

LIGHT: REFLECTION AND REFRACTION

MIRROR: a mirror is a highly polished surface used to reflect the light falling on it.

- **Concave mirror:** a spherical mirror whose reflecting surface is curved inwards.
- **Convex mirror:** a spherical mirror whose reflecting surface is curved outwards.

DEFINITIONS

- **Centre of Curvature:** a centre of hollow sphere of which mirror forms a part of.
- **Pole:** centre of spherical mirror is called Pole.
- **Radius of curvature:** a radius of hollow sphere of which mirror forms a part of.
- **Principal axis:** an imaginary line that passes through Pole and centre of curvature of a spherical mirror.
- **Focus:** a point on principal axis where a beam of light parallel to PA meet or appear to meet is called focus.
- **Focal length:** the distance between Pole and focus.
- **Aperture:** The diameter of reflecting surface of a spherical mirror.
- **Lateral displacement:** is the perpendicular distance between incident ray and emergent ray.



Uses of concave mirror

- i] used in torches, search lights and vehicles headlights.
- ii] used in shaving mirrors.
- iii] dentists and ENT specialists use concave mirror to get larger ~~mirror~~ image
- iv] Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.

Uses of convex mirror

- i] commonly used in rear view mirrors.
- ↓
- because they always give an erect and diminished image and provide a wider view
- ii] used as reflector in street lamps.

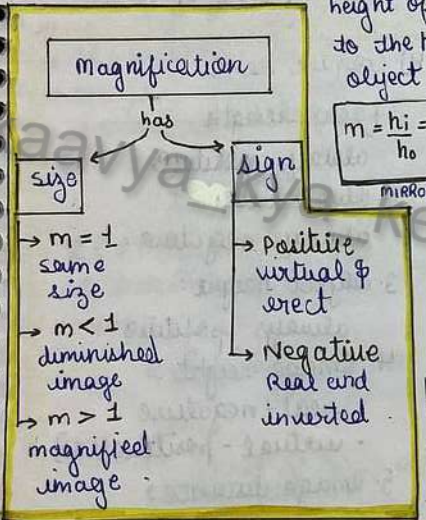
$$f = \frac{R}{2} \text{ or } 2f = R$$

magnification: is the ratio of height of image to the height of object.

Mirror formula:-

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

MIRROR



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

MIRROR



LENS

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

- A) concave mirror**
1. object distance ⇒ always negative
 2. image distance ⇒ when in between P & F it forms a virtual and erect image. $v = \text{Positive}$. ⇒ all other cases (real and inverted) $v = \text{negative}$
 3. focal length = negative
 4. Radius of curvature = negative.

(B) convex mirror

1. object distance = always negative
2. Image distance = always positive (virtual & erect)
3. focal length = positive
4. Radius of curvature = positive

Lens formula

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

LENS.

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LENS: a lens is a piece of transparent refracting material bound by 2 spherical surfaces or one spherical and other plane surface.

DEFINITION

- **centre of curvature**: centre of 2 spherical surfaces of which lens form a part of.
- **radius of curvature**: radius of 2 spherical surface of which lens form a part of.
- **optical centre**: The centre point of lens is called optical centre.
- **Aperture**: the diameter of circular boundary of lens.

A) concave lens

1. **focal length**:
always negative
2. **object distance**:
always negative
3. **object height**:
always positive
4. **Image height**:
 - real - negative
 - virtual - positive
5. **Image distance**:
always negative

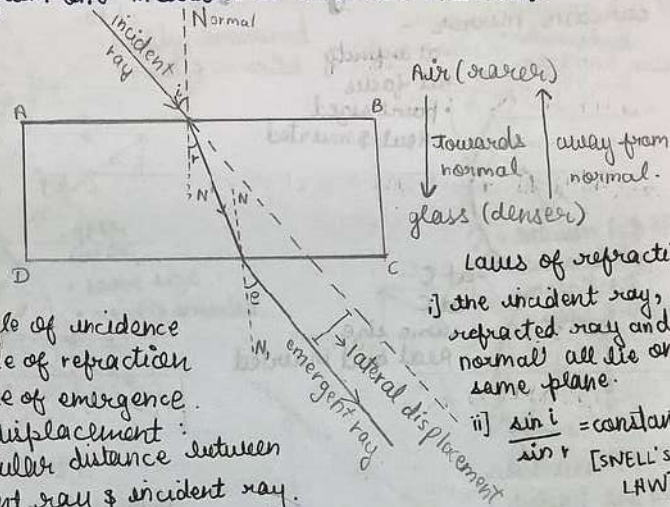
B) convex lens

1. **focal length**:
always positive
2. **object distance**:
always negative
3. **object height**:
always positive
4. **Image height**:
 - real - negative
 - virtual - positive (F1, F2)
5. **Image distance**:
 - real - positive
 - virtual - negative

• **speed of light**:

- 1] air/vacuum - 3×10^8 m/s
- 2] water - 2.25×10^8 m/s
- 3] glass - 3×10^8 m/s.

REFRACTION: The bending of light when it passes from one medium to another medium.



- * $\angle i$ = angle of incidence
- * $\angle r$ = angle of refraction
- * $\angle e$ = angle of emergence
- * lateral displacement: perpendicular distance between emergent ray & incident ray.

- laws of refraction:
- i) the incident ray, refracted ray and normal all lie on same plane.
 - ii) $\frac{\sin i}{\sin r} = \text{constant}$. [SNELL'S LAW]

REFRACTIVE INDEX: Refractive index is the measure of bending of light when passed from one medium to another medium.

Q. Refractive index of glass with respect to water?

Sol:-

speed of light in glass: $2 \times 10^8 \text{ m/s}$

speed of light in water: $3 \times 10^8 \text{ m/s}$.

absolute RI $\mu = \frac{c}{v}$

$$\mu_{wg} = \frac{\text{speed in water}}{\text{speed in glass}}$$

$$\mu_{wg} = \frac{\mu_g (\text{RI of glass})}{\mu_w (\text{RI of water})}$$

Power:

OR $P = \frac{1}{f}$ Reciprocal of focal length.

convex \rightarrow +ve
concave \rightarrow -ive

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Ray diagrams

Concave mirror :-

- at infinity
- at focus
- point sized
- Real & inverted.

- beyond C.
- between C & F
- diminished
- real & inverted

- at C
- at C
- same size
- Real and inverted

- between C & F
- beyond C
- magnified
- real & inverted

- at focus
- infinity
- highly magnified
- real & inverted

- between P & f
- behind the mirror
- magnified
- virtual & erect.

Convex mirror :-

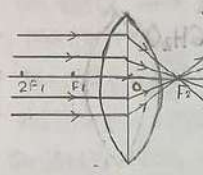
- at infinity
- at focus behind the mirror.
- point sized.
- virtual & erect.

- between ∞ & pole
- between P & f
- diminished
- virtual & erect.

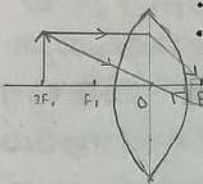
nd C.
n C & F
ished
& inverted

C & F
d C
fied
& inverted

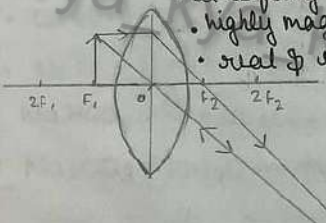
Convex lens:



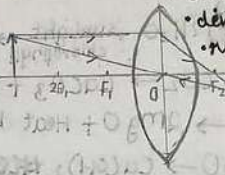
- at infinity
- at F_2
- highly diminished
- real & inverted



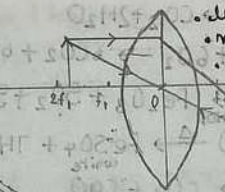
- at $2F_1$
- at $2F_2$
- same size
- real & inverted



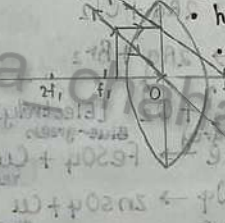
- at F_1
- at infinity
- highly magnified
- real & inverted



- beyond $2F_1$
- between F_2 & $2F_2$
- diminished
- real and inverted

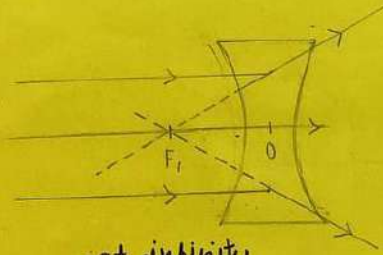


- between F_1 & $2F_1$
- beyond $2F_2$
- magnified
- real & inverted

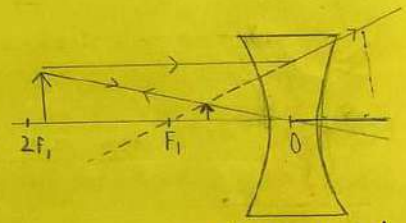


- between F_1 & O
- behind the object
- highly magnified
- virtual & erect

Concave lens:



- at infinity
- at F_1
- point sized
- virtual & erect



- between F_1 and ∞
- between F_1 & O
- diminished
- virtual & erect

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CH 1

