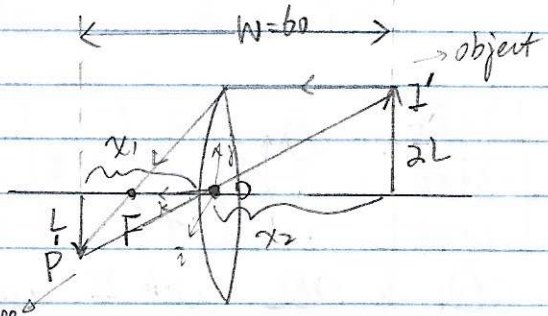
Problem 2



As drawn in the figure, x_1, x_2 denote the distances of image and object from the lens respectively. f denotes the focal length of the lens.

$$\frac{x_1}{x_2} = \frac{L}{2L} = \frac{1}{2} \Rightarrow x_2 = 2x_1.$$

$$W = x_2 + x_1 = 3x_1 = 60 \Rightarrow x_1 = 20\text{ cm},\ x_2 = 40\text{ cm}$$

$$\frac{1}{x_1} + \frac{1}{x_2} = \frac{1}{f} \Rightarrow f = \frac{40}{3}\text{ cm}.$$

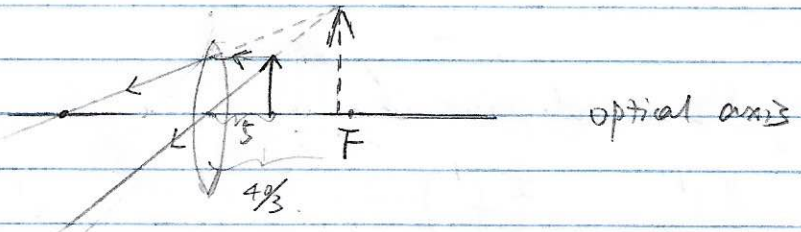
1. The object must be placed $\boxed{40\text{ cm}}$ far from the lens. The focal length of the lens is $\boxed{\frac{40}{3}\text{ cm}}$.

2. From the question, we need to ensure $x_1 = x_2$. So we get

$$\frac{1}{x_1} + \frac{1}{x_2} = \frac{1}{f} \Rightarrow \frac{2}{x_1} = \frac{1}{f} \Rightarrow x_1 = \frac{80}{3}\text{ cm}$$

So, the arrow should be placed $\boxed{\frac{80}{3}\text{ cm}}$ from the center of the lens.

3.



We suppose x is the distance of the image from the center of the lens.

$$\frac{1}{5} + \frac{1}{x} = \frac{1}{f} \qquad x = -8\text{ cm}$$

Since the object is placed at the distance less than the focal length ($5 < \frac{40}{3}$), the image is $\boxed{\text{virtual}}$ and it locates on the same side of the object with a distance of $\boxed{8\text{ cm}}$ from the focal center.