Astronomy 11 — Fall 1998 (S.T. Myers)

Homework Set 1

Due Thursday September 24, 1998 (5pm)

Make sure that your work is neat, legible, and complete. If we can't read it, it can't get credit. It is important to show all your work, and to tell where you got any numbers that you used in the problem (given in the question, from some page of the text, or from the tables in the Appendix, etc). These homework sets are as much about teaching you how to go about using your astronomical knowledge to solve the problems as they are about getting the right answer. There will be partial credit, but if we cannot follow your work, we will not give you credit. You may work together on homework assignments, but you should all contribute and not just copy each others work. Use your good judgement and follow the honor code.

To ease you into problem solving, I am giving you some hints in this assignment. These problems include explanatory text to place them in an astronomical context, and not all information is directly relevant to the problem, and you may have to look up necessary information — this is not meant as a trick, but to give you a feel for actual scientific problem solving as it occurs in research. Whenever possible, use drawings to diagram a problem as a visual aid (as I do on the blackboard in lecture).

1. The Daedalus Lunar Farside Observatory (established in 2014) is located at the 180° lunar meridian. An observer at Daedalus notes from the shadow of the vertical crater wall that the Sun is directly overhead. A colleague who is exploring the crater Dante, which is due North of Daedalus, reports by radio that the shadow of a vertical crater wall falls at an angle of $31\overset{\circ}{.}5$. How far away is Dante from Daedalus? Does it matter that it is due North from Daedalus? (Hint: This is a variation on the way Erathosthenes measured the circumference of the Earth. You can find the radius of the Moon in Appendix 3 of the textbook. You should sketch a diagram to guide your work.)

2. What is the greatest elongation of Mars as seen from Jupiter? Assume circular orbits in the plane of the ecliptic. (Hint: use the Appendix 3 to get the orbital semimajor axes of these two planets. Remember what the definition of elongation is.)

3. How long is it between consecutive inferior conjunctions of Jupiter and the Sun as seen from Saturn? How long between consecutive oppositions of Saturn and the Sun as seen from Jupiter? (Hint: this is a synodic period question. You can find the sidereal orbital periods in Appendix 3 of the text, but do not use the synodic period, as that refers to the Earth.)

4. Suppose that a tenth planet was discovered in our solar system with a perihelion distance of 80 AU and an aphelion distance of 100 AU. Find the eccentricity e and semimajor axis a of this orbit. (Hint: use the location of the focus from the center of an ellipse.)

5. Using the semimajor axis determined in Problem 4, what would the sidereal period of its orbit be (in years)? (Hint: Use Kepler's Third Law, with respect to Earth's orbit.)