

$$\textcircled{220} M = \frac{h'}{h} = -\frac{s'}{s} \rightarrow$$

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

$s > 0$	$s < 0$
$s' < 0$	$s' > 0$

$$f > 0 \quad \Sigma f < 0$$

Upright	Inverted
$M+$	$M-$

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enlarge	unmag	reduce
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$$|M| : \quad > 1 \quad = 1 \quad < 1$$

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Real	Virtual
$s, s'$	$s, s'$
$> 0$	$< 0$

$$s' < 0 \quad s > 0$$

$$M + R' = 2 \text{ cm}, \quad R = 1 \text{ cm}, \quad M = +2$$

$$s = 20$$

$$M = \frac{R'}{R} = \frac{2}{1} = +2$$

$$M = \frac{R'}{R} = -\frac{s'}{s}$$

$$s' = -s \cdot M = -40$$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{20} - \frac{1}{40} = \frac{2}{40} - \frac{1}{40} = \frac{1}{40}$$

0

$$f = +40 \text{ cm}$$

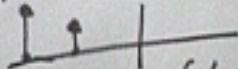
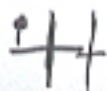


image: upright (t: M +

virtual:  $s' < 0$

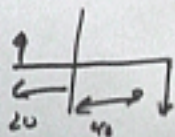
enlarged:  $|M| > 1$

$$s' > 0 \quad s = +20$$



$$M < 0 \quad |M| = 2$$

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



$$s' = 2s = 2(20) = \underline{40 \text{ cm}}$$

Real ( $s' > 0$ )

inverted ( $M (-)$ )

enlarged ( $|M| > 1$ )

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{f} = \frac{1}{20} + \frac{1}{40} = \frac{2}{40} + \frac{1}{40} = \frac{3}{40}$$

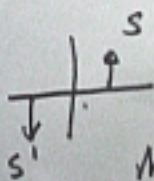
$$\textcircled{0} \quad f = \frac{40}{3} = \underline{13.3 \text{ cm}}$$



$$s = -10 \text{ cm}$$

$$f = -5 \text{ cm}$$

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



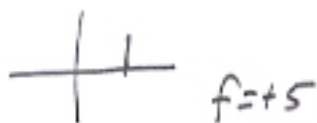
$$s' = -10 \text{ cm}$$

$$M = \frac{h'}{h} = -\frac{s'}{s} = -\frac{-10}{-10} = -1$$

inverted:  $M(-)$

virtual:  $s'(-)$

Unmag:  $|M| = 1$

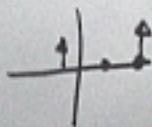


$$f = +5$$

$$s = -10$$

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

$$\frac{1}{s'} = \frac{2}{10} + \frac{1}{10} = \frac{3}{10} \Rightarrow s' = \frac{10}{3}$$



$$s' = 3.33$$

$$M = -\frac{s'}{s} = -\frac{3.33}{-10} = +0.333$$

Upright:  $M (+)$

Real:  $s' > 0$

Reduced:  $|M| < 1$

$$s' = +10$$

$$f = -15$$

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

$$\frac{1}{s} = \frac{1}{-15} - \frac{1}{10} = -\frac{2}{30} - \frac{3}{30} = -\frac{5}{30}$$

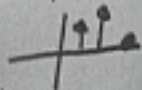
$$s = -\frac{30}{5} = -6 \text{ cm}$$

$$M = -\frac{s'}{s} = -\frac{10}{-6} = \frac{10}{6} = +1.67$$

Upright (+M)

enlarged  $|M| > 1$

Real  $s' > 0$



$s = s_0 - vt$

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

$$= \frac{s - f}{sf}$$

$$s' = \frac{sf}{s - f} = \frac{(s_0 - vt) f}{s_0 - vt - f}$$

$$s': \frac{\Delta s'}{\Delta t} =$$

"Non Linear"