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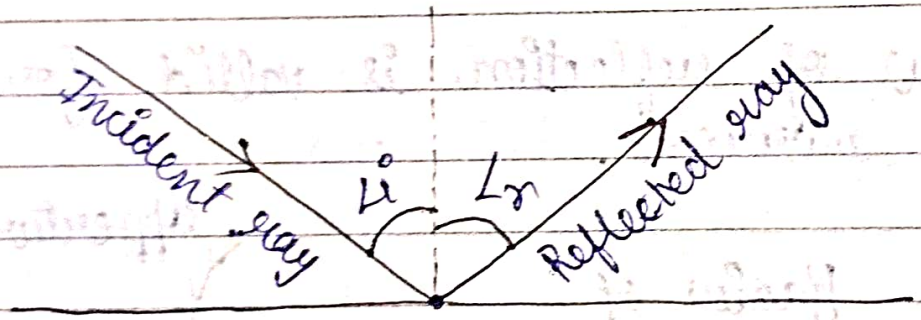
CHAPTER-9
LIGHT

Properties Of Light

* Light is a form of energy
* Speed of light : 3×10^8 m/s
  Kilometres : 3×10^5 Km/s
* Light always travels in straight line.
* Light depends on nature of surface of colour of material.

REFLECTION

Bouncing back of light when it strikes on a polished surface.



LAWS : Incident, reflected ray & normal all lie on the same plane.
$\angle i = \angle r$.

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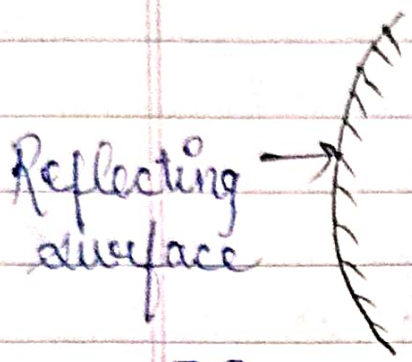
SPHERICAL MIRRORS

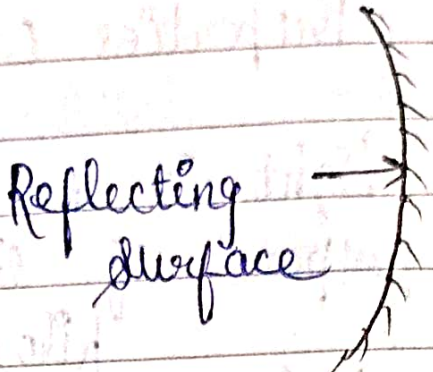
Convex Mirror



Diverging Mirror

- Large Image.
- Used as rear view mirrors in vehicles

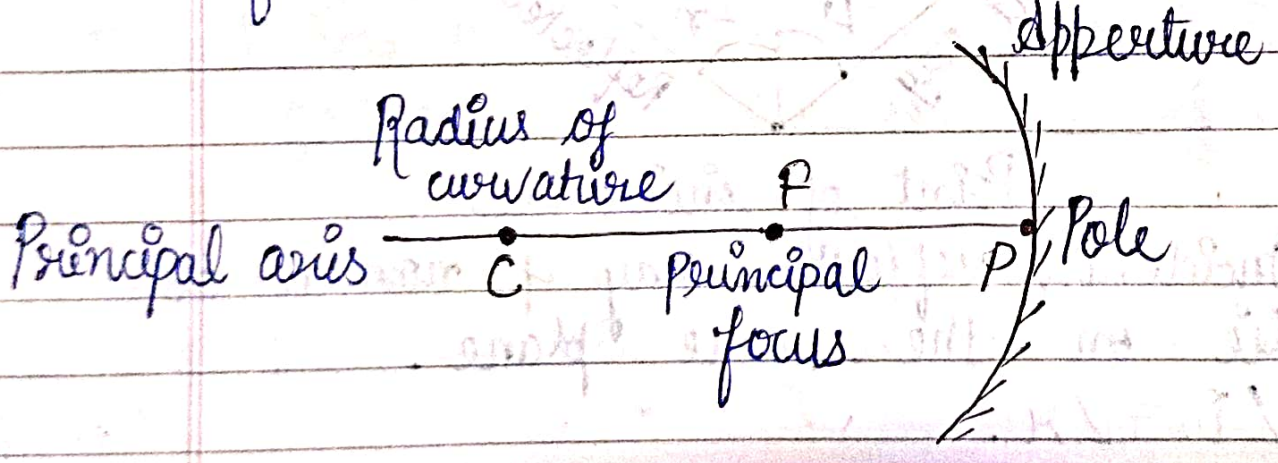
Concave Mirror

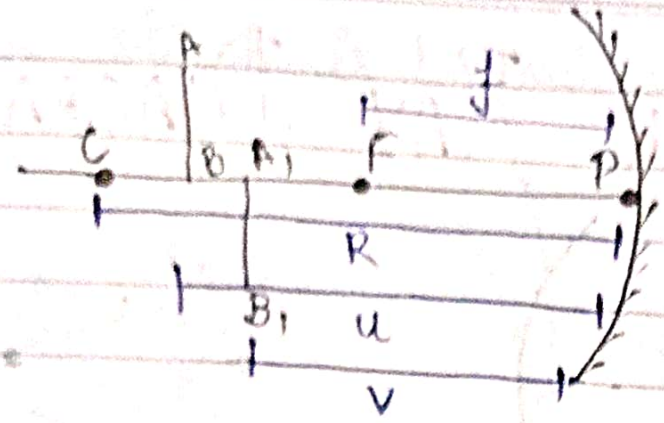


Converging mirror

- Small image
- Side mirror of vehicle
- (headlights)
- Dentists

Law of reflection is valid for all type of mirrors.





Radius of curvature (R)

Distance between Pole & curvature.

$$R = 2 \times f$$

focal length (f)

Distance between pole and focus.

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

Object distance (u)

Distance between pole & object

Image distance (v)

Distance between pole & image.

Image

- **Real**
  - Real & inverted
  - In front of mirror
- **Virtual**
  - Virtual (Imagenory)
  - Behind the mirror

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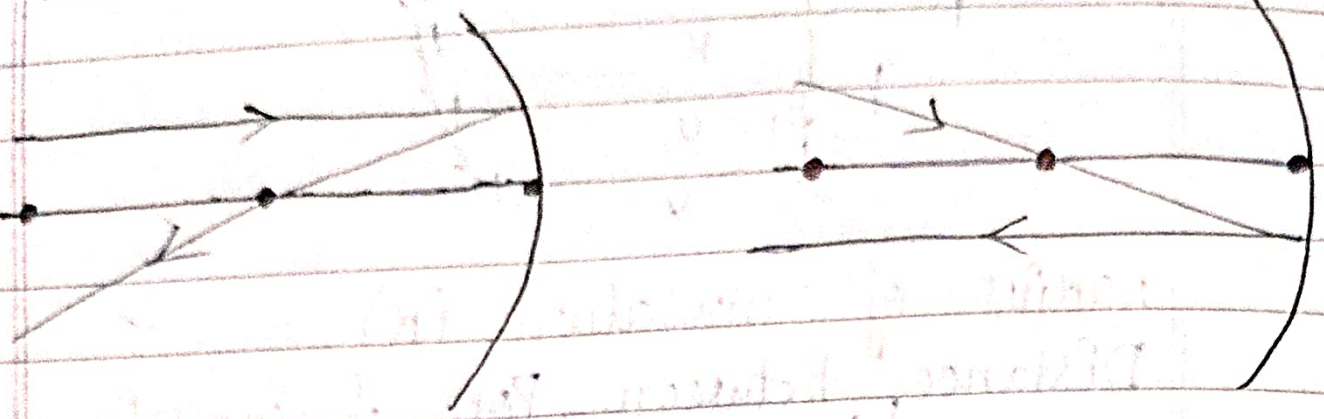
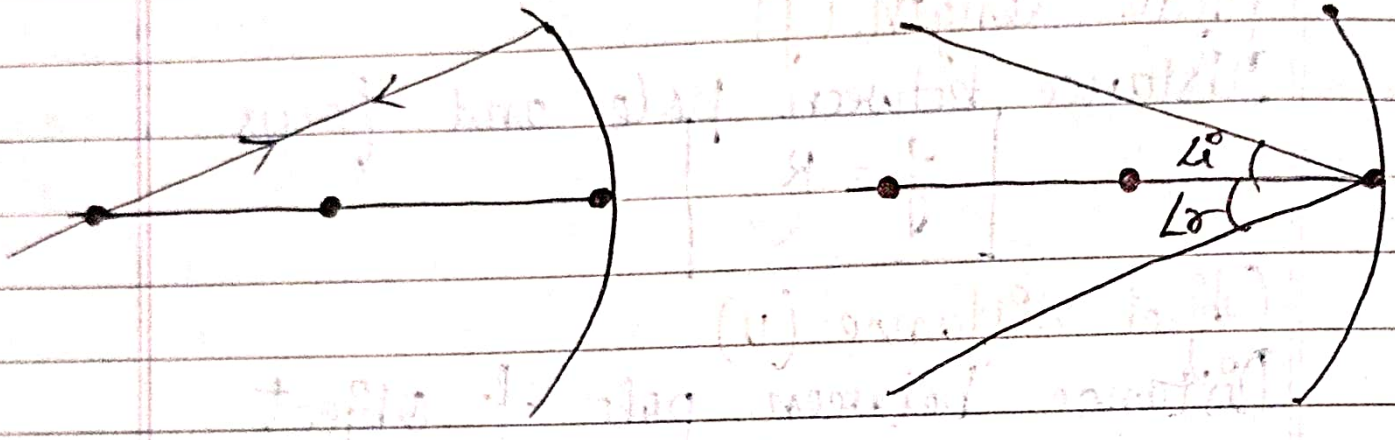
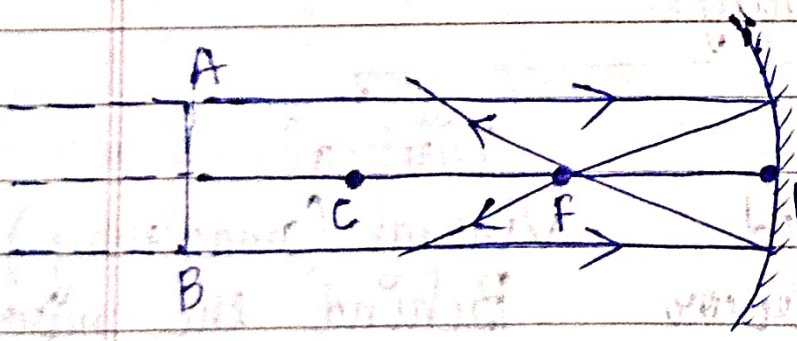
Rules for Ray Diagram





Concave Mirror

1. When object is at infinity :



P.I - At 'F'
Nature - Real, inverted
Size - point sized or highly diminished.

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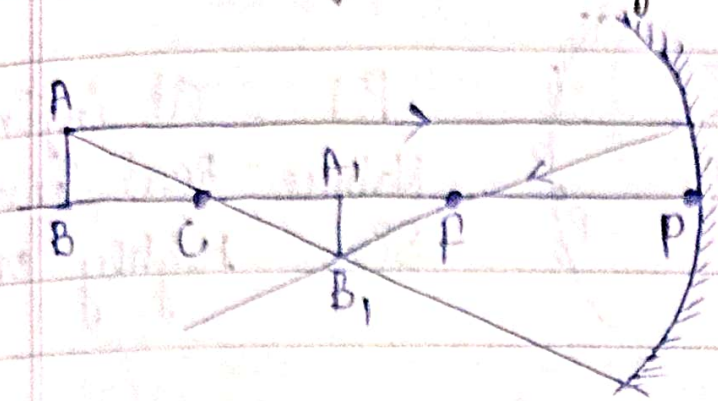
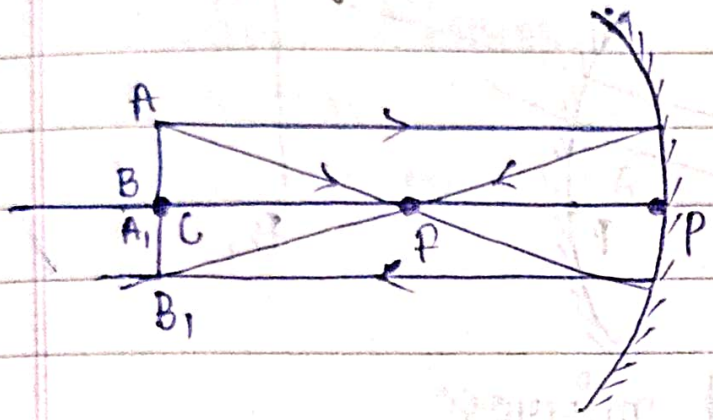
2. When object is beyond 'C'



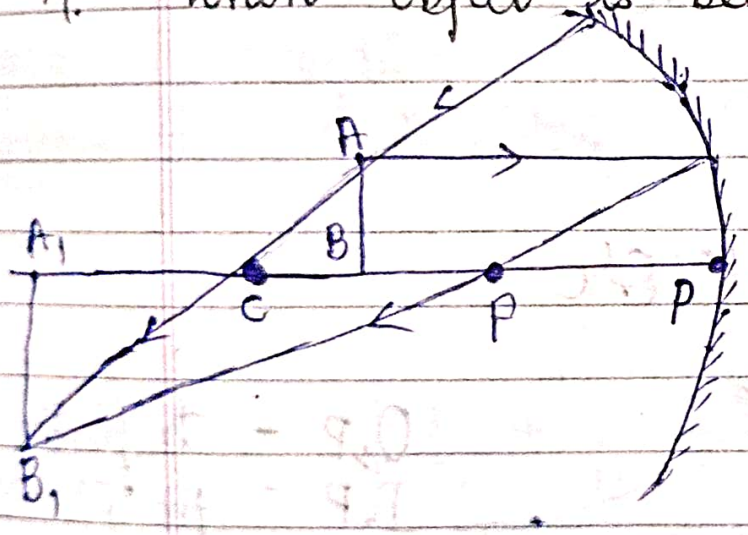
P.I - Between 'F' & 'C'
Nature - Real, inverted
Size - Diminished

3. When, object is at 'C'



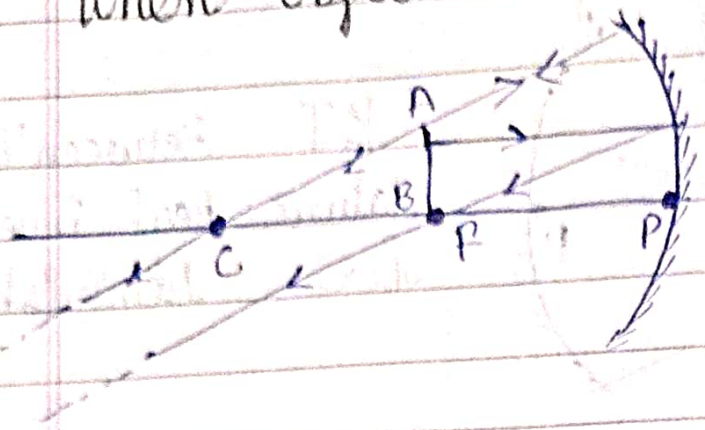
P.I - At 'C'
Nature - Real, inverted
Size - same size

4. When object is between 'F' and 'C'



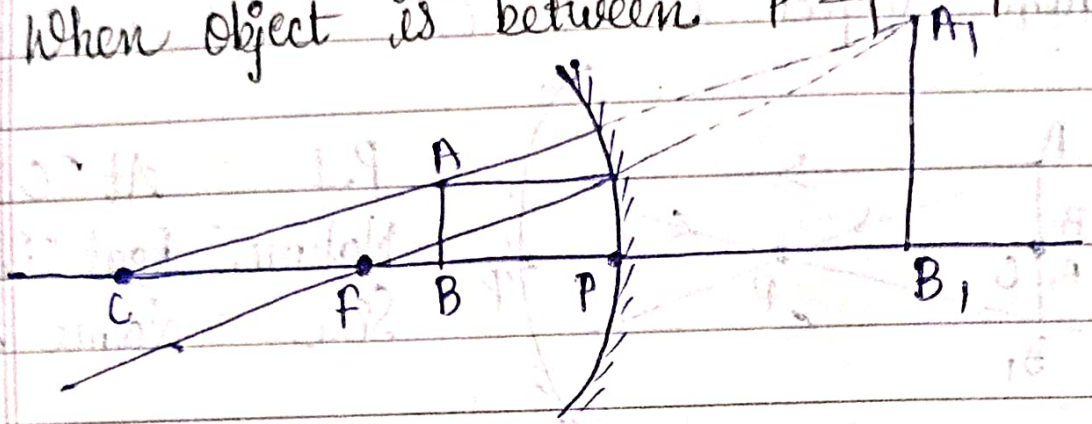
P.I - Beyond 'C'
Nature - Real, inverted
Size - Enlarged

5. When object is at 'f'



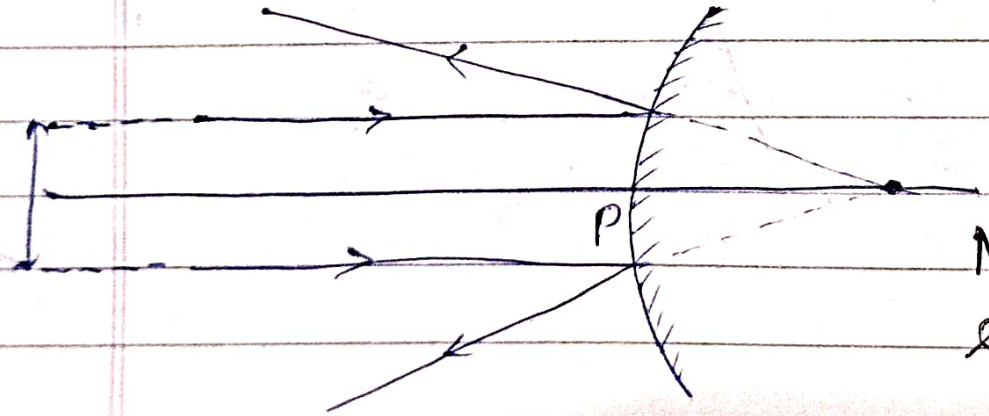
P.I - At infinity
Nature - Real, inverted
Size - Highly enlarged

6. When object is between 'P' & 'F'

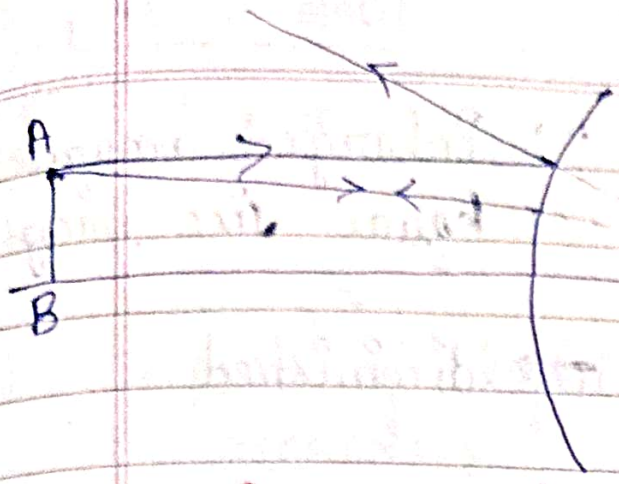


P.I - Behind mirror
Nature - virtual, erect
Size - Enlarged

Convex Mirror



O.P - Infinity
I.P - At 'F'
Nature - Virtual, erect
Size - Point size



O.P - P f Infinity
I.M - B 'p' f 'P'
∴ Nature - Virtual, erect
Size - Diminished

Sign Convention

Concave Mirror	Convex Mirror
u = −ve	u = −ve
v = −ve or +ve 6.	v = +ve
f = −	f = +ve

m

+ve $|m>1|$ Concave — Negative: Real & inverted

Positive: Virtual & erect — $|m<1|$ +ve convex

MIRROR FORMULA

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

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

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

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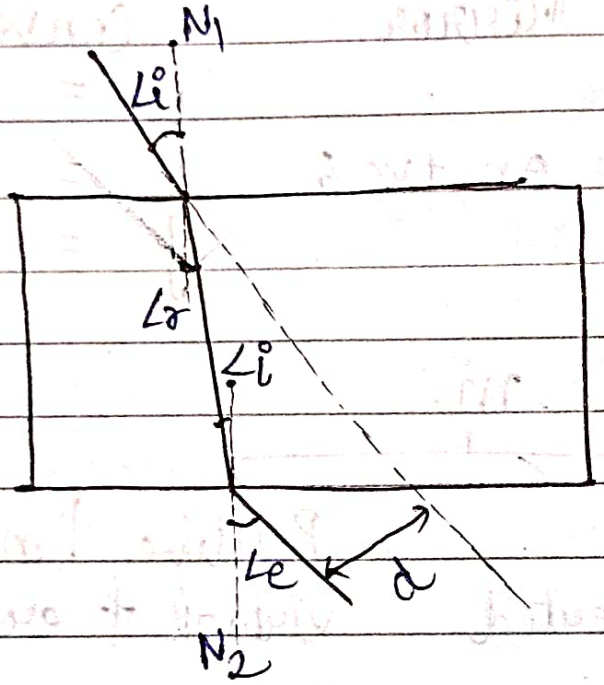
NOTE: $h_i > h_o$ then $|m > 1|$ → Enlarged image
$h_i = h_o$ then $|m = 1|$ → Equal size image
At 'C', $|u = v|$
$h_i < h_o$ then $|m < 1|$ → diminished

REFRACTION

Bending of light when it enters one transparent medium to another.

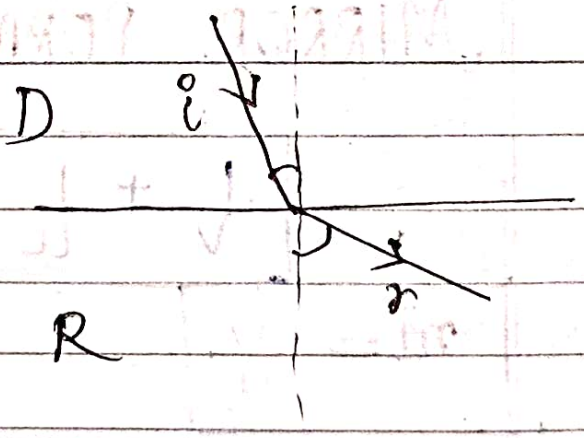


★ Case I

If D → R

$\angle i < \angle r$

Speed of light increases.



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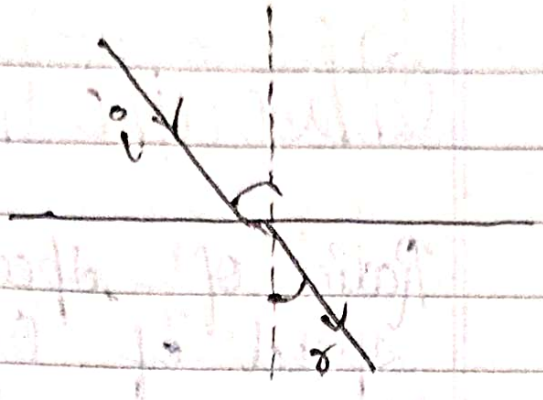
★ Case II

If R → D

$\angle i > \angle r$

Speed of light decreases.



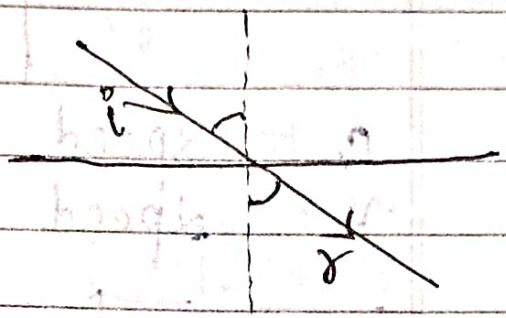
★ Case III

If D → D, R → R

$\angle i = \angle r$

Speed of light constant.

No refraction occur.



LAW OF REFRACTION

★ Incident ray, normal and refracted ray all lie on the same plane.

★ The ratio of angle of incidence to the sin angle of refraction is proportional to constant it is also called Snell's law.

$$\boxed{\frac{\sin I}{\sin R} = \text{constant}}$$

Refractive Index (n) = $\frac{\sin I}{\sin R}$ (Unit less)

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Absolute Refractive Index

Ratio of speed of light in vaccum to speed of light in medium.

$$n = \frac{c}{v}$$

c = speed of light in vaccum 3×10^8 m/s
v = speed of light in medium

$n \propto \frac{1}{v}$ → $n \uparrow \rightarrow v \downarrow \rightarrow D$
→ $n \downarrow \rightarrow v \uparrow \rightarrow R$

Relative Refractive Index

Ratio of refractive index of one medium to another medium.

n_{21} = Refractive index of medium m-2 with respect to m-1.

n_{12} = Refractive index of m-1 with respect to m-2.

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$$n_{21} = \frac{n_2}{n_1}$$

$$n_{12} = \frac{n_1}{n_2}$$

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

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

Material medium	Refractive Index
Air	1.0003
Ice	1.31
Water	1.33
Glass	1.52
Rock salt	1.54
Diamond	2.42

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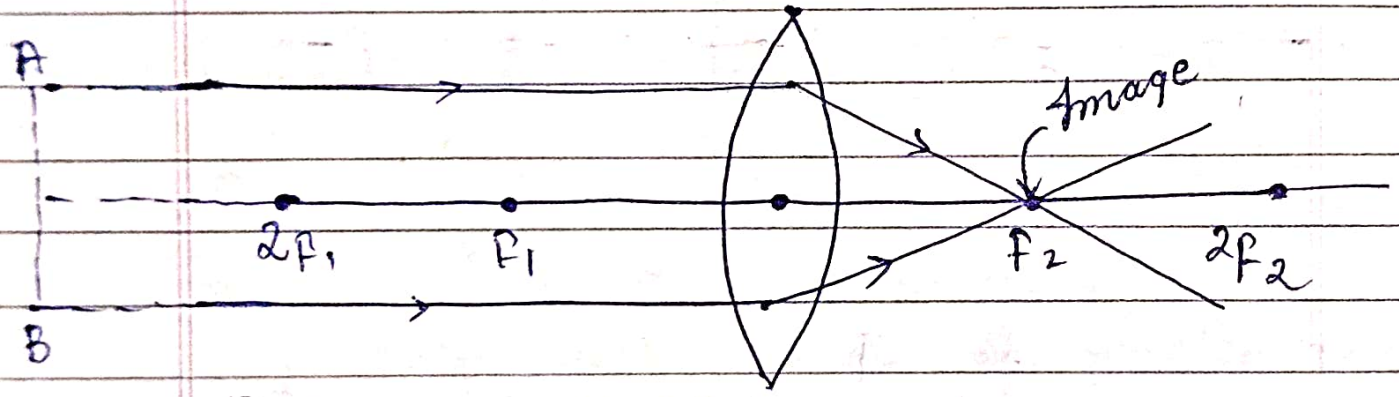
Lenses

Convex lens
Converging lens

Concave lens
Diverging lens

Convex lens

1. When object is at Infinity



P.I - at 'F_2'
Nature - Real, Inverted
Size - Point size or highly diminished

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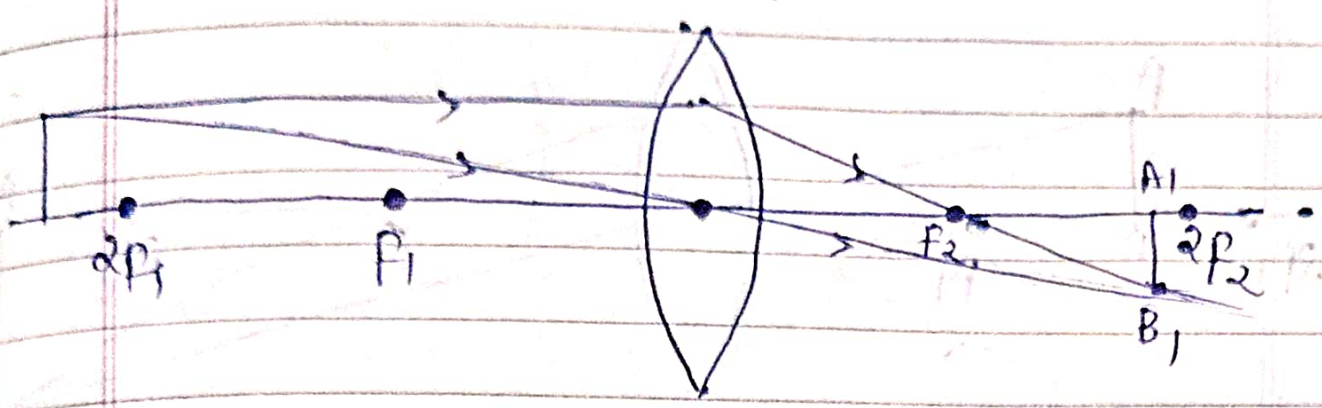
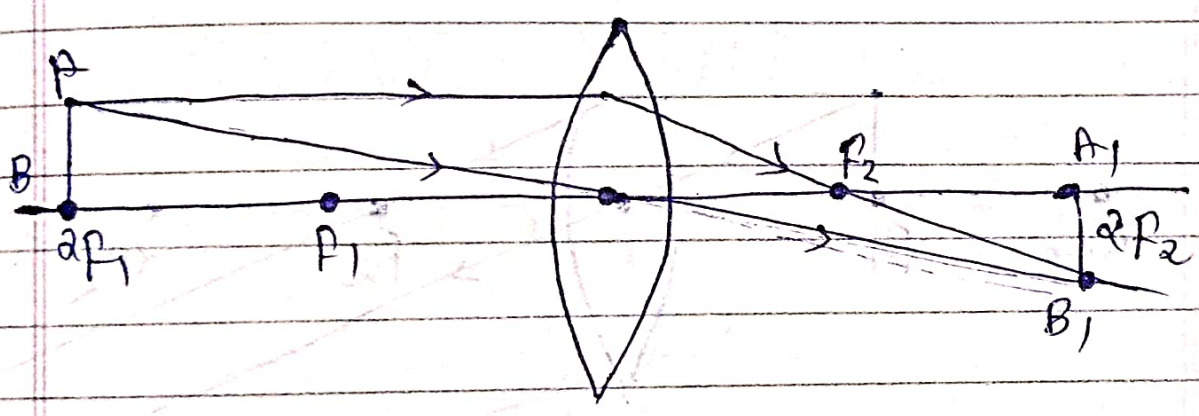
2. When object is beyond '2F'



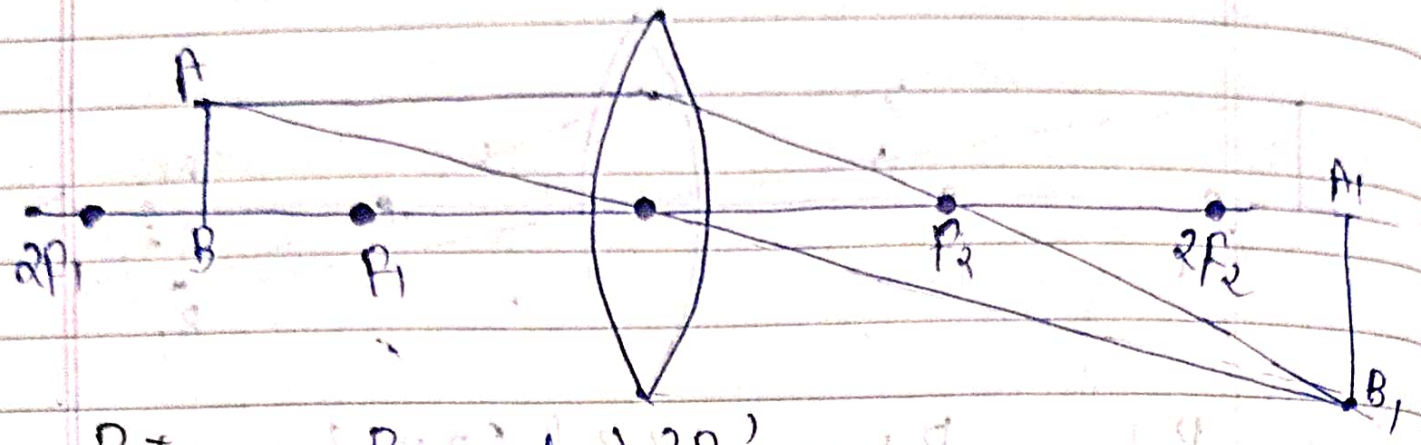
P.I - Between 'F_2' & '$2F_2$'
Nature - Real, inverted
Size - Diminished

3. When object is at '2F'



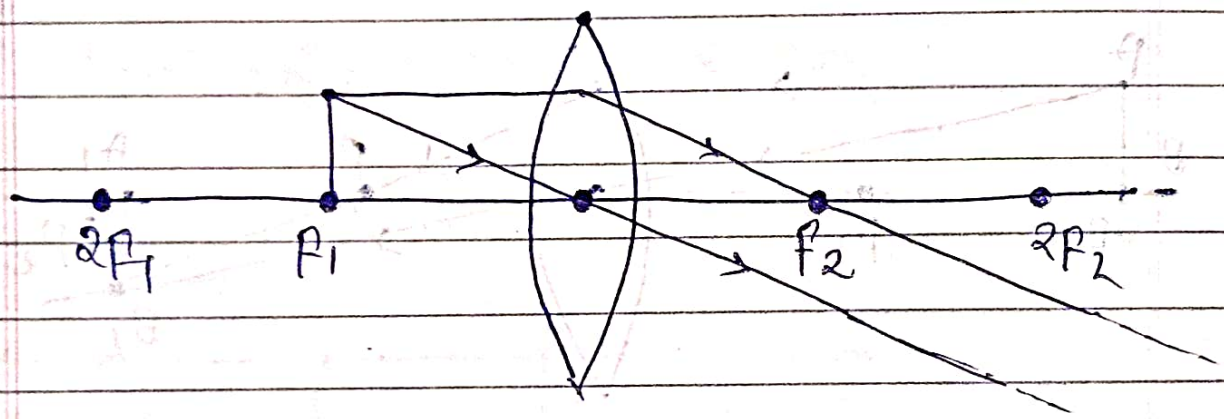
P.I - At '$2F_2$'
Nature - Real, inverted
Size - Same size

4. When object is between 'F_1' and '$2F_1$'



P.I - Beyond '$2F_2$'
Nature - Real, Inverted
Size - Enlarged

5. When object is at 'F_1'



P.I - At infinity
Nature - Real, Inverted
Size - Highly enlarged

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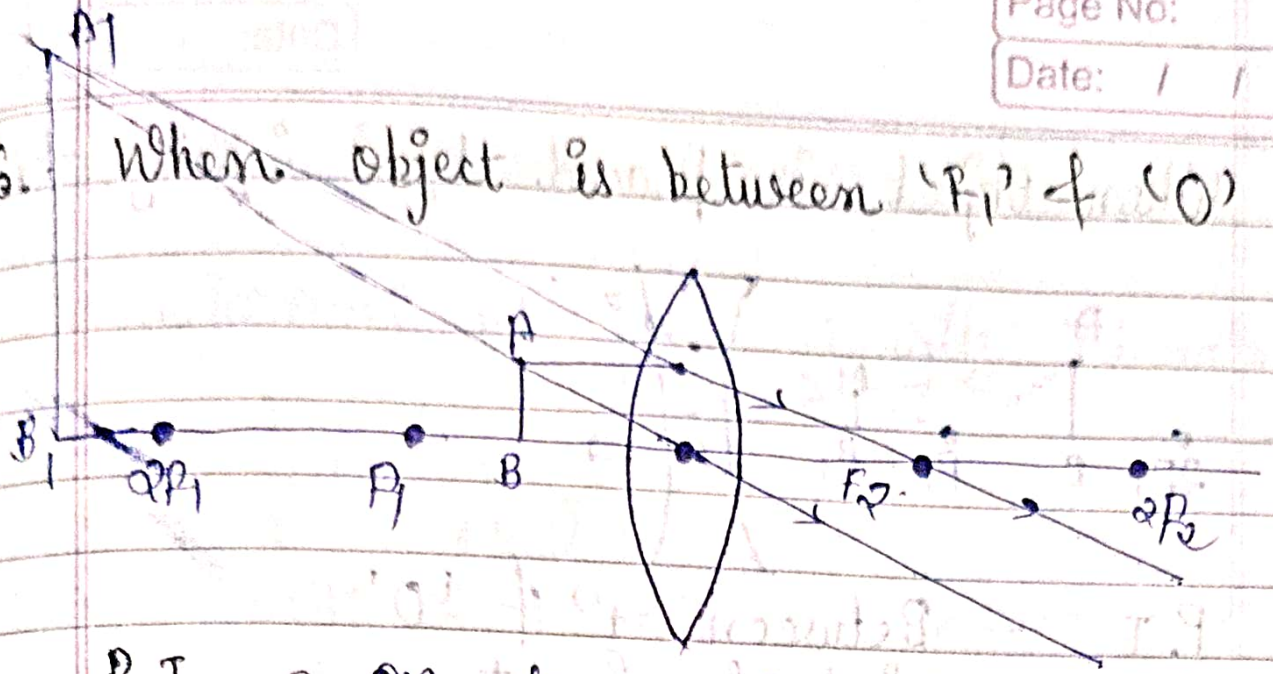
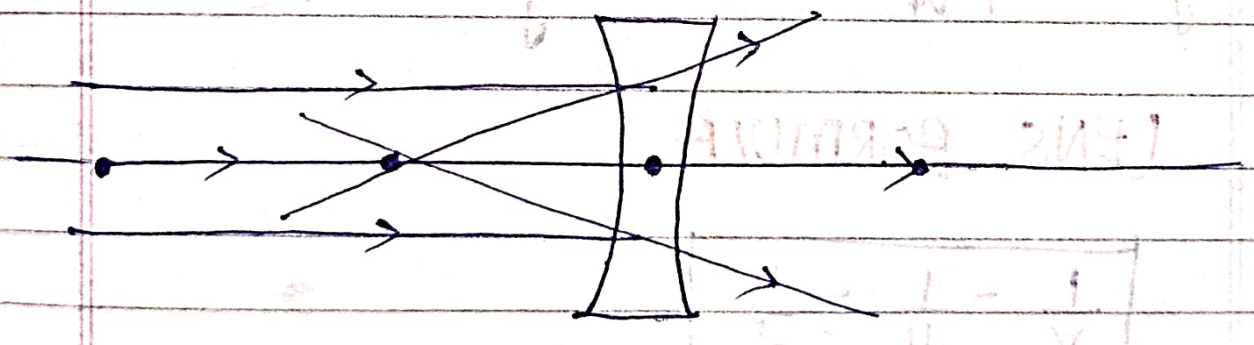
6. When object is between 'F_1' & 'O'



P.I - on same side of lens as the object
Nature - Virtual & erect
Size - Enlarged
Magnifying lens

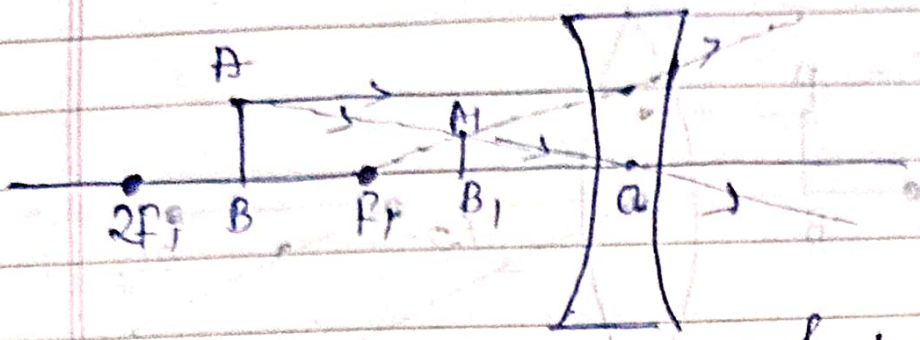
Concave lens

1 When object is placed at infinity



P.I - at 'f_1'...
Nature - Virtual, Erect
Size - Highly diminished

2. When object is placed b/w infinity & 'O'



P.I - Between 'F' & 'O'
Nature - Virtual, Erect
Size - Diminished

Sign Convention

Convex lens	Concave lens
u = -ve	u = -ve
v = +ve or -ve 6.	v = -ve
f = +ve	f = -ve

LENS FORMULA.

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

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

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

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POWER OF A LENS

Reciprocal of focal length in metre.

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

SI UNIT OF POWER = DIOPTRE = 'D'

P = +ve convex lens

P = -ve concave lens

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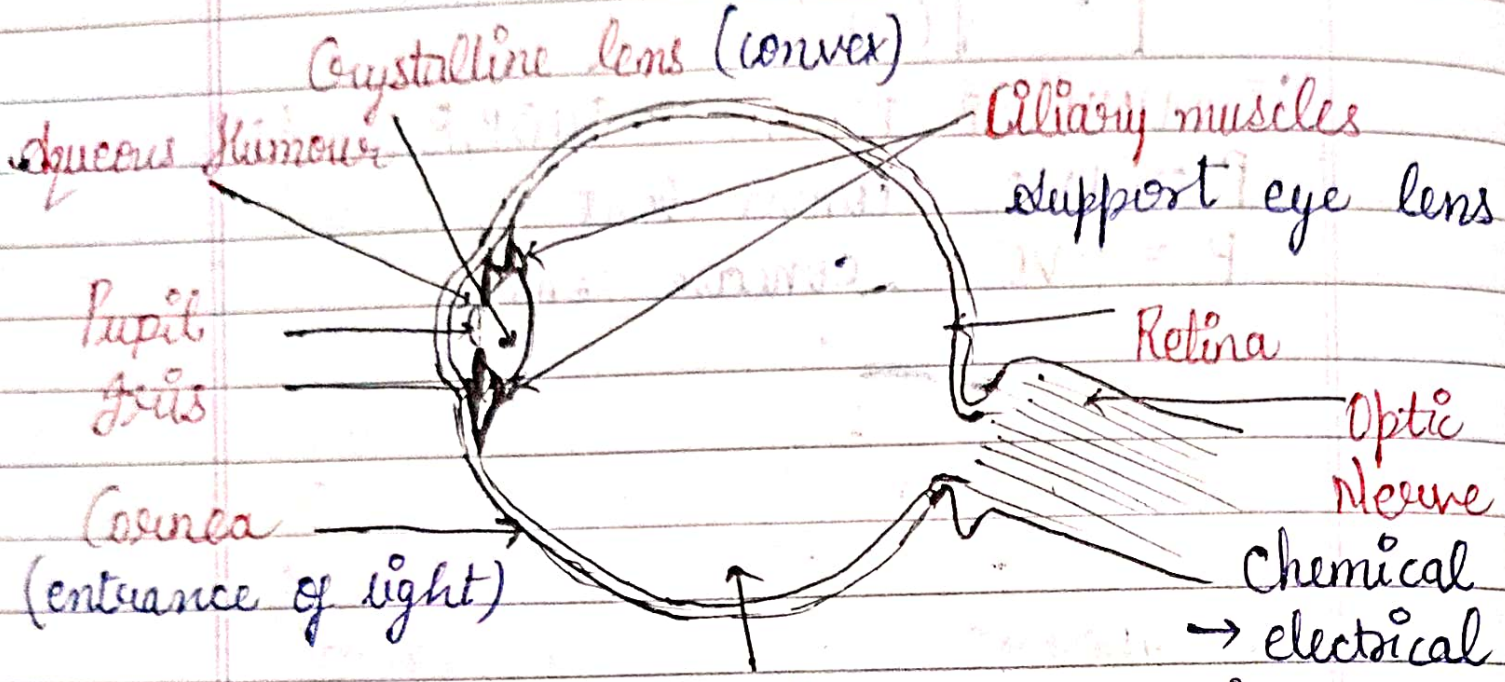
CHAPTER - 10
HUMAN EYE AND THE COLOURFUL WORLD

Human Eye



- Cornea - Outermost & transparent part. Entrance of light.
- Lens - Composed of fibrous, jelly material. Provides focused real & inverted image of the object (convex lens).
- Iris - Dark masculer & controls pupil size.
- Pupil - Regulates & controls amount of light entering the eye.
- Retina - Image formation

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FAR POINT - Infinity
NEAR POINT - 25 cm

ACCOMMODATION

Ability of eye lens to adjust its focal length.
Focal length changed help of ciliary muscles.

EYE DEFECTS

Myopia (Near-sightedness)

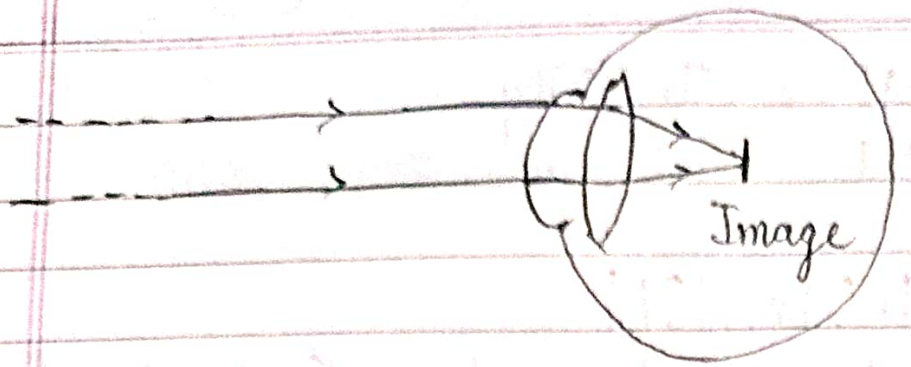
Can see nearby objects clearly but cannot see distant objects.
Image formed in front of retina.

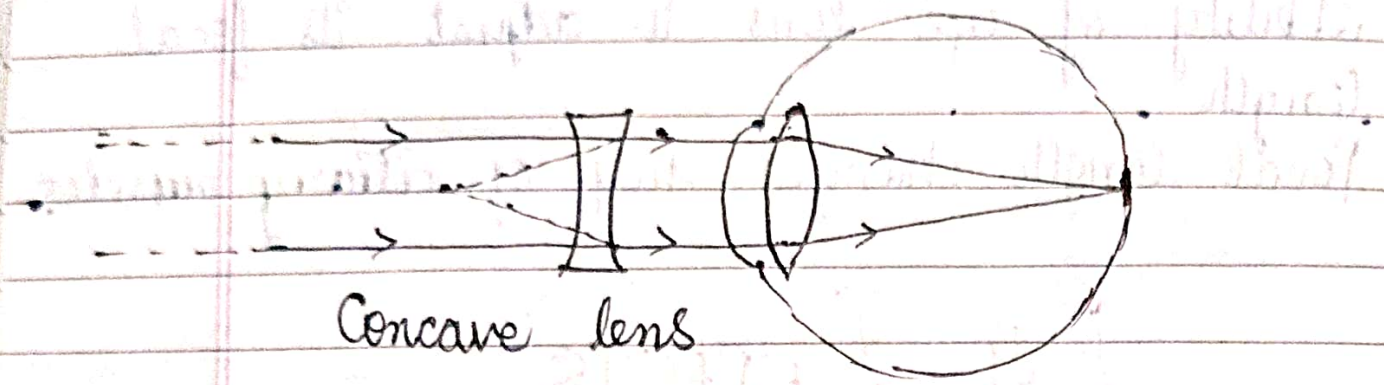
Causes

Excessive curvature of eye lens.
Elongation of eye ball.

Correction

Use of concave lens.





Concave lens

Hypermetropia (far-sightedness)

Can see far objects clearly but cannot nearby objects.

Image formed behind the retina.

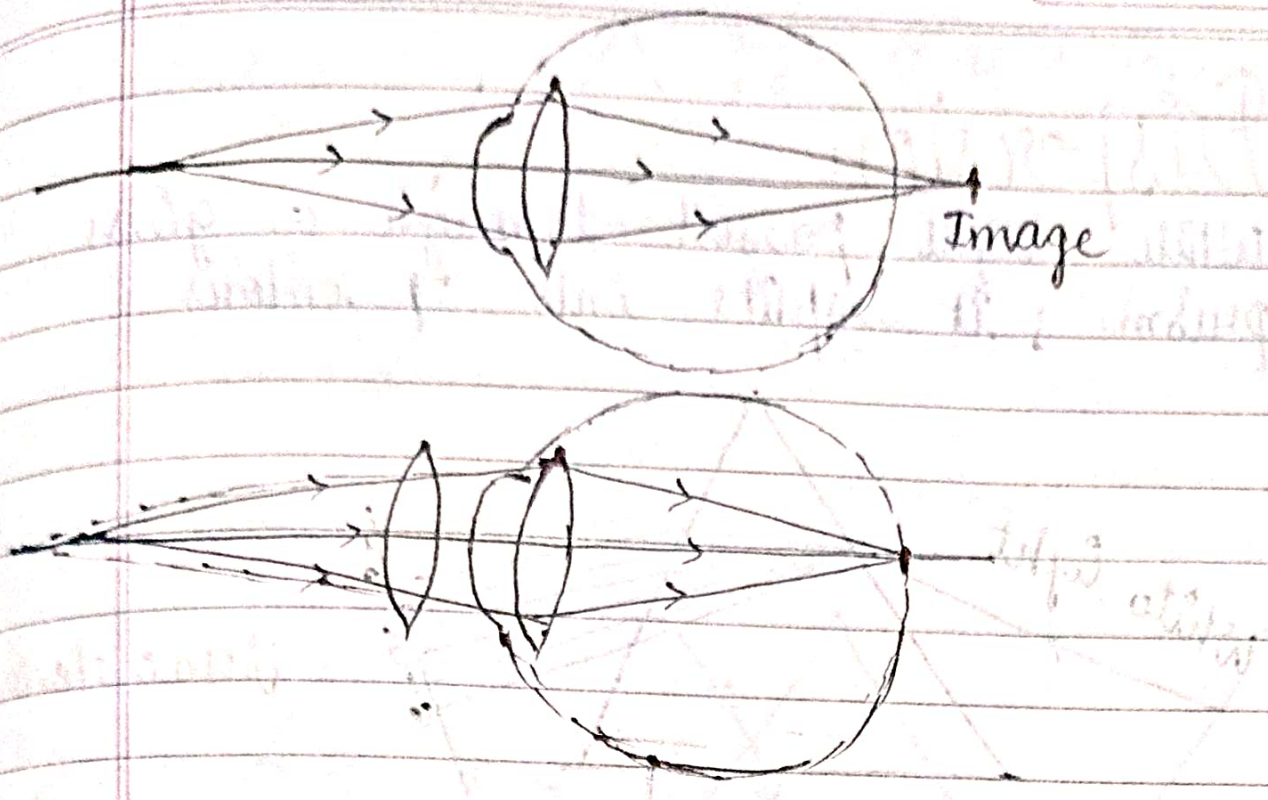
Causes

focal length becomes too long

Eye ball becomes too small.

Correction

Use of convex lens



Presbyopia

Old person cannot see nearby objects as well as distant objects.

Causes

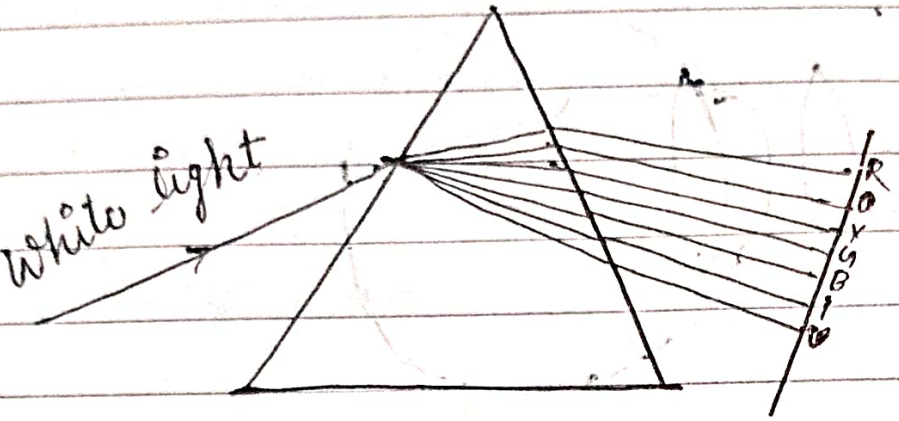
Gradual weakening of ciliary muscles.
Diminshing flexibity of eye lens.

Correction

Use of bi-focal lens.

Dispersion

White light passed through a glass prism, it splits into 7 colours



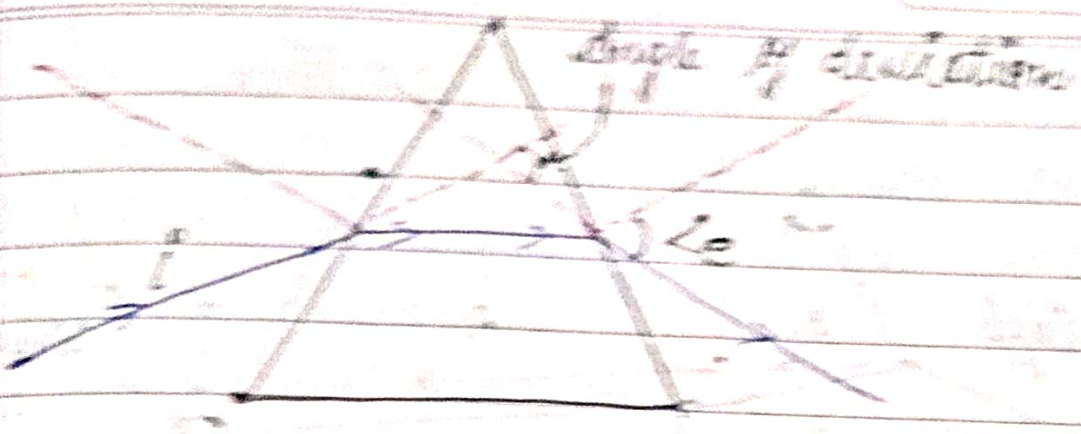
Issac Newton

Spectrum : Band of 7 colours.

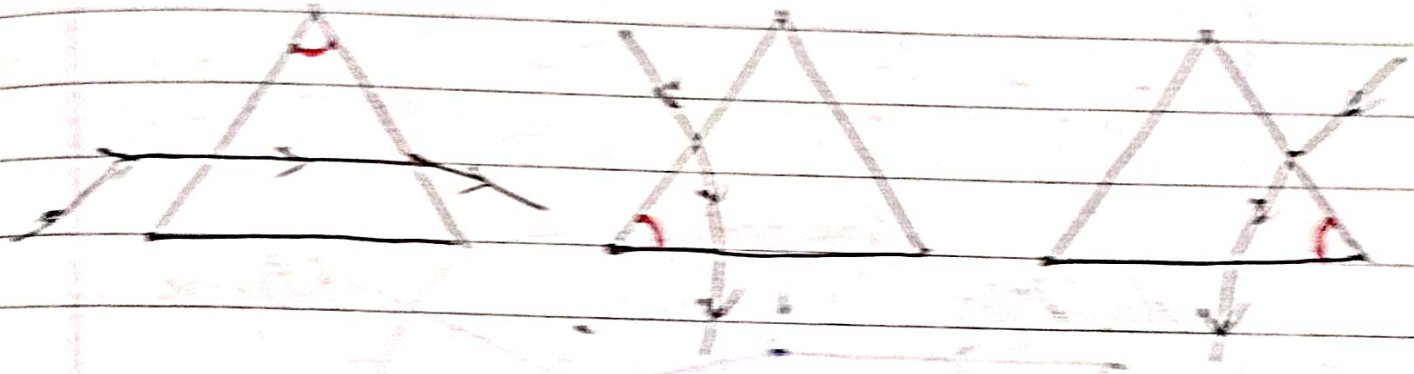
- Red is least deviated.
  It has longest wavelength.
- Violet is most deviated.
  It has smallest wavellength.

PRISM

* Pyramidal glass piece.
* 2 triangular & three rectangular surfaces.



Prism angle



Ax - 1.
Bending of light

Angle of deviation : Angle between incident ray & emergent ray

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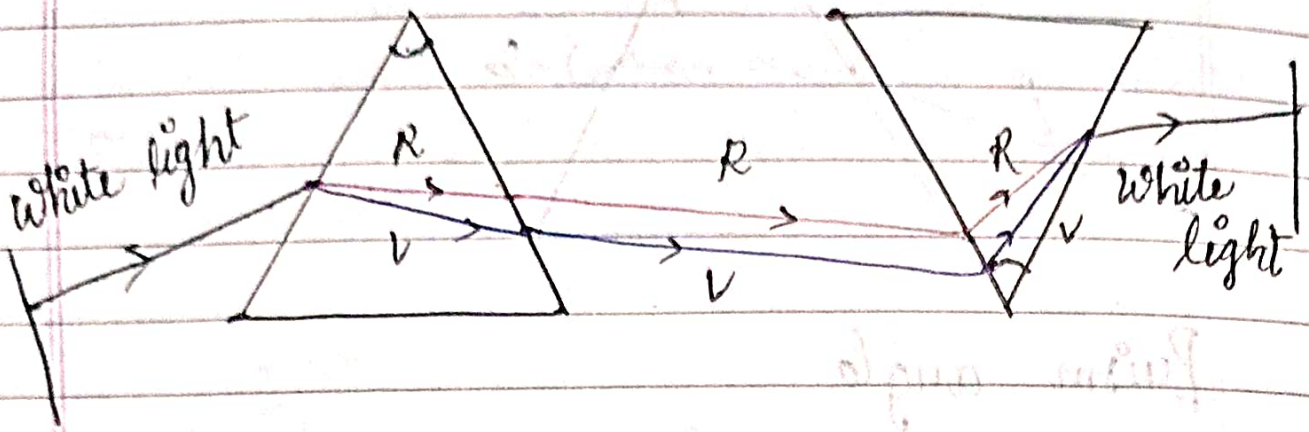
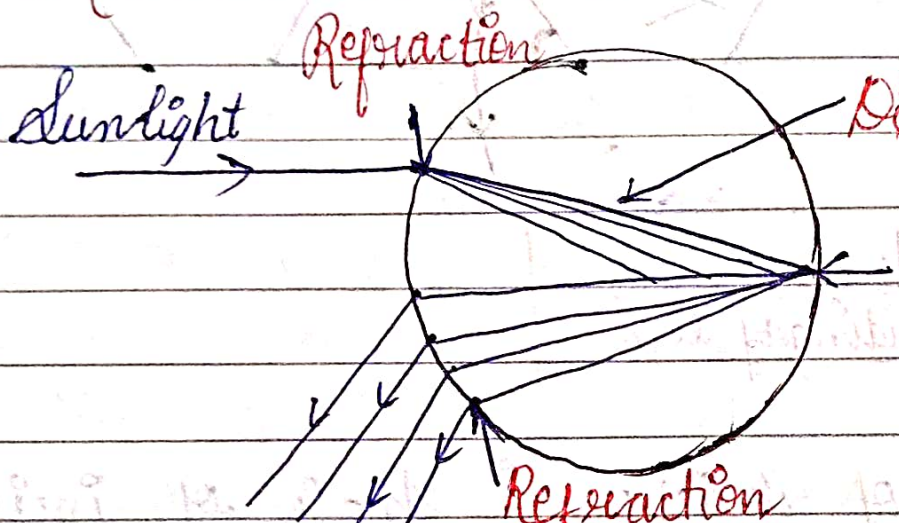
Recombination of Spectrum



Rainbow Formation



Rainbow is a natural spectrum.

REASON

Due to internal reflection & dispersion of light & refraction

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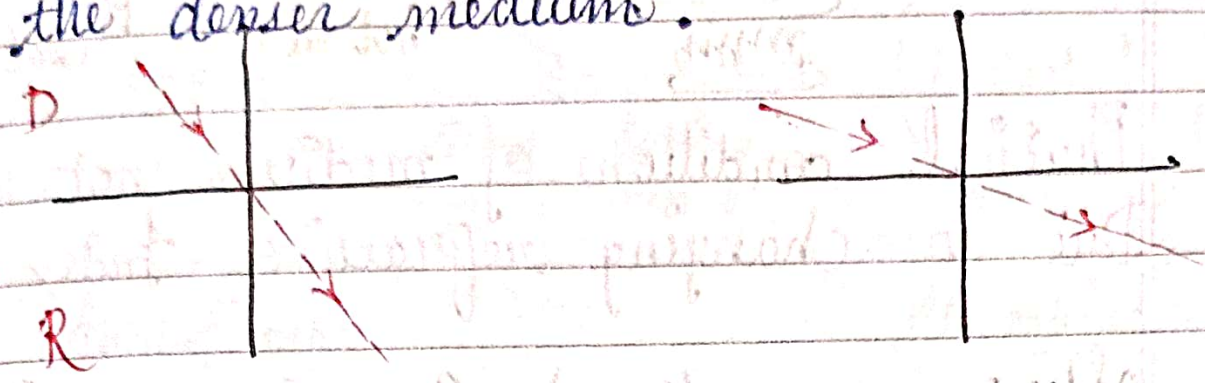
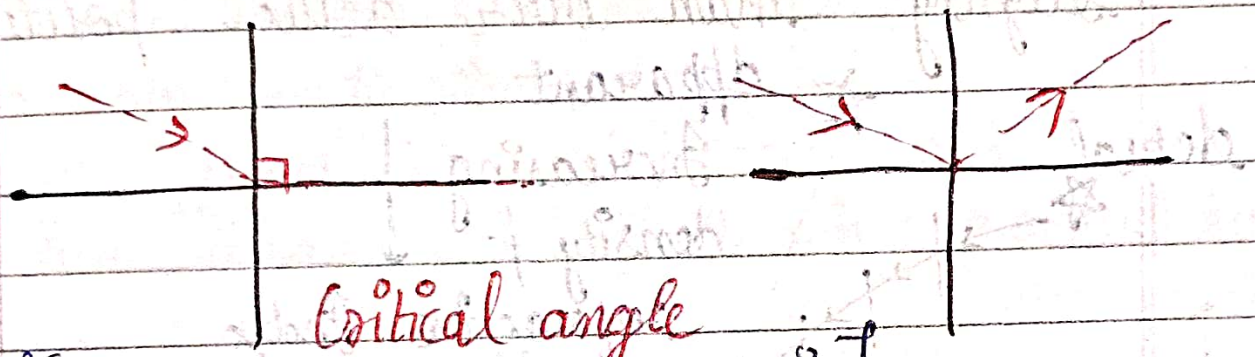
Total Internal Reflection

Light enters from a denser to rarer medium & angle of incidence exceeds critical angle, the light reflects in the denser medium.





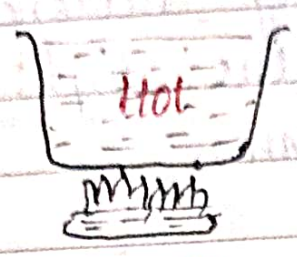
Critical angle

[$\angle i$ for which $\angle r = 90°$]

Atmospheric Refraction

The refraction by different layers of atmosphere.

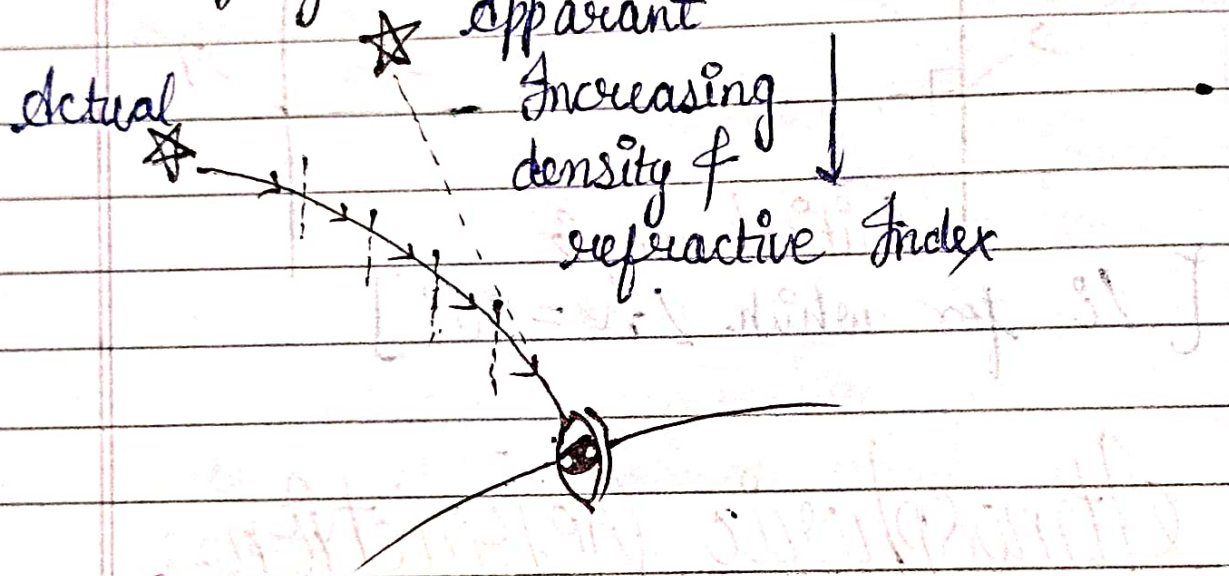
Apparant flickering of objects placed behind a hot object or fire.



$R_{hot\ air} < R_{cool\ air}$

- Physical condition of medium not constant.
- Due to changing refractive index.

Stars near the horizon apper highly slightly than their actual position.



- Earth's atmosphere increases from top to bottom.
- Rarer → denser ∴ it bends towards normal.

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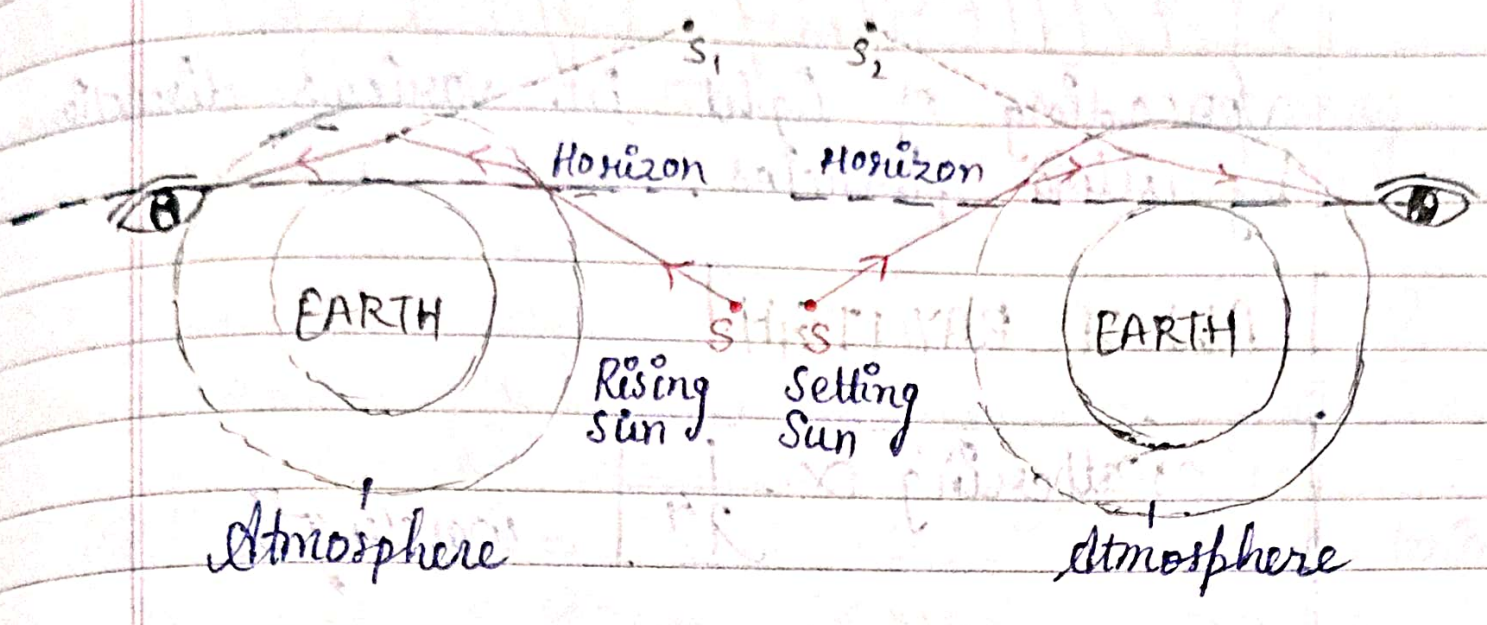
Advanced Sunrise



- Sun is below horizon, rays pass R → D. So, ray bends towards normal.
- Sun appears 2 min ← actual sunrise.
- Sun remains visible 2 min → actual sunset.

Twinkling Of Stars

- Very far from us, behave source of light. Physical condition of earth's atmosphere are not constant. Light comes from different directions.
- Due to refractive index.

Scattering Of Light

Spreading of light in various directions by colloid particles.

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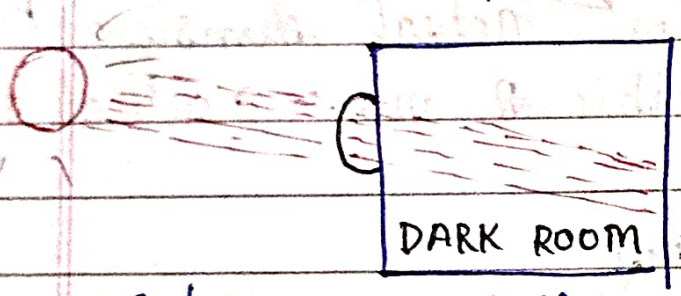
$$\text{Scattering} \propto \frac{1}{\lambda^4}$$ wavelength

Tyndall Effect : Light passes through a colloid its path becomes visible.



Light passes through dense of trees in a forest.

Scattering lights depends on size of particles

* Shorter wavelength very fine (mainly blue)
* Longer wavelength medium (mainly red)
* Larger particles scatters all colours of light → white.

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Ques Why danger signs are made of red colour?

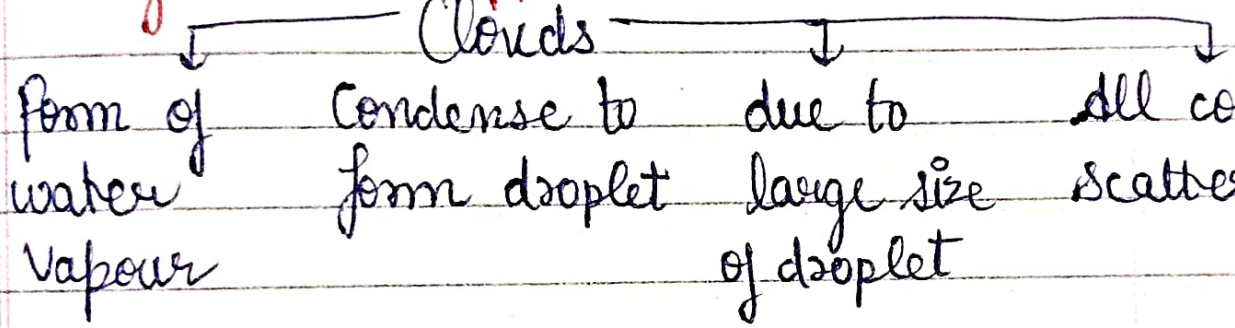
Ans Least scattered colour.
Seen in fog or smoke over a long distance.

Ques Why the colour of sky appears blue?

Ans Upper layer of atmosphere very fine particles of water vapours & gases.
fine Particles are more effective in scattering of light → shorter wavelength mainly blue than larger wavelength.

Ques Why clouds appear white?

Ans



Ques Why colour of sun appear red during sunrise & sunset

Ans ★ Sun is near horizon, so light travels larger distance in atmosphere. Due to most of the blue light (S.W) are scattered away by particls.
★ Light of longer wavelength red colour will reach our eye.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