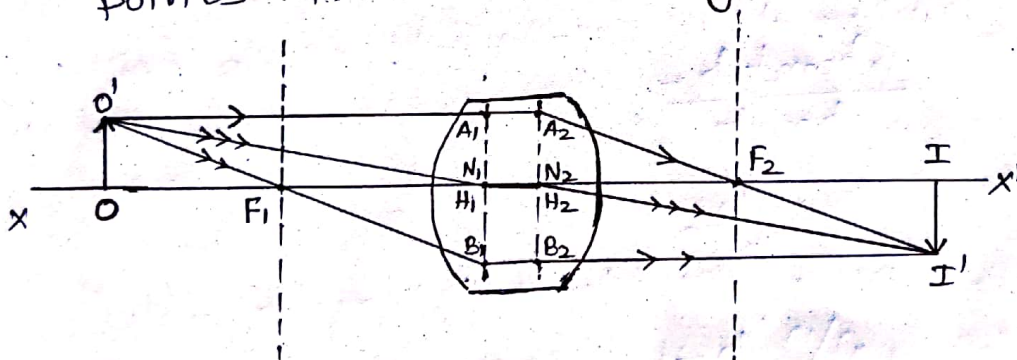


Cardinal points of thick lens:-

When the thickness of a lens is not negligible in comparison with the focal length, the lens is called a thick lens.

There are six cardinal points of a thick lens; two focal points F_1, F_2 ; two principal points H_1, H_2 and two nodal points N_1, N_2 . When the lens is placed in air, the nodal points N_1, N_2 coincide with the principal points H_1, H_2 respectively.



Focal points :- The focal points F_1, F_2 are a pair of points lying on the principal axis and conjugate to points at infinity. An incident ray $O'A_1$ parallel to the principal axis, after refraction through the lens, passes through the second focal point F_2 , while an incident ray $O'B_1$ through the first point F_1 , after refraction, emerges parallel to the principal axis xx' .

Principal points! —

The principal points H_1, H_2 are a pair of conjugate points on the principal axis having unit positive linear transverse.

An incident ray meeting the first principal plane at a certain height from the principal axis emerges through the second principal plane at the same height and on the same side of the axis.

We can see $O'A_1$ is a ray parallel to the axis meeting the first principal plane at A_1 . It will emerge from the lens through A_2 on the second principal plane such that $H_1A_1 = H_2A_2$ and also pass through F_2 . $O'F_1$ is another ray through the first focal point F_1 and meeting to the first principal plane B_1 . It will emerge parallel to the axis through B_2 such that $H_1B_1 = H_2B_2$.

Nodal points! —

The nodal points N_1, N_2 are a pair of conjugate points on the principal axis having unit positive angular magnification. They are such that an incident ray directed towards N_1 emerges through N_2 parallel to itself. An incident ray $O'N_1$ and its conjugate parallel ~~ray~~ emergent ray N_2I' .