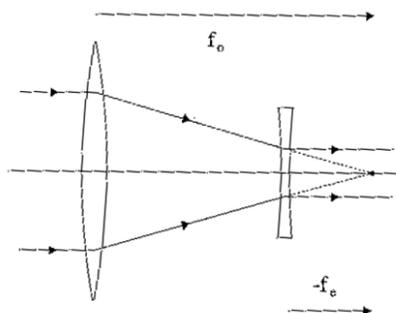


Homework #3 (due Sept. 16)

Each problem is 10 points

Textbook problems (modified): 4.1, 4.2, 4.4, 4.8

Problem 4.1: Show that the Galilean telescope produces angular magnification $M_{\theta} = f_o/f_e$. What is the factor by which the telescope contracts a laser beam?



In a particular Galilean telescope the objective has focal length $f_o = 16$ cm and diameter 44 mm, and the eyelens $f_e = -2$ cm and diameter 10 mm. What is the angular magnification? What is the position and diameter of the objective which is formed by the eyelens? (This size would be relevant to estimate the field of view of the telescope)

Problem 4.2: A microscope has an objective of 2 mm diameter and focal length 10 mm, an eyelens of diameter 15 mm and focal length 25 mm, with tube length 160 mm. Calculate the magnification of each stage of the microscope, and the overall magnification (we assume this microscope is used by a person with perfect vision, and the final image is formed at the distance $d_{\text{near}} = 25$ cm).

Problem 4.4: The near point is defined as the closest distance on which the eye can focus. "Normal" vision is usually considered to be vision with a near point of 25cm. A far-sighted person has a near point of 100cm rather than the normal 25cm. To correct this vision, his/her prescription should be designed so that the lenses will take an object at 25cm and create a virtual image at 100cm, so the "non-normal" eye can see it. What focal length lens should be used?

Problem 4.8: An eye piece is constructed from two identical plano-convex lenses with curved surfaces facing and separated by $2f/3$ where f is the focal length of either lens. What is the effective focal length of the eyepiece?

A1. Captain James Cook is sailing through the south pacific on a mission from the Royal society to observe the passage of Venus across the sun. He has a telescope with him, but he doesn't know how good it is, so he brings you along to help him figure it out. The eyepiece of the telescope is 2 cm in diameter and has a focal length of 4 cm. The telescope has an angular magnification of 45. What is the focal length of the objective lens? What is the limit of the telescope's resolution due to diffraction?