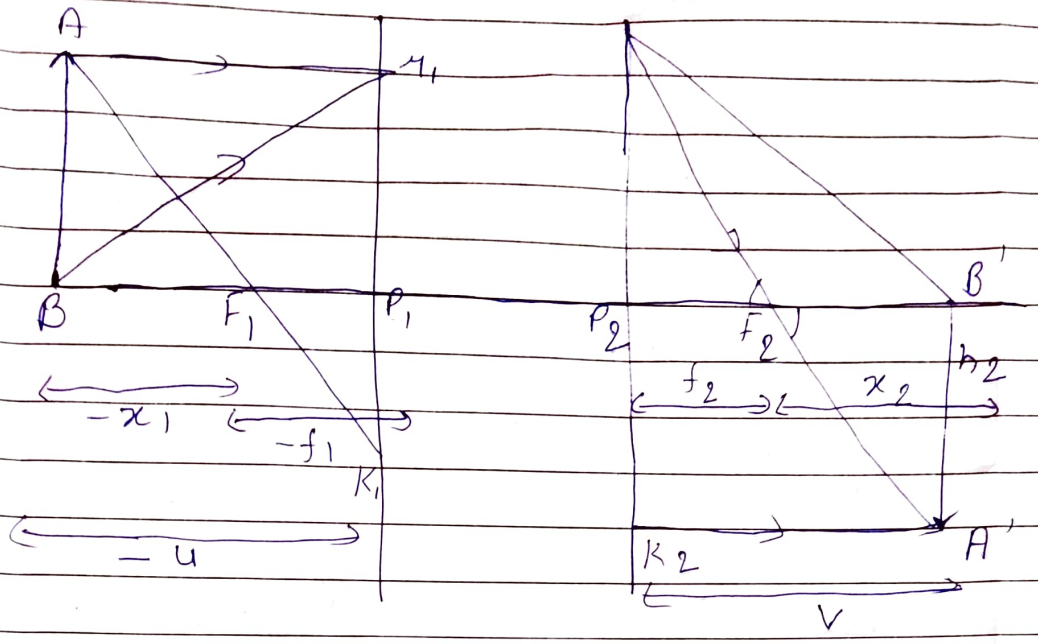
Some relationship for a co-axial lens System

(a) object Image Relation.



If $\triangle F_1P_1K_1$ and $\triangle AH_1K_1$

$$\frac{F_1P_1}{AH_1} = \frac{P_1K_1}{H_1K_1}$$

$F_1P_1 = -f_1$

$AH_1 = P_1B = -u$

$P_1K_1 = A'B' = -h_2$

$H_1K_1 = H_1P_1 + P_1K_1$

$H_1K_1 = h_1 + (-h_2)$

$= h_1 - h_2$

$$\frac{-f_1}{-u} = \frac{-h_2}{h_1 - h_2}$$

$$\frac{f_1}{u} = \frac{-h_2}{h_1 - h_2} \quad \text{---------- (1)}$$

In $\triangle$'s $P_2F_2H_2$ and $A'K_2H_2$

$$\frac{P_2F_2}{K_2A'} = \frac{H_2P_2}{H_2K_2}$$

$$\frac{f_2}{V} = \frac{h_1}{h_1 - h_2} \quad \text{— (ii)}$$

$P_2F_2 = +f_2$

$H_2P_2 = +h_1$

$H_2K_2 = H_2P_2 + P_2K_2$

$H_2K_2 = h_1 - h_2$

By adding eqn (i) and (ii)

$$\frac{f_1}{u} + \frac{f_2}{V} = \frac{-h_2}{h_1 - h_2} + \frac{h_1}{h_1 - h_2}$$

$$\frac{F_1}{u} + \frac{F_2}{V} = \frac{-h_2 + h_1}{h_1 - h_2}$$

$$\frac{F_1}{u} + \frac{F_2}{V} = \frac{h_1 - h_2}{h_1 - h_2} = 1$$

$$\frac{F_1}{u} + \frac{F_2}{V} = 1$$

In medium is same

$F_1 = F_2 = f$

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

$$f\left(\frac{1}{u} + \frac{1}{V}\right) = 1$$

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

—x—