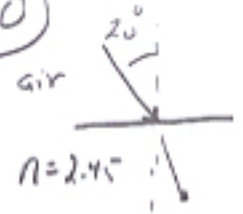
(250)



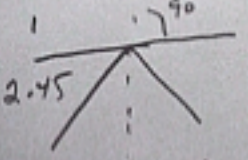
$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_2 = \frac{n_1}{n_2} \sin\theta_1$

$\sin\theta_2 = \frac{1}{2.45} \sin 20$

$\Rightarrow \theta_2 = 8^\circ$

$n = \tan\theta_B \Rightarrow \theta_B = 68^\circ$



$n_1 \sin\theta_1 = n_2 \cdot 1$

$\sin\theta_c = \frac{n_2}{n_1} = \frac{1}{2.45} =$

$\theta_c = 24^\circ$

$$M = -\frac{s'}{s_o} = +2$$

$$s' = -2s_o \Rightarrow s' = -2(25)$$

$$= -50\,cm$$

$$\frac{1}{s_o} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{f} = \frac{1}{25} - \frac{1}{50}$$

$$= \frac{2}{50} - \frac{1}{50} = \frac{1}{50}$$

$$f = +50\,cm$$

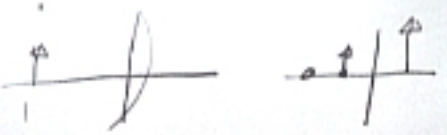
$$\frac{1}{s'} = \frac{1}{50} - \frac{1}{10} = \frac{1}{50} - \frac{5}{50} = -\frac{4}{50}$$

$$s' = -\frac{50}{4} = -12.5$$

$$M = -\frac{s'}{s} = -\frac{-12.5}{10} = +1.25$$

Virtual ($s' < 0$)

Enlarged ($|M| > 1$) upright $M > 0$



$$\frac{1}{S_o} + \frac{1}{S_i} = \frac{1}{f}$$

$$\frac{1}{20} + \frac{1}{20} = \frac{1}{f} = \frac{2}{20} = \frac{1}{10}$$

$f = +10$ $\quad f = \frac{R}{2} \Rightarrow R = 2f$

$R = +20$

$$\frac{1}{S_i} = \frac{1}{f} - \frac{1}{S_o} = \frac{1}{10} - \frac{1}{5} = \frac{1}{10} - \frac{2}{10}$$

$S(-)$ $\quad = -\frac{1}{10} \Rightarrow S_i = -10$

Virtual $\quad M = -\frac{S_i}{S_o} = -\frac{-10}{5} = +2$

Enlarged ($|M|>1$) upright ($M>0$)

~~Real ($S_i > 0$)~~

$M = -\frac{S_i}{S_o} = -1 \Rightarrow S_i = +S_o$

$S_i = +50$

$\frac{1}{f} = \frac{1}{S_o} + \frac{1}{S_i} = \frac{1}{50} + \frac{1}{50} = \frac{2}{50} = \frac{1}{25}$

$f_{eff} = +25$ $\quad L_1 : f_1 = -25$

$\frac{1}{f_{eff}} = \frac{1}{f_1} + \frac{1}{f_2} \Rightarrow \frac{1}{f_2} = \frac{1}{+25} - \frac{1}{-25}$

$= \frac{2}{25} \Rightarrow f_2 = 12.5$

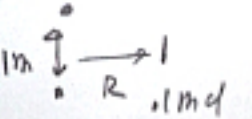
$S_o = +10$

$\frac{1}{S_i} = \frac{1}{25} - \frac{1}{10} = \frac{2}{50} - \frac{5}{50} = -\frac{3}{50}$

$S_i = -16.67$ $\quad M = -\frac{S_i}{S_o} = +1.67$

Virtual ($S_i < 0$) ENLarged ($|M| > 1$)

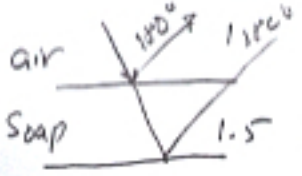
UPRight ($M+$)



$$S = R\Delta\theta \Rightarrow \Delta\theta = \frac{S}{R} = \frac{1m}{R} = 1.22\frac{\lambda}{D}$$

$$= 1.22\ \frac{500\times10^{-9}}{.1} = 6.1\times10^{-6}$$

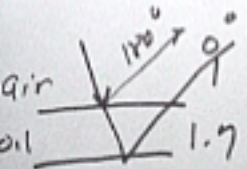
$$R = 1.6\times10^{5}\,m$$



$2n_2 t = m\lambda$

$m = 1, \ldots$

$t = \frac{\lambda}{2n_2} = \frac{500}{2(1.5)} = 167\,nm$



$2n_2 t = m\lambda \quad m = 1, \ldots$

$t_{min} = \frac{\lambda}{2n_2} = \frac{500}{2(1.7)}$

$= 147\,nm$