

1. Compose the ABCD-matrix of a 1:1 imaging setup composed of only one lens with focal length f .
2. What is the Abbe-Number? Make a sketch of a $n(\lambda)$ in a λ - n -diagram for Flint- and Crown-glasses. What are the two main differences between the curves?
3. What is the origin of spherical aberration? Explain this e.g. at a simple lens with spherical surfaces. How looks the OPD-diagram (optical path difference diagram) for this aberration like? Assume focusing a collimated beam with a plan convex lens. On which side the focus should be – the plane or the convex side?
4. Make a sketch of a two-lens imaging set up. Assume that the diameter of the second one (the one facing towards the image) represents the limiting aperture (the stop) of the system. Construct the entrance pupil of the system (location and size)! (Hint: better use a ? for a more precise construction).
5. What limits the spot size of a beam focused by a lens in case the lens has no aberrations? How can the spot size be calculated?
6. Matter equations.
 - a) Formulate the three linear matter equations in the frequency domain.
 - b) When does one obtain the same equations for the fields in the time domain?
7. When do we speak about homogeneous, isotropic and non-dispersive media respectively?
8. Plane waves:
 - a) Give the mathematical form of a plane wave (with vector signs!).
 - b) Plane waves in dielectrics can be homogeneous and inhomogeneous (evanescent), how are the two types of plane waves defined?
 - c) Discuss the criterion in terms of wavenumbers (k_x, k_y) to distinguish between them?
 - d) What is the wavelength of evanescent plane waves?
 - e) Derive the dependency of the z -component of a plane wave from the x and y components.
9. Polarization:
 - a) Give the mathematical form of a harmonic field (with vector sign).
 - b) Why are harmonic fields always polarized?
 - c) Describe the general case of the polarization of harmonic fields.
 - d) Discuss the difference between globally and locally polarized paraxial fields.
10. The z -component of a harmonic field in an isotropic and homogeneous media can be calculated from its x - y -components. What are the basic arguments for deriving this dependency?