Learning Tip

Does it Make Sense?

Explain to students that they can always make sure their answer makes sense by substituting it into the original equation and testing it. If it does not work, encourage them to try to see if it is too high or too low, or in the wrong form. Students should then go back and find out where they went wrong.

Extend and Assess

- Wrap up the lesson by asking questions based on Table 1. Ask, *If the image distance, d_i, is positive, is the image real or virtual?* (real) *On which side of the lens is the image?* (opposite side) *If the image distance, d_i, is negative, is the image real or virtual?* (virtual) *On which side of the lens is the image?* (same side) Repeat with similar questions, covering the height of the object and image, focal length, and magnification. It may be helpful to draw diagrams demonstrating each of the scenarios being addressed so that students can better connect the quantities with what they represent.
- You may wish to distribute *BLM 13.4-1 Lens Equations* to students. This BLM contains questions to help students correctly use the equations from this section and contains additional problems for practice in using the equations.
- Have students complete the **Check Your Learning** questions on page 566 of the Student Book.

CHECK YOUR LEARNING

Suggested Answers

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

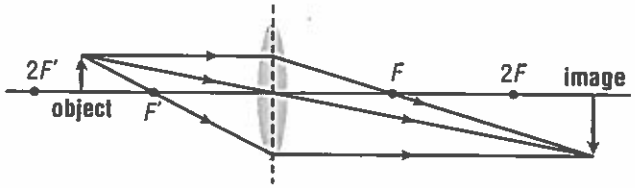
$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$

$\frac{1}{d_i} = \frac{1}{23\text{ cm}} - \frac{1}{32\text{ cm}}$

$\frac{1}{d_i} \doteq 0.0122\text{ cm}^{-1}$

$d_i \doteq 82\text{ cm}$

The image of the frog is 82 cm from the centre of the lens on the opposite side of the lens.

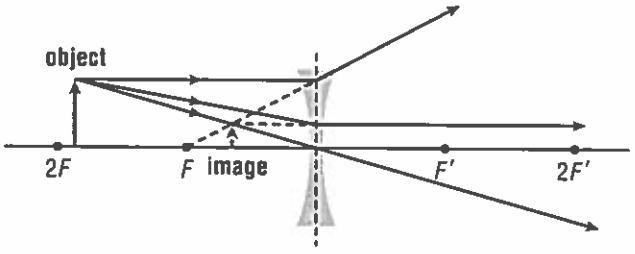


2. $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$\frac{1}{2.53\text{ cm}} + \frac{1}{-18\text{ cm}} = \frac{1}{f}$

$-0.0367\text{ cm}^{-1} \doteq \frac{1}{f}$

$-27\text{ cm} \doteq f$



3. $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

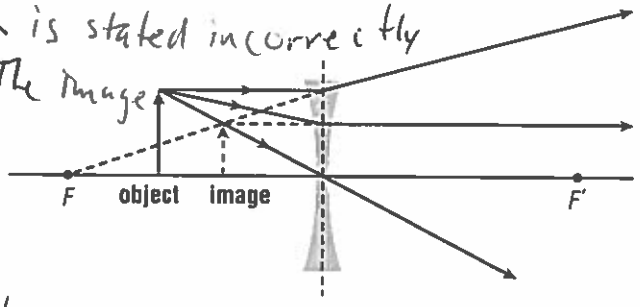
$\frac{1}{d_o} = \frac{1}{f} - \frac{1}{d_i}$

$\frac{1}{d_o} = \frac{1}{-34\text{ cm}} - \frac{1}{-13\text{ cm}}$

$\frac{1}{d_o} \doteq 0.0475\text{ cm}^{-1}$

$d_o \doteq 21\text{ cm}$

The booklet is 21 cm from the centre of the lens on the same side as the image.



This question is stated incorrectly in the text. The image is not behind the lens as stated in the text

4. $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

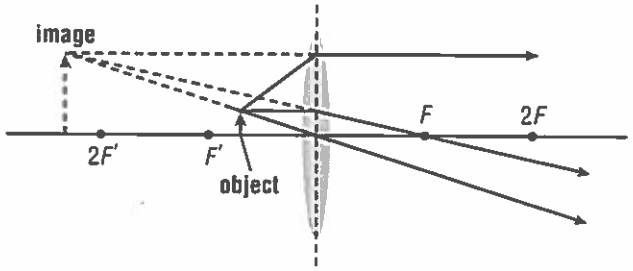
$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$

$\frac{1}{d_i} = \frac{1}{16\text{ cm}} - \frac{1}{11\text{ cm}}$

$\frac{1}{d_i} \doteq -0.0284\text{ cm}^{-1}$

$d_i \doteq -35\text{ cm}$

The image will be 35 cm from the lens on the same side as the object.

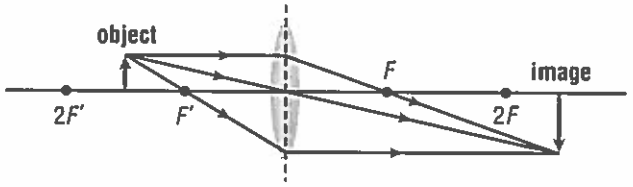


5. (a) $M = \frac{h_i}{h_o}$

$= \frac{-35}{12}$

$\doteq -2.9$

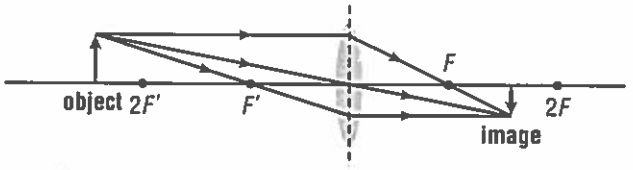
(b) The image is real.



6. $M = \frac{h_i}{h_o}$

$= \frac{-7.9}{14}$

$\doteq -0.56$

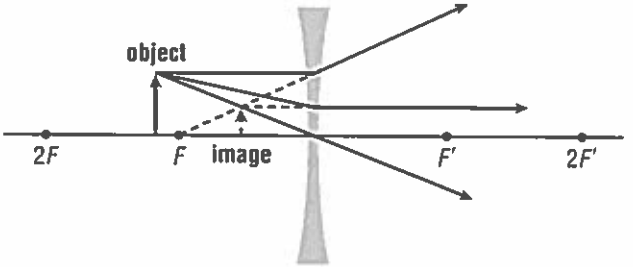


7. (a) $M = \frac{h_i}{h_o}$

$= \frac{1.3}{2.8}$

$\doteq 0.46$

(b) The image is upright.



8. (a) $M = -\frac{d_i}{d_o}$

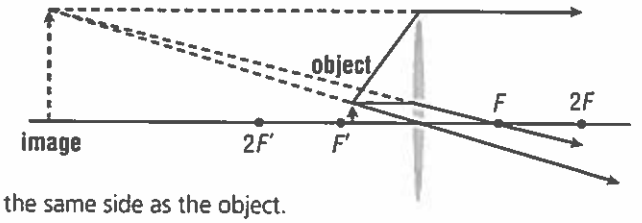
$-Md_o = d_i$

$d_i = -Md_o$

$= -5.6(9.4\text{ cm})$

$\doteq -53\text{ cm}$

The image is 53 cm from the centre of the lens on the same side as the object.



(b) $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$\frac{1}{9.4\text{ cm}} + \frac{1}{-53\text{ cm}} = \frac{1}{f}$

$-0.0875\text{ cm}^{-1} \doteq \frac{1}{f}$

$11\text{ cm} \doteq f$

(c) The lens is converging because it has a positive focal length. Also, only a converging lens can produce a virtual image that is larger than the original object. A diverging lens always produces a virtual image that is smaller than the original object.