Pre-Lab 6 Lens III

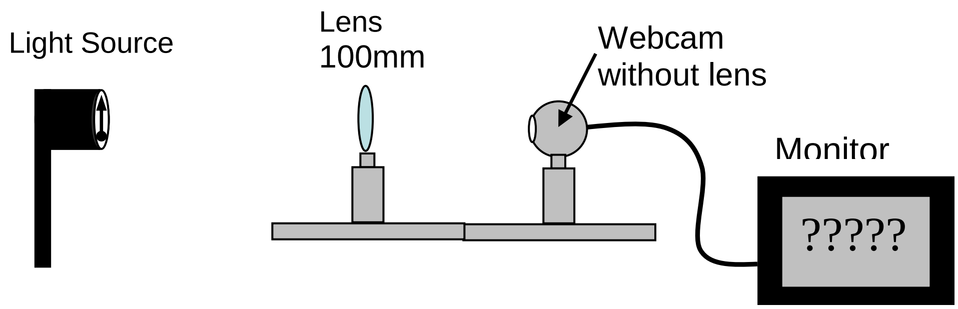
1) Does each lens in a pair of eye-glasses form a real image, a virtual image, or no image at all (as far as the eye-glass wearer is concerned)? How do you know? Does it make a difference as to what object the eye-glass wearer is looking at (near objects, far objects, small objects, large objects, etc.)? Explain!
2) A fellow optics lab student observes that a converging lens held near an object produces a right side up, enlarged image. The student wants the image to be always right side up, but bigger. As the student backs the lens away from the object, the image gets bigger at first. But then the image disappears. The student hypothesizes that, "The image disappears as the image changes from a virtual image to a real image. If one replaces the converging lens with a diverging lens, one could then have enlarged right side up images with increased image size." What do you think about the student's hypothesis?

Lab 6 Lens III

Section 1

The purpose of this section is to familiarize you to using a webcam without a lens and a 100mm focal length lens as a unit. This apparatus will be used as a measuring device.

I. Set up the following equipment (see sketch shown below). The rail cart with the 100mm focal length lens and the rail cart with the webcam should touch each other. In this way, the lens and webcam will always be the same distance apart.

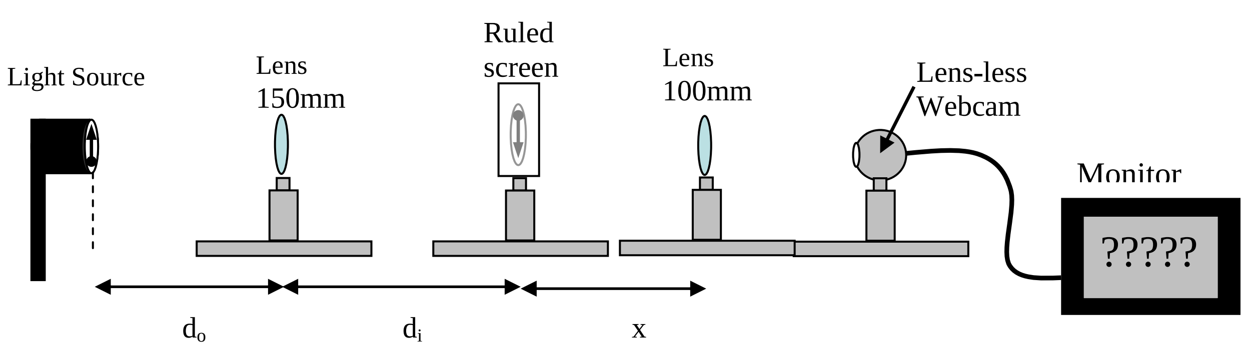


More the 100mm lens-camera assembly as a unit until you see a clear image on the screen. Take a picture (and print it out). Measure the distance from the lens to the light source.

Section 2

How does the image location, magnification, and distance to our 100mm lens / webcam system change as we change the object distance?

Set up the following…



Fill out the following table and take pictures of the image (printing them) each time. Make sure the screen is removed for each picture. To determine the magnification, find the ratio of the image size from the current set up to the image size from section 1.

d_o	d_i	x	d_i / d_o	Magnification	Inverted?
200mm					
300mm					
400mm					
500mm					

How does d_i change as d_o is varied? Why might you expect this?

How does x change as d_o is varied? Why might you expect this?

How does the magnification change as d_o is varied? Why might you expect this?

What is the importance of the ratio d_i / d_o?

For your limited range of d_o values, when is the image non-inverted?

What type of image was formed by the 150mm lens (real or virtual)? Defend your choice.

SHOW YOUR ANSWERS TO THE INSTRUCTOR BEFORE PROCEEDING.

Section 3

In this section you will explore the effects of using a large focal length lens instead of the 150mm focal length lens.

Replace the 150mm focal length lens with a 400mm bi-convex focal length lens. Move the lens car with the 400mm focal length lens so that it is in contact with the car with the light source. Continue to use the 100mm lens-camera assembly as a unit. Move the assembly until you see a focused image on the monitor. Print out a picture of this image. Where does the image form from the 400mm lens? How can you tell?

Draw a sketch with measured values showing the spacing between the optical elements.

What type of image is formed by the 400mm lens? How is the image of the test pattern oriented on the monitor?

Predict what would happen if we remove the 100mm lens from the current set up. Could we get a focused image on the monitor by simply changing the webcam position?

Remove the 100mm lens car from the rail and move the webcam backward and forward. Try to get a clear image on the screen. Resolve any differences with your predictions

Put the 100mm lens car back on the rail. Get a clear image on the screen keeping the 100mm lens car and the webcam car touching each other. Replace the 400mm focal length lens with a -25mm bi-concave focal length lens. Move the lens car with the -25mm focal length lens as close to the light source as possible. Where does the image form from the -25mm lens? Draw a sketch with measured values showing the spacing between each of the optical elements. What type of image is formed by the -25mm lens? How is the image of the test pattern oriented on the screen?

Section 4

In this section you will explore issues regarding diverging lenses and virtual images.

Suppose you replace the 400mm lens with a -100mm lens (a diverging lens). Would you have to move the 100mm lens –camera assembly closer to the -100mm lens (in comparison to the position the assembly had for the 400mm lens), farther from the -100mm lens, or would it be impossible to form a clear image on the monitor?

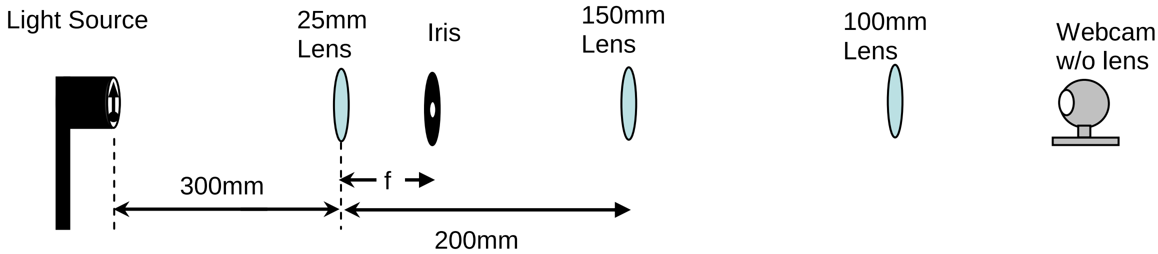
Replace the 400mm focal length lens with a -100mm lens (a diverging lens). Reposition the 100mm lens – camera assembly until you have a clear image on the monitor (if possible). Take a picture of the image. Draw a sketch showing the position of the source, lenses, camera, and image with the correct distances in between each element.

How does the image size from the -100mm lens compare to the image size from the 400mm lens in section 3? Why might you expect this?

Is it possible to use a single diverging lens (no other lenses) and form an enlarged image (an image larger than the object)?

Lab 6 Task

Consider the diagram shown below. Under these circumstances, **predict** whether one can form an image of the whole light source pattern on the monitor while using an iris one focal length away from a lens? Assume an iris aperture diameter of 5.0mm. NOTE: The drawing is not to scale so that all of the elements can be shown.



SHOW YOUR PREDICTION TO YOUR INSTRUCTOR.

Set up the apparatus as shown above. Move the 100mm lens – camera apparatus (as a unit) looking for a clear image. Resolve any discrepancies with your prediction.