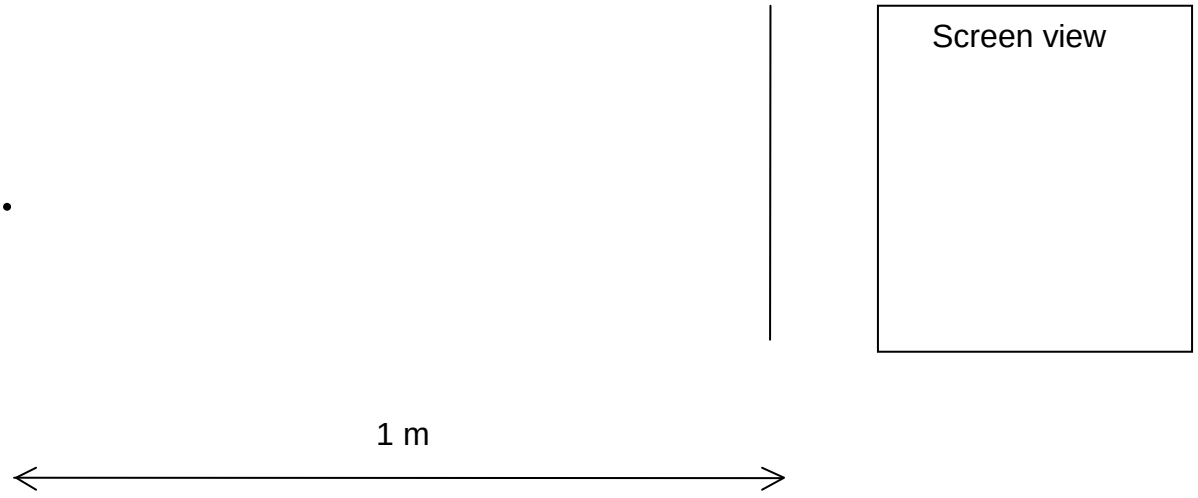
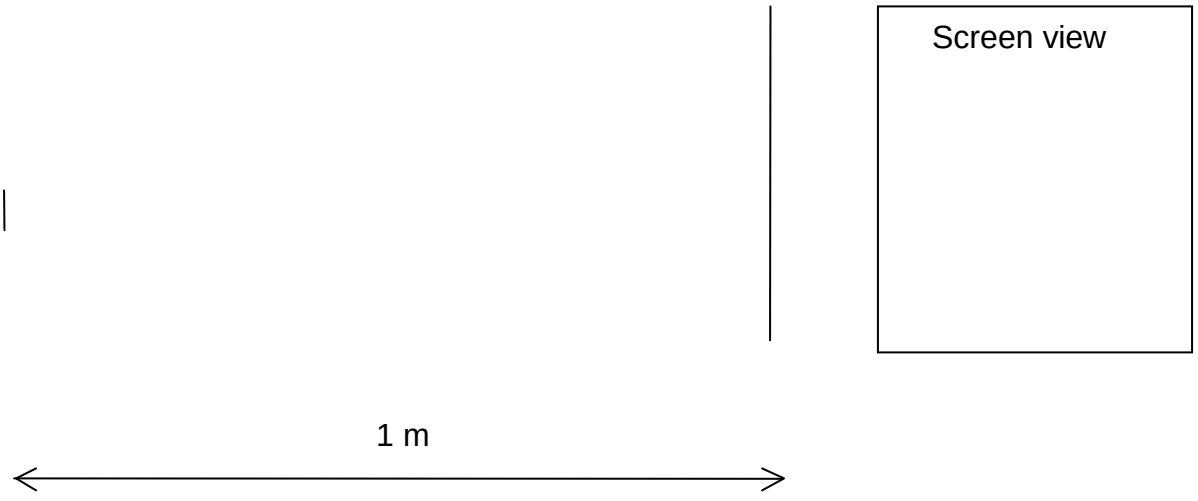
Physics 345 Pre-lab 1

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

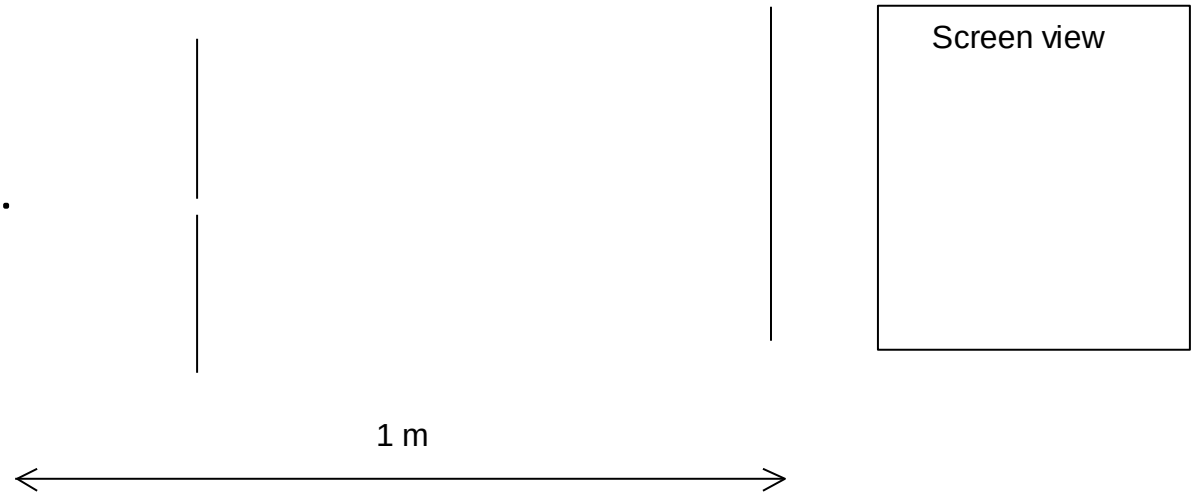
1. (a) Consider a small light bulb with an even tinier filament (point source). If the small light bulb is held one meter from the screen, carefully draw rays on the diagram in order to determine the extent of the illumination on the screen.



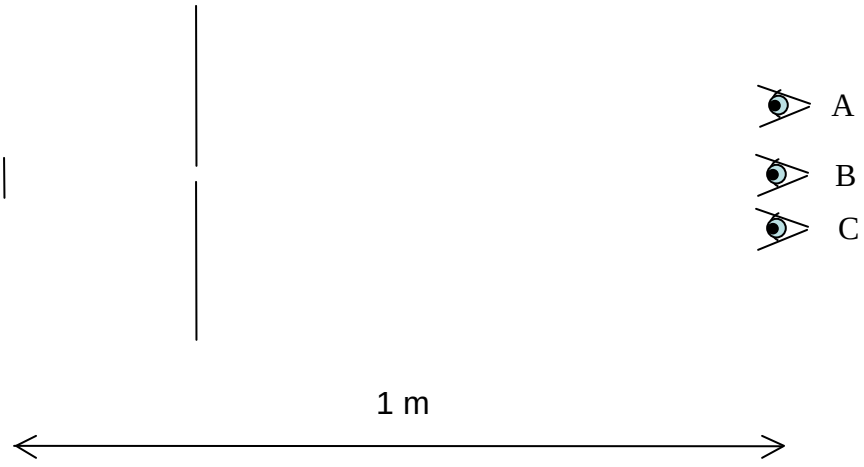
2. (b) Now imagine a thin fluorescent tube (extended source). If the fluorescent tube is held one meter from the screen, carefully draw rays on the diagram in order to determine the extent of the illumination on the screen.



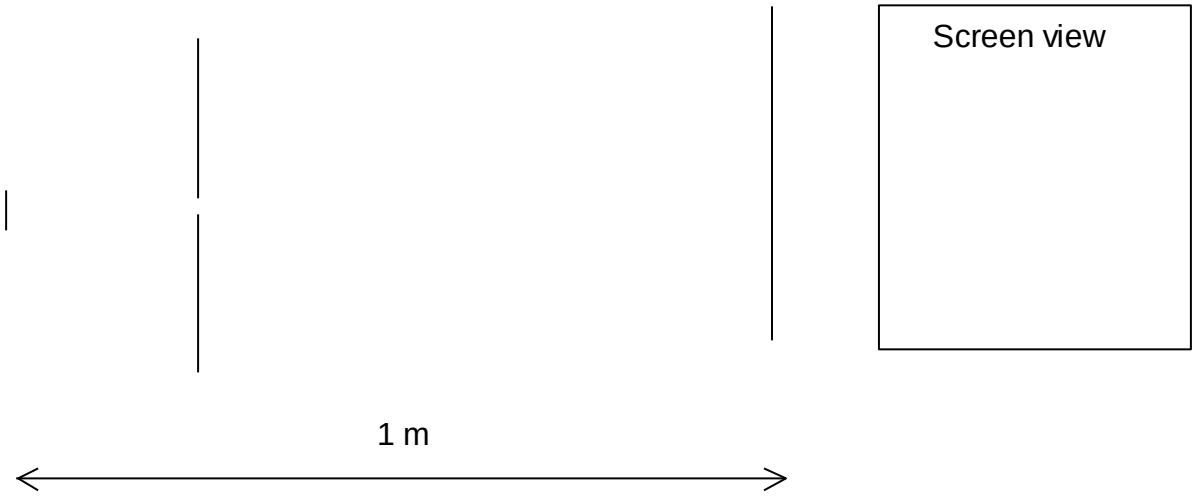
3. Now the light from the point source passes through a small circular hole in opaque material. Carefully draw rays on the diagram in order to determine the extent of the illumination on the screen for the point source. Draw the pattern of illumination you would expect to see on the screen to SCALE.



4. The light from the extended source now passes through a small circular hole in opaque material. Three different observers place their eyes one meter from the light source (on the opposite side of the opaque material) as shown in the scaled figure below. (a) Which of the observers can see the top of the the extended source. Explain. (b) Which of the observers can see the bottom of the extended source. Explain. (c) How many of the observers can see all of the extended source through the aperture? Explain.



5. Now a screen replaces the three observers.. Carefully draw rays on the diagram in order 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.

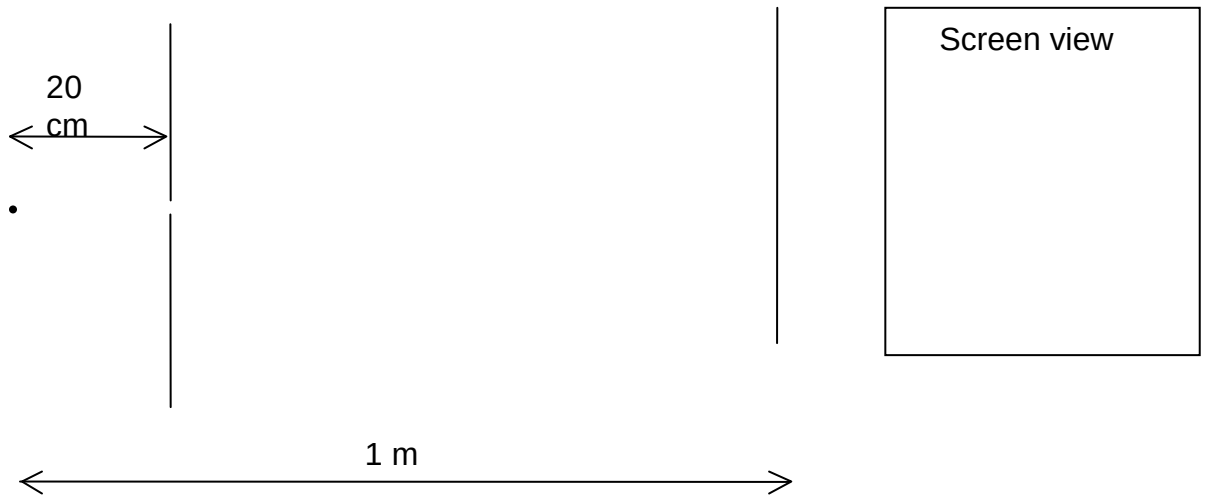


6. What is the minimum number of rays needed to determine the horizontal and vertical extent of the illumination on the screen in problem 5? Explain your reasoning.

Physics 345 Lab 1

I. Point source.

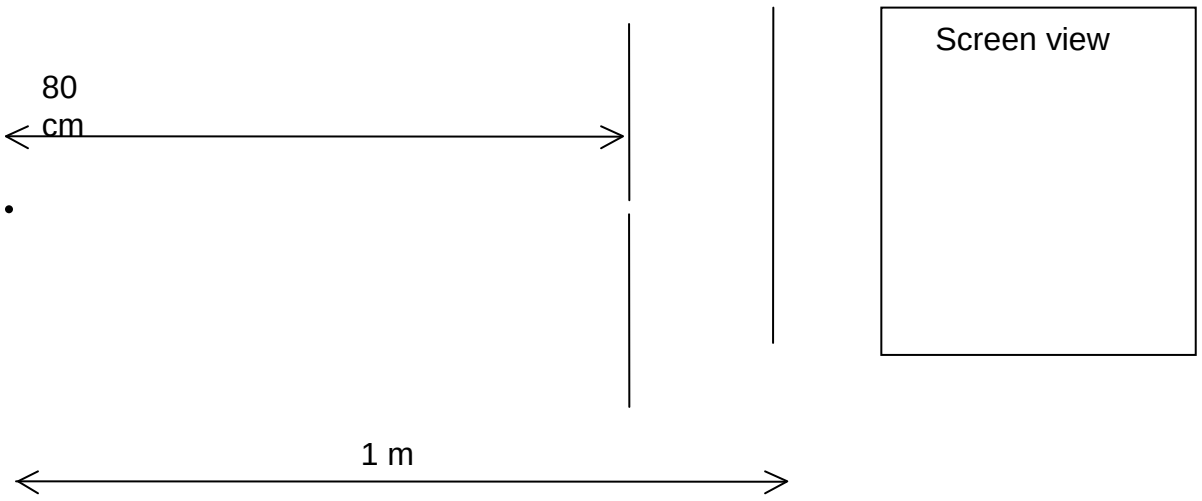
Consider the hypothetical circumstances shown below. A point source is 1.0m from a screen. A baffle (light blocker) with a circular aperture (r = 0.875cm) is 0.20m from the point source. . Everything is drawn to scale. Predict what you expect to see on the screen (shape and size of the image).



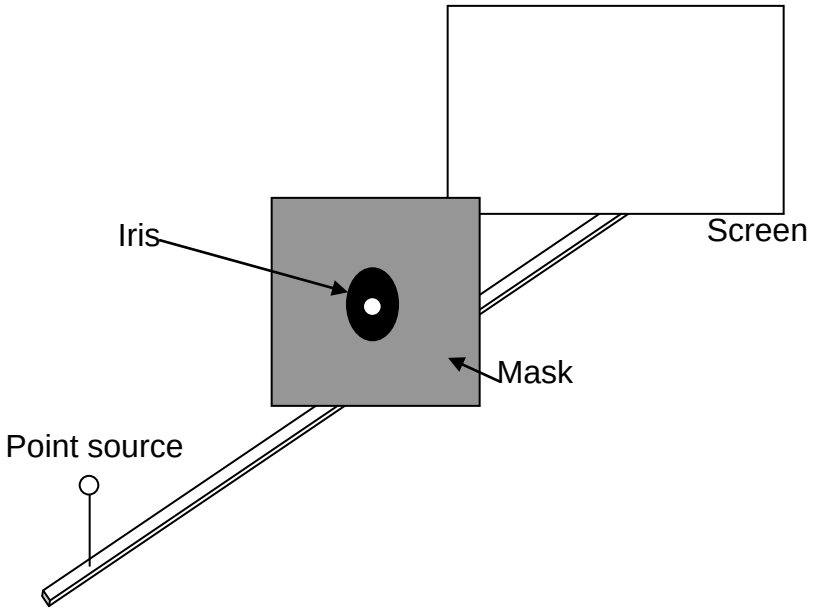
Explain your diagram.

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

Explain your PREDICTION



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



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.

Explore changing the distance between the point source and the aperture, the distance from the aperture to the screen, and the aperture size. Comment on your experimental measurements. Do your measurements confirm or refute your predicted mathematical model? If it is refuted, go back and reconsider your mathematical model.

II. Two Point Sources

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

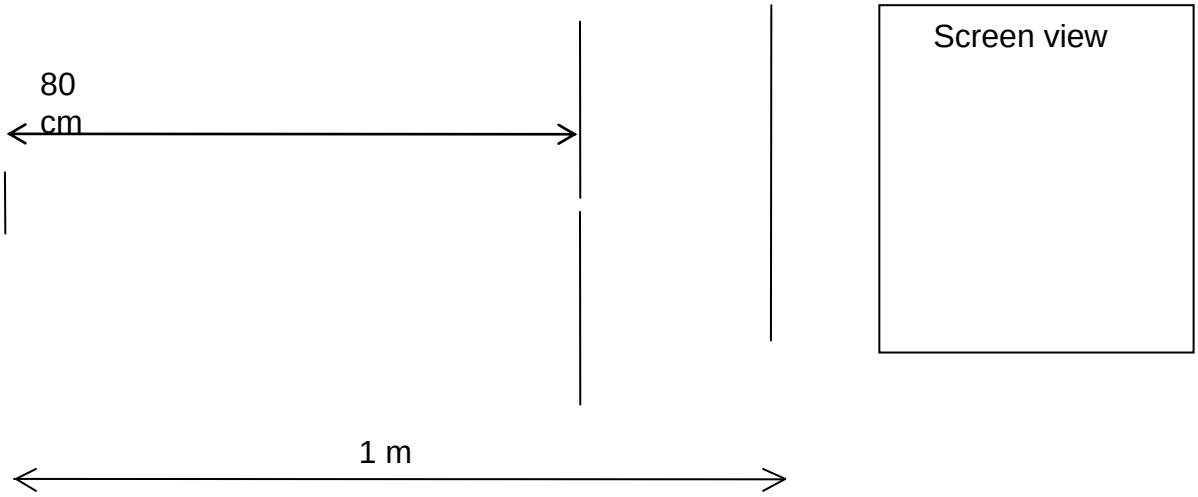
Predict how moving the second point source upward slightly would affect what you see on the screen. Explain.

You now have a second point source (small light bulb powered by a DC supply).
Perform the experiment using both point sources. 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

Use the bulb with the long straight filament as an extended source. The extended source is 1.0m from a screen. A baffle with a circular aperture (r = 0.875cm) is 0.80m from the extended source. Observe and record the illumination pattern on the screen.



Using your previous observations and conclusions concerning point sources (sections I and II), come up with an explanation for how the above illumination pattern could have occurred..

SHOW YOUR EXPLANATION TO YOUR INSTRUCTOR!

Explore changing the distance between the extended source and the aperture, the distance from the aperture to the screen, and the aperture size. Comment on your experimental measurements.
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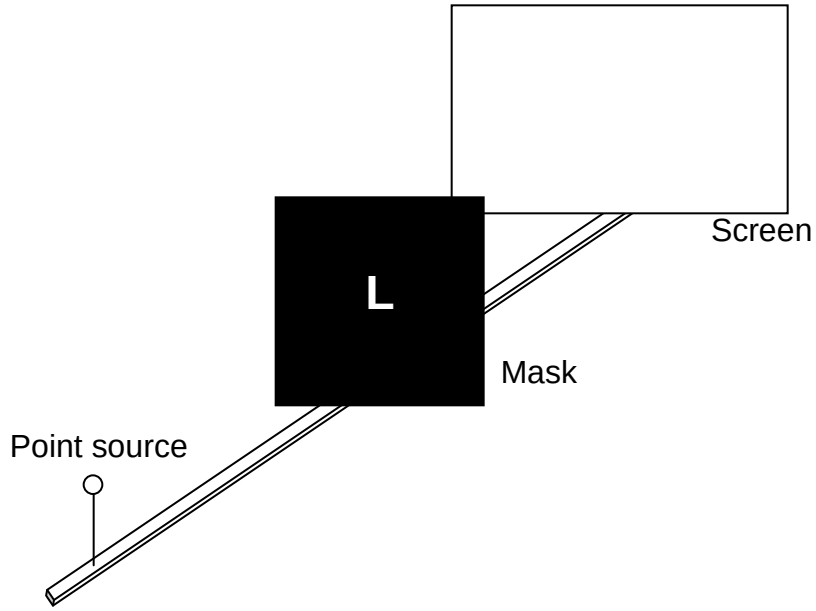
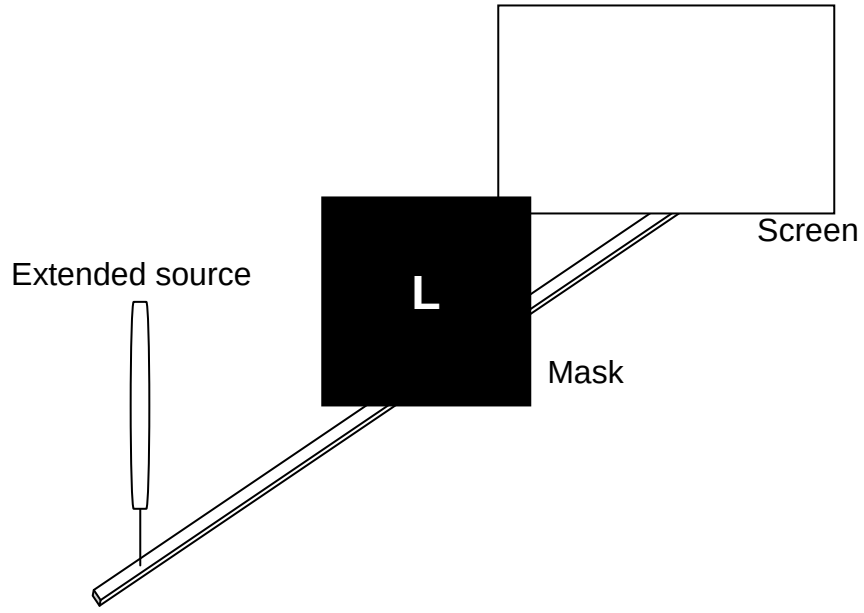
IV Non-symmetric apertures

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. Reconcile the differences between your prediction and experimental results.

Now **consider** what would happen if we replace the point source with the bulb with the long filament. Predict what you would see on the screen.



Now test your prediction. Reconcile the differences between your prediction and experimental results.

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 have a _____ size.

Final Task.

A filament light source is placed 100 cm from a screen. An opaque baffle with a 2 mm aperture is placed exactly between the light source and the screen. The image formed on the screen is drawn to actual size below. Determine the size and shape of the light source. Explain your answer completely