PHOT 451 Fall (2025-2026) | **Quiz 1** | Date: 27 October 2025
Michaël Barbier | Example questions | Student No:
| Student Name:

Grading: Each quiz counts for 15% of your total grade.

Exam type: Closed-book, all questions can be answered **using only pen and paper**. Calculators are allowed but not necessary for the exam (numerical values will be fractions).

The duration of the quiz is 1 hour.

Please fill in all questions listed below. Each of the questions is valued equally in the score calculation of the exam. Please tell if any question is unclear or ambiguous.

Question 1: Thin lens

Assume a thin glass lens $n = 1.5 = 3/2$ with $R_1 = 100$ mm, and $R_2 = -20$ mm and entrance pupil diameter $D = 10$ mm. Use the Lensmakers formula:

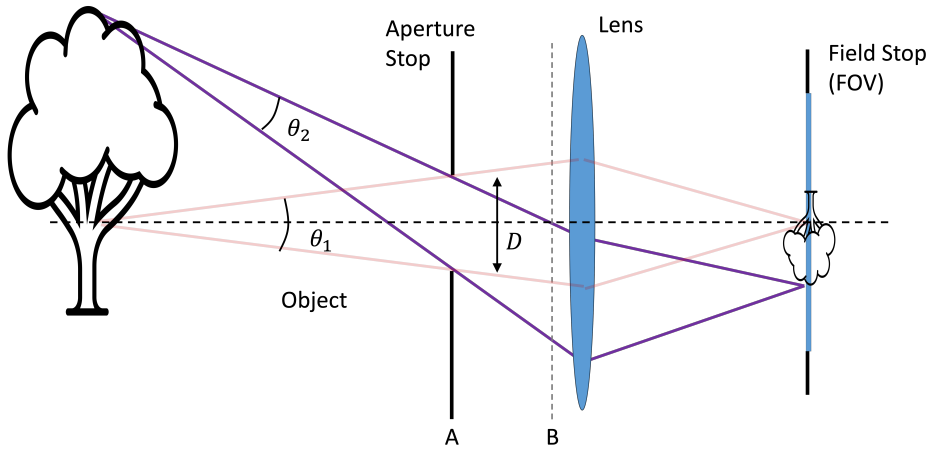
$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(a) First calculate the standard lens properties: the focal length f, the f-number $f/\# = \frac{f}{D}$ and the lens power $P = \frac{1}{f}$.
(b) If you scale down the system, by dividing R_1, R_2, and D by 1000, what are the new values for the lens properties f, $f/\#$, and P?

Question 2: Vignetting

Assume you have the imaging system in below figure 1 where an equally illuminated object is imaged. Although the image is equally illuminated, the borders of the image will be darker due to vignetting (because $\theta_2 < \theta_1$).

(a) Suppose the aperture stop is moved closer towards the lens to an alternative aperture position B. What happens to the vignetting of the lens?
(b) What happens if you scale down the diameter of the aperture stop $D \longrightarrow \frac{D}{4}$ in figure 1, do you expect more, equal, or less vignetting? And what about the average image intensity, how will it scale?



Question 3: Lens abberations

Consider an imaging system with two identical lenses as in below figure 2. The Seidel diagram is given as well (chromatic abberations and distortion is ignored).

(a) Why do surfaces 4 and 6 correspond to higher values of abberation than surfaces 3 and 5?
(b) Which of the incident angles is by visual inspection the least in focus at the image plane:

a) 0 degrees (blue curves),
b) 5 degrees (red curves), or
c) 10 degrees (green curves)