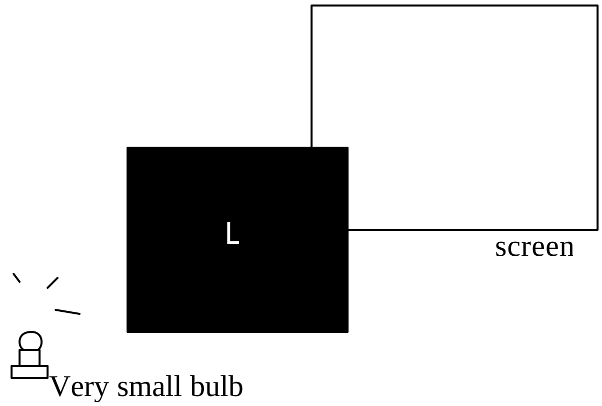
Physics 122, sections 502-4 and 8101 **Assignment 8**
Laura Lising **Due April 10, start of class**

Reference: Cutnell & Johnson, Chapter 25 (not very useful)

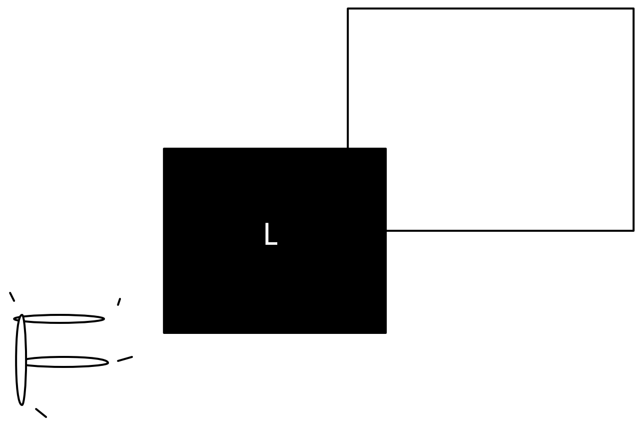
1) A mask containing a hole in the shape of the letter L is placed between a screen and a very small bulb as shown at right.

a) On the diagram, sketch what you would see on the screen when the bulb is turned on.



b) the small bulb is replaced by three long-filament bulbs that are arranged in the shape of the letter F as shown at right.

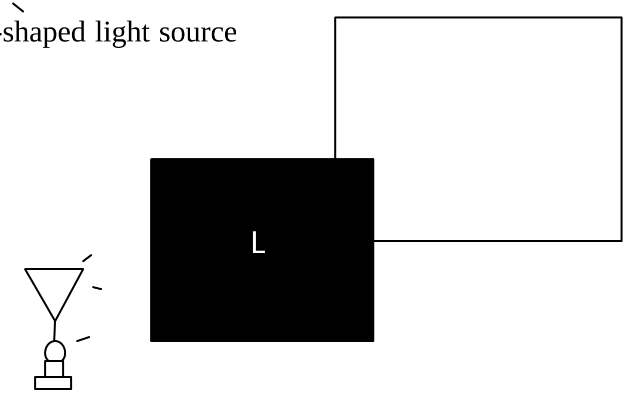
On the diagram, sketch what you would see on the screen when the bulbs are turned on. The scale of your sketch should be consistent with your answer to part a. Explain how you determined your answer.



F-shaped light source

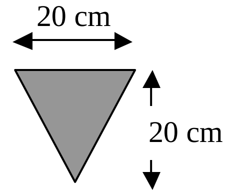
c) the three long-filament bulbs are replaced by a small bulb and a large triangle-shaped frosted bulb as shown at right.

On the diagram, sketch what you would see on the screen when the bulbs are turned on. The scale of your sketch should be consistent with your answers to part a. Explain how you determined your answer.

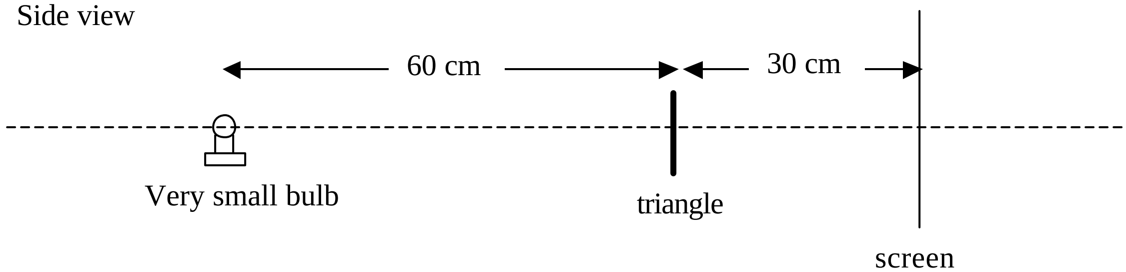


Small bulb and frosted, triangle-shaped bulb

2) A piece of cardboard has been cut into the shape of a triangle. The dimensions of the triangle are shown at right.



a) Predict the size and shape of the shadow that will be formed on the screen when a lit bulb, the cardboard triangle, and a screen are arranged along a line as shown. Draw a sketch to illustrate your prediction. Assume the bulb is small enough that it can be regarded as a point source of light. Explain your reasoning.



b) Is it possible to place the bulb in another location along the horizontal dashed line so that the shadow of the triangle is twice as tall as in part a? If so, where? If not, why not?

c) Suppose that the bulb were placed along the dashed line very far away from the triangle and the screen. What would be the approximate shape and size of the shadow? Explain.

d) Write a formula for the size of the shadow on the screen, in terms of how far you place the bulb from the triangle.

3) Try this at home.

a) Stand within touching distance in front of a bathroom mirror and use soap to mark the place where you see your eyebrows and your mouth. Now back away from the mirror. Do you see more of your face, less of your face or the same?

b) Measure the distance between the two soap lines you drew. How does that distance compare to the distance between your eyebrows and mouth? How can you make sense of this?

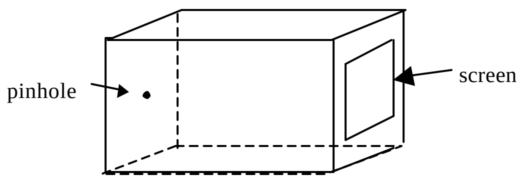
c) Many people in class said they thought that you see more of your face when you back away. But that's not what most people see when they try it, if they're careful. What were you (or they) thinking, and why didn't that reasoning work? When *would* that thinking work, and how is this situation different?

4) Look at your reflection in a spoon (you'll need a shiny one), or a curved mirror. (If it's curved inward we call it *concave* and if it's curved outward we call it *convex.* Use a concave mirror for this – your reflection off the *inside* of a spoon.)

a) When you look at your reflection, is it magnified or reduced? Can you account for that, using our model of light? Draw a diagram.

b) Move the spoon or curved mirror away. What happens to your reflection? Can you account for that, using our model of light? Draw a diagram.

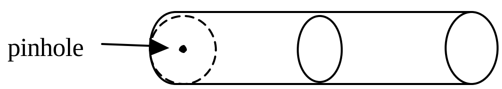
5) Make a pinhole camera.



You could do this with a small cardboard box, something like a shoebox, a pair of scissors, and some paper towel (or some other translucent sheet - wax paper would be ok, too). Poke a hole with a pin (or a pen tip can work) on one side, and cut a screen on the other side.

To use that version, cover your head and the screen end with a blanket, and point the pinhole end at some well-lit object. You could also put the screen in the middle of the box, leaving just a little hole to look through at the end – that's more pleasant than covering your head with a blanket! The idea is to make it dark around the screen, so that most of the light that hits the screen is the light from the pinhole.

Or use a cardboard tube – this time I'm showing the screen in the middle of the tube.



However you make it, you may need to play around with it a bit to get it to work.

For the assignment you hand in, draw a diagram of the pinhole camera that explains how it works.

6) Now, use your explanation of how the pinhole camera works to make some predictions. Test your predictions with your camera, and try to reconcile any inconsistencies.

a) What do would be the result of widening the pinhole? Will it make the image brighter? Bigger? Sharper or blurrier?

b) What would be the result of changing the shape of the pinhole – e.g. using a triangular hole as in tutorial, or a star shape, etc?

c) What affects the size of what you see on the screen — e.g., suppose you're using the pinhole camera to look at a 5 foot tall window (the *object*). What affects how big the window looks on the screen?

d) Formalize that last part. If you're looking at an object of height h_o that's a distance d_o away from the camera, what would be the height h_i of the "image"[1] you see on the screen. Call the distance from the screen to the pinhole h_i. (Start with a diagram!)

[1] In quotes, because we're going to define "image" in a technical way… don't worry about it for now, but some time in the future you might be studying from this sheet!