Start

Light

Q what is light? and write characteristics.

Ans light is a form of energy which gives us sensation of sight.

characteristics of light

(i) light travells in a straight path.
(ii) It is electromagnetic waves (It does not require any material mediam to travel)
(iii) Light is form of invisible energy.
(iv) It is a transversal wave.
(v) Speed of light is different in different mediam. In vaccum speed of light is 3×10^8 m/s.
(vi) Light is reflected when it strikes a surface
(vii) Reflection is regular from a smooth surface.
(viii) Light is scattered from a rough surface
(ix) when it goes one medium to another mediam it get bands.
(x) Light itself is not visible but it makes other objects visible.
(xi) Image is formed when light is reflected from a mirror.
(x) Shadow is formed when an opaque objects comes in the path of light

The wave length of visible light waves is very small (being only about 4×10^{-7} m to 8×10^{-7} m)

Nature of light :->

light is dual in nature - Particles as well as waves.

At the begning of 20th century it became known that the waves theory of light often becomes inadequate for ~~the~~ treatment of the interaction of light with matter, and light often behaves somewhat like a stream of particles. This confusion about the true nature of light continued continued for some years till a modern quantum theory of light emerged in which light is neither a 'waves' nor a 'particles'. The new theory reconciles the particle properties of light with the wave nature.

(प्रकाश)

=> There are three types of body ->

(1) luminous bodies -> Those bodies which emit (gives out) the light are called luminous bodies.

eg:- Sun, Star, firefly (Jugnu), lamp, bulb, etc.

There are two types of luminous bodies

(1) Natural luminous body or (Natural Source

of light) → Those source of light which found in nature are called natural sources of light.

eg → Sun, Star, firefly (Jugnu) etc

(ii) Artificial luminous bodies or (man-made source of light) → Those source of light which made by man are called artificial source of light.

eg → electric buld, burning candle, oil lamb, tube light etc.

(2) Non-luminous bodies → Those bodies which do not emit (or give out) light are called non-luminous bodies

eg → book, table, wall, brick, moon etc.

Note → moon is non-luminous body because it does not has on light. it reflect the sun light.

moon shines at night. But moon is a nonluminous body because it does not emit (gives) its own light. This happens because light from the sun falls on the moon and gets reflected to reach us.

Just like moon light, we

talk of the earth light. The light coming from the sun gets reflected from the surface of the earth is called earth light. The earth light can be seen from the moon.

vii) Incandescent bodies ⇒ Those body which emit light (gives out light) when heated to very high temperature are called incandescent bodies.

Incandescent bodies are hot sources of light.

~~for~~ for example

i) An electric bulb has a tungsten filament in it. At room temperature, this filament does not emit light. When electricity is passed through the filament, it gets heated and start glowing to emit light. At this stage, the filament is in the incandescent state.

The filament inside electric bulb is non-luminous at room temperature. But when electricity is passed it gets very hot and start emitting light.

ii) Iron is a non-luminous substance at room temperature. But when heated to about 700°C, it begins to glow and

emit light.
Conclusions: many substance which are non luminnous at room temperature become luminous on strong heating.

Ray of light ⇒

* Ray of light → A straight path drawn in the direction of propagation of light is called ray of light.

(Propogation) ⇒ गमन otherword travells

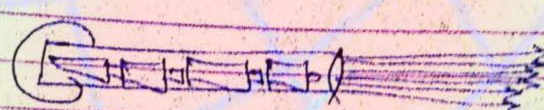
This can show in (→) → ray of light

ray of light.

* Beam of light ⇒ Group or bunch of ray of light is called beam of light

Beam of light

There are three types of beam of light
(i) Parallel beam of light :- A beam of light in which ray of light are parallel to each other is called Parallel beam of light.

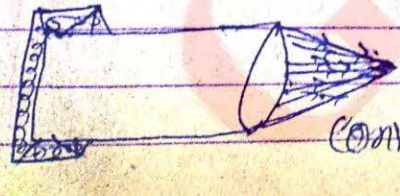


Parallel beam of light.

(ii) Divergent beam of light :- A beam of light in which ray of light goes away from each other or diverse from each other is called divergent beam of light.

Divergent beam of light.

(iii) Convergent beam of light :- A beam of light in which ray of light converse or meet at a point is called convergent beam of light.



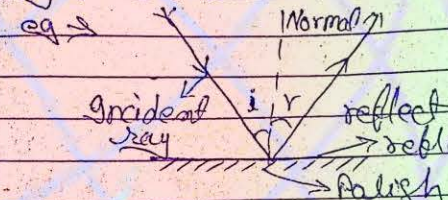
Convergent beam of light.

[Polish/smooth]

Reflection of light

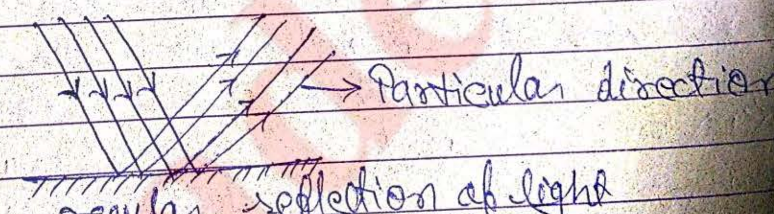
* Reflection of light ⇒ when light falls on a (smooth) surface it get bounce back in the same medium. This phenomenon of light is called reflection of light.

eg ⇒



There are two types of reflection of light ⇒

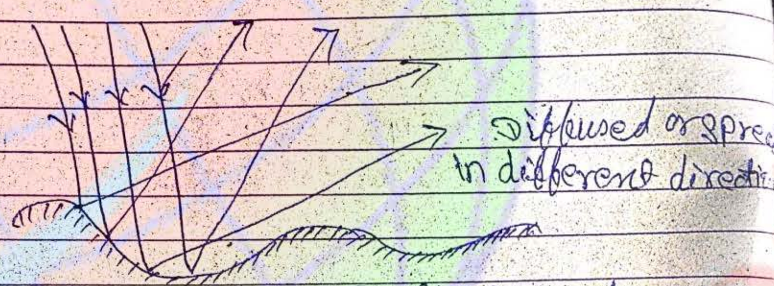
I) Regular reflection of light ⇒ A reflection of light in which reflected light reflect in a particular direction from smooth surface is called regular reflection of light.



II) Irregular reflection of light ⇒ A reflection of light in which reflected ~~light~~

ray goes in a ~~particular~~ different direction from reflecting irregular surface is called Irregular reflection of light/ Diffuse reflection of light

eg →



Irregular Reflection of light.

Note → Reflection of light from a wall, a paper and many other common objects is irregular (or diffused reflection).

In our daily life irregular reflection is very importantful after our living life. we see different object in different direction in irregular reflection of light

(1)

This figure show that it is regular reflection when our eye is goes in (T) position then we see object. But we can not see object in position (R)

(11)

This figure show that irregular reflection of light when our eyes is goes in any position (T, Q, R, S) we see this object from our eyes.

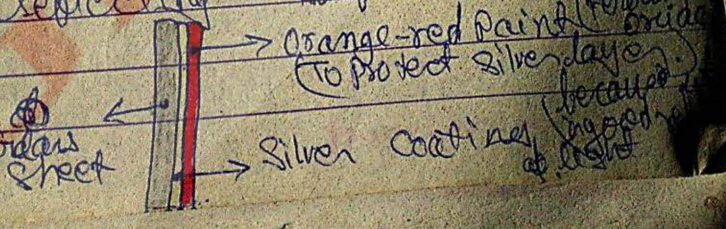
So, we say that in our daily life irregular reflection help to see any object in any position.
So, we say that object can be seen from the different position easily.

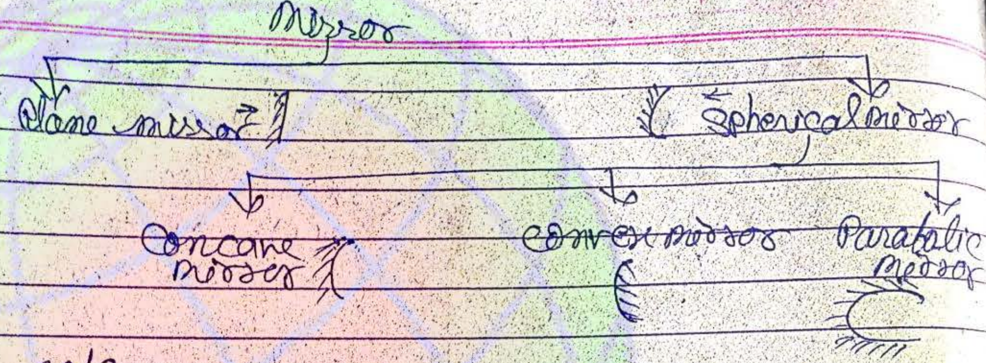
Mirror

Mirror :- A smooth, highly polished reflecting surface is called mirror.
(another answer)

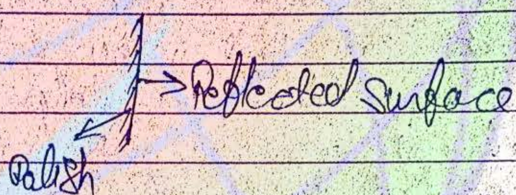
A glass whose one surface is polished with silver and coated with paint to prevent the rubout of polish surface and other surface acts as a reflecting surface is called as a mirror.

eg:-





note



Plane mirror :- A mirror whose reflecting surface is plane is called plane mirror

eg

Spherical mirror :- A mirror whose reflecting surface is curve is called Spherical mirror.

eg

→ There are three type of spherical mirror→

(i) Convex mirror→ A spherical mirror whose reflecting surface is convex (outward or bulging-out surface, elevation) is called convex mirror.

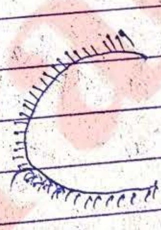
eg

(ii) Concave mirror→ A spherical mirror whose reflecting surface is concave (inward surface) or bent-in surface is called concave mirror.

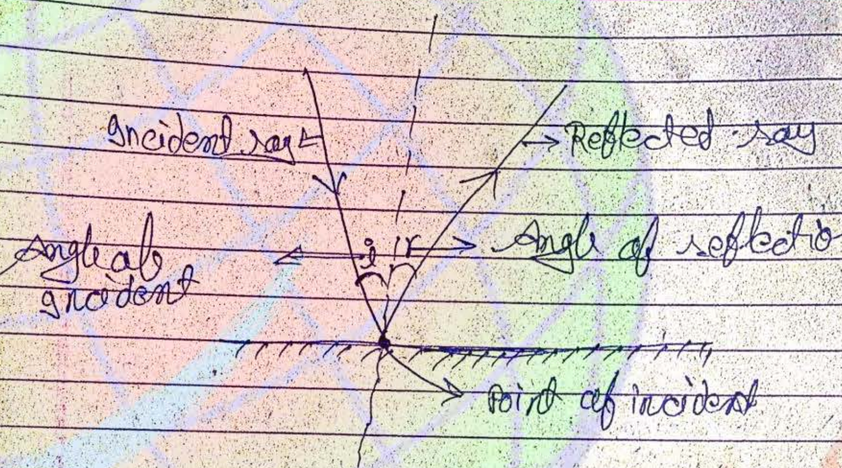
eg

(iii) Parabolic mirror→ A spherical mirror whose reflecting surface is parabolic surface is called parabolic mirror.

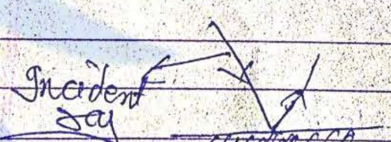
eg



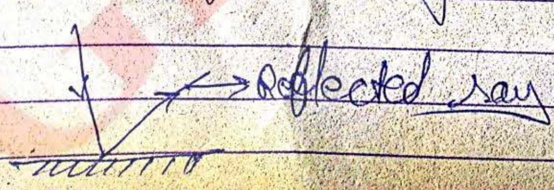
Reflection from a plane Surface:→



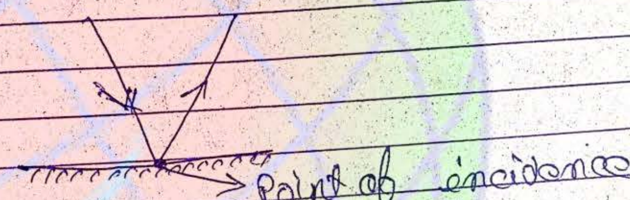
* Incident ray :- A ray of light which falls ~~on the~~ (or strike) on the surface is called incident ray.



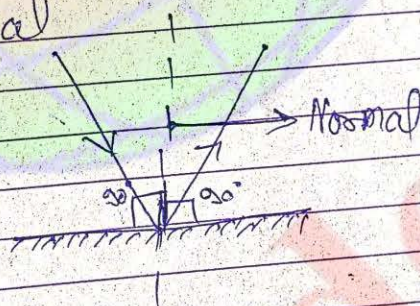
* Reflected ray :- A ray of light which reflected (or send back) from the surface is called reflected ray.



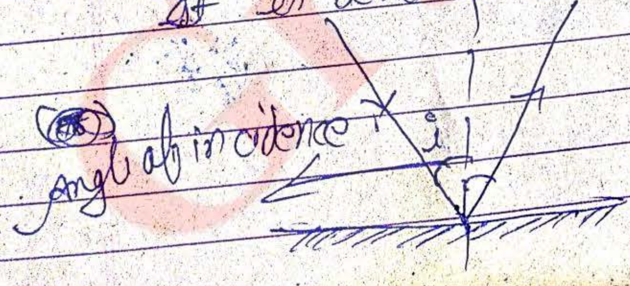
* Point of incidence = A point on a surface at which incident ray is fall is called point of incidence.



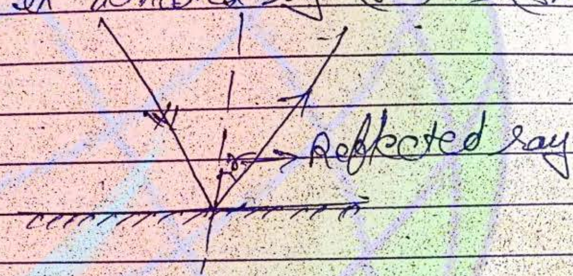
* Normal → A perpendicular line drawn at a point of incidence is called normal



* Angle of Incidence = Angle between incident ray and normal is called angle of incidence.
It is denoted by (i) → (small letter)



* Angle of reflection ⇒ Angle between normal and reflected ray is called angle of reflection.
It is denoted by (r) → (small letter)



Laws of Reflection of light ⇒

There are two laws of reflection :-

(i) Angle of incidence is equal to angle of reflection.

$\angle i = \angle r$

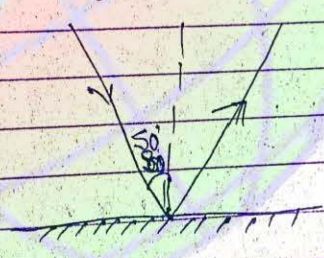
(ii) The incidence ray, the reflected ray and the normal (at the point of incidence), all lie in the same plane.

Note ⇒ A ray of light which is incident normally (or perpendicularly) on a mirror, is reflected back along the same path (because the angle of incidence as well as the angle of reflection for a such a ray of light are zero.

Mathematically

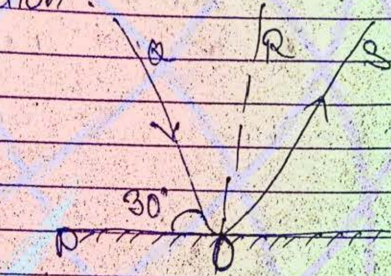
(1) If angle of incident is 50°. Find the angle of reflection.

Ans -



Given
Angle of incident (i) = 50°
Angle of reflection (r) = ?
we know that,
By law of reflection of light
$\angle i = \angle r$
$50° = \angle r$
$\therefore \angle r = 50°$
So, Angle of reflection is 50°

Q) Angle between the incident ray and plane is 30° then find the angle of reflection.



Given ⇒

∠POQ = 30°

∠ROS = ?

we know that normal is perpendicular to the ~~xxx~~ point of incident.

So,

∠POQ + ∠QOR = 90°

30° + ∠QOR = 90°

∠QOR = 90 − 30°

∠QOR = 60° ——(1)

Now,

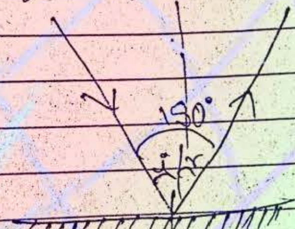
By law of reflection of light

∠i = ∠r

60° = ∠r (from eq(1))

∴ ∠r = 60°

<Q3> The angle between the incident ray and reflected ray is 150°, then find angle of incidence or angle of reflection



Given ⇒ $\angle i + \angle r = 150°$

Let

$\angle i = \angle r = x$ —— ① (By law of reflection of light)

Then,

$\angle i + \angle r = 150°$ (Given)

$\angle x + \angle x = 150°$ (from eq①)

$2\angle x = 150°$

$\angle x = \frac{150}{2}$ 75

$\angle x = 75°$

Therefore, $\angle i = \angle r = x$

⇒ $\angle i = \angle r = 75°$ Ans

<Q4> The angle of incidence of reflection are complementary and angle of reflection

Question

The angle between incidence ray and reflected ray is complementary angle. Find angle of incidence and angle of reflection.

Ans

Given

$\angle i + \angle r = 90°$ (The value of complementary angle is 90°)

By law of reflection of light,

$\angle i = \angle r$

Let,

$\angle i = \angle r = \angle x$ —(1)

Then

$\angle i + \angle r = 90°$ (given)

$\angle x + \angle x = 90°$ (from eq(1))

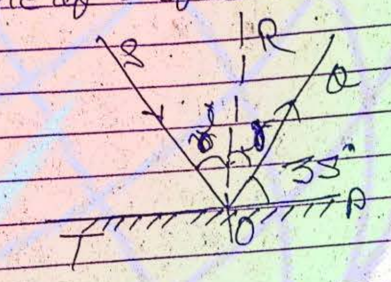
$2\angle x = 90°$

$\angle x = \frac{90}{2}$

$\angle x = 45°$ $\therefore \angle i = \angle r = 45°$

(Q5) The angle between the plane and reflected ray is 35°. Find the angle of reflection.

Ans



Given

$\angle POQ = 35°$

$\angle r = ?$

$\angle r + \angle POQ = 90°$ ($RO \perp TP$)

$\angle r + 35° = 90°$ (given)

$\angle r = 90 - 35$

$\angle r = 55°$ Ans

Image

* Image ⇒ when object place infront of a mirror then similar object can be seen in a mirror that is called image of the object.

⇒ There are two type of Image :⇒

(I) Real image ⇒ An image form by actual intersection of reflected or refract ray of light is called real image

other

The image which can be obtained on a screen is called real image

eg ⇒ The image formed on a cinema screen is an example of real image.

(II) Virtual image ⇒ An image form by virtual intersection or backward movement of reflected or refracted ray of light, is called virtual image,

other

The image which can not be obtained on a screen is called virtual image.

eg ⇒ The image of our face in a plane mirror.

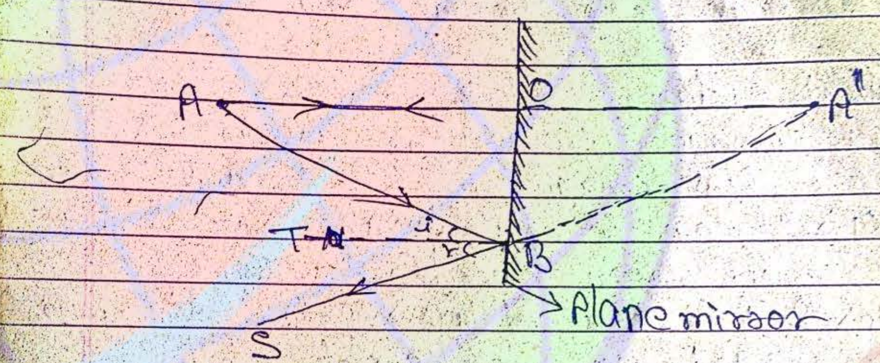
(Q) What is difference between the real and virtual image?

Ans:- Difference between real and virtual image are as follows:-

Real image	Virtual image
(i) It can be obtained on a screen	(i) It can't be obtained on a screen
(ii) Real image is laterly inverted	(ii) Virtual image is erect
(iii) It is always form infront of the mirror	(iii) It is always form behind the mirror.
(iv) An image is form by actual intersection of reflected or refracted ray of light is called real image.	(iv) An image form by virtual intersection or backwardly movement of reflected or refracted ray of light is called virtual image
(v) The image form cinema screen is an example of real image.	(v) The image ~~form~~ of our face in a plane mirror is an example of virtual image.

Formation of image by a plane mirror:

(1) Image of point object



Since,

AA'' // BT

∴ ∠OAB = ∠ABT (Alternate interior angle)

∠OAB = ∠i —— eq(I) (∵ ∠ABT = ∠i)

Again

∠OA'B = ∠TBS (Corresponding angle)

∴ ∠OA'B = ∠r —— (II)

By law of reflection of light.

∠i = ∠r

∴ ∠OAB = ∠OA'B (from eq(I) and eq(II))

In ΔAOB and ΔOA'B

∠OAB = ∠OA'B (above proved)

OB = OB (common)

∠AOB = ∠A'OB = 90°

∴ ΔAOB ≅ ΔOA'B (By AAS)

∴ OA = OA'' (By C.P.C.T.)

∴ object distance from the mirror = OA

Image distance from the mirror = OA''

⇒ Formation of image of extended object by plane mirror.

Nature ⇒ (i) virtual and erect
(ii) Same size of the object.
(iii)

⇒ Lateral inversion ⇒
The change of left size to the right size and right size to the left size ~~by a plane mirror~~ of object by a plane mirror is called lateral inversion.

Q ⇒ The word ambulance written laterally inverted
⇒ The word ambulance written laterally inverted in the van because

opp. word → Real – virtual
वास्तविक – आभासी

opp. word → erect – inverted
सीधा – उल्टा

The driver of the infront vehicles see the ~~errect~~ erect word AMBULANCE. So it can pass it quickly.

⟹ characteristics of the image form by the plane mirror

(i) It is virtual and erect.
(ii) It is same size of the object.
(iii) Image form at the same distance behind the mirror as far object place infront of the mirror from it.
(iv) It is laterly inverted.

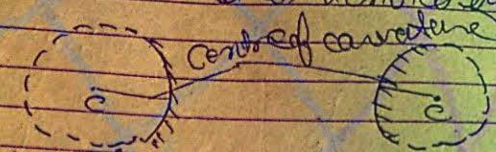
⟹ Spherical mirror ⟹

(i) Centre of curvature
(ii) Radius of curvature
(iii) Pole
(iv) Principle axis
(v) Aperture
(vi) Focus
(vii) Focal length

1) Centre of curvature ⟹ The centre of the whole sphere whose spherical mirror is

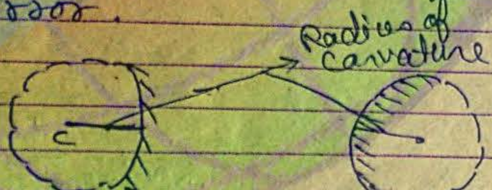
a part is called centre of curvature. It is denoted by C

eg

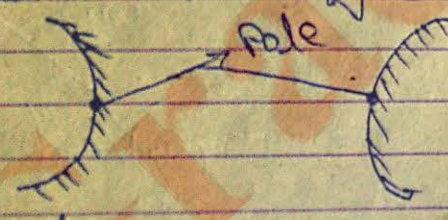


(ii) Radius of curvature ⇒ The radius of the hollow sphere whose spherical mirror is a part is called radius of curvature of spherical mirror.

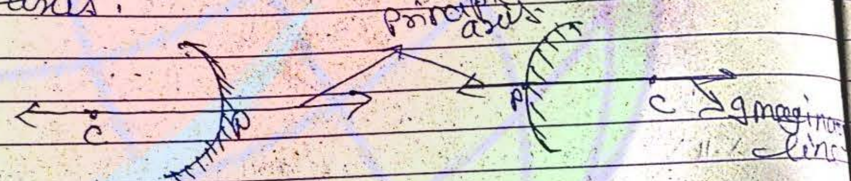
eg



(iii) Pole ⇒ The mid-point of the reflecting surface of spherical mirror is called Pole.
It is denoted by P

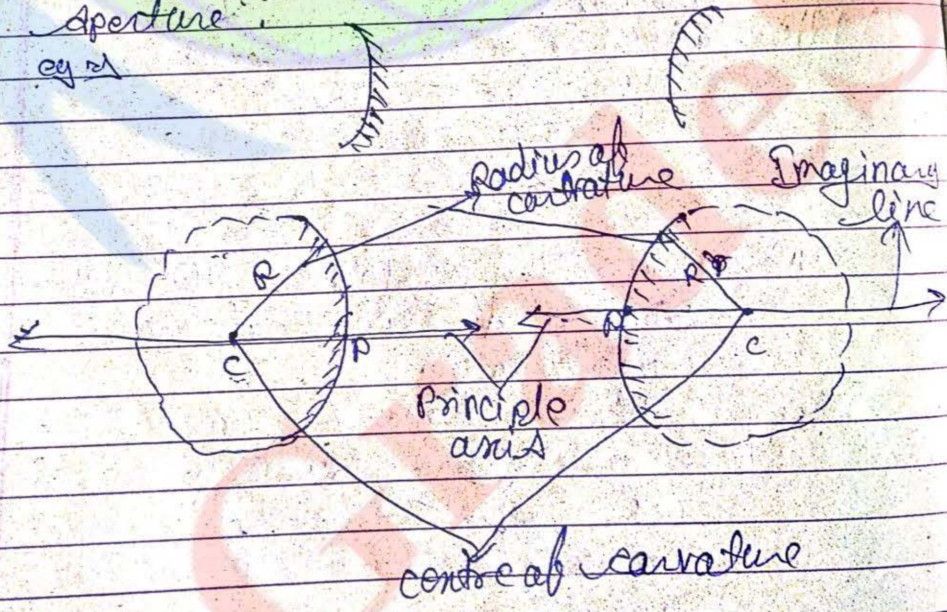


(iv) Principle axis ⇒ An imaginary line which passes through the centre of curvature and pole of the spherical mirror is called principle axis.



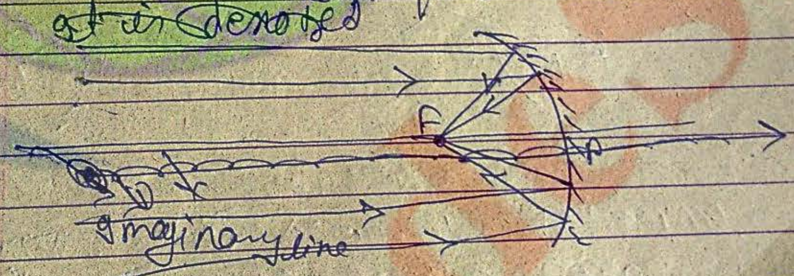
(V) Aperture → The length of the reflecting surface of the spherical mirror is called Aperture.

eg →



(VI) Fo...

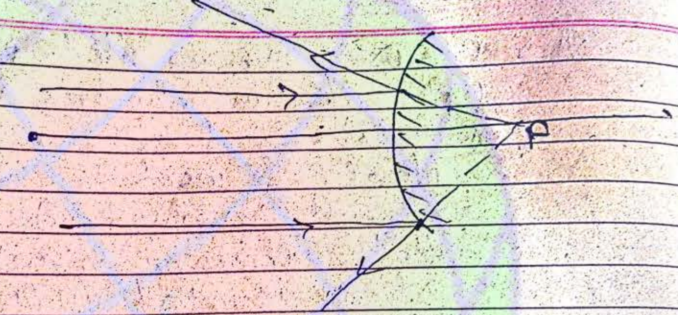
Ans → Focus ⇒ The parallel beam of light of the principle axis of a spherical mirror after the reflection meet or appears to meet at a point on a principle axis is called focus or Priciple focus.
It is denoted by (F) — capital
(a) Focus of concave mirror ⇒ The parallel beam of the light of the principle axis of a concave mirror meet at a point on a principle axis that point is called focus of concave mirror.
Its focus is real.
~~it is denoted~~



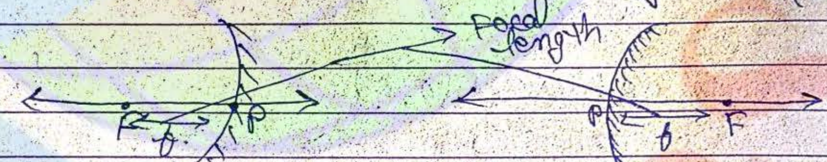
(b) Focus of convex mirror ⇒ The parallel beam of light of the priciple axis of a convex mirror after the reflection appears to meet at a point on a principle axis that point is called focus of convex mirror.
Its focus is imaginary/virtual

(Diverse/spread out)

eg



Focal length:- The distance between Pole and focus of a spherical mirror is called Focal length.
It is denoted by small (f)

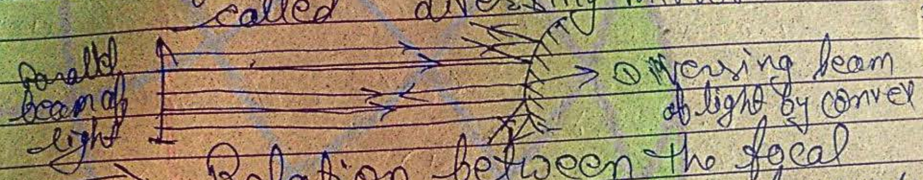


Converging mirror => Since Parallel beam Concave mirror converge all the Parallel beam of light of a principle axis so it is called converging mirror

eg

Drivation

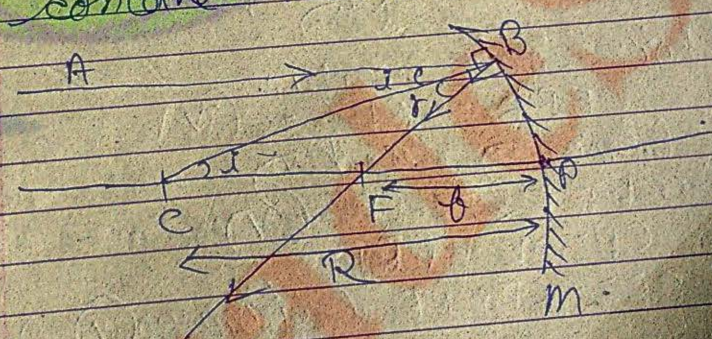
* Diverging mirror: Convex mirror diverse all parallel beam of light of the principle axis. So it is called diverging mirror.



Relation between the focal length (f) and radius of curvature (r).

$$f = \frac{r}{2}$$

* Relation between f and R in concave mirror.



Let us consider incident ray AB falls on concave mirror M

(≈) ⇒ sign of Approximate
लगभग का चिह्न

Parallel to the principle axis after the reflection it passes through the focus and joint B to C and its focal length be 'f' and radius of curvature 'R'

By law of reflection of light
$\angle i = \angle r$
$\angle ABC = \angle CBF$ — (I)
Since, AB ∥ CP
∴ $\angle ABC = \angle BCF$ (Alternate interior angles) — (II)

from eq (I) and (II)

$\angle CBF = \angle BCF$
∴ CF = FB (opp. side of equal angles are equal) — (III)

For small aperture
FB ≈ PF — (IV)
from eq (III) and (IV)
CF = FB = PF — (V)
CP = CF + PF
CP = PF + PF (from eq (V))

R = f + f
R = 2f
∴ f = R/2

⟹ Relation between 'f' and 'R' in convex mirror.

Let us consider incident ray AB strike on a convex mirror parallel to the principle axis after the reflection from it goes along BD which apper to comes from focus 'F'. Drawn the normal CE at point B on a mirror.

By laws of reflection of light,

$\angle ABE = \angle DBE$ — (1)

$\angle DBE = \angle CBF$ (vertically opp. $\angle$s)

Since, AB ∥ PC and EC is transversal line

$\angle ABE = \angle BCF$ (corresponding angle

From above equation

∴ $\angle CBE = \angle BCF$

∴ $FB = FC$ (∵ sides opp. to equal angle are equal) — (i)

for very small aperture

$PF \cong FB$ — (ii)

from eq (i) and (ii)

$FB = FC = PF$ — (iii)

∴ $CP = PF + FC$

$CP = PF + PF$ (from eq (iii))

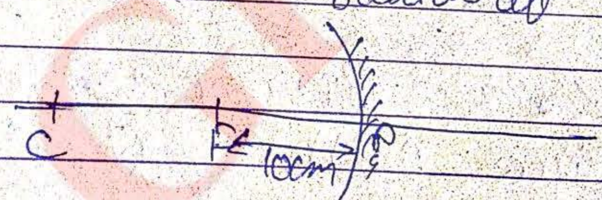
$R = f + f$

$\boxed{R = 2f}$

∴ $f = \frac{R}{2}$

Q ⇒ The focal length of concave mirror is 10cm. Find radius of curvature of it.

Ans



Givens
Focal length (f) = 10cm
(R) radius of curvature = ?

we know that
$r = 2f$
$= 2 \times 10$
$= 20cm$

Q) The radius of curvature of a convex mirror is 30cm. Find its focal length.

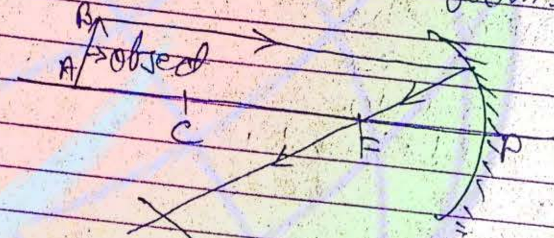
Ans

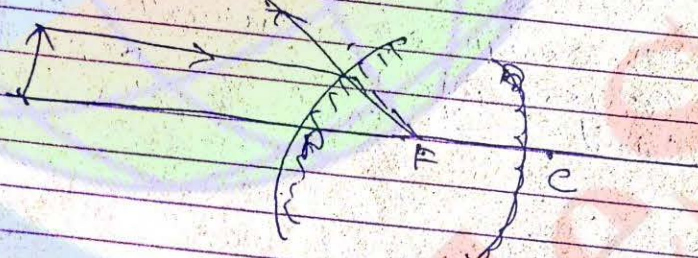
Given :
R = 30cm
f = ?
we know that
$F = \frac{R}{2}$

$= \frac{30}{2} = 15cm$

Rule of formation of image by spherical mirror :→

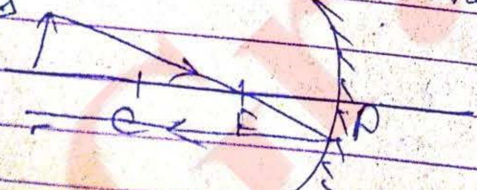
Rule Ist ⇒ The parallel ray of light of the principle axis of a spherical mirror after reflection passes through focus (concave mirror) or appears to come from focus (convex mirror)



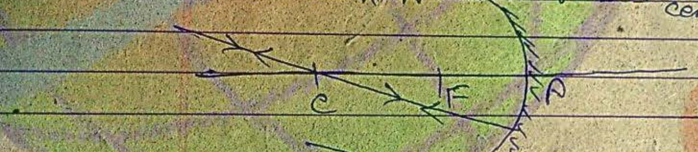


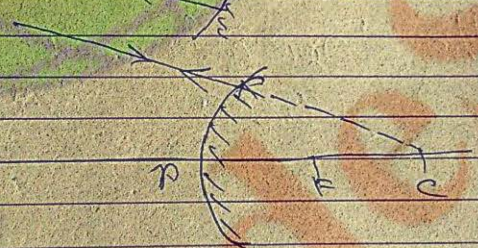
Rule IInd ⇒ when ray of light passes through the focus of spherical mirror (concave mirror) after reflection it goes parallel to the principle axis.
For convex appear to passes throught the focous.

eg→

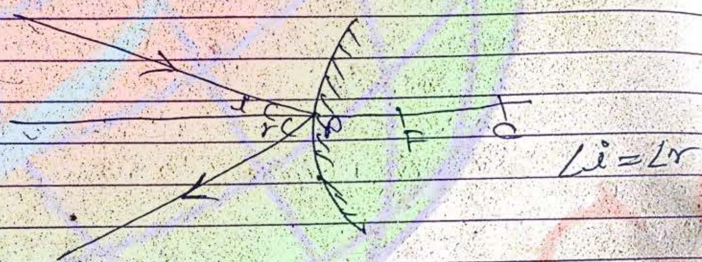


Rule IIIrd :- A ray of light which passes through the centre of a spherical mirror after reflection it reflect back in the same path.
For convex mirror it appears to passes through the centre of curvature.

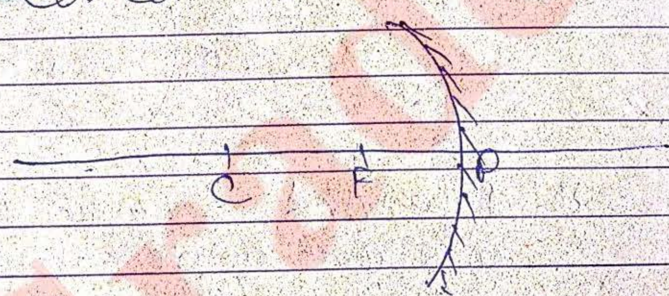




Rule IVth :- A ray of light falls on pole of a spherical mirror. it reflect by follows the law of reflection of light.

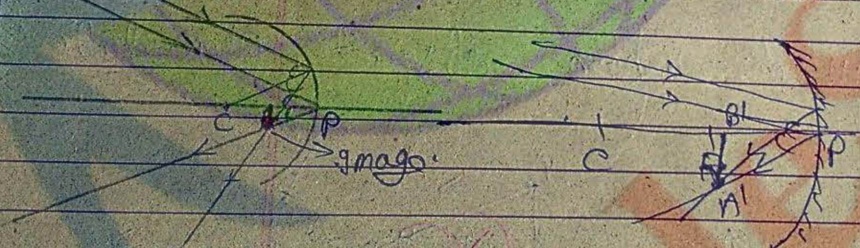


⇒ The Formation of Image by Concave mirror



Position of the object.
(I) At infinity
(II) Beyond C or/between infinity and C
(III) At 'C'
(IV) beth C and F
(V) At focus
(VI) bet P and F

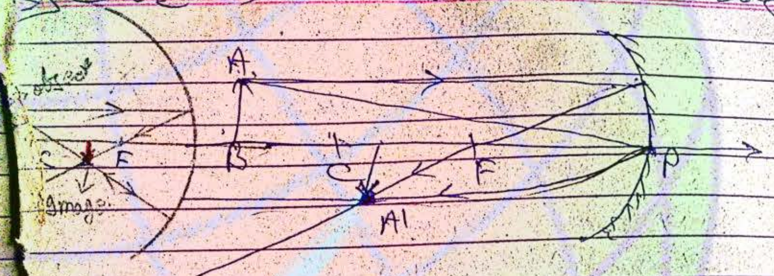
Case Ist
image ⇒ when object place at infinitive



characteristics of image.
(I) Nature ⇒ Real and inverted
(II) Position ⇒ At focus
(III) Size ⇒ Diminished or point in size

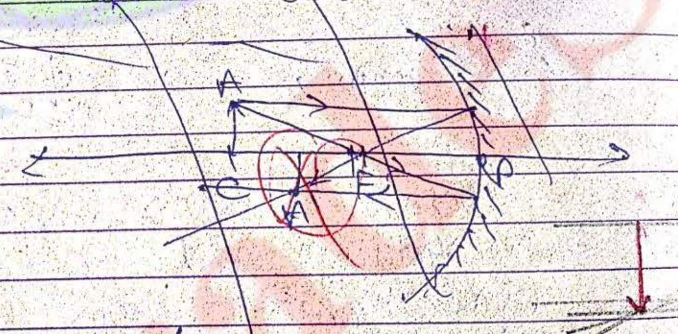
Case IInd ⇒ when object place at beyond the C.

⇒ Case IInd ⇒ when object placed beyond the C



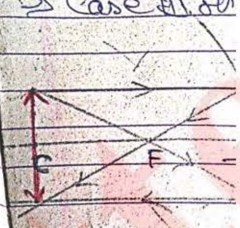
characteristics of image
(i) Nature ⇒ Real and ~~image~~ inverted
(ii) Positions ⇒ F and C
(iii) Size ⇒ Small in size

⇒ Case IIIrd ⇒ when object placed at C'



characteristics of image
(i) Nature ⇒ Real and inverted
(ii) Position ⇒ C and F
(iii) Size ⇒ Small in size

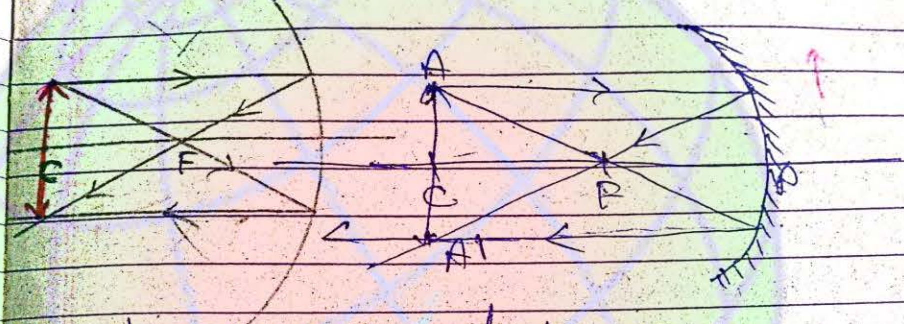
⇒ Case IIIrd



characte...
(i) Nat...
(ii) Pos...
(iii) S...

⇒ Case...

⇒ Case IIIrd ⇒ when object placed at 'C'

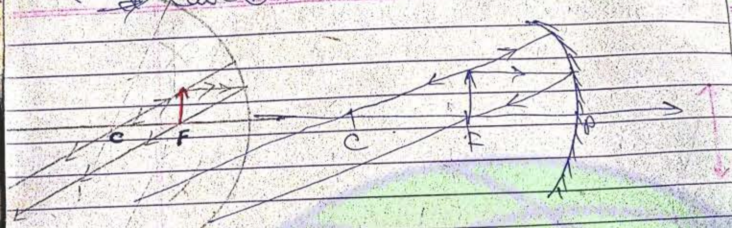


characteristics of image
(i) Nature ⇒ Real and inverted
(ii) Position ⇒ At 'C'
(iii) Size ⇒ Same size of the object.

⇒ Case IVth ⇒ when object placed betn 'C' and 'F'

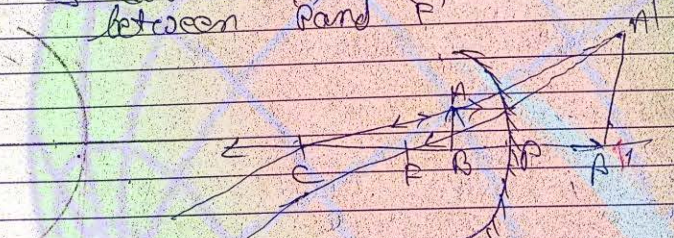
characteristics of image
(i) Nature ⇒ Real and inverted
(ii) Position ⇒ Beyond 'C'
(iii) Size ⇒ larger in size

⇒ Case IVth ⇒ when object placed at 'F'



characteristics
(i) Nature ⇒ Real and inverted
(ii) Position ⇒ At infinitive
(iii) Size ⇒ very-very large in size.

⇒ Case Vth when object place between 'P and F'



characteristics ⇒
(i) Nature ⇒ virtual and erect
(ii) Position ⇒ behind the mirror
(iii) Size ⇒ larger in size.

Q ⇒ when obje
mirror to
image.

Ans ⇒ Obser

Position
of the
object

Case

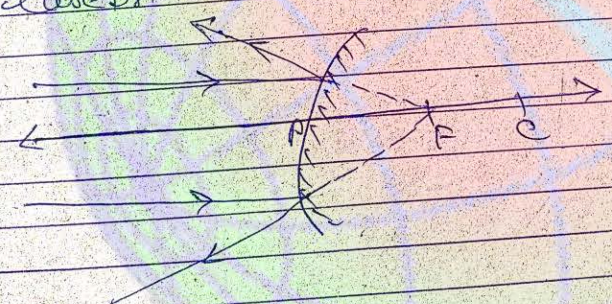
Q3 when object is place infront of concave mirror to obtain the virtual and erect image.

ans: Object place between Pole and Focus

Position of the object	Nature	Position	Size

Y ⇒ Formation of Image By Convex mirror

Case 1st ⇒ when object placed at infinitive



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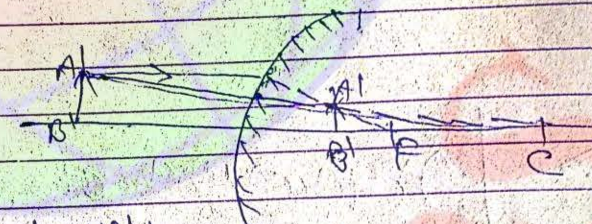
When object at F
Characteristics of image
(i) Nature: virtual and erect
(ii) Position: At 'F'
(iii) Size: diminished

⇒ Case IInd
When object place in front of convex mirror:



Characteristics
(i) Nature: virtual and erect
(ii) Position: Between 'P and F'
(iii) Size: At small in size.

Image ... Concave ...

Position of object	
At infinite	
Beyond C	
At centre C	
Between C and F	
At F.	

⇒ Usc...
Sc...
(i) ...
(ii) ...

erect

...son of

C

d F'

in size.

Image formation of any object by a Concave mirror for different position:

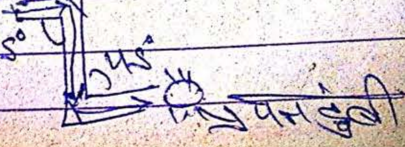
Position of object	Position of the image	Size of Image	Nature of the Image
An infinite	At the focus F	Highly diminished or point in size	Real and Inverted
Beyond C	Between C and F	Diminished or very small	Real and Inverted
At centre C	At C	Same size	Real and Inverted
Between C and F	Beyond C	large in size	Real and Inverted
At F.	Infinity	very-very large	virtual and erect

⇒ Uses of plane mirror:→

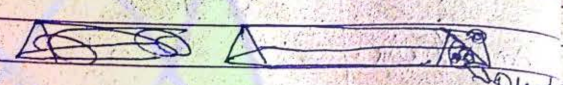
["Scope" means "to see"]

(i) As a looking glass

(ii) In a periscope



(iii) Kaleidoscope.

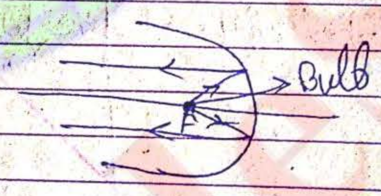


(iv) It is also uses saving mirror in a Salune

(v)

⟹ Uses of concave mirror :→

(i) Concave mirror is uses a a reflector in torch, headlight of the vehicle.



(ii) It is used as a saving mirror.

(iii) It is used by the duentis to see the large image of the teeth.

(iv) It is used as solar Furnace

सूर्य के द्वारा आगमनी भट्ठी

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⟹ Uses of convex mirror ⟹

(i) It is use in a street light.

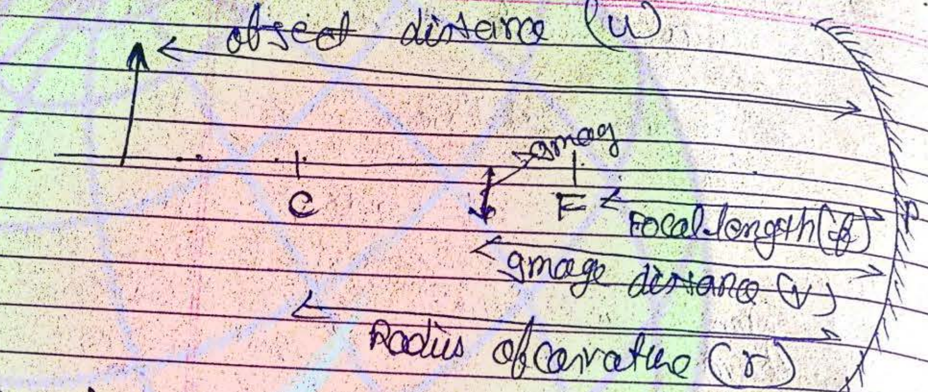
(ii) It is used in a side/rear view mirror in a vehicle.

Convex mirror is at side view mirror because drive enable to see large traffic behind him. So driver can drive vehicle safty on the road because convex mirror always form small erect and virtual image.

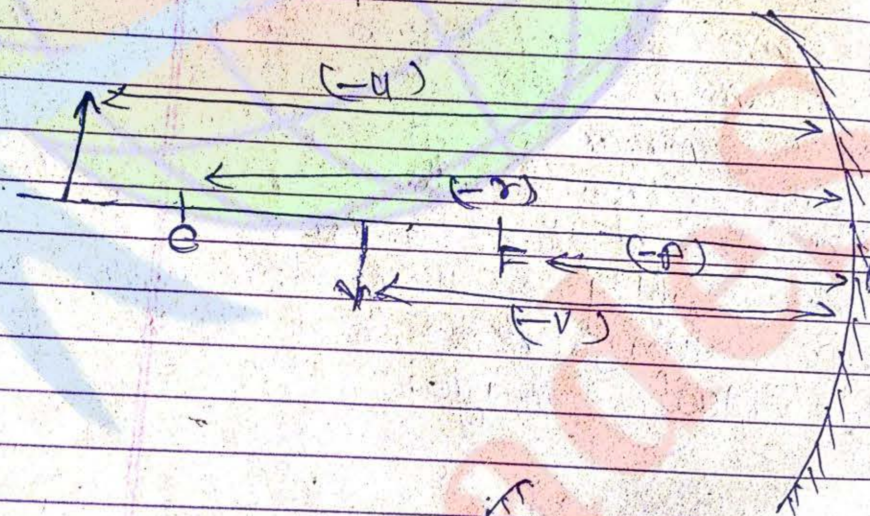
Q. Why convex mirror is use as a rear view mirror.

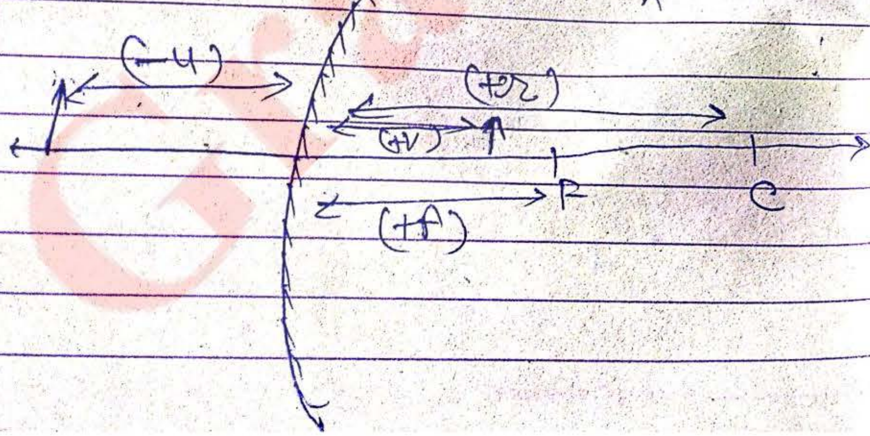
Ans Convex mirror is at side view mirror because drive enable to see large traffic behind him so driver can drive vehicle safty on the road. because convex mirror always form small erect and virtual image.

New Cartesian Sign Conversion in Spherical mirror.

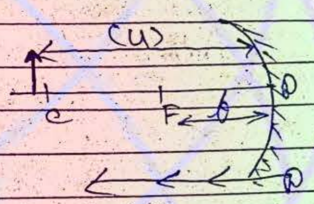


(—) → minus sign (u, r, f)

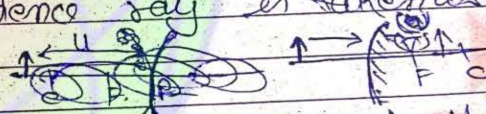




* Rule Ist ⇒ All the distance are measure from pole.

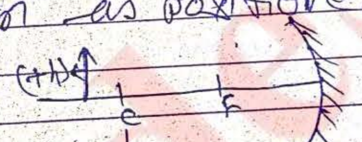


* Rule IInd ⇒ The distance measure in the direction of incidence ray is taken as positive.

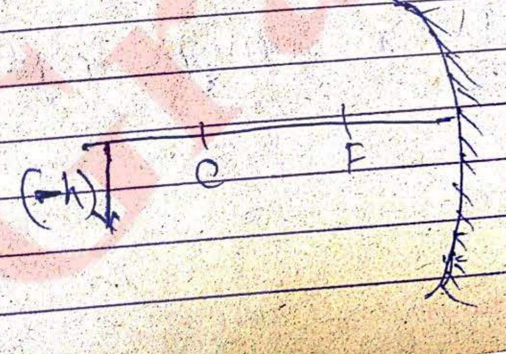


* Rule IIIrd ⇒ The distance measure in the opposite direction of incident is taken as negative

* Rule IVth ⇒ Upward hight of the Principle axis is taken as positive.



* Rule Vth ⇒ downward hight (distance) is taken as negative



⇒ Sign conventing for Concave mirror.
(u, r, and f) are always negative
'v' is positive for virtual image
and negative for real image.

⇒ Sign convention for convex mirror.
"f, r and v" are always positive.
'u' is always negative

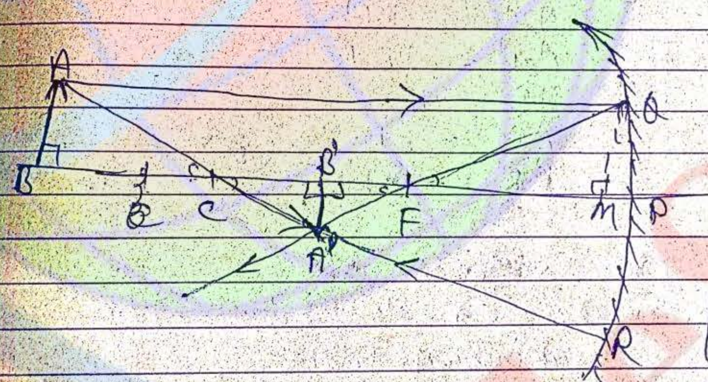
Notes 'u' is always negtive.

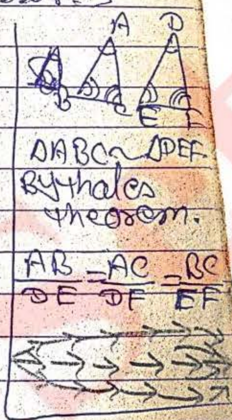
Mirror Formula :→

The Relation between the 'u', 'v' and 'F' is called mirror Formula

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

⇒ Mirror formula in a concave mirror :-





Let an incident ray of AQ and AR after the reflection from the concave mirror they are intersect at a point A' and drawn the perpendicular A'B' on a principle axis that is the image of object AB

To drawn an Perpendicular Perpendicular on BP (or Principle axis)

In ΔABC and ΔA'B'C'

∠ACB = ∠A'CB' (vert. opp. angle)

($\sim$ Similar)

$\angle ABC = \angle A'B'C = 90^\circ$

$\therefore$ By AA, $\Delta ABC \sim \Delta A'B'C$

$$\frac{AB}{A'B'} = \frac{BC}{B'C} \quad \text{--- (i)}$$

Similarly, $\Delta QMF \sim \Delta A'B'F$

$$\frac{QM}{A'B'} = \frac{FM}{B'F}$$

But, $AB = QM$

$$\therefore \frac{AB}{A'B'} = \frac{FM}{B'F} \quad \text{--- (ii)}$$

~~From eq (i) and (ii)~~

For small Aperture 'm'

m is near to P

It means $FM = FP$

Therefore $\frac{AB}{A'B'} = \frac{FP}{B'F}$ --- (ii)

From eq (i) and (ii)

$$\frac{BC}{B'C} = \frac{FP}{B'F} \quad \text{--- (iii)}$$

$BC = BP - CP$

$= (-u) - (-2f)$

$= -u + 2f$

$B'C = CP - B'P$
$= (-2f) - (-v)$
$= -2f + v$
$FP = -f$
$B'F = B'P - FP$
$= -v + f$

Putting value in eq^n (ii)

$$\frac{-u+2f}{-2f+v} = \frac{-f}{-v+f}$$

$-f(-2f+v) = (-u+2f)(-v+f)$
$2f^2 - vf = -uv - uf - 2vf + 2f^2$ ~~$2f^2$~~
$-vf + 2vf + uf = uv$
$vf + uf = uv$

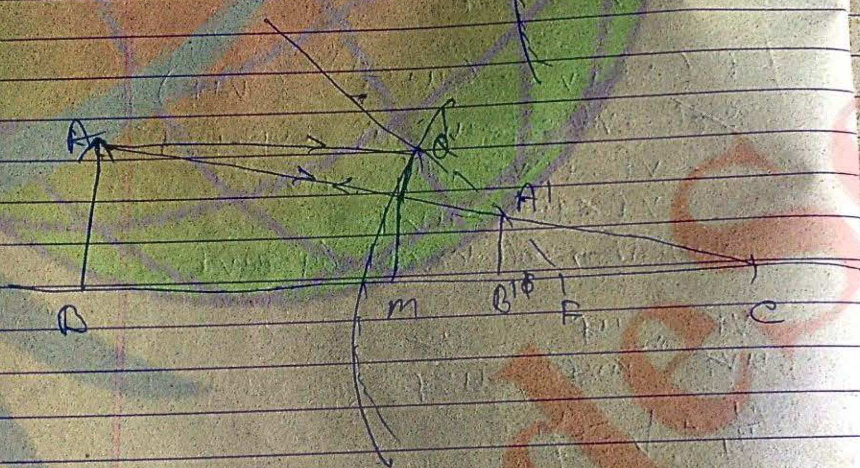
Dividing all terms by uvf

$$\frac{vf}{uvf} + \frac{uf}{uvf} = \frac{uv}{uvf}$$

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

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

Mirror formula for a convex mirror



Let an object AB Place infront of convex mirror and the incident ray AQ and AC after the reflection from the convex mirror Appears to meet at a point A' and Drawn A'B' ⊥ BC which

The ima

ΔABC

Similar

But

For re

than

From

BC / B'C

BC

B'C

the image of AB to drawn $QM \perp BC$

$\Delta ABC \sim \Delta A'B'C$ (By AA)

$\frac{AB}{A'B'} = \frac{BC}{B'C}$ — (i)

Similarly, $\Delta QMF \sim \Delta A'B'F$

$\frac{QM}{A'B'} = \frac{MF}{B'F}$

But $QM = AB$

For very small Apperture

$MF \approx PF$

than above eqn becomes

$\frac{AB}{A'B'} = \frac{PF}{B'F}$ — (ii)

From eq (i) and (ii)

$\frac{BC}{B'C} = \frac{PF}{B'F}$

$BC = -u + 2f$

$B'C = 2f - v$

$PF = f$

$B'F = f - v$

NCER

Ans

$$\frac{-u+2f}{2f-v} = \frac{f}{f-v}$$

$f(2f-v) = (f-v)(-u+2f)$

$2f^2 + vf = -uf + 2f^2 + uv - 2vf$

$-vf + uf + 2vf = uv$

$vf + uf = uv$

All terms are divides uvf

$$\frac{vf}{uvf} + \frac{uf}{uvf} = \frac{uv}{uvf}$$

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

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

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(15 Q) A candle 7cm in size placed 27cm infront of a concave mirror of radius of curvature 36cm. At what distance from the mirror should screen be place in order to form a sharp image describe the nature and size of the image.

Ans $h = 7cm$

$u = -27cm$

$f = -18cm$ $\left(\frac{-36}{2} = -18cm\right)$

$v = ?$

By mirror formula.

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

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

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

$\frac{-3+2}{54} = \frac{1}{v}$

$\frac{-1}{54} = \frac{1}{v}$

$v = -54$

27cm
ed
of
should
40
the

27cm
10cm

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

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

$m = 2$

Real and inverted

$m = \frac{h_i}{h_0}$

$\frac{-2}{1} = \frac{h_i}{7}$

$h_i = -2 \times 7$

$h_i = -14$

Erect = सीधा
Scalene करना (स्केल करना) Unit मानकर

(7)

$f = -15cm$

$r = -2f = -2 \times 15 = -30cm$

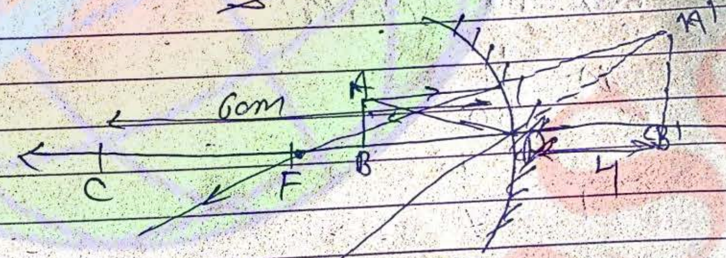
Let Scale (Scalene कर रहे)

1 unit = 5cm

then

$15cm = \frac{15}{5} = 3$ unit

$30cm = \frac{30}{5} = 6$ unit



$v = 4$ unit

$= 4 \times 5 = 20cm$

(14) An object 5cm in length is placed at a distance of 20cm infront of a convex mirror of radius of curvature 30cm. Find the position nature and size of the image

Ans) Given

$h_o = 5cm$

$u = -20cm$

$r = 30 \quad \therefore f = \frac{r}{2}$

$f = \frac{30}{2} = 15cm$

$v = ?$

By mirror formula

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

$\frac{1}{15} = \frac{1}{v} + \frac{1}{-20}$

$\frac{1}{15} + \frac{1}{20} = \frac{1}{v}$

$\frac{4+3}{60} = \frac{1}{v}$

$\frac{7}{60} = \frac{1}{v}$

$\therefore v = \frac{60}{7}$

Image distance $= \frac{60}{7}$ cm

Nature = virtual and erect

Position = Between P and F.

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

$m = [illegible]$

$m = \frac{3}{7}$

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

$\frac{3}{7} = \frac{h_i}{5}$

$\frac{3}{7} \times 5 = hi$

$\therefore hi = \frac{15}{7}$ cm

Q A convex mirror used for rear view on a automobile has a radius of curvature of 3 m. If a bus is located at 5 m from this mirror. Find position, Nature, size of image.

Ans $r = 3\,m$

$f = \frac{r}{2} = \frac{3}{2}\,m$

$u = -5\,m$

$v = ?$

By mirror formula

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

$\frac{1}{\frac{3}{2}} = \frac{1}{v} + \frac{1}{-5}$

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

$\frac{5+6}{30} = \frac{1}{v}$

$\frac{11}{30} = \frac{1}{v}$

$\therefore v = \frac{30}{11}$

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

$=$

$\frac{2}{3} = \frac{1}{v} + \frac{1}{15}$

$\frac{1}{v} = \frac{2}{3} + \frac{1}{15}$

$\frac{1}{v} = \frac{10+}{30}$

$\frac{2}{3} = \frac{1}{v} + \frac{1}{5}$

$\frac{2}{3} + \frac{1}{5} = \frac{1}{v}$

$\frac{10+3}{15} = \frac{1}{v}$

$\frac{13}{15} = \frac{1}{v}$

$\therefore v = \frac{15}{13}$

Nature = virtual and erect

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

$= \frac{+15}{13 \times +5}$

$= \frac{15^3}{5 \cdot 13}$

$= \frac{3}{13}$

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

$$\frac{3}{13} = \frac{h_i}{h_o}$$

$$h_i = \frac{3}{13} \times h_o$$

Height of the image is $\frac{3}{13}$ times of the object

~~प्रकाश~~ (1) आकाश नीला क्यों दिखाई देता
(1) मानव को देखने के लिए प्रकाश की जरूरत होती है, पर उल्लू को क्यों नहीं,

(2) प्रकाश की किरण [illegible] जल जालक मुड़ जाती है क्यों

(3) ~~(तारे का ..... और सूर्य का प्रकाश लाल क्यों होता है,~~

(4) Light का वेग ..... होता है इस ..... बात से सहमत होंगे

(5) आइंस्टीन के अनुसार जब किसी ..... से प्रकाश निकलता

है तो उसका आर पहले की तुलना में कण क्यों मैं जाता है। (E=mc²) कैसे, क्यों,

(6) Hydrogen किस परिस्थिती के कारण Helium में convert होकर बहुत high light energy पैदा करता है।

(7) सूर्य ग्रहण में क्यों नहीं रहना चाहिए। ~~[illegible]~~ पहले सीधी सूर्य का प्रकाश आर पार नहीं जाता क्योंकि बिच में पृथ्वी में आ जाता है। परउस समय सूर्य को नहीं देखने के लिए क्यों सलाह दिया जाता है उससे Harmful ray क्यों निकलती है।

(8) ~~[illegible]~~ Glass और लोहा दोनों ~~[illegible]~~ material का बना हुआ है जो कि atoms के मिलने से बना है, पर glass से light पास करता है लोहा से क्यों नहीं;

(9) सूर्य का प्रकाश Parall पृथ्वी पर आती है पर जब कोई Jet विमान, Aeroplane यही आकाश में पड़ती है तो उसका छाया पृथ्वी पर क्यों नहीं बनता

(10) Liquid water की तुलना में ice अधिक प्रकाश को ~~[illegible]~~ क्यों Reflect करता है जबकी दोनों Same atom and molecales के ~~[illegible]~~ मिलने से बना है।

Q1. सूर्योदय और सूर्यास्त के समय सूर्य का रंग लाल क्यों हो जाता है।

Q2. An object 5 cm height is placed at a distance of 10cm from a convex mirror of radius of curvature 30cm. Find the nature, position and size of the image

Ans $h_o = 5cm$

$u = -10cm$

$R = 30$; $f = \frac{R}{2} = \frac{30}{2} = 15cm$

$v = ?$

By mirror formula

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

$$\frac{1}{15} = \frac{1}{v} + \frac{1}{-10}$$

7:30 test

$\frac{1}{15} + \frac{1}{10} = \frac{1}{v}$

$\frac{1}{v} = \frac{10+15}{150}$

$\frac{1}{v} = \frac{25}{150} = \frac{1}{6}$

v = 6cm.

Now

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

$= \frac{+6}{+10} = \frac{3}{5}$

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

$\frac{3}{5} = \frac{h_i}{5}$

$h_i = 3$ cm

Nature = Real and inverted virtual and erect

Position - Between P and F

Size = small in size

Q. An arrow 2.5 cm high is placed at a distance of 25cm from a diverging mirror of focal length 20cm. Find nature, position and size of the image.

Ans $h_o = 2.5cm$
$u = -25cm$
$f = 20cm$
$v = ?$

By mirror formula

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

$$\frac{1}{20} = \frac{1}{v} + \frac{1}{-25}$$

$$\frac{1}{v} = \frac{1}{20} + \frac{1}{25}$$

$$\frac{1}{v} = \frac{5+4}{100}$$

$$\frac{1}{v} = \frac{9}{100} \Rightarrow v = \frac{100}{9}$$

Now,
Magnification

m is unit less

$\frac{-9}{100} \div \frac{-25}{1}$

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

$= \frac{-9}{100}$ ... $\frac{-100}{9} \times \frac{4}{-25}$

$= \frac{-9}{100} \times \frac{4}{25}$ ... $= \frac{4}{9}$

$= \frac{9}{4}$ ... $m = \frac{hi}{ho}$

$\therefore m = \frac{hi}{ho}$ ... $\frac{4}{9} = \frac{hi}{2.5}$

$\frac{9}{4} = \frac{hi}{2.5}$ ... $\frac{20}{9} = hi$

$hi = \frac{225}{4 \times 10}$ ... $hi = \frac{20}{9}$

$10 = 9hi$

$hi = \frac{45}{8}$ ... $\therefore hi = \frac{10}{9}$

Nature = virtual and erect

Position = Between P and F

Size = Small in size.

⇒ multiple image form by the Plane mirror when two Plane mirror are placed at certain angle.

① when θ (theta) is even (like, 10, 20, 60, 30 etc)

No. of image $= \frac{360}{\theta} - 1$

when θ = 90°
No. of image form $= \frac{360}{90} - 1$
$= 4 - 1$
$= 3$ image.

another
when θ = 60,
No. of image form $= \frac{360}{60} - 1$
$= 6 - 1$
$= 5$ image for

⇒ when theta (θ is odd)

No. of image form $= \frac{360}{\theta}$
$= \frac{360}{45}$

whe
No. o
whe
No.
θ A
30
for
Po
Ans
(Ch

when θ = 45

No. of image form = $\frac{360°}{45}$ = 8

when θ = 11

No. of image forme = $\frac{360}{11}$ 32.7

= 32 image form

(Note ⇒ Point की संख्या)

Q. A concave mirror has radius of curvature 30cm an object placed infront of it form 3 times enlarge real image. Find Position of image and size.

Ans ⇒ r = 30cm ∴ f = $\frac{r}{2}$ = $\frac{30}{2}$ = 15cm

(ho) let ~~size~~ height of image be x

hi = 3x

v = ?

(m = রৈখিক বিবর্ধন

~~By mirror formula~~

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

~~$\frac{1}{f} = \frac{1}{v} + \frac{1}{34}$~~

$r = -30$, $f = \frac{r}{2} = \frac{30}{2} = 15cm$

$m = -3$

$v = ?$

~~From mirror formula~~

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

$-3 = \frac{-v}{u}$

$-34 = -v$

$\therefore v = 34$

From mirror formula

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

$\frac{1}{-15} = \frac{1}{3u} + \frac{1}{u}$

$\frac{1}{-15} = \frac{1+3}{3u}$

$\frac{1}{-15} = \frac{4}{3u}$

$3u = -15 \times 4$

$u = \frac{-15 \times 4}{3}$

$u = -20$

$v = 3u$

$= 3 \times -20$

$= -60cm$

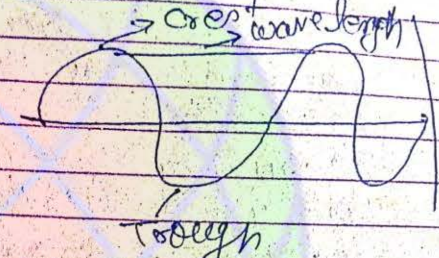
$\frac{h_i}{h_o} = -3$

$h_i = 3h_o$

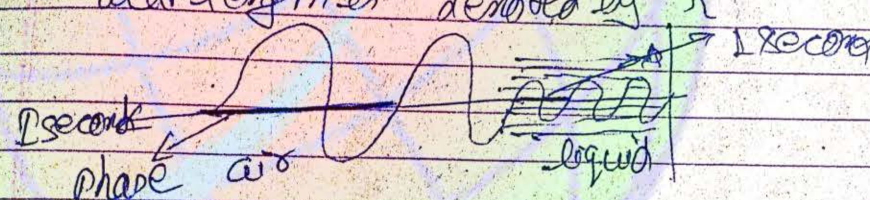
height of image is three times the height of object.

Refraction of light:-

* OR.



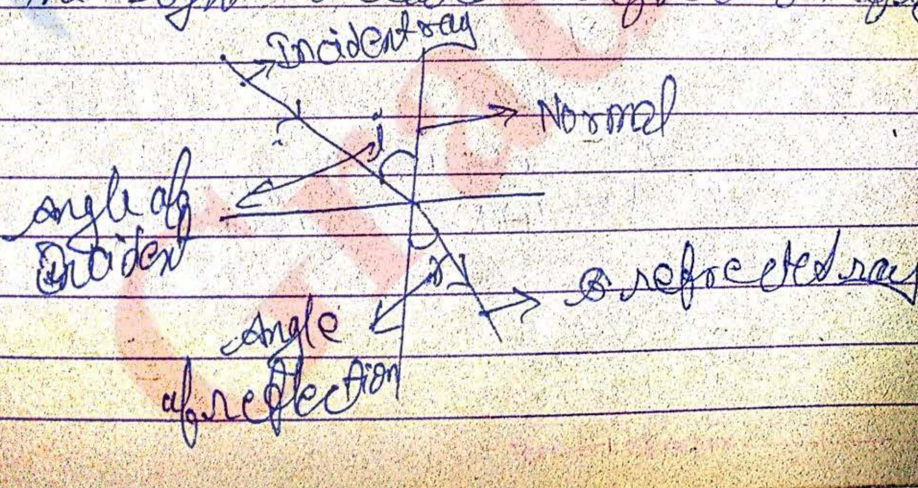
wavelength is denoted by λ



$V = n\lambda$

* Refraction ⇒

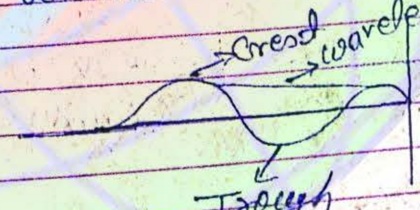
when light travels from one medium to another medium it get bends from its original path. This phenomenon of the light is called refraction of light

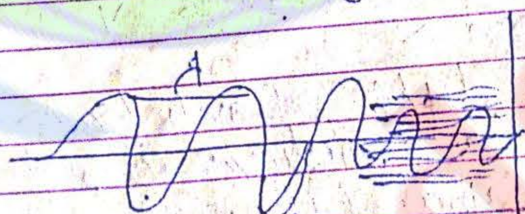


Frequency = Nard

Causes of refraction of light :→

→ The speed of light is different in differt middium because wavelength of the light is different in different middium but frequency remains same due to this when light travels from one medium to another medium it get bends.





velocity = frequency × wavelength.

$V = n\lambda$

V = velocity

n = frequency

λ = wavelength

Q> which of ...
during ...
(I) Fr...
(II) wa...
(III) ve...
(IV) ...
(V) ...
Ans> ...

donot ...

*→ Op...
thro...
trav...
e...
Alco...

The...
(I) Rare...
(II) De...

(I) Rare...
in ...
ran...

n = v d

Q-> which of the following does not change when during the refraction of the light :-

(i) Frequency
(ii) wavelength -> change
(iii) velocity -> change
(iv) Phase of light
(v) Amplitude ->

Ans -> (i) Frequency
(iv) Phase of light
donot change during refraction of light.

* -> Optical medium -> A medium through which light can be travel is called optical medium
eg -> Air, glass, water, lens, Alcohal etc.

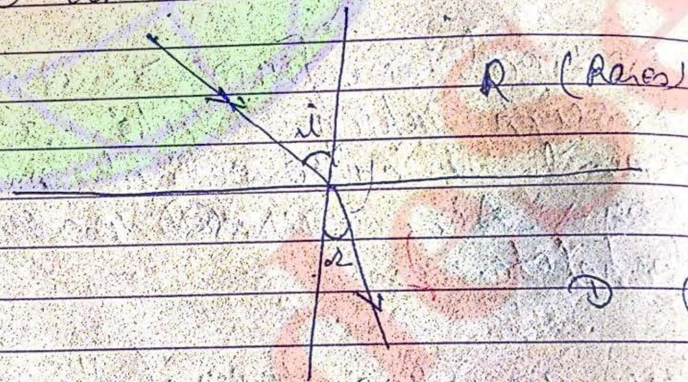
There are two types of the medium ->
(i) Rarer optical medium.
(ii) Denser optical medium.

(i) Rarer optical medium -> An optical medium in which speed of light is more is called rarer medium
eg -> Air, vaccume etc. (less mass)

(II) Denser optical medium → An optical medium in which speed of light is less is called denser medium. eg → glass, water etc. (10 high mass)

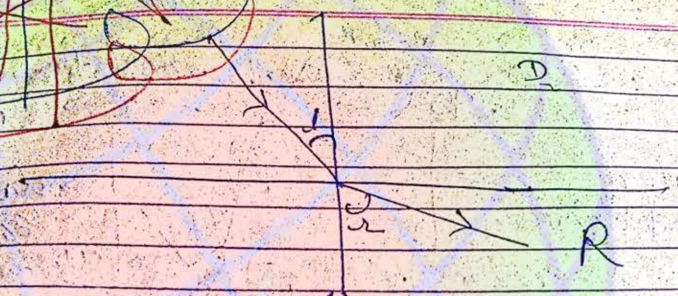
→ Rules of Refraction of light =

(I) when light travels from rarer medium to denser medium it bends towards the normal



$\angle r < \angle i$

(I) when light travels from denser medium to rarer medium it moves away from the normal.

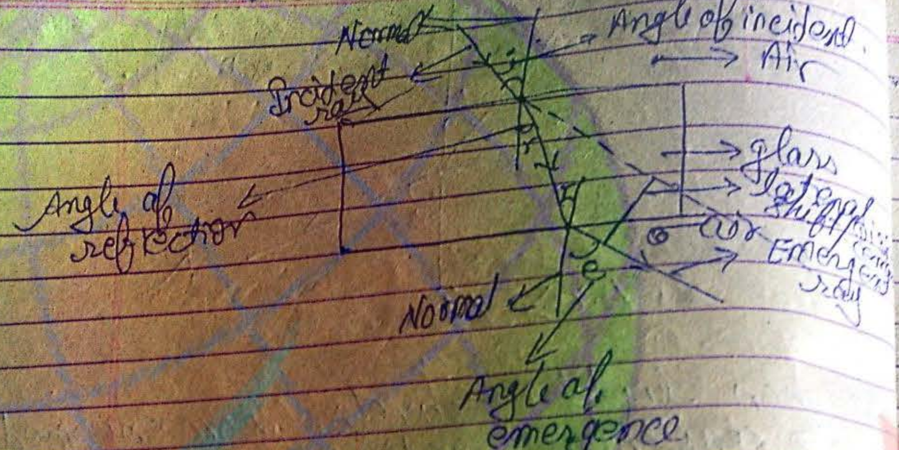


∠r > ∠i

(II) when light travels from one medium to another medium perpendicularly it goes without deviation.

deviation → विचलन

⟹ Refraction through a glass slab ⟶



when light travels from air medium to glass that is rarer to denser medium it bends towards the normal. After the refraction in a glass it comes from glass medium to air. that is denser medium to rarer medium. it moves away from the normal. in such way refraction of light done through the glass slab.

Conclusion → Angle of incidence is always equal to angle of Emergence

$\angle i = \angle e$

incident ray is always parallel to the emergent ray.

⇒ lateral shift → (lateral displacement)
The perdi perpendicular distance between the incident ray and emergent ray is called lateral displacement or lateral shift

⇒ Factor affecting the lateral shifts.

(i) lateral displacement directly proportional to angle of incidence.

(ii) lateral displacement is directly proportional to thickness of the glass slab.

(iii) lateral displacement is directly proportional to refractive index.

ll → meu or

(iv) Lateral displacement inversely proportion to wavelength of light.

⟹ Refractive index → The ratio of speed of light in one medium to the speed of light in another medium.

Refractive index = $\frac{\text{Speed of light in medium}}{\text{speed of light in medium}}$

μ or $n_2 = \frac{V_1}{V_2}$

Refractive Index of medium-2 with respect to medium-1.

a_{n_g} or n_g → Refractive Index of glass with respect to air

or Refractive Index of glass

n =

w.r. a_{n_w}

w_{n_g} =

when

a_{n_m}

Let

m-

m-n = frequency   C => air / med

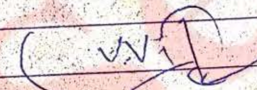
$^a n_w$ → Refractive index of water with respect to air.

$^w n_g$ → Refractive index of glass with respect to water.

when 1st medium is air/vacuum

$$^a n_m = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$$

$$^a n_m = \frac{C}{V}$$



C = 3×10^8 m/s (speed of light)

v = velocity of light in medium

Let $v_1 = n\lambda_1$

$v_2 = n\lambda_2$

$$^1 n_2 = \frac{v_1}{v_2} = \frac{n\lambda_1}{n\lambda_2}$$

$$^1 n_2 = \frac{\lambda_1}{\lambda_2}$$

Refractive index can also be defined as the ratio of wavelength in medium first to wavelength in medium second

S.I. unit of refractive index = no unit

$\frac{v_1}{v_2} = \frac{m/s}{m/s}$ = no unit

Refractive Index is the unitless quantities because it is the ratio of same Physical quantities which is simply represented by a number.

⇒ Refractive Index of some medium are following
Air → 1.003
water → 1.33
crown glass → 1.52
Flint glass → 1.66
diamond → 2.42

with respect to air

Note:) The refra... then ...

⇒ Refractive ... of light ...

Ans ⇒ n_w = ...
C = ...
v_2 ...

vice-versa → उल्टा ↑

Note:) The refractive index is more of the medium then speed of light is less and vice-versa

⇒ Refractive Index of water is 1.33 Find speed of light in water.

Ans ⇒ $n_w = 1.33$

$c = 3 \times 10^8$ m/s

$v = ?$

$_a n_w = \frac{c}{v}$

$1.33 = \frac{3 \cdot 10^8}{v}$

$1.33v = 3 \times 10^8$

$\therefore v = \frac{300 \times 10^8}{1.30}$

$= 2.25 \times 10^8$ m/s

⇒ The velocity of light in water = 2.25×10^8 m/sec refractive index of the water.

$$ {}^{a}n_{w} = \frac{v_a}{v_w} $$

$$ = \frac{3 \times 10^8 \text{ m/s}}{2.25 \times 10^8 \text{ m/s}} $$

$$ = 1.33 $$

$$ \frac{4}{3} = 1.33 $$

⇒ The refractive index of diamond is 2.42. calculate the speed of light in a diamond.

$n_d = 2.42$

$c = 3 \times 10^8$ m/s

$$ {}^{a}n_{d} = \frac{c}{v} $$

$$ 2.42 = \frac{3 \times 10^8}{v} $$

$$ v = \frac{3 \times 10^8}{2.42} $$

$$ v = \frac{3 \times 10^8 \times 100}{242} $$

$v = 1.23 \times 10^8$ m/s

Q Refractive index of glass with respect to water is $\frac{9}{8}$ if speed of light in water is 2.25×10^8 m/s. calculate speed of light in a glass

⇒ $_w n_g = \frac{9}{8}$

speed of light in water = 2.25×10^8 m/s
speed of light in glass = ?

$$_w n_g = \frac{v_w}{v_g}$$

$$\frac{9}{8} = \frac{2.25 \times 10^8}{v_g}$$

$$\frac{9}{8} v_g = 2.25 \times 10^8$$

$$v_g = \frac{2.25 \times 10^8}{9}$$

~~$v_g = 2.5 \times 10^6$ m/s~~

$$v_g = 2.5 \times 10^8 \text{ m/s}$$

Q The wave length of light in air is 4×10^6 m. calculate wavelength of light in water if it refractive index is $\frac{4}{3}$

$\Rightarrow {}^{a}n_{w} = \frac{\lambda_1}{\lambda_2}$

$\frac{4}{3} = \frac{4 \times 10^{6}}{\lambda_2}$

~~$\frac{4}{3} = 4\times$~~ $\lambda_2 = \frac{4 \times 10^{6} \times 3}{4}$

$= 3 \times 10^{6} m$ Ans

V.V. Q-> The wavelength of light in air is 500nm enter a glass plate whose refractive index is 1.5 calculate -
(I) Speed
(II) Frequency
(III) wavelength of light in glass.

(11)

$\lambda = 500\ nm = 500 \times 10^{-9} m$

${}^{a}n_{g} = 1.5$

$c = 3 \times 10^{8} m/s$

${}^{a}n_{g} = \frac{c}{v}$

$1.5 = \frac{3 \times 10^{8}}{v}$

index is $\frac{4}{3}$

Ans

is 500nm

refractive

$v = \frac{3 \times 10^8}{1.5} = 2 \times 10^8$ m/s

~~$v = n \lambda g$~~ $v = n \times \lambda a$

~~$= 3 \times 10^8$~~

$3 \times 10^8 = n \times 500 \times 10^{-9}$

$\frac{3 \times 10^8}{500 \times 10^{-9}} = n$

$\frac{3}{5} \times 10^{15} = n$

$0.6 \times 10^{15} = n$

$\therefore n = 6 \times 10^{14}$ Hz

(ii) wavelength of glass

$v = n \lambda g$

$v = 2 \times 10^8$ m/s

$n = 6 \times 10^{14}$ Hz

$\lambda g = ?$

$v = n \lambda g$

$\lambda g = \frac{v}{n}$

$\lambda g = \frac{2 \times 10^8}{6 \times 10^{14}} = \frac{1}{3} \times 10^{-6}$

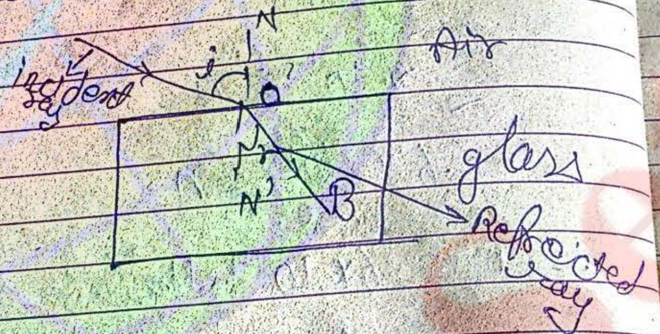
$= 0.33 \times 10^{-6}$ m

Laws of refraction of light.

~~Snell's law of refraction~~

There are two types of law of refraction

(i) The incident ray, the refracted ray and normal at the point of incidence all lie in the same plane.



(ii) The ratio of sine of the angle of incidence to the sine of angle of refraction is a constant for a given pair of media.

$$\frac{\sin i}{\sin r} = \text{a constant} \quad (\mu \text{ or } n)$$

where constant is called refractive index. It is denoted by μ or n
→ (mew) → (म्यू)

Note ⇒ 2nd law of refraction of light is also known as snell's law of refraction

Q ⇒ Light travel from air medium to glass medium calculate refractive index of glass. If angle of incidence (i) for a ray of light in air is 37° and the angle of refraction (r) in glass be 24°

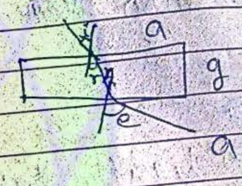
Ans ⇒

$$ {}^{a}n_{g} \Rightarrow \frac{\sin 37°}{\sin 24°} = \frac{0.6}{0.4} $$

$$ \Rightarrow \frac{0.6}{0.4} = \frac{3}{2} = 1.5 \text{ Ans} $$

$a_{n_g} \rightarrow a \rightarrow g$

⇒ Show that $a_{n_g} = \frac{1}{g_{n_a}}$ or $a_{n_g} \times g_{n_a} = 1$



Let a glass placed in a air when refraction of light when light travels from air to glass.

$a_{n_g} = \frac{\sin i}{\sin r}$ — (I)

Refraction of light when light travels from glass to air

$g_{n_a} = \frac{\sin r}{\sin e}$

But $e = i$

Above equation can be written

$g_{n_a} = \frac{\sin r}{\sin i}$ — (II)

eq (I) × eq (II)

$a_{n_g} \times g_{n_a} = \frac{\sin i}{\sin r} \times \frac{\sin r}{\sin i}$

alcohal ⇒ Al

$_a n_g$ & $_g n_a$ ⇒ 1

$$_a n_g = \frac{1}{_g n_a}$$

or Reciprocal

$$_g n_a = \frac{1}{_a n_g}$$

Ans

Q> Refractive index of glass is 1.5 find the refractive index of air with respect to glass.

$_a n_g = 1.5$

$_g n_a = ?$

$$_g n_a = \frac{1}{_a n_g}$$

$$_g n_a = \frac{1 \times 10^2}{15} = 0.66$$

Q> Refractive index of glass with respect to alcohal is 1.2 find refractive index of alcohal with respect to glass

$^{a}n_g = 1.2$

$^{g}n_{al} = 2$

$^{g}n_{al} = \frac{1}{^{a}n_g}$

$^{g}n_{al} = \frac{1 \times 10}{12}$

$= \frac{5}{6} = 0.83$

Refraction through air water glass

Refraction ... air to ...

$^{a}n_w =$

Refraction ... from water ...

$^{w}n_g =$

Refraction ... from glass ...

$^{g}n_a =$

But ...

$^{g}n_a =$

eq (1) ...

$^{a}n_w \times {^{w}n}$ ...

$^{a}n_w \times$ ...

(note ...

Refection of light with travels from air to water.

$$ {}^{a}n_{w} = \frac{\sin i}{\sin r} \quad \text{(I)} $$

Refection of light when light travels from water to glass

$$ {}^{w}n_{g} = \frac{\sin r_1}{\sin r_2} \quad \text{(II)} $$

Refection of light when light travels from glass to air

$$ {}^{g}n_{a} = \frac{\sin r_2}{\sin e} $$

But $e = i$

$$ {}^{g}n_{a} = \frac{\sin r_2}{\sin i} \quad \text{(III)} $$

eq (I) × eq (II) × eq (III)

$$ {}^{a}n_{w} \times {}^{w}n_{g} \times {}^{g}n_{a} = \frac{\sin i}{\sin r_1} \times \frac{\sin r_1}{\sin r_2} \times \frac{\sin r_2}{\sin i} $$

$= 1$

$$ {}^{a}n_{w} \times {}^{w}n_{g} \times {}^{g}n_{a} = 1 $$

(Note → जिस medium से शुरू हुआ

Q→ Refraction of light through 'n' number of medium

$_1n_2 \times {}_2n_3 \times {}_3n_4 \times {}_4n_5 \cdots {}_nn_1 = 1$

Q→ Refractive index of water and glass with respect to air is 1.33 and 1.5 respectively find refractive index of glass with respect to water

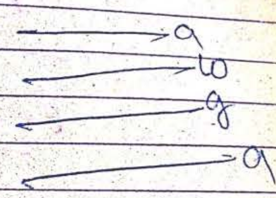
Ans Given

$_an_w = 1.3$

$_an_g = 1.5$

$^{w}n_{g} = ?$

$^{a}n_{w} \times {}^{w}n_{g} \times {}^{g}n_{a} = 1$



$^{a}n_{w} \times {}^{w}n_{g} \times \frac{1}{^{a}n_{g}} = 1$

$1.3 \times x \times \frac{1}{1.5} \times 1$

$x = \frac{1.5}{1.3} = 1.15$

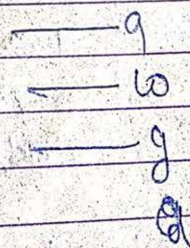
Q- Refractive index of water and glass is 1.3 and 1.5 respectively find refractive index of water with respect to glass

Ans- Given

$^{a}n_{w} = 1.3$

$^{a}n_{g} = 1.5$

$^{g}n_{w} = ?$



$^{a}n_{w} \times {}^{w}n_{g} \times {}^{g}n_{a} = 1$

$1.3 \times \frac{1}{^{g}n_{w}} \times \frac{1}{1.5} = 1$

$$\frac{1}{g_{nw}} = \frac{1.5}{1.3}$$

$$\frac{1}{g_{nw}} = \frac{15}{13}$$

$$15\, g_{nw} = 13$$

$$g_{nw} = \frac{13}{15}$$

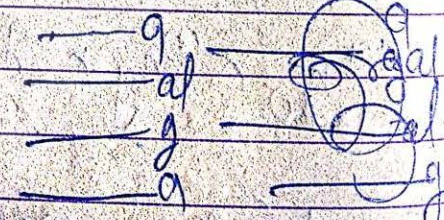
$= 0.86$ Ans

Q. Refractive index of alcohal and glass are 1.36 and 1.5 respectively calculate refractive index of glass with respect ~~to air~~ alcohal

Ans: $^{a}n_{al} = 1.36$

$^{a}n_{g} = 1.5$

$^{al}n_{g} = ?$



$^{g}n_{al} \times {}^{al}n_{g} \times {}^{g}n_{a} = 1$

$1.36 \times x \times \frac{1}{1.5} = 1$

$x = \frac{1.50}{1.36}$

$x = \frac{150}{136}$

$= 1.11$

136) 150 (1.1
136
140
136
14

इस प्रश्न की इमे

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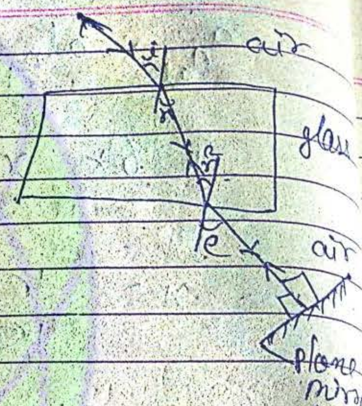
Reversibility of light :->



when refracted ray after the refraction from the medium falls perpendicular on the plane mirror it ~~get back~~ return back with the same path this phenomenon of the light is called reversibility of light

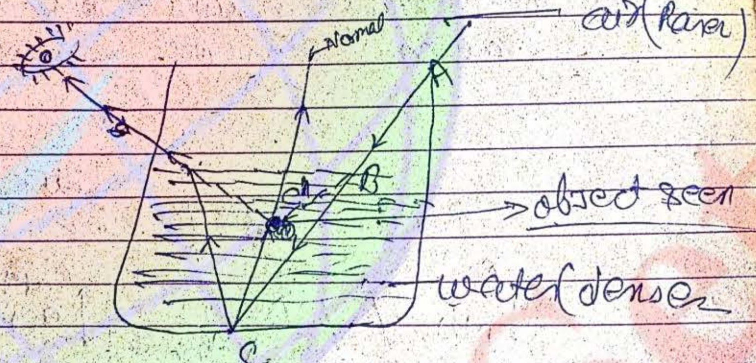
Effects of refraction of light :->

* when a stick or pencil partially immerge in a water, it appears bend at the surface of the water.

* Coins appears raised (उठना) in a water
(Coin उठा हुआ लगता है)

real/virtual
defect

① when object / Pen or stick emmerge in a water it appears bend at water surface.



when a straight stick or pen AC Partialy emmerged in a water in oblicly in such a way lower Portion BC in water and AB in a air take a two Points from the Point C after the refraction from water to air that is denser to rarer medium it appers to meet C' Point.

To Join B to C' which is the image of BC Portion of the stick, so we can see whole stick ABC' at the place of actual stick ABC which appears bends at a Point B.

So when stick after being emmerge in a water it appears bend due the refraction of light.

(ii) when coins of fish placed in a water it appears to be raised.

When coins of fish placed in a water due to the refraction of light it appears to be raised.

A coin emmerge in water at point. Take a two ray from point O after the refraction from the water to air that is denser to rarer medium it appears to meet at a point O' that is the position of image of coins and fish which is the just above the point O

*> Note => when fish placed in a water it can not be catch easily because due to the refraction of the light it always to be seen the the apparent deft.

=> Refractive index = $\frac{\text{Real depth}}{\text{Apparent depth}}$

Q An object place whose refractive index is 1.33. if its real depth is 5cm find its apparent depth

Ans

Oil = 1.33

real depth = 5cm

Refractive index = $\frac{\text{Real depth}}{\text{Appearent depth}}$

$1.33 = \frac{5}{\text{appearent depth}}$

∴ app. depth = $\frac{5 \times 100}{133} = \frac{500}{133} = 3.75cm$

Q) A coin place under a glass slable which appears at a height of 5cm it refractive id index of glass is 1.5cm. calculate actual heigh

Ans- Refrecti index of glass = 1.5cm
height = 5

real height = 1.5 × 5 × 10 / 10

= 1.5 × 5

= 7.5cm

V.V.I

Refractive index = speed of light in medium Ist / speed of light in medium IInd
(μ) or n
(meu)

= wavelength of light in medium Ist / wave length of light in medium IInd

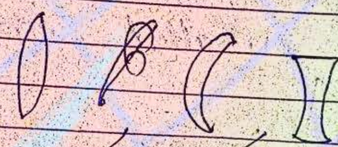
= Angle of incident (Sin i) / Angle of reflection (Sin r) = Real depth / Appearent depth

constant by Snell's law

Refraction of light through a lense:→

* Lense → A transparent materia which is bonded by two refracting surface in which at least one surface is a curve is called lense.

eg →

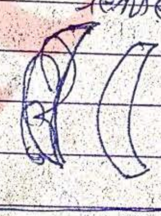


Lense

- Convex lense
  - Biconvex lense or convex lense

  - Plano convex lense

  - Concavo convex lense



- Concave lense
  - Biconcave lense or concave lense

  - Planoconcave lense

  - Convexo concave lense

* There are two types of lense:→

(i) Convex lense→ A lense which is thicker at middle and thinner at edge is called convex lense.

eg→ ()

(ii) Concave lense→ A lense which is thinner at middle and thicker at the edge is called concave lense.

eg

* There are three types of convex lense

(i) Bi-convex lense→ A convex lense whose both reflecting surface is convex is called Bi-convex lense or convex lense

eg→

(ii) Plano convex lense→ A convex lense whose one reflecting surface is plane and another is convex is called plano convex lense

(iii)

(iii) concavo
one
other
lense

There

(i) Bi-co
whos
conc

(ii) pla
wh
a
pl

(iv)

* There are two types of lense:→

(i) Convex lense→ A lense which is thicker at middle and thinner at edge is called convex lense
eg→ Σ

(ii) Concave lense→ A lense which is thinner at middle and thicker at the edge is called concave lense
eg

* There are three types of convex lense

(i) Bi-convex lense→ A convex lense whose both reflecting surface is convex is called Bi-convex lense or convex lense
eg→

(ii) Plano convex lense→ A convex lense whose one reflecting surface is plane and another is convex is called Plano convex lense

(iii)

(iii) concavo c...
one s...
other is...
lense
eg

There ...
(i) Bi-conca...
whose ...
concav...

(ii) Plano...
whose...
and ...
Plano...

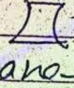
(iv) Co...
wh...
co...

(III) Concavo convex lense → A convex lense whose one reflecting surface is concave and other is convex is called concavo convex lense.

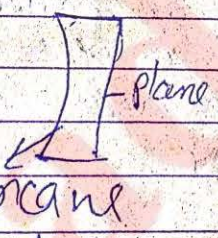
eg →

There are three types of concave lense:→

(I) Bi-concave lense → A concave lense whose both reflecting surface is a concave is called Bi-concave lense.

eg → 

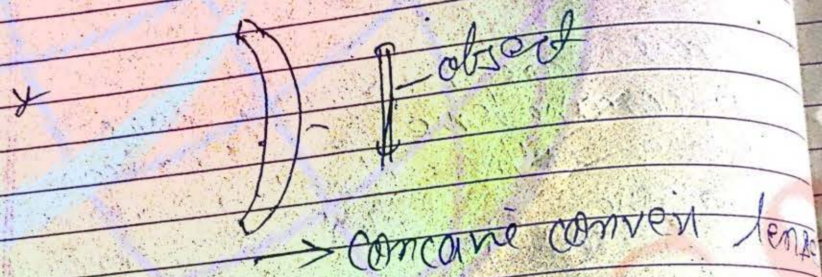
(II) Plano concave lenses → A concave lense whose one reflecting surface is plane and another is concave is called plano concave lenses.



(III) Convex-concave lenses → A convex lense whose one reflecting surface is ~~concave is called~~ convex and another concave is called convexo-concave lense

eg 

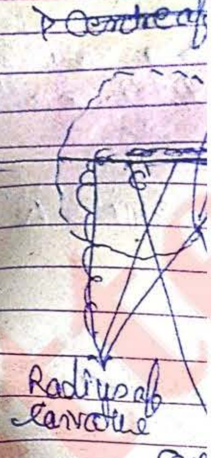
Note → See carefully (because they ... looking at ...



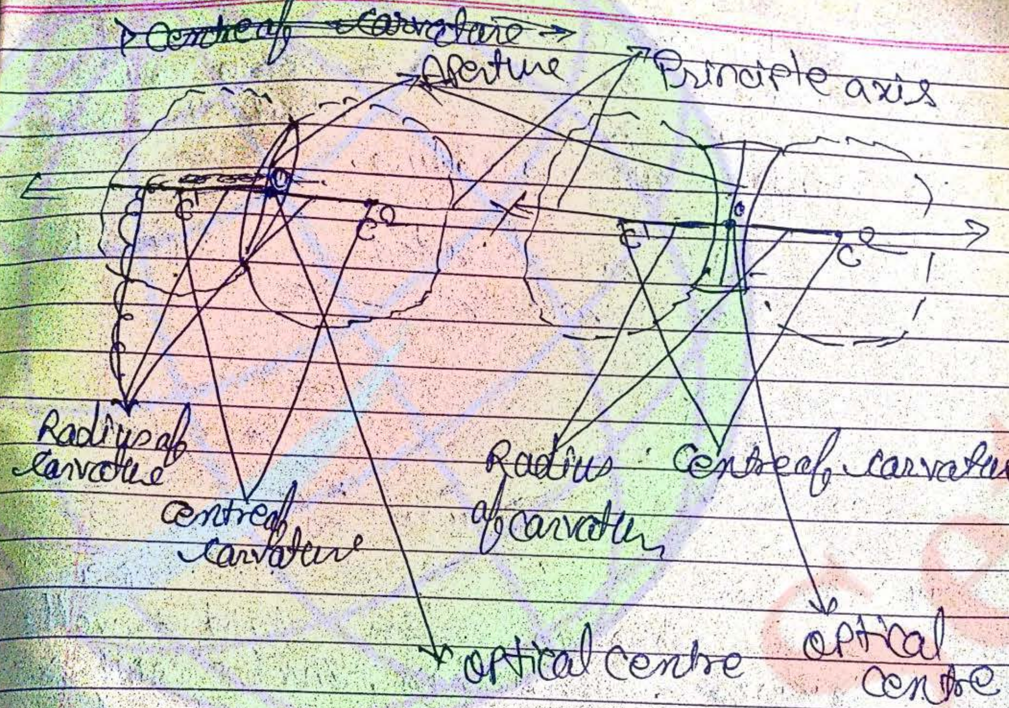
Importants terms of the lense:→

(I) Centre of curvature
(II) Radius of curvature
(III) optical centre
(IV) Principle axis.
(V) Aperture
(VI) Focuse
(VII) Focal length.

Im...

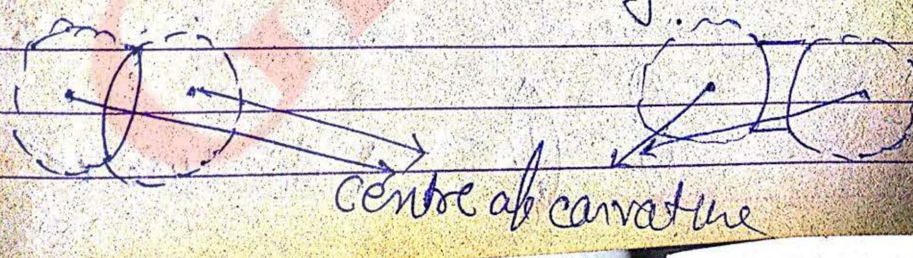


Important terms of the lense:→



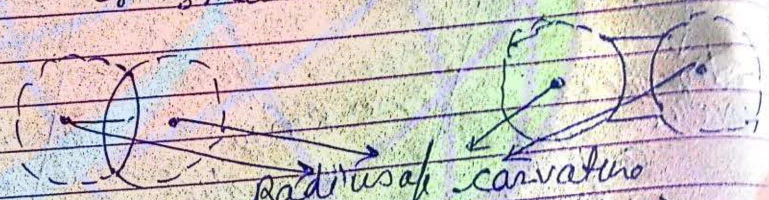
(1) Centre of carvatur→ The centre of the sphere whose ~~reflecti~~ refracting surface of a lense is a part is called centre of carvature of the lense.

It is denoted by capital 'C'



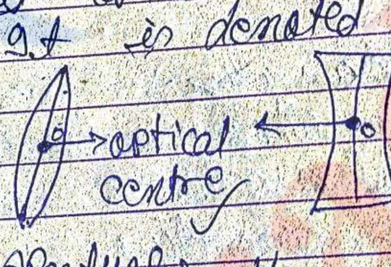
(II) Radius of curvature → The radius of sphere whose refracting surface of the lense is a part is called radius of curvature.

It is denoted by capital 'R' or small 'r'.

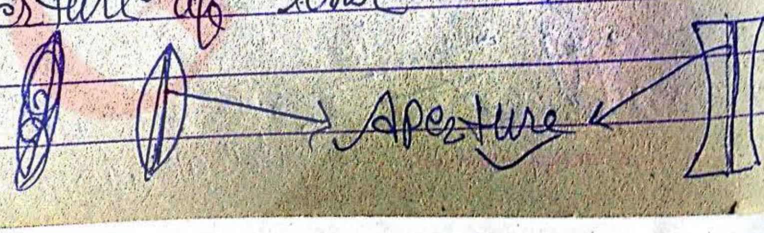


(III) Optical centre → A point in a lense through which light travells without diviation, that point is called optical centre of a lense.

It is denoted by O.



(IV) ~~Curvature~~ Aperture → The length of the refracting surface of lense is called aperture of lense.

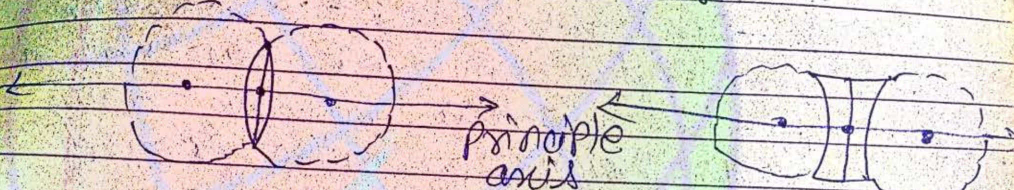


(V) Princi... Passes... and... called

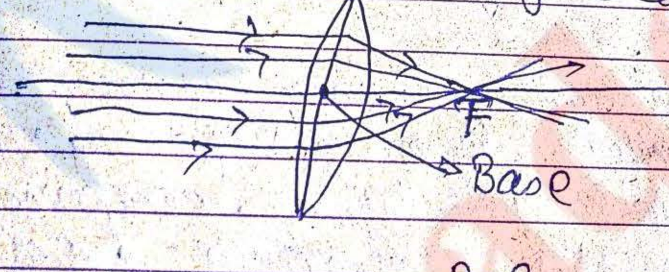
(VI) Focus... Princ... refrac... oppea... an... I...

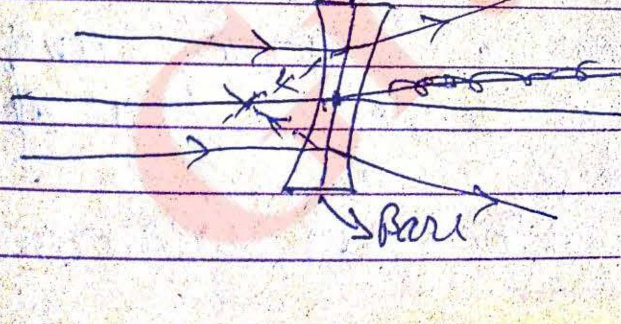
Focus/Principle focus

(i) Principle axis → A imaginary line which passes through the centre of curvature and optical centre of a lense is called principle axis.



(ii) Focus → The parallel beam of the light of the principle axis of a lense, after the refraction from it they are meet or appears to meet at a point on a principle axis, that point is called focus of lence. It is denoted by capital F.





(a) Focus of convex lense → The parallel beam of the light of a principle axis of a convex lense after the refraction from it they are meets at a point on the principle axis that point is called focus of convex lense.

Focus of convex lense is real

(b) Focus of concave lense → The parallel beam of light of the principle axis of a concave lense after the refraction from it, they are appears to meet at a point on a principle axis. That point is called focus of concave length.

Focus of concave lense

is

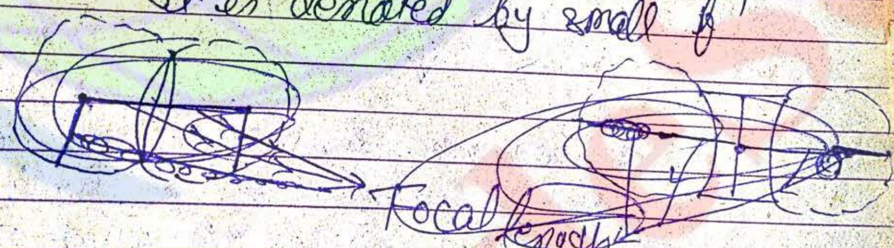
(v) Foca optic lense lense

Fo
r
eg
2F F
(Rea

is virtual or imaginary (काल्पनिक)

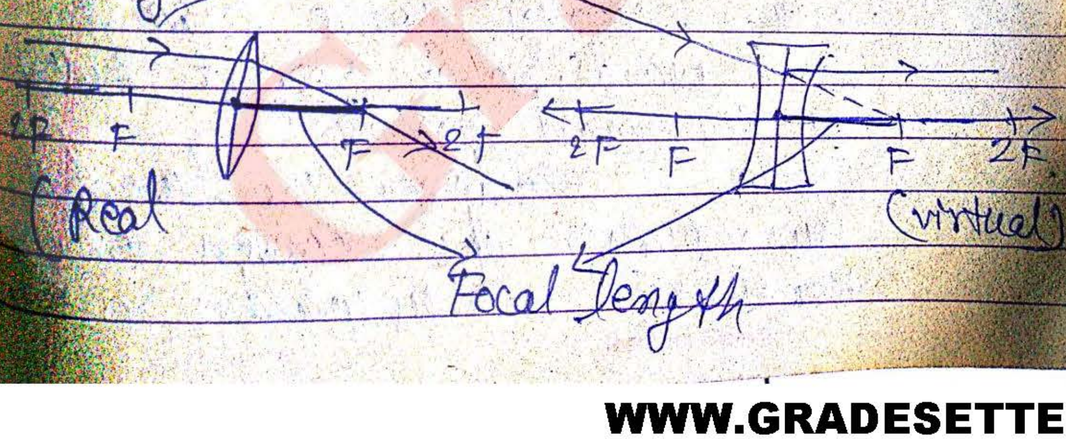
(vi) Focal length → The distance between the optical centre to ~~focus~~ the focus of a lense is called focal length of the lense.

It is denoted by small 'f'



Focal length of convex lense is real concave lense is virtual

eg →



Q→ why convex lense is called converging lense?

Ans

A convex lense is made up of a large number of small prism when light Passes through the prism it get bends towards its base after the refraction from it. The base of the upper portion of the convex lense prism is down wards. so it refract the light in downward direction. The base of the lower portion of a convex lense of prism is upwards. So they

refract
rays a
so con
convergi

Q→ why

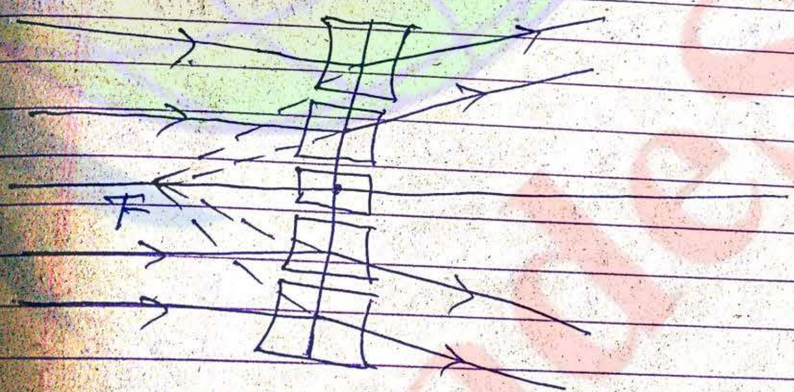
Q. why
lense

the
prs

refract light upwards as a result
rays of the light are converse at a point
so convex lense is also called the
conversing leng.

~~Q- why concon~~

Q- why concave lense is called diversing lense.



A concave lense is made up of the large number of the small prism. The light passing through the prism get diviates towards its base. The base of the upper portion of the concave lense prism is up wards. so light after refract from it goes in up upward direction.

The base of a lower position of the concave lense of the prism is downward so refracted ray bend towards downward. As a result parallel beam of the light of the principle axis of concave lense get diverge. so this lense is also known as diversing lense.

Conclu-

* ->

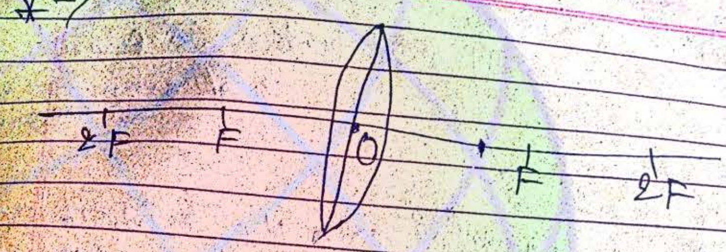
2F

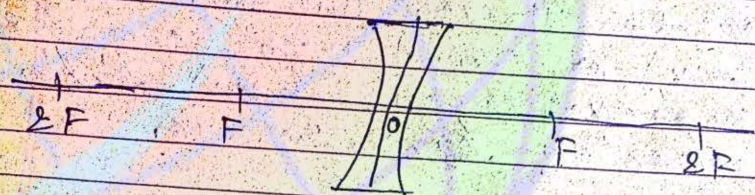
2F

* Ru le

2F

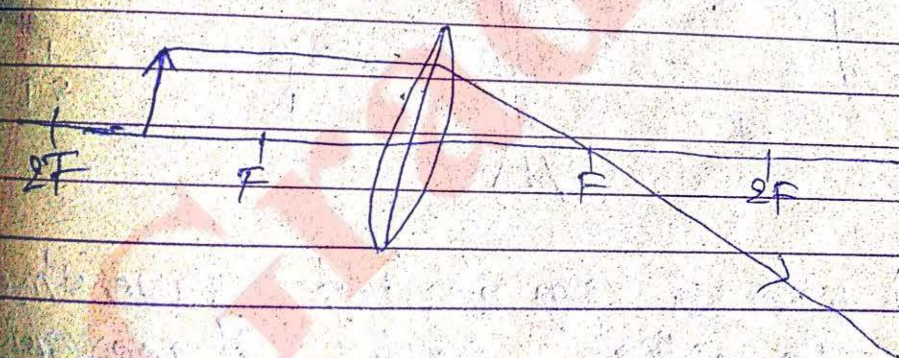
*→





centre of curvature is denoted by 2F.

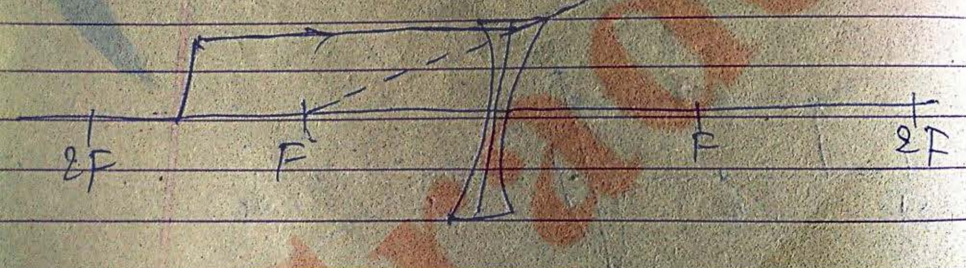
* Rules for formation of the image by a lense:→



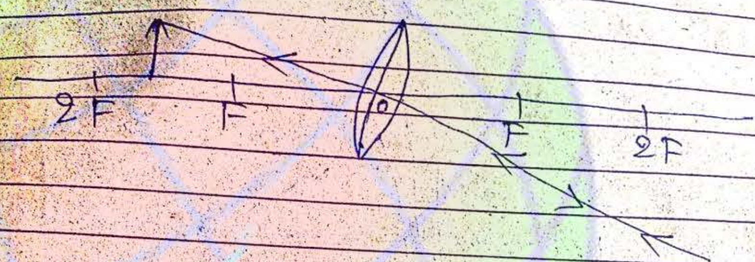
⟹ Rules of formation of image by a lense: →

(Note → जो Principle के Parall होगा वही Focus से जायेगा)

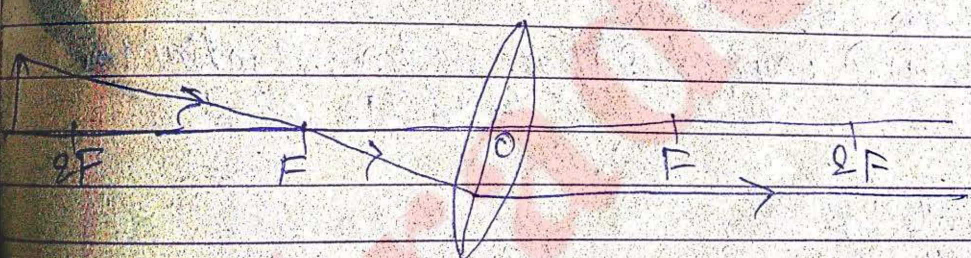
(1) A ray parallel to the principle axis passes through the focus (convex lence) or appears to comes from the focus (concave lense) after the refraction from the lense.



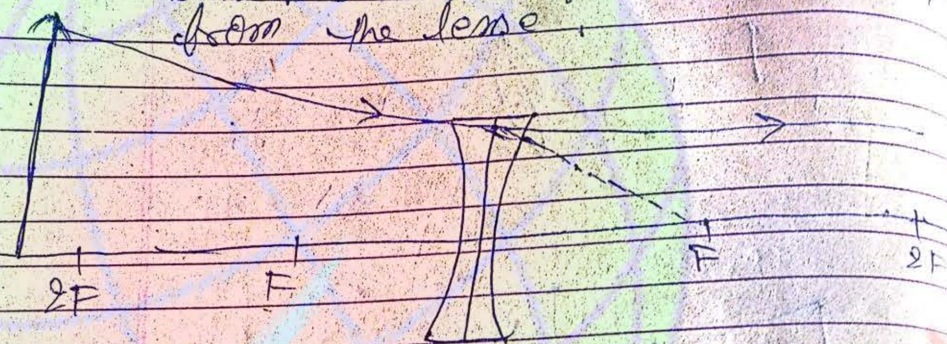
(II) when a ray of light passes through the optical centre it goes without diviation after the refraction from the lense.



(III) (a) when a ray passes through the focus in a convex lense it goes parallel to the principle axis after the refraction from it



(b) A ray ~~which app~~ of light which appears to passes through the focus in a concave lense it goes parallel to the principle axis after the refraction from the lense.



Formation of image by a Convex lense:→

Position of object placed at the front of convex lense

(i) At infinity

(ii) Beyond 2F or between infinity and 2F

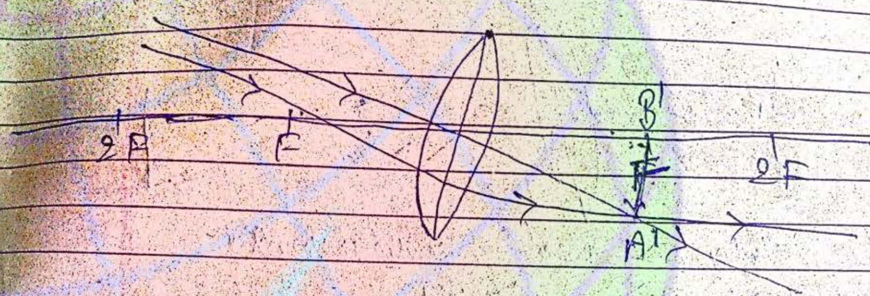
(iii) At 2F

(iv) Between 2F and F

(v) At F

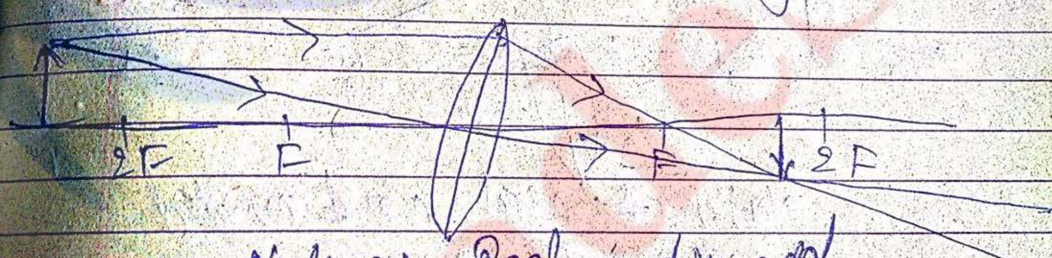
(vi) Betn F and O

(i) When object placed at infinite infron of convex lense.



Nature → Real and inverted
Position → At F
Size → Diminished or point in size.

(ii) When object place beyond 2F.

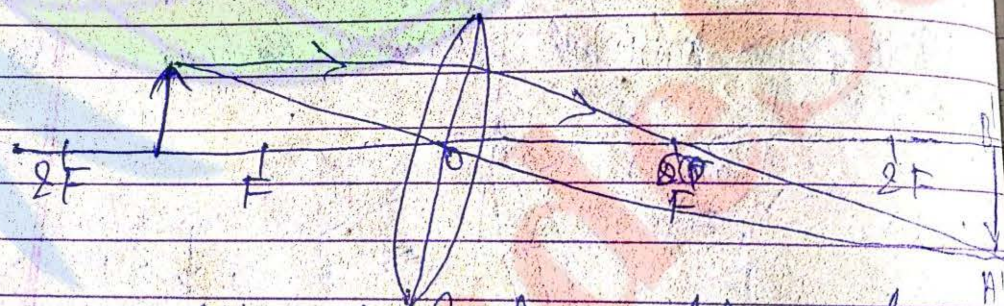


Nature → Real and inverted
Position → Betn F and 2F
Size → Small

(III) when object place at 2F.

Nature -> Real and inverted
Position -> At 2F
Size -> Same.

(IV) object place between 2F and F.

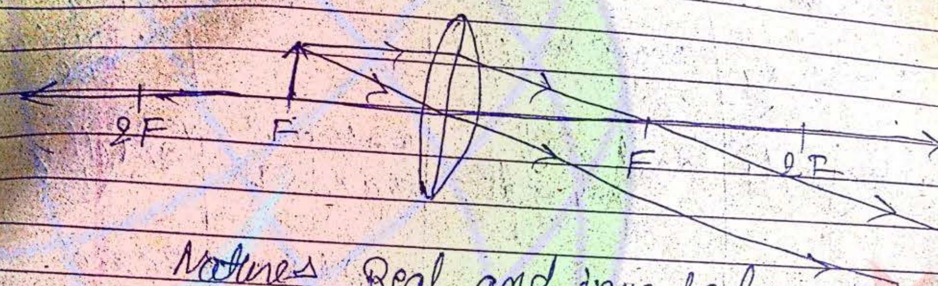


Nature -> Real and inverted
Position -> Beyond 2F
Size -> Enlarge

real → (opp) → virtual
वास्तविक   काल्पनिक

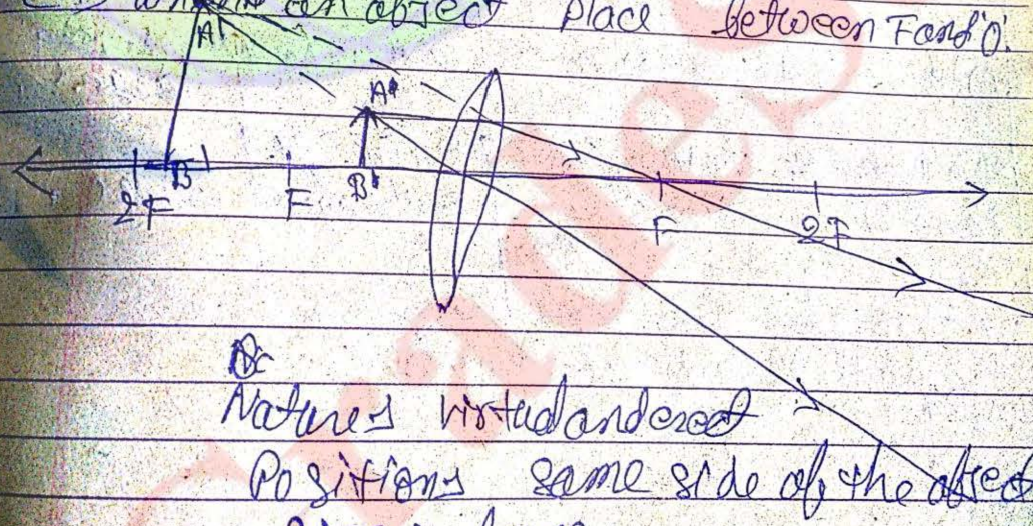
erect → (opp) → Inverted
सीधा   (उल्टा)

(V) when object place at F.



Nature → Real and inverted
Position → At infinity
Size → Highly enlarge.

(VI) When an object place between F and 'O'.



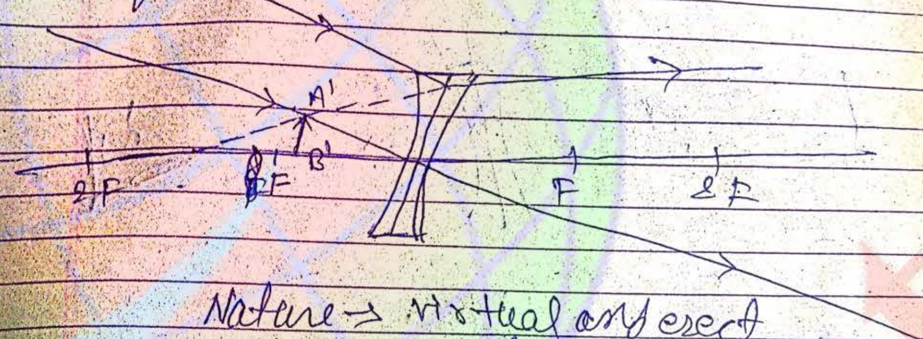
Nature → virtual and erect
Position → same side of the object
Size → large.

Position of object	Nature	Position	Size
(i) At infinity	Real and inverted	At F	diminished or point size
(ii) Beyond 2F	Real and inverted	Between F and 2F	very small in size
(iii) At 2F	"	At 2F	Same size
(iv) Between 2F and F	"	Beyond 2F	large
(v) At F	"	At infinity	very-very large
(vi) Between F and O	virtual and erect	Same side of the object	large

Important condition

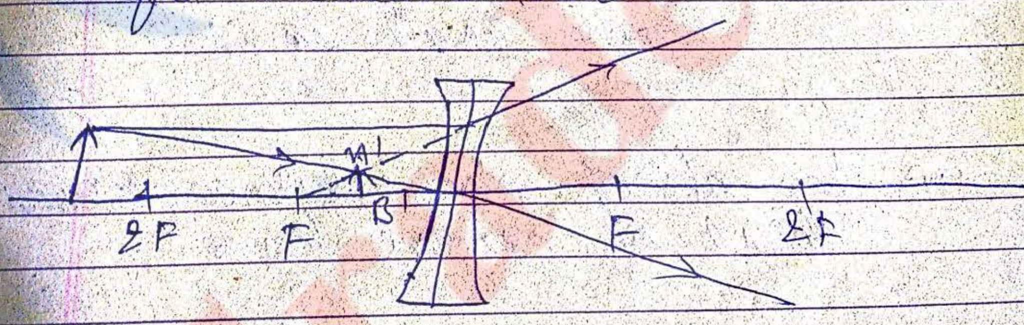
Formation of image by concave lens.

(1) when object placed at infinity infront of a concave lense:



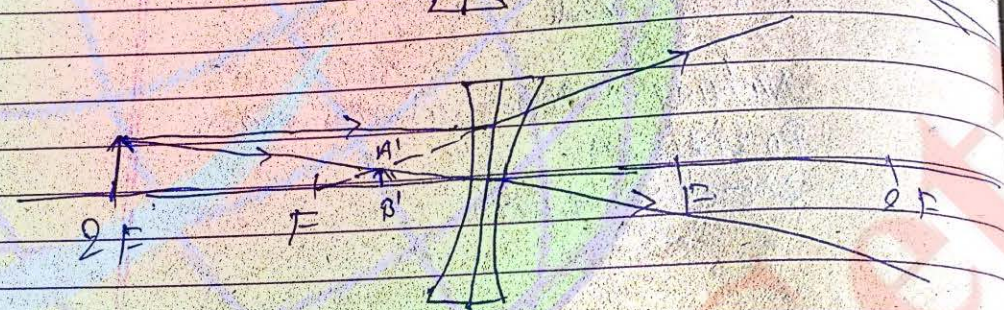
Nature → virtual and erect
Position → At F
Size → smaller

(11) when object place beyond 2F infront of a concave lense.



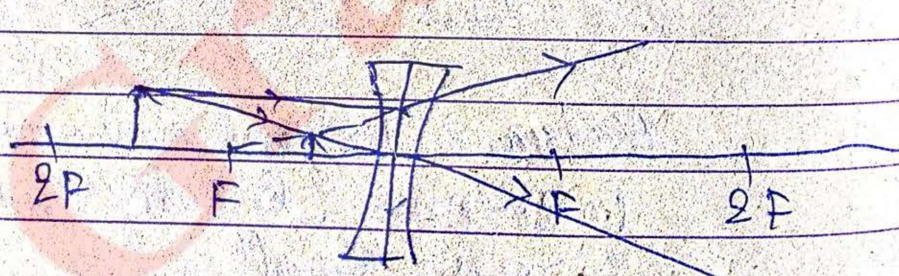
Nature → Virtual and erect
Position → Betn F and O
Size → small

(III) when object placed at 2F infront of concave lense



(IV) nature → virtual and erect
Position → Between O and F
size → small in size

(V) when object place between 2F and F infront of concave lense



Natures virtual and erect
Position→ Between O and F.

(6)

Q-> How to find focal length of a convex length.

Ans we know that when object placed at infinity infront of a convex lense then real and inverted image is form at focus.

Take a lense and placed with help of the stand in such a way ray coming from the infinite ~~object~~ the object place at infinite can passes through the lense. And ~~at~~ ~~the~~ the another side of the lense placed the screen at the different place we are ~~a~~ get real inverted and clear image.

The distance

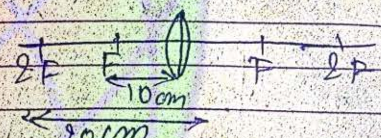
between the lense and screen where we are gets clear real and inverted is a focal length of the convex length.

Q-> Find the nature position and size

(8)

Find the nature, position and size of the object when placed infront of convex lens at a different distance whose focal length is 10 cm

(a) 10 cm
(b) 15 cm
(c) 8 cm
(d) 20 cm



Given $f = 10$
$2f = 2\times10 = 20$

(a) $u = 10$
$u = f$
object place at f
Nature → real and inverted
Position → At infinity
size → very-very large

(b) $F = 10$
$2f = 20$
$u = 15$
$10 < 15 < 20$
object place between F and 2F

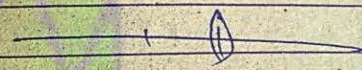
Nature
Position
size

(C) F
2

object
is

(D)

Nature → Real and Inverted
Position → Beyond 2F
size → large

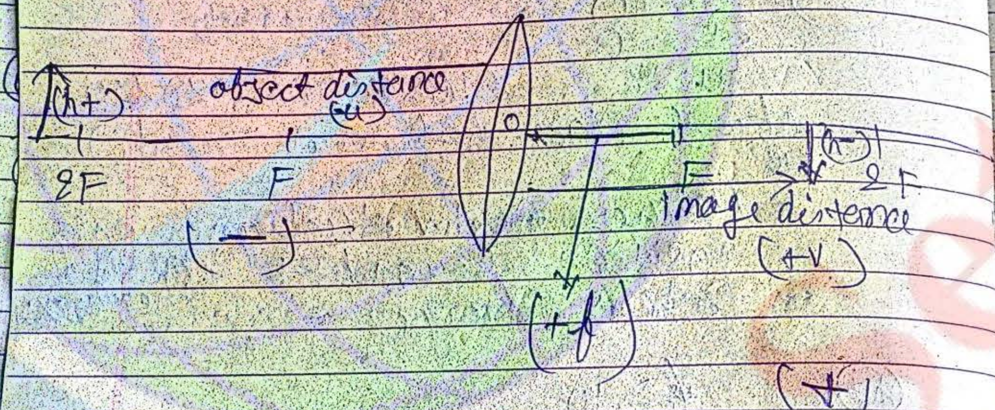
(C) F = 10 
2F = 20
u = 8 (10 > 8 < 20) 0 < 8 < 10
object place between F and O

Nature → ~~Real~~ virtual and erect
Position → ~~Beyond 2F~~ (same side of the object)
size → larger

(D) f = 10
2F = 20 
u = 20
object place between 2F
Nature → Real and inverted
size → same side
Position → At 2F

Good question

→ Sign convention or new cartesian sign convention



(i) All the distance are measured from the optical centre of a lens

(ii) The distance measure in the direction of incident ray is taken as a positive.

(iii) The

(iii) The distance measured in the opp. direction of the incident ray is taken as a negative.

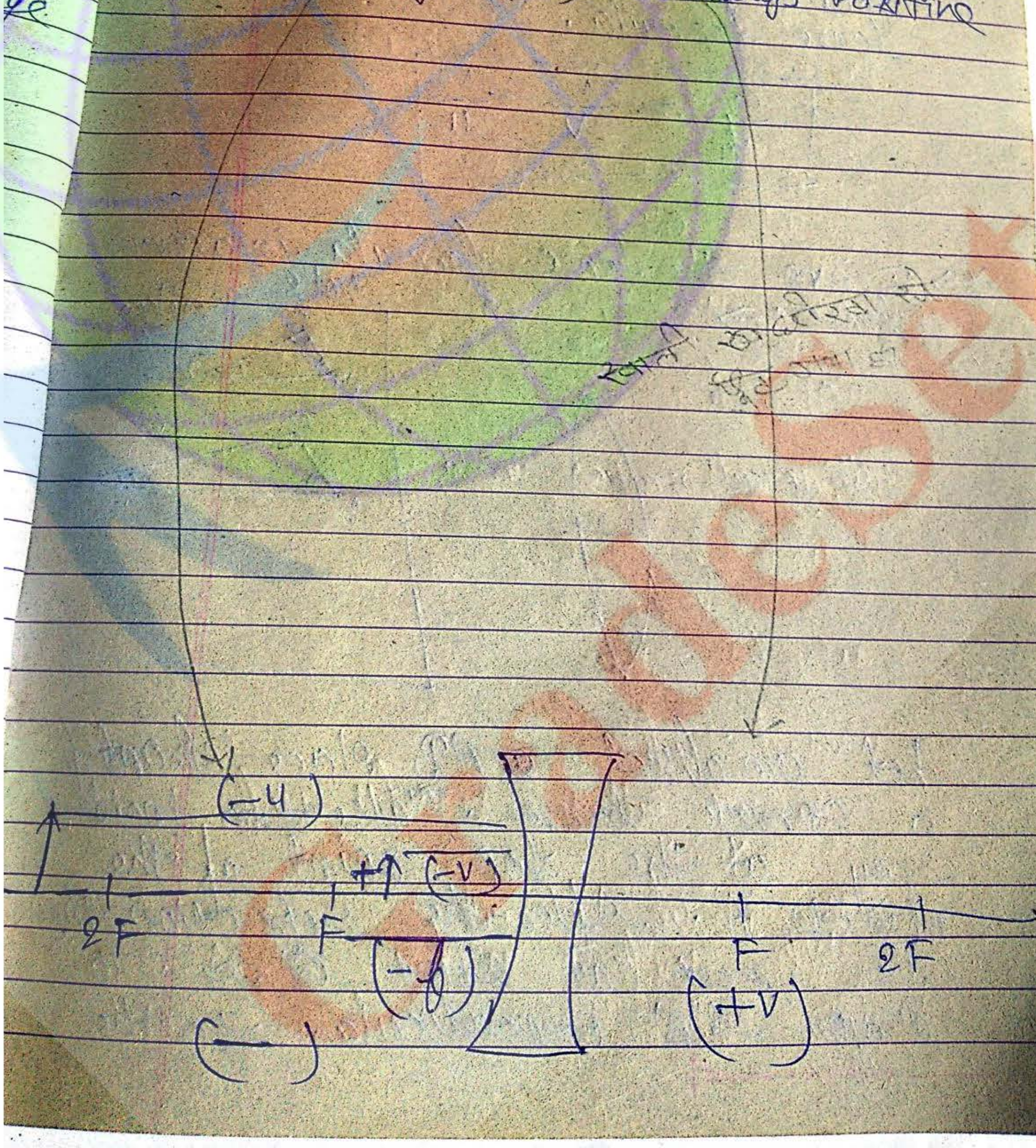
(iv) The upheight of the principle axis is taken as positive whereas down ward height is taken as negative

⇒ Sign convention for a convex lens

(I) 'u' is always negative (object distance)
(II) Focal length (f) is always positive
(III) Image distance (v) for the real image is always positive and for virtual image it is negative.
(IV) For height of object (ho) is always positive (+ve)
(V) height of image (hi) is negative for real image.
(VI) height of image (hi) is positive for virtual image

→ Sign Convention of Concave lense :->

(i) u, v and F all are negative
(ii) height of object (ho) and height of image (hi) is always positive

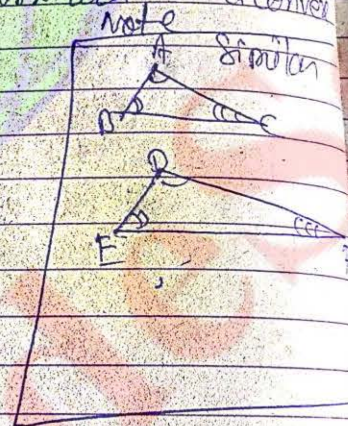


Lense formula.

⟹ The relation between object distance (u), image distance (v), and focal length (f) of a lense is called lense formula.

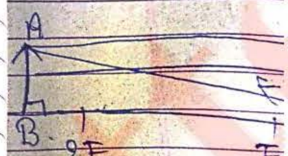
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

→ Drive the lense formula in a convex lense :→



Let an object AB place infront of a convex lense. Take two incident ray at the top point of the objects 'A'. After the refraction they are meet at point A'. To drawn A'B' perpendicular to the

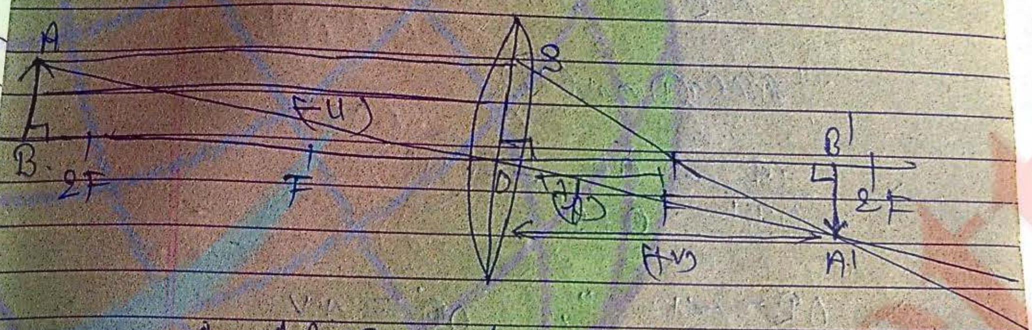
Princip
the a



In Δ

By

principle axis which is the image of the objects.



In $\triangle AOB$ and $\triangle A'OB'$

$\angle ABO = \angle A'B'O = 90°$

$\angle AOB = \angle A'OB'$ (vert. opp. $\angle$s)

By AA $\triangle AOB \sim \triangle A'OB'$

$\therefore \frac{AB}{A'B'} = \frac{OB}{OB'}$ —— (1)

In $\triangle SFO$ and $\triangle A'FB'$

$\angle SOF = \angle A'B'F = 90°$

$\angle SFO = \angle A'FB' = $ (vert. opp. $\angle$)

By AA,

$\triangle SFO \sim \triangle A'FB'$

$\therefore \frac{SO}{A'B'} = \frac{OF}{FB'}$ —— (11)

But SO = AB
then above eqn becomes

$\Rightarrow \frac{AB}{A'B'} = \frac{OF}{FB'}$ — (ii)

From eq(i) and (ii)

$\Rightarrow \frac{OB}{OB'} = \frac{OF}{FB'}$ — (iii)

$\Rightarrow OB = -u$; $OB' = +v$

$\Rightarrow OF = -f$; $FB' = OB' - OF = v - f$

Putting all values in eq(iii)

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

$\Rightarrow -u(v-f) = vf$

$\Rightarrow -uv + uf = vf$

Dividing all terms by uvf

$\Rightarrow \frac{-uv}{uvf} + \frac{uf}{uvf} = \frac{vf}{uvf}$

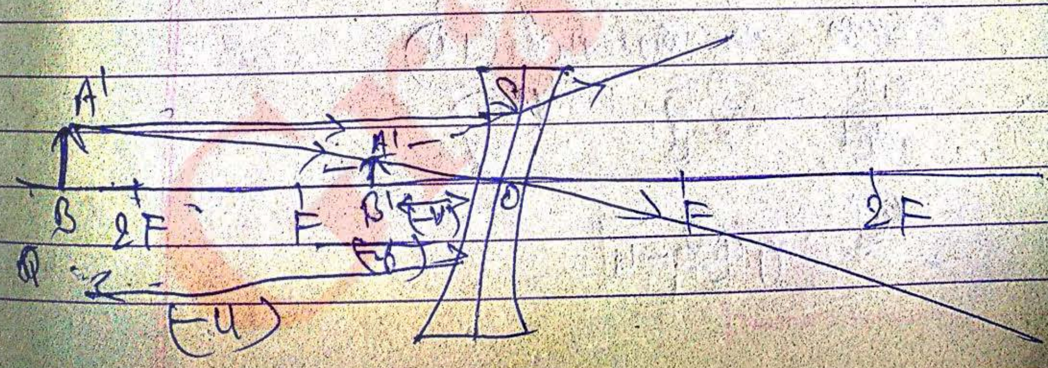
$$\Rightarrow -\frac{1}{f} + \frac{1}{v} = -\frac{1}{u}$$

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

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

⇒ Drive the lense formula in a concave lense

Let an object AB placed infront of a concave lense whose virtual and erect A'B' image is form.



In ΔAOB and $\Delta A'OB'$

$\angle AOB = \angle A'B'O = 90$

$\angle AOB = \angle A'OB'$ (common angle)

By AA $\Delta AOB \sim \Delta A'OB'$

$\Rightarrow \therefore \frac{AB}{A'B'} = \frac{OB}{OB'}$ — (I)

In ΔSFO and $\Delta A'FB'$

$\Rightarrow \angle SOF = \angle A'B'O = 90°$

$\Rightarrow \angle SFO = \angle A'FB'$ (common angle)

By AA, $\Delta SFO \sim \Delta A'FB'$

$\Rightarrow \therefore \frac{SO}{A'B'} = \frac{OF}{FB'}$

But $SO = AB$

$\Rightarrow \therefore \frac{AB}{A'B'} = \frac{OF}{FB'}$ — (II)

From eq (I) and (II)

$\Rightarrow \frac{OB}{OB'} = \frac{OF}{FB'}$ — (III)

$\Rightarrow OB = -4$

$\Rightarrow OB' = -v$

$\Rightarrow OF = -f$

$\Rightarrow FB' = -f - (-v)$

$= -f + v$

Putting all values in eq (iii)

$\Rightarrow \frac{+u}{+v} = \frac{-f}{-f+v}$

$\Rightarrow u(-f+v) = -vf$

$\Rightarrow -uf + uv = -vf$

Dividing all terms by uvf

$\Rightarrow \frac{-uf}{uvf} + \frac{uv}{uvf} = \frac{-vf}{uvf}$

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

$-\left(\frac{1}{f} = \frac{1}{v} - \frac{1}{u}\right)$

$$\frac{AB}{A'B'} = \frac{OB}{OB'}$$

$$\frac{A'B'}{AB} = \frac{OB'}{OB}$$

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

→ magnification of lens

The ratio of the size of the image to size of the object is called magnification.

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

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

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

SI Unit

$$m = \frac{m/s}{m/s} = \text{unit less}$$

magnification is a unit less quantity because it is a ratio of same physical quantities.

→ Note → magnification of the real image is always negative

And for virtual image always positive

mirror $= \frac{-v}{u}$ | lense $= \frac{v}{u}$

Q> An object 5cm place infront of convex mirror at a distance 30cm. If its focal length 20cm. Find the position of the image and nature and its size.

Given :

For convex lense

Height of object = 5cm

$u = -30$

$f = 20cm$

$v = ?$

$h_i = ?$

From lense formula

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

$\frac{1}{20} = \frac{1}{v} - \frac{1}{-30}$

$\frac{1}{20} = \frac{1}{v} + \frac{1}{30}$

$-\frac{1}{v} = \frac{1}{30} - \frac{1}{20}$

$-\frac{1}{v} = \frac{2-3}{60}$

$+\frac{1}{f} = \frac{+01}{60}$

$v = 60$

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

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

$m = -2$

~~Nature~~

$m = \frac{hi}{ho}$

$\frac{-2}{1} = \frac{hi}{5}$

$hi = -2 \times 5$

$hi = -10$

Nature - Real and inverted.

Ans A object place infront of concave lense at a distance of 20 cm. If its focal length is 10 cm find position ~~size~~ and nature of the image.

Given → For concave lense
u = -20 cm
f = -10 cm

for lense formula

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

$\frac{1}{-10} = \frac{1}{-20} - \frac{1}{u}$ $\frac{1}{-10} = \frac{1}{v} - \frac{1}{-20}$

$\frac{-1}{10} - \frac{1}{20} = \frac{-1}{u}$ $\frac{-1}{v} = \frac{1}{10} + \frac{1}{20}$

$\frac{-1}{u} = \frac{-2-1}{20}$ $\frac{-1}{v} = \frac{3}{20}$

$\frac{+1}{u} = \frac{+3}{20}$ $3v = -20$

$3u = 20$ $v = \frac{-20}{3}$

$u = \frac{20}{3}$

$M = \frac{v}{u}$ $M = \frac{-20}{3 \times -20}$

$M = \frac{+2}{+20}$ $M = \frac{1}{3}$

$M = \frac{+1}{+10}$

Nature → virtual and erect.

Q → An ... of a ... in ... 60 ... 20 ... 20 ...

Ans → Giv...

Q-> An object of 3cm placed infront of a convex lense, such that its ~~inverted~~ image is format a distance of 60cm. If its focal length is 20cm. Find position of the object, ~~size and~~ size of the image and its Nature.

Ans: Given:

For convex lense,

$h_o = 3cm$

$v = 60cm$

$f = 20cm$

From lense formula

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

$\frac{1}{20} = \frac{1}{60} - \frac{1}{u}$

$+\frac{1}{u} = \frac{1}{60} - \frac{1}{20}$

$\frac{1}{u} = \frac{1-3}{60}$

$\frac{1}{u} = \frac{-2}{60}$

$\frac{1}{u} = \frac{-1}{30}$

$u = -30$

Position of object = 60cm behind the convex lense.

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

$m = \frac{hi}{ho}$ $m = \frac{60}{-60}$

$m = -1$

$m = \frac{hi}{ho}$

$-1 = \frac{hi}{3}$

$-3 = hi$

$hi = -3$

Nature ⇒ Real and inverted
size ⇒ Same size of the object.

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

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

$m = -2$

$m = \frac{hi}{ho}$

m = magnification

→ Important

$-2 = \frac{hi}{3}$

$hi = -6$

Nature → Real and inverted

~~Position → large in size~~

Size → large in size

Q → A convex lens form 3 times magnifying image of an object. If focal length of the lens is 10cm. Find position of the object and Image?

Ans → For convex lens

$F = 10cm$

$m = \pm 3$

~~when~~

Case 1st, when $m = 3$

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

$3 = \frac{v}{u}$

$v = 3u$ — (1)

From lens formula

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

$\frac{1}{10} = \frac{1}{3u} - \frac{1}{u}$

$\frac{1}{10} = \frac{1-3}{3u}$

$\frac{1}{10} = \frac{-2}{3u}$

$3u = -20$

$\therefore u = \frac{-20}{3}$

Putting value of u in eq (1)

$v = \frac{3 \times -20}{3}$

$v = -20$

object distance $= \frac{-20}{3}$ cm

Image distance $= -20$ cm

Case IInd

when, $m = -3$

From lense formula

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

$$\frac{1}{-10} = \frac{1}{3u} - \frac{1}{u}$$

$$-\frac{1}{10} = \frac{1-3}{3u}$$

$$-\frac{1}{10} = \frac{-2}{3u}$$

$$3u = -20$$

$$\therefore u = \frac{-20}{3}$$

Putting value of u in eq (1)

$$v = 3 \times \frac{-20}{3}$$

$$v = -20$$

object distance $= \frac{-20}{3}$ cm

Image distance $= -20$ cm

Case IInd

when, $m = -3$

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

$-3 = \frac{v}{u}$

$v = -3u$ (iv)

$\frac{1}{+10} = \frac{1}{-3u} - \frac{1}{u}$

$\frac{1}{10} = \frac{-1-3}{3u}$

$\frac{1}{10} = \frac{-4}{3u}$

$3u = -40$

$u = -\frac{40}{3}$

Putting value of u in eq find v

$v = -3 \times -\frac{40}{3}$

$v = 40$

Q4

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

$-3 = \frac{v}{u}$

$v = -3u$ — (iv)

$\frac{1}{+10} = \frac{1}{-3u} - \frac{1}{u}$

$\frac{1}{10} = \frac{-1-3}{3u}$

$\frac{1}{10} = \frac{-4}{3u}$

$3u = -40$

$u = \frac{-40}{3}$

Putting value of u in eq 3rd v

$v = -3 \times \frac{-40}{3}$

$v = 40$

Q4

Q A convex lense of focal lense 15cm Forms 4 times magnifying real and inverted image. Find position of the object and Image

Ans- Given
For convex lense

$m = -4$

$f = 15cm$

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

$-4 = \frac{v}{u}$

$4u = v$

$v = 4u$ —— (1)

From lense formula

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

$\frac{1}{15} = \frac{1}{4u} - \frac{1}{u}$

$\frac{1}{15} = \frac{1-4}{4u}$

$\frac{1}{15} = \frac{-5}{4u}$

$4u = -75$

$u = \frac{-75}{4}$

$4u = -75$

$u = \frac{-75}{4}$

Putting $v = \frac{-75}{4}$ in eq (1)

$v = -4 \times \frac{-75}{4}$

$v = 75$.

→ Power of lense :→

Power of lense.

⇒ Power → The reciprocal of focal length of a lense is called Power of lense.

mathematically :→

$$\text{Power of lense} = \frac{1}{\text{focal length}}$$

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

S.I unit of power of lense = $\frac{1}{m}$ = m^{-1}

m^{-1} is called diaptre (D) → Scientist Name

1) The power of the convex lense is always positive.

As F = 20cm

ii) The power of the concave lense is always Negative

S.I unit of power of lense = $\frac{1}{m}$ = m^{-1}

m^{-1} is called diaptre (D)
→ Scientist Name

1) The power of the convex lense is always positive.

eg F = 20cm

11) The power of the concave lense is always Negative

Q→ The focal length of a convex lense is 25 cm. Find power of the lense

$F = 25\,cm = \frac{25}{100} = \frac{1}{4}\,m$

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

$P = \frac{1}{\frac{1}{4}}$

$= 4$ diapter

Q→ The focal length of a concave lense is 10 cm. calculate power of the lense.

⇒ For concave lense

$F = -10\,cm = \frac{-10}{100} = \frac{-1}{10}$

$P = ?$

$P = \frac{1}{\frac{-1}{10}}$

$= -10$ diapter.

Q→ The power of the lense is −2 diapter. Find its focal length and Nature

Ans → $P = -2$

$F = ?$

$P = \frac{1}{f}$ / $f = \frac{1}{P}$

$P = \frac{1}{-2} \times 100$ cm

$= -50cm$

Name of lense →

concave lense.

Q→ The power of the lense 2.5 diapter find its focal length and write the name of the lense

$P = \frac{25}{100} \cdot 4$ $P = 2.5 m$

$f = \frac{1}{2.5}$ m

$f = \frac{1}{P}$ $f = \frac{1}{25} \times 10 \times 100$

$f = \frac{1}{\frac{1}{4}}$ $f = 40cm$

$f = 4$ cm name of lens → convex lense.

$P = \frac{1}{f}$ / $f = \frac{1}{P}$

$P = \frac{1}{-2} \times 100$ cm

$= -50$ cm

Name of lense →

concave lense.

Q→ The power of the lense 2.5 diapter find its focal length and write the name of the lense

$P = \frac{25}{100}$ ~~$\frac{5}{4}$~~

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

$f = \frac{1}{\frac{1}{4}}$

$f = 4$ cm

$P = 2.5$ m

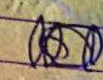
$f = \frac{1}{2.5}$ m

$f = \frac{1}{25} \times 10 \times 100$

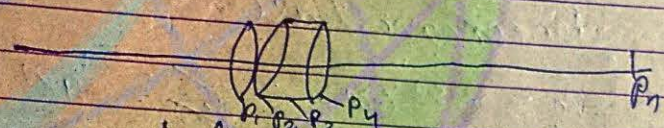
$f = 40$ cm

Name of lens → convex lense.

Power of Combination of lense:→



The reasultant power of combination of lense is equal to the algebric sum of the individual power of lense



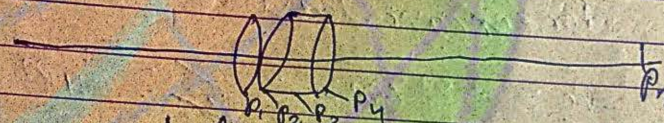
Let us consider 'n' number of lense whose power are P_1, P_2 — P_n are contact to each other. then resultant power of lense is given by

$$P = P_1 + P_2 + P_3 \text{ ——— } P_n$$

Q→ The focal length of a convex and Concave lense are 20cm and 25cm. If both lenses are placed contacted to each other calculate power power and focal length of combination of lense

Power of Combination of lense:→

The resultant power of combination of lense is equal to the algebric sum of the individual power of lense



Let us consider 'n' number of lense whose power are P_1, P_2 —— P_n are contact to each other. then resultant power of lense is given by

$$P = P_1 + P_2 + P_3 \text{ ——— } P_n$$

Q→ The focal length of a convex and Concave lense are 20cm and 25cm. If both lenses are placed contacted to each other calculate power and focal length of combination of lense

D = diaptor

Focal length of convex lense → $\frac{20}{100} = \frac{1}{5}$ m

Focal length of concave lense → -25 cm $= \frac{-25}{100} = \frac{-1}{4}$ m

$P = P_1 + P_2$ $\quad P_1 = \frac{1}{f_1}$

$= \frac{1}{5} + \frac{1}{4}$ $\quad = \frac{1}{\frac{1}{5}} = \frac{1 \times 5}{1} = 5$ Diopt.

for concave lense

$P_2 = -25 cm = \frac{-25}{100} = \frac{-1}{4}$ m

$P_2 = \frac{1}{f_2}$

$= \frac{1}{\frac{-1}{4}} = \frac{1 \times -4}{1} = -4$ D

We know that

$P = P_1 + P_2$

$= 5D + (-4D)$

$= 5D - 4D$

$= 1D$

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

$P = f$

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

~~= 1m = 100 cm Ay~~

$\Rightarrow 1 m = 100 cm$

Q. Two convex and one concave lense are placed with contact to each other. If their focal length are 10cm, 20cm, and 25cm respectively.

Find Power and focal length of combination of lense:→

Ans:

Power of convex lense = 10 cm = $\frac{1}{10} m$

P_2 " " " " $= \frac{20}{100} = \frac{1}{5} m$

Power of concave lense = $\frac{-25}{100} = -\frac{1}{4} m$

$P_1 = \frac{1}{f}$

$P_1 = 10 D$

$P_2 = 5 D$

$\frac{1}{5}m$

$\frac{-25}{100} = \frac{1}{4}m$

Diagr

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

~~= 1m = 100 1m Ay~~

$= 1\,m = 100cm$

Q- Two convex and one concave lense are placed with contact to each other. If their focal length are 10cm, 20cm, and 25cm respectively.

Find Power and focal length of combination of lense :→

Ans :- ~~P~~ ~~P~~

Power of convex lense = $10cm = \frac{1}{10}m$

$''_2$ $''$ $''$ $''$ = $\frac{20}{100} = \frac{1}{5}m$

Power of ~~convex~~ concave lense = $\frac{-25}{100} = -\frac{1}{4}m$

$P_1 = \frac{1}{f}$

$P_1 = 10D$

$P_2 = 5D$

$P_2 = -4D$

$P = 10D + 5D - 4D$

$= 15D - 4D$

$= 11D$

$f = \frac{1}{11D}$

$f = \frac{1}{11m} \times 100$

$= 9.09$ cm

Q. A object 60 cm from a lense gives a virtual Image at a distance of 20cm. Infront of the lense what is the focal length of the lense. Is the lense converging or diverging. Give reason for your answer.

Ans. ~~h = 60cm~~
~~v = 20cm~~
$u = -60cm$
$v = -20cm$
$f = ?$

we know the

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

$\frac{1}{f} = \frac{-1}{60} - \frac{1}{-20}$

$\Rightarrow \frac{-1}{60} + \frac{1}{20}$

$\Rightarrow \frac{-3+1}{60}$

$\Rightarrow \frac{-2}{60}$

$\frac{1}{f} = \frac{-1}{30}$

$f = -30$

Name of lense → Diversing

Reason → Because focal length of diversing lense is negative.

Q → An object is 2m from a lense which forms and erect image $\frac{1}{4}$ The size of the object. Determine the focal length of the lense what type of lense is thin

$u = -2\,m$

$v = \frac{1}{4}$

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

$\frac{1}{f} = \frac{1}{\frac{1}{4}} - (-2)$

$\frac{1}{f} = 4 + 2$

$\frac{1}{f} = 6$

$f = \frac{1}{6}$

$u = -2\,m$

$h_i = \frac{1}{4} h_o$

$\frac{h_i}{h_o} = \frac{1}{4}$

$m = \frac{1}{4}$

we know that $\frac{v}{u} = m$

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

$\Rightarrow \frac{v}{u} = \frac{1}{4}$

$\Rightarrow v = \frac{1}{4} \times -2$

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

we know that

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

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

$\frac{1}{f} = \frac{-2}{1} + \frac{1}{2}$

$\frac{1}{f} = \frac{-4+1}{2}$

$\frac{1}{f} = \frac{-3}{2}$

$f = -\frac{2}{3} m$

$f = -\frac{2}{3} \times 100cm$

$f = -66.6cm$

nameal lense = concave

Q→ A concave lense has focal length -15cm. At what distance should the object from the lense be replaced so that it forms an image at 10cm from the lense. Also find the magnification produced by the lense.

Ans- focal length of concave = -15cm

$v = 10cm$

we know that

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

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

$\frac{-1}{-15} + \frac{1}{10} = \frac{-1}{u}$

$-\frac{1}{u} = \frac{-2+3}{30} =$

[illegible] 6