Experimental Physics III

Submission due: October 27, 2022, before the lecture starts

Exercise Sheet 2

2.1

A spherical concave mirror of a telescope has a radius of curvature of 8.0 m. Using the paraxial limit calculate at which position the image of the moon is generated by this mirror as well as the diameter of the image. Assume that the moon has a diameter of $3.5 \cdot 10^6$ m and a distance of $3.8 \cdot 10^8$ m to the earth.

2.2

An object is situated 17.5 cm to the left of a lens that has a focal length of 8.5 cm. A second lens, which has a focal length of -30 cm, is located 5 cm to the right of the first lens.

- Calculate the distance between the object and the image formed by the two lenses.
- Determine the magnification of the setup.
- Is the image real or virtual? Is the image upright or inverted?

2.3

In a lab you have found a biconvex thick lens which is labeled with "$n = 1.51$", "Curvature (radius): 100/130 mm", and "Thickness: 15 mm".

- Draw a scheme of this lens and indicate the measures that you have got from the label (R_1, R_2, d).
- Calculate the actual focal length and the optical power of this lens.
- How does the focal length change if you flip the lens (i.e., backside becomes foreside and vice versa) and why?
- Sketch the image formation of an object due to the thick lens. Assume that the distance of the object to the lens is larger than the distance of the focal point to the lens.

2.4

Initially, an object is observed from a distance of $a_\mathrm{s} = -250\,\mathrm{mm}$ to a reference point (Figure 1). Subsequently, the same object is observed with a microscope setup such that the respective image appears keen again at the distance a_s. The focal distances of the objective as well as the ocular are $f_1 = 5\,\mathrm{mm}$ and $f_2 = 48\,\mathrm{mm}$, respectively. Assume thin lenses.

- Draw a sketch for the construction of the image.
- Show that the magnification M of the microscope is equal to the product of the two image ratios b_1 and b_2 of the objective and the ocular, respectively.
- Calculate b_1 and b_2 as well as the magnification M if the distance of the object to the objective is $a_1 = -5\,\mathrm{mm}$. Furthermore, compute the distance e between the two lenses as well as the tube length t.

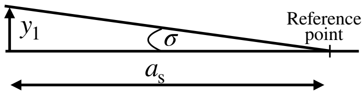

Figure 1: Object y_1 in front of a reference point with distance a_s and visual angle σ.