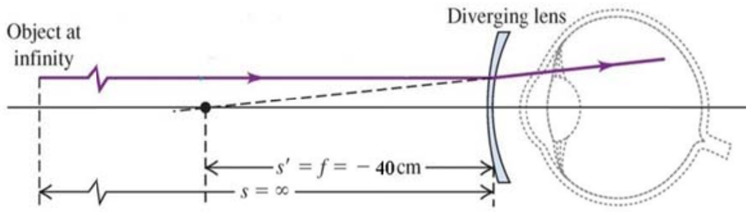
ANSWERS OPTICS, FYSA13

O1 Answers:

a) 17.2 cm
b) 40+2 = 42 cm

O1 Solutions:



a) $f = \frac{1}{-2.5} = -0.40\text{m} = -40\text{cm}$

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

$$R_2 = \frac{1}{\frac{1}{100} - \frac{1}{-40(1.52-1)}} = 17.2\text{ cm}$$

b) $\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$

$$\frac{1}{-40} = \frac{1}{\infty} + \frac{1}{s'} \Rightarrow s' = -40\text{cm}$$

The far point distance is $40+2 = 42$ cm

O2 Answers:

a) S_1 is five times larger than S_2
b) R =92 cm

O2 Solutions

a) distance 1:

$$m = -\frac{s_1'}{s_1} = -\frac{3}{2} \Rightarrow s_1' = \frac{3}{2}s_1$$

$$\frac{1}{s_1} + \frac{1}{s_1'} = \frac{1}{f} \Rightarrow \frac{1}{s_1} + \frac{2}{3s_1} = \frac{5}{3}\frac{1}{s_1} = \frac{1}{f} \Rightarrow f = \frac{3}{5}s_1$$

distance 2:

$$m = -\frac{s_2'}{s_2} = +\frac{3}{2} \Rightarrow s_2' = -\frac{3}{2}s_2$$

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

Combine:

$$\frac{3}{5}s_1 = 3s_2 \Rightarrow s_1 = 5s_2$$

b)

$$\left.\begin{aligned} f &= \frac{3}{5}s_1 \\ s_1' &= \frac{3}{2}s_1 \end{aligned}\right\} f = \frac{2}{5}s_1' = 46\text{cm} \qquad R = 2f = 92\text{cm}$$

O3 Answers:

a) $f_1 = 75.3$ cm and $f_2 = 4.71$ cm
b) The distance has to be increased by 6.1 cm

O3 Solutions:

a) $M = -\frac{f_1}{f_2} = -16 \Rightarrow f_1 = 16 f_2$

$L = f_1 + f_2 = 80\,cm \Rightarrow 16 f_2 + f_2 = 80\,cm \Rightarrow f_2 = 4.71\,cm$

$f_1 = 80 - 4.71 = 75.29\,cm$

b) $\left.\begin{array}{l} f_1 = 75.29\,cm \\ S_1 = 10\,m \end{array}\right\} S_1' = \frac{S_1 f_1}{S_1 - f_1} = \frac{10 \cdot 0.7529}{10 - 0.7529} = 0.814\,m$

$L_{new} = S_1' + f_2 = 0.814 + 0.0471 = 0.861$

$\Delta L = L_{new} - L = 0.861 - 0.800 = 0.061\,m$