HW 28-1

(1) Lens equation: $\frac{1}{o_1} + \frac{1}{i_1} = \frac{1}{f_1} \Rightarrow i = \frac{o_1 f_1}{o_1 - f_1}$

$f_1 = 9.5\,cm$

where $o_1 = |x_0| = 13.3\,cm$ and $x_1 = i_1$

$\Rightarrow \underline{x_1 \doteq 33.25\,cm}$ $\quad f_2 = 21.3\,cm$

(2) Magnification formula:

$$\frac{y_1}{y_0} = -\frac{i_1}{o_1} \Rightarrow y_1 = \left(-\frac{i_1}{o_1}\right) \cdot y_0 = \underline{-10\,cm}$$

$y_0 = +4\,cm$

(3) $o_2 = x_2 - i_1 \Rightarrow i_2 = \frac{o_2 \cdot f_2}{o_2 - f_2} \Rightarrow x_3 = i_2 + x_2$

$(x_2 = 62.45\,cm)$ $\quad \doteq \underline{141.18\,cm}$

(4) $\frac{y_3}{y_1} = -\frac{i_2}{o_2} \Rightarrow y_3 = \left(-\frac{i_2}{o_2}\right) \cdot y_1 \doteq \underline{+26.96\,cm}$

(5) Real & Upright

(6) Move the second lens to $x = 43.9\,cm$, keeping the first lens at $x = 0$.

HW 28-2

(1) $o_1 = |x_1| = 29.5\ cm$ $\quad (f_1 = -12.4\ cm)$

$$i_1 = \frac{o_1 \cdot f_1}{o_1 - f_1} \Rightarrow x_1 = i_1 \doteq -8.73\ cm$$

(2) $$\frac{y_1}{y_0} = -\frac{i_1}{o_1} \Rightarrow y_1 = \left(-\frac{i_1}{o_1}\right) \cdot y_0 \doteq 14.23\ cm \qquad (y_0 = 14.3\ cm)$$

(3) $o_3 = |x_1 - x_2|$

$i_3 = x_3 - x_2$

$$\frac{1}{o_3} + \frac{1}{i_3} = \frac{1}{f_2}$$

$$f_2 = \frac{o_3 \cdot i_3}{o_3 + i_3} \doteq +13.51\ cm$$

(4) $$\frac{y_3}{y_1} = -\frac{i_3}{o_3} \Rightarrow y_3 = -\frac{x_3 - x_2}{|x_1 - x_2|} \cdot y_1 \doteq -3.57\ cm$$

(5) Real & Inverted

HW28-3

① $o = \dfrac{i \cdot f_d}{i - f_d}$ $\quad f_d = -31.2\,cm$ & $i = -17.2\,cm$

$x_1 = -|o| = -\left|\dfrac{i \cdot f_d}{i - f_d}\right| \doteq -38.33\,cm$

$y_2 = 2.4\,cm$

② $\dfrac{y_2}{y_1} = -\dfrac{i}{o} \Rightarrow y_1 = \left(-\dfrac{o}{i}\right) \cdot y_2 \doteq +5.34\,cm$

③ $o_4 = -(x_1 - x_3) = x_3 - x_1$ $\quad (f_c = +10.64\,cm)$

$\dfrac{1}{o_4} + \dfrac{1}{i_4} = \dfrac{1}{f_c} \Rightarrow i_4 = \dfrac{o_4 \cdot f_c}{o_4 - f_c}$

$x_4 = i_4 + x_3 = +21.93\,cm$

④ $o_5 = -x_4$ $\quad \dfrac{1}{o_5} + \dfrac{1}{i_5} = \dfrac{1}{f_d} \Rightarrow$

$i_5 = \dfrac{o_5 \cdot f_d}{o_5 - f_d} \Rightarrow x_5 = i_5 \doteq +73.69\,cm$

⑤ Real & Inverted