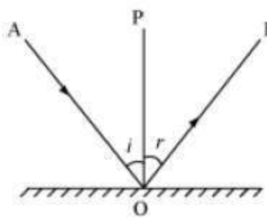
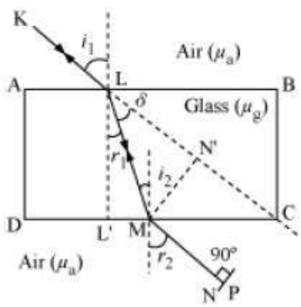
Laws of reflection:



- $\angle i = \angle r$ (holds for all types of surfaces)
- Incident ray, reflected ray, refracted ray and normal all lie in the same plane.

Laws of refraction:



On going from a rarer medium to a denser medium, a ray bends towards the normal; on going from a denser medium to a rarer medium, a ray bends away from the normal.

Snell's law (for air–glass interphase):

$$^{a}\mu_{g} = \frac{\mu_g}{\mu_a} = \frac{\sin i_1}{\sin r_1}$$

Point to remember: According to the principle of reversibility of light, when the final path of a ray of light (after any number of reflections and refractions) is reversed, the ray retraces its entire path.

Condition for total internal reflection:

If a ray of light travelling from an optically denser medium to an optically rarer medium is incident at an angle greater than the critical angle for the pair of media in contact, the ray is totally reflected back into the denser medium, thereby causing total internal reflection.

Applications of total internal reflection:

Multiple internal reflections in diamond ($i_c \cong 24.4^\circ$), totally reflecting prisms and a mirage are some examples of total internal reflection. Optical fibres consist of glass fibres coated with a thin layer of material having a lower refractive index. Any light that is incident at an angle at one end comes out from the other after multiple internal reflections, even if the fibre is bent.

Mirror equation:

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

f is (approximately) half the radius of curvature R.

f is negative for concave mirror and positive for a convex mirror.

Linear magnification of a spherical mirror:

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

Lens maker's formula:

$$\frac{1}{f}=\frac{\mu_2-\mu_1}{\mu_1}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

R_1 and R_2 are the radii of curvature of the lens surfaces.

f is positive for a converging lens and negative for a diverging lens.

Power of lens:

The power of a lens, $P=\frac{1}{f}$

The SI unit for the power of a lens is dioptre (D):

$1\ \text{D} = 1\ \text{m}^{-1}$

If several thin lenses of focal lengths $f_1, f_2, f_3, \ldots$ are in contact, then the effective focal length of their combination is given by

$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}+\ldots$$

The total power of a combination of several lenses is

$P = P_1 + P_2 + P_3 + \ldots$

Linear magnification produced by a lens:

$$\boxed{m=\frac{h_2}{h_1}=\frac{v}{u}}$$

Dispersion:

Dispersion is the splitting of light into its constituent colours.

The angle of deviation $\rightarrow \delta=(\mu-1)A$

Where, A is the angle of prism and μ is the refractive index of the material of the prism

Prism formula:

$$\mu = \frac{\dfrac{\sin \ A+\delta_m}{2}}{\dfrac{\sin A}{2}}$$

Where, δ_m is the angle of a minimum deviation

The eye:

The eye has a convex lens of focal length about 2.5 cm. This focal length can be varied somewhat so that the image is always formed on the retina. This ability of the eye is called accommodation. In a defective eye, if the image is focussed before the retina (myopia), then a diverging corrective lens is needed; if the image is focussed beyond the retina (hypermetropia), then a converging corrective lens is needed.

Simple microscope:

- Magnifying power $(m) = 1 + \dfrac{D}{f}$

  Where,

  $D = 25$ cm, is the least distance of distinct vision

  $f =$ Focal length of the convex lens

- If the image is formed at infinity:

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

Compound microscope:

The magnifying power is given by

$m = m_e \times m_0$

Where, $m_e = 1 + \dfrac{D}{f_e}$ is the magnification due to the eyepiece and $m_0 = \dfrac{v_0}{-u_0}$ is the magnification due to the objective lens

Telescope:

The magnifying power m of a telescope is the ratio of the angle β subtended at the eye by the image to the angle α subtended at the eyepiece by the object.

$$m = \frac{\beta}{\alpha} = \frac{f_0}{f_e}$$

Where, f_0 and f_e are the focal lengths of the objective and the eyepiece respectively