Chapter - 9

Ray Optics And Optical Instrument

Visible light →

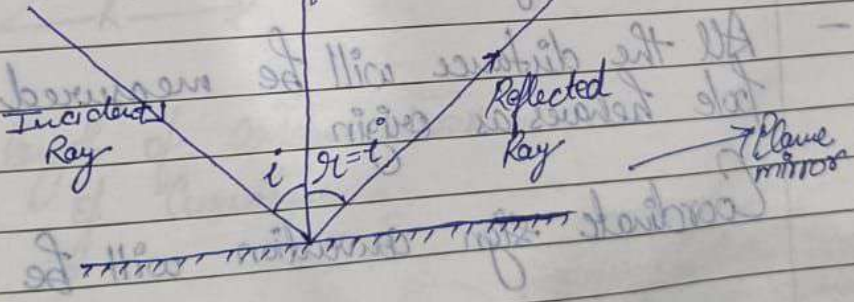
400 nm → 700 nm
4000 Å → 7000 Å
4×10^{-7} m → 7×10^{-7} m
3900 Å → 7800 Å
0.4 μm → 0.7 μm

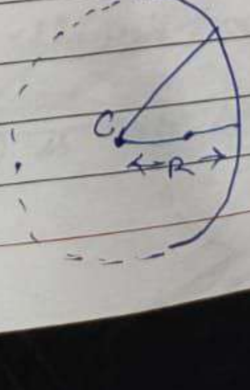
Ray → A light wave can be considered to travel from one point to another point along a straight line joining them. The path is called ray of light.

And bundle of such rays constituted beam of light

Ray is defined as path of energy propogation in the limit of wavelength tending to zero.

Reflection of Light By Spherical Mirrors





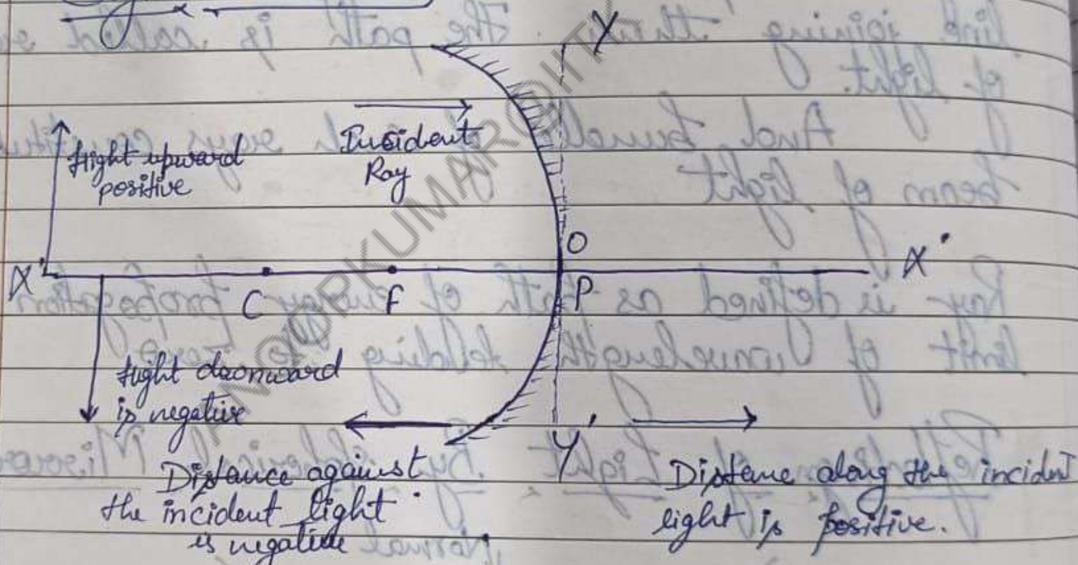
Normal will be draw on the spherical surface b/w center of curvature and point of incidence light

Law of Reflection

(i) Incident ray, Reflected Ray & Normal to the plane of Incidence all lies in same plane.

(ii) ∠ of i = ∠ of r

Sign Convention



— All the distance will be measured from pole and pole behaves as origin

Coordinate sign convention will be follewed.

In $\triangle CMP$

$$i = \frac{MP}{CP} = \tan i$$

$$i = \frac{MP}{CP} \quad \text{—— (1)} \qquad \left(\because i \text{ is very small} \quad \tan i \approx i \right)$$

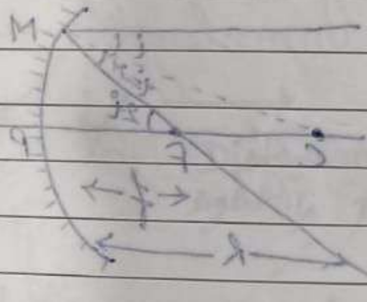
In $\triangle MPF$

$$\tan 2i = \frac{MP}{PF}$$

$$2i = \frac{MP}{PF} \quad \text{—— (2)}$$

Putting value of i from eq (1) in eq (2)

$$\frac{2MP}{CP} = \frac{MP}{PF}$$



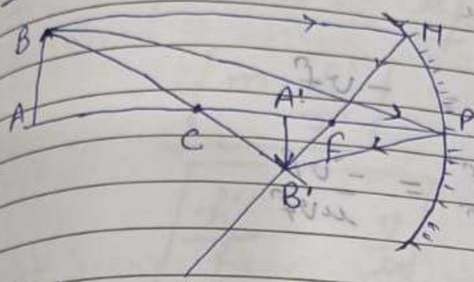
$$PF = \frac{CP}{2}$$

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

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

~~# Mirror eq~~

Mirror Equation



In $\Delta A'B'F$ & ΔMPF

$$\frac{A'B'}{MP} = \frac{A'F}{PF}$$

$$\frac{A'B'}{AB} = \frac{A'F}{PF} \quad \text{--- (1)}$$

In $\Delta A'B'P$ & ΔABP

$$\frac{A'B'}{AB} = \frac{A'P}{AP} \quad \text{--- (2)}$$

From eq (1) and eq (2)

$$\frac{A'F}{PF} = \frac{A'P}{AP}$$

$$\frac{A'P - FP}{PF} = \frac{A'P}{AP}$$

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

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

$$-uv + uf = -vf$$

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

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

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

Magnification

Magnification is defined as ratio of hight of image upon hight of object

$$m = \frac{h'}{h} = \frac{\text{height of image}}{\text{height of object}}$$

We know from eq — (1)

$$\frac{A'B'}{AB} = \frac{A'P}{AP}$$

$$\frac{-h'}{h} = \frac{-v}{u}$$

or $$\frac{h'}{h} = \frac{-v}{u}$$

...e spherical surface
...t point of incidence

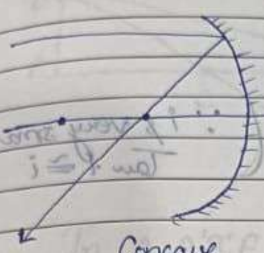
...y & Normal to the
...s in same plane.

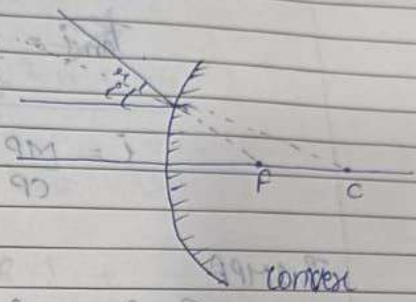
...tence along the incident
... is positive.

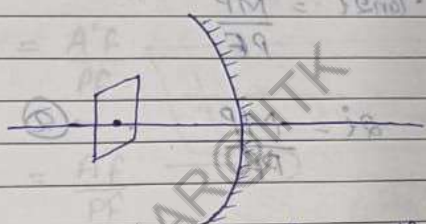
...red from pole and

...be followed.

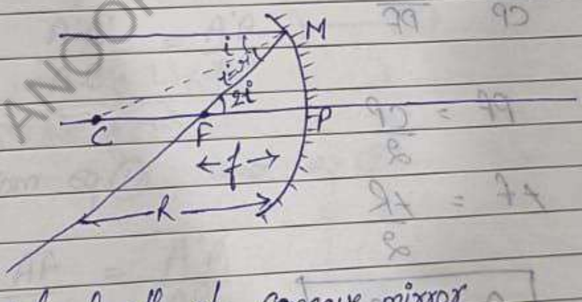
Focal length of spherical Mirror







Focal plane is plane which passes through focal pt. is normal to the principle axis.



f = focal length of concave mirror
R = Radius of Curvature.

Assumption

Radius of curvature of spherical surface is large

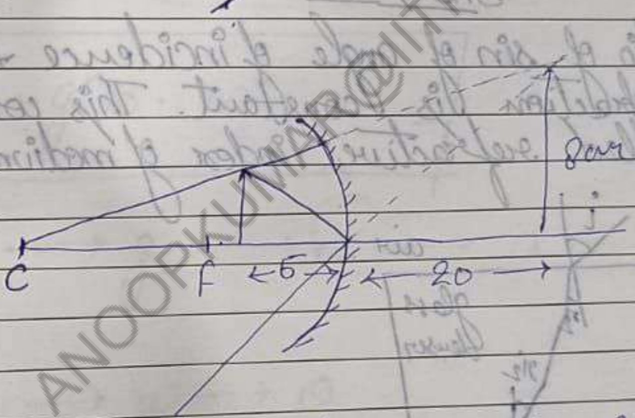
$\tan\theta \cong \theta$
$\sin\theta \cong \theta$
$\cos\theta \cong 1$
} when θ is very small.

Or $m = \frac{h'}{h} = -\frac{v}{u}$

$$m = \frac{h'}{h}$$

$$\frac{h'}{h} = -\frac{v}{u}$$

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



M is positive nature of image is virtual and erect

M is negative then natural of image is real and inverted and on the same side as object.

Refraction

When light travels from one medium to another medium it deviates from its rectilinear path. This phenomenon is called refraction of light.