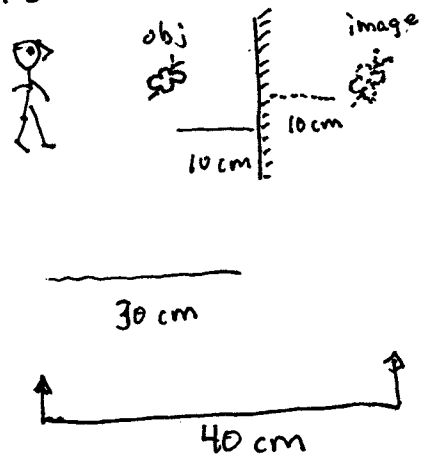
Ch34-2



$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$ $\quad r = \infty$, $f = \infty$

$\frac{1}{10} + \frac{1}{i} = \frac{1}{\infty}$

$i = -10\text{ cm}$

34-9 obj = +18cm, concave, f = +12 cm

$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$

$\frac{1}{18} + \frac{1}{i} = \frac{1}{12}$

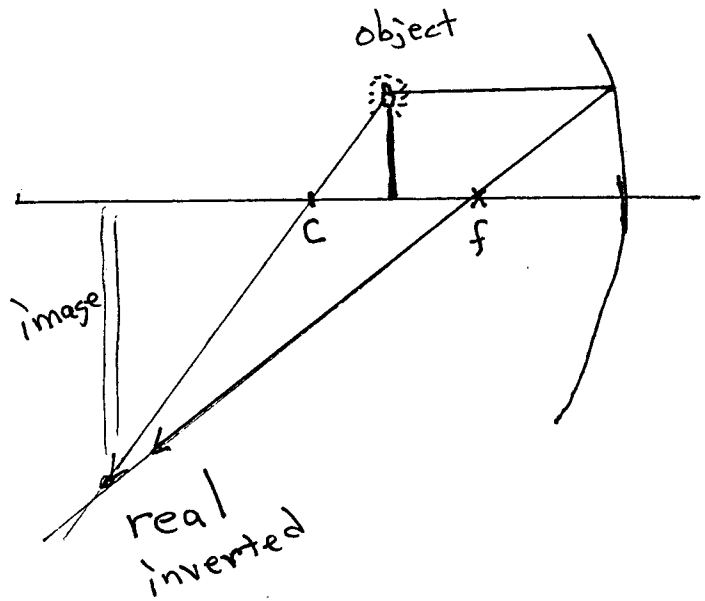
$i = 36\text{ cm}$

$f = \frac{r}{2}$

$12 = \frac{r}{2}$

$r = +24\text{ cm}$

magntf $= (-)\frac{i}{o} = (-)\frac{36}{18} = -2$ → inverted



Ch34-11 obj = +8 cm Convex f = −10 cm

$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$

$\frac{1}{8} + \frac{1}{i} = \frac{1}{-10}$

$i = -\frac{1}{10} - \frac{1}{8}$

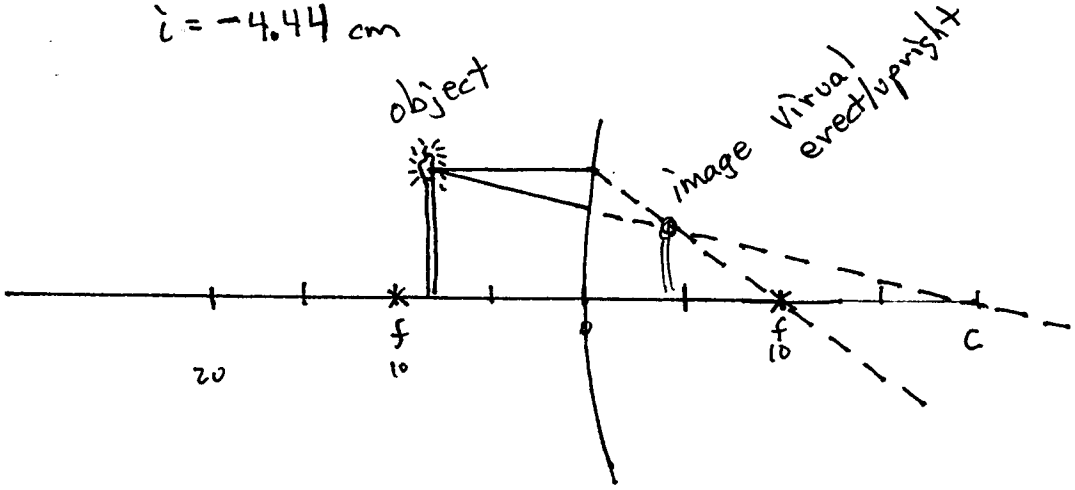
$= \frac{-8-10}{80} = \frac{-18}{80} = \frac{-9}{40}$

$i = -4.44$ cm

$f = \frac{r}{2}$

$-10 = \frac{r}{2}$

$r = -20$ cm



magnif $= (-)\frac{i}{o}$

$= (-)\frac{-4.44}{8}$

$= +0.56$

erect/upright

34-12 obj = +24 cm Concave f = +36

$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$

$\frac{1}{24} + \frac{1}{i} = \frac{1}{36}$

$i = -72$ cm

$f = \frac{r}{2}$

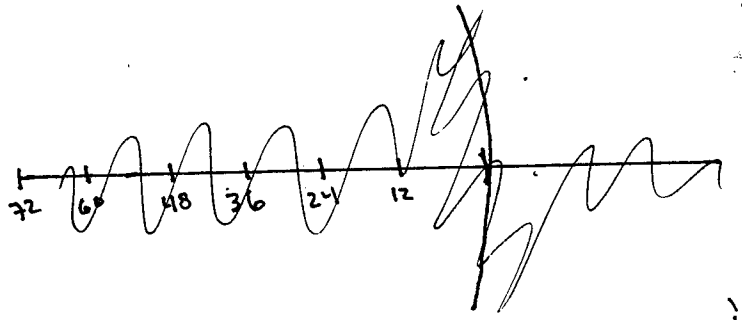
$+36 = \frac{r}{2}$

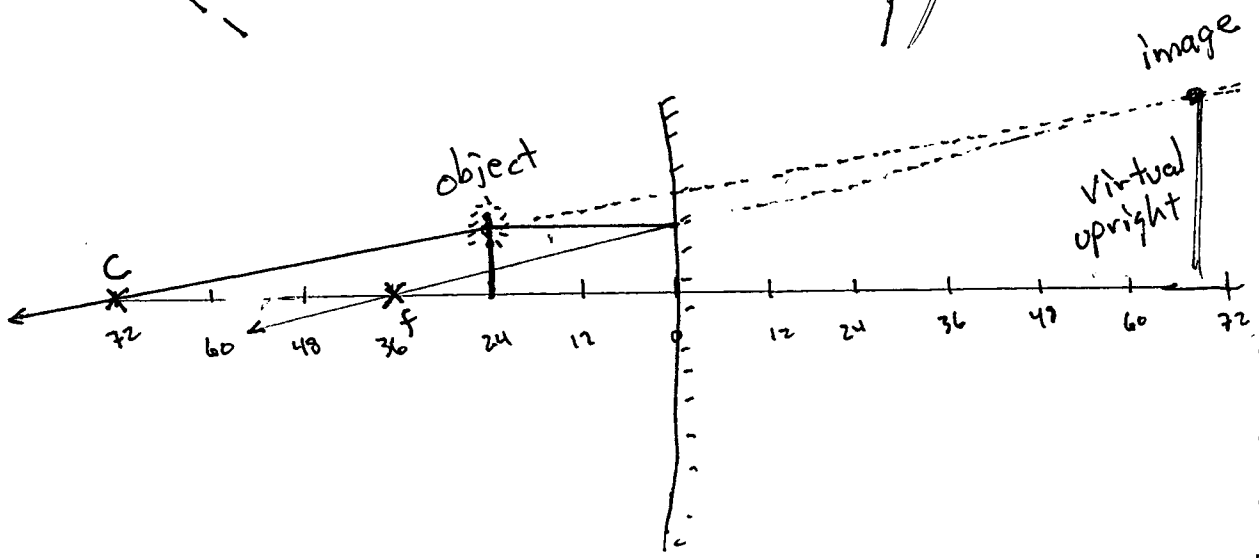
$r = +72$ cm

magnif $= (-)\frac{i}{o} = (-)\frac{-72}{24}$

$= +3$

upright





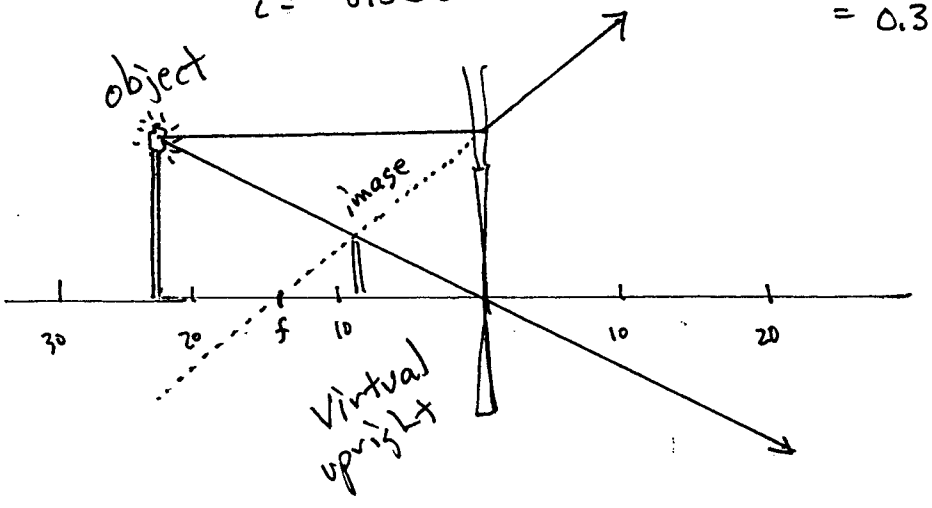
34-55 object $o = +22\,cm$ Diverging $f = -14\,cm$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

$$\frac{1}{22} + \frac{1}{i} = \frac{1}{-14}$$

$$i = -8.56\,cm$$

$$\text{magnif} = (-)\frac{i}{o} = (-)\frac{-8.56}{22} = 0.38$$



34-66 object $o = +18\,cm$

$n = 1.6$

$r_1 = -27 \quad r_2 = 24$

#1 #2

$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

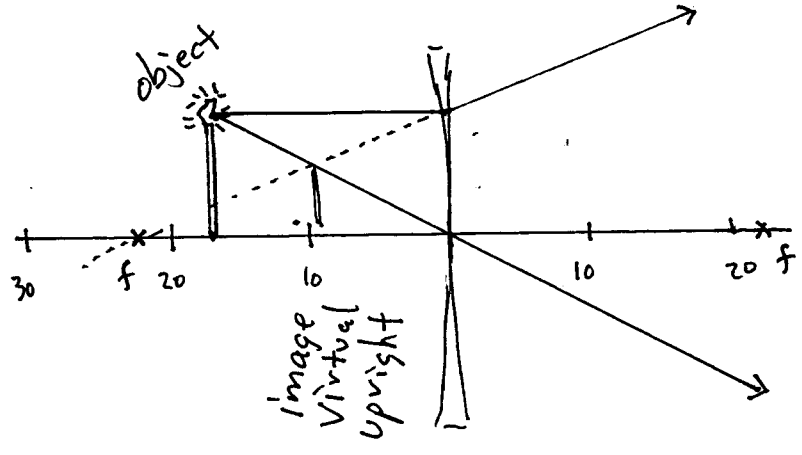
$$= (1.6-1)\left[\frac{1}{-27} - \frac{1}{24}\right]$$

$$f = -21.2\,cm$$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

$$\frac{1}{18} + \frac{1}{i} = \frac{1}{-21.2}$$

$$i = -9.73\,cm$$



$$\text{magnif} = (-)\frac{i}{o} = (-)\frac{-9.73}{18}$$

$$= 0.54$$

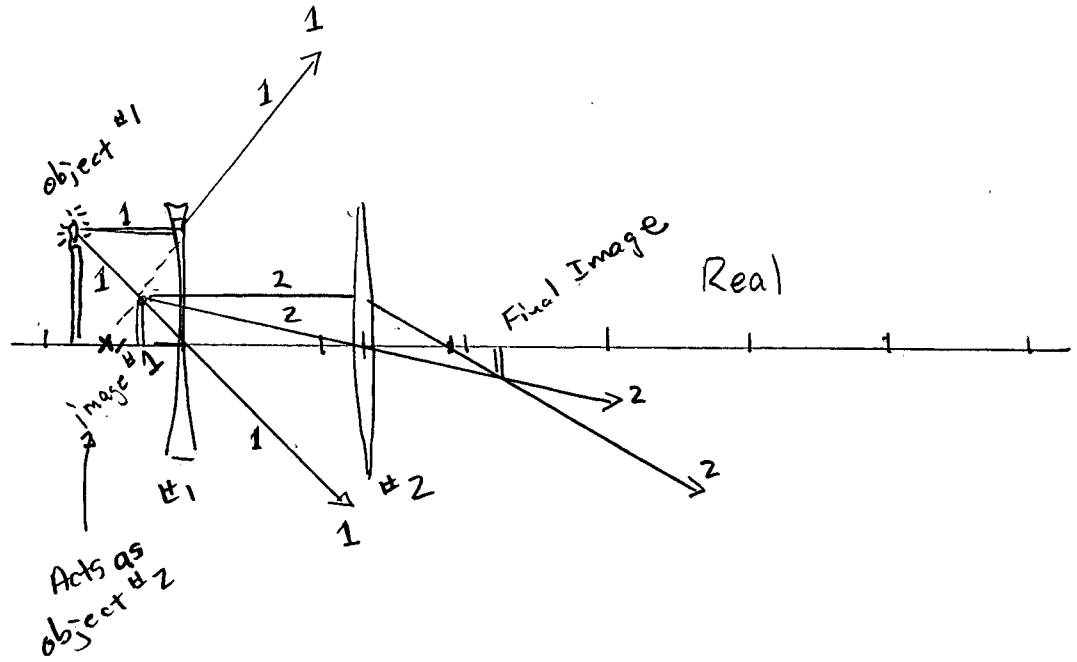
upright

34-82 object $o_1 = 8$

lens #1 $f_1 = -6$ diverging

separation 12 cm

lens #2 $f_2 = 6$ converging



Do lens #1

$$\frac{1}{o_1} + \frac{1}{i_1} = \frac{1}{f_1}$$

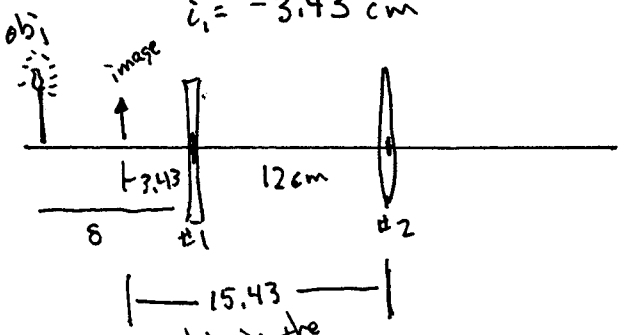
$$\frac{1}{8} + \frac{1}{i_1} = \frac{1}{-6}$$

$$i_1 = -3.43 \text{ cm}$$

#1 magnif $= (-)\frac{i}{o}$

$= (-)\frac{-3.43}{8}$

$= 0.43$



this is the object for the second lens

$o_2 = 15.43$

Do 2nd lens

$$\frac{1}{o_2} + \frac{1}{i_2} = \frac{1}{f_2}$$

$$\frac{1}{15.43} + \frac{1}{i_2} = \frac{1}{6}$$

$$i_2 = 9.82 \text{ cm}$$

#2 magnif $= (-)\frac{i}{o}$

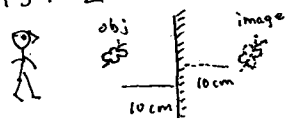
$= (-)\frac{9.82}{15.43}$

$= -0.64$

Overall magnification $= (0.43)(-0.64)$

$= (-)\ 0.275$ inverted

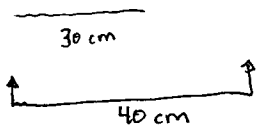
Ch34-2



$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$ $r = \infty$, $f = \infty$

$\frac{1}{10} + \frac{1}{i} = \frac{1}{\infty}$

$i = -10$ cm



34-9 obj = +18cm, concave, f = +12 cm

$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$

$\frac{1}{18} + \frac{1}{i} = \frac{1}{12}$

$i = 36$ cm

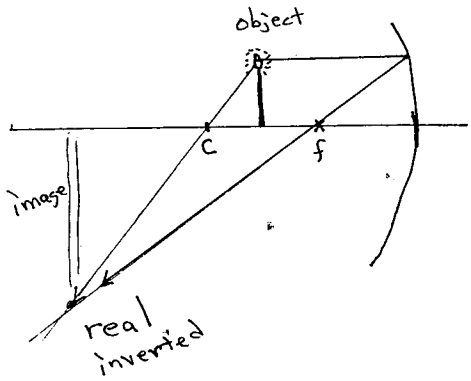
$f = \frac{r}{2}$

$12 = \frac{r}{2}$

$r = +24$ cm

magnif $= (-)\frac{i}{o} = (-)\frac{36}{18} = -2$

↳ inverted



Ch34-11 obj = +8 cm Convex f = −10 cm

$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$

$\frac{1}{8} + \frac{1}{i} = \frac{1}{-10}$

$i = -\frac{1}{10} - \frac{1}{8}$

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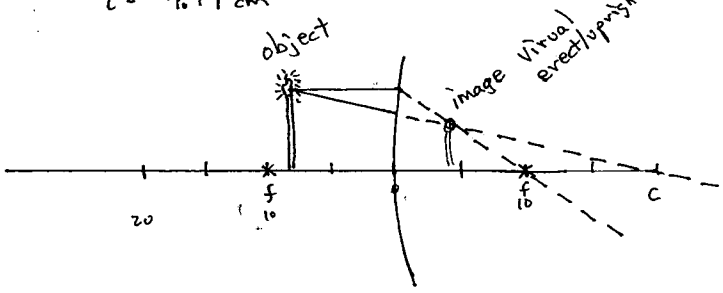
$i = -4.44$ cm

$f = \frac{r}{2}$

$-10 = \frac{r}{2}$

$r = -20$ cm



magnif $= (-)\frac{i}{o}$

$= (-)\frac{-4.44}{8}$

$= +0.56$

↳ erect/upright

34-12 obj = +24 cm Concave f = +36

$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$

$\frac{1}{24} + \frac{1}{i} = \frac{1}{36}$

$i = -72$ cm

$f = \frac{r}{2}$

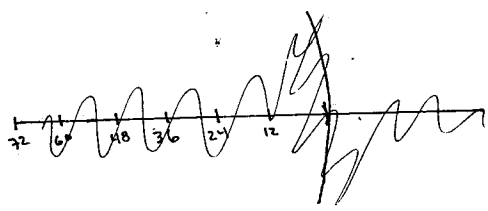
$+36 = \frac{r}{2}$

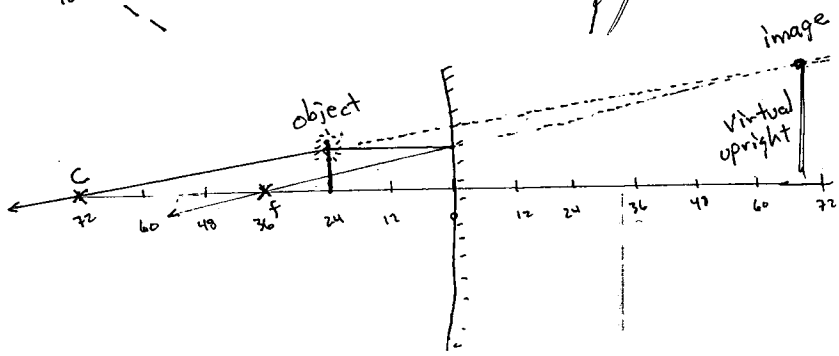
$r = +72$ cm

magnif $= (-)\frac{i}{o} = (-)\frac{-72}{24}$

$= +3$

↳ upright





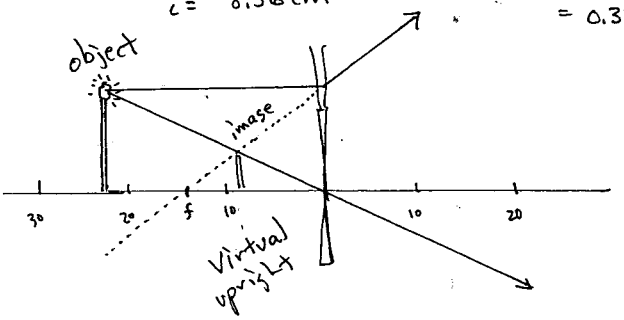
34-55 object $o = +22$ cm Diverging $f = -14$ cm

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

$$\frac{1}{22} + \frac{1}{i} = \frac{1}{-14}$$

$$i = -8.56 \text{ cm}$$

$$\text{magnif} = (-)\frac{i}{o} = (-)\frac{-8.56}{22} = 0.38$$



34-66 object $o = +18$ cm

$n = 1.6$

$r_1 = -27 \quad r_2 = 24$

#1 #2

$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

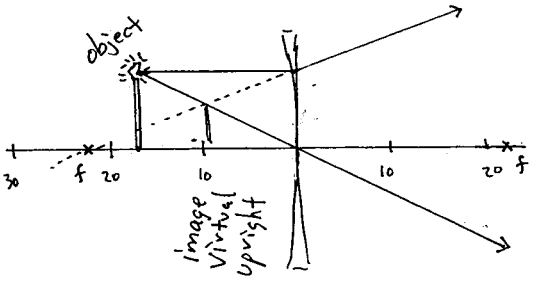
$$= (1.6-1)\left[\frac{1}{-27} - \frac{1}{24}\right]$$

$$f = -21.2 \text{ cm}$$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

$$\frac{1}{18} + \frac{1}{i} = \frac{1}{-21.2}$$

$$i = -9.73 \text{ cm}$$



$$\text{magnif} = (-)\frac{i}{o} = (-)\frac{-9.73}{18} = 0.54$$

upright

34-82 object $o_1 = 8$

lens #1 $f_1 = -6$ diverging

separation 12 cm

lens #2 $f_2 = 6$ converging

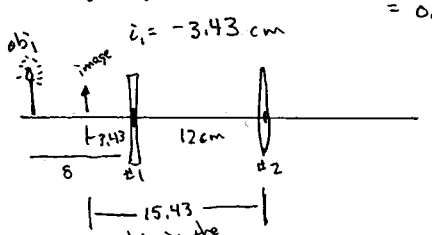
Do lens #1

$$\frac{1}{o_1} + \frac{1}{i_1} = \frac{1}{f_1}$$

$$\frac{1}{8} + \frac{1}{i_1} = \frac{1}{-6}$$

$$i_1 = -3.43 \text{ cm}$$

#1 $\text{magnif} = (-)\frac{i}{o} = (-)\frac{-3.43}{8} = 0.43$



$o_2 = 15.43$

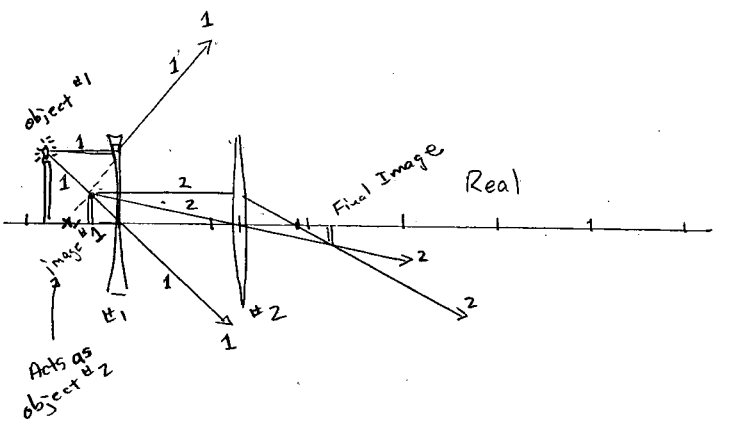
Do 2nd lens

$$\frac{1}{o_2} + \frac{1}{i_2} = \frac{1}{f_2}$$

$$\frac{1}{15.43} + \frac{1}{i_2} = \frac{1}{6}$$

$$i_2 = 9.82 \text{ cm}$$

#2 $\text{magnif} = (-)\frac{i}{o} = (-)\frac{9.82}{15.43} = -0.64$



Overall magnification $= (0.43)(-0.64)$

$= (-)\ 0.275$ inverted