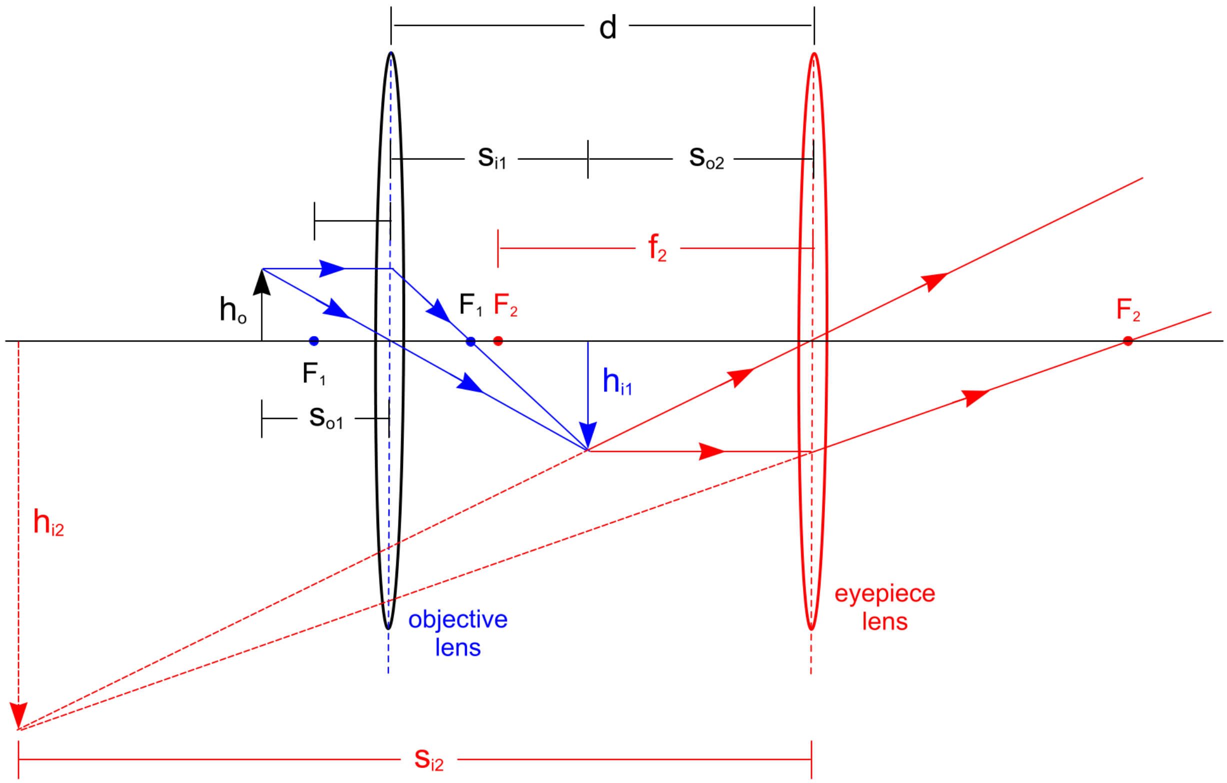
Modern Optics, Prof. Ruiz, UNCA doctorphys.com
Chapter J Homework. Microscopes, Telescopes, and Eclipses.

HW-J1. The Microscope.

Here is a detailed drawing for a microscope.



Microscope. Inspired by Maier A, Steidl S, Christlein V, et al., editors. Medical Imaging Systems, Cham (CH): Springer; **2018.** Creative Commons License

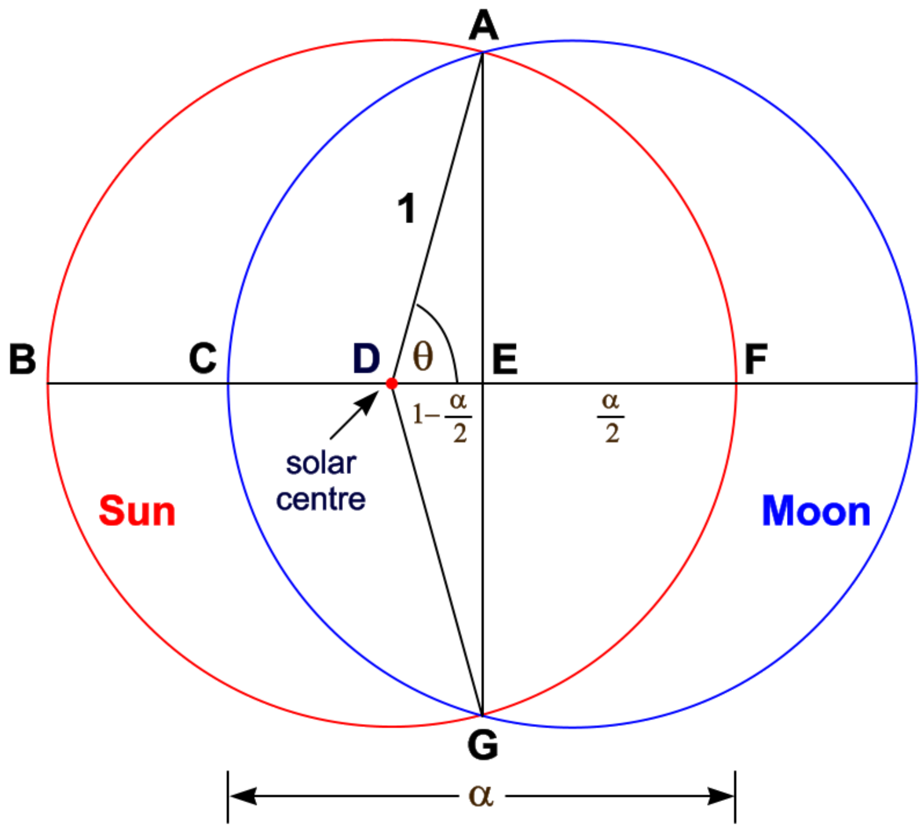
Derive the general formula for the total magnification M as a function of s_{o1}, f_1, f_2, and d.

Then verify your formula for the specific microscope we designed in class.

$$s_{o1} = 5.2 \text{ mm} \qquad f_1 = 5 \text{ mm} \qquad f_2 = 22 \text{ mm} \qquad d = 150 \text{ mm}$$
$$M = -275$$

Your formula is most likely correct if you get $M = -275$ when you plug in the above specific values for s_{o1}, f_1, f_2, and d.

HW-J2. Solar Eclipse Model.



The Moon is moving across the Sun from right to left. In this ideal scenario, the Moon blocks the Sun perfectly during the eclipse for an instant and the total eclipse will last for only that instant. Find the area ACGFA of the covered Sun. Then, subtract this area from the area $\pi \cdot 1^2$ of the Sun in our units where the radius of the Sun is 1.

Work with angles in radians for this entire problem.

(a) Show that the exposed area of the Sun (the bright part ABGC) is given by

$$A_{exposed} = \pi - 2\theta + 2\cos\theta\sin\theta \, .$$

(b) Then express this area in terms of the parameter α in the figure. When $\alpha = 0$ the Moon begins its journey across the Sun. When $\alpha = 1$ the Moon is completely covering the Sun.

(c) What percent of the Sun is exposed when $\alpha = \frac{1}{2}$? Don't Look at the Sun!