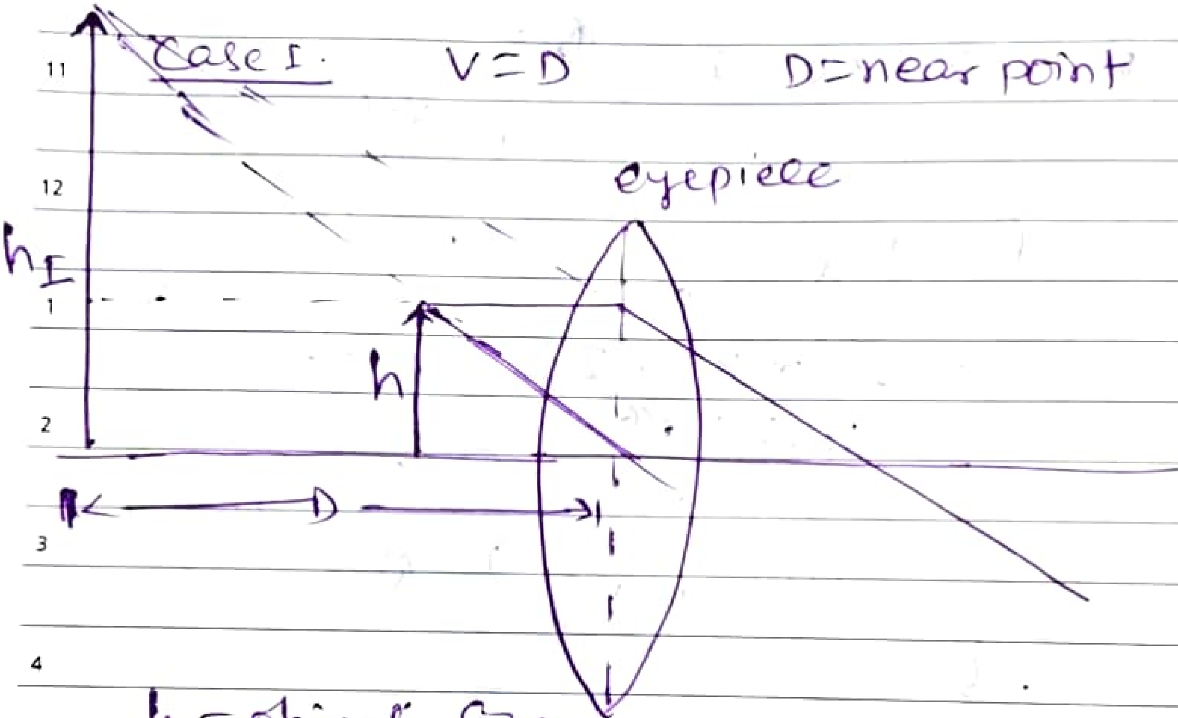
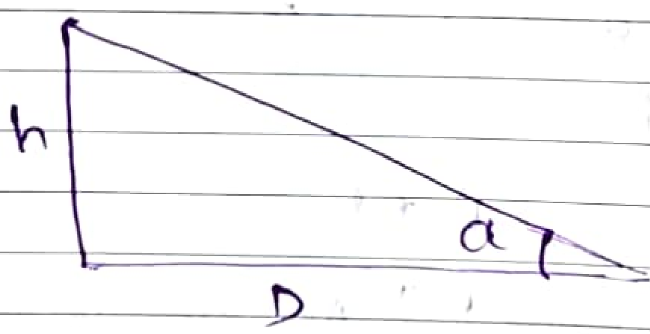
Simple microscope

$m \leq 9$

Case I: $V = D$ D = near point ($D = -25\,cm$)



h = object size



$\tan\alpha = h/D$ $\tan\beta = \frac{h_I}{D}$

$\alpha = h/D$ $\beta = h_I/D$

$m = \beta/\alpha$

$= h_I/h = \frac{v}{u}$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$ (lens equation)

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

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

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

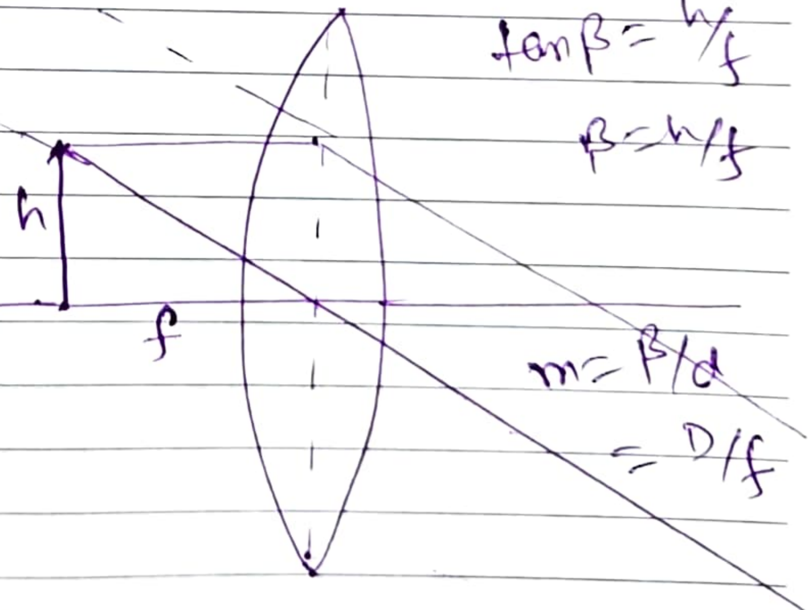
$$m = \frac{v}{u}$$

$$= 1 - v/f$$

$$m = (1 + D/f)$$

Case II.

$V = \infty$

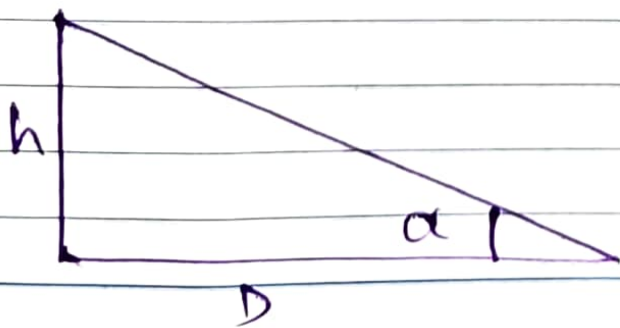


$\tan\beta = h/f$

$\beta = h/f$

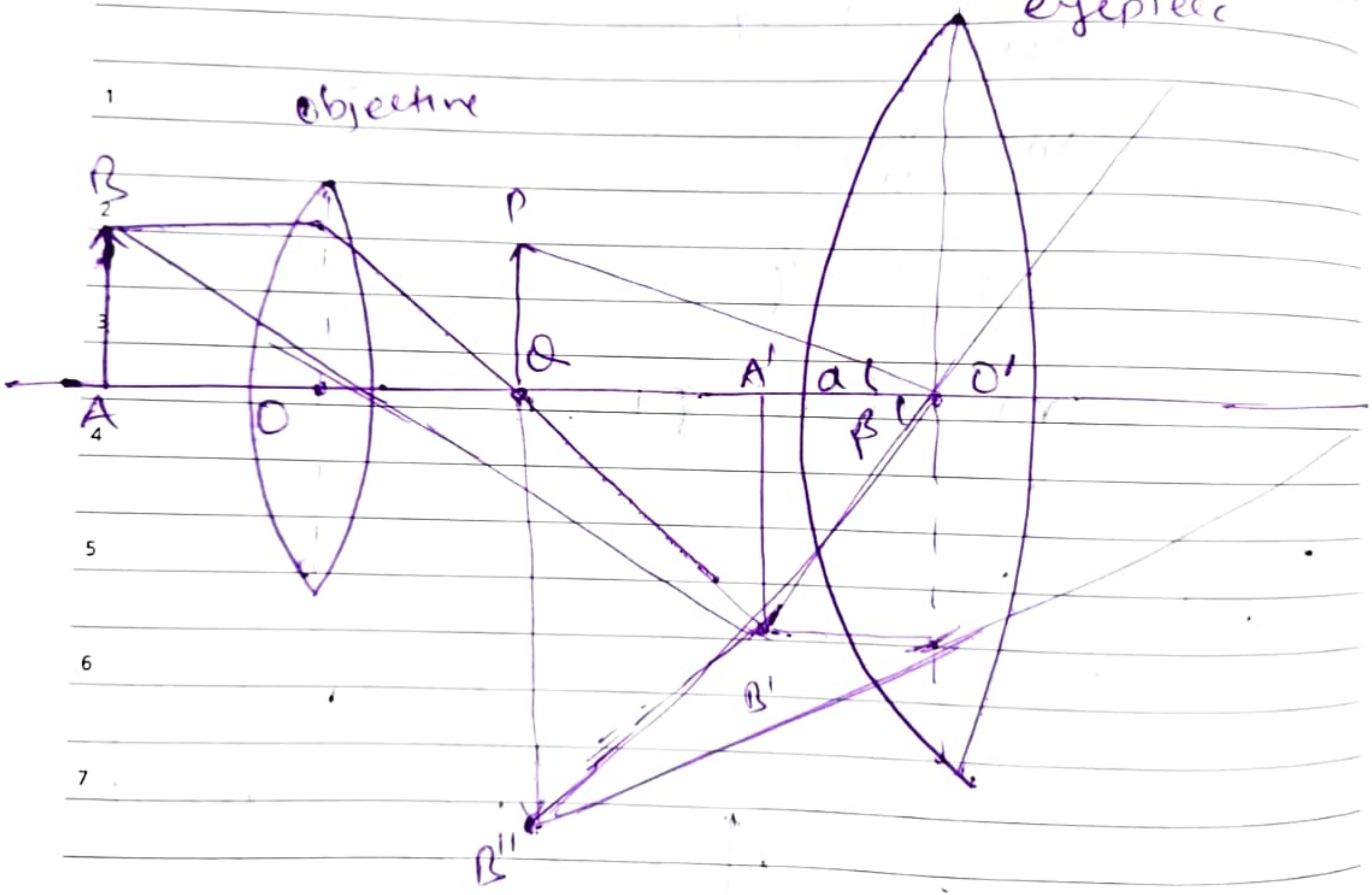
$m = \beta/\alpha$

$= D/f$



$\tan\alpha = h/D \Rightarrow \alpha = h/D$

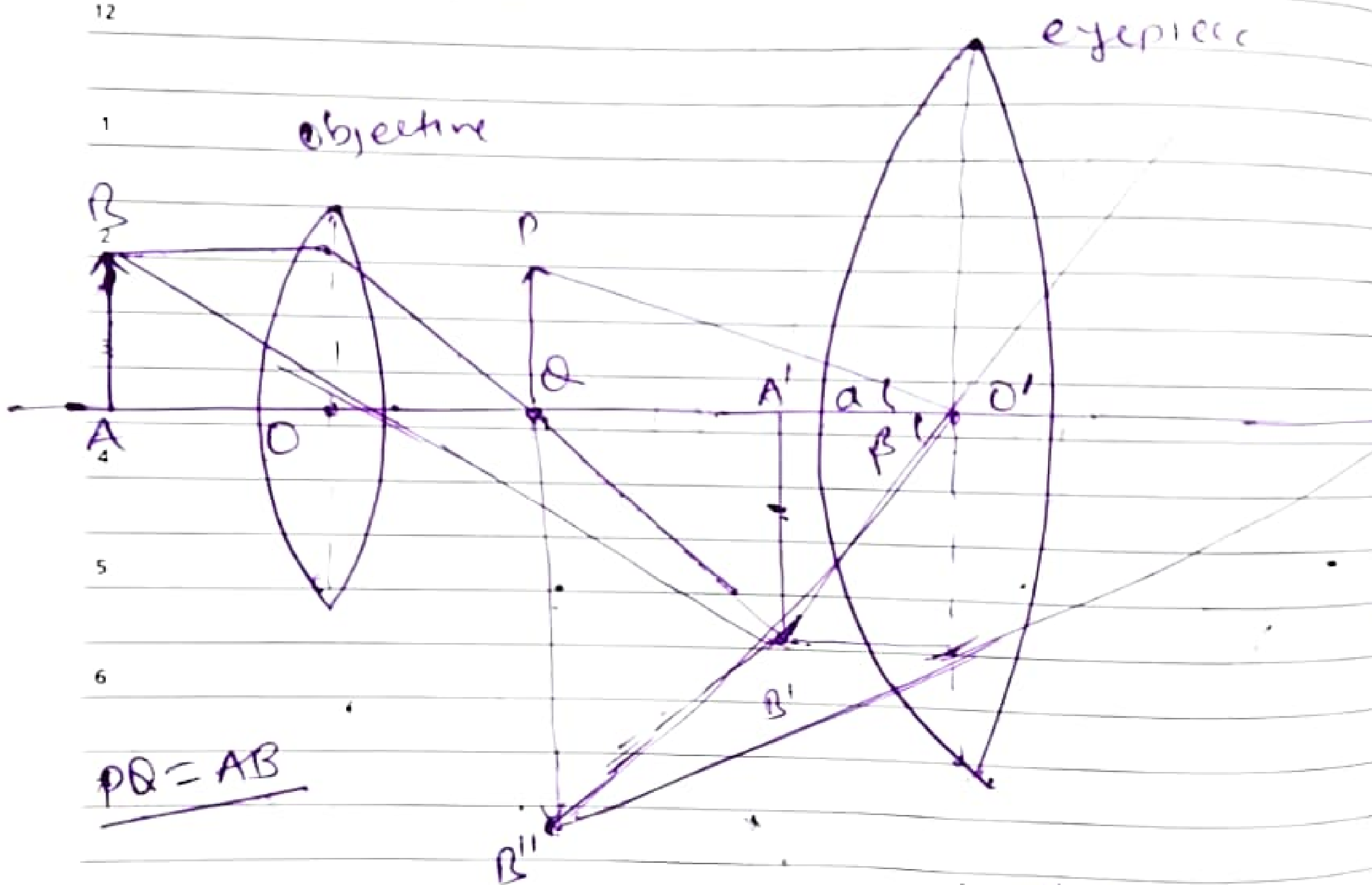
$f_e > f_o$



Compound microscope

uses two lens
(i) objective lens
(ii) eyepiece lens

$f_e > f_o$



PQ = AB

$\tan\alpha = \frac{PQ}{QO'}$, $\tan\beta = \frac{B''Q}{QO'}$.

$\alpha = \frac{AB}{QO'}$ $\beta = \frac{B''Q}{QO'}$

$\therefore m = \beta/\alpha$

$= \frac{B''Q}{AB} \times \frac{A'B'}{A'B'}$

$$m = \frac{B''Q}{A'B'} \times \frac{A'B'}{AB}$$

$$= m_e \times m_o$$

Case I. $v = D$

$$m = \left(1 + D/f_e\right) \frac{v_o}{u_o}$$

$$\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$$

$$\frac{v_o}{f_o} = \frac{v_o}{v_o} - \frac{v_o}{u_o}$$

$$\frac{v_o}{u_o} = 1 - v_o/f_o$$

$$m = \left(1 + D/f_e\right)\left(1 - v_o/f_o\right)$$

Case II. $v = \infty$

$m = m_e \times m_o$

$= \frac{D}{f_e} \times \frac{v_o}{u_o}$

$OO' =$ Length of tube

$L = v_o + |u_e|$

$v = \infty$

$L = v_o + f_e$

Astronomical (refracting) telescope

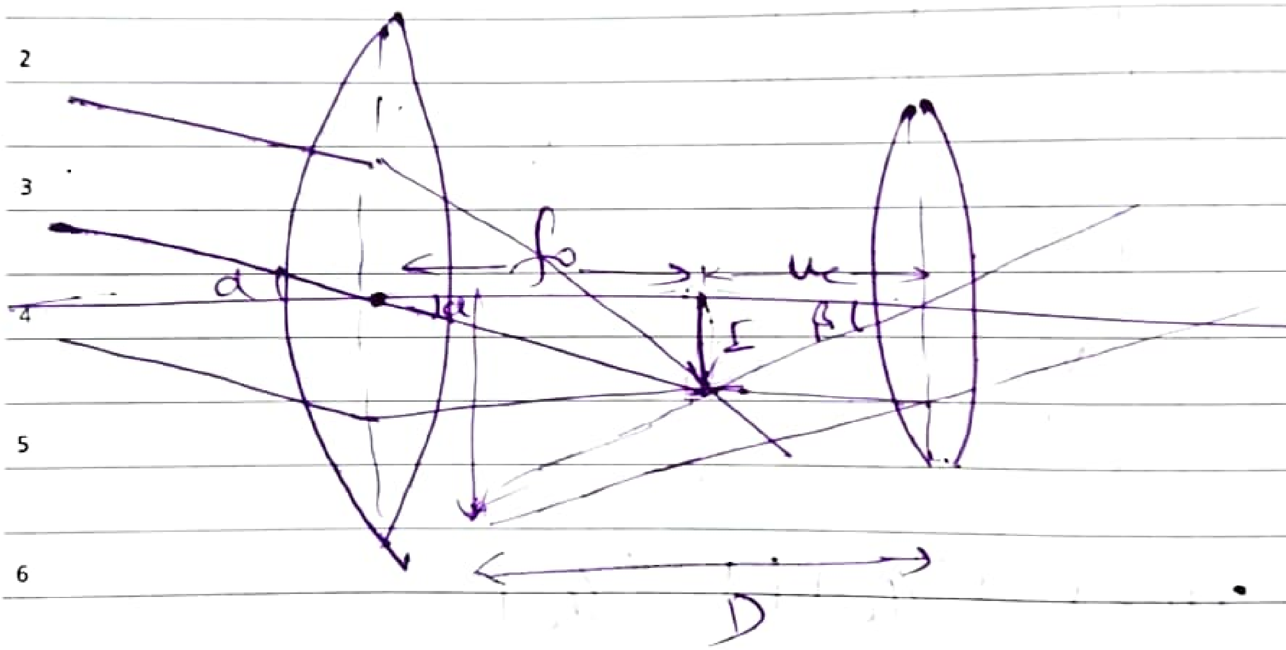
$u = \infty$

Two lens are used

(i) objective lens

(ii) eyepiece lens

$f_o > f_e$



Case I

$V = D$

$\tan\beta = \frac{I}{-u_e}$

$\tan\alpha = I/f_o$

$\alpha = I/f_o$

$\beta = \frac{I}{-u_e}$

$m = \beta/\alpha$

$= \frac{-f_o}{u_e}$

Case II.

$$V = \infty$$

$$\tan \alpha = I/f_o \Rightarrow \alpha = I/f_o$$

$$\tan \beta = I/f_e \Rightarrow \beta = I/f_e$$

$$m = \beta/\alpha$$

$$= \frac{f_e}{f_o}$$