1.

(a)

(1) Entrance pupil

$$\frac{1}{d_2} = \frac{1}{f} + \frac{1}{d_1} = \frac{1}{4} - \frac{1}{2} = \frac{1}{4} - \frac{2}{4} = -\frac{1}{4}$$

$d_2 = -4$ cm from the lens. (4cm behind the lens.)

$$M = \frac{-4}{-2} = 2 \Rightarrow D(\text{Entrance Pupil}) = 12\text{cm}$$

(2) Exit pupil

Exit pupil is at the aperture stop, 2cm behind the lens, 6cm in diameter.

(b) $$\frac{1}{d_i} = \frac{1}{f} + \frac{1}{d_o} = \frac{1}{4} + \frac{1}{(-10)} = \frac{10}{40} - \frac{4}{40}$$

$$= \frac{6}{40} = \frac{3}{20} = \frac{1}{20/3} \Rightarrow d_i = \frac{20}{3}\text{cm} = 6.67\text{cm}$$

(c) Last page

2. Use $\frac{1}{f} = (n_e - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

For example, pick $n = 1.6$. $R_1 = 2R$, $R_2 = -R$

$$\frac{1}{60} = (1.6-1)\left(\frac{1}{2R} - \frac{1}{-R}\right) \Rightarrow R = \frac{3}{5}(0.6)60 = 54\text{cm}$$

$\therefore R_1 = 108\text{cm}$, $R_2 = -54\text{cm}$, $n_e = 1.6$

3. Image formed by lens 1:

$$\frac{1}{d_2} = \frac{1}{f} + \frac{1}{d_1} = \frac{1}{10} + \frac{1}{-20} = \frac{1}{20}$$

$d_2 = 20 \quad \therefore \quad m_1 = -1$

For lens 2; total remaining distance from image to screen is 45cm.

$$-d_1 + d_2 = 45\text{ cm}$$

$$m_2 = -25$$

$$\therefore \quad \frac{d_2}{d_1} = -25$$

$$-d_1 - 25d_1 = 45 \Rightarrow d_1 = \frac{-45}{26} = -3.27\text{cm}$$

$$d_2 = -25d_1 = 81.725\text{ cm}$$

$$\frac{1}{f} = \frac{1}{d_2} - \frac{1}{d_1} = \frac{1}{81.725} - \frac{1}{-3.27}$$

$$\boxed{f = 3.14\text{cm}}$$

Separation = d_2(lens 1) − d_1 (lens 2)

$= 20 - (-3.27)$

$= \underline{\underline{23.27\text{cm}}}$

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PR1. Part (c)