Ray diagrams

- Three rays leave one point on an "object":

1) A ray parallel to the principal axis (aka optic axis), will (seem to) pass through the focal point F.
2) A ray that (seems to) pass(es) through F', will end up parallel to the principal axis.
3) A ray that passes through the center of the lens, will continue virtually undeflected.

- Where these three rays converge (or seem to converge), is the corresponding point on the image.

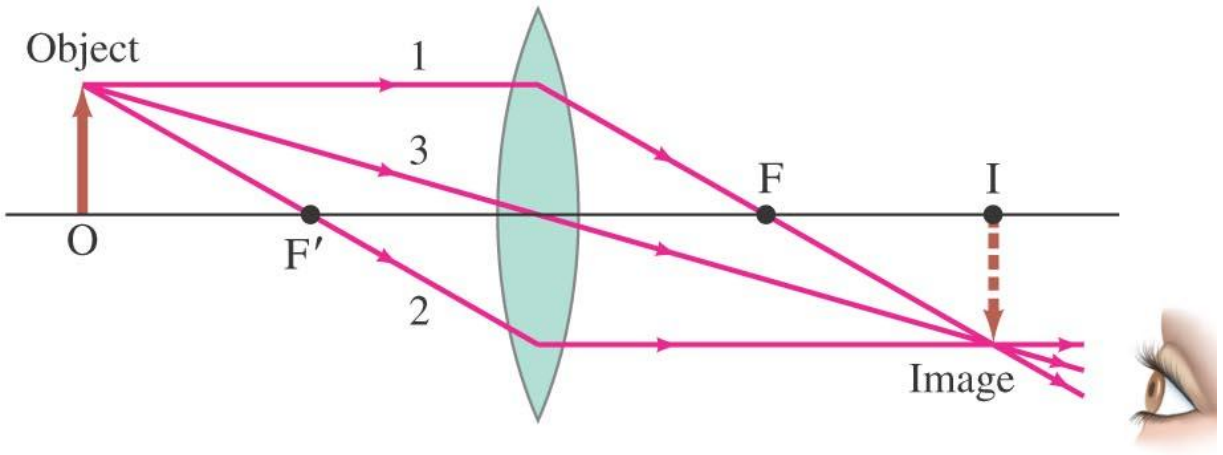


Figure 33.6c

Object and Image distances

- d_0 = "object distance" = distance of object from lens.
- d_i = "image distance" = distance of image from lens.
- f = "focal length" = distance of F from lens.

- d_0 is positive if the object is on the same side of the lens as the incident rays.
- d_i is positive if the image is on the same side of the lens as the transmitted rays.
  - d_i positive means image is "real and inverted".
  - d_i negative means image is "virtual and upright".
- f is positive if incident rays parallel to the optic axis actually converge at F (or F').
  f is negative if the rays only appear to converge at F (or F').

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

$$m=\frac{h_i}{h_o}=-\frac{d_i}{d_o}$$

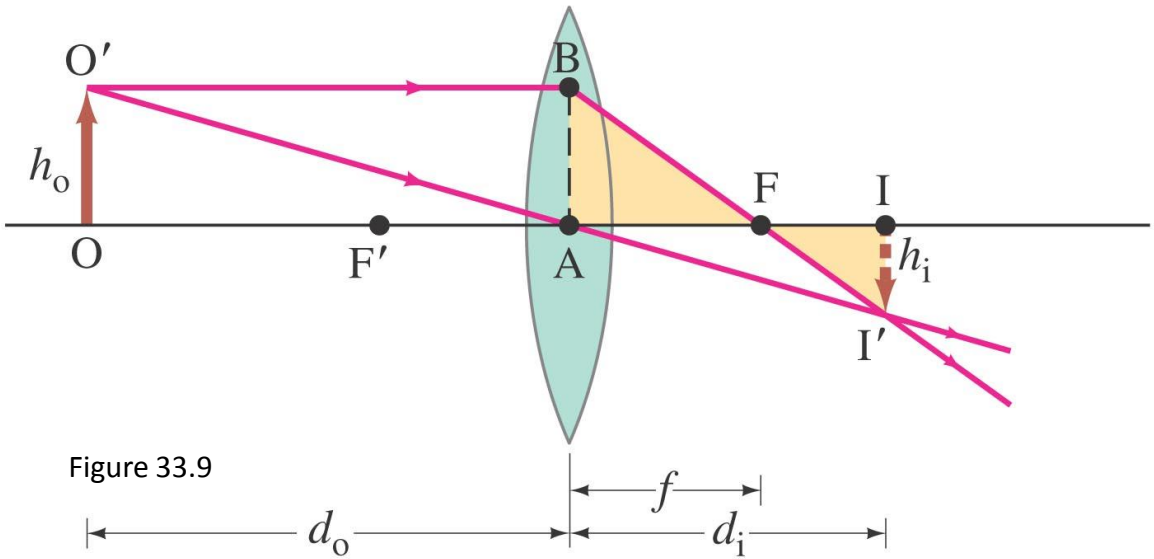
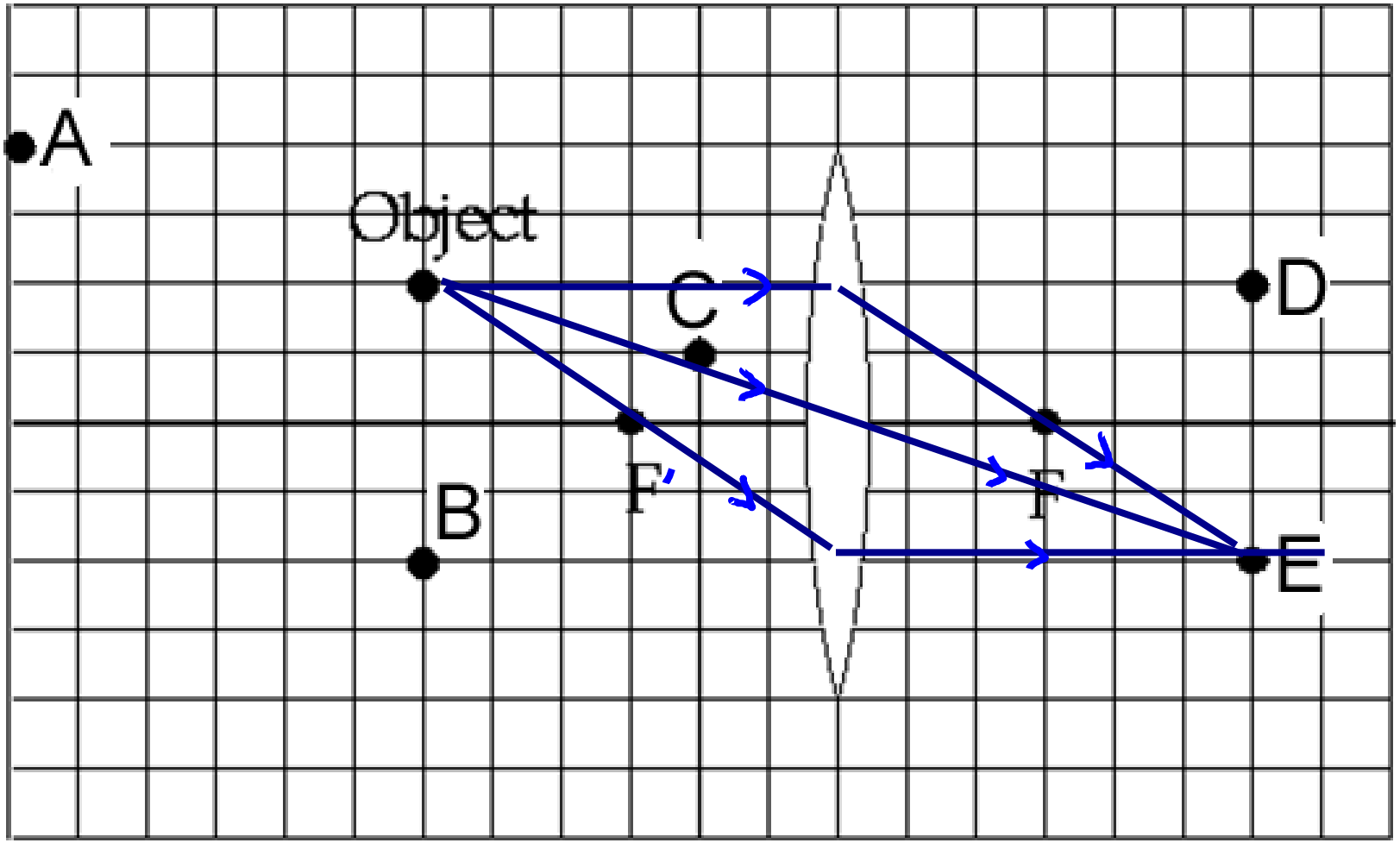


Figure 33.9

A convex lens has a focal length *f*. The only way to get a magnification of –1 is to

1) place a real object at the focal point.
2) place a real object at a distance 2*f* from the lens.
3) place a real object at a distance 3*f* from the lens.
4) Magnifications from a positive lens can never be negative.
5) None of these is correct.

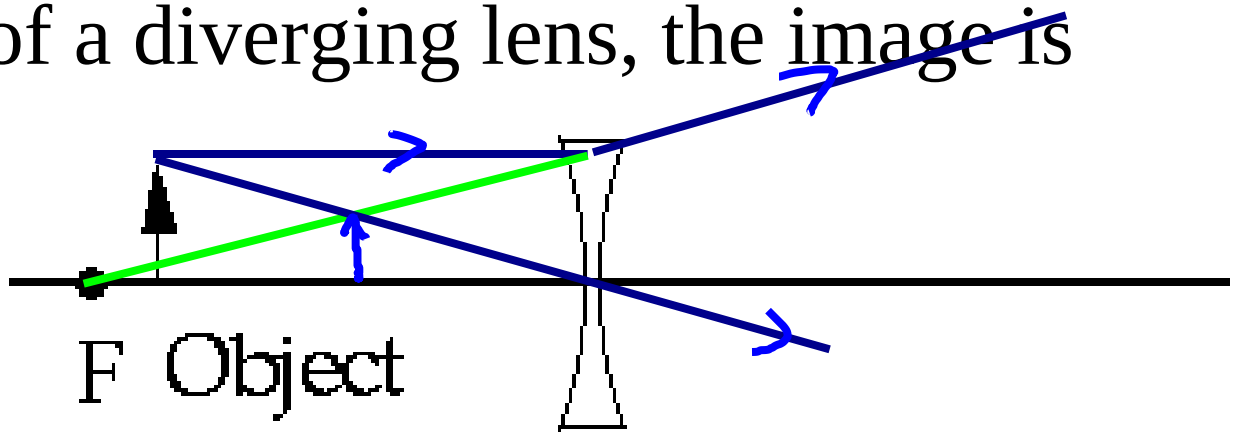
The image produced by the converging lens is at which point? (F marks the two focal points.)



A converging lens and a screen are so arranged that an image of the sun falls on the screen. The distance from the lens to the screen is

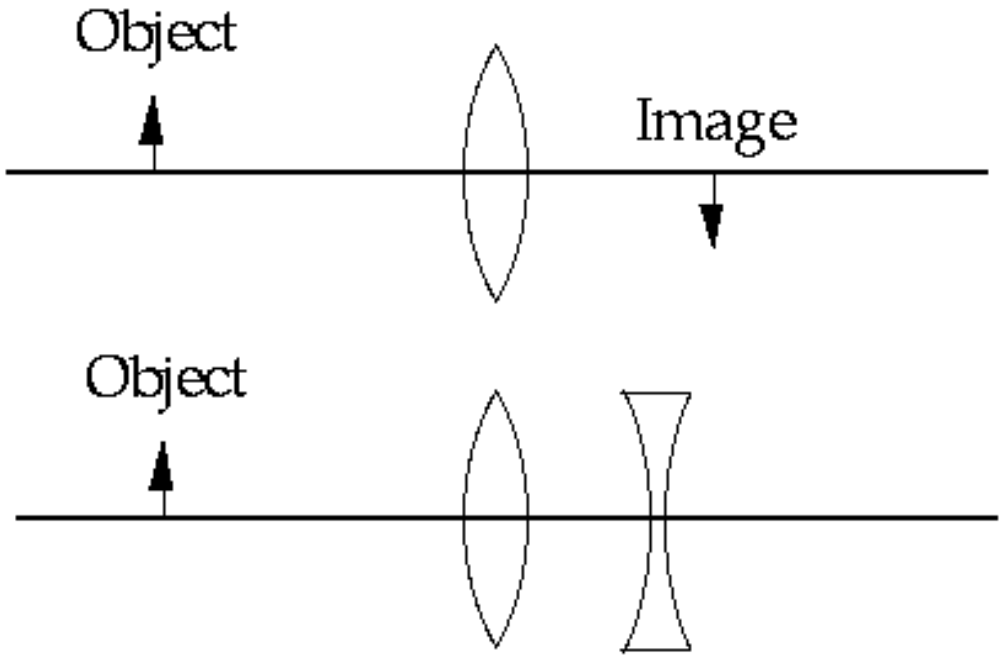
1) the focal length.
2) the object distance.
3) the magnifying power.
4) one-half the radius of curvature of one of the lens faces.
5) the average radius of curvature of the two lens faces.

When a real object is placed just inside the focal point F of a diverging lens, the image is



1) virtual, upright, and diminished.
2) real, inverted, and enlarged.
3) real, inverted, and diminished.
4) virtual, upright, and enlarged.
5) virtual, inverted, and diminished.

A real image is formed by a converging lens. If a weak diverging lens is placed between the converging lens and the image, where is the new image located?



1) farther from the converging lens than the original image.

2) closer to the converging lens than the original image.

3) at the original image position.

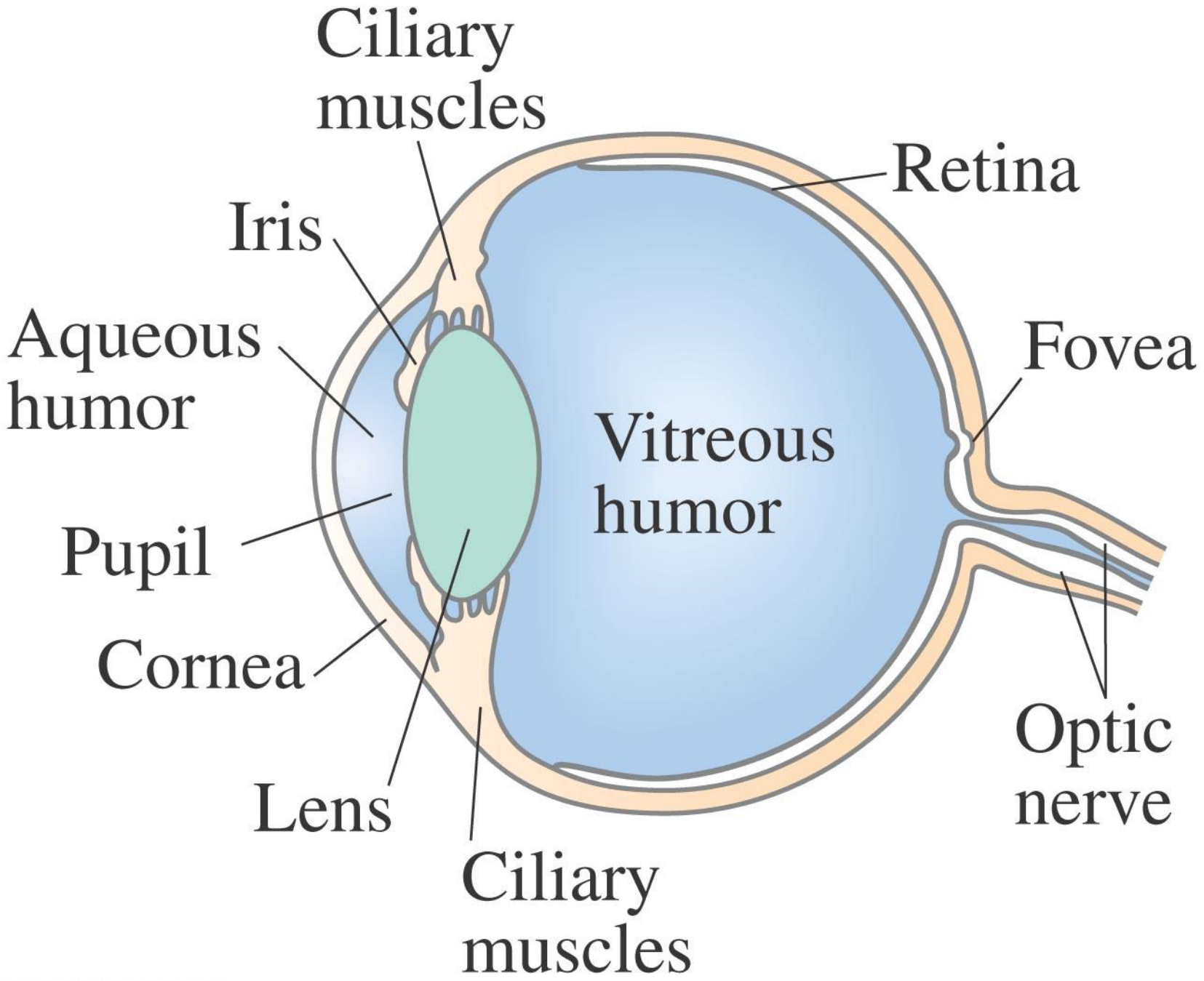


Figure 33.25

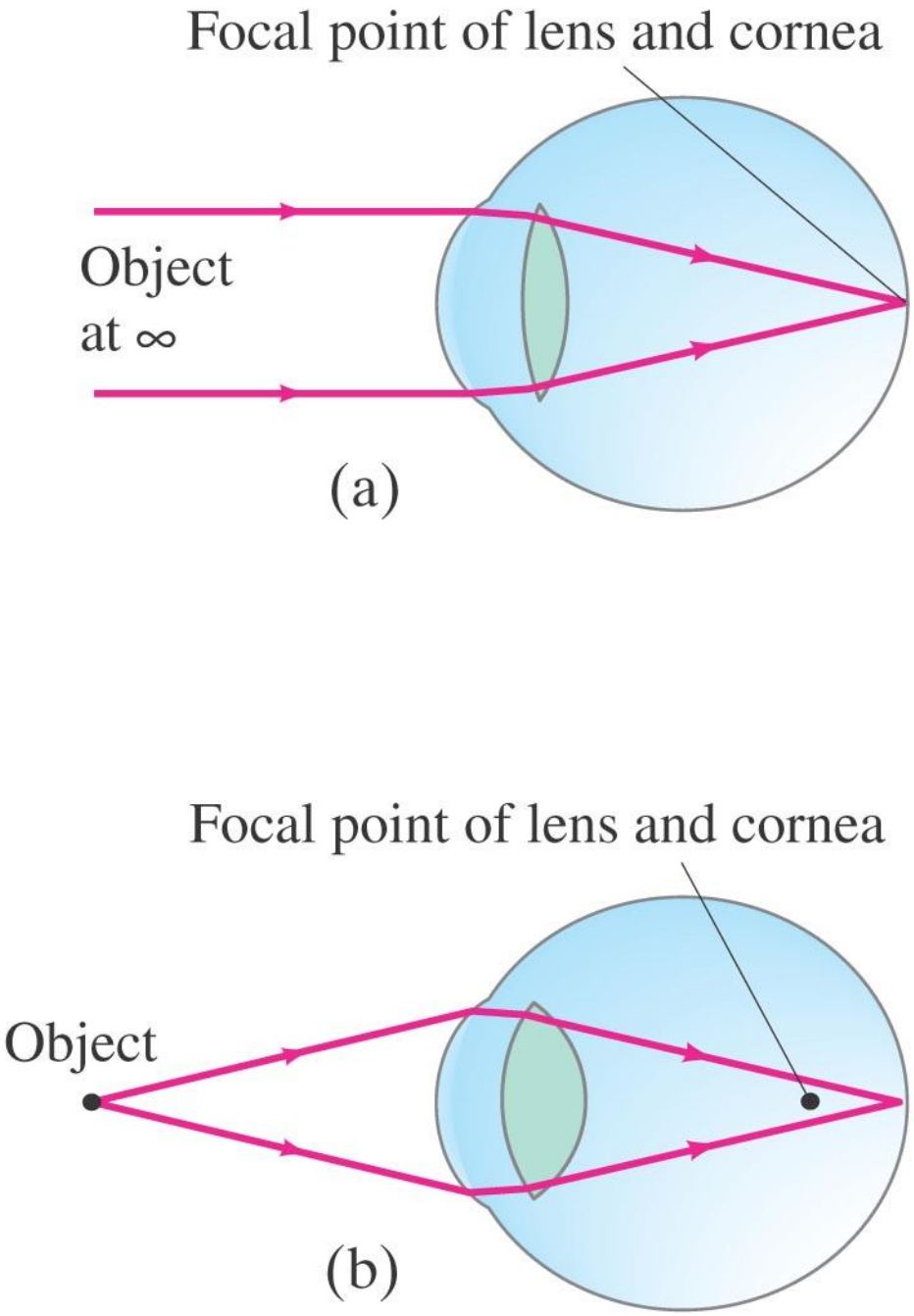
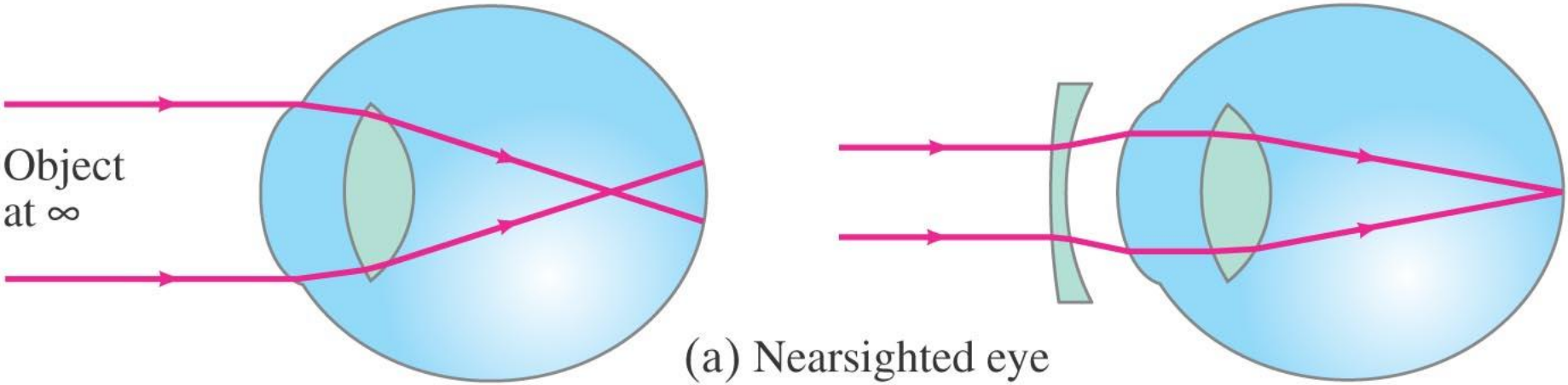
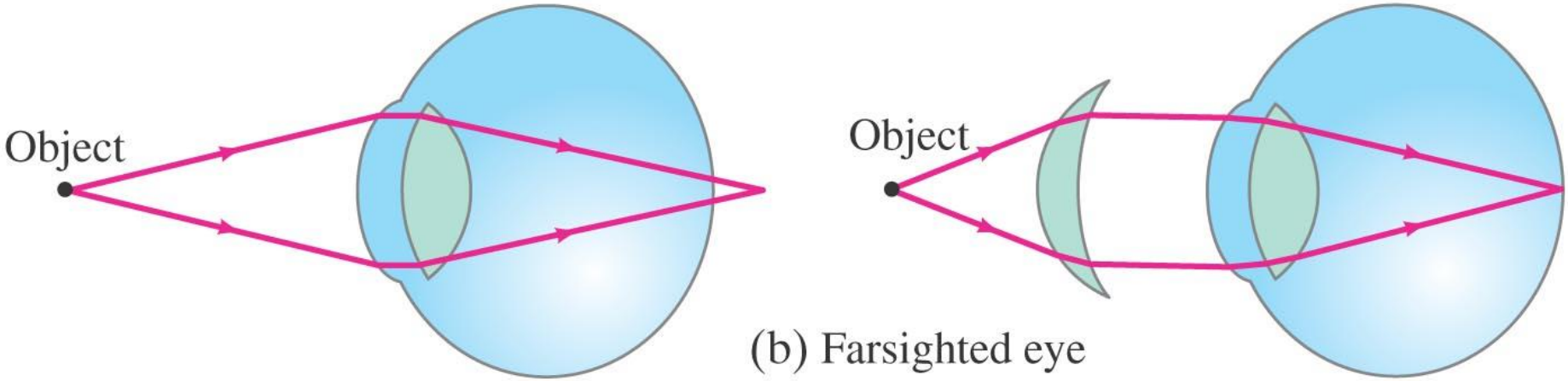


Figure 33.26



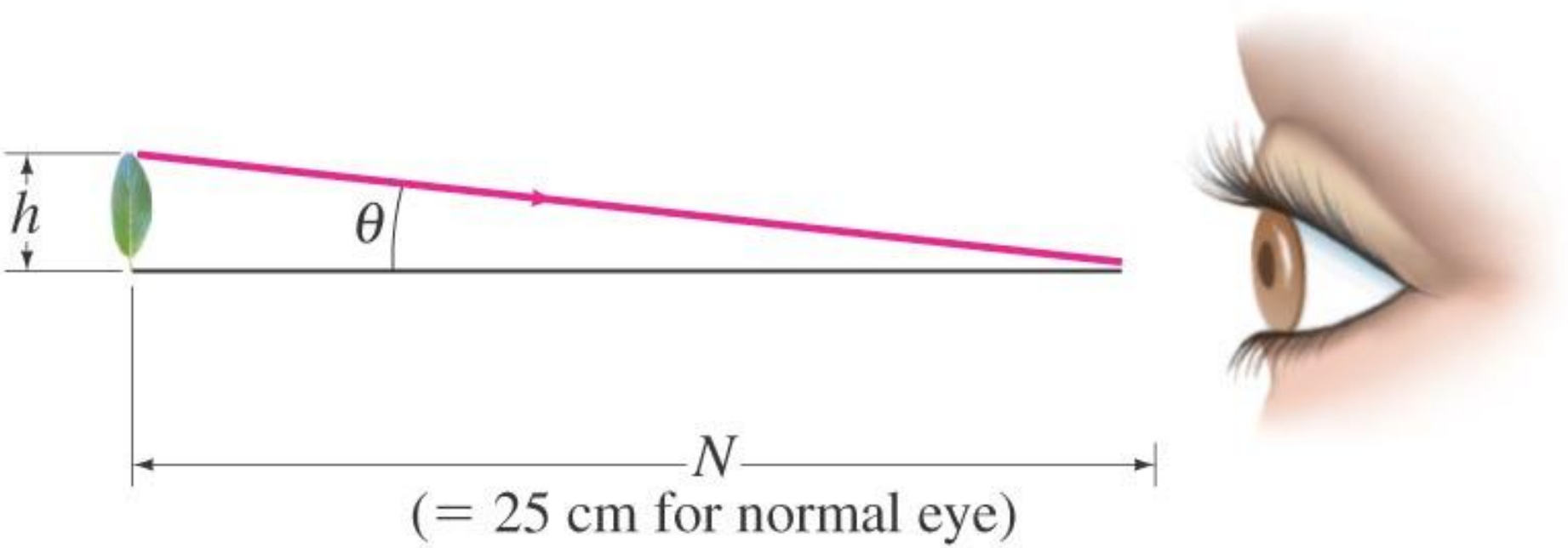
(a) Nearsighted eye

Figure 33.27a



(b) Farsighted eye

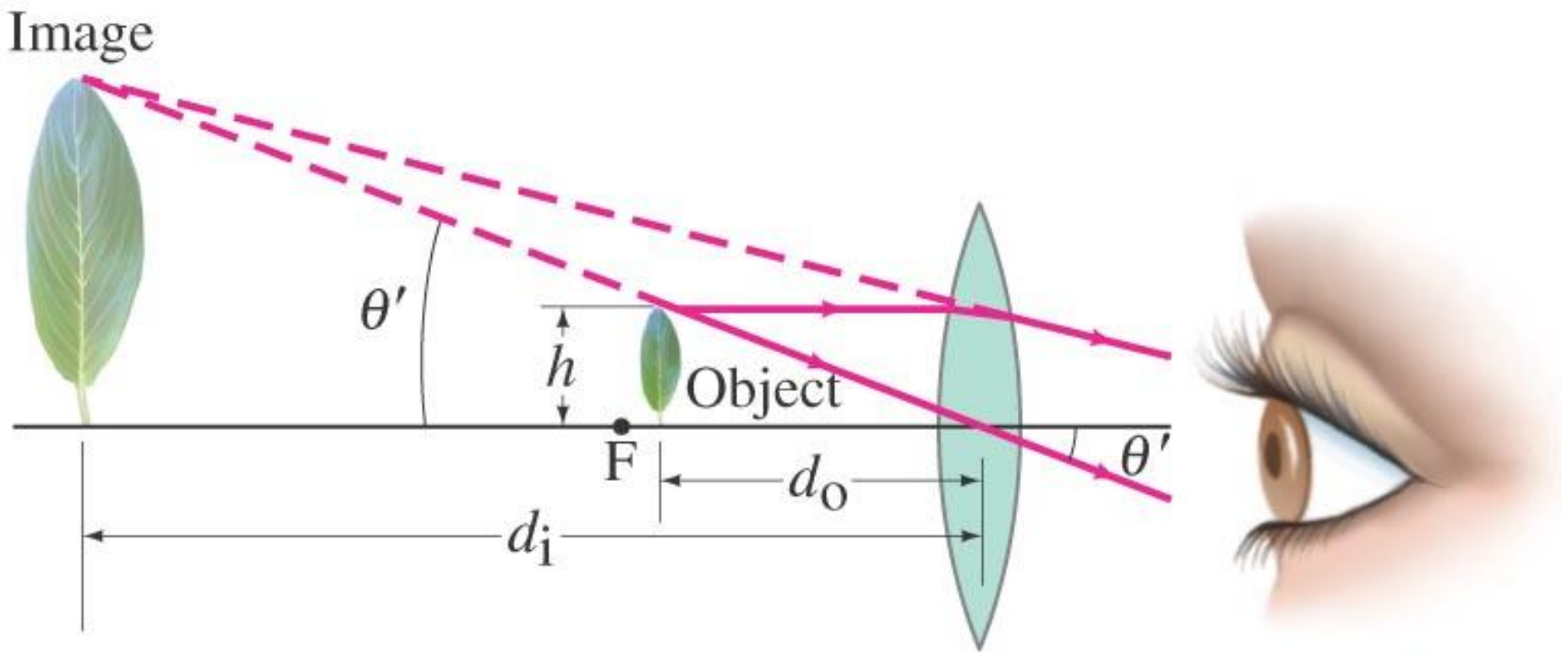
Figure 33.27b



(b)

Figure 33.33b

Magnifying Glass/Reading Glasses



(a)

Figure 33.33a

Telescope

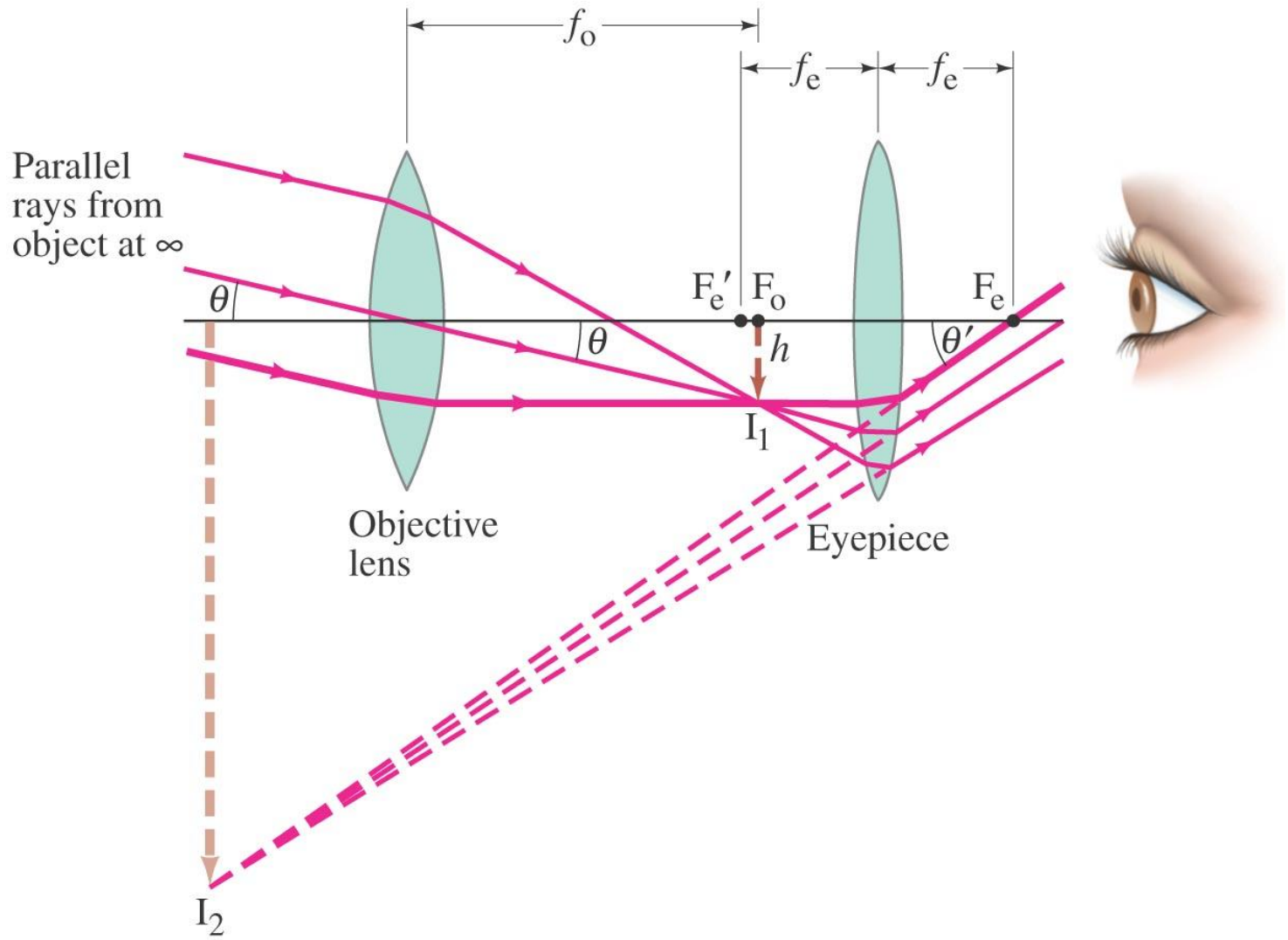
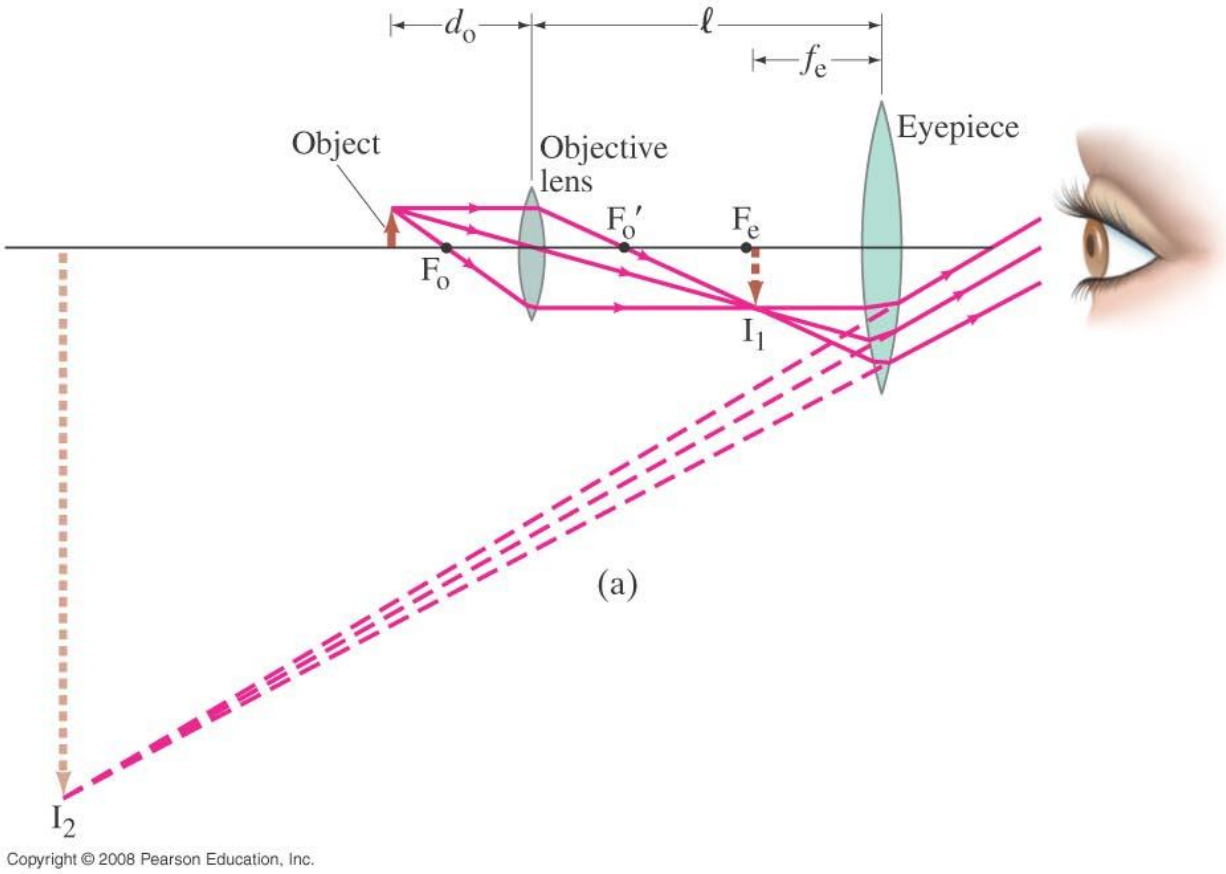


Figure 33.36

Microscope



(b)

Figure 33.40