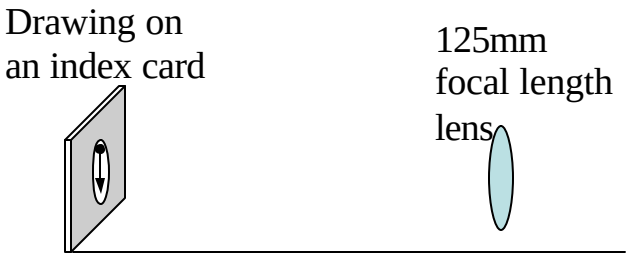
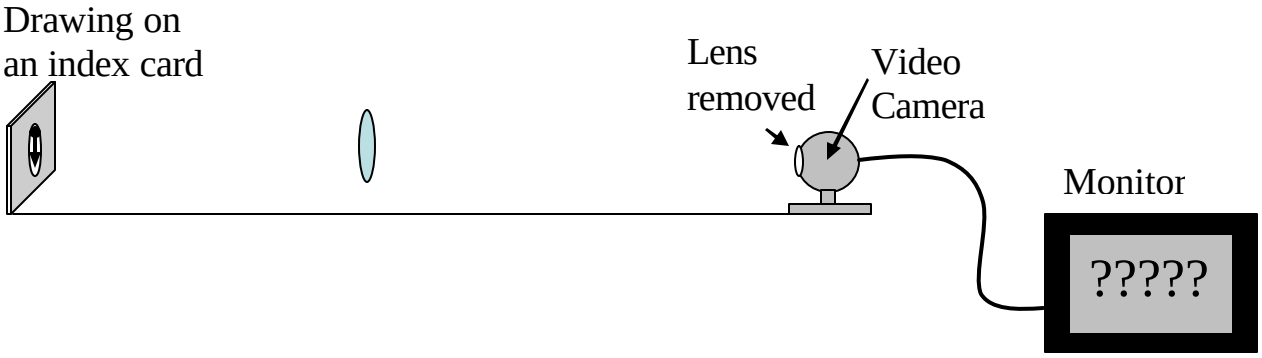
Physics 345 Pre-Lab 4 Single Converging Lens

Consider putting a 125mm focal length converging lens 250mm away from the index card



1) As a result of the 125mm focal length lens, does an image of the drawing form? If yes, where does the image form, how is the image oriented and what type of image is it? If no, what further conditions or equipment would be needed to form an image? Explain your reasoning.

Consider adding the video camera without its lens to the above circumstance.

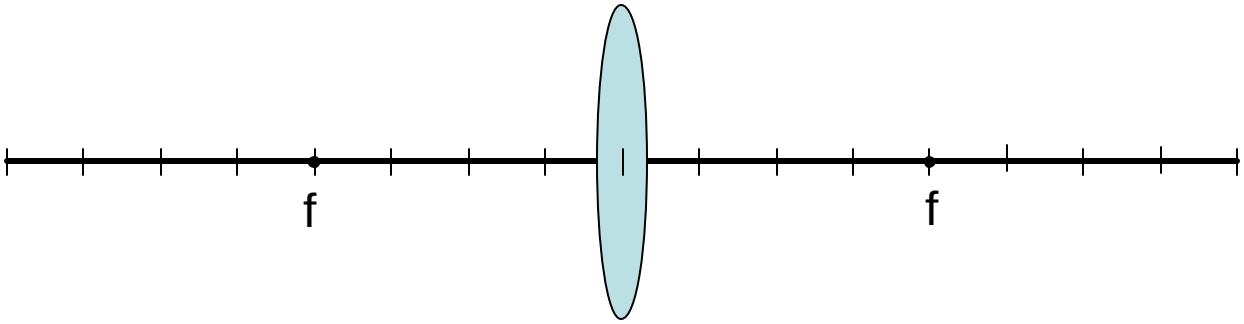


2) Consider moving the video camera towards and away from the lens. Is there a camera location where one can form a focused picture on the monitor of the index card drawing? Explain your reasoning.

Physics 345 Lab 4 Single Converging Lens

Equipment: Optical Rail, optical rail carts, light source with test pattern, lens holder, lens set, white screen (metal), webcam (without lens), USAF resolution card, optical posts, post holders and a computer.

Consider a light source that is a distance of 400mm from a 200mm focal length lens. Using the scaled diagram shown below and rays, determine the following: Where (if anywhere) would one expect to find an image? What type of image is it? How is the image oriented? What magnification would you expect? Fully explain how you arrived at your answers!



SHOW YOUR ANSWERS TO YOUR INSTRUCTOR BEFORE PROCEEDING

Now attach the light source with the test pattern a distance on an optical rail cart. Next put a 200mm focal length double convex lens in a lens holder. Connect the lens holder to an optical cart using a post and post holder. Place the two optical rail carts on the optical rail such that the light source and the lens are exactly 400mm apart. It is highly important that the lens faces are nearly perpendicular to the light beam path.

WITH YOUR INSTRUCTOR PRESENT AND THE LIGHT SOURCE OFF, PLACE THE SCREEN WHERE YOU WOULD EXPECT TO FIND THE IMAGE.
Using the equipment, determine the object distance, object orientation, and magnification. Take a picture of the image using the webcam (with the lens). Resolve any differences from your previous predictions!

Consider a light source that is a distance of 500mm from a 200mm focal length lens. DO NOT SET THIS UP EXPERIMENTALLY AT THIS TIME. Using the thin lens equation $\left(\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f}\right)$ determine the following: Where (if anywhere) would one expect to find an image? What type of image is it? How is the image oriented? What magnification would you expect? Fully explain how you arrived at your answers!

SHOW YOUR ANSWERS TO YOUR INSTRUCTOR BEFORE PROCEEDING

Now Place the two optical rail carts on the optical rail such that the light source and the lens are exactly 500mm apart. It is highly important that the lens faces are nearly perpendicular to the light beam path.

WITH YOUR INSTRUCTOR PRESENT AND THE LIGHT SOURCE OFF, PLACE THE SCREEN WHERE YOU WOULD EXPECT TO FIND THE IMAGE.
Using the equipment, determine the object distance, object orientation, and magnification. Take a picture of the image using the webcam (with the lens). Resolve any differences from your previous predictions.

Is the image still present if the white screen is removed? Explain your reasoning. Make a prediction without any experimental testing (at this time).

Keep the same lens set-up as you used just above. Now remove the screen from the optical rail noting its position. Take a picture with the webcam (with lens). You will have to change the camera settings so that the picture on the screen is not saturated. Resolve any differences.

Predict what you would see if you placed your eye at screen's former location. How would the image look?

Place your eye at the screen's former location. Can you see the image? Resolve any differences with you prediction.

Predict what would happen if you placed your eye approximately 400mm farther away from the lens than the webcam's position (webcam removed). What do you think you will see if you look back towards the lens? Fully explain your reasoning.

Remove the webcam noting its location. Now place your eye approximately 400mm farther from the lens than the webcam's former location. Can you see a clear picture of the test pattern?

Resolve any differences you might have had over the last 2 pages between your predictions and observations.

SHOW YOUR RESULTS TO YOUR INSTRUCTOR BEFORE PROCEEDING.
For the rest of the exercise you will be using the webcam **without the lens**. Make a prediction. Can the webcam take a picture of the image formed by the 200mm lens (500mm from the light source)? What will be the orientation of the picture seen on the screen? Explain your reasoning.

Attach the webcam (without a lens) to an optical rail cart using a post holder. With the 200mm lens still in place with a lit light source, move the webcam along the optical rail until you find a clear image of the test pattern. Resolve any differences from your prediction.

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.

Physics 345 Lab 4 TASK Single Converging Lens

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 before turning on the light source.