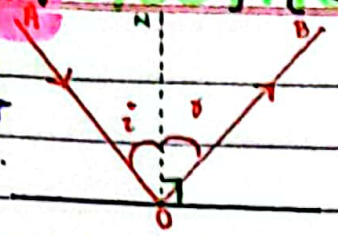
Geometrical Optics

Date: ..... Sun Mon Tue Wed Thu Fri Sat

Reflection of light:

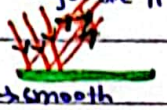


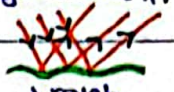
∠AON = i
∠BON = r
∠i = ∠r.

- light travels in air, it touches to a surface i.e mirror, bounces back to the first medium which is air. This is called reflection.

conditions for law of reflection:
- NO, NO, OB all lie on same plane.
- ∠i = ∠r.

Regular Reflection	Irregular Reflection
• surface is smooth	• surface is rough.
• reflected light rays are ∥	• reflected light rays are not ∥.


→ smooth

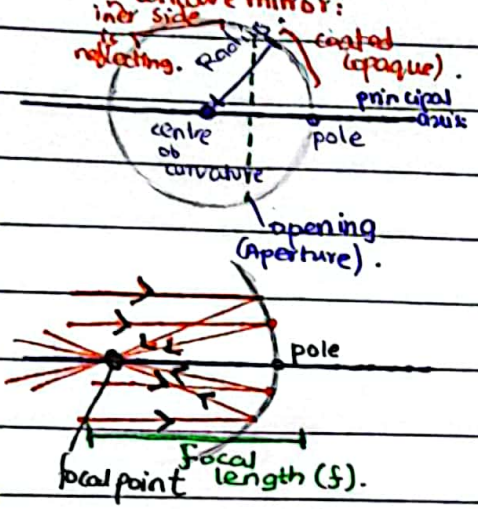

→ rough.

Terms related to spherical mirrors:

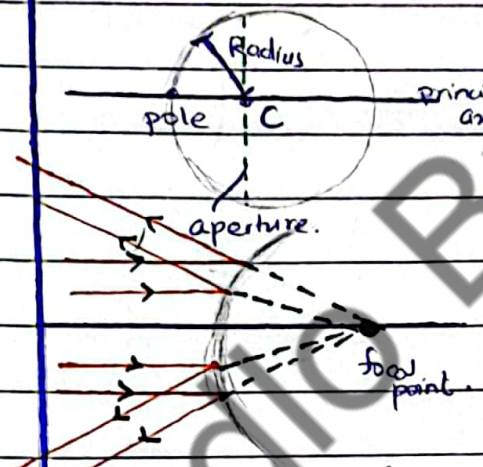
- Principal axis: is the line on which mirror is placed. It is the line joining pole and the centre.
- Pole: is the point at which mirror and principal axis meet.
- Radius of curvature: is the distance b/w centre and outer (opaque) side of the mirror.
- Aperture: is the opening of the mirror.
- Focal point: point at which all the reflected rays meet.
- Focal length (f): distance b/w focal point and pole is called focal length.

Spherical mirror:

concave mirror:



convex mirror:



• In concave mirror, both real and virtual images can be formed. Real = +ve.	f = +ve, R = +ve, p = +ve, q = +ve
• converging mirror	
• In convex mirror, only virtual images can be formed. virtual (imaginary) = -ve.	f = -ve, q = -ve, p = +ve
• diverging mirror.	

Real focus and real image:

→ light rays meeting at a single point (focal point) after reflecting from the mirror are called real focus and form real image.

virtual focus & virtual image:

→ in convex mirror, reflected light rays do not meet at at point, so we draw imaginary point of joining. this is called virtual focus and image formed is virtual image.

Spherical mirror formula:

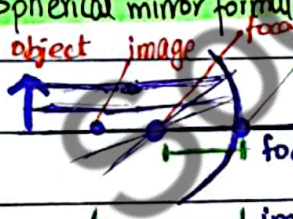


image distance (q)
object distance (p).

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$$

$$\frac{1}{q} = \frac{p-f}{fp}$$

$$q = \frac{fp}{p-f}$$

Refraction of light:

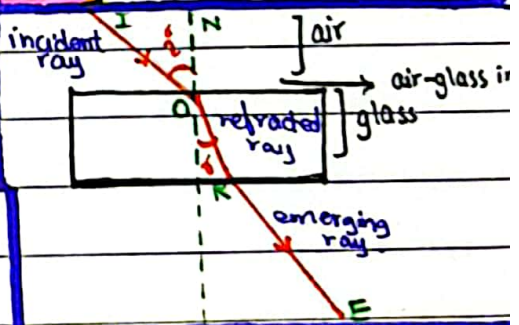
- when light passes from air to glass or v.v it bends. This is refraction.

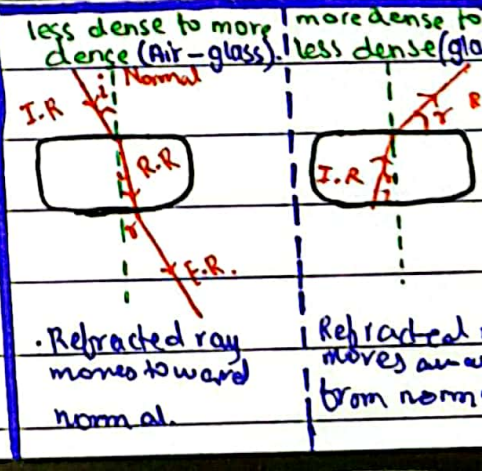
conditions for law of refraction:
- IO, ON, OR lie on the same plane.

$\frac{\sin i}{\sin r} = n$] is constant.

→ This is called refractive index.

This is snell's law.





- Refracted ray moves toward normal.
- Refracted moves aw from norm

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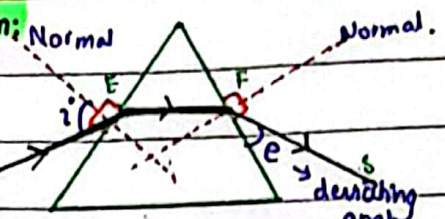
Application of Total internal REFLECTION.

- used in prism periscopes
- used in optical fibres
- used in Binoculars.
- used in light pipes.
- used in Endoscope.

Refraction through Prism:

- emerging ray not ∥ to incident ray.
- It is deviated by an angle called "angle of deviation". (e)



PE → incident ray
EF → Refracted ray
FS → Emerging ray.

Concave lens	Convex lens.
	
• is a diverging lens	• converging lens.
• thin in the middle & thick at the edges	• thick in the middle & thin at the edges.
• used for correction of near sightedness	• used for correction of far sightedness
• imaginary focus	• real focus

Power of lens = $\frac{1}{\text{focal length in meters.}}$

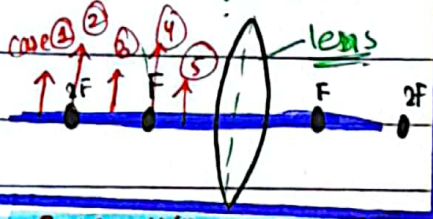
$D = \frac{1}{m}$

$1D = 1m^{-1}$

→ convex mirror: +ve(f) so, +ve D.

→ concave mirror: -ve(f) so, -ve D.

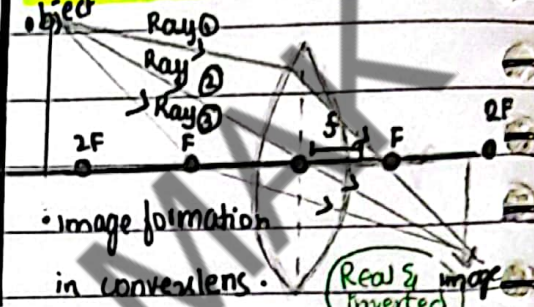
Locations of object



Case 1 - 5 (summarized):

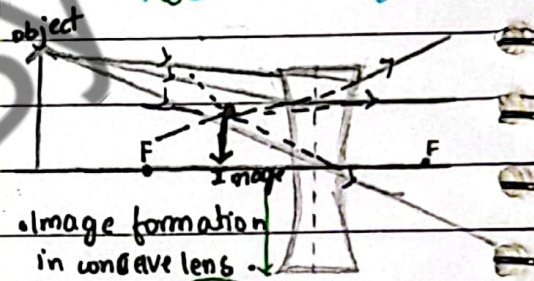
	Object location	Nature of image
1	object behind 2F.	Real, inverted & smaller than object size.
2	Object on 2F	Real, inverted and equal to the size of object
3	object b/w 2F & F.	magnified, real, inverted.
4	object on F.	No image is formed cuz light rays are ∥.
5	object placed b/w F & lens.	virtual erat & magnified.

IMAGE FORMATION:



- Image formation in convex lens.

Real & inverted image



- Image formation in concave lens.

virtual & erect

$M \propto \frac{1}{f}$

COMPOUND MICROSCOPE:

- two lenses used i.e objective (small) & eye piece (large).

1) Case (3) [objective] light ray comes forms image b/w Fe & lens.

2) Case (5) [eyepiece]. image of objective lens acts as object for eyepiece.

3) So, virtual erect & magnified image is formed.

4) $L > f_o + f_e$.

$L = f_o + f_e + x$.

TELESCOPE

- two lenses used i.e objective (large) & eye piece (small).

(1) Case 3) applied at objective lens.

(2) eye piece acts as a simple magnifier and doesn't reinvert.

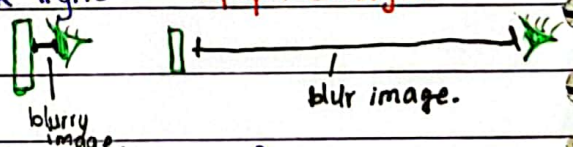
(3) So, overall image is virtual & inverted.

(4) $L < f_o + f_e$.

(No gap of x).

HUMAN EYE:

- if pupil, retina, lens are perfect perfect image is formed.
- eye lens change focal length for proper focus.
- Bright light ----> pupil contracts
- Dim light ----> pupil enlarges.



- min distance b/w eye & object when retina forms clear image
- max distance b/w object & eye → on which relaxed eye can focus.

Myopia can be

- far objects not seen
- Diverging lens used for correction.

hypermetropia.

- near object can't be seen.
- converging lens used for correction.