REFLECTION

➢ **Light:-** It is a form of energy that enable us to see around us.

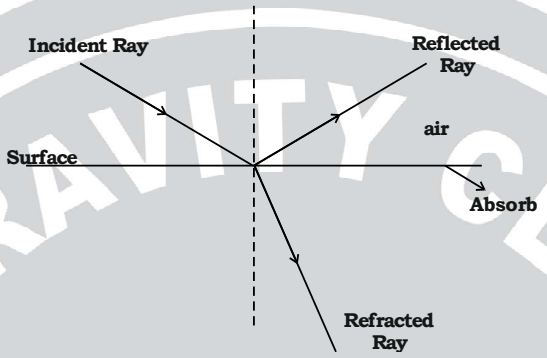
- It is an electromagnetic wave that can travel through medium as well as through vaccum.

There are two types of Object.

(i) **Luminous Object:-** Are those which have own light. It's own energy is converted into another energy. Ex.- Sun (Nuclear Energy → Light Energy), Candle (Chemical Energy → Heat & Light), Bulb (Electrical Energy → Light Energy)

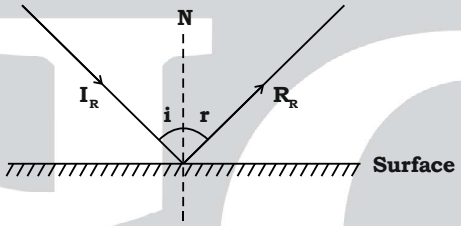
(ii) **Non-Luminous Objects:-** Are those which do not have their own light. Ex.- Chair, Table, Book, Building etc.

- When light falls on any surface either of these phenomena takes places.



(i) Reflected Back
(ii) Refracted Back
(iii) Absorption

- **Reflection:-** It is the bouncing back of light rays on striking the surface.



Types of Surface
(i) Transparent
(ii) Translucent
(iii) Opaque

- **Characteristics of Best Reflector:-**

→ It should have shiny surface.
→ It should have polished surface.
→ It should have smooth surface.

Q. How do we see things ?

→ The reflected ray which reaches to our eyes only and rest of coloured ray absorbed by object. Ex.- Green Leave, Red Rose etc.

➢ **Laws of Reflection:-**

(i) Incident ray, reflected ray and normal all lie on same plane.

(ii) Angle of incidance is always equal to angle of Reflection. $\boxed{\angle i = \angle r}$

- **Types of Mirror:-**

(i) Plane Mirror
(ii) Spherical Mirror:-

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Opp. Kulhariya Complex, Pillar Number-09

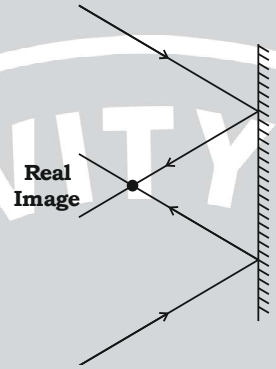
Concave:- Is that in which reflection occurs through inner surface of mirror.

Convex: Is that in which reflection occurs through outer surface of mirror.

- **Types of Images**

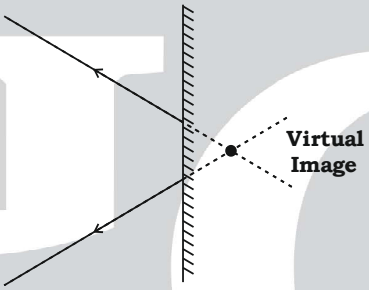
(i) Real Image:-

→ Is that which is formed when reflected rays actually meet at certain point.
→ It is always inverted.
→ It can be obtained on screen.

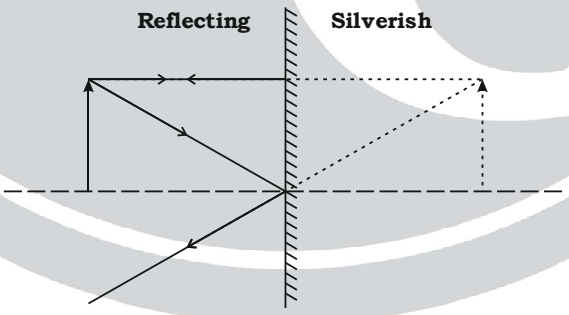


(ii) Virtual Image:

→ Is that which is formed when reflected rays do not meet actually but appear to meet at certain point.
→ It is always erect.
→ It can't be obtained on screen.



- **Image formation by Plane Mirror**



Nature of Image:-

→ Same distance as that of object.
→ Same size as that of the object.
→ Virtual Image.
→ Erect Image.
→ Laterally Inverted.

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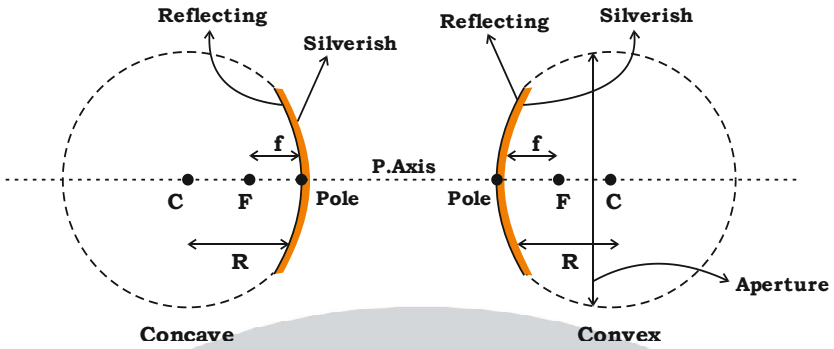
- **Lateral Inversion:-** It is the phenomenon when LHS becomes RHS or vice-versa when an object is exposed to plane mirror.
- **Spherical Mirror**

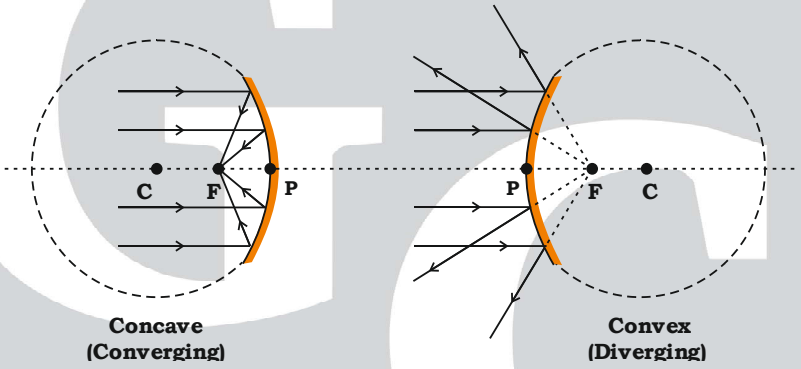


Where, R = Radius of Curvature (Distance between C & P)
C = Center of Curvature (Center of Spherical Mirror)
P = Pole (Where P-axis strikes the Mirror)
F = Principal Focus.
f = Focal Length.
P.Axis = Principal Axis.

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

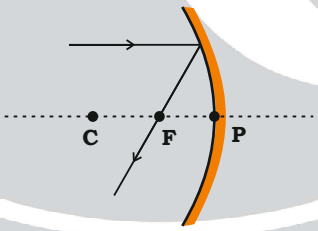
- **Aperture:-** It is a part of spherical mirror from which actually the reflection occurs.
- **Focus (F):-** It is the point where all reflected rays meet or appear to meet.

➢ **Nature of Mirror:-**

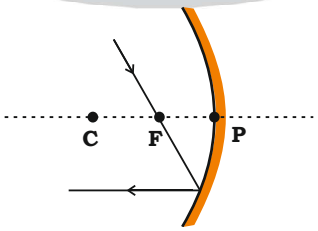


➢ **Rules to obtain images from Concave Mirror:-**

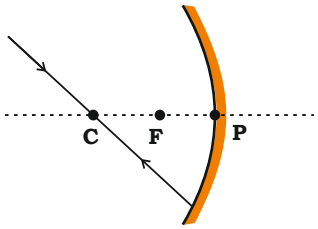
(i) The incident ray that come parallel to P.axis after reflection passes through focuses.



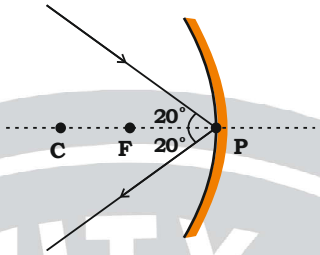
(ii) The incident ray coming from focus after reflection becomes parallel to P.axis.



(iii) The incident ray coming through 'C' retraces its path.

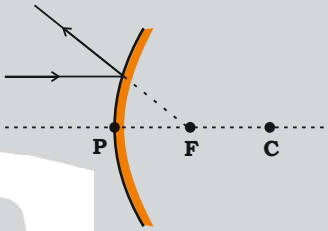


(iv) The I.R. sriking at pole by certain angle is reflected through same angle.

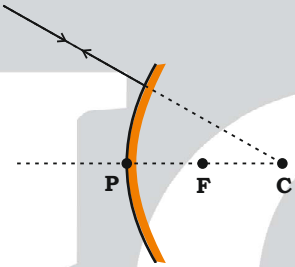


➢ **Rules to obtain image from Conves Mirror:-**

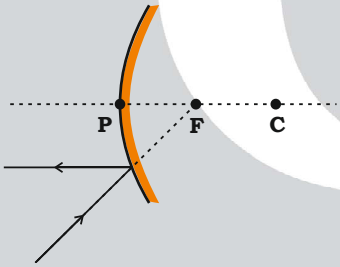
(i) The I.R. coming parallel to P.axis diverge but appear to pass through focus.



(ii) The I.R. appears to be coming from 'C' rebound back.

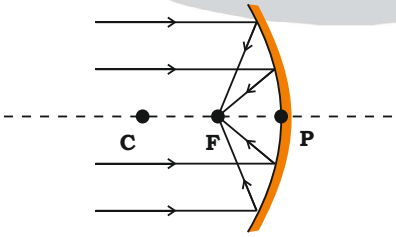


(iii) The I.R. appears to be coming from 'F' will become parallel.



➢ **Image formation : Concave Mirror**

1. Object at Infinity



Nature Of Image

- At Focus
- Highly Diminished
- Real
- Inverted

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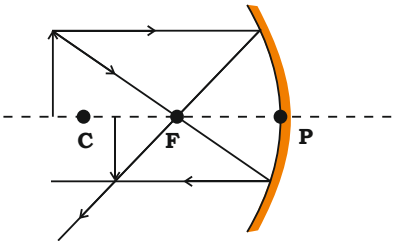
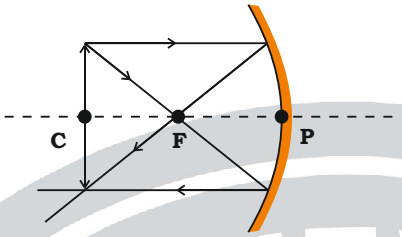
2. Object beyond C



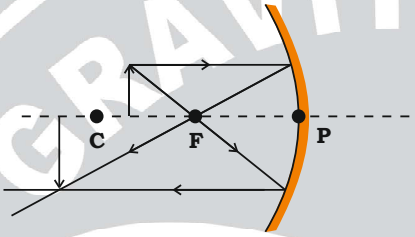
Nature Of Image
- Between C and F
- Diminished
- Real
- Inverted

3. Object at C



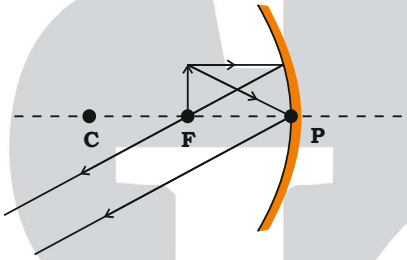
Nature Of Image
- At C
- Same Size
- Real
- Inverted

4. Object beteween C and F



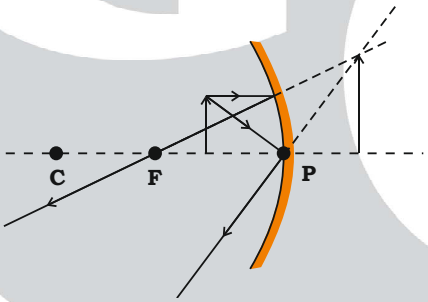
Nature Of Image
- Beyond C
- Larger in Size/Enlarged
- Real
- Inverted

5. Object at F



Nature Of Image
- At Infinity
- Highly Enlarged
- Real
- Inverted

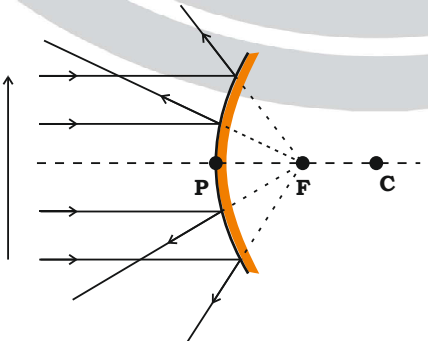
6. Object between F and P



Nature Of Image
- Behind the Mirror
- Enlarged
- Virtual
- Erect

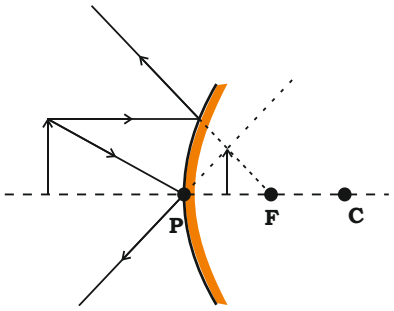
➢ **Image formation : Convex Mirror**

1. Object at Infinity



Nature Of Image
- At F
- Highly Diminished
- Virtual
- Erect

2. Object at Finite Distance



Nature Of Image
- Between P and F
- Diminished
- Virtual
- Erect

Uses of Concave Mirror:-

(i) It is used in Torches:- As it produces powerful beam of light rays that converge at infinity.

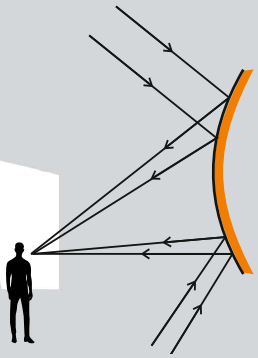
(ii) It is used in making Solar Devices:- As it converges all the rays so when solar rays converge, they increase the temperature at that converging point.

(iii) It is used as Shaving Mirror:- As when face is placed between pole and focus it gives virtual erect and magnificied image.

Uses of Convex Mirror:-

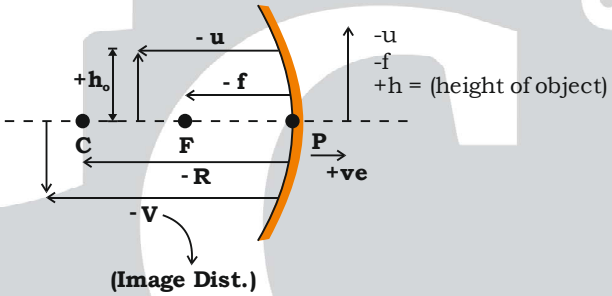
(i) It is used as Rear View Mirror:- It gives virtual and diminished image, it covers wide view, image formed is within focus.

(ii) Parking Lots, Sharp Turns:- Wide are of view.

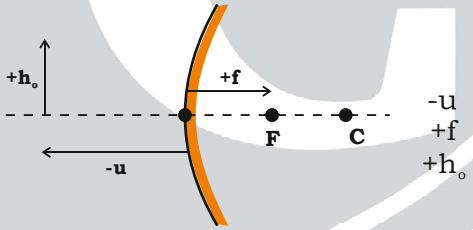


➢ **Sign Convention and Formula:-**

CONCAVE MIRROR



CONVEX MIRROR



Mirror Formula	Magnification Formula
$\boxed{\frac{1}{f}=\frac{1}{v}+\frac{1}{u}}$	$\boxed{m=\frac{hi}{ho}=\frac{-v}{u}}$
Where, f = Focal Length (cm) v = Image Distance (cm) u = Object Distance (cm)	Where, m = Magnification hi = Height of Image (cm) ho = Height of Object (cm)
	$\boxed{m=\frac{-v}{u}}$ unit less

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- **Important Point:-**

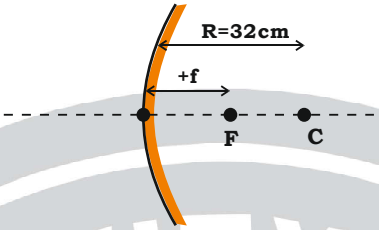
Case-I $0 < m < 1$ (Diminished)
Case-II $m = 1$ (Same)
Case-III $m > 1$ (Enlarged)

$m \longrightarrow +ve \rightarrow$ (Erect + Virtual)

$m \longrightarrow -ve \rightarrow$ (Inverted + Real)

Q. Find the Focal length of convex mirror of radius of curvature is 32 cm ?

Sol.



$R = +32\,cm$

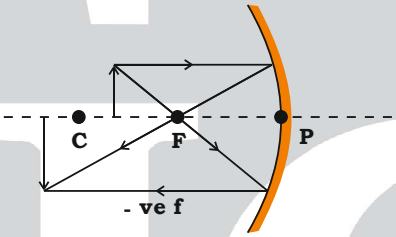
$f = \frac{R}{2} = \frac{32}{2} = 16\,cm$

$\boxed{f = +16\,cm}$

Q. A concave mirror produces three times magnified real image of object placed at 10 cm in front of it, where is the image formed.

Given, $m = -3(Real), u = -10\,cm, v = ?$

Sol.



We know from magnification formula

$$m = \frac{-v}{u} \Rightarrow -3 = \frac{\cancel{-}v}{\cancel{-}10} \Rightarrow \boxed{v = -30\,cm}$$

$\rightarrow$ 30 cm infront of mirror image will formed.

Q. An object 7 cm in length away from converging mirror at a distance of 27 cm of local length 18 cm at what distance from the mirror should the screen be placed in order to obtain sharp image also find size and nature of image ?

Sol. Given, $h_o = +7\,cm, u = -27\,cm, f = -18\,cm, v = ?, m = ?, h_i = ?$

From Mirror Formula

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

$$\frac{1}{-18} = \frac{1}{v} + \frac{1}{-27}$$

$$\frac{1}{27} - \frac{1}{18} = \frac{1}{v}$$

$$\boxed{v = -54\,cm}$$

From Magnification formula

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

$$= \frac{-(-54)}{-27}$$

$$\boxed{m = -2}$$

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

$$-2 = \frac{h_i}{7}$$

$$\boxed{h_i = -14\,cm}$$

$\rightarrow$ -ve sign indicates that Real and Inverted.

$\rightarrow$ 2 shows image is 2 times larger, (Enlarged).

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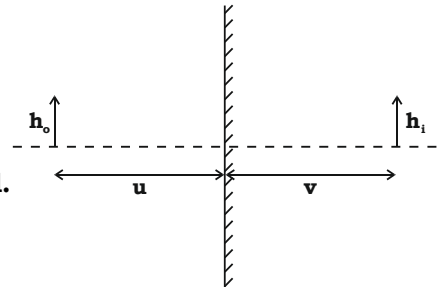
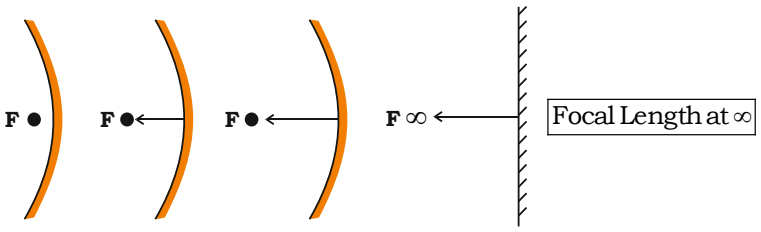
Q. Write the magnification and focal length of plane mirror ?

Sol.





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

$$\boxed{m = 1}$$

Q. Name the mirror in headlight of car and solar furnace ?

A. Parabolic Concave Mirror (Converging Mirror).

Q. What is regular and diffused reflection ?

Specular/Regular Reflection **Diffused/Irregular Reflection**

Q. If you stand in front of plane mirror, concave mirror and convex mirror how our image will appear?

Plane Mirror	Concave Mirror	Convex Mirror
Same Size	Real	Diminished
Virtual	Inverted	Erect
Erect		Virtual

- **Regular or Reflection:-** When a parallel beam of lights is incident on a plane or smooth surface a beam remains parallel after reflection in a specific directino. Ex.- Plane Mirror.
- **Diffused Reflection or Irregular Reflection:-** When all the parallel rays reflected from a plane surface are not parallel, the reflection is known as diffused or Irregular Reflection. Ex.- A wall, Piece of Paper.

Q. A concave mirror has a focal length of 20 cm. At what distance from the mirror should a 4 cm tall object be placed so that it forms an image at a distance of 30 cm from the mirror? Also calculate the size of the image formed.

A. Given, $u = x, f = -20\,cm, h_o = 4\,cm, v = 30\,cm\ (\text{Sign not clear}), h_I = ?$

(a) $u = -60\,cm, h_I = 2\,cm$

(b) $u = 60\,cm, h_I = -2\,cm$

(c) $u = -60\,cm, h_I = -2\,cm$

(d) $u = 60\,cm, h_I = 2\,cm$

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Sol.

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

$$m = \frac{-(-30)}{-60}$$

$$m = \frac{-1}{2}$$

$$m = \frac{h_I}{h_o}$$

$$4 \times \frac{-1}{2} = h_I$$

$$\boxed{-2\,cm = h_I}$$

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

$$\frac{1}{(-20)} - \frac{1}{(-30)} = \frac{1}{u}$$

$$u = -60$$

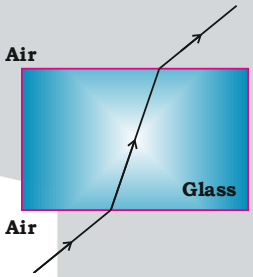
So, u = – ve sign shows that 'v' will be – 30 cm.

REFRACTION

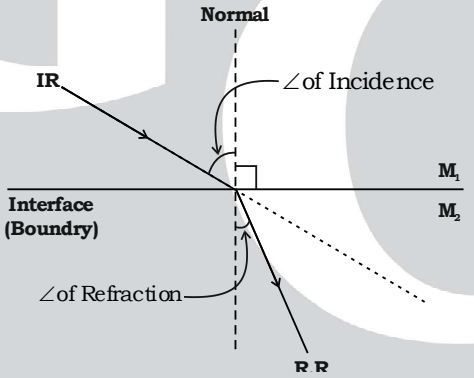
➢ **Refraction of Light:-** The bending of light ray when it passes from one medium to another is called refraction.

→ Whenever light moves in one some medium it follows straight line path.

→ But when it travels from one medium to another its path doesn't remain a straight line.



- Speed of light in Air/Vaccum $\boxed{(C) = 3 \times 10^8\, m/s}$
- **Medium:-** Ex.- Air, Vaccum, Glass, Water, Kerosane, Diamond, Oils etc.
- **Rarer Medium:-** Which has less density and speed of light is more in it.
- **Denser Medium:-** Which has more density and speed of light is lesser in it.

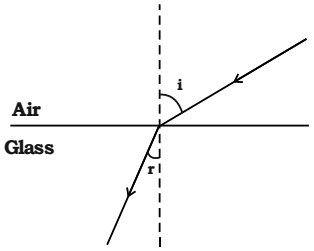


➢ **Laws of Refraction:-**

(i) Incident ray, refracted ray and normal all lie on same plane of paper.

(ii) **Snell's Law:-** The ratio of sine of Angle of incidence to sine of Angle of refraction is always constant for particular pair of media and for a fixed wavelength.

$$\boxed{\mu_{21} = \eta_{21} = \frac{\sin i}{\sin r} = \text{Constant}}$$



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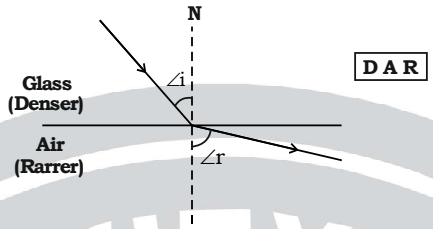
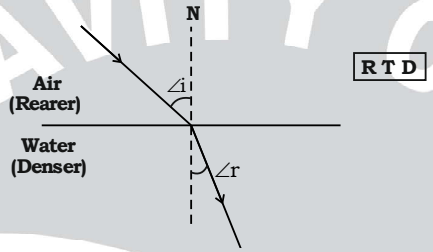
$i = 50$	$r = 45$
$i_1 = 40$	$r_1 = 36$
$i_2 = 30$	$r_2 = 27$
$i_3 = 20$	$r_3 = 18$
$i_4 = 10$	$r_4 = 1$

$$\frac{\sin i}{\sin r} = \frac{\sin i_1}{\sin r_1} = \frac{\sin i_2}{\sin r_2} = \frac{\sin i_3}{\sin r_3} = \frac{\sin i_4}{\sin r_4} = \text{Constant}$$

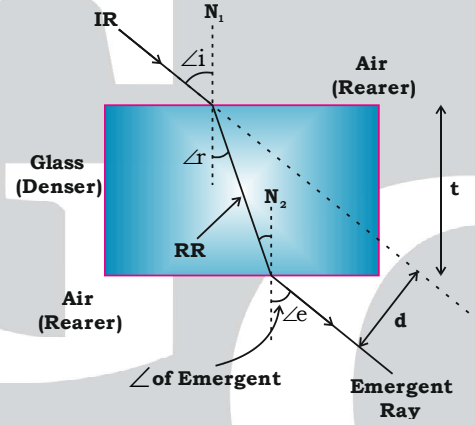
Rule (1):- Refraction when light passes from denser to rarer medium it bends away from Normal.



Rule (2):- Refraction when light passes from rarer to denser medium it bends toward Normal.



- **Refraction Through Glass Slab**



d = [Lateral Shift or Optical Shift or Optical Displacement or Lateral Displacement] All are same.

N_1 & N_2	Normal
I_R	Incident Ray
R_R	Refracted Ray
E_R	Emergent Ray
$\angle i$	Angle of Incidence
$\angle r$	Angle of Refraction
$\angle e$	Angle of Emergence
d	Lateral Displacement

➢ **Lateral Displacement (d)/(L):-** It is the perpendicular shift in the path of incident ray when it travels through certain media and then returns to its original media.

(i) Angle of Incidence ($\angle i$)

(ii) Optinal density of Glass (η)

(iii) Wavelength of Light (λ) Ex.- Voilet

(iv) Thickness of Slab (t)

Note:- $\boxed{i = e}$ $\boxed{I.R \parallel E.R}$

'L'-or-'d' depends on factors.

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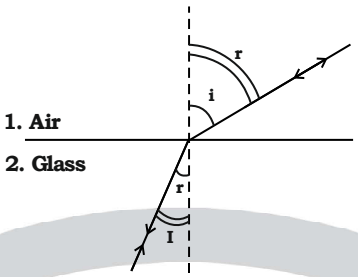
$i\uparrow$	$L.D\uparrow$
$(R.I)\eta\uparrow$	$L.D\uparrow$
$(Thickness)t\uparrow$	$L.D\uparrow$
$(Wavelength)\lambda\downarrow$	$L.D\uparrow$ (Violet $\downarrow$ Wavelength $\downarrow$ min $\rightarrow$ Bending $\uparrow$)

➢ **Reversibility of path of Light:-**



$$\frac{\sin i}{\sin r} = n_{21} \text{ .....(i)}$$

Path reverse

$$\frac{\sin r}{\sin i} = n_{21} \text{ .....(ii)}$$

Multiplying eq (i) and (ii)

$$n_{21} \times n_{12} = \frac{\sin i}{\sin r} \times \frac{\sin r}{\sin i}$$

$$n_{21} \times n_{12} = 1$$

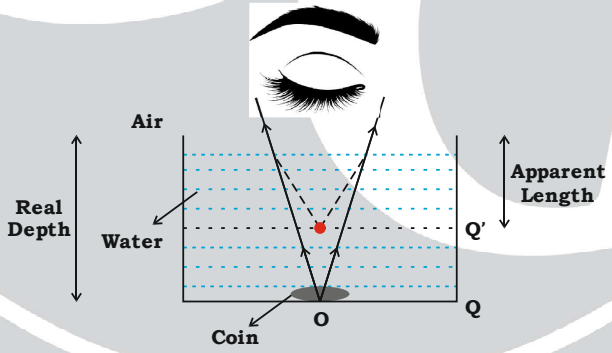
$$\boxed{n_{12} = \frac{1}{n_{21}}}$$

Result:- The R.I. of medium 1 w.r.t medium 2 is equal to reciprocal of R.I. of medium 2 w.r.t medium 1.

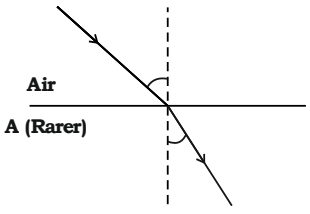
Q. R.I of Glass w.r.t air is $\frac{3}{2}$, then the R.I of air w.r.t glass will be $\frac{2}{3}$.

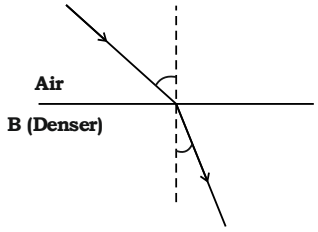
Q. R.I of water w.r.t air is $\frac{4}{3}$, then the R.I. of air w.r.t water will be $\left(\frac{1}{4/3}\right) = \frac{3}{4}$.

➢ **Consequence of Refraction:-** The water level appears to be raised.



- **Refractive Index:-** $\boxed{n = \frac{c}{v}}$ $\rightarrow c = \text{speed of light} = 3\times10^8 \text{ m/s}$ $\rightarrow$ velocity of medium





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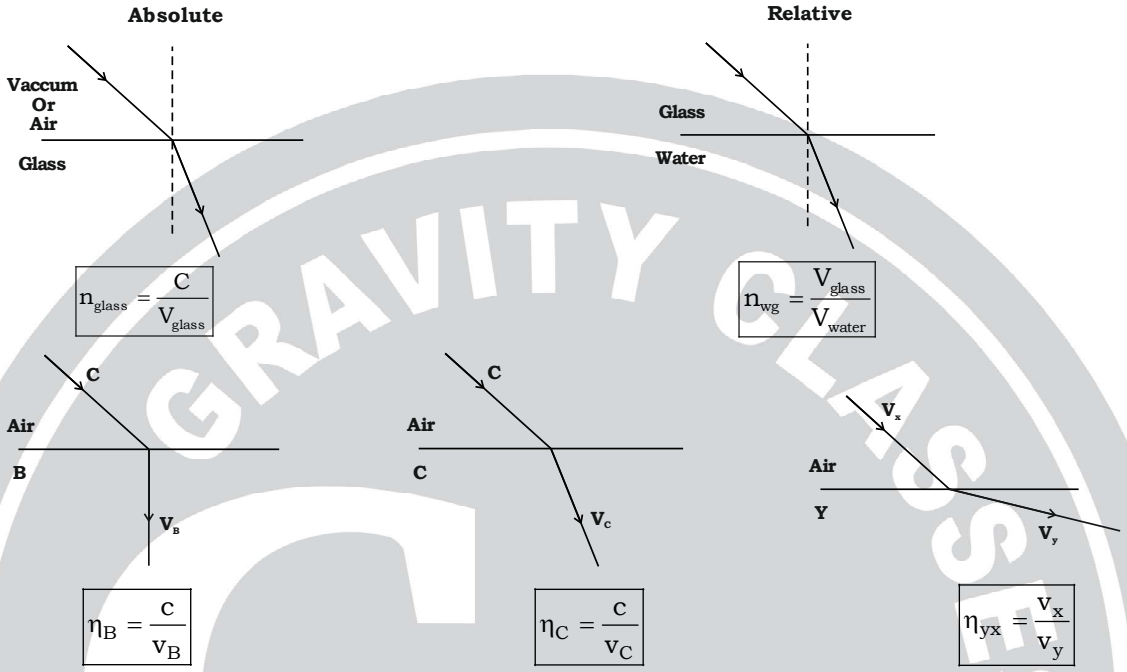
A (rarer) as compare to B (Denser)

$$\boxed{n_A = \frac{c}{v_A}} \qquad \boxed{n_B = \frac{c}{v_B}}$$

$$\rightarrow \quad n_m = \frac{\text{Speed of Light in Vaccum}}{\text{Speed of Light in Given Medium}}$$

$$\boxed{n_m = \frac{c}{v_m}} \qquad \left(c \rightarrow 3\times10^8\,m/s\right)$$

Note:- R.I. is denoted by 'n' and it has no units.



$$\boxed{n_{glass} = \frac{C}{V_{glass}}} \qquad \boxed{n_{wg} = \frac{V_{glass}}{V_{water}}}$$

$$\boxed{\eta_B = \frac{c}{v_B}} \qquad \boxed{\eta_C = \frac{c}{v_C}} \qquad \boxed{\eta_{yx} = \frac{v_x}{v_y}}$$

Q. The R.I. of a material is 1.4. If velocity of light in vaccum is 3×10^8 m/s. Find the velocity of light in material ?

Sol. Given $\eta_m = 1.4,\ c = 3\times10^8\,m/s,\ v_m = ?$

$$\boxed{\eta_m = \frac{c}{v_m}} \qquad v_m = \frac{3\times10^8}{1.4}$$

$$1.4 = \frac{3\times10^8}{v_m} \qquad \boxed{v_m = 2.1\times10^8\,m/s}$$

Q. A light of wavelength 500m in air enters a block of R.I. is 1.5. Find speed, frequency ? Take velocity of light is 3×10^8 m/s.

Sol. Given $\lambda = 500m, \eta_b = 1.5,\ v/c = 3\times10^8\,m/s,\ v_b = ?,\ v = ?$

From Sound, $\boxed{v = \lambda\nu}$

Where, v = velocity, ν = Frequency, λ = Wavelength

(i) $v = \lambda\nu$	(ii) $\eta_b = \frac{c}{v_b}$
$3\times10^8 = 500\times\nu$	$1.5 = \frac{3\times10^8}{v_b}$
$\frac{3\times10^8}{500} = \nu$	$v_b = \frac{3\times10^8}{1.5}$
$\frac{3\times10^6}{5} = \nu$	$\boxed{v_b = 2\times10^8\,m/s}$
$0.6\times10^6 = \nu$	
$\boxed{6\times10^5\,Hz = \nu}$	

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Q. R.I of water 1.5 and that of glass is 1.8. Find the R.I. of water w.r.t glass and glass w.r.t water?

Sol. $\boxed{\eta_{AB} = \frac{v_B}{v_A} = \frac{\eta_A}{\eta_B}}$ .....(i)

If, $\eta_A = \frac{c}{v_A} \Rightarrow \boxed{v_A = \frac{c}{\eta_A}}$ .....(ii)

If, $\eta_B = \frac{c}{v_B} \Rightarrow \boxed{v_B = \frac{c}{\eta_B}}$ .....(iii)

Using eq. (ii) and (iii) in eq. (i)

$$\boxed{\eta_{AB} = \frac{\eta_A}{\eta_B}}$$

Given, $\eta_w = 1.5, \eta_g = 1.8, \eta_{wg} = ?, \eta_{gw} = ?$

$$\eta_{wg} = \frac{\eta_w}{\eta_g} = \frac{1.5}{1.8} = \frac{5}{6}$$

$$\eta_{gw} = \frac{\eta_g}{\eta_w} = \frac{1.8}{1.5} = \frac{6}{5}$$

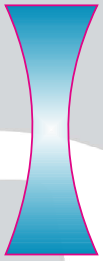
➢ **Spherical Lenses:-** It is the portion of transparent optical material having one or two spherical faces.

Types of Lens

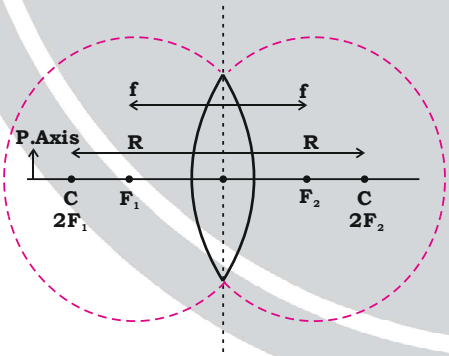
1.

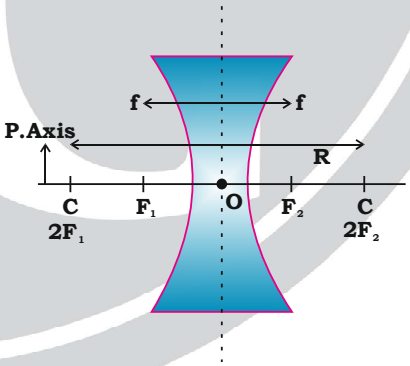
Convex

2.



Concave

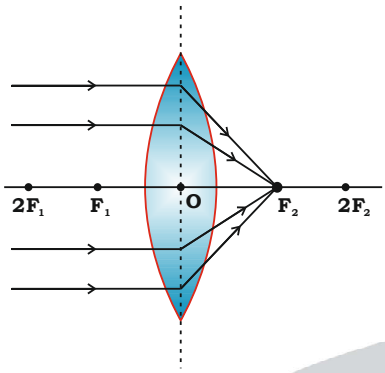




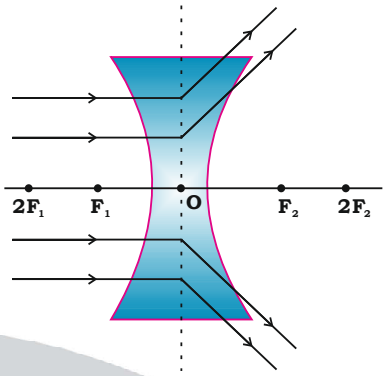
→ **Optical Center (O):-** It is the center of lens.
→ **P.Axis (P):-** It is the line passing straight through optical center.
→ **Focus (F):-** Point where refracted rays meet or appear to meet.
→ **Focal Length (f):-** Distance between focus and optical center.
→ **2f:-** Twice of focal length.

- **Nature:-** The rays that fall on convex lens after refraction meet at one point so it is converging lens.

→ On the other hand concave lens make all refracted rays split in different direction so it is diverging lens.



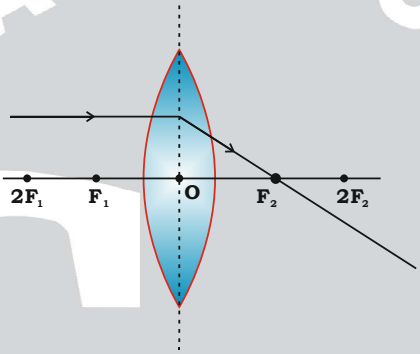
Convex
(Converging)



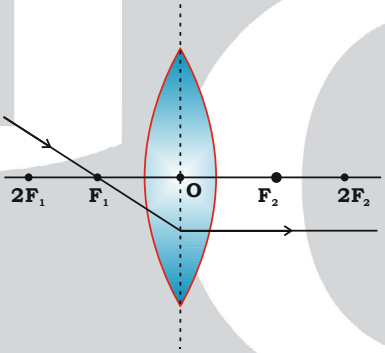
Concave
(Diverging)

- **Rules of obtain image from Convex Lens:-**

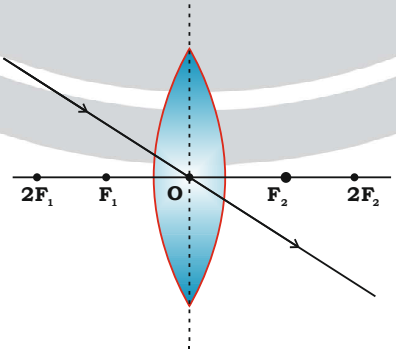
(i) Incident ray coming parallel to p.axis after refraction passes through focus.



(ii) Incident ray coming from focus after refraction becomes parallel to p.axis.

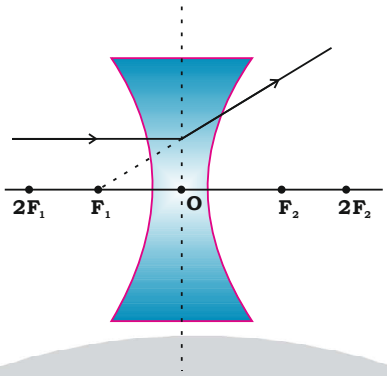


(iii) Incident ray coming from 'O' goes straight or undeviated.



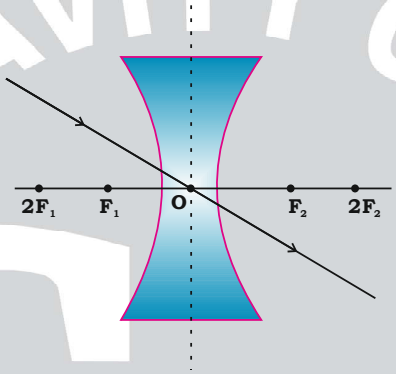
- **Rules of obtain image from Concave Lens:-**

(i) I.R. coming parallel to p.axis diverge but appears to pass through focus.

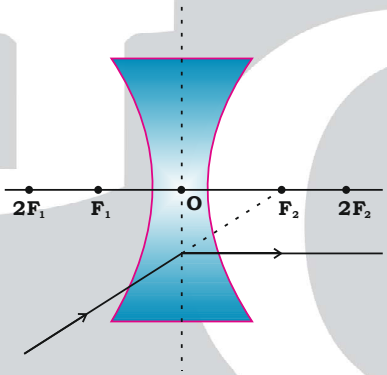


→ || to P-axis appear converge on F_1.
→ Diverging using F_1.

(ii) I.R. coming from O goes straight.

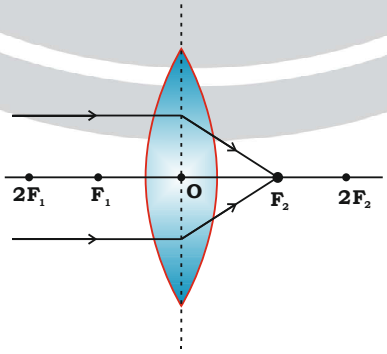


(iii)I.R. appears to go 'F_2' parallel to p.axis.



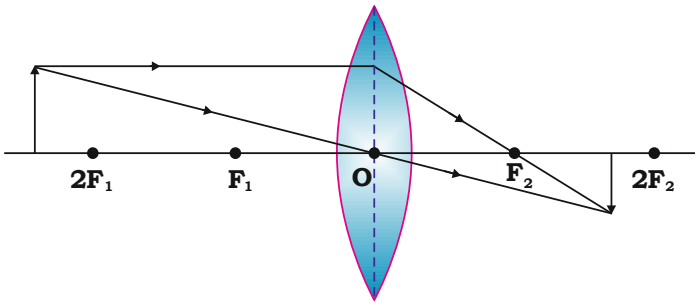
- **Image Formation : Convex Lens**

(1) Object at infinity (∞)



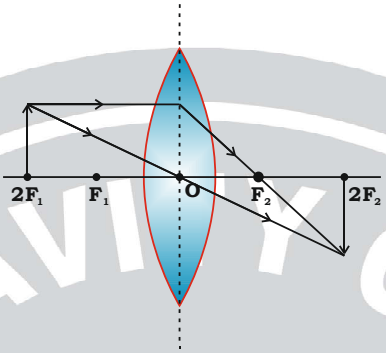
Nature of Image:-
→ At 'F'
→ Highly Diminished
→ Real
→ Inverted

(2) Object 'beyond $2F_1$'



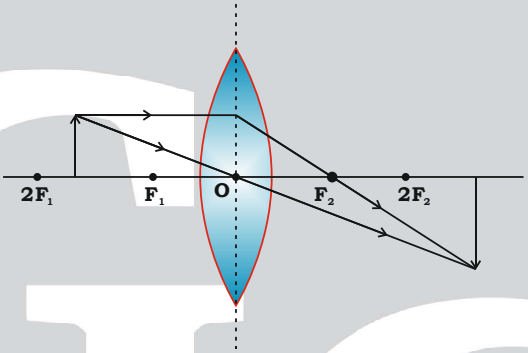
Nature of Image:-
- → Between F_2 and $2F_2$
- → Diminished
- → Real
- → Inverted

(3) Object at '$2F_1$'



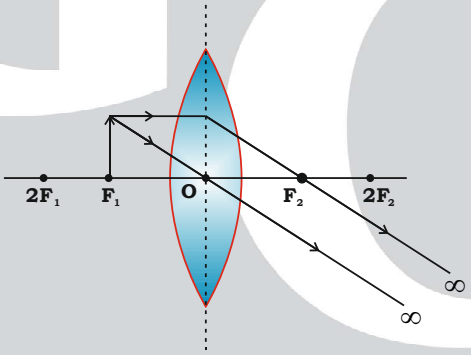
Nature of Image:-
- → A $2F_2$
- → Same Size
- → Real
- → Inverted

(4) Object between $2F_1$ and $2F_1$



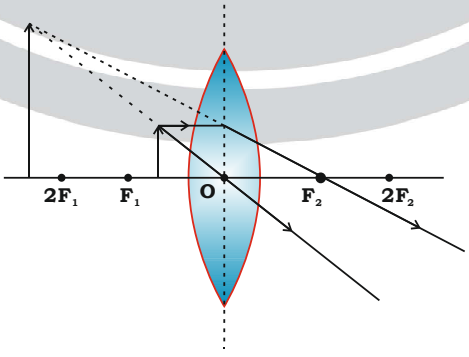
Nature of Image:-
- → Beyond $2F_2$
- → Enlarged
- → Real
- → Inverted

(5) Object at 'F_1'



Nature of Image:-
- → At (∞)
- → Highly Enlarged
- → Real
- → Inverted

(6) Object between F_1 and O



Nature of Image:-
- → Infront of the lens
- → Enlarged
- → Virtual
- → Erect

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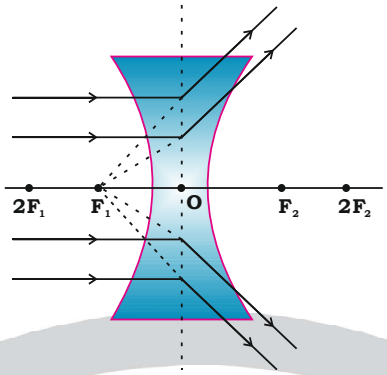
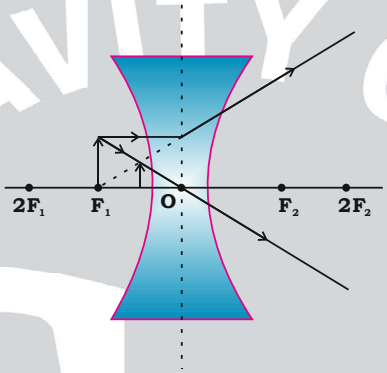
- **Image Formation : (Concave Lens)**

(1) Object at Infinity (∞)



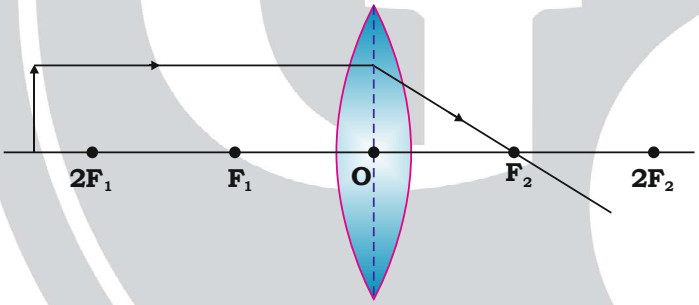
Nature of Image:-
→ At F_1
→ Highly Diminished
→ Virtual
→ Erect

(2) Object at a Finite Distance

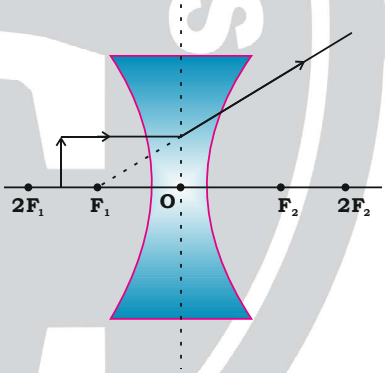


Nature of Image:-
→ Between F_1 and O
→ Diminished
→ Virtual
→ Erect

➢ **Sign Convention and Formula**



$u = -ve$ (always)
$f = +ve$
$h_o = +ve$



$u = -ve$
$f = -ve$
$h_o = +ve$

- Lens Formula

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

- Magnification

$$\boxed{m = \frac{h_{img}}{h_{obj}}} \qquad \boxed{m = \frac{v}{u}}$$

→ Tools

$$\text{Nature}\begin{cases} m \longrightarrow +ve \rightarrow (\text{Erect + Virtual}) \\ m \longrightarrow -ve \rightarrow (\text{Inverted + Real}) \end{cases}$$

$$\text{Size}\begin{cases} m > 1 : (\text{Enlarged}) \\ m = 1 : (\text{Same Size}) \\ 0 < m < 1 : (\text{Diminished}) \end{cases}$$

Q. A convex lens produce a real and invertal image 2.5 times magnified at a distance of 2.5 cm from the lens. Calculate focal length and power of lens ?

Sol, Given, $m = -2.5$ ($\because$ –ve because inverted)

$v = +25\,cm, f = ?, u = ?$

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

$$-2.5 = \frac{25}{u}$$

$$u = \frac{25}{-2.5} = \boxed{-10\,cm}$$

Using Lens Formual

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

$$\frac{1}{f} = \frac{1}{25} - \frac{1}{(-10)}$$

$$\boxed{f = 7.1\,cm}$$

Q. An object is placed at a distance of 10 cm from convex lens of focal length 15 cm. Find position and nature of imaged formed ?

Sol. $f = +15\,cm, u = -10\,cm, v = ?, m = ?$

From Lens Formula

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

$$\frac{1}{15} = \frac{1}{v} - \frac{1}{(-10)}$$

$$\boxed{v = -30\,cm}$$

From Magnification

$$m = \frac{v}{u} = \frac{-30}{-10} = +3$$

$\boxed{m = +3}$ (+ Erect+Virtual, 3 > 1 Enlarged)

Q. An object 5 cm in length is hold 25 cm away from converging lens of focal length 10 cm. Find position, size and nature of image formed ?

Sol. $h_o = 5\,cm, u = -25\,cm, f = +10\,cm$

$h_I = ?$ $v = ?$ $m = ?$

From Lens Formula

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

$$\frac{1}{10} = \frac{1}{v} - \frac{1}{(-25)}$$

$$\boxed{v = \frac{50}{3}\,cm}$$

$$m = \frac{v}{u} = \frac{50}{3} = \frac{-2}{3}$$

$$\boxed{m = \frac{-2}{3}} = -0.66$$ (- Real and Inverted, 0.66 - 0 < m < 1 = Diminished)

$$m = \frac{h_i}{h_o} \Rightarrow \frac{-2}{3} = \frac{h}{5} \Rightarrow h_i = \frac{-2}{3} \times 5 = \frac{-10}{3} = \boxed{-0.33}$$

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Q. A concave lens of focal length 15 cm forms image as a distance of 10 cm from lens. How far is the object placed from the lens. What is the magnification and nature of image ?

Sol. $f = -15\,cm, v = -10\,cm, u = ?, m = ?$

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

$$\frac{1}{-15} = \frac{1}{(-10)} - \frac{1}{u}$$

$$\boxed{u = -30\,cm}$$

From Magnification

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

$$= \frac{-10}{-30} = \frac{1}{3} = 33.3$$

$$\boxed{m = +33.3}$$ (+ Virtual and Erect, 33.3 - 0 < m < 1 Diminished)

➢ **Power (P) of the Lens:-** The degree of ability to converge or diverge ray.

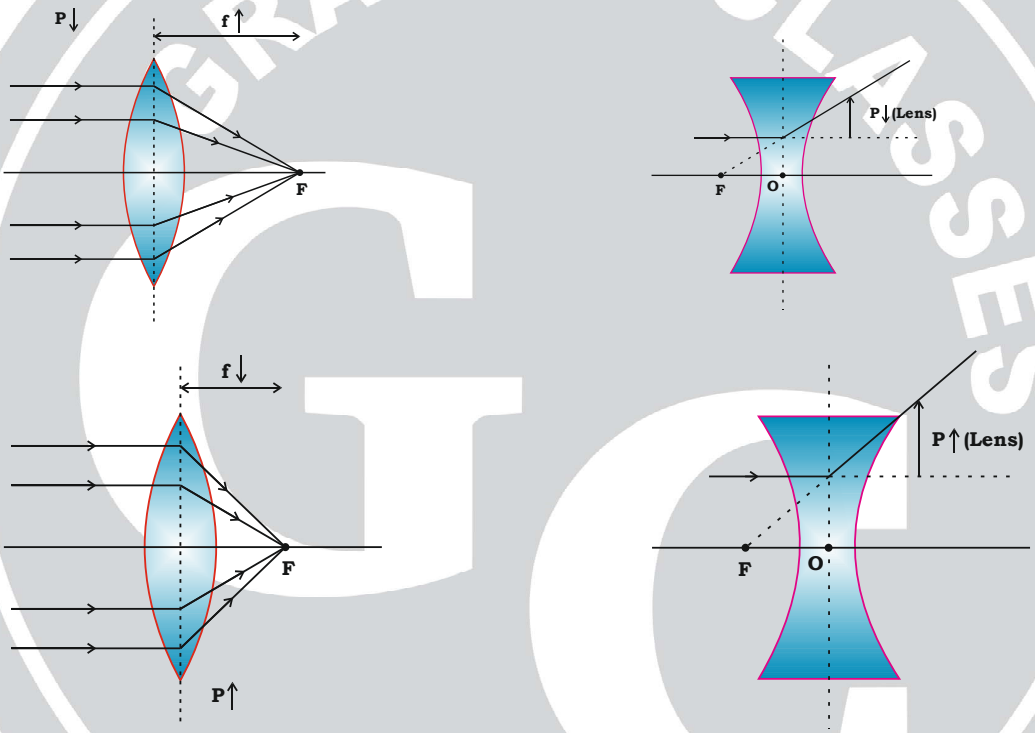
→ Formual $\boxed{(P) = \frac{1}{f(m)}}$

→ Unit : Dioptre (D)

→ For converging lens (convex) → (+ve dioptre)

→ For diverging lens (concave) → (-ve dioptre)

- **Power of Lens :** Means



Note:-

$$\boxed{\frac{\text{Thick } P\uparrow F\downarrow}{\text{Thin } P\downarrow F\uparrow}}$$

Diopter ← $\boxed{P = \frac{1}{f(m)}}$

$$\boxed{P = \frac{100}{f(cm)}}$$

Q. An eye specialist prescribes a number of +4.5 D to a person for his glasses. What is the nature of lens ? What is the focal length of Lens ?

Sol. $P = +4.5\,D$

$$P = \frac{100}{f}$$

$$f = \frac{100}{P} = \frac{100}{4.5} \Rightarrow \frac{1000}{45} = +22.1\,cm$$

$$\boxed{f = +22.1\,cm}$$

- +ve shows converging lens/convex lens.

Q. Two thin lens of power +2.5 D and - 1.5 D are placed in contact. Calculate power of their combination and focal length of their combination ?

Sol. $P_1 = +2.5D$ (Convex)

$P_2 = -1.5D$ (Concave)

$P_N = P_1 + P_2$

$= 2.5 - 1.5$

$\boxed{P_N = 1D}$

We know,

$P = \frac{100}{f(cm)}$

$1 = \frac{100}{f}$

$\boxed{f = 100\,cm}$

Q. A Convex lens of focal length 40 cm and a concave lens of focal length 50 cm are placed in contact with each other calculate power of their combination and focal length of combination?

Sol. $f_1 = +40\,cm$ ($\because$ Convex Lens)

$f_2 = -50\,cm$ ($\because$ Concave Lens)

(i) Power of Combination

$P_1 = \frac{100}{f_1} = \frac{10\cancel{0}}{4\cancel{0}} \Rightarrow 2.5\,D$

$P_2 = \frac{100}{f_2} = \frac{100}{50} \Rightarrow -2\,D$

$P_T = P_1 + P_2$

$= 2.5 - 2$

$\boxed{P_T = 0.5\,D}$

(ii) Focal Length of Combination

$\frac{1}{f_T} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{f_T} = \frac{1}{40} + \frac{1}{-50}$

$\boxed{f_T = 200\,cm}$

$P_T = \frac{100}{f_T}$

$0.5 = \frac{100}{f_T}$

$\boxed{f_T = 200\,cm}$