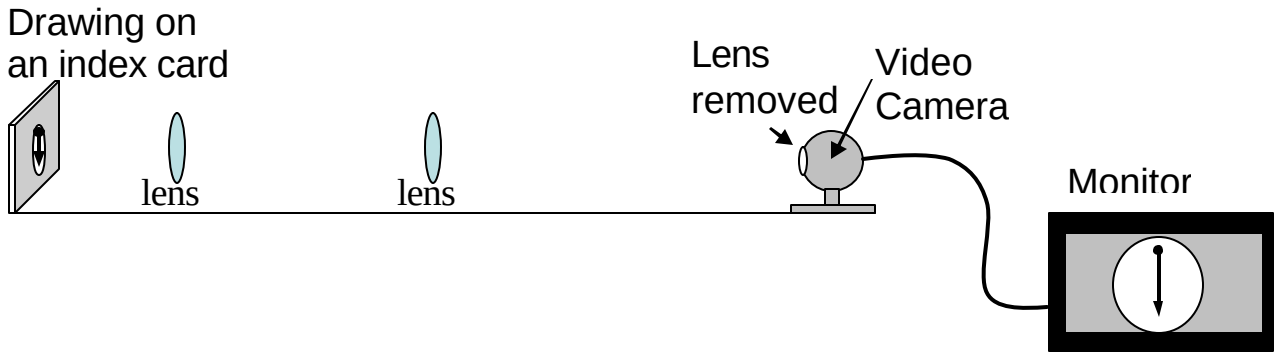
Physics 345 Pre-Lab 5 Lenses Part II

1) Does a lens in 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) Consider the optics set-up shown below. The two lenses are converging lenses and there is a focused picture as shown on the monitor. (Remember what you observed in the last lab concerning the orientation of images seen on the monitor while using a lenseless webcam).



a) Does the lens closer to the index card form a real image, a virtual image, or no image at all (an image of the picture on the index card)? How do you know?

b) Does the lens closer to the video camera form a real image, a virtual image, or no image at all (an image of the picture on the index card)? How do you know?

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For this exercise you will be using the webcam **without the lens**. Set up a light source and a 150mm focal length lens. Adjust the lenseless webcam's position until you see a clear picture on the monitor. Make a prediction of what you think will happen to the picture on the monitor if you turn off the light source? Explain your reasoning.

Now turn off the light source. Resolve any differences you might have between this observation and your previous prediction.

Shine a flashlight beam on the test pattern (light source still off). Does this improve or worsen the contrast of the picture seen on the monitor? Why might this happen?

Use a black cloth to cover the lens and the webcam while still allowing an optical path between these two devices. Does this improve or worsen the contrast of the picture seen on the monitor? Why might this happen?

For the current optical set-up, predict what we would see on the monitor if we covered the right side of the lens? Fully explain your reasoning.

Using a small piece of paper, cover the right side of the lens and observe the picture on the monitor screen. Resolve any differences you might have between this observation and your previous prediction.

A light source with a test pattern is separated from a screen by a distance of 900mm. The image on the screen is upside and exactly twice as large as the test pattern. You will have only one attempt at setting up this situation using any double convex lens in the set.

HOWEVER,…

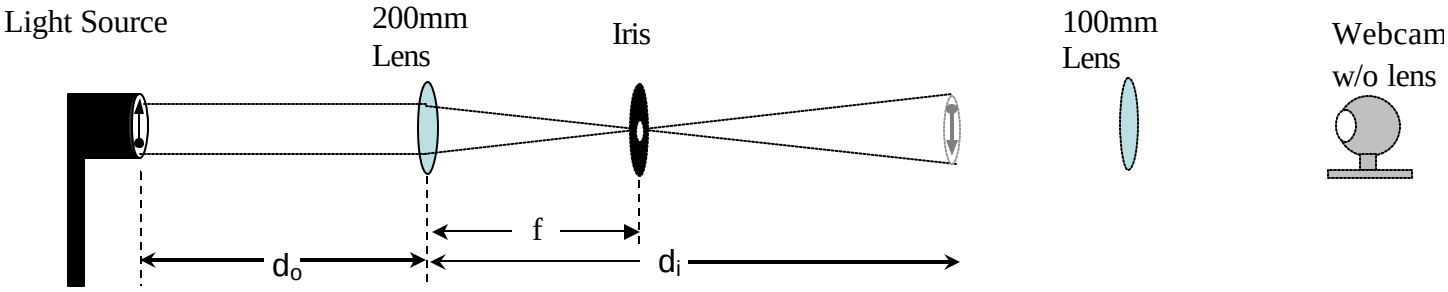
1. You must show all of your predictions to your instructor before turning on the light source
2. You are only allowed one choice of lens. That is, you may NOT try various lenses and see which works best.
3. You have to position the lens, light source, and screen before turning on the light source.

Using a 150mm lens and the light source get a clear image on the cm ruled screen. Mount the lenseless webcam at the center of a rail car and mount a 100mm bi-convex lens at the center of another rail car. Place these cars on the optical rail and remove the cm ruled screen. Keep the 100mm lens car and the webcam car together and touching each other. Position the 100mm lens car and the webcam car (still touching each other) so you can see a focused picture on the monitor using the 150mm lens and light source. How is the picture aligned on the monitor screen? Why do you think the picture is oriented this way?

Using the same set-up, place the cm-ruled screen back on the optical rail between the 100mm lens and 150mm lens. Move the screen until you see a focused image on the screen. Measure the distance from the 100mm lens to the screen. Why do you think the screen's position is so critical?

Replace the 150mm lens with a 200mm lens. Move the cm ruled screen until you find a clear image (on the cm ruled screen). Now move the 100mm lens car and webcam car (keeping these two cars touching) so that a clear image appears on the monitor. Measure the distance from the 100mm lens to the screen. How does this compare to your previous measurement (screen to 100mm lens)? Explain why one might expect this result.

Consider what would happen if we add an iris to the set-up and remove the cm ruled screen. A student suggests that an iris will have a minimal effect if it is placed at focal point of the 200mm lens closest to the 100mm lens (see the sketch). Do you agree or disagree with this students reasoning? EXPLAIN YOUR THOUGHTS.



Try putting the iris at the location shown in the sketch above. Does this match your predictions? Resolve any differences.

Now consider placing the iris anywhere between the light source and the 100mm lens. Make a prediction of where we could place the iris so that it will have a minimal effect on the viewable picture on the monitor?

Try multiple iris locations. Find the location where the iris will have a minimal effect. Resolve any differences with your predictions.

Remove the iris from the set up and put the cm ruled screen back on (between the two lenses) so that you have a clear image. Move the screen so that the picture on the monitor is blurry. Without moving the light source, 200mm lens, or the screen try to get a clear image of the test pattern by moving just the 100mm lens and the video camera (together as a unit). Can you get a clear picture on the monitor? Using your knowledge of lenses, explain why you might expect this result?

CHECK WITH YOUR INSTRUCTOR BEFORE PROCEEDING!

Replace the 200mm focal length lens with a 400mm bi-convex focal length lens. Move the lens car with the 400mm focal length lens close to the light source (within 200mm). Keep the car with the 100mm lens next to the car with the video camera. Once more move these two cars together as one unit until you see a focused image on the monitor. 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 screen?

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?