Thin Lens Equation and the Magnification Equation
Learning Goals

• I can calculate using the lens equation.
Thin Lens Equation and the Magnification Equation

For simplicity we will only be using converging lenses and thin lenses.

The equations are the same as for mirrors:

\[
\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}
\]

\[
M = \frac{h_i}{h_o} = -\frac{d_i}{d_o}
\]
Example: An object is 8.5 cm high and is placed 28 cm from a converging lens. The focal length of the lens is 12 cm.

a) Calculate the image distance. b) Calculate the image height.

a) Given: \( d_o = 28 \text{ cm} \) \( f = 12 \text{ cm} \) \( h_o = 8.5 \text{ cm} \)

Required: \( d_i = ? \text{ cm} \)

Analysis: \( \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \) OR

Solution: \( \frac{1}{d_i} = \frac{1}{f} \) - \( \frac{1}{d_o} \)

\[
\begin{align*}
1/d_i &= 1/12\text{cm} - 1/28 \text{ cm} \\
&= 7/84 \text{ cm} - 3/84 \text{ cm} \\
&= 4/84 \text{ cm}
\end{align*}
\]

Find inverse:
\[
\begin{align*}
d_i &= 84/4 \text{ cm} = 21 \text{ cm}
\end{align*}
\]

Therefore the image is 21 cm from the lens.
b) Calculate the image height.

Given: \( d_i = 21 \text{ cm} \quad h_o = 8.5 \text{ cm} \quad f = 12 \text{ cm} \quad d_o = 28 \text{ cm} \)

Required: \( h_i = ? \text{ cm} \)

Analysis: \( m = \frac{h_i}{h_o} = -\frac{d_i}{d_o} \quad \text{OR} \quad \frac{h_i}{h_o} = -\frac{d_i}{d_o} \)

\[
h_i = \frac{(-d_i)(h_o)}{d_o} = \frac{(-21 \text{ cm})(8.5 \text{ cm})}{28 \text{ cm}} = -6.375 \text{ cm} = -6.4 \text{ cm}
\]

Therefore the height is 6.4 cm and the image is inverted.
Success Criteria

• I can use GRAS to solve the following problems: (next slide)
Homework

- Using the example on the back as a guide:
- Complete Qs #1-4 on page 500 (ON Science 10)
- Also Complete Qs #1-4 on page 498 (ON Science 10)