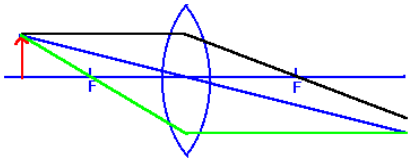
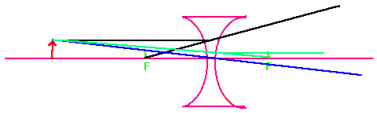
In Class Exercise -- Thin Lens Rules for Ray Tracing

**Ray-tracing rules for a converging lens**




1. A ray that strikes the lens parallel to the axis is refracted through the lens and passes through the focal point on the far side of the lens.
2. A ray that passes through the center of the lens emerges traveling in the same direction with no change.
3. A ray which passes through the focal point on the object side of the lens is refracted so that it emerges on the other side parallel to the axis of the lens.

**Ray tracing rules for a diverging lens:**



1. A ray that strikes the lens parallel to the axis is refracted through the lens so that it appears to come from the focal point on the object side of the lens.
2. A ray that strikes the lens heading for the focal point on the image side of the lens is refracted through the lens so that it emerges parallel to the axis on the other side.
3. A ray that strikes the lens in the center emerges traveling in the same direction on the image side.

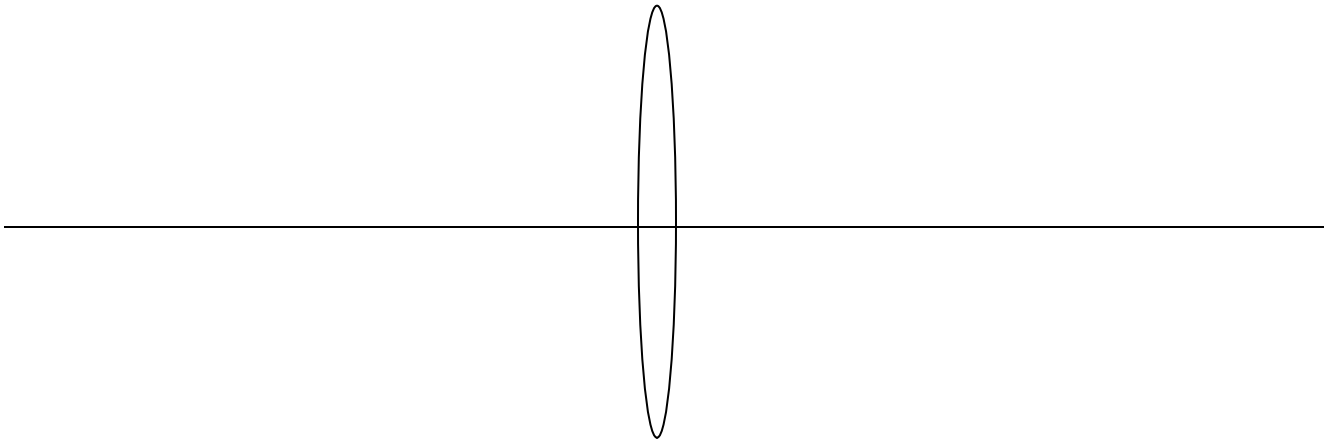
The Thin Lens Equation works in both cases, although you need to be careful about your plus and minus signs.

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

**Sample Question:**

You are given a convex lens that has a focal length of 3cm. An object 2.0 cm tall is placed 5.0cm away from the lens. Treating the lens as a thin lens, find the position and magnification of the image using the two methods below:

a) Use the rules of ray optics to geometrically find the position and magnification of the image.



b) Use the lens equation and the magnification equation in order to find the position and magnification of the image.