I. Converging Lens
Using a single converging (positive) lens, make a series of \((s, s')\) measurements, a “straight-line” plot your data, etc. to determine \(f\), the focal length of the lens. Of course, we assume that the lens equation, which - of course - looks just like the mirror equation, describes the behavior of light rays passing through your lens:

\[
\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}
\]  

Pay some attention to the experimental uncertainties so that you can end up making a meaningful statement of the form:

\[
f = \text{__________________ cm } \pm \text{__________________ cm}.
\]

In this lab you should be able to measure the distances rather more precisely than in the mirror lab.

Repeat the measurements for a second positive lens.

II. Diverging (Negative) Lens
A. Measure the focal length of a diverging (negative) lens by using it together in one holder with the positive lens you just studied, so that the pair of lenses together produce a real image. Again include uncertainty estimates.

B. Also, using the same negative lens, this time alone, form a virtual image of a ruler while holding a second ruler in front of the lens. Keep the lens and object fairly far from your eye. What is the location of the object when the virtual image is half the size of the original object? You should also use parallax (ask me, if this concept is new) to try to find out where the image is. Thus try to estimate the focal length. It’s not easy; but do the best you can.

III. Astronomical and Galilean Telescopes
A. On an optical bench, use two positive lenses to make a crude astronomical telescope. No data needed. Use it to look at something far away. See the handout for the basic idea. Obviously you want a positive lens of large focal length (weak) and another of small focal length (strong).

B. Do the same for a Galilean telescope. See handout. (This one should be non-inverting.)
Be prepared to discuss all of the above for the exit interview. Show explicit calculations of uncertainties for the first two parts. If you calculate \( f \) from the slope of a line using a regression analysis, be sure to obtain an uncertainty estimate from the program you use.