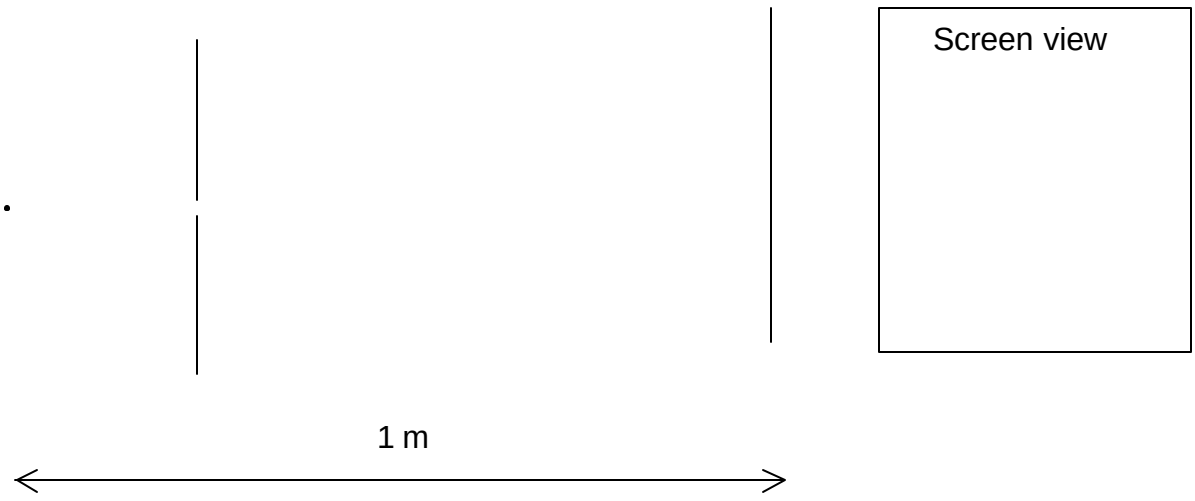
Physics 345 Pre-lab 1 due 1/11/06 3:00pm

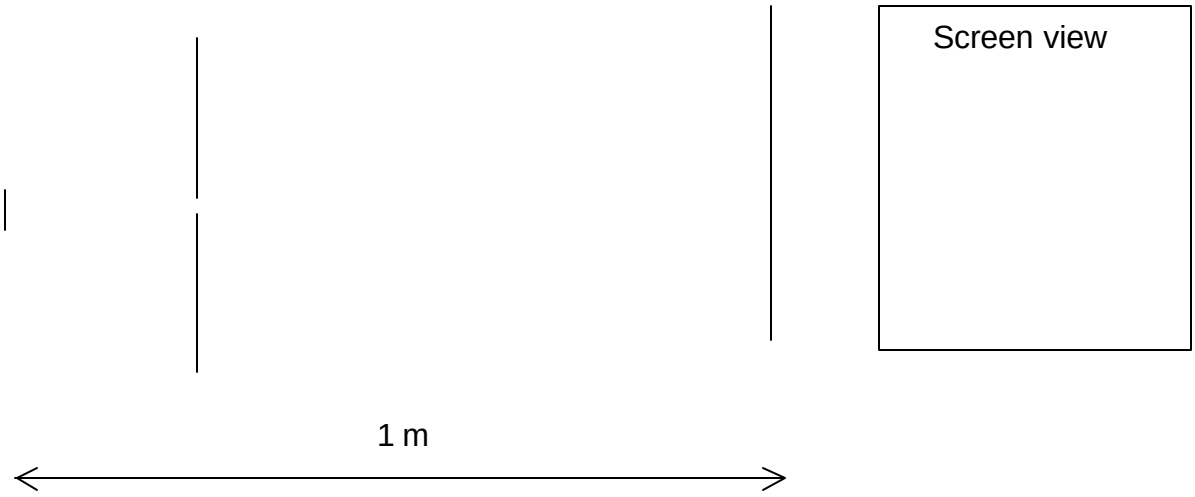
Suppose we have a circular aperture in a baffle and two light sources, a point source and a line source.

1. Point source. Determine how many rays do we need to use to determine the extent of the illumination on the screen for the point source. Draw the pattern of illumination you would expect to see on the screen to SCALE.



Explain your diagrams and reasoning fully.

2. Consider an extended source. For this example, the extended source is a line that is producing light (something like a small radius fluorescent light tube). Determine how many rays we need to determine the extent of the illumination on the screen. Draw the pattern of illumination you would expect to see on the screen to SCALE.

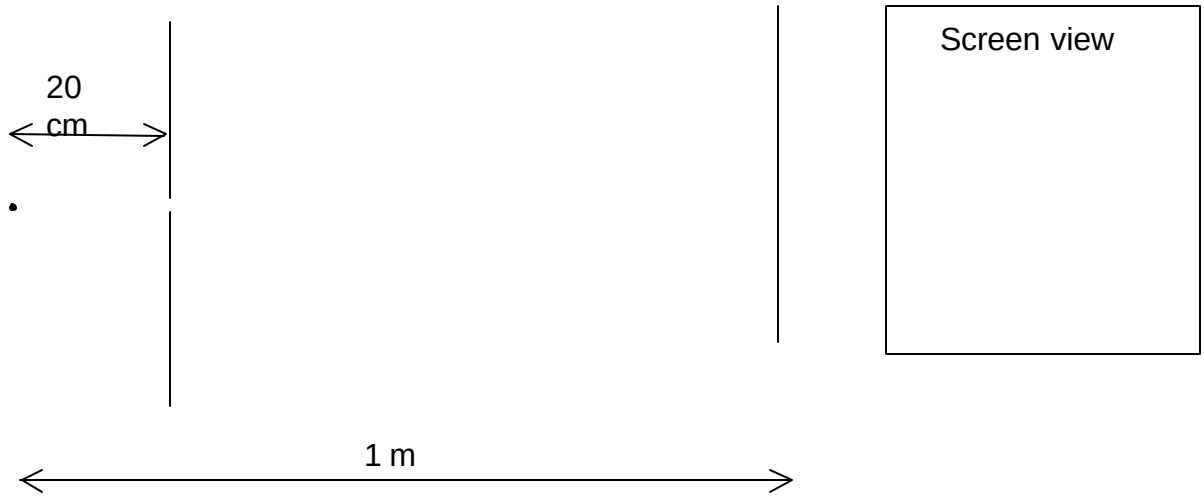


Explain your diagrams and reasoning fully.

Physics 345 Lab 1

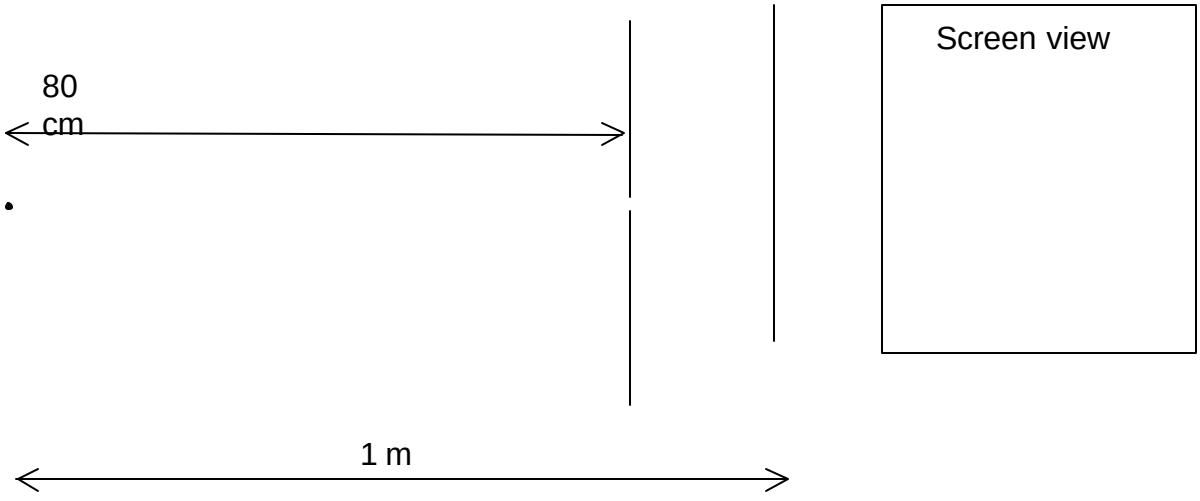
I. Point source.

Consider a baffle with a circular aperture. You have a point source located 20 cm to the left of the baffle and a screen located 80 cm to the right of the baffle. Everything is drawn to scale. Predict what you expect to see on the screen (shape and size of the image).



Explain your diagram.

If the total distance between the source and screen is constant at 1 m and the source-baffle distance is set at 80 cm, predict what size and shape of an image you would see on the screen. Explain your PREDICTION



What sort of mathematical relationship exists for the image diameter based on a point source being a distance "d_o" away from the baffle, the aperture having a radius "r", and there is a distance "d_i" between the baffle and the screen? Assume the point source is on axis with the aperture hole.

Using the large optical rails on the optics table, the Pasco light point source, an iris, the centimeter ruled screen, a black mask with circular aperture, and the webcam (with lens) make several experimental measurements and record your results. Print out a reasonable picture of what you saw on the screen. Do your observations agree with your predictions? If not, then correct your predictions.

Generalize. Comment on all aspects of the illumination of the screen from a point source through an aperture.

II. 2 Point Sources

You now have a second point source.

Predict how placing a second point source above the first light source would affect what you see on the screen. Explain

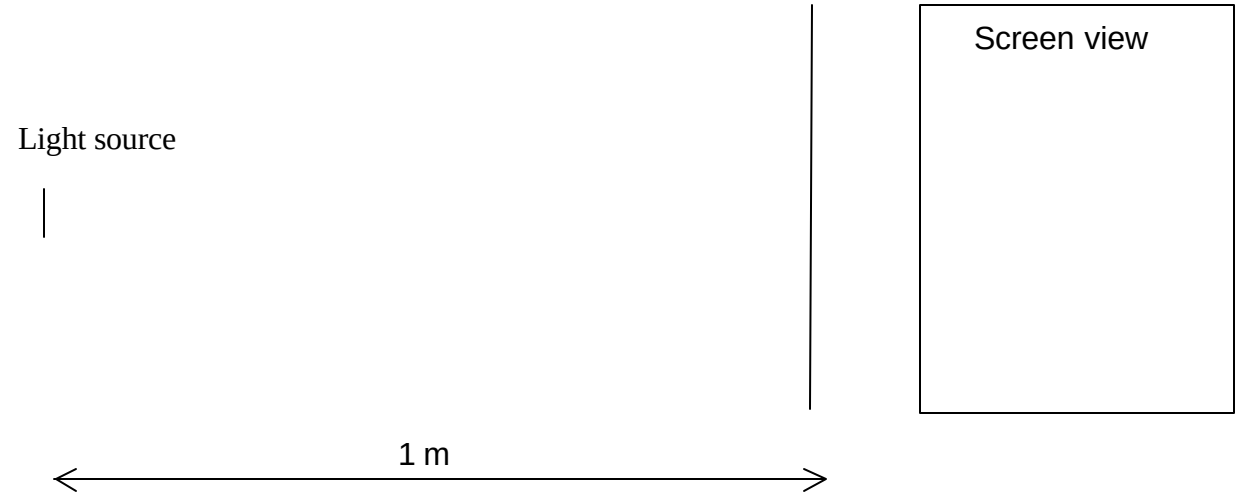
Predict how moving the second point source upward slightly would affect what you see on the screen. Explain.

Perform the experiment using a flashlight as the second point source. Compare with your predictions. If any of your predictions were incorrect, resolve the inconsistency.

What do your observations suggest about the path taken by light from the bulb to the screen? (Summarize your observations so far)

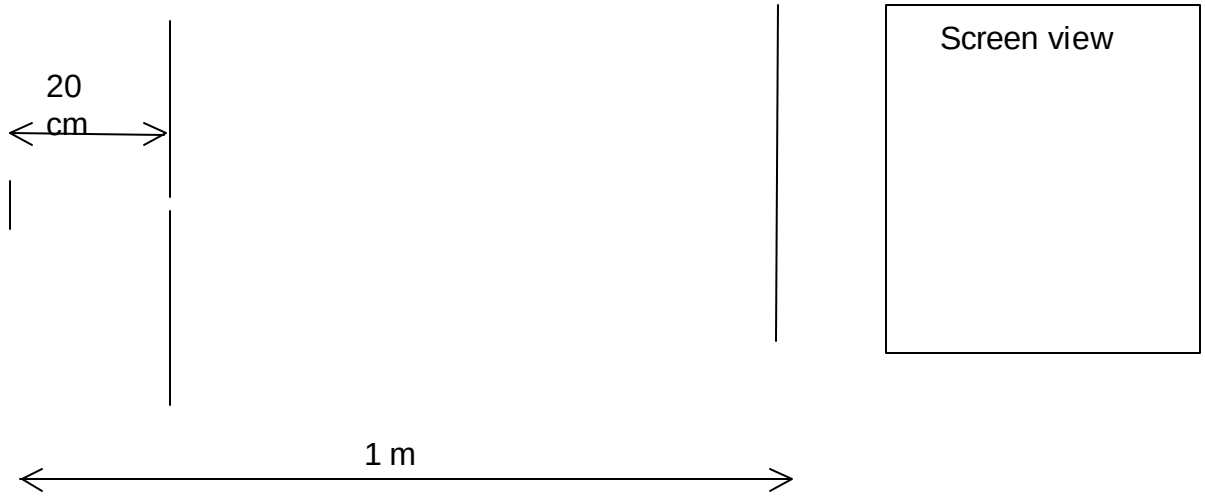
III. Extended Source

Now consider a simple extended source; that is a source in the shape of a line. Predict what one would expect to see on a screen if no baffle were used

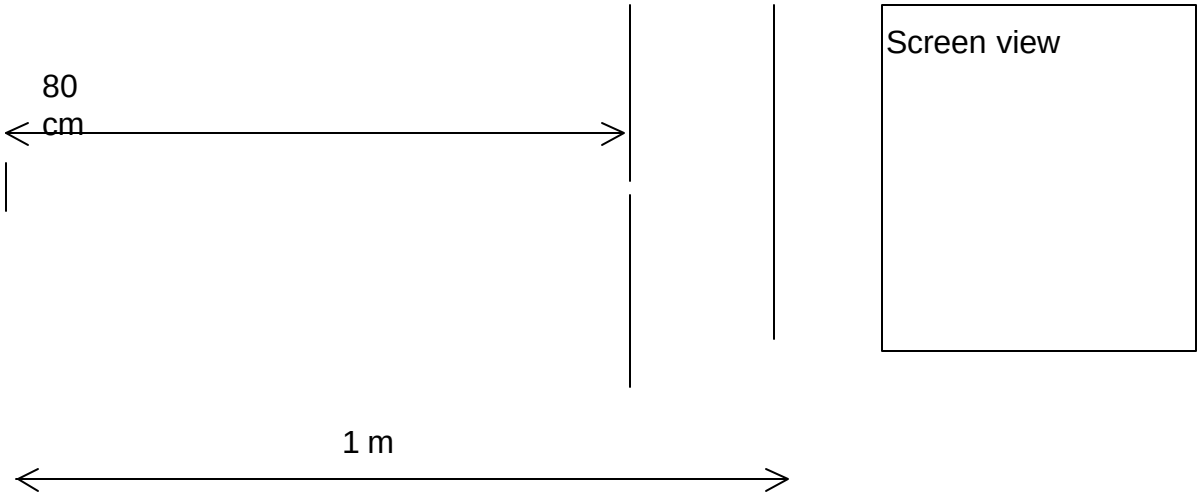


Explain your prediction.

Predict the size and shape of the illumination on a screen for the two baffle to light source distances (20 and 80 cm)

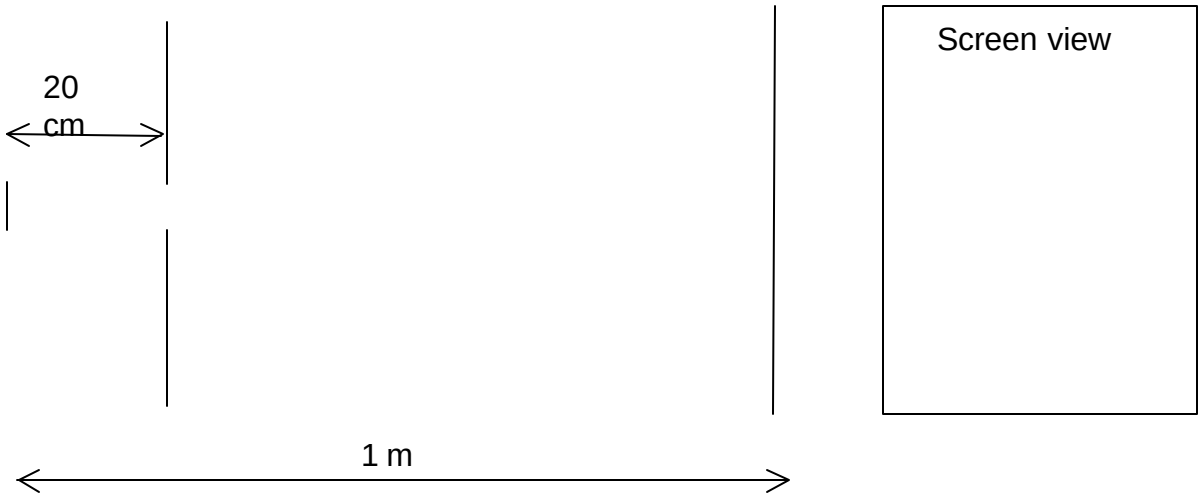


Explain your prediction.

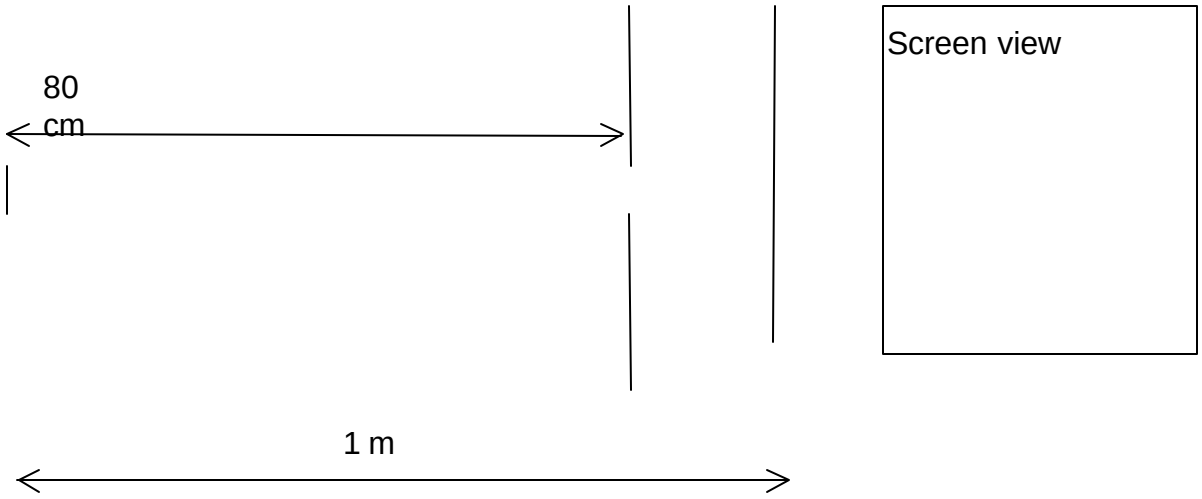


Explain your prediction.

What happens if we use a much larger aperture?



Explain your prediction.



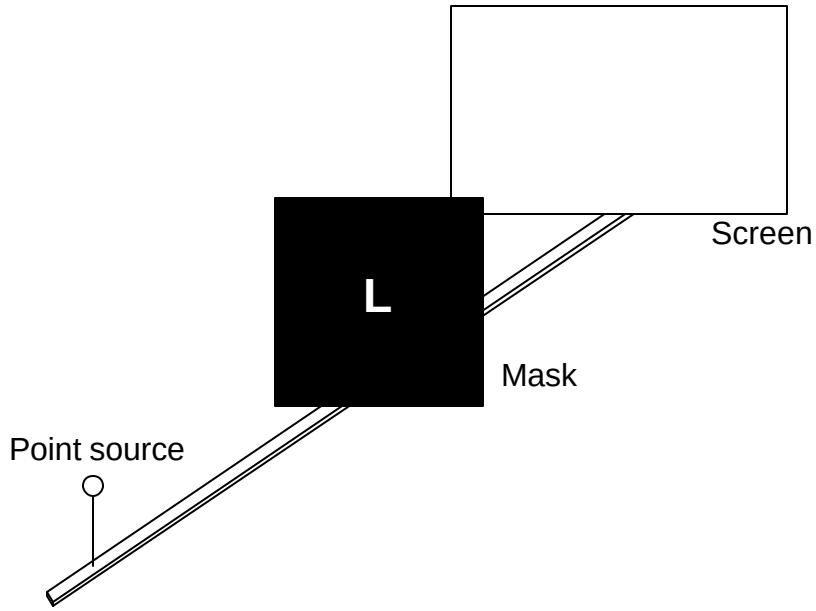
Explain your prediction

SHOW YOUR PREDICTIONS TO YOUR INSTRUCTOR!

Perform measurements and compare with all of your predictions. Draw general conclusions regarding the extended source and baffle. Resolve any differences between your experimental results and your predictions.

IV Non-symmetric apertures

A mask containing a hole in the shape of the letter L is placed between a screen and a very small bulb as shown below. On the diagram, sketch what you would see on the screen when the bulb is turned on. Explain your reasoning.



Now test your prediction. Open the Iris to its maximum size and attach (with tape) an aluminum square with a "L" shaped aperture to the back of the black mask. Record a picture using the webcam.

V. Fill in the blank questions

1. Using a circular aperture, the region of illumination from a single point source on the screen is _____ shaped.

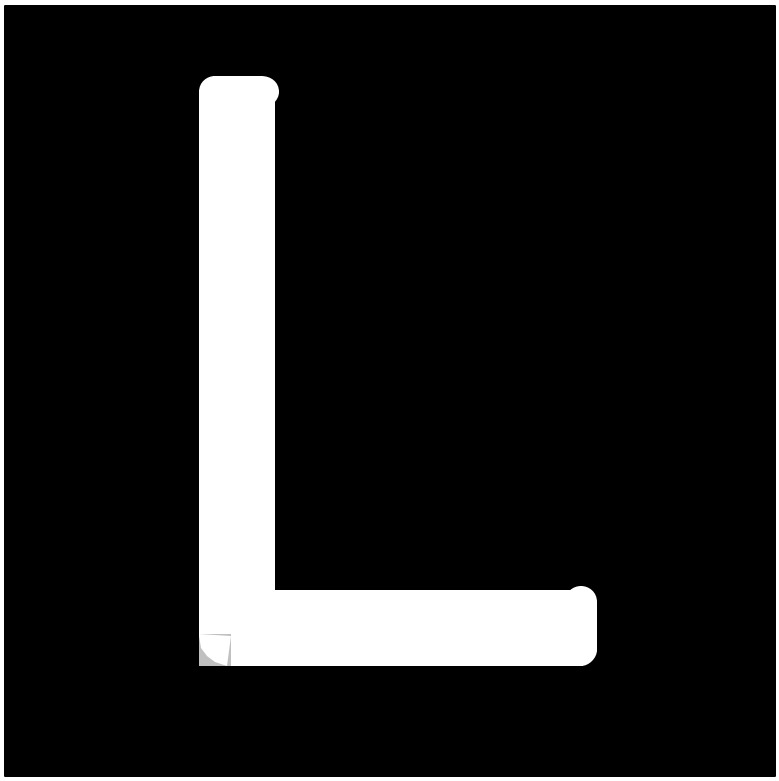
2. An extended source is a collection of _____.

3. With a circular aperture and an extended source (shaped like a line), the region of illumination is _____ shaped.

4. To make the region of illumination on the screen the most accurate, scaled representation of the extended source's shape, the aperture should be _____ shaped.

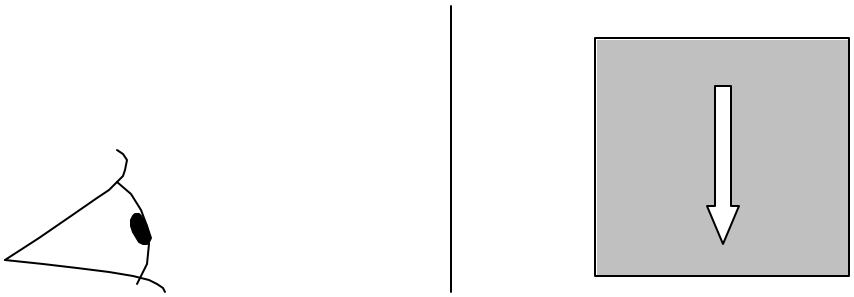
5. To make the region of illumination on the screen the most accurate, scaled representation of the extended source's shape, the aperture should have a _____ size.

A baffle has a “L” shaped hole as shown below. Predict the shape one would see on the screen if one used a vertical line extended source.



SHOW YOUR PREDICTION TO YOUR INSTRUCTOR!

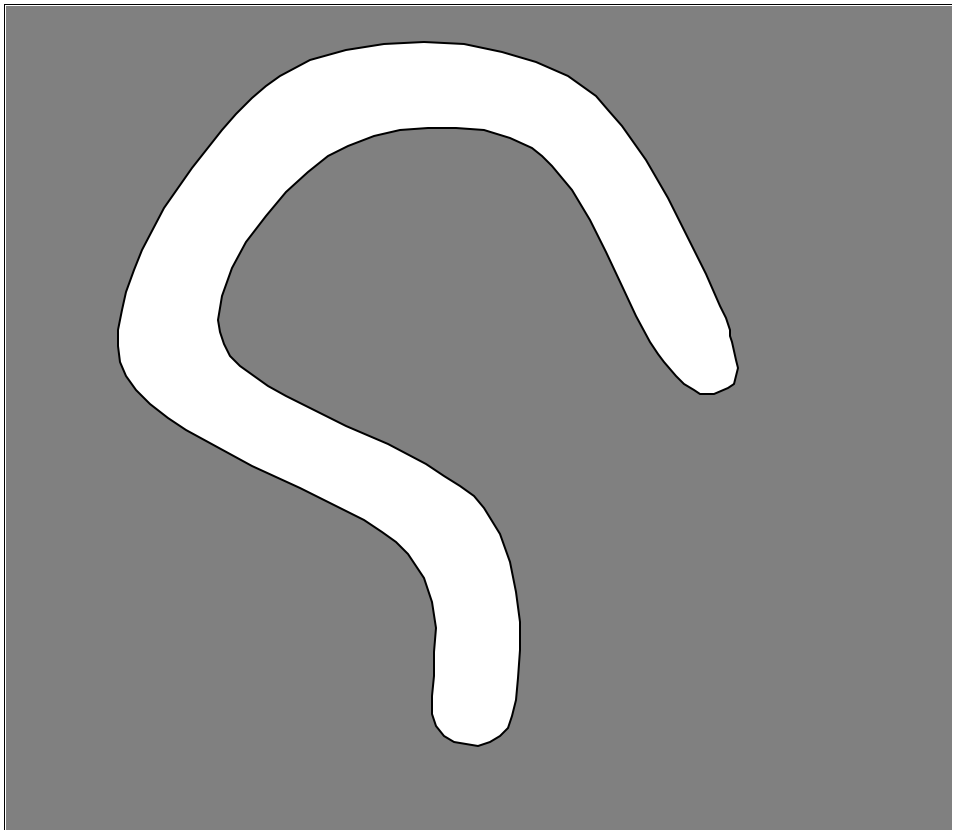
Set up and perform the above experiment. Resolve any differences between your prediction and the experiment.



Imagine these two situations: a screen illuminated by a lighted arrow source with out an aperture, and one that is illuminated through an aperture. Explain using a reasonable number of appropriate rays why and how we actually see this image on the screen in the case with the aperture and no image without an aperture.

Final Task.

A baffle with a 2 mm circular aperture is placed 50 cm from a light source. The image formed on the screen (50 cm from the baffle also) is drawn to scale below. Determine the size and shape of the light source. Explain your answer completely



Final Task

Consider, you have an extended source shaped like an equilateral triangle 5 cm on an edge. An aperture is placed 60 cm from the source. The distance from the aperture to the screen is 40 cm. How big must the aperture be before the image of this extended source is indistinguishable from that of a point source?

Final Task

A baffle with a 2 mm circular aperture is placed 50 cm from a light source. The image formed on the screen (50 cm from the baffle also) is drawn to scale below. Determine the size and shape of the light source? Explain your answer completely