive Index:

Refractive index of medium 2 w.r.t medium 1:

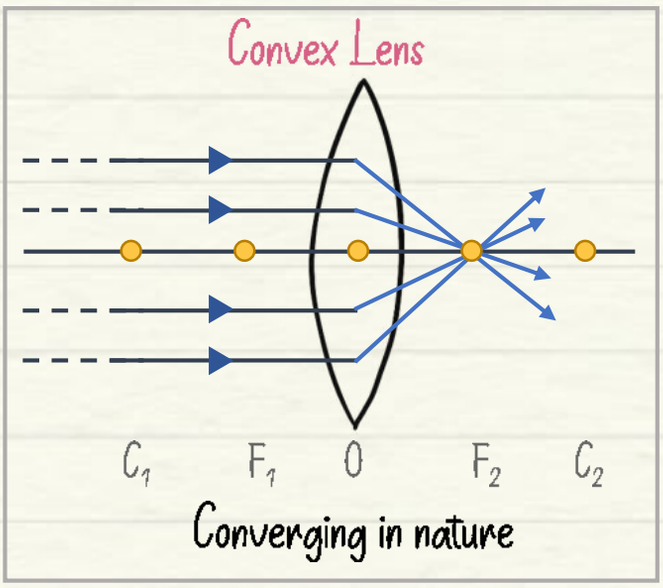
$$n_{21} = \frac{v_1}{v_2}$$

Absolute refractive index of any medium:

$$n_m = \frac{c}{v_m}$$

6. Lenses

6.1 Types of Lenses:



6.2 Important Terms:

Centre of Curvature (C1, C2) : The centre of sphere of which a lens is formed.

Principal Axis

Imaginary line through C1 and C2

Optical Centre (O)

The central point in a lens.

Aperture

The effective diameter of the circular outline of a spherical lens.

Principal Focus (F)

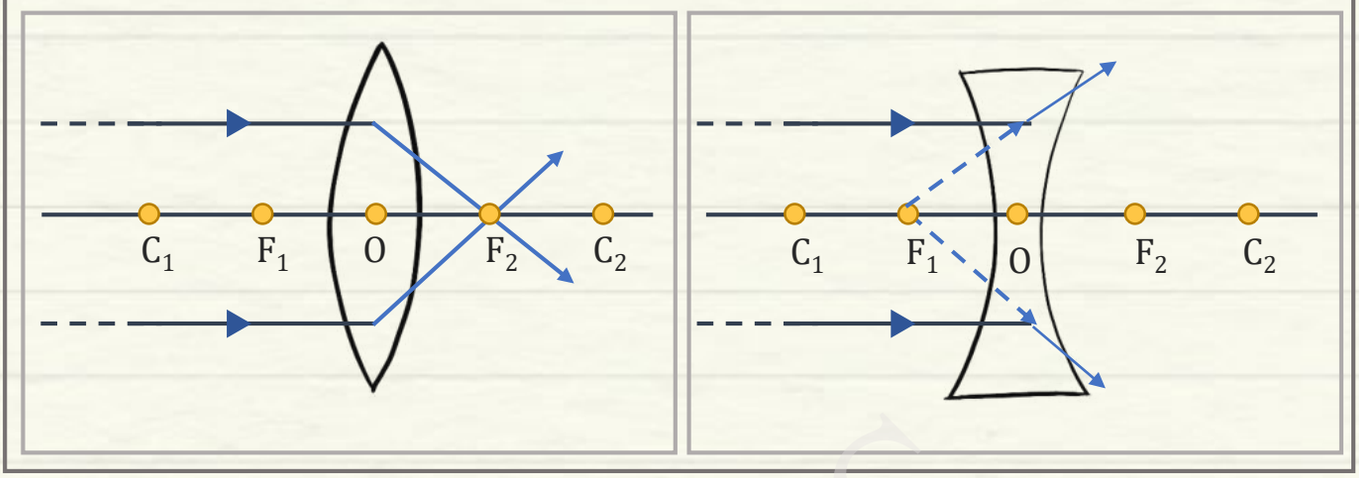
The point at which parallel rays of light converge in a convex lens and appear to diverge from a point in case of a concave lens.

6.3 Sign Convention:

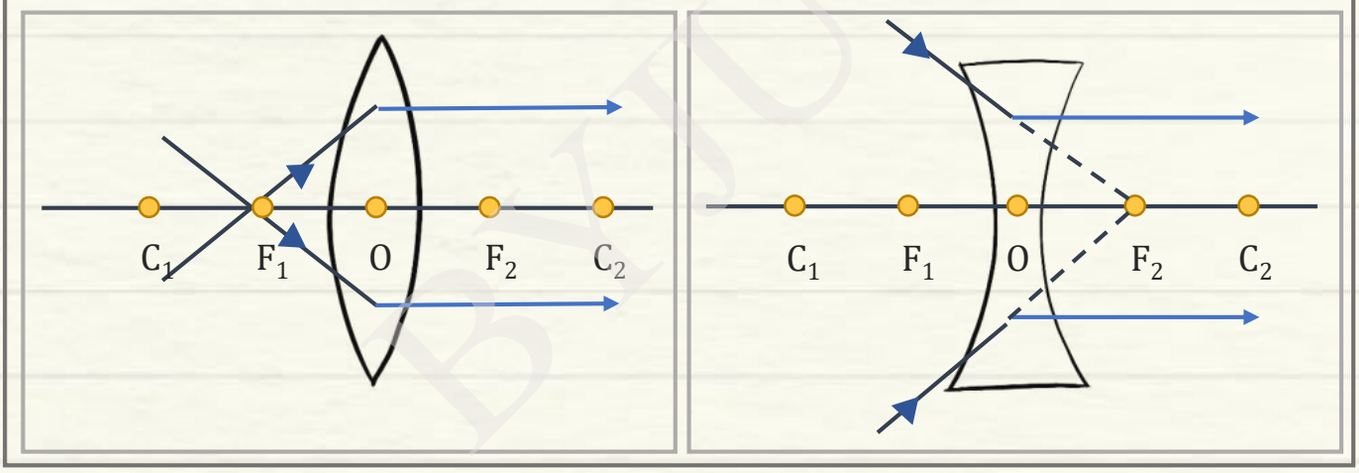
The same sign convention is followed for lenses that is used for spherical mirrors except that all the distances are measured from the optical centre of the lens.

6.4 Special Rays:

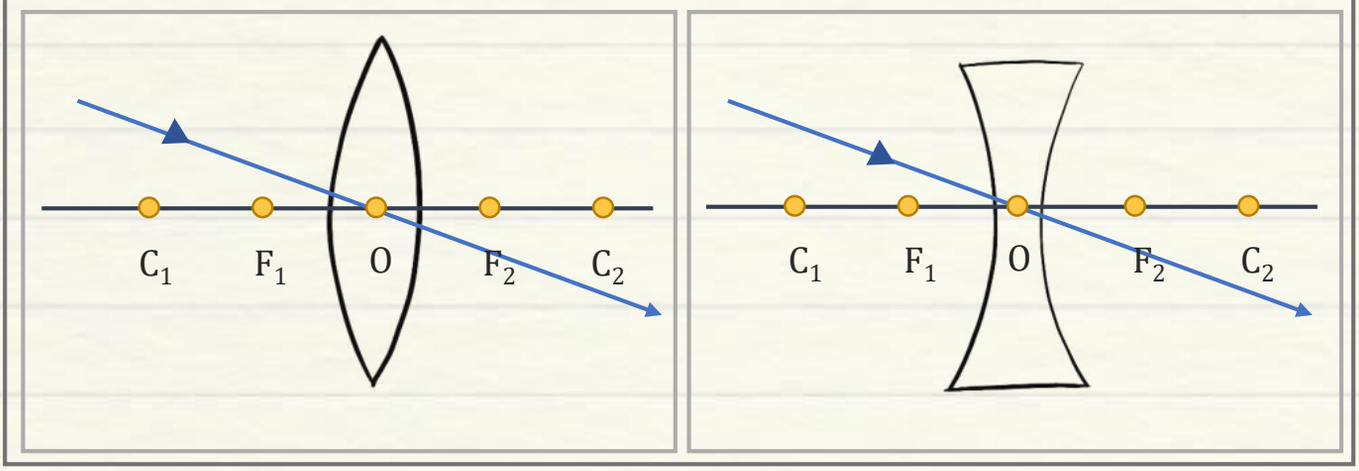
Rays Parallel to the Principal Axis



Rays Passing through the Principal Focus



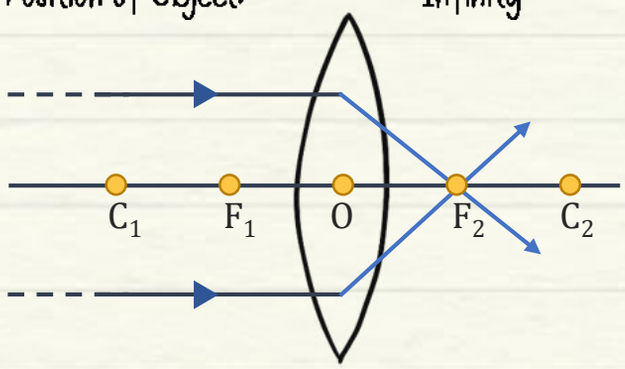
Ray Passing/Directing through the Centre of Curvature



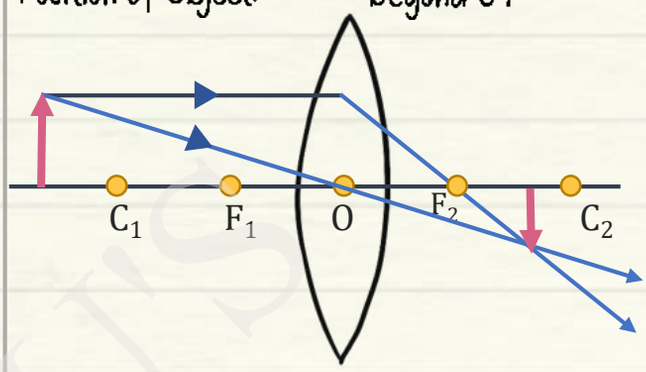
7. Image Formation by Lenses

7.1 Image Formation by a Convex Lens

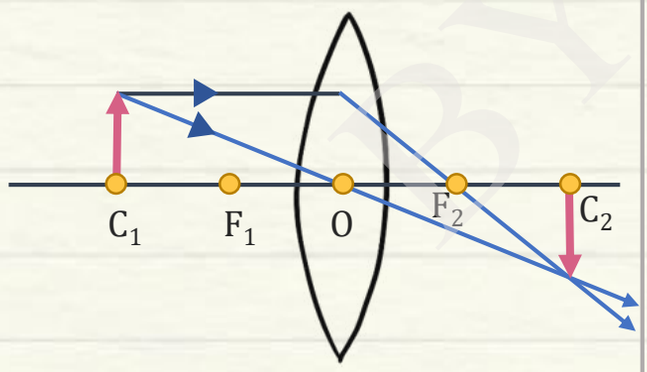
Position of Object: Infinity



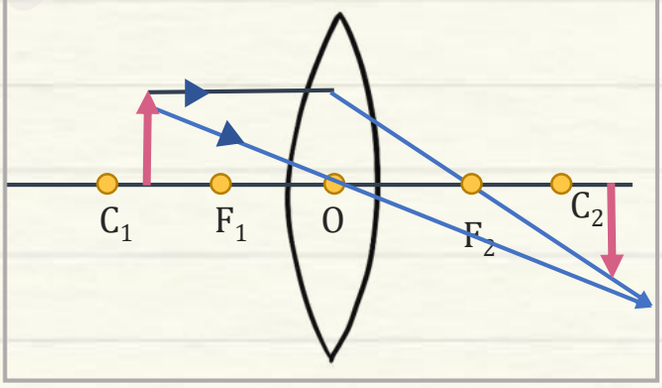
Position of Object: Beyond C1



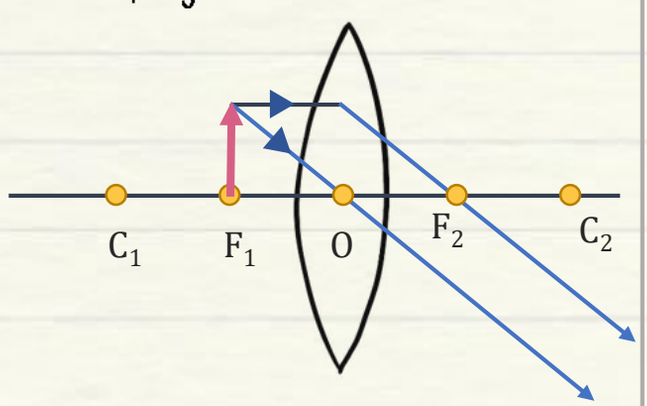
Position of Object: At C1



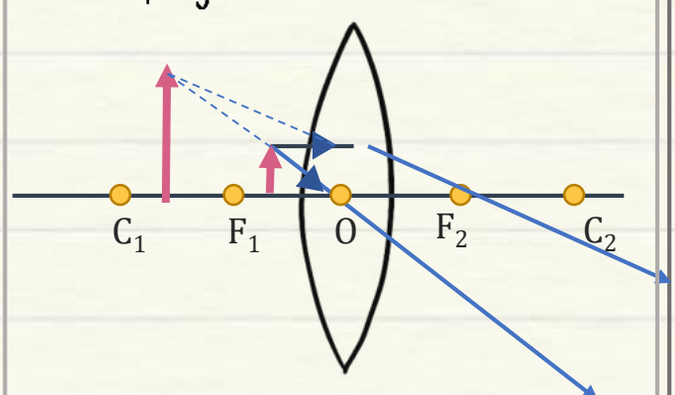
Position of Object: Between C1 and F1



Position of Object: At F1



Position of Object: Between F1 and O



7.2 Characteristics of Images Formed by a Convex Lens

Position of the object	Position of the image	Size of the image	Nature of the image
At Infinity	At focus F2	Highly diminished	Real and inverted
Beyond C1	Between F2 and C2	Diminished	Real and inverted
At C1	At C2	Same size	Real and inverted
Between F1 and C1	Beyond C2	Enlarged	Real and inverted
At focus F1	At infinity	Infinitely large	Real and inverted
Between F1 and O	On the same side of the lens as the object	Enlarged	Virtual and erect

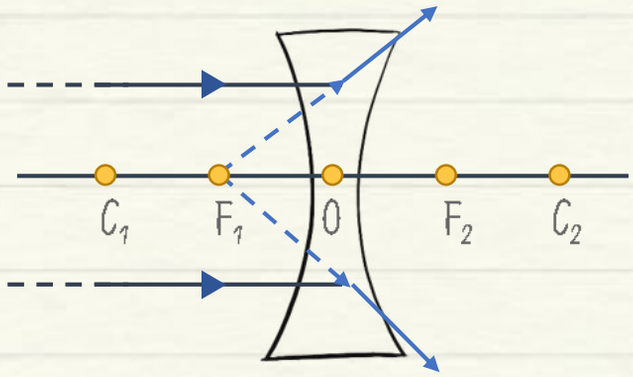
Uses of Convex Lens

Spectacles

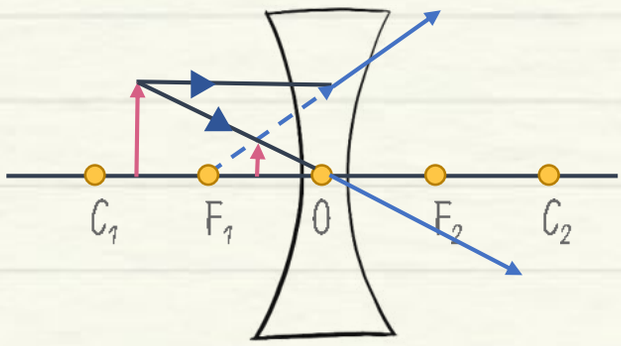
Magnifying lens

7.3 Image Formation by a Concave Lens

Position of Object At infinity



Position of Object Between infinity and O



7.4 Characteristics of Images Formed by a Concave Lens

Position of the object	Position of the image	Size of the image	Nature of the image
At Infinity	At focus F1	Highly diminished	Virtual and erect
Between infinity and optical centre O	Between focus F1 and optical centre O	Diminished	Virtual and erect

Image formed by a convex mirror is always virtual and erect

8. Lens Formula and Magnification

8.1 Lens Formula:

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

8.2 Magnification

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

9. Power of a Lens

9.1 Power of a lens (P):

Power of a convex lens is its converging ability, whereas, power of a concave lens is its diverging ability.

$$P = \frac{1}{\text{Focal length(in metres), f}}$$

- SI Unit: Dioptre 'D".
- The net power of lenses of individual powers P1, P2, P3, and so on, placed in contact is given by,

$$P = P1 + P2 + P3 + ...$$

Important Formulae

Quantity	Formula (or Value)
Mirror formula	$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$
Magnification by a mirror	$m=\frac{h'}{h}=-\frac{v}{u}$
Snell"s law	$\frac{\sin i}{\sin r}=constant$
Absolute refractive index	$n_m=\frac{c}{v_m}$
Relative refractive index	$n_{21}=\frac{v_1}{v_2}$
Lens formula	$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$
Magnification by a lens	$m=\frac{h'}{h}=\frac{v}{u}$
Power of a lens	$P=\frac{1}{f}$

Mind Map