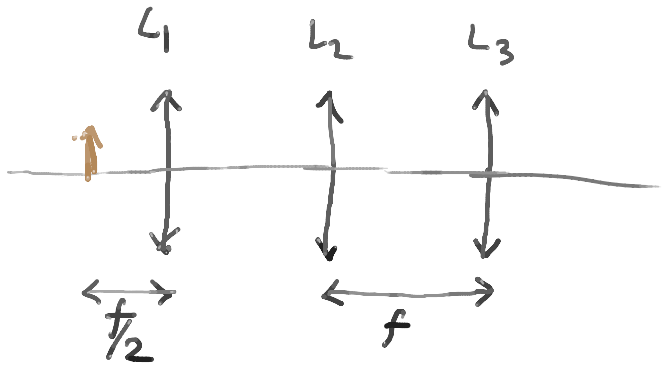
SOLUTION PRACTICE MT 1

#1



1) IMAGE THROUGH L1:

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

VIRTUAL AT LEFT FOCAL POINT OF L1

2) IMAGE THROUGH L2: OBJECT AT 2f

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

REAL 2f RIGHT OF L_2
f RIGHT OF L_3

3) IMAGE THROUGH L_3 : POSITION OF OBJECT = $-f$ (RIGHT OF L_3)

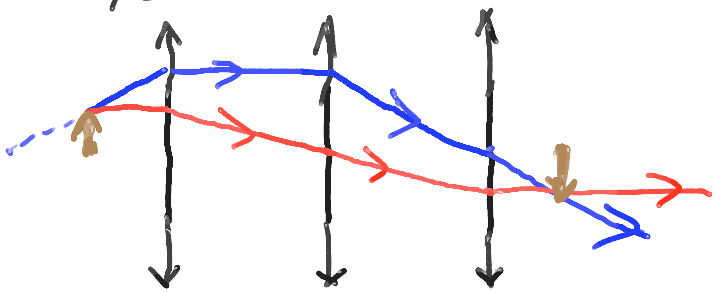
$$\frac{1}{-f} + \frac{1}{s_3'} = \frac{1}{f} \Rightarrow s_3' = \frac{f}{2} \Rightarrow$$

FINAL IMAGE $\frac{f}{2}$ TO THE RIGHT OF L_3

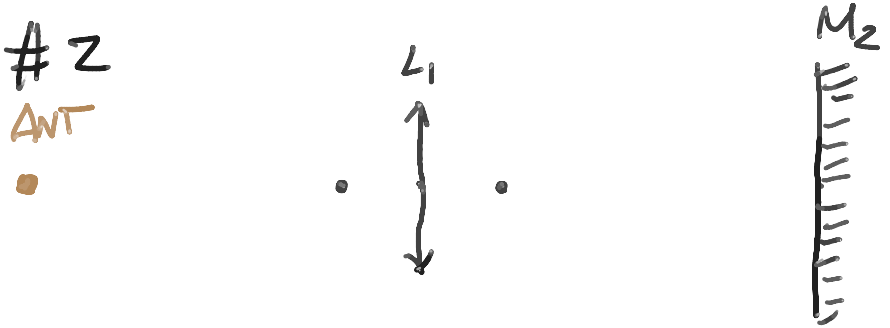
$$m = -\frac{s_3'}{s_1} = -\frac{f/2}{f/2} = -1$$

INVERTED SAME SIZE

RAY TRACING



#2



1) IMAGE THROUG L1: I_1

$$\frac{1}{250} + \frac{1}{s_1'} = \frac{1}{50} \Rightarrow \frac{1}{s_1'} = \frac{4}{250} \Rightarrow s_1' = \frac{250}{4} = 62.5 \text{ cm}$$

RIGHT OF L_1
REAL IMAGE

2) IMAGE THROUGH M_2 : IMAGE I_1 IS AT $s_2 = \frac{3}{4}.250$ TO THE LEFT OF $M_1 \rightarrow I_1$ IS NOW OBJECT FOR $M_2 \Rightarrow \frac{1}{s_2} + \frac{1}{s_2'} = 0 \Rightarrow s_2' = -\frac{3}{4}.250 \Rightarrow I_2$

$\Rightarrow$ VIRTUAL IMAGE 187.5 cm RIGHT OF M_2

3) IMAGE OF I_2 THROUG L_1. LIGHT IS REFLECTED FROM MIRROR $\Rightarrow$ PATHS FROM VIRTUAL IMAGE I_2 CONVERGE TO A THIRD IMAGE I_3

I_2 IS A $\frac{7}{4}\cdot 250$ TO THE RIGHT OF L_1, LIGHT IS GOING R $\rightarrow$ L

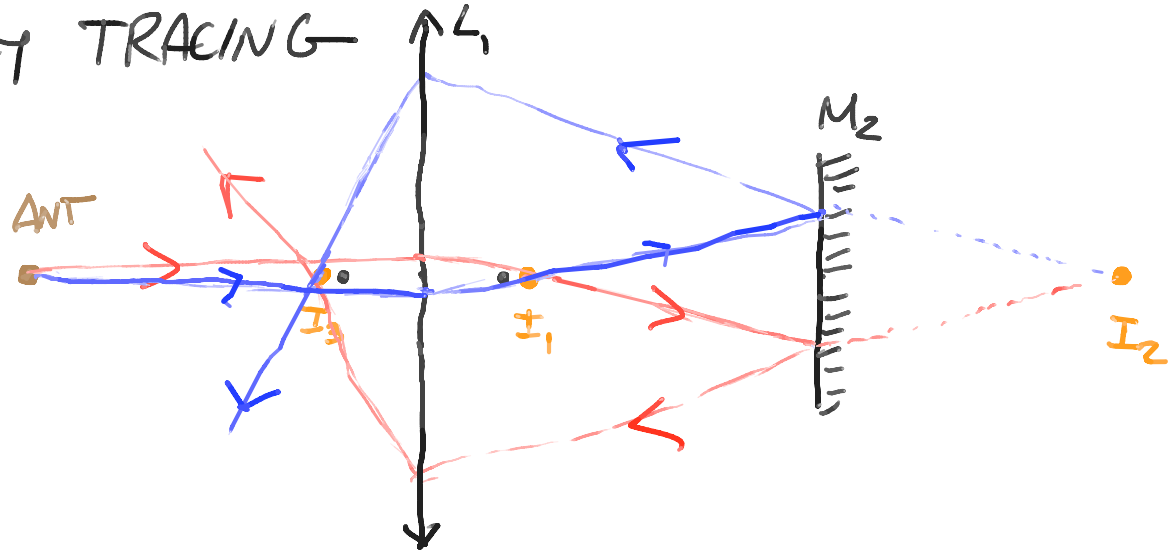
$$\Rightarrow \quad s_1 = \frac{7}{4}\cdot 250$$

$$\frac{1}{s_1} + \frac{1}{s_1'} = \frac{1}{50} \quad \Rightarrow \quad \frac{4}{7\cdot 250} + \frac{1}{s_1'} = \frac{1}{50}$$

$$\frac{1}{s_1'} = \frac{1}{50}\left(1 - \frac{4}{35}\right) = \frac{1}{50}\cdot\frac{31}{35} \quad \Rightarrow s_1' = 56.45 \text{ cm}$$

LEFT OF L_1

RAY TRACING



#3

1) IMAGE THROUGH n/n' INTERFACE

$$\frac{n}{s} + \frac{n'}{s'} = 0 \Rightarrow \frac{4/3}{12} + \frac{1}{s'} = 0 \Rightarrow s' = -9 \text{ cm}$$

(9 cm BELOW SURFACE)

2) IMAGE THROUGH LENS

$$\frac{1}{15+6} + \frac{1}{s''} = \frac{1}{f} \Rightarrow \frac{1}{15} + \frac{1}{s''} = \frac{1}{90} \Rightarrow s'' = -18\ \text{cm}$$

$s'' = -18\,\text{cm}$ WITH RESPECT TO THE LENS

$\Rightarrow$ THE IMAGE (VIRTUAL) IS EXACTLY AT THE REAL POSITION OF THE FISH

MAGNIFICATION: $m = m_1 \cdot m_2$ $\quad m_1 = -\frac{s'}{s}\frac{n}{n'} = +1$

$$m_2 = -\frac{s''}{15} = -\frac{(-18)}{15} = \frac{6}{5} \Rightarrow m = +\frac{6}{5}$$