

Astronomy 210 Spring 2005

Homework #2

Due in Class: Friday, Feb. 4

Note: Your homework solutions should be legible and include all calculations, diagrams, and explanations. The TA is not responsible for deciphering unreadable or illegible problem sets! Also, homework is graded on the method of solution, not just the final answer; you may not get any credit if you just state the final answer!

1. The earth's orbit is an ellipse with semi-major axis of 1 AU (1.496×10^{11} m) and eccentricity $e = 0.0167$. What is the fractional increase in the Sun's angular diameter between perihelion and aphelion? (7 points)
2. The Earth's obliquity evolves very, very slowly. (Obliquity is the angle between the Earth's spin axis and the perpendicular, or normal, to its orbital plane.) Currently, the obliquity is 23.5° , but it is decreasing by 47.5 arcseconds per century! Suppose that the Earth's obliquity reaches zero. What would maximum height of the sun above the horizon be in Chambana over the course of an entire year? Hint: Chambana's latitude is 40.11° N. (7 pts)
3. For reasons that will become apparent later in the course, the Moon is slowly moving away from the Earth. This has several implications; here we will look at the impact on solar eclipses. Some data: the radius of the Earth is 6370 km; the radius of the moon is 1740 km; the radius of the sun is 6.96×10^8 m (careful with units!); the semi-major axis and eccentricity of the Moon's orbit are 384,000 km and 0.055.
 - a) Based on your result from (1), find the angular diameter of the sun, in degrees, as seen from the surface of the Earth at aphelion? At perihelion? (2 points)
 - b) What is the angular diameter of the moon when it is directly overhead at apogee? At perigee? (4 points)
 - c) Can a total solar eclipse occur when the moon is at apogee? At perigee? Why? (4 points)
 - d) The semi-major axis of the Moon's orbit is increasing by 3.68 cm/yr. How long will it be until total solar eclipses cease (assume that all other orbital elements are fixed)? (6 points)
 - e) Now work backwards. Using the same assumptions as in part (d), find how long ago it was in the past when the first annular eclipse of the Sun occurred. We will see that the age of the Earth is 4.6 billion years $= 4.6 \times 10^9$ yr. How does your result compare to this? That is, was there a time in the past when no solar eclipses were annular, and all were total? (5 points)
4. Based on your reading from Ferris, discuss Newton's approach to understanding the Universe with respect to those before him. Make sure to include examples from your reading and keep it less than 1 page (typed). (15 points)