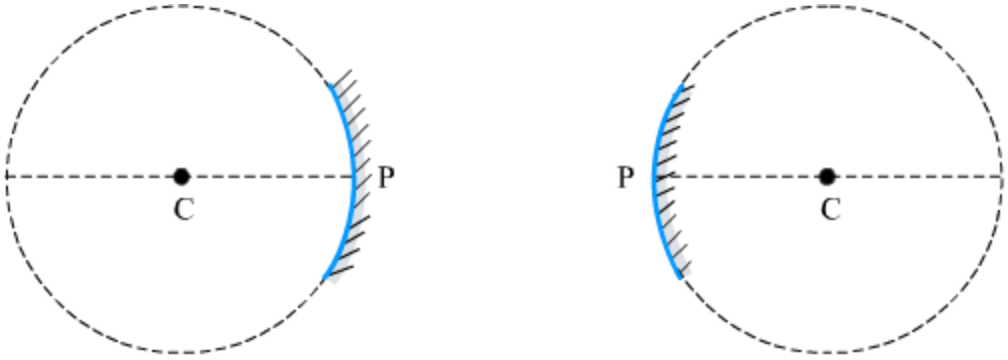
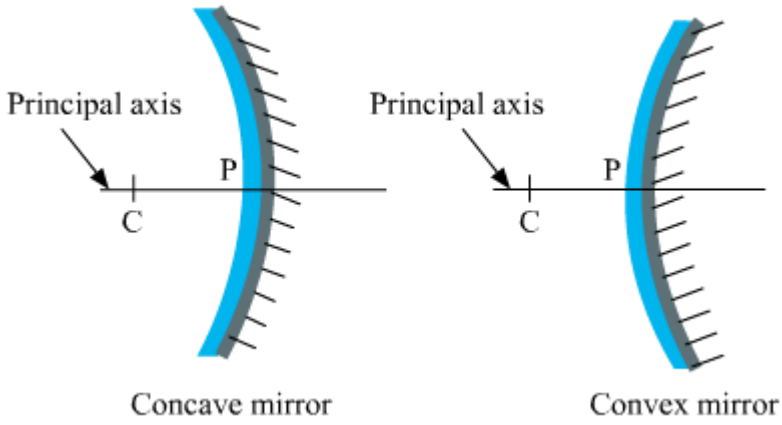
Light - Reflection And Refraction

Spherical Mirror

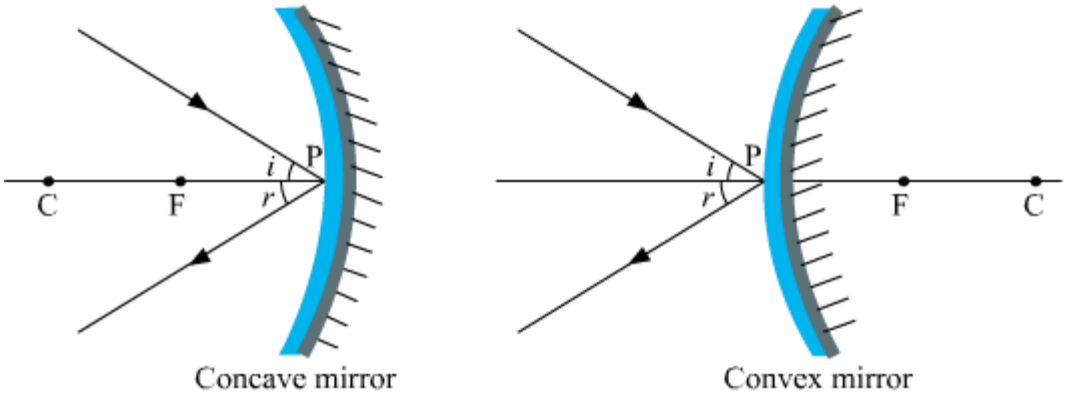
- Centre of curvature: Centre of the sphere of which the spherical mirror is a part



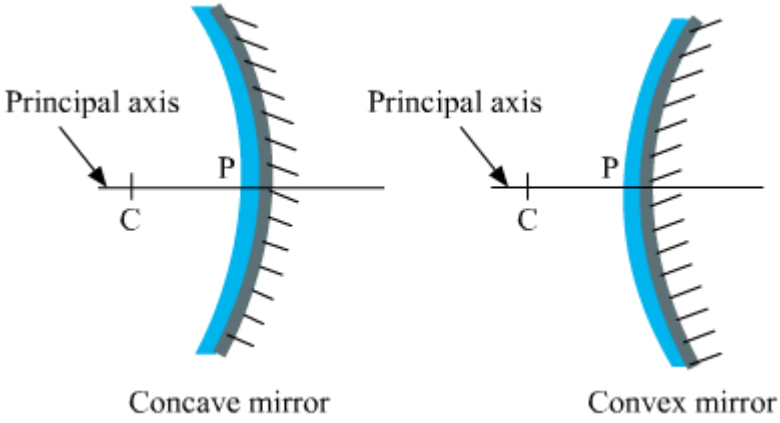
- Pole: It is the midpoint of the aperture of the spherical mirror or mirror centre.



- Focus: Where parallel rays (parallel to the principal axis) meet or appear to meet after reflection.
- Principal Axis: The imaginary line that runs through the pole and the center of curvature of a spherical mirror.
- Distance of focus from the pole is half the radius of curvature.



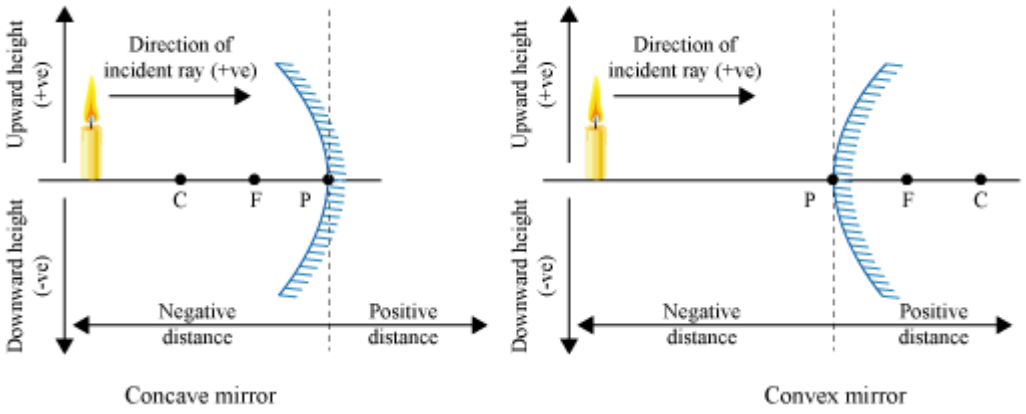
Two types of spherical mirrors



1. The image formed by a convex mirror is **erect** and **diminished**. It is formed behind the mirror.
2. The image formed by a concave mirror can be **erect as well as inverted**, **diminished as well as magnified**, behind the mirror as well as in front of the mirror, depending on the distance of the object from the mirror.
3. The image that can be obtained on a screen is called **real** image. The image that cannot be obtained on a screen is called **virtual** image.
4. The image formed by a **convex** mirror is always **virtual**. The image formed by a **concave** mirror can be **real** as well as **virtual**.

1. Concave mirror is used as the reflector of a torch, dentist mirror, etc. It is also used in solar furnaces.
2. Convex mirror is used as a rear view mirror in vehicles. It also used road safety mirrors.

- **Sign Conventions for Spherical Mirrors:**



- **Mirror formula**

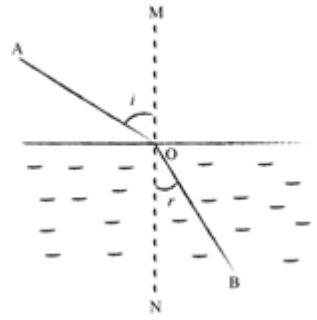
  $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

  For concave mirror, f = –ve and for convex mirror, f = +ve

- **Magnification**

  Magnification = −vu-vu
  For real image, v = –ve
  Virtual image, v = +ve

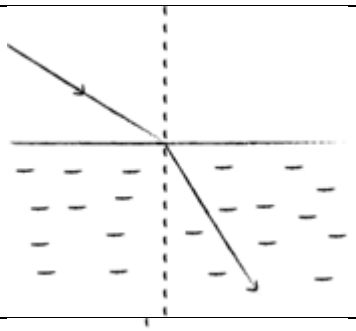
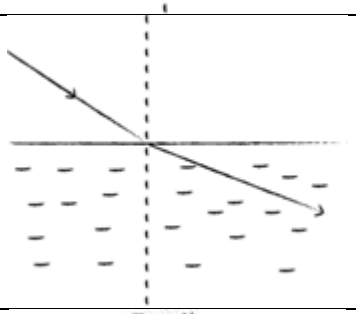
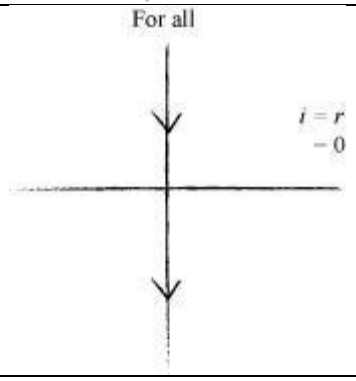
- **Refraction Laws**

	AO, OB, and MON are co-planar $\frac{\sin i}{\sin r} = \text{constant}$ (Snell's law)	Incident ray, refracted ray, and normal to the interface at incident point are co-planar

- **Refractive index (RI)**

  μ21 (μ of 2 w.r.t 1)=Velocity of light in medium 1Velocity of light in medium 2=v1v2μ12 (μ of 2 w.r.t 1)=Velocity of light in medium 1Velocity of light in medium 2=v1v2

  (Absolute RI when medium 1 = Vacuum)
  (Light speed in vacuum is = 3×10^8 m/s)

	Medium (Optically denser) = μ > 1
	Optically rarer = μ < 1
	path of a ray when there is no change in medium.

- **Differences between a spherical mirror and a lens:**

Spherical mirror	Spherical lens
Image is formed by reflection of light.	Image is formed by refraction of light.
A spherical mirror has only one focus.	A spherical lens has two foci.
The centre of the spherical mirror is termed as its pole.	The centre of the spherical lens is termed as its optical centre.

- Centre of curvature = Centre of the sphere of which the lens surfaces is a part of (Same as Spherical mirror)
- Optical centre is a point at the centre of the lens. It always lies inside the lens and not on the surface
- The straight line joining the two centers of curvature and the optical centre is called the principal axis of the lens.
- Focus = Where parallel rays meet after refraction (On principal axis = principal focus)

- **Convex lens and Image**

- Virtual and erect images – when the object is placed between F1 and the optical centre (Magnifying glass)
- Image size = object size when object at 2F (= Centre of curvature)

- **Concave lens and Image**
- Virtual and erect at all object positions

- **Lens Formula**

  For concave lens f = –ve
  convex lens f = +ve

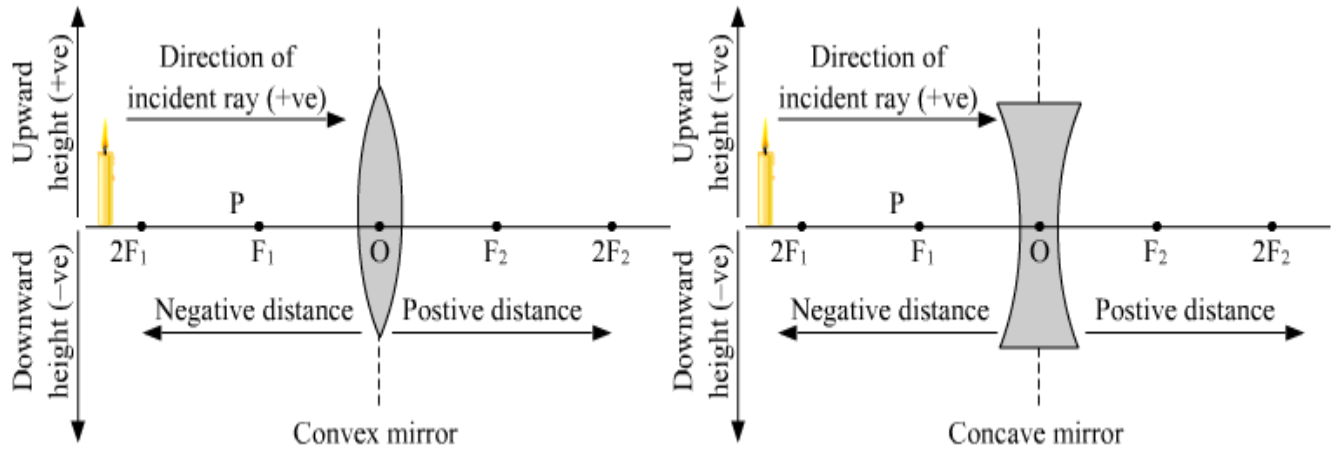
- **Magnification**

$$m = \frac{\text{Image height}}{\text{Object height}} = \frac{v}{u} \text{(Same as mirror)}$$

- **Lens power**

$$\text{P}\left(\text{Unit dioptre}\right) = \frac{1}{f\,(\text{in } m)} \quad f = -\text{ve for concave}$$

- **Sigh Convention for Lenses:**



- **Lens Formula**

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

For concave lens f = –ve
convex lens f = +ve

- **Magnification**

$$m = \frac{\text{Image height}}{\text{Obhect height}} = \frac{v}{u} (\text{Same as mirror})$$

- **Lens power:** Power of lens is the reciprocal of its focal length.

  $$\text{P (Unit dioptre)} = \frac{1}{f\,(\text{in } m)} = -\text{ve for concave}$$ and + ve for convex lens.