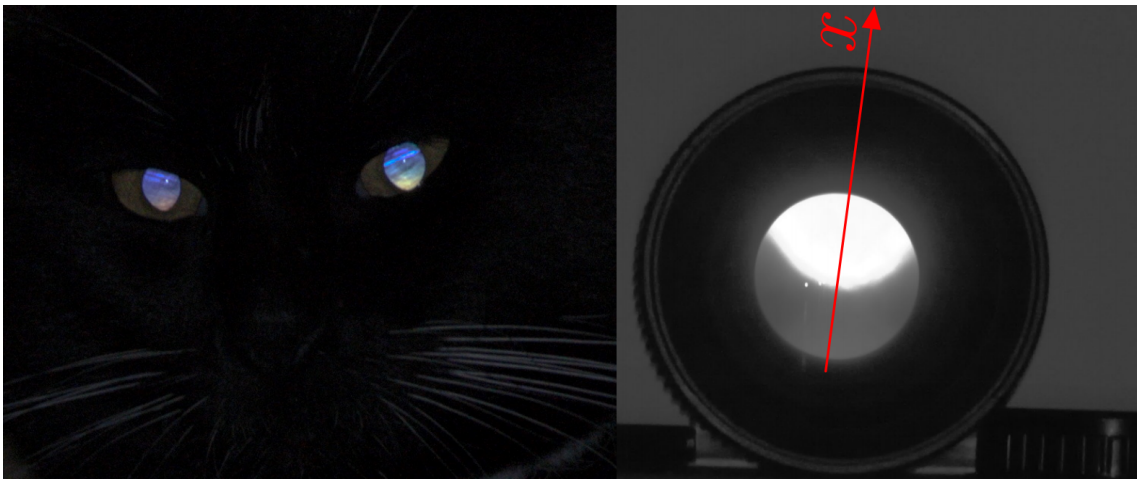
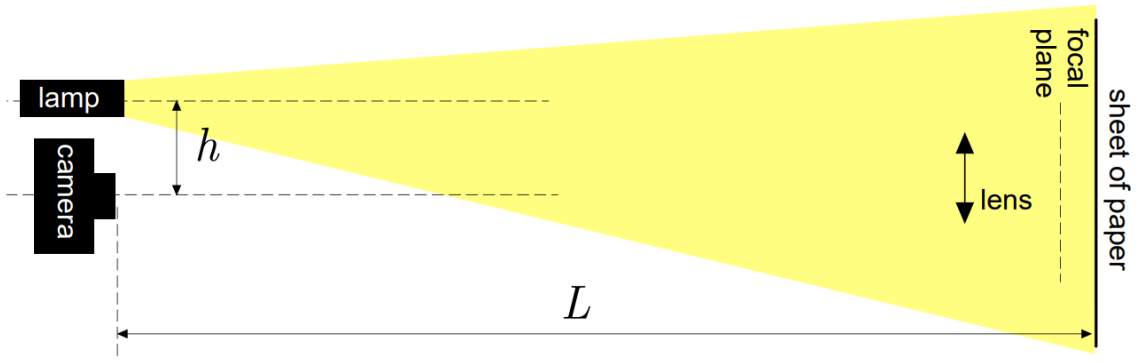
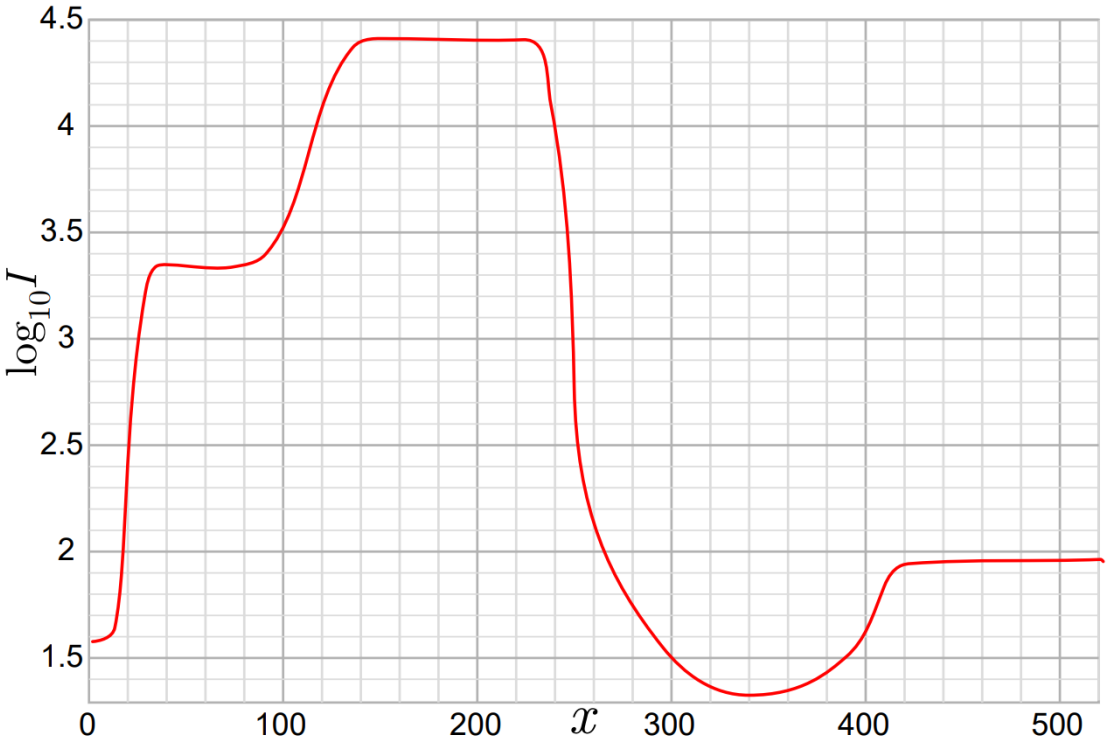
Cat eyes

You may have noticed that in darkness, when a cat is within the light beam of a headlamp, its eyes appear very bright, see the photo below (left). This phenomenon can be modelled by a lens setup, see the photo on right, and the diagram beneath the photos.





The photo on right was taken by a digital single-lens reflex camera. The light intensity at the camera sensor pixels marked by a red line (in the photo) is shown in the graph below: the log base 10 of the light intensity (measured as the number of photons caught by each pixel) is plotted against the x-coordinate, with the pixels' side length serving as the unit length.



The lens modelling cat eyes can be treated as an ideal thin lens of focal length $f = 55\ mm$ and diameter $D = 39\ mm$; however, you should keep in mind that the given graph shows real measurement data, and the lens has certain non-ideal features. Most importantly, partial reflections of brightly lit areas from the lens surfaces may decrease the contrast: dark areas seen through the lens appear less dark than they actually are; this effect can be neglected for the camera lens, but not so for the lens serving as a model of a cat's eye.

Based on the given data, estimate (with the accuracy of *ca* 20%) the distance h between the axis of the camera and the axis of the lamp (which can be considered as a point source) if the distance of the camera from the paper sheet was $L = 4.8\ m$.