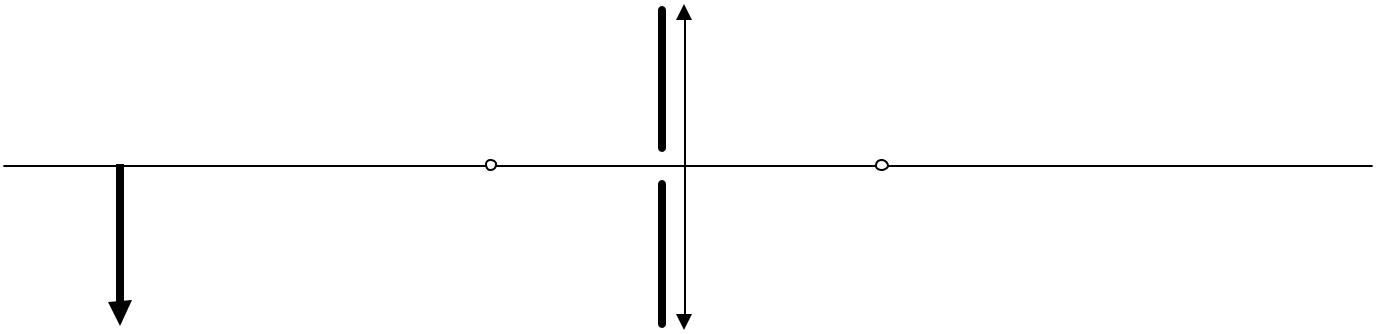
1. What will placing an aperture in close proximity of a lens do to the completeness of the image formed? Explain your answer.

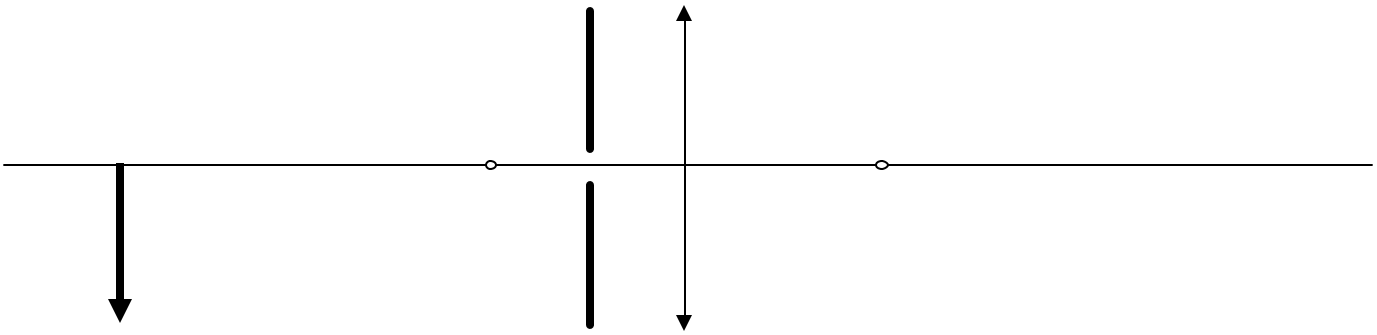
Now use ray tracing to see if it agrees or disagrees with your prediction. If it disagrees, determine what problems there were in your logic. Determine if the whole image can be seen.



This is known as an aperture stop. Its purpose is ultimately to limit the amount of light getting through the optical system. The aperture stop can be a lens itself or another lens in the system.

Imagine that we placed an aperture

2. What impact will the aperture have on the completeness of the image if it is moved so that it is half way between the lens and the focal point?



Ray trace to confirm your prediction and resolve any differences between prediction and diagram.
Label the aperture stop AS on the diagram.

On this diagram, draw the possible rays that can get to the image from the top of the object and the bottom of the object. What optical element is limiting the range of the rays that can go from the object to the image?

This is the Entrance Pupil. The entrance pupil is the limiting aperture entering rays experience.

Determine the location and size of the image of the aperture stop. Draw this on the diagram. Then extend back rays from the top and bottom of the image. Where do these rays go?

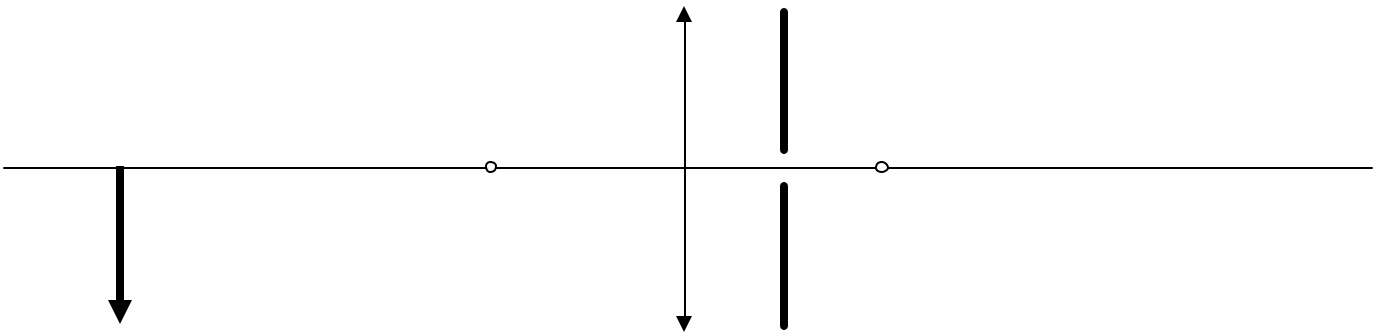
This is the Exit pupil. The exit pupil limits the angle of the rays leaving the lens.

Are the top and bottom of the image of equal brightness? How do you know?

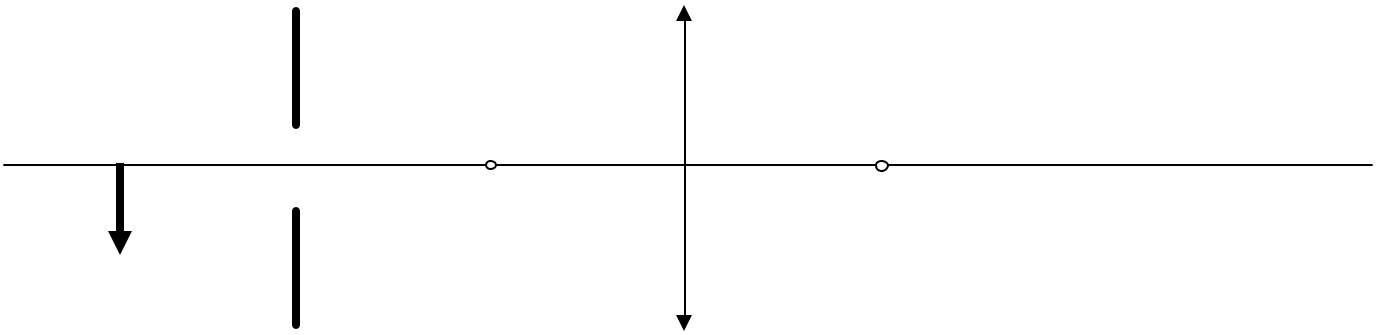
Draw a ray that seems to start from the center of the entrance pupil and also (or at least could have) passes through the center of the exit pupil. This is the **chief ray**. The chief ray is an off axis ray that passes through the center of the the aperture stop (entrance pupil) and exits through the center of the exit pupil.

Draw a ray that starts on the axis and passes through both the entrance and exit pupils at the maximum possible limit. This is the **marginal** ray.

3. Consider the diagram below. Determine the aperture stop, entrance and exit pupil, and the chief and marginal rays.

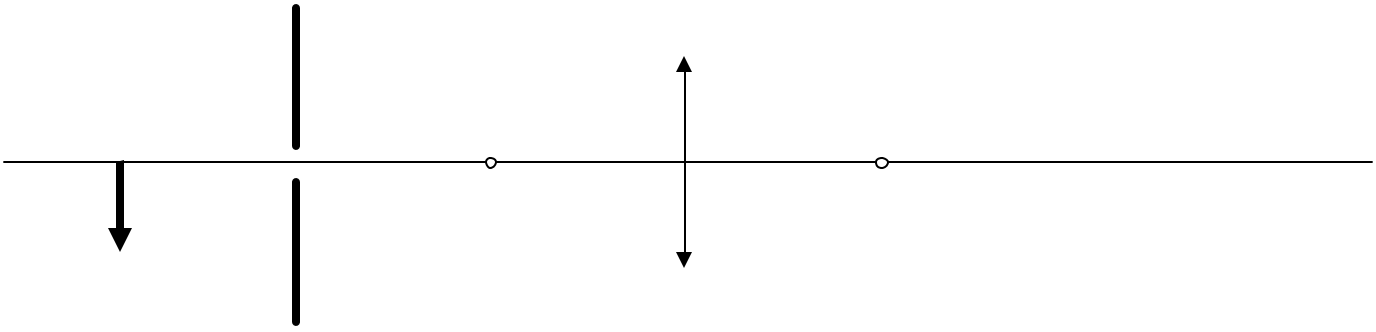


4. Consider the diagram below. Determine the aperture stop, entrance and exit pupil, and the chief and marginal rays.



The entrance pupil and the exit pupils are determined by the image of the aperture stop through the lenses between the object and the aperture stop and the image and the aperture stop respectively.

5. Consider the situation with the aperture located as shown. Determine the aperture stop, entrance pupil, exit pupil, chief and marginal rays.



Is the image complete?

Consider that the image is cut off. This is known as *Vignetting*. An optical system can limit the light passing through it by use of a **field stop**. A field stop limits the field of view. Identify the field stop in the current system.

Is there an optical element that limits the "size" of the object?

This is known as the *entrance window*. The entrance window limits the area of the object.

Calculate the location and size of the image of the field stop. Sketch this on the diagram. This is the *exit window*. The exit window limits the area of the image. If you determine the field stop, then you can determine the entrance and exit windows and determine what is vignetted. You may determine the field of view of the optical system. This can be important if you want to avoid imaging the sides of a hot oven.

6. Consider the situation with the aperture located as shown. Determine the aperture and field stops, entrance and exit pupil, entrance and exit window, chief and marginal rays.