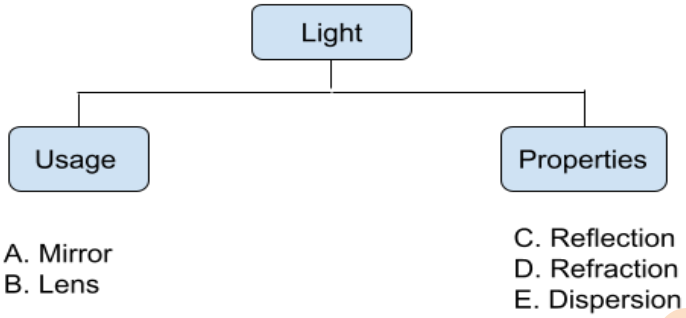
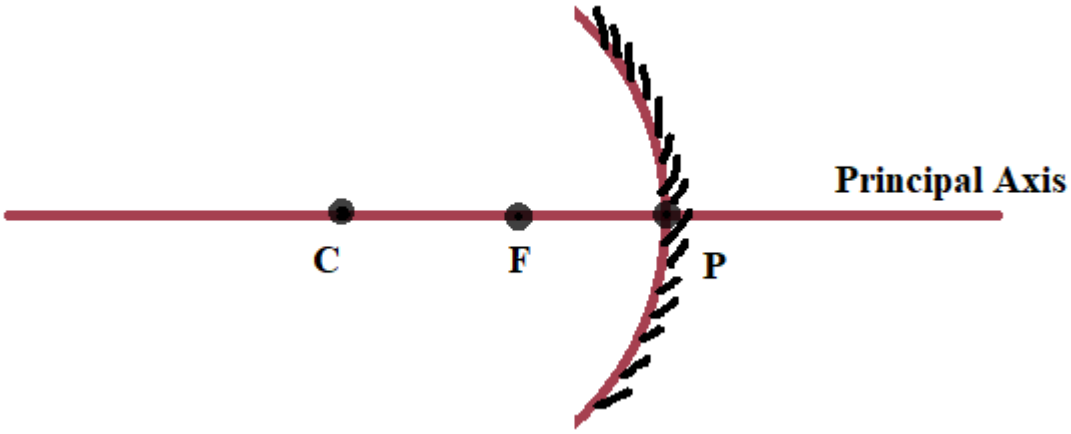
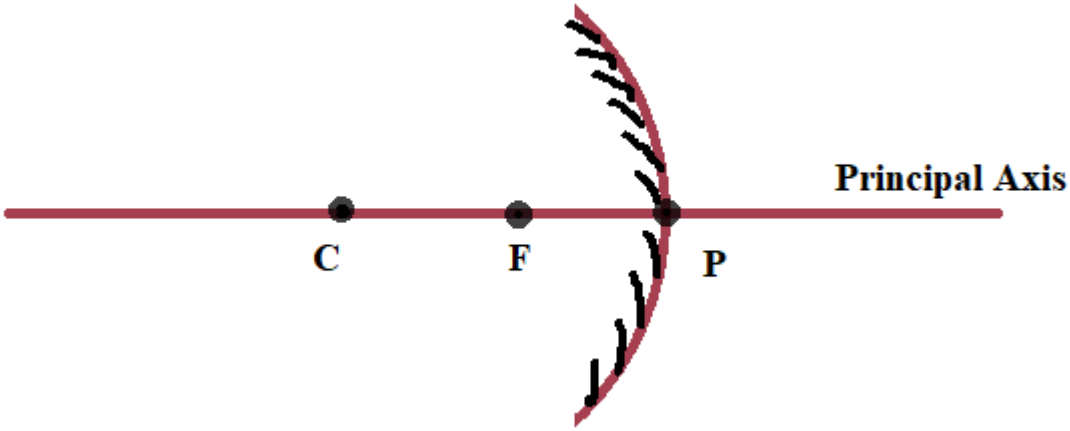
Light



Mirror (Spherical)



Concave Mirror



Convex Mirror

Centre of Curvature

- ➔ Centre of curvature of a spherical mirror is defined as the centre of the sphere of which the spherical mirror is a part.

Pole (P)

- ➔ The center point of a spherical mirror is called a pole.

Principal Axis

- ➔ The straight line passing through the pole of the mirror and the center of curvature is called the Principal Axis.

Focus (F)

- ➔ The principal focus of a spherical mirror is a point on that spherical mirror's principal axis where parallel light rays intersect (meet) or emerge to deviate after reflection.

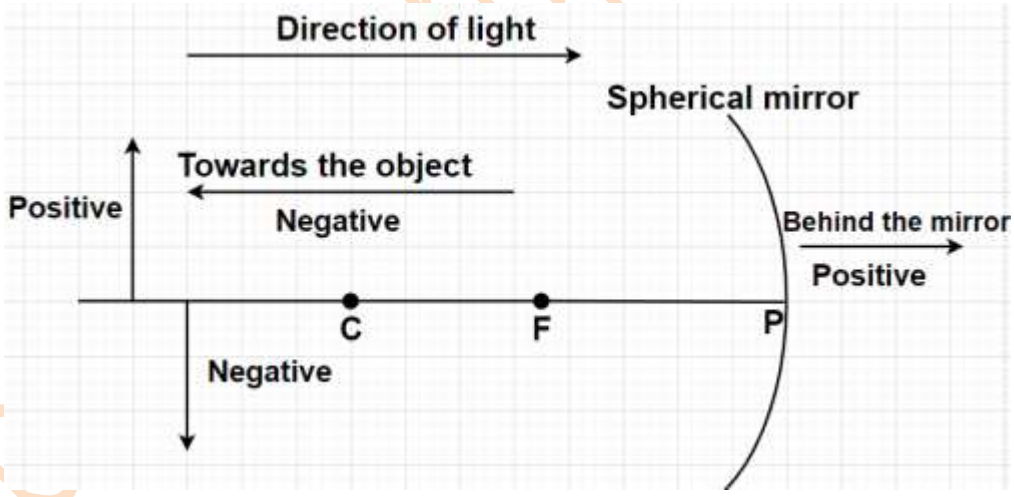
Focal Length (f)

- ➔ The distance between the Focus and the pole is called the Focal Length.
- ➔ The focal length of any spherical mirror is half its radius. i.e. f= R/2

Radius of curvature (R)

- ➔ The distance between the center of curvature and the pole is called Radius of Curvature.
- ➔ The radius is twice the focal length. i.e R = 2f

Sign Convention for Spherical Mirrors



- ➔ All distances on a spherical mirror are measured from the pole.
- ➔ Objects are placed to the left of the mirror.
- ➔ All distances from the pole to the left are measured Negative.
- ➔ Since the object is always placed to the left, the distance to the object is always Positive.
- ➔ All distances to the left of the spherical mirror are measured Positive.
- ➔ Note-

- The focal length is measured to the right of the concave mirror, so the focal length is measured Negative.
- The focal length is measured to the right of the convex mirror, so the focal length is measured Positive.

Formula for concave and convex mirror

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

$f = focal\ length$

$v = image\ distance$

$u = object\ distance$

Magnification

$M = \frac{h2}{h1}$

$h2 = The\ height\ of\ the\ image$

$h1 = The\ height\ of\ the\ object$

Also,

$M = \frac{-v}{u}$

Hence,

$$\frac{h2}{h1} = \frac{-v}{u}$$

Que. If the height of an object is 3cm and it is placed at a distance of 201m from the concave mirror with a distance of 12 cm, then where will the image be found and what will be its appearance?

Solution:

$The\ height\ of\ the\ object\ (h1)$ = +3cm

$focal\ length\ (f)$ = -12cm

$object\ distance\ (u)$= 20cm

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

$$1/-12 = 1/v + 1/-20$$

After solving,

$$v = -30\ cm$$

The resulting image will be 30cm to the left.

Its appearance or enlargement= $M = \frac{h2}{h1} = \frac{-v}{u}$

$\frac{h2}{3} = \frac{-(-30)}{-20}$

After solving,

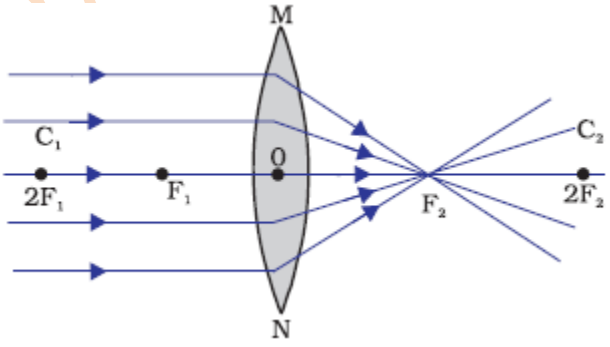
$h2 = -4.5\ cm$

$$M = \frac{h2}{h1}$$

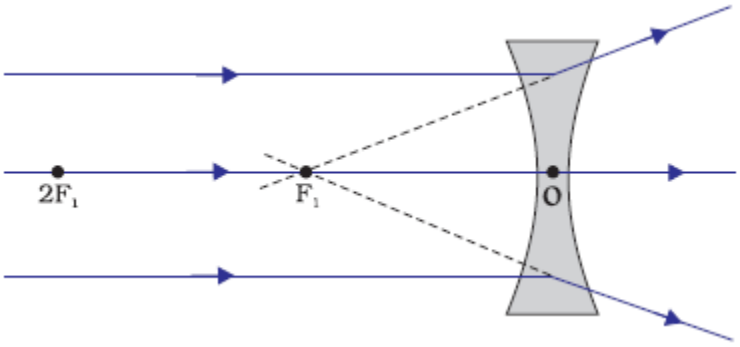
$$M = -1.5$$

The resulting image will be 1.5 times larger than the object and will be inverted and real.

Lens



Convex Lens - Converging Action



Concave Lens - Diverging Action

Centre of curvature (C1, C2)

➔ The center of curvature of the two spheres of the lens is called the center of curvatures. In most cases, both are at equal distance from O.

Principal Axis

➔ The straight line passing through both curves is called the principal axis.

Optical Centre

➔ The center point of the lens is called the optical center.

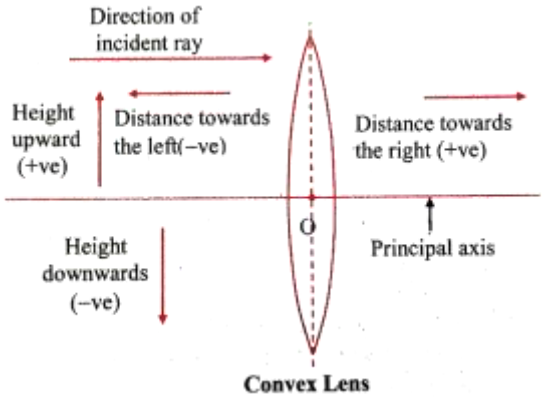
Principal focus

➔ When the incident ray comes parallel to the principal axis and intersects at the point on the principal axis after refracting from the lens, the point is called the Principal focus.

Focal length (f)

➔ The distance between the optical center and the focus is called the focal length.

Sign Convention for lens



➔ Any distance in the magnifying glass is measured from the center of the lens.

- ➔ All distances to the left of the magnifying glass (-ve) are negative, while all distances to the right (+ ve) are considered positive.
- ➔ The object is always placed to the left of the magnifying glass, so the distance to the object is always calculated as Negative.
- ➔ The object is always kept flat, so the height of the object is measured positively.
- ➔ Note:
  - ◆ The focal length of a convex lens is positive, as it is measured on the right side.
  - ◆ The focal length of the concave lens is negative, as it is measured on the left side.

Formula for concave and convex lens

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

$f = Focal\ length$

$v = image\ distance$

$u = object\ distance$

Magnification

$M = \frac{h2}{h1}$

$h2 = The\ height\ of\ the\ image$

$h1 = The\ height\ of\ the\ object$

Also,

$M = \frac{v}{u}$

Hence,

$$\frac{h2}{h1} = \frac{v}{u}$$

Lens Power (P)

- ➔ Lens Power (P) depends on the focal length.
- ➔ Lens Power (P) s and the focal length (f) are proportional to each other.

$P = 1 / f$

P = Diopters (+ve)

f= meter (+ve)

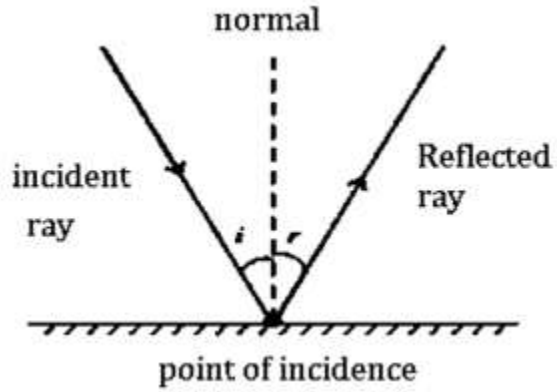
Que. एखादा व्यक्ती 2.0 मी. पेक्षा लांब अंतरावरील वस्तू स्पष्टपणे पाहू शकत नाही, त्या वस्तू स्पष्ट दिसण्याकरिता भिंगाची शक्ती (पावर) किती असावी? (MPSC Subordinate **Prelim-2017**)

(1) +20 diopters (2) -1.0 diopters (3) +10 diopters (4) -0.5 diopters

A person cannot see objects clearly beyond 2.0 m. The power of lens required to correct his vision will be:

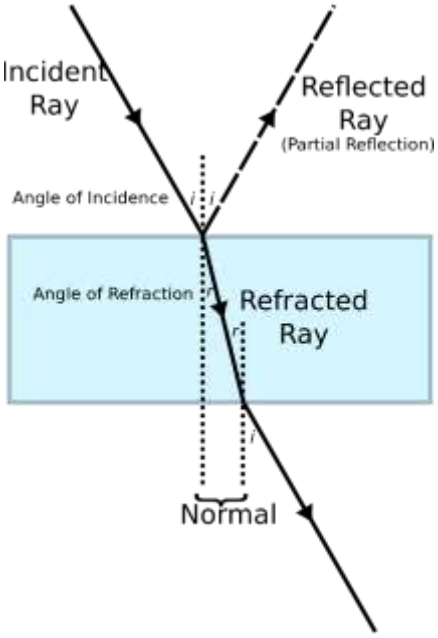
(1) +20 diopters (2) -1.0 diopters (3) +10 diopters (4) -0.5 diopters

Reflection



- ➔ When a ray of light passes from one transparent medium to another opaque medium, it returns to the same medium. This property of light is called reflection.
- ➔ The angle of incidence (i) and the angle of reflection (r) are the same. i.e. i=r

Refraction



➔ As light travels from one transparent medium to another, our direction changes. The natural phenomenon of changing this direction is called refraction of light.

➔ The speed of light varies between different media, so the light beam changes its direction as the medium changes.

➔ Light is refracted twice through a glass chip.

1st Refraction

➔ The first refraction occurs when light rays pass through a sparse medium to a solid medium.

➔ When a ray of light passes through a sparse medium to a solid medium, it tends to 'Normal'.

➔ When a ray of light passes through a sparse medium to a solid medium, the angle of incidence is greater than the rate of refraction. In this case the refractive index of the second medium is higher than the refractive index of the first medium.

➔ The higher the refractive index of the second medium, the more the light bends towards the column.

2nd Refraction

➔ The second refraction of the glass chip is on the lower part of the glass as the light beam passes through the solid through the sparse medium.

➔ When light travels through a solid to a sparse medium, it moves away from 'Normal'

➔ In this case, the angle of refraction is greater than the angle of incidence.

➔ In this case, the refractive index of the first medium is higher than the refractive index of the second medium.

➔ The higher the value of the refractive index of the first medium, the farther the radiation goes from 'Normal'.

Refractive Index

➔ The rate of change in the direction of light rays varies as they pass through different mediums. They are related to the refractive index of the standard medium.

➔ Different media have different refractive indexes, so different media have different directions of light.

- The refractive index of the second medium with respect to the first medium is the ratio of the speed of light in the first medium to the speed of light in the second medium.

  $\eta = \eta_{m1} / \eta_{m2} = v_1 / v_2$

- Similarly, the refractive index of the first medium with respect to the second medium is

  $\eta = \eta_{m2} / \eta_{m1} = v_2 / v_1$

Substance	Refractive Index
Air	1.003
Ice	1.31
Water	1.36
Alcohol	1.44
Benzene	1.52
Diamond	2.42

Que. If the speed of light in a transparent medium is $2\ X\ 10^8 m/s$, then what is the refractive index of that medium? ? ($v_{air} = 3\ X\ 10^8 m/s$)

Solution-

$v_x = 2\ X\ 10^8 m/s$

$v_{air} = 3\ X\ 10^8 m/s$

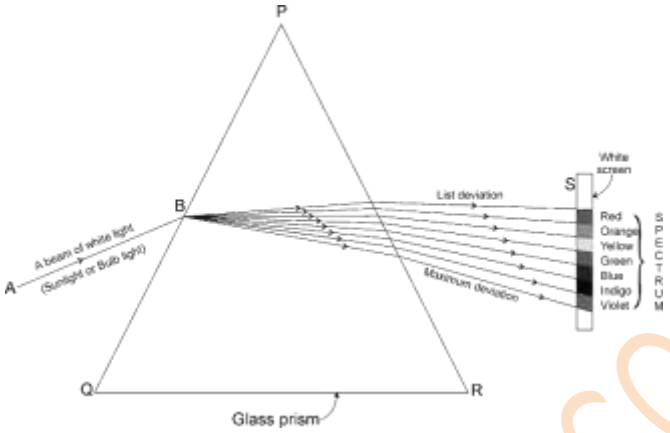
$\eta = \eta_{air} / \eta_x = v_{air} / v_x$

$\eta = \eta_{air} / \eta_x = 3\ X\ 10^8 m/s / 2\ X\ 10^8 m/s$

$\eta = \eta_{air} / \eta_x = 1.5$

The refractive index of that medium will be 1.5.

Dispersion



- ➔ Dispersion of light can be defined as the splitting of the light beam (white) into its seven constituent colors when it is passed through any transparent media.
- ➔ Decreasing order of wavelengths: R, O, Y, G, B, I, V
- ➔ Ascending order of frequency: R, O, Y, G, B, I, V

Que. खालील विधाने विचारात घ्या :

(a) प्रकाश किरणे एका पारदर्शक माध्यमातून दुसऱ्या माध्यमात जाताना त्यांचा मार्ग बदलतो.

(b) वेगवेगळ्या माध्यमामधे प्रकाशाचा वेग वेगवेगळ्य असतो. (MPSC Subordinate **Prelim-2019**)

खालीलपैकी योग्य पर्याय निवडा:

(1) विधान (a) सत्य असून त्याचे योग्य स्पष्टीकरण (b) हे होय.

(2) विधाने (a) व (b) दोन्ही सत्य आहेत पण (b) हे त्याचे योग्य स्पष्टीकरण नाही.

(3) विधान (a) सत्य आहे व (b) असत्य आहे.

(4) विधाने (a) व (b) दोन्ही असत्य आहेत.

Consider the following statements:

(a) Light ray changes its direction when it passes from one transparent medium to another.

(b) The velocity of light is different in different media.

Select the correct option:

(1) Statement (a) is correct and (b) its correct explanation.

(2) Statements (a) and (b) both are correct but (b) is not its correct explanation.

(3) Statement (a) is correct but (b) is wrong

(4) Statements (a) and (b) both are wrong.