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Continued ……

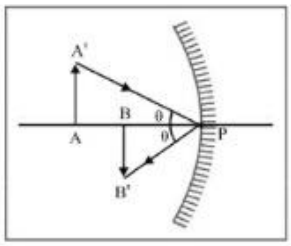
While deriving the above result, if we do not use sign convention, results obtained will be different for different cases.

4.4 Magnification

The linear magnification produced by a mirror is defined as

$$\frac{\text{height of image}}{\text{height of object}}$$

$$m = \frac{I}{O} = \frac{-BB'}{AA'}$$



PB = – v (distance of image)

PA = – u (distance of object)

Now, $\Delta A'AP - \Delta B'BP \Rightarrow \frac{B'B}{A'A} = \frac{BP}{AP}$

$$\Rightarrow \quad m = \frac{-PB}{PA} = \frac{-(-v)}{(-u)} = \frac{-v}{u}$$

Note.

By mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

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

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

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

The magnification is negative when image is inverted and positive when image is erect.

If an object is placed with its length along the principal axis, then so called longitudinal magnification becomes,

$$m_L = \frac{I}{O} = -\left(\frac{v_2 - v_1}{u_2 - u_1}\right) = -\frac{dv}{du} \quad \text{(for small objects)}$$

From $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ we have $-v^{-2}dv - u^{-2}du = 0$

or $\quad \frac{dv}{du} = -\left(\frac{v}{u}\right)^2$

or $\quad m_L = -\frac{dv}{du} = \left(\frac{v}{u}\right)^2 = m^2$

If we differentiate the mirror formula

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

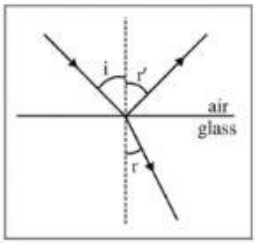
with respect to time, we get

$$-v^{-2}\cdot\frac{dv}{dt} - u^{-2}\frac{du}{dt} = 0 \qquad \text{(as f = constant)}$$

or $\quad \frac{dv}{dt} = -\left(\frac{v^2}{u^2}\right)\frac{du}{dt}$ ...(iii)

As every part of mirror forms a complete image, if a part of the mirror is obstructed, full image will be formed but intensity will be reduced.

5. REFRACTION OF LIGHT



When a ray of light is incident on the boundary between two transparent media, a part of it passes into the second medium with a change in direction.

This phenomenon is called refraction.

5.1 Refractive Index

Absolute refractive index of a medium is defined by the ratio of speed of light in vacuum to speed of light in the medium $\mu = \frac{c}{v}$, where c is speed of light in vacuum and v is the speed of light in the medium.

5.2 Law of Refraction (Snell's Law)

A refracted ray lies in the plane of incidence and has an angle of refraction related to angle of incidence by $\mu_1 \sin i = \mu_2 \sin r$. Where,