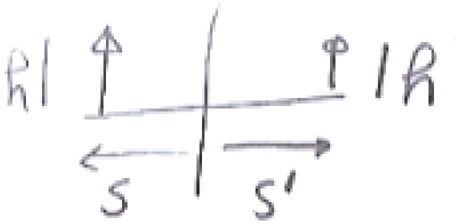
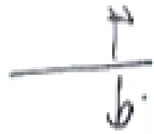
(220)





h +: upright

h' +: upright

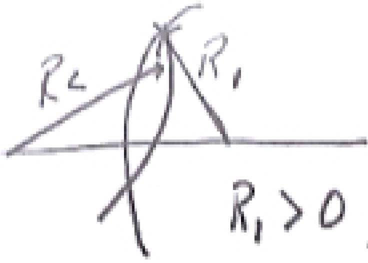
$$M = \frac{h'}{h}$$

+: upright

-: inverted

$$M = \frac{h'}{h} = -\frac{s'}{s} \qquad n = \frac{c}{v}$$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \qquad \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$



$R_1 > 0$, $R_2 < 0$

Converging
$f > 0$

diverging
$f < 0$

upright $M>0$ (+)

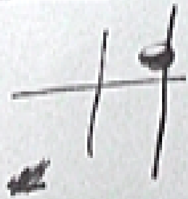
inverted $M<0$ (−)

Real $s>0$

Virtual $s<0$

Real $s'>0$

Virtual $s'<0$



No Image forms

$|M|>1$ Enlarged

$|M|<1$ Reduced

$|M|=1$

conv $f = 10\,cm \Rightarrow f = +10\,cm$

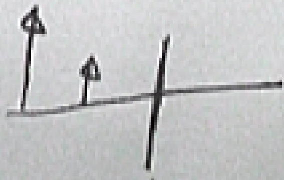
$h = 1\,cm \quad s = 5\,cm$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{s'} = \frac{1}{f} - \frac{1}{s}$$

$$\frac{1}{s'} = \frac{1}{+10} - \frac{1}{5} = \frac{1-2}{10} = -\frac{1}{10}$$

$$s' = -10$$

$$M = \frac{h'}{h} = -\frac{s'}{s} = -\frac{-10}{5} = +2$$



upright: $M > 1$

Enlarge: $|M| > 1$

Virtual: $s' < 0$

conv $f=10 \rightarrow f=+10$

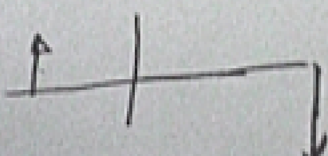
$h=1cm$ $s=15cm$

$$\frac{1}{s}+\frac{1}{s'}=\frac{1}{f} \Rightarrow \frac{1}{s'}=\frac{1}{f}-\frac{1}{s}$$

$$\frac{1}{s'}=\frac{1}{10}-\frac{1}{15}=\frac{3-2}{30}=\frac{1}{30}$$

$s'=+30$ $\quad M=-\frac{s'}{s}=-\frac{30}{15}=-2$

$M=-2$



Real $(s'>0)$

enlarged $(|M|>1)$

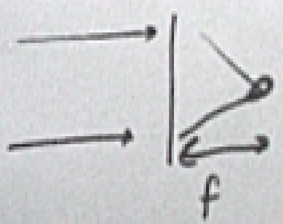
Inverted $M<0$ $(-)$

Conv $f = +10\,cm$

$h = 1\,cm \quad s = 10\,cm$

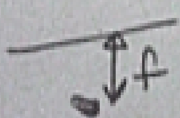
$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{s'} = \frac{1}{10} - \frac{1}{10} = 0$$

$s' = \infty$ No image forms



if $s = \infty$

$s' = f$



$h = 1\,cm \quad s = 10\,cm$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{s'} = \frac{1}{f} - \frac{1}{s}$$

$$\frac{1}{s'} = -\frac{1}{10} - \frac{1}{10} = -\frac{2}{10}$$

$$s' = -\frac{10}{2} = -5\,cm$$

$$M = -\frac{s'}{s} = -\frac{-5}{10} = +\frac{1}{2}$$

Reduced ($|M| < 1$)

Upright $M > 0$

Virtual $s' < 0$