

Biomicroscopy I - Exercise Sheet 2

September 17, 2024

1 Thin lenses: Ray tracing

Consider a lens configuration shown in Figure 2. One lens is divergent, another is convergent.

- A Draw the system scaled correctly. Place a 1 cm tall object 15 cm before the first lens (see Fig. 1). By ray tracing through the two lenses, find out where the image is located. What is the magnification?
- B Now move the object 2.5 cm closer to the optical system and find its image by ray tracing. What magnification do you find here? Where is the image located?
- C Repeat the same calculations but moving the object 2.5 cm farther away from the optical system.

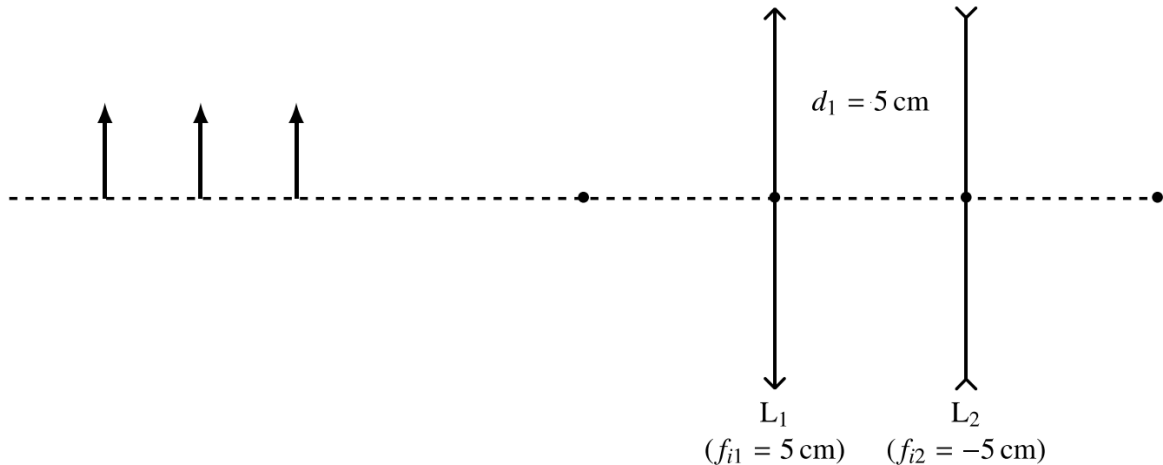


Figure 1: Two thin lenses and set of objects

2 Thin lenses: ABCD-matrix

Consider the system of two lenses L_1 and L_2 with focal distances f_1 and f_2 correspondingly and separated by distance d in between (see Fig. 2). Calculate the ABCD-matrix for such a system using the multiplication rule for the transfer matrices. The ABCD-matrix for a thin lens is given by:

$$M = \begin{bmatrix} 1 & 0 \\ -1/f & 1 \end{bmatrix}$$

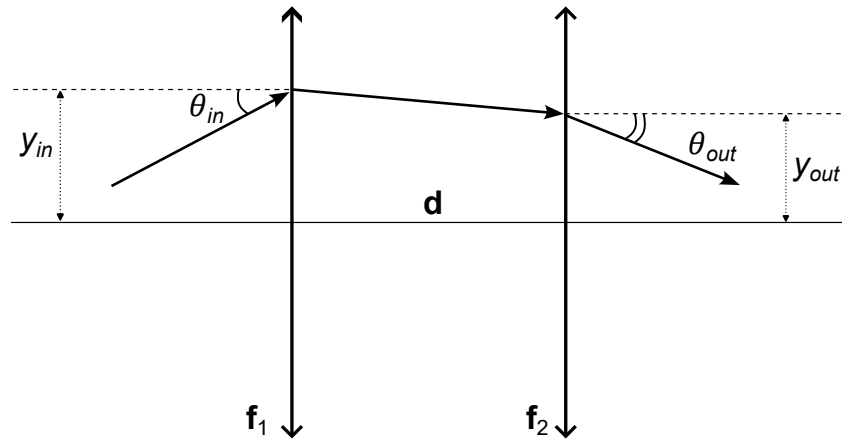


Figure 2: Two thin lenses with a free space distance in between

3 Consecutive thin lenses

Consider a system of two thin lenses L_1 and L_2 which are not separated, *i.e.* $d = 0$ cm. Using ABCD matrices, prove that this system is equivalent to having no lenses if and only if L_1 is convergent (divergent) with focal distance f and L_2 is divergent (convergent) with focal distance $-f$.