Answer on Question 59113, Physics, Optics

Question:

An object of size 10 cm is kept at a distance of 10 cm from a convex lens. If the focal length of the lens is 5 cm, the size of the image is__?

Solution:

Let's first find the the distance from the convex lens to the image from the lens equation:

$$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f},$$

here, d_o is the distance from the object to the convex lens, d_i is the distance from the convex lens to the image and f is the focal length.

So, we get:

$$\frac{1}{10\ cm}+\frac{1}{d_i}=\frac{1}{5\ cm},$$

$$\frac{1}{d_i}=\frac{1}{5\ cm}-\frac{1}{10\ cm}=\frac{1}{10}\ cm,$$

$$d_i=10\ cm.$$

As we can see, the distance from the lens to the image is positive, so the image is real.

Then, we can calculate the magnification of the lens from the formula:

$$M=\frac{h_i}{h_0}=\frac{-d_i}{d_o},$$

here, h_i is the size of the image, h_0 is the size of the object, d_o is the distance from the object to the convex lens, d_i is the distance from the convex lens to the image.

Thus, we get:

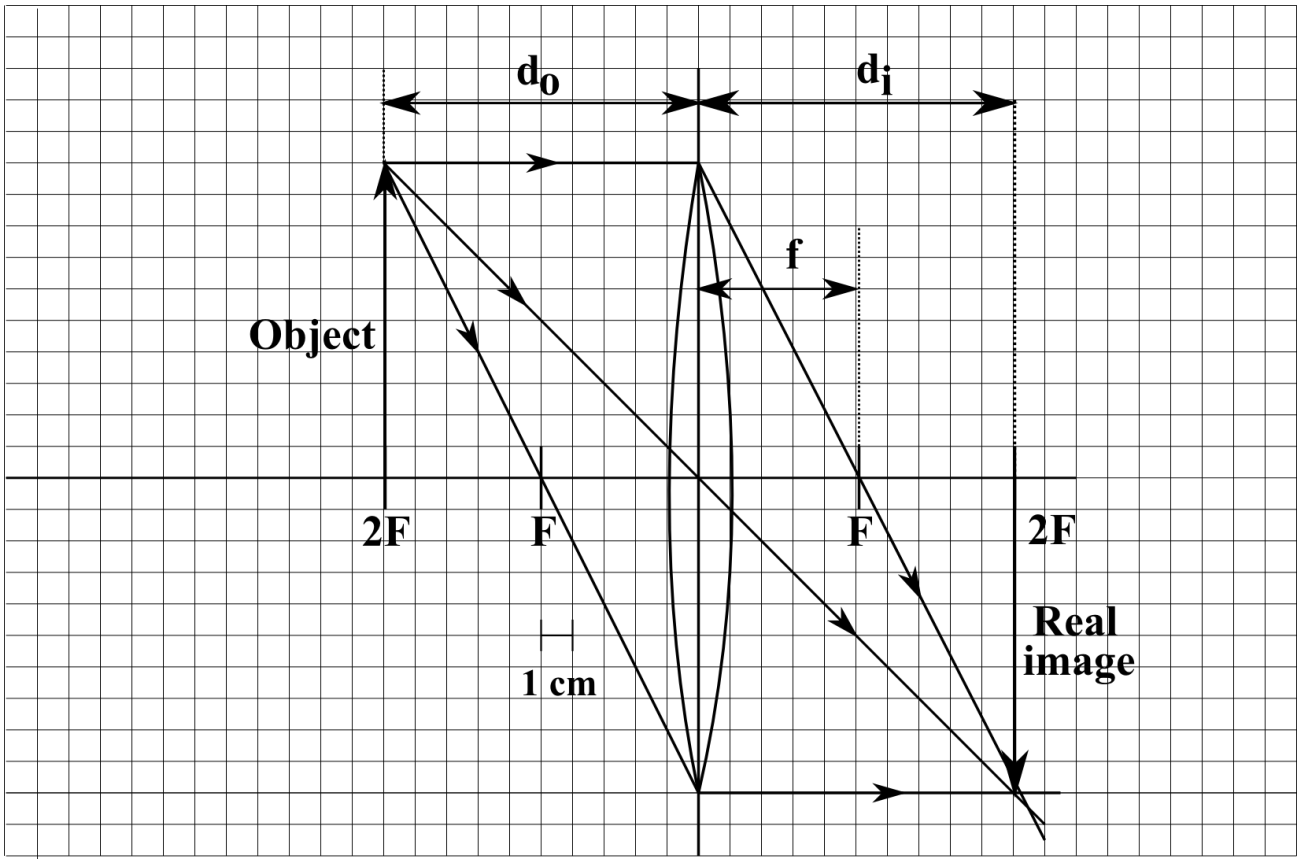
$$M=\frac{-d_i}{d_o}=\frac{-10\ cm}{10\ cm}=-1.$$

As we know, the magnification, we can find the size of the image:

$$h_i = M \cdot h_0 = (-1) \cdot 10\ cm = -10\ cm.$$

The sign minus indicates that the image is inverted. As we can see the image is the same size as the object.

Let's draw the ray tracing diagram:



The object is located at a distance of two focal point ($2F$) from the lens (here, 1 cell is equal to 1 centimeter). According to the theory, we obtain a real, inverted image, that is the same size as the object and located at a distance of two focal point on the other side of the convex lens.

Answer:

$h_i = -10\ cm.$