



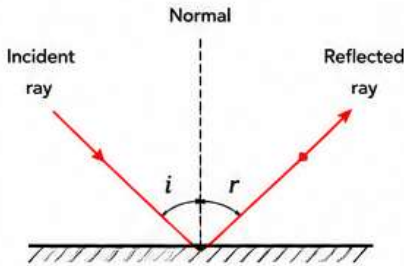
LIGHT – REFLECTION AND REFRACTION

REFLECTION AND SPHERICAL MIRRORS

Key Concepts, Definitions, Formulas, Ray Diagrams & Quick Facts

1 LAWS OF REFLECTION

- The incident ray, the reflected ray and the normal to the reflecting surface at the point of incidence, all lie in the same plane.
- The angle of incidence (i) is equal to the angle of reflection (r).



$$\angle i = \angle r$$

2 SPHERICAL MIRRORS

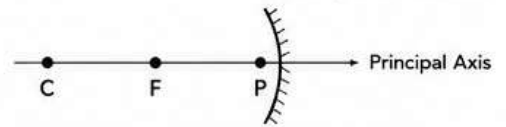
- A spherical mirror is a part of a hollow sphere whose inner or outer surface is polished and reflecting.

Two types:

- Concave Mirror:** Reflecting surface is inner (curved inwards).
- Convex Mirror:** Reflecting surface is outer (curved outwards).

3 IMPORTANT TERMS

- Pole (P)** : The midpoint of the mirror.
- Centre of Curvature (C)** : The centre of the sphere of which the mirror is a part.
- Radius of Curvature (R)** : The radius of the sphere.
- Principal Axis** : The straight line passing through P and C.
- Principal Focus (F)** : The point on the principal axis where parallel rays actually meet (concave) or appear to meet (convex) after reflection.



Relation: $R = PC$ and $f = \frac{R}{2}$
(f = focal length)

4 RULES FOR DRAWING RAY DIAGRAMS (REFLECTION)

- A ray parallel to the principal axis, after reflection passes through (or appears to pass through) the focus.
- A ray passing through (or directed towards) the focus, after reflection becomes parallel to the principal axis.
- A ray passing through the centre of curvature is reflected back along the same path.
- A ray incident at the pole is reflected obeying the law of reflection ($\angle i = \angle r$).

5 IMAGE FORMATION BY CONCAVE MIRROR

Object Position	Image Position	Size of Image	Nature of Image
At infinity	At F	Highly diminished (point-sized)	Real and inverted
Beyond C	Between C and F	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	Not formed	—	—
Between F and P	Behind the mirror	Enlarged	Virtual and erect

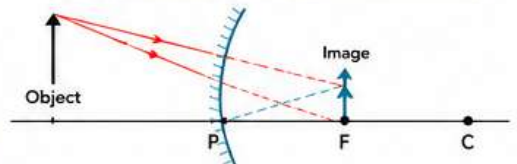
C = Centre of curvature, F = Principal focus, P = Pole

6 IMAGE FORMATION BY CONVEX MIRROR

Object Position	Image Position	Size of Image	Nature of Image
At any position (in front of mirror)	Between P and F (behind the mirror)	Diminished	Virtual and erect

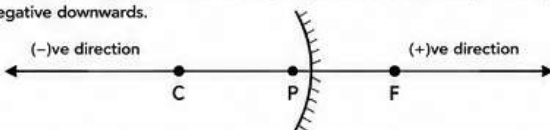
Key Point:

A convex mirror always forms a virtual, erect and diminished image, regardless of the position of the object.



7 SIGN CONVENTION (NEW CARTESIAN SIGN CONVENTION)

- All distances are measured from the pole (P) along the principal axis.
- Distances measured in the direction of incident light are taken as positive.
- Distances measured opposite to the direction of incident light are taken as negative.
- Distances measured perpendicular to the principal axis are taken as positive upwards and negative downwards.



8 MIRROR FORMULA AND MAGNIFICATION

Mirror Formula

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

Where,
 u = object distance
 v = image distance
 f = focal length

Magnification (m)

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

Where,
 h_i = height of image
 h_o = height of object

Important

For concave mirror :

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

For convex mirror :

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

QUICK FORMULAS / POINTS

- $\angle i = \angle r$
- Mirror formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$
- Magnification: $m = -\frac{v}{u} = \frac{h_i}{h_o}$
- For concave mirror: $f = -\frac{R}{2}$
- For convex mirror: $f = +\frac{R}{2}$
- $R = 2f$

TIPS / QUICK FACTS

- ✓ Concave mirror can form real and virtual images.
- ✓ Convex mirror always forms virtual, erect and diminished images.
- ✓ The focus of a concave mirror is real (in front of mirror).
- ✓ The focus of a convex mirror is virtual (behind the mirror).

COMMON MISTAKES

- ✗ Forgetting the direction of distances (u and v) as per sign convention.
- ✗ Using wrong sign of focal length.
- ✗ Not placing image on the principal axis.
- ✗ Confusing real focus (concave) with virtual focus (convex).

★ KEY TAKEAWAY

- Reflection obeys two simple laws.
- Spherical mirrors are concave or convex.
- Use ray rules to locate images.
- Concave mirror can form all types of images depending on position.
- Convex mirror always gives virtual, erect and diminished image.



Remember:

Practice ray diagrams regularly and apply mirror formula with sign convention carefully – that's the key to scoring full marks!