[14] 1. $\lambda = 500\ nm$; $n_g = 1.50$ (3/2)

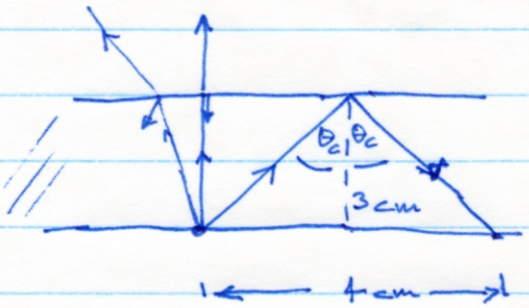
(a) $\omega = ck = c\frac{2\pi}{\lambda} = \frac{3\,10^8\ m\,s^{-1}}{5\,10^{-7}\ m}\,2\pi = \frac{6\pi}{5}\,10^{15} = \underline{3.77\,10^{15}\ s^{-1}}$

$\omega_{vac} = \omega_g$

(b) $n = \frac{\lambda_0}{\lambda} = \frac{k}{k_0}$; vac $k_0 = \frac{2\pi}{\lambda_0} = \frac{2\pi}{5\cdot10^{-7}}\ m^{-1} = \underline{1.26\,10^{7}\ m^{-1}}$

glass $k = nk_0 = \frac{3\pi}{5}\,10^7 = \underline{1.88\,10^{7}\ m^{-1}}$

[20] 2.



AT θ_c, all light undergoes TIR

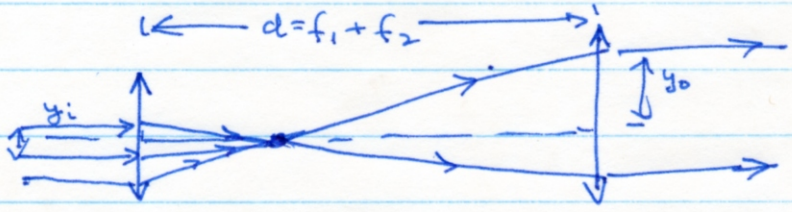
$\theta > \theta_c$, reflected light forms a ring

$\tan\theta_c = \frac{2}{3}$; $\sin\theta_c = 2/\sqrt{13}$

$\theta_c = 33.7$ deg

$n_p \sin\theta_c = n_{air}$; $\underline{n_p = 1/0.55 = 1.80}$ (not actual n for plex)

[30] 3.



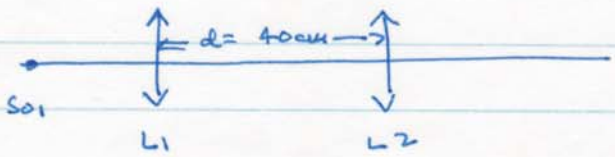
Parallel beam is focused to f_1. If f_1 coincides with f_2 it will be a parallel beam after L2.

$\frac{y_o}{y_i} = \frac{f_2}{f_1} = \frac{250}{5} = 5$; $\underline{y_o = 5 \times 2mm = 10\ mm}$

[36] 4. a) $|R| = 20$ cm $\quad 1/f_1 = \left(\frac{n_g - n_o}{n_o}\right)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] = \left(\frac{1.5-2.0}{2.0}\right)\left(\frac{1}{20}\right) = +\frac{1}{80\text{ cm}}$

$f_1 = f_2$; $f_{eff}^{-1} = f_1^{-1} + f_2^{-1}$; $f_{eff} = +40$ cm

b)



L1: $\frac{1}{S_{i1}} = \frac{1}{f} - \frac{1}{S_{o1}} = \frac{1}{80} - \frac{1}{60} = -\frac{1}{240\text{ cm}}$; $S_{o2} = d - S_{i1}$

$= +280$ cm

$\frac{1}{S_{i2}} = \frac{1}{f} - \frac{1}{S_{o2}} = \frac{1}{80} - \frac{1}{280} = +\frac{5}{560}$; $S_{i2} = +112$ cm

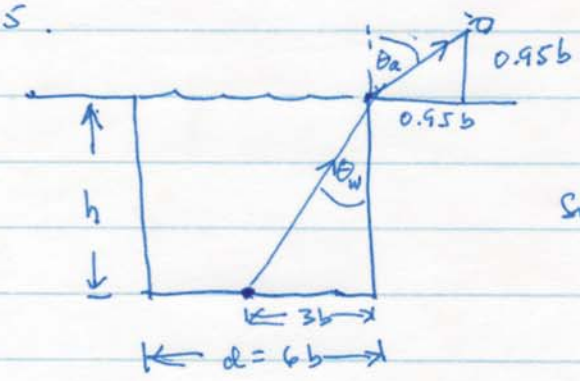
$S_{o1} + d + S_{i2} = 60 + 40 + 112 = 212$ cm

(c) $M_T = M_{T_1} M_{T_2}$

$M_{T_1} = -\frac{S_{i1}}{S_{o1}} = -\frac{-240}{60} = +4$

$M_{T_2} = -\frac{S_{i2}}{S_{o2}} = -\frac{112}{280} = -\frac{2}{5}$; $M_T = 4\left(-\frac{2}{5}\right) = -\frac{8}{5}$

[10] 5.



$h_{eyes} \approx 0.95b \Rightarrow \theta_{air} = 45$ deg

Snell says: $n_w \sin\theta_w = n_a \sin\theta_a$

$\sin\theta_w = \left(1/3/2\right)\frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{3} = 0.47$

$\theta_w = 28$ deg

$\tan\theta_w = \frac{3b}{h}$; $h = 3b / \tan\theta_w$

$\tan\theta_w = 0.53$; $h = 5.6\,b$

where b = your hit in m.