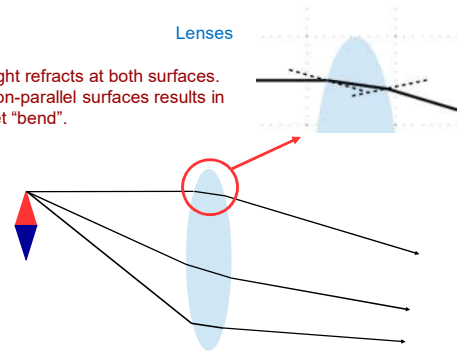
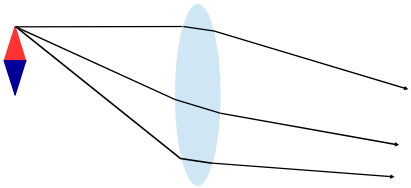
Lenses

Light refracts at both surfaces. Non-parallel surfaces results in net “bend”.



Lenses

Focusing power of the lens is function of
- radius of curvature of each surface and
- index of refraction of lens.



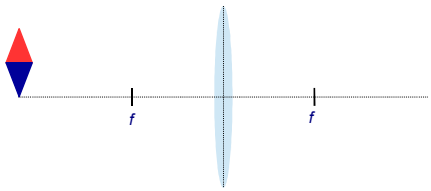
Lenses

Converging lenses are thicker in the center of the lens.

Diverging lenses are thinner in the center of the lens.

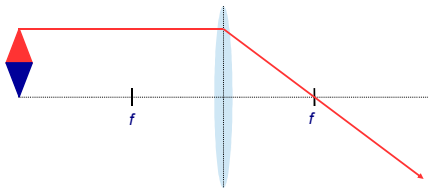
Symmetric Thin Lens Approximation

Assume all bend occurs along a line through the lens.
Assume the same focus on each side of the lens.



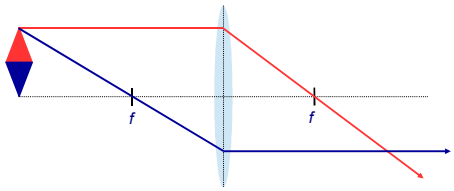
Use geometric ray diagram to determine image location.

- From the object to the lens, parallel to the principle axis
  From there (lens) through the far focal point



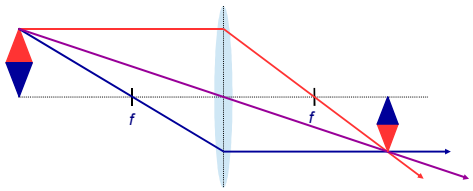
Use geometric ray diagram to determine image location.

- From the object through the near focal point to the lens
  from there (lens) parallel to the principle axis



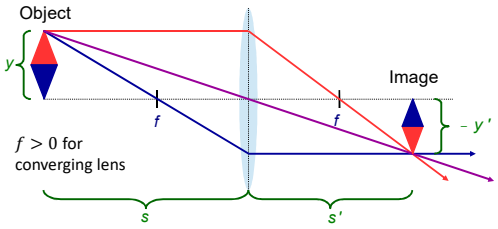
Use geometric ray diagram to determine image location.

- From the object through the center of the lens



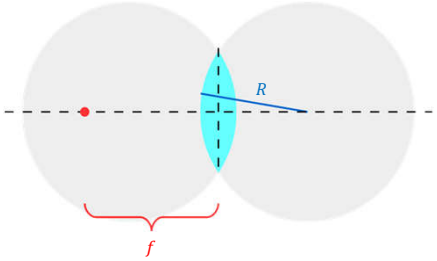
Calculation

$$\frac{1}{s}+\frac{1}{s'}=\frac{1}{f} \qquad m=\frac{y'}{y}=\frac{-s'}{s}$$



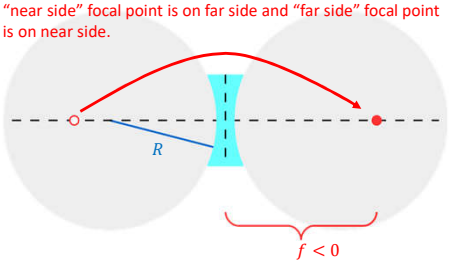
Sign Conventions

Positive f associated with positive R on opposite side of lens.



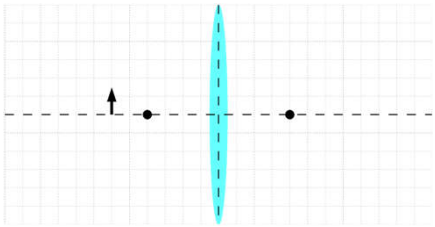
Sign Conventions

Negative f associated with negative R. Negative f means "near side" focal point is on far side and "far side" focal point is on near side.

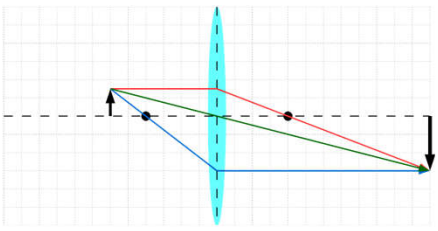


$f < 0$

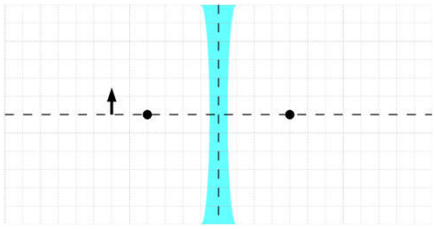
Example: A 3cm tall object is placed 12cm from a converging thin lens with a focal length of 8cm. (a) Where would the image be? (b) How tall would the image be?



Example: A 3cm tall object is placed 12cm from a converging thin lens with a focal length of 8cm. (a) Where would the image be? (b) How tall would the image be?



Example: A 3cm tall object is placed 12cm from a diverging thin lens with a focal length of – 8cm. (a) Where would the image be? (b) How tall would the image be?



Example: A 3cm tall object is placed 12cm from a diverging thin lens with a focal length of – 8cm. (a) Where would the image be? (b) How tall would the image be?