ANSWERS OPTICS, FYSA13

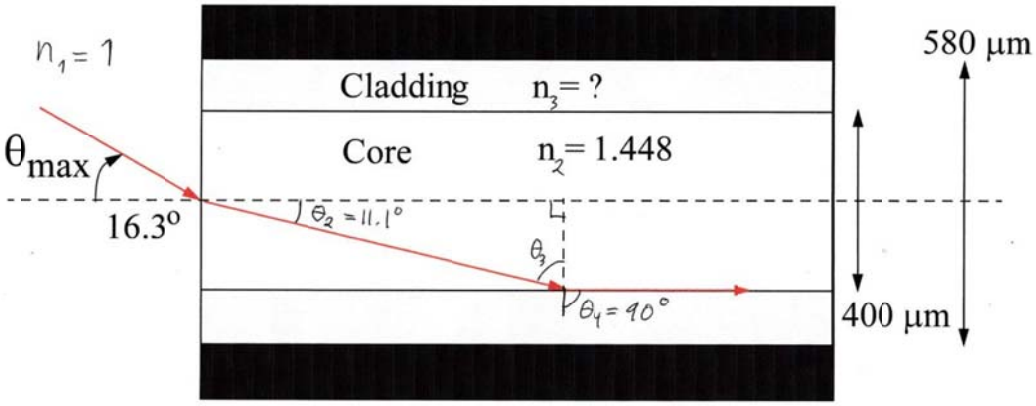
O1 Answers:

a) 1.421

b) 1.02 mm ≤ *L* ≤ 3.06 mm

O1 Solutions:

a)



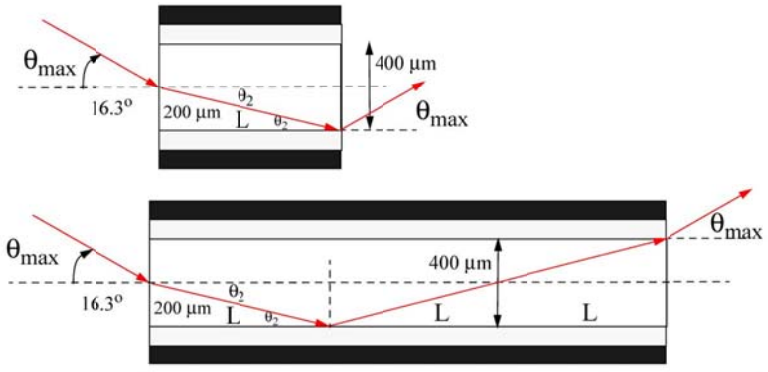
$\sin\theta_{max} = 0.28 \Rightarrow \theta_{max} = 16.3°$

$n_1 \sin\theta_{max} = n_2 \sin\theta_2 \Rightarrow \theta_2 = \sin\left(0.28/1.448\right) = 11.1°$

$\theta_2 + \theta_3 + 90° = 180° \Rightarrow \theta_3 = 90° - 11.1° = 78.9°$

$n_2 \sin\theta_3 = n_3 \sin 90° \Rightarrow n_3 = n_2 \sin\theta_3 = 1.448 \cdot \sin 78.9° = 1.421$

b)



The length of the fiber can be between L and 3L

$\tan\theta_2 = \frac{200\mu m}{L}$

$L = \frac{200\mu m}{\tan 11.1°} = 1019\mu m$

The length of the fiber can be between 1.02mm and 3.06mm

O2 Answers:

a) 55 cm away from the mirror.
b) 220 cm

O2 Solutions

2a) $f = \frac{R}{2} = \frac{110}{2} = 55\,cm$

$m_1 = -\frac{s_1'}{s_1} = +2.00 \Rightarrow s_1' = -2s_1$

$\frac{1}{f} = \frac{1}{s_1'} + \frac{1}{s_1} = -\frac{1}{2s_1} + \frac{1}{s_1} = \frac{1}{2}\frac{1}{s_1} \Rightarrow s_1 = \frac{1}{2}f = 27.5$

$m_2 = -\frac{s_2'}{s_2} = -2.00 \Rightarrow s_2' = 2s_2$

$\frac{1}{f} = \frac{1}{s_2'} + \frac{1}{s_2} = \frac{1}{2s_2} + \frac{1}{s_2} = \frac{3}{2}\frac{1}{s_2} \Rightarrow s_2 = \frac{3}{2}f = 82.5$

$\Delta s = 82.5 - 27.5 = 55\,cm$ away from the mirror

b) $s_1' = -2s_1 = -55\,cm$

$s_2' = 2s_2 = 165\,cm$

$\Delta s' = 165 - (-55) = 220\,cm$

O3 Answers:

a) 4.0%
b) f = -79.4 cm
c) R = -39.7 cm

O3 Solutions:

a) $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$f = \frac{1}{(n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)} = \frac{1}{n-1}K$

$f_{red} = \frac{1}{1.5-1}K = 2K$

$f_{blue} = \frac{1}{1.52-1}K = 1.923K$

$\frac{f_{red} - f_{blue}}{f_{blue}} = 0.0400 \Rightarrow 4\%$

b) $m = \frac{y'}{y} = \frac{1.33}{2} = 0.665$

$m = -\frac{s'}{s} = 0.665 \Rightarrow s' = -0.665s = -26.6\,cm$

$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'} \Rightarrow f = \frac{1}{\frac{1}{s} + \frac{1}{s'}} = \frac{1}{\frac{1}{40} - \frac{1}{26.6}} = -79.4\,cm$

c) $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{-79.4} = 0.5\left(\frac{1}{R} - \frac{1}{\infty}\right)$

$R = (-79.4) * 0.5 = -39.7\,cm$