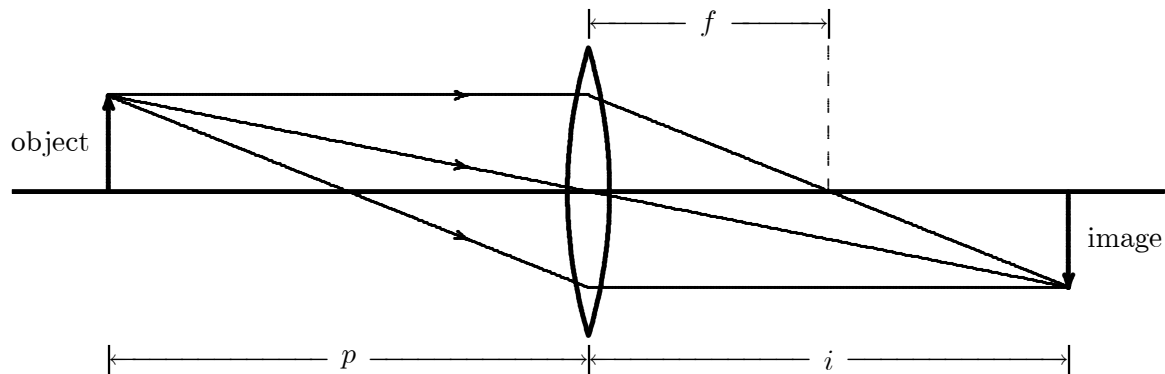# Lenses*

Object

To study image formation due to a converging lens and measure its focal length.

Theory

If p is the distance of an object from a lens and i the distance of its image on the other side of the lens then:

$$\frac{1}{p} + \frac{1}{i} = \frac{1}{f}.$$

where f is the constant focal length of the lens.

For an object at a large distance (compared to f), one may consider $p = \infty$. Then the image is formed at a distance f from the lens. This position is called the focal point of the lens.

When $p < f$, i is negative. This means a virtual image is formed on the same side of the lens as the object. At the position of a virtual image, light from the object does not really converge. From the other side of the lens it just appears as if the rays of light are coming from that image position.
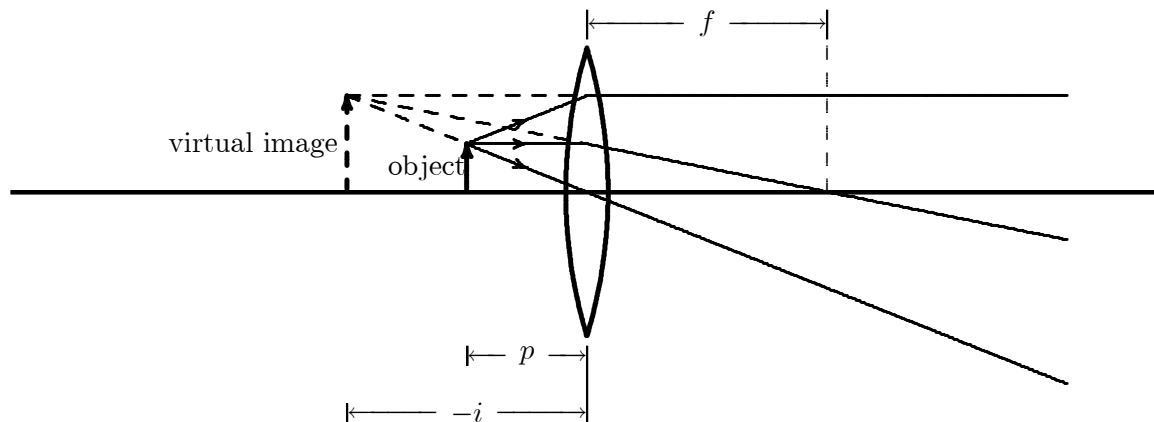
The measurement method

A meter stick with a lens holder and a paper screen is provided for rough measurements. If you take this setup outside the lab, it will be possible to use a distant tree or light as an object at infinity. The image formed can be focussed on the paper screen by adjusting its distance. This image distance is the focal length.

For more accurate measurements, an "optical bench" is provided. This has movable clamps to hold a lens, a ground glass screen, an illuminated object and a metal rod. The object and the screen may be placed on either side of the lens so as to focus an image on the screen. The measured values of p and i can now be used to compute f from the above formula.

Some trials

Find the rough focal lengths of the lenses provided using the meter stick setup. Then use the optical bench to find more accurate values for the same focal lengths. You may not be able to do this for the largest focal length lens as the optical bench is not that long.

Try to locate the position of the virtual image when $p < f$. You will need some help from the instructor to do this as a virtual image cannot be focussed on a screen. The middle focal length lens should give the best results for this experiment.

If possible, measure magnifications of the images formed in each experiment and note their orientations.