SAMPLE PROBLEM B

Lenses

PROBLEM

An object is placed 30.0 cm in front of a converging lens and then 12.5 cm in front of a diverging lens. Both lenses have a focal length of 10.0 cm. For both cases, find the image distance and the magnification. Describe the images.

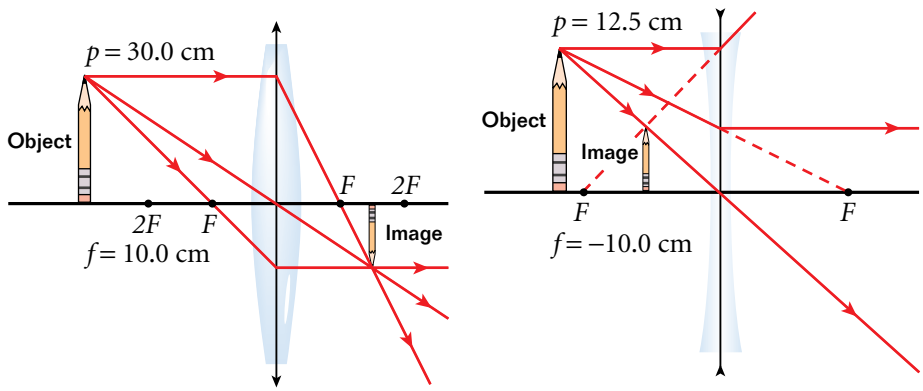
SOLUTION

1. DEFINE

Given: $f_{converging} = 10.0\text{ cm}$ $f_{diverging} = -10.0\text{ cm}$
$p_{converging} = 30.0\text{ cm}$ $p_{diverging} = 12.5\text{ cm}$

Unknown: $q_{converging} = ?$ $M = ?$ $q_{diverging} = ?$ $M = ?$

Diagrams:



2. PLAN

Choose an equation or situation:

The thin-lens equation can be used to find the image distance, and the equation for magnification will serve to describe the size and orientation of the image.

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} \qquad M = -\frac{q}{p}$$

Rearrange the equation to isolate the unknown:

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$$

3. CALCULATE

For the converging lens:

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{10.0\text{ cm}} - \frac{1}{30.0\text{ cm}} = \frac{2}{30.0\text{ cm}}$$

$$\boxed{q = 15.0\text{ cm}}$$

$$M = -\frac{q}{p} = -\frac{15.0\text{ cm}}{30.0\text{ cm}}$$

$$\boxed{M = -0.500}$$