Answer on Question #52216-Physics-Optics

An object is placed 50.0cm from a screen. Where a converging lens of focal length 10.0cm should be placed to form an image on the screen? Find the magnification of the lens.

Solution

From the thin lens equation, $\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$, and $p+q=50.0\text{cm}$ the image distance is found to be

$$\frac{1}{50-\text{q}}+\frac{1}{q}=\frac{1}{f}\to\frac{50}{q(50-q)}=\frac{1}{f}\to 50f=-q^2+50q.$$

$$q^2-50q+500=0.$$

$$D=(-50)^2-4\cdot 500=500.$$

$$q=\frac{50\pm\sqrt{500}}{2}=25\pm 5\sqrt{5}.$$

Thus a converging lens should be placed at $q_1=36.2cm$ or $q_2=13.8cm$.

The magnification of the lens is

$$m_1=-\frac{q_1}{p_1}=-\frac{36.2}{50-36.2}=-2.62\ or$$

$$m_2=-\frac{q_2}{p_2}=-\frac{13.8}{50-13.8}=-0.38.$$