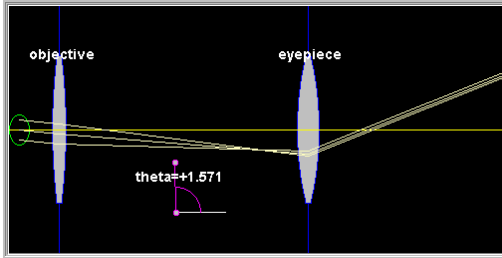


Worksheet for Exploration 36.2: Telescope



In order to understand the magnification of a telescope, it is helpful to understand the idea of the angle that an object or image subtends. So, before exploring a telescope, we need to understand the idea of "the angle that an object subtends". [Restart](#).

- a. If an eye is located where the image of the eye is **(position is given in centimeters and angle is given in radians)**, the object subtends an angle of 6° . You should check this by moving the protractor along the optical axis, putting its vertex at the front of the eye, and measuring the angle a light ray from the top of the arrow would make with the optical axis (remember that your protractor measures in radians).
- b. Now, [add a simple magnifying glass](#). The angle that the image subtends is the angle at which the light exits the lens crossing the optical axis. What angle does the image subtend?

$$\theta = \underline{\hspace{2cm}}$$

The magnification is the ratio of the height of the image to the height of the object but, with small enough angles, it is also the ratio of the angles the image and object subtend.

- c. Two lenses, an eyepiece and an objective are used to make a [telescope](#). What good is the telescope if it takes essentially parallel light (from essentially infinity) and turns it back into essentially parallel light (for the relaxed eye)? The answer is in the difference in the angle the object and image subtend. Consider the angle that the object (very far away) subtends. Measure the angle between the beams from infinity and the optical axis. What is that angle?

$$\theta_1 = \underline{\hspace{2cm}}$$

- d. Now, measure the angle the light exiting the eyepiece makes with the optical axis (the angle the image subtends). What is that angle?

$$\theta_2 = \underline{\hspace{2cm}}$$

- e. The ratio of these angles is the magnification. What is the magnification of this telescope?

$$\theta_1/\theta_2 = \underline{\hspace{2cm}}$$

- f. Change the focal length of the eyepiece and focus it (move it so that the light exiting is again parallel light). What is the magnification of this new lens?

- g. Verify that the magnification of the telescope is equal to the ratio of the focal lengths of the two lenses.