Phys 262 Spring 2010 Exam I solutions

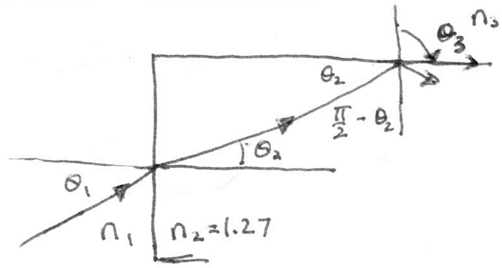
1a) $I = \frac{P}{A} = \frac{1}{2}\epsilon_0 c E^2$ (for sinusoidal wave)

$$E = \sqrt{\frac{2P}{\epsilon_0 c A}} = \sqrt{\frac{2 \cdot 0.5\times10^{-3}}{8.85\times10^{-12}\, 3\times10^{8}\, \pi \left(\frac{1.2\times10^{-3}}{2}\right)^2}} = 577\ \frac{V}{m}$$

b) $B = \frac{E}{c} = 1.92\times10^{-6}$ (WHATEVER THE SI UNITS!) (Tesla)

c) $\frac{F}{A} = \text{PRESSURE} = \frac{2I}{c} = \frac{2P}{Ac}$; $F = ma = \frac{2P}{c}\frac{A}{A}$; $a = \frac{2P}{mc} = \frac{2\cdot 0.5\times10^{-3}}{1.5\times10^{-6}\, 3\times10^{8}} = 2.22\,\mu N$

2)



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

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

$\underline{\frac{1}{n_2}\sin\theta_1 = \sin\theta_2}$

•) $n_2 \sin\left(\frac{\pi}{2} - \theta_2\right) = n_3 \sin\theta_3 = 1$

$n_2\left(\sin\frac{\pi}{2}\cos\theta_2 - \cancel{\cos\frac{\pi}{2}}^{\,0}\sin\theta_2\right) = 1$

$n_2 \cos\theta_2 = 1$

$\cos\theta_2 = \frac{1}{n_2}$

$\cos^2\theta_2 + \sin^2\theta_2 = 1$

$\frac{1}{n_2^2} + \frac{1}{n_2^2}\sin^2\theta_1 = 1$

$\sin^2\theta_1 = n_2^2 - 1$; $\sin\theta_1 = \sqrt{n_2^2 - 1}$

$\theta_1 = \text{ARCSIN}\left[\sqrt{1.27^2 - 1}\right] = 51.5°$

3) (B) LENS 1

$\frac{1}{s_1} + \frac{1}{s_1'} = \frac{1}{+150}$; $\frac{1}{270} + \frac{1}{s_1'} = \frac{1}{150}$; $s_1' = 338$

$m_1 = -\frac{s_1'}{s_1} = \frac{-338}{270} = -1.25$

LENS 2 : IMAGE 1 = OBJECT 2

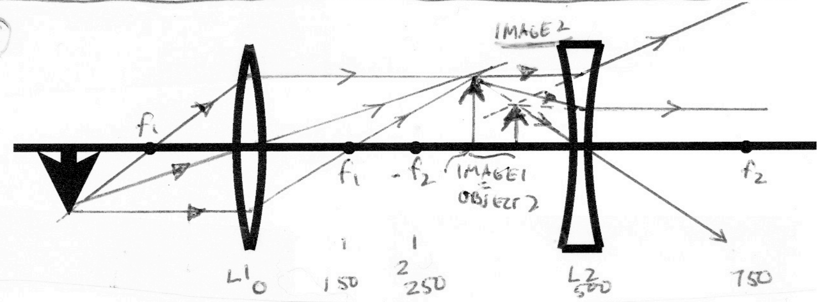
$\frac{1}{s_2} + \frac{1}{s_2'} = \frac{1}{-250}$; $\frac{1}{s_2'} = \frac{1}{-250} - \frac{1}{500-338}$

$\boxed{s_2' = -98.5\text{ cm}}$ TO THE LEFT OF LENS 2

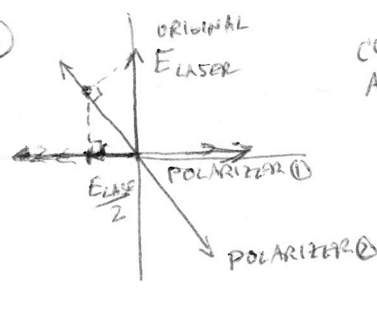
$m_2 = -\frac{s_2'}{s_2} = \frac{+98.5}{500-338} = +0.61$

$\boxed{m_{TOTAL} = m_1 \cdot m_2 = -0.76}$

(a)



4 (A)



COULD USE ANY ARGUMENT TO SHOW THAT POLARIZER 2 HAS TO BE AT $45° = \pi/4$ TO MAXIMIZE OUTPUT

(B) $I_2 = I_0 \cos^2\frac{\pi}{4} = I_0 \frac{1}{2}$

$I_1 = \frac{I_0}{2}\cos^2\frac{\pi}{4} = \frac{I_0}{4}$