

Converging Lenses

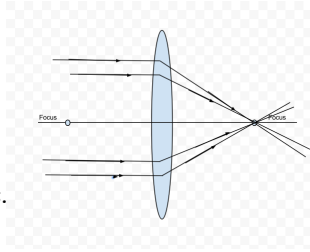
Converging Lenses

Objectives

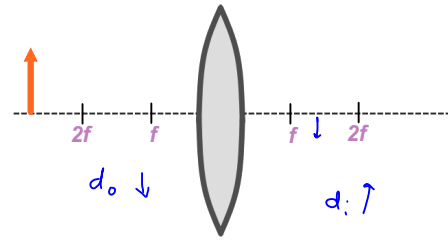
Calculate image distance and magnification in converging lenses.

Identify the properties of images in converging lenses.

Draw ray diagrams for virtual images in converging lenses.



Ray Diagram



Ray Diagrams

Lens Equation

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

$$d_o^{-1} + d_i^{-1} = f^{-1}$$

Example:

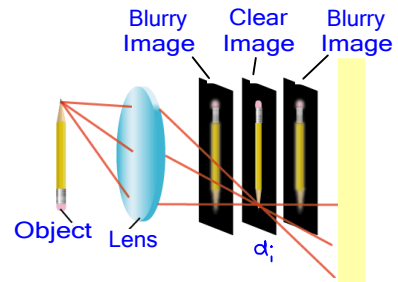
$$f = 15 \text{ cm}$$

$$d_o = 40 \text{ cm}$$

$$(40 \text{ cm})^{-1} + (d_i)^{-1} = (15 \text{ cm})^{-1}$$

$$d_i = 24 \text{ cm}$$

Eye Lens



Magnification

$$M = -\frac{d_i}{d_o}$$

Size

Example:

$$f = 15 \text{ cm}$$

$$d_o = 40 \text{ cm}$$

$$d_i = 24 \text{ cm}$$

$$M = -\frac{24}{40}$$

$$M = -.6$$

Magnification

$M > 1$ (larger)
 $M < 1$ (smaller)
 $M = 1$ (same size)

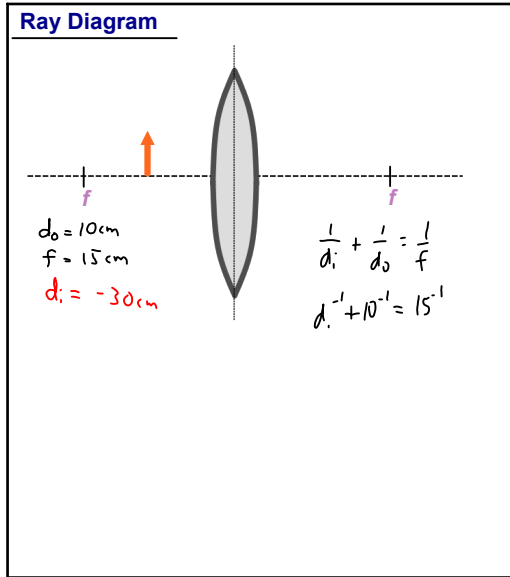
+M (upright)
 -M (inverted)

+d_i (real)
 -d_i (virtual)

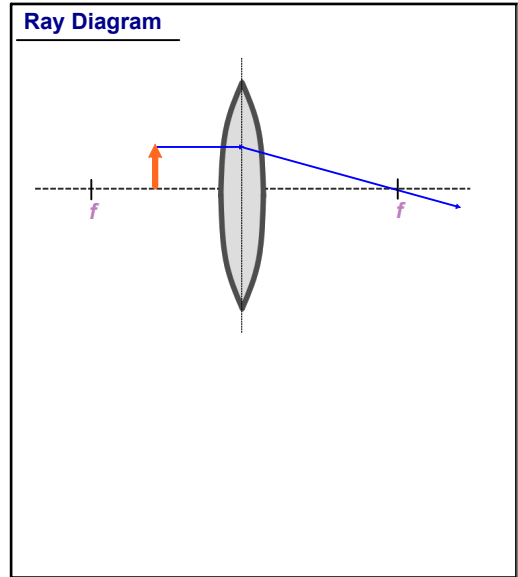
$-.6$
 Smaller
 inverted
 real image

Converging Lenses

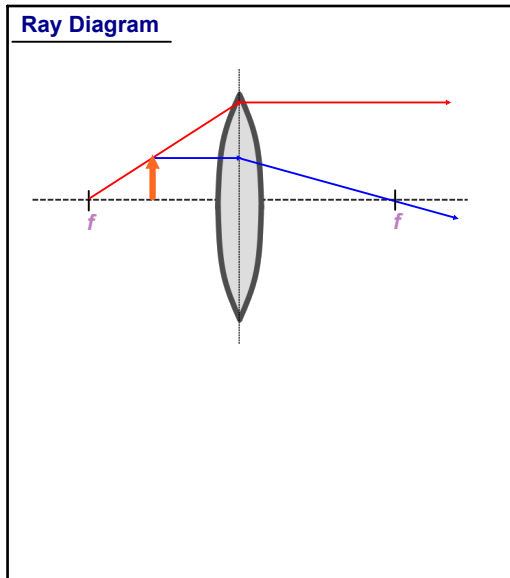
Ray Diagram



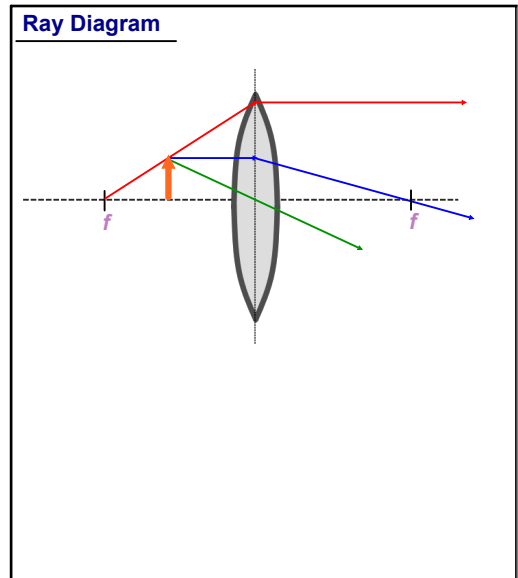
Ray Diagram



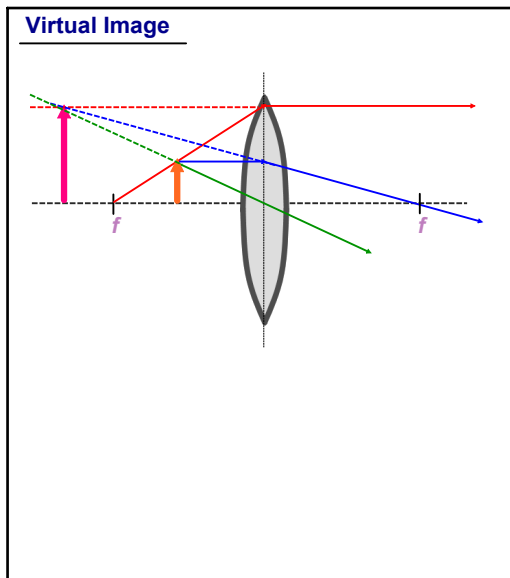
Ray Diagram



Ray Diagram

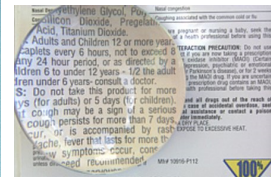


Virtual Image



Converging Lenses: Magnifying Glass

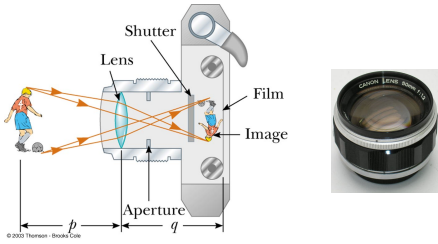
Object inside focal pointupright, larger, virtual image.



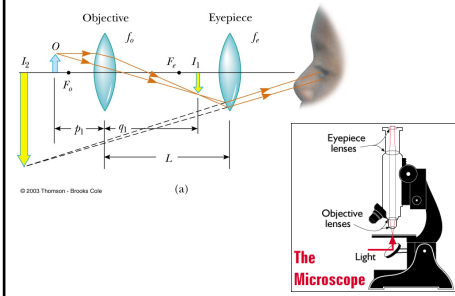
Converging Lenses

Converging Lenses: Camera

Object outside $2f$ inverted, smaller, real image.



Converging Lenses: Microscope






Assignments . . .



- Chapter 23 Homework #1 - 7



Attachments

-  Eye lens
-  Human Eye Accommodations
-  Ray Diagrams