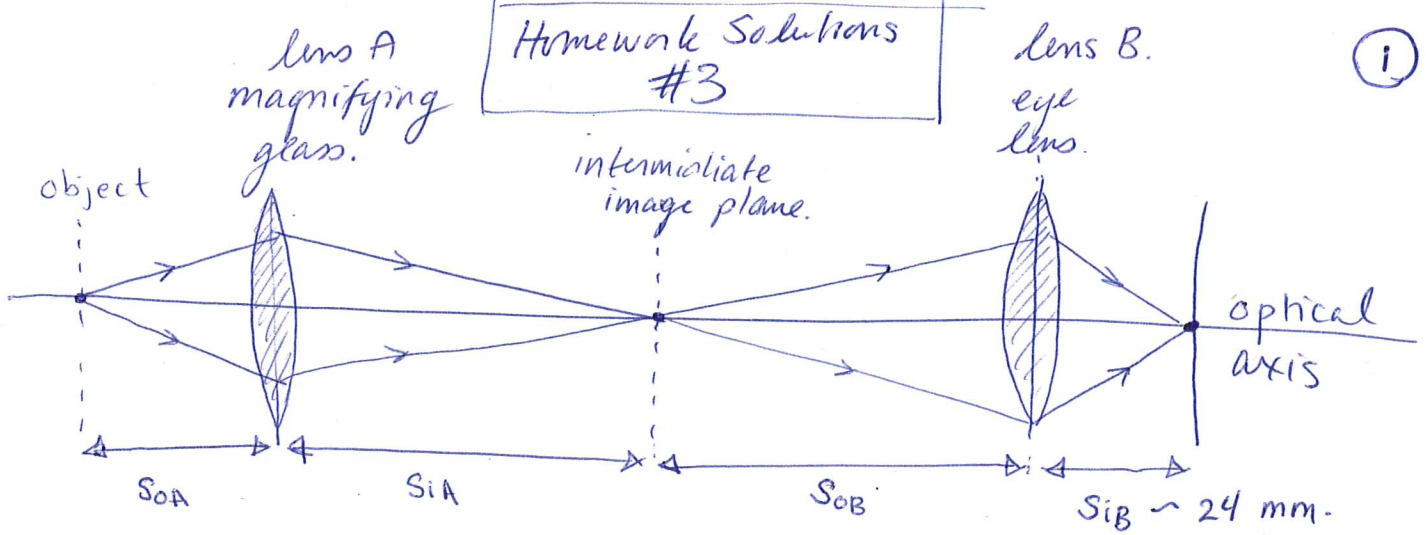


Homework Solutions #3

(1)



$$f_A = 100 \text{ mm}$$

$$S_{oA} + S_{iA} + S_{oB} = 1 \text{ m} = 10^3 \text{ mm.}$$

Problem 1a: Plot $S_{oA} + S_{iA}$ as a function of S_{oA} .
 (image position) (object distance)

Thin lens equation

$$\frac{1}{S_{oA}} + \frac{1}{S_{iA}} = \frac{1}{f_A}$$

$$S_{iA} + S_{oA} = \frac{S_{iA} S_{oA}}{f_A}$$

$$\frac{1}{S_{iA}} = \frac{S_{oA} + f_A}{f_A S_{oA}}$$

$$S_{iA} = \frac{f_A S_{oA}}{S_{oA} - f_A}$$

$$l \equiv S_{iA} + S_{oA} = \frac{S_{oA}^2}{S_{oA} - f_A}$$

Problem 1b:

$$l \equiv S_{iA} + S_{oA}$$

$$S_{oA} + S_{iA} + S_{oB} = L = 1 \text{ m.}$$

$$S_{oB} + l = L$$

$$S_{oB} = -l + L$$

Thin lens Eqn to find f_B

(2)

$$\frac{1}{S_{OB}} + \frac{1}{S_{iB}} = \frac{1}{f_B}$$

$$f_B = \left(\frac{1}{L-l} + \frac{1}{S_{iB}} \right)^{-1}$$

Find Range of f_B values.

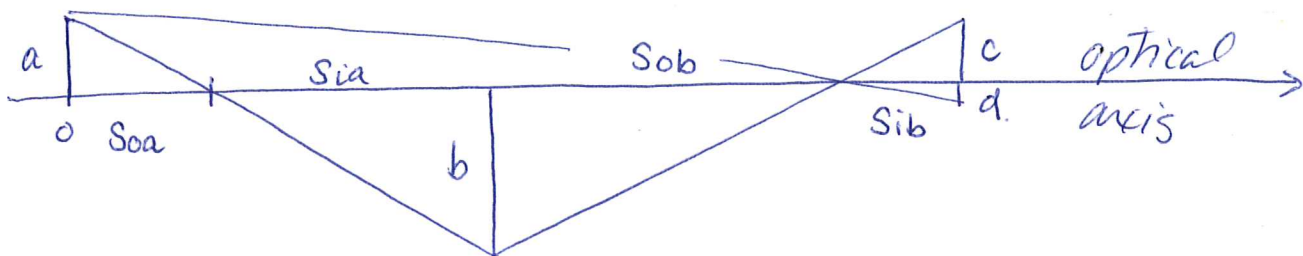
$$f_B^{\max} \approx ?$$

$$\frac{1}{S_{OB}} \Big|_{S_{OB} \rightarrow \infty} + \frac{1}{S_{iB}} = \frac{1}{f_B^{\max}} \Rightarrow f_B^{\max} = 24 \text{ mm.}$$

$$f_B^{\min} \approx ?$$

$$\frac{1}{S_{OB}} \Big|_{\substack{S_{OB} \rightarrow 120 \text{ mm} \\ \text{near point}}} + \frac{1}{S_{iB}} = \frac{1}{f_B^{\min}} \Rightarrow f_B^{\min} = 20 \text{ mm.}$$

Problem 10:



(3)

$$\frac{b}{S_{ia}} = -\frac{a}{S_{oa}}$$

↓

$$b = -\frac{S_{ia}}{S_{oa}} a$$

$$\frac{c}{S_{ib}} = -\frac{b}{S_{ob}}$$

↓

$$c = -\frac{S_{ib}}{S_{ob}} b$$

$$\frac{a}{L} = -\frac{d}{S_{ib}}$$

$$d = \frac{S_{ib}}{L} a$$

$$c = \frac{S_{ia} S_{ib}}{S_{oa} S_{ob}} a$$

$$M \equiv \frac{c}{d} = \frac{S_{ia} L}{S_{oa} S_{ob}}$$

4

