As we discussed in class, most angles encountered in astronomy are quite small so degrees are often divided into 60 minutes and, if necessary, minutes in 60 seconds. Therefore to convert an angle measured in degrees to minutes, multiply by 60. To convert minutes to seconds, multiply by 60. To use trigonometric formulae, angles might have to be written in terms of radians. Recall that \( 2\pi \) radians = 360 degrees. Therefore, to convert degrees to radians, multiply by \( 2\pi/360 \).

1. The average angular diameter of the Moon is 0.52 degrees. What is the angular diameter of the moon in minutes?

2. The mean angular diameter of the Sun is 32 minutes. What is the angular diameter of the Sun in degrees?

And in radians?

3. Early astronomers measured the Sun’s physical diameter to be roughly 109 Earth diameters (1 Earth diameter is 12,750 km). Calculate the average distance to the Sun using trigonometry. (Hint: because the angular size is small, you can make the approximation that \( \sin \alpha = \alpha \) but don’t forget to express \( \alpha \) in radians!).

4. Suppose an asteroid’s closest approach to the Sun is 2 AU, and its greatest distance from the Sun is 4 AU. Sketch its orbit. How large is its semi-major axis, \( a \)? What is its period, \( P \)? What is the eccentricity of its orbit, \( e \)?
(Hint: For the next two problems consider Newton’s Generalization of Kepler’s Laws).

5. Suppose the Sun were nine time as massive it now is, and the Earth’s orbit where unchanged? Would the year be longer or shorter? By how many times? Explain your answers.

6. A television satellite is in circular orbit about the Earth, with a period of 24 hours (as viewed from a fixed point in space). What is the distance from the Earth’s surface for such a satellite (express your answer in Earth radii)? If the satellite appears stationary to an earth-bound observer, what is the orientation of the satellite’s orbit relative to the Earth?